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Behavioral Health Disorders and the Quality of Diabetes Care: A Dissertation

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BEHAVIORAL HEALTH DISORDERS AND THE QUALITY OF DIABETES

CARE

A Dissertation Presented

By

Yat (Gary) Hung Leung

Submitted to the Faculty of the
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March 02, 2010

Clinical and Population Health Research

BEHAVIORAL HEALTH DISORDERS AND THE QUALITY OF DIABETES CARE

A Dissertation Presented

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Yat (Gary) Hung Leung

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Clinical and Population Health Research
March 02, 2010

To Dr. Clifford Parks, my life partner, and to my family

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Abstract

Both diabetes and behavioral health disorders (mental and substance use disorders) are significant health issues in the United States. While previous studies have shown worse health outcomes in people with diabetes and co-occurring behavioral health disorders (BHDs) than those with diabetes alone, it is unclear whether the quality of diabetes care was poorer in the presence of co-occurring BHDs. Although previous research has observed a trend of positive outcomes in people with comprehensive diabetes care, there is a lack of evidence about whether that mode of care delivery can improve outcomes in people with co-occurring BHDs. Therefore, further studies are necessary.

Using a combined dataset from Medicare and Medicaid claims for Massachusetts residents, this study compared the quality of diabetes care (e.g., having at least 1 hemoglobin A1c test) and diabetes outcomes (e.g., eye complications) among Medicare and Medicaid beneficiaries with diabetes and co-occurring BHDs to those with diabetes alone in Massachusetts in 2005. The results showed a mixed picture on the relationships between BHDs and diabetes outcomes. While substance use disorders had adverse impact on adherence to quality measures (e.g., 20% less likely to attain full adherence, $p<0.001$) and health outcomes (60% more likely to be hospitalized with a diabetes-related primary diagnosis, $p<0.001$), the relationship between mental health disorders and diabetes outcomes were not consistent. For example, schizophrenia/ paranoid states was correlated with higher rates of full adherence to quality measures and lower rates of hospitalizations ($p<0.01$) whereas bipolar disorder and other mental health disorders were

not significantly associated with these outcomes. The measure, comprehensive diabetes care, which indicated the adherence to multiple diabetes care measures within one visit was created to approximate the way that care was delivered by providers who specialized in managing diabetes in patients. The adjusted analysis showed a trend for lower odds of diabetes-related complications and hospitalizations with this measure but the associations were not statistically significant (i.e., p>0.05).

Findings from this dissertation research suggest that disparities exist in the quality of diabetes care and health outcomes between people with substance use disorders and those without. The mode of care delivery needs to be further examined so that interventions can be designed to improve the outcomes of people with diabetes.

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List of Abbreviations

BHDs   Behavioral Health Disorders

SUD   Substance use disorders

HbA1c   Hemoglobin A1, subunit c

LDL-c   Low Density Lipoprotein -c

ICD-9   International Classification of Diseases- 9th Edition

OR   Odds Ratio

95%CI   95% Confidence Interval

Preface

This study was conducted as part of a larger project, "Improving Community Based Mental Health Services for Elders in Massachusetts", which was supported by the University of Massachusetts Medical School and the Massachusetts Executive Office of Elder Affairs. The aim of the parent project was to investigate the prevalence of mental health disorders and treatment modalities for mental health disorders among elders in Massachusetts. Consequently, the current study employed the definitions of disorders and measures from the parent project. The objective of the current study was to investigate how co-occurring behavioral health disorders (BHDs) impact the quality of diabetes care and whether adherence to quality measures improves health outcomes.

This dissertation is presented in six chapters. The first chapter provides a brief background and rationale for the study. The second chapter explains the conceptual framework, measures and analytic methods used in the study. The third chapter describes the characteristics of study population and the adherence to quality benchmarks for diabetes care across BHDs. The fourth chapter explores various diabetes-related outcomes, such as complications and hospitalizations among people with BHDs.   The fifth chapter examines the relationships among BHDs, the mode of care delivery, adherence to quality measures and diabetes-related hospitalizations. The final chapter discusses the significance of study findings, limitations of the study and implications for future studies.

Chapter I. Introduction and Study Aims

Background

Diabetes has reached epidemic proportions in recent years. The prevalence of diabetes was 7.8% in 2007, affecting about 23.6 million Americans.[1] According to the Centers for Disease Control and Prevention, diabetes increases the risks for heart disease and hypertension, as well as blindness (diabetes retinopathy), kidney disease (nephropathy), nervous system damage and lower-limb amputations. The risk of death for people with diabetes is at least twice that of people without diabetes.[1]

Like diabetes, behavioral health disorders (or BHDs), which include anxiety, depression, schizophrenia, bipolar disorder, other mental health disorders (such as personality disorders) and substance use disorders (such as alcohol dependence, alcohol abuse, drug dependence and drug abuse), affect a large proportion of the US population. For example, about 6% of the US population had serious mental health disorders in 2004 according to the National Institute of Mental Health.[2] The Substance Abuse and Mental Health Services Administration estimated that about 22.9 million people over 12 years old, i.e., 8.9% of this population, had a substance use disorder in 2008.[3]

High prevalence of Diabetes among people with Behavioral Health Disorders

Previous studies have shown that persons with behavioral health disorders (BHDs) have a high co-occurrence of diabetes and most of them observed that the prevalence of diabetes among people with BHDs was double that of people with no BHDs.[4-8] For example, Jiang and colleagues observed that diabetes was more prevalent

among people with a lifetime diagnosis of depression (14.4%, vs. 7.4% for no

depression), post-traumatic stress disorder (12.0% vs. 7.2% for no PTSD) or alcohol

dependence (18.4%, vs. 7.0% for no alcohol dependence) in two Native American

reservation communities.[8] In a case-control study using Blue Cross/Blue Shield claims

data from Iowa between 1996 and 2001, Carney and colleagues found that the prevalence

of diabetes was almost twice as high among people with schizophrenia (7.7%) than

among those without mental illnesses (3.0%).[5] A similar pattern has been observed in

bipolar disorder. Using a clinical sample, Cassidy and colleagues observed a higher

frequency of diabetes among people with bipolar disorders (9.9%) than the general

population (3.5%) in 1999.[6]

Mortality associated with dual diagnoses of Diabetes and Behavioral Health

Disorders

There is evidence that people with diabetes and co-occurring BHDs suffer higher

rates of mortality than those with diabetes alone. In a mortality report, the Massachusetts

Department of Mental Health (DMH) compared the death rate due to diabetes of their

clients statewide to that of an age-matched cohort in the general population during 2000.[9]

The DMH observed that their clients with diabetes had a 120% higher risk of death than

non-clients with diabetes.[9] However, this observation may not be applicable to people

with all BHDs because of possible selection bias in the eligibility criteria for DMH

services. In order to be a client of DMH, a person must have a persistent serious mental

disorder, such as schizophrenia, major depression, anxiety disorders (excluding those of

organic origins), multiple personality disorders, eating disorders and borderline

personality disorder, with significant functional impairment that limit one's ability to meet basic needs in daily living.[10] Currently, Massachusetts DMH serves approximately 27,000 clients across the state but there are about 160,000 people with serious mental health disorders in the state.[11] The restrictive selection criteria indicate that the general health of DMH clients may be worse than the overall population with BHDs; thus, the high mortality may not be generalizable to non-DMH clients with diabetes and BHDs.

Other studies have used community samples and demonstrated similar patterns. In a longitudinal study, Katon and colleagues compared the mortality rates between people with diabetes and depression and those with diabetes alone.[12] They observed that people with diabetes and major depression had a 43% higher risk of death than those with diabetes alone, after adjusting for age, gender, ethnicity, education, obesity, glycemic control, diabetes complications and co-morbidities.[12] Notably, people with 2 or more complications had a 79% higher risk of mortality.[12] However, the study was not able to assess the cause of death; therefore, it is uncertain if the high mortality is related to diabetes. In a study of Medicaid population, Jackson and colleagues found people with psychotic and substance use disorders who had diabetes were more likely to die prematurely (40%) than those without diabetes (10%).[13]

Unfortunately, studies to date have not been able to fully explain why people with diabetes and comorbid BHDs had higher rates of mortality, compared to those with diabetes alone. One hypothesis attributes higher rates of mortality to poorer quality of diabetes care and management among people with diabetes and comorbid BHDs.[13] However, additional evidence is necessary to understand whether such health disparity

was due to the quality of diabetes care. If it is true, interventions can be implemented to improve the quality of diabetes care and reduce diabetes-related mortality among people with diabetes and comorbid BHDs.

Behavioral Health Disorders and Quality of Diabetes Care

To date, there is no conclusive evidence that people with BHDs have poorer quality of diabetes care. For example, in a meta-analysis of depression and glycemic control, Lustman and colleagues reported that depression had small to moderate effect (standardized effect size, r: 0.17, 95% confidence interval [CI]: 0.13, 0.21) on poor glycemic control for people with diabetes.[14] In addition, in a cohort study using claims data from a private insurance company between 1996 and 2001, Jones and colleagues found that people with diabetes and any BHDs, i.e., depression, schizophrenia, bipolar disorder, anxiety disorders and substance use disorders, were less likely to receive hemoglobin A1c tests (adjusted Hazard Ratio: 0.92, 95%CI: 0.87, 0.97) and low-density lipoprotein tests (adjusted HR: 0.92, 95%CI: 0.86, 0.98) than those with diabetes alone.[15] Similar results were also reported by Frayne and colleagues using claims data from the Veterans Administration in 1999.[16]

In contrast, better quality of diabetes care was observed among people with BHDs than those without BHDs in other studies. For example, Dixon and colleagues observed that those with diabetes and schizophrenia had lower HbA1c levels (7.73%±0.25%) than those with diabetes alone (9.03%±0.25%, p<0.001), indicating better glycemic control among people with schizophrenia after adjusting for age, gender, race/ethnicity, education, obesity, self-care activities and frequency of outpatient visits.[17]

Such inconsistency in current literature was further compounded by studies that observed no significant relationships between quality of diabetes care and BHDs. For example, in a community-based study, Kreyenbhul and colleagues examined glycemic, lipid and blood pressure control among people with schizophrenia and depression.[18] In the multivariate model adjusting for age, gender and race/ethnicity, they observed that glycemic control among people with BHDs (schizophrenia: 7.9±2.2; depression: 7.7±2.0) was not significantly different from those with diabetes alone (8.7±2.5, p=0.08) .[18] Similarly, in a cross-sectional study using a clinical sample, Geringer and colleagues showed that the presence of depression was not significantly associated with glycemic, lipid or blood pressure control (p=NS).[19] Therefore, further studies are necessary to examine the relationship between BHDs and the quality of diabetes care.

Comprehensive Diabetes Care and Diabetes-related Outcomes

Comprehensive diabetes care provides diabetes-focused care in a single setting. A multidisciplinary team is usually employed to coordinate care between physicians and patients with diabetes so that optimal results, such as adherence to quality measures, can be achieved.[20] Such mode of care delivery has been shown to improve the quality of care among people with diabetes. For example, Rubin and colleagues reported that the rates of hospitalization decreased from 239 per 1000 member years to 196 per 1000 member years after implementing comprehensive diabetes care program in a managed care organization for a year.[20] In a separate study, Huang et al. compared the quality of care between a diabetes center that provided comprehensive diabetes care and a general medical clinic. Their analyses suggested that patients of the diabetes center might have

lower odds of hospitalizations than those of the general medical clinic (adjusted OR:

0.88, 95%CI: 0.52, 1.49) although the association was not statistically significant.[21]

However, no studies to date have examined whether comprehensive diabetes care

improves diabetes outcomes among people with diabetes and comorbid BHDs.

Indicators for quality of diabetes care

The goal of diabetes care is to prevent complications and death through proper

clinical monitoring and self-management. This leads to the use of surrogate measures

such as laboratory tests and clinical examinations in evaluating interim quality of care in

diabetes because clinical outcomes, such as retinopathy, which indicate the failure of

diabetes care, may not be appropriate tools to denote ongoing management of diabetes. In

1997, the Diabetes Quality Improvement Project[22] was established by the Centers for

Medicare and Medicaid Services (CMS), the National Committee for Quality Assurance

(NCQA) and the American Diabetes Association (ADA) to develop quality performance

measures for diabetes care. The objective of the project was to select a set of clinical

procedures or processes that are both representative of diabetes care and amenable to be

assessed accurately in clinical databases. In 2000, the project team chose the frequencies

and/or results of the following as quality indicators of diabetes care: 1) hemoglobin A1c

test (HbA1c), 2) low-density lipoprotein test (LDL), 3) nephropathy screening, 4) eye

examination in the past year, 5) foot examination and 6) blood pressure check in the past

year. These clinical tests and examinations are also Healthcare Effectiveness Data and

Information Set (HEDIS) measures, which are indicators used to reliably compare the

performance across different health plans,[23] for the quality of diabetes care.

Behavioral Health Disorders and Adverse Health Outcomes in diabetes

Beside quality indicators, adverse diabetes outcomes, such as complications and hospitalizations have been investigated in previous research. However, there were few studies that examined adverse diabetes outcomes in people with BHDs.[24-27] These studies reported higher risks of diabetes-related complications and hospitalizations among people with BHDs and diabetes. In a cross-sectional study, Black and colleagues compared the clinical outcomes for people with diabetes and depression to those with diabetes alone.[24] When compared to those without mental health disorders, people with diabetes and depression had 61% higher odds of having vascular diseases (OR: 1.61, 95%CI: 1.13, 2.31) and 86% higher risk for eye problems (OR: 1.86, 95%CI: 1.30, 2.67).[24] They were also more than twice as likely to have kidney disease (OR: 2.34, 95%CI: 1.42, 3.86) and to be hospitalized (OR: 2.71, 95%CI: 1.84, 3.98).[24] In addition, a meta-analysis of literature by de Groot and colleagues showed that depression was significantly correlated with diabetes complications (retinopathy, nephropathy, neuropathy and ischemic heart disease).[25]

In a study using claims data from the Veterans Administration (VA) in 1998, Krein and colleagues showed that people with diabetes and BHDs (schizophrenia and bipolar disorder) were more than twice as likely to be hospitalized than those with diabetes alone (OR: 2.8, 95%CI: 2.67, 2.94).[26] In a cohort study using claims data from the VA between 1991 and 1995, Fortney and colleagues showed that people with diabetes, depression and alcohol abuse (hospital days: 200.4), people with diabetes and depression (hospital days: 154.7) and people with diabetes and alcohol abuse (hospital

days: 125.3) had longer hospital stays than people with diabetes alone (hospital days: 75.9).[27] However, the aforementioned studies did not address any of the quality indicators for diabetes care or whether the hospitalizations were diabetes-related. Therefore, it is not certain if poor clinical outcomes are associated with poor quality of diabetes care.

Significance of the study

Despite evidence suggesting that co-occurring BHDs are associated with poorer quality of diabetes care and diabetes-related outcomes, there are gaps in the existing literature in terms of delineating relationships between quality of diabetes care and BHDs, and between quality of diabetes care and clinical outcomes. This is because: 1) previous studies illustrated a mixed picture of behavioral health disorders and the quality of diabetes care; 2) few studies examined diabetes complications and hospitalization among people with diabetes and co-occurring BHDs, as well as the impact of adherence to quality measures on these outcomes[24-28]; and 3) no studies to date investigated the effect of comprehensive diabetes care among people with diabetes and co-occurring BHDs. Therefore, further research is needed. This study attempts to fill these gaps in research through fulfilling the following objectives.

- This study examines the rates at which people with diabetes and different BHDs meet quality measures for diabetes care among, compared to those with diabetes alone.
- The associations between adherence to quality measures and BHDs are examined separately according to the type of BHD.

- This study compares the rates of diabetes-related complications and hospitalizations for those with BHDs to those with diabetes alone.

- This study investigates whether and how the mode of diabetes care delivery (e.g., comprehensive diabetes care), as well as adherence to quality measures of diabetes care, affects diabetes-related outcomes in people with diabetes and co-occurring BHDs.

Study Aims

In order to accomplish the objectives above, this study is divided into three separate aims.

Aim 1

Aim 1 is to compare the rates of adherence to the quality measures for diabetes care (hemoglobin A1c tests, low-density lipoprotein (LDL-c) tests, nephropathy screening and eye examinations), as defined by Health Effectiveness Data and Information Set (HEDIS), among people with type 2 diabetes and co-occurring behavioral health disorders to those with diabetes alone. In addition, the population characteristics are also compared.

Aim 2

Aim 2 is to investigate diabetes-related outcomes (complications and hospitalizations) in 2005 among people with diabetes and each major type of behavioral health disorder.

Aim 3

Aim 3 is to investigate the impact of adherence to quality measures and mode of service delivery (i.e., Comprehensive diabetes care, defined by having 2 or more quality measures achieved in a visit during 2004) on diabetes-related outcomes in 2005 among people with diabetes and comorbid BHDs.

Chapter II. Conceptual Framework and Study Design

Conceptual Framework

The study's conceptual framework was based on the Anderson-Newman Behavioral Model (Phase 4),[29] which is presented in figure 2.1. The Behavioral Model is a widely used framework for evaluating health service utilization.[30-32] In this model, health-related factors and outcomes are classified into five categories: 1) Predisposing, 2) Enabling, 3) Need, 4) Behavior and 5) Outcome.[29] Predisposing factors, which include having a behavioral health disorder (BHD), gender and race/ethnicity, influence the individual's ability to gain access to resources such as health coverage and perceptions of need to use health services. These factors may directly or indirectly affect the outcomes. Enabling factors, such as healthcare coverage and socioeconomic status, are social or physical resources that allow the individual to access services. Need factors are conditions that can directly influence health-seeking behavior in an individual, such as pre-existing diabetes complications. All three factors (Predisposing, Enabling and Need) affect behaviors of patient and provider (Behavior factors) such as having outpatient visits and referrals to specialists for certain procedures by a primary care physician. In turn, Behavior factors directly influence the intermediate health outcomes (Proximal Outcomes), such as getting HbA1c, LDL-c and nephropathy tests. Proximal Outcomes then predispose the individual to the eventual health outcomes (Distal Outcomes), such as newly diagnosed diabetes complications.

For example, an individual has diabetes and untreated depression. The individual may also have very high levels of blood sugar due to poor self-management. He/ she may not visit a primary care physician for diabetes care because of depressive symptoms. Consequently, the individual does not receive the procedures for diabetes management, such as HbA1c tests and eye exams. Thus, no actions are taken to control the levels of blood sugar and the individual subsequently develops retinopathy. The Behavioral model (see figure 2.1) illustrates the complex relationships among psychological, physical and social factors in health behavior and outcomes.

Figure 2.1 Conceptual Model of the Study
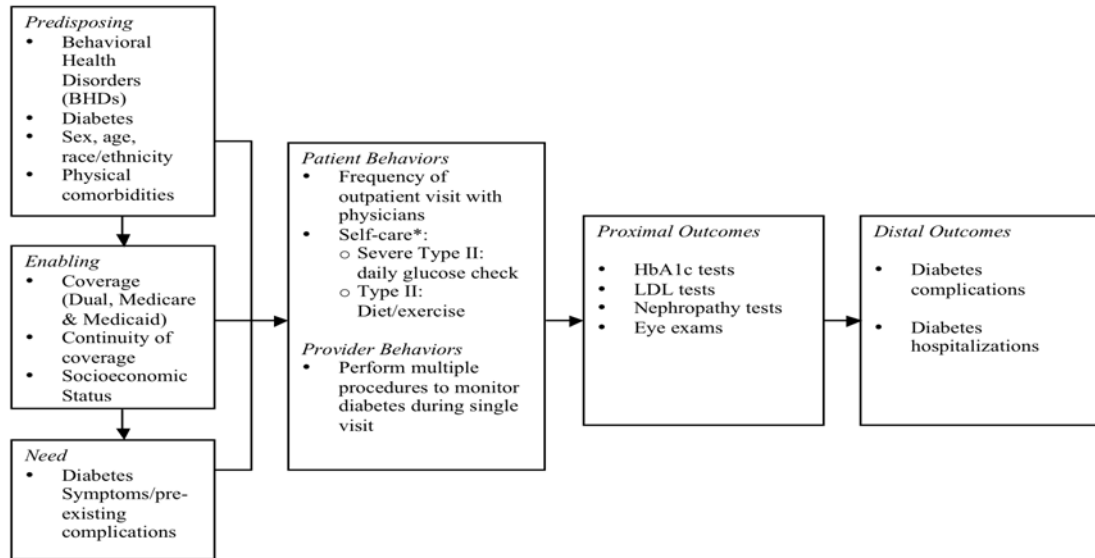
* Unable to assess in current dataset

Study Design

This is a two-year cohort study. In 2004, the index year, the population characteristics among people with type 2 diabetes were assessed. In 2005, the study examined diabetes outcomes. These outcomes include: 1) the rates of adherence to the quality measures for diabetes care (hemoglobin A1c tests, low-density lipoprotein (LDL-c) tests, nephropathy screening and eye examinations); 2) the rates of diabetes-related complications (e.g., ischemic heart disease, blindness (diabetes retinopathy), kidney disease (nephropathy), nervous system damage (neuropathy) and lower-limb amputations) and 3) the rates of diabetes-related hospitalizations (defined by hospitalizations with primary diagnoses of diabetes-related conditions, such as diabetes and diabetes complications). This study has been approved by the Institutional Review Board at the University of Massachusetts Medical School.

Study Populations

Rationale for the selection criteria of study populations

The study identified beneficiaries in Massachusetts by the source of health coverage during 2004, i.e., Medicare only, Medicaid only and dually-eligible (both Medicare and Medicaid) because there are underlying differences in the socio-economic and medical conditions among beneficiaries with these 3 types of coverage. According to an analysis by the Kaiser Commission on Medicaid and the Uninsured, dually-eligible beneficiaries are usually poorer and less well-educated, but more likely to have diabetes and disabilities than those who are only eligible for Medicare and other types of

insurance.[33] Since Medicare eligibility requires a history (10 years in most cases) of payroll tax contributions to Medicare by the beneficiary or his/her spouse, people who have less work experience or are new immigrants may not be eligible for Medicare when they become disabled or reach age 65.[34] Instead, they may be qualified for Medicaid if they are disabled or live in medical institutions and have monthly income up to 300% of the Federal poverty rate.[35] Therefore, people with Medicaid only in the age group of 65 years and older, are more likely to be poorer and less healthy than those with Medicare only. Such differences may affect the quality of diabetes care across these types of health coverage. If such differences are not accounted for in the study, the associations between BHDs and quality of diabetes care may be biased towards the estimates for the group with the largest sample size. To demonstrate such differences exist, a separate analysis was performed. For more information on the analysis, please refer to Appendix I on p.113.

Criteria for Medicare eligibility in study

In this study, Medicare beneficiaries were enrolled in both Medicare Part A (hospital insurance) and Part B (ambulatory care) for at least 10 months during 2004 and 2005. The requirement for 10 months in Medicare enrollment was to ensure that the coverage period for each beneficiary was long enough for the meaningful assessment of procedures performed. This was because people with diabetes were expected to have the quality measures (i.e., having at least one occurrence of hemoglobin A1c tests, LDL-c tests, nephropathy screening and eye examinations) assessed annually as recommended. Those enrolled in Medicare Advantage (capitated) plans or with primary coverage from a

private health insurer were excluded because this study did not have access to complete claims from either source.

Criteria for Medicaid eligibility in the study

Medicaid eligibility in the study was defined as an enrollment period of at least 10 months during each year (2004 and 2005). The requirement for 10 months of Medicaid enrollment was to ensure the completeness of information regarding health coverage and service utilization. Unlike Medicare, which is a health insurance program, Medicaid recipients can lose coverage when they fail to meet the requirements for Medicaid entitlement, for example, living above the preset poverty level (135% Federal Poverty Level for Medicare beneficiaries). However, this exclusion criterion limited the generalizability of the study because it excluded people with discontinuous enrollment. This exclusion might potentially bias the estimates of study outcomes because conditions such as homelessness and death, which are reasons of discontinuing enrollment, may be associated with poor quality of diabetes care. A secondary analysis (see Chapter VI on p.101) was carried out to compare the characteristics between those who were excluded from the study and those who met the inclusion criteria.

Criteria for Dual-eligibility in the study

In the study, Dual-eligible beneficiaries were enrolled in: 1) Medicare Part A for at least 10 months during 2004 and 2005; and 2) MassHealth (Massachusetts Medicaid) for at least 10 months during 2004 and 2005. They did not have either Medicare Advantage coverage or other health insurance (i.e., third-party insurance) during these 2

years for the same reason as for those with Medicare alone. The requirement for 10

months in Medicaid enrollment was for the same rationale.

Other selection criteria for study populations

Beneficiaries were at least 18 years of age or older. There are two reasons for the

age selection. First, HEDIS measures for diabetes care used in this study, are intended for

patients over 18 years of age;[36] therefore, including pediatric patients was not

appropriate. Second, the age of onset for certain BHDs, such as depression, anxiety and

substance use disorders, are usually at or after the age of 19 according to the National

Comorbidity Survey.[37] Thus, it was inappropriate to select study populations below the

age of 18. Beneficiaries who had any stay in a nursing home or hospital for at least 90

days in 2004 were excluded because they might have health services provided within

institutional settings, which were not recorded in Medicare or Medicaid claims. HEDIS

measures were developed for the evaluation of outpatient services[38] and it may not be

appropriate to apply HEDIS measures to institutionalized populations. Beneficiaries in

the study had 2 outpatient diagnoses or 1 inpatient diagnosis of type 2 diabetes in 2004.

The selection process is described as followed. First, all types of diabetes were identified

by International Classification of Diseases- 9th Edition (ICD-9) codes. Then the two

types of diabetes (Type 1 and Type 2) were further classified. If an individual had

missing diabetes type, type 2 diabetes was assigned. If an individual had both type 1 and

type 2 in record, type 1 diabetes was assigned as diagnosis. Only individuals with type 2

diabetes were included in all of the analyses. Further selection was applied so that the

study population had no missing socioeconomic status data (see section on 'Measures

assessed in the study: Enabling factors: Socioeconomic status' on p.36). An additional

selection criterion was applied in the analysis of Aim 3 to include only people with any

type of BHD. As a result, the study included 106,174 individuals in Aims 1 and 2 while

31,350 individuals were in the analysis of Aim 3. Please refer to Figure 2.2 for the

overall selection process and Appendix II on p.137 for diagnostic codes.

Figure 2.2 Selection of Study Population
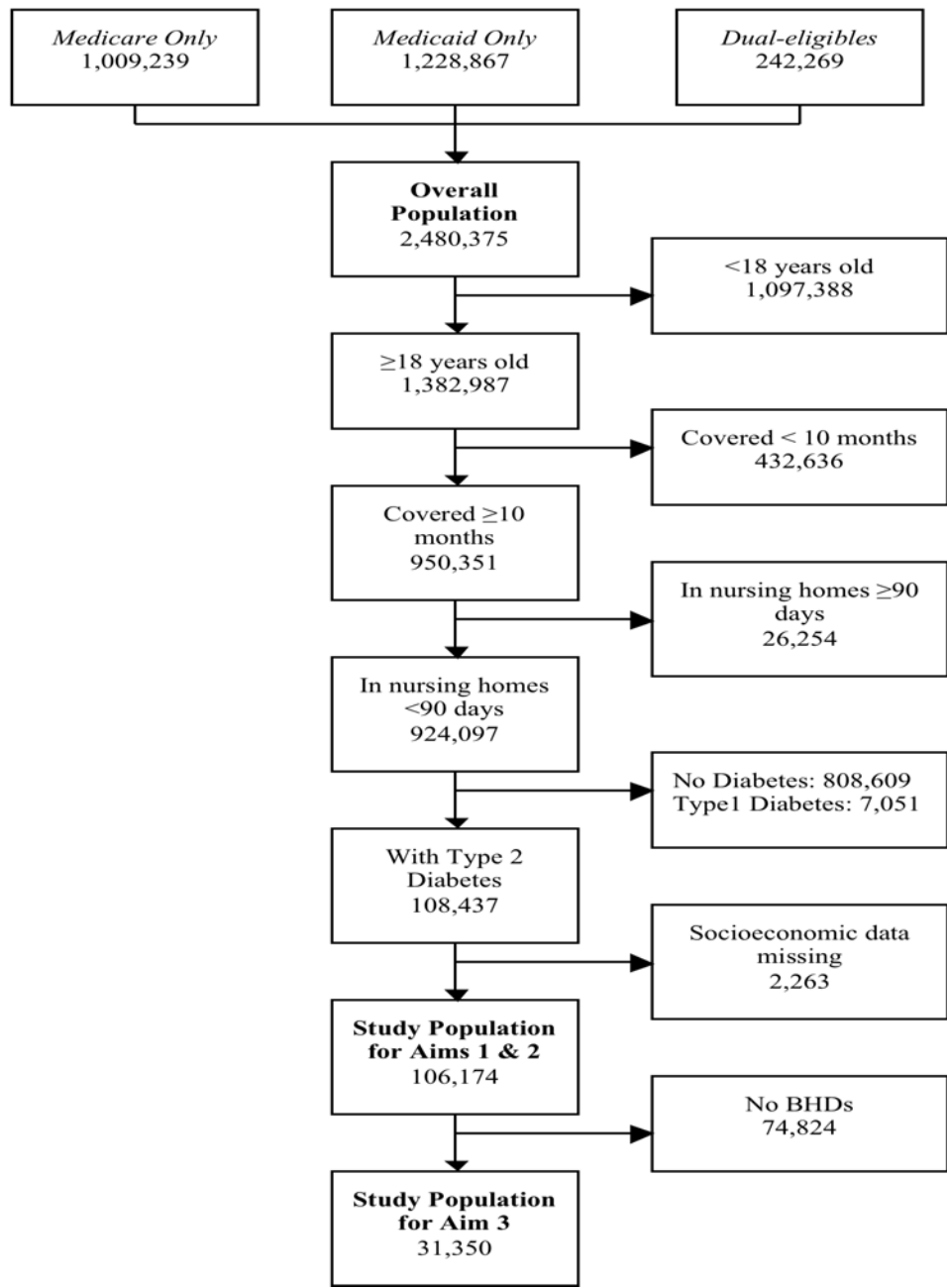
Data source

This study used 2004 and 2005 paid insurance claims for Massachusetts Medicare and Medicaid beneficiaries. Diabetes outcomes, such as adherence to quality measures for diabetes care and diabetes complications, were assessed with data from CY 2005. Data from CY 2004 were used for identifying study populations according to the selection criteria for the types of health coverage, diabetes and BHDs, as well as assessing other measures belonging to Predisposing, Enabling, Need and Behavior factors (see Figure 2.1).

Medicare data were obtained from the Centers for Medicare and Medicaid Services in the form of Research Identifiable Files (RIFs). RIFs contained individual-level data and allowed researchers to identify the dates, providers and beneficiaries for services paid by Medicare .[39] In this study, only two components of the RIFs were used to create the working datasets: 1) Standard Analytical Files (SAFs) and 2) Medicare enrollment and vital statistics files.[39]

The SAFs contained claim-level data on seven types of services: Inpatient, Skilled Nursing Facility, Outpatient, Home Health Agency, Hospice, Carrier and Durable Medical Equipment. Information in SAFs included diagnosis (ICD-9 diagnosis codes), procedure (ICD-9 procedure codes, Current Procedural Terminology (CPT) codes, and Common Procedure Coding System (HCPCS) codes), Diagnosis-Related Group (DRG), dates of service, reimbursement amount paid by Medicare, provider identification, and demographic data for beneficiaries.[39]

This study used the Denominator File, one of the three parts in the Medicare enrollment and vital statistics files. This file contained information for all beneficiaries for the entitlement year, including beneficiary unique identifiers (Medicare Identification numbers), zip codes, date of birth, date of death, sex, race/ethnicity, state/county codes, entitlement indicators (i.e., part A and/or B) and reason for entitlement.[39]

Medicaid data came from the Medicaid Management Information Systems of Massachusetts (MMIS). The MMIS data contained individual-level data. These data were held in two files: 1) Medicaid eligibility file: beneficiary identifiers (Social Security Numbers), eligibility, sex, race/ethnicity and enrollment dates and participation of other insurance programs; and 2) claims file: diagnosis (ICD-9 codes), inpatient and outpatient service use (ICD-9 procedure codes, CPT codes and HCPCS codes), prescription drug use (National Drug Codes [NDCs]) and payments by Medicaid.

Data extraction

Medicare and Medicaid files were merged to: 1) identify the appropriate source of health coverage for each beneficiary, i.e., Medicare alone, Medicaid alone and Dual-eligible; and 2) link the diagnoses and health service utilization of beneficiaries with the appropriate target populations. Three data files were used in identifying the target populations: 1) Medicare Denominator file, 2) Medicaid eligibility file and 3) Crosswalk file. The Crosswalk file was provided by JEN Associates, Inc., a research/consulting firm contracted by the Centers for Medicare and Medicaid Services and contained two types of identifiers for Medicare and Medicaid beneficiaries: 1) Medicare Identification numbers and 2) Social Security Numbers. [40]

First, the Medicare denominator file and the Crosswalk file were merged using Medicare Identification numbers to identify beneficiaries who were potentially Dual-eligible. Those who were present only in the Medicare denominator file were classified as Medicare only and this information was stored as the identification file for Medicare alone. Then the merged file was combined with Medicaid eligibility file using Social Security Numbers. Beneficiaries who were present in both files were Dual-eligibles and the information was stored as a separate identification file for Dual-eligibles. Those who only existed in Medicaid eligibility file were classified as Medicaid only and an identification file was created separately to store this information. These identification files were also used for calculating age and length of enrollment for beneficiaries.

Second, claims files from Medicare and Medicaid were sorted according to the coverage categories (Medicare only, Medicaid only and Dual-eligibles) to create working datasets. Diagnoses, such as diabetes, BHDs and complications, and utilizations, such as hospitalizations, quality measures for diabetes care and frequencies of outpatient visits (ambulatory setting) were then assessed using the working datasets. Chronic Illness and Disability Payment System (CDPS) scores[41] were also estimated using these datasets.

Third, socioeconomic status data for beneficiaries' zip code-based neighborhoods, i.e., median household income in 1999 and percentage of high school graduates, were obtained from Census 2000. From the Dartmouth Atlas of Health Care, a cross-reference file for 2004 Hospital Service Areas was obtained to identify Hospital Service Areas in Massachusetts using residential zip codes.[42] Using residential zip codes, socio-economic data and identification of Hospital Service Areas were merged with the identification

files. Hospital Service Areas were used for clustering beneficiaries in the analyses. Please refer to the section 'Hospital Service Areas: Rationale' on p.43 for details.

Finally, the three populations in their respective identification files were then merged with the corresponding working datasets to create a combined dataset of all three populations. SAS 9 for UNIX was used in all the procedures for sorting, extracting and merging data.

Measures assessed in the study

Measures used in this study were selected based on the Behavioral Model.[29] They were classified into five categories: 1) Predisposing factors, 2) Enabling factors, 3) Need factors, 4) Behavior factors and 5) Outcomes. The Predisposing factors included behavioral health disorders, gender, age, race/ethnicity and physical comorbidities (as represented by Chronic Illness and Disability Payment System, or CDPS). Enabling factors included types of health coverage, continuity of coverage, neighborhood socioeconomic status (median income and percentage of high school graduates). Need factors included previous diabetes complications (e.g., eye complications, neuropathy, nephropathy, ischemic heart disease, cerebrovascular disease and lower-limb amputations). Behavior factors consisted of comprehensive diabetes care, defined by having 2 or more quality measures achieved in a single visit during 2004, frequency of outpatient visits and number of quality measures met in 2004. Outcomes included the quality measures for diabetes care in 2005 (i.e., hemoglobin A1c test, low-density lipoprotein test, nephropathy test and eye examination), diabetes complications in 2005 (e.g., eye complications, neuropathy, nephropathy, ischemic heart disease,

cerebrovascular disease and lower-limb amputations) and diabetes-related hospitalizations, defined by hospitalizations with primary diagnoses of diabetes-related conditions (e.g., diabetes and diabetes complications), in 2005. The following passage describes the rationale and assessment of each study measures.

Based on prior literature, some hypotheses can be made between study measures and outcomes. For example, having a diagnosis of substance use disorders may negatively impacts the adherence to quality measures while it may increase the odds for diabetes-related hospitalizations. Having a previous diabetes complication may increase the odds for adherence to quality measures; however, its effects on subsequent diabetes complications are unknown. Please refer to table 2.1 for more information.

Table 2.1 Hypothesized associations between study factors and outcomes

Factors	Variables	Hypothesized associations with	
		Adherence to quality measures	*Diabetes complications & hospitalizations*
Predisposing	Mental health disorders	Unknown	Unknown
	Substance use disorders	**-**	+
	Age	+	Unknown
	Male Gender	+	+
	Race/ethnicity	**-**: for non-white	+: for non-white
	Burden of Co-morbidities (CDPS)	+	Unknown
Need (pre-existing diabetes complications in 2004 data)	No complications	**-**	Unknown
	Eye complications	+	Unknown
	Nephropathy	+	Unknown
	Neuropathy	+	Unknown
	Lower Limb Amputation	+	Unknown
	Ischemic heart disease	+	Unknown
	Cerebrovascular disease	+	Unknown
Enabling	Type of coverage	**-**: for Medicaid	+: for Medicaid
	Continuity of coverage	+	Unknown
	Median household income	+	Unknown
	Education level	+	Unknown
Behavior	Frequency of Outpatient Visit with physicians	+	**-**
	Comprehensive diabetes care	Not assessed	**-**

Predisposing factors

Behavioral health disorders (BHD)

Rationale for BHD categorization

Behavioral health disorders (BHDs) in the study included mental health disorders and substance use disorders. Mental health disorders were assessed in five categories: 1) No mental health disorders, 2) schizophrenia/ paranoid states, 3) bipolar disorder, 4) depression/ anxiety and 5) other mental health disorders. Substance use disorders consisted of: 1) alcohol abuse/ dependence and 2) drug abuse/ dependence.

The categorization of mental health disorders was based on evidence from previous studies. From a brief review of literature, no significant differences in the quality of diabetes care among people with depression and those with anxiety disorders were observed. For example, 14 studies[16,24,27,43-53] reported that the presence of depression was associated with poor diabetes management while eleven studies [18,19,54-62] did not find significant associations between depression and quality of diabetes care. Similarly, four studies did not find significant relationships between the presence of anxiety and quality of diabetes care [51,52,61,62] while two studies indicated poorer quality of diabetes care (in terms of glycemic control) among those with anxiety disorders compared to those without mental illnesses [16,63] and one showed better quality of care for people with anxiety disorders.[64] In addition, Trief and colleagues showed that there was no significant associations between depression/ anxiety disorders and quality of diabetes care, no matter if depression and anxiety co-occurred together or exist separately.[62] Although bipolar disorder is a mood disorder, like depression, Frayne and colleagues

showed that people with bipolar disorder had poor quality of diabetes care and further studies are needed.[16]

Therefore, mental health disorders, i.e., schizophrenia/ paranoid states, bipolar disorder, depression/ anxiety and other mental health disorders, were categorized based on a hierarchical system with no mental health disorders as the reference group because a beneficiary might have multiple mental health disorders. In this system, any diagnosis of schizophrenia/ paranoid states superseded any other diagnoses while any diagnosis of bipolar disorder outranked depression/ anxiety disorders. In turn, depression/ anxiety disorders superseded other mental health disorders. The system assumed more severe disease states and disabilities among people with schizophrenia or bipolar disorders than depression, anxiety or other mental health disorders. There was no further breakdown between depression and anxiety disorders. Similar systems have been used in previous studies of claims data to compare healthcare expenditures[65] and quality of diabetes care[15] between people with mental health disorders and those with non-psychiatric illnesses.

The diagnosis of substance use disorders (SUD) remained a separate measure. The reference category for this measure included people with no SUD. This is because SUD frequently co-occur with mental health disorders and there is evidence that the quality of diabetes care is poorer for those with SUD or those with both mental health disorders and co-morbid SUD.[16,66,67]

Assessment

For Chapters III and IV:

Based on two outpatient or one inpatient ICD-9 diagnosis, behavioral health disorders were identified among study population: 1) schizophrenia/ paranoid states, 2) bipolar disorder, 3) depression/ anxiety disorders, 4) other mental health disorders, 5) any alcohol abuse/ dependence and 6) any drug abuse/ dependence. Schizophrenia/ paranoid states included schizophrenia and paranoid states. Bipolar disorder consisted of bipolar I disorder and other unspecified bipolar disorders. Depression/ anxiety disorders included major depression, other depression, anxiety states and post-traumatic stress disorder. Other mental health disorders comprised of psychosis (excluding schizophrenia and paranoid states), hysteria, phobic disorders, obsessive compulsive disorders, neurasthenia, depersonalization syndrome, neurotic disorders, personality disorders, sexual deviations, physiological malfunction from mental factors, special syndrome, adjustment reactions, disturbance of conduct or emotions, hyperkinetic syndrome of childhood, specific delays in development and psychic factors.

Substance use disorders (SUD) included any alcohol abuse/ dependence and any drug abuse/ dependence. Any alcohol abuse/ dependence included alcoholic psychoses, alcoholic dependence, alcohol abuse, alcoholic gastritis, and alcoholic liver diseases. Any drug abuse/ dependence consisted of drug psychoses, drug dependence and drug abuse. These two types of substance use disorders were not mutually exclusive and thus an individual could have both at the same time. In the unadjusted anaylses, substance use disorders were represented by one summary measure, namely SUD, for having any types of SUD and the reference group consisted of people without any SUD. In the adjusted analyses, substance use disorders were represented by the two separate variables, 'any

alcohol abuse/ dependence' and 'any drug abuse/ dependence'. The reference group for 'any alcohol abuse/ dependence' included people without alcohol abuse/ dependence while the referenece group for 'any drug abuse/ dependence' consisted of people without drug abuse/ dependence. These two variables were not mutually exclusive; therefore, they were allowed to co-occur with each other, as well as with mental health disorders.

For Chapter V:

Since the study population was restricted to individuals with any types of BHDs, the reference group for mental health disorders included beneficiaries with any SUD but no mental health disorders. Two new variables, 'co-occurring alcohol abuse/ dependence' and 'co-occurring drug abuse/ dependence', were created to represent substance use disorders co-occurring with mental health disorders. The reference group for 'co-occurring alcohol abuse/ dependence' consisted of individuals with mental health disorders only as well as those with SUD only while the reference group for 'co-occurring drug abuse/ dependence' included individuals with mental health disorders only and those with SUD only.

Please refer to Appendix II on p.137 for diagnostic codes and table 2.2 for the classification scheme of mental health disorders.

Table 2.2 Hierarchical System for Mental health disorders

Circumstances of Co-occurrence	*Decision on Mental Disorder*
Schizophrenia/ paranoid states and (depression/ anxiety, bipolar and/or other mental health disorders)	Schizophrenia/ paranoid states
Bipolar disorder and (depression/ anxiety and/or other mental health disorders)	Bipolar disorder
Depression/ anxiety and (other mental health disorders)	Depression/ anxiety

Sub-analysis using Medication data to identify mental health disorders:

Besides ICD-9 codes, medication data can also be used in identifying mental health disorders. One example is the Medicaid Rx models.[68] Medicaid Rx is a SAS®-based program using National Drug Code (NDC) to identify relevant medical diagnoses for each individual.[68] A full description of this method and its impact on results can be found in Appendices III through XI (p.138-147).

Rationale for using ICD-9 codes only in assessment of mental health disorders

There were two reasons for not using Medicaid Rx models in identifying mental health disorders. First, the sub-analysis showed consistent relationships between mental health disorders and adherence to quality measures, regardless of case-identification methods. Second, there were no medication data available for individuals with Medicare only during the study period and Medicaid Rx models were designed primarily for people with Medicaid coverage. In order for the analyses to be consistent across individuals with different types of health coverage, this study only used ICD-9 codes in assessing mental health disorders.

Concerns about the assessment method of BHDs

This study defined beneficiaries with BHDs as having 2 outpatient diagnoses or 1 inpatient diagnosis using ICD-9 codes in 2004. All claims diagnoses were used for BHD assessment. The reason for this assessment criterion was the high likelihood of false positives in identifying depression if only a single outpatient diagnosis was used. In a study comparing claims and physician diagnoses of depression, Spettell and colleagues observed a false positive rate of 26% when only 1 outpatient or pharmacy claim was

used.[69] However, if 2 outpatient diagnoses are required for depression, the false positive

rate was reduced to 9%.[69] In a separate study, Solberg and colleagues showed that using

2 outpatient claims or 1 inpatient claim yielded high accuracy in case identification for

depression (positive predictive value 99%).[70] Therefore, using 2 outpatient diagnoses or

1 inpatient diagnosis to identify BHDs can increase the specificity of case identification.

Age

Rationale

In a study examining glycemic control in people with diabetes and co-morbid

depression**,** Paschalides and colleagues showed that older age was associated with better

glycemic control in people with diabetes and co-occurring depression or anxiety

disorders.[71] Further, age was categorized based on a study by Frayne et al. [16] In their

study, the prevalence of having any BHD varied significantly across different age groups.

[16] Therefore, age groups were created in this study to account for such variability.

Assessment

Age in 2004 was calculated using date of birth. No missing age or age greater

than 110 was found in the study population. In adjusted analyses, age was further

categorized into four groups: <55, 55-64, 65-74, 75 and older.

Gender

Rationale

Two previous studies have shown that female gender was associated with poorer

glycemic control[15,72] while two indicated the otherwise. [55,73]

Assessment

Gender was used unaltered from the existing Medicare/Medicaid data.

Race/ethnicity

Rationale

Three previous studies[17,71,73] observed that white race was associated with better glycemic control while the study by Trief et al. showed the opposite. [74]

Assessment

Race/ethnicity was reformatted to match the data from Medicare because a Dual-eligible individual with missing data on race/ethnicity in Medicaid might have known race/ethnicity in Medicare data. If an individual had unknown race/ethnicity in Medicare (for those covered by Medicare only), Medicaid (covered by Medicaid only), or both (Dual-eligible), the race/ethnicity variable was coded as 'Unknown'. People with race/ethnicity of Asian, Pacific Islander, Native Hawaiian, Alaskan native or Native American were coded as 'Others'.

Concerns about the assessment of race/ethnicity

A major concern in assessing race/ethnicity was the category of 'Unknown'. Due to limitations of data, it was not possible to further examine or determine the race/ethnicity of this group. Overall, this group constituted approximately 4% of the study population. The majority of people with 'Unknown' race/ethnicity had only Medicaid (16.5%) compared to those with Medicare only (0.1%) and Dual-eligibility (0.4%). This is one of the weaknesses of the study.

Burden of Physical Comorbidities

Rationale

In their study, Paschalides and colleagues observed that the presence of physical comorbidities was associated with improved glycemic control in people with diabetes and co-occurring depression or anxiety. [71] However, the type of comorbidity measure was not described. [71]

Description of Chronic Illness and Disability Payment System (CDPS)

In this study, burden of physical comorbidities was represented by Chronic Illness and Disability Payment System (CDPS). The CDPS is a diagnostic classification system using ICD-9 diagnostic codes, developed by researchers at the University of California at San Diego.[41] The CDPS was originally designed to allow the Medicaid program predict healthcare expenditures for its beneficiaries using ICD-9 based diagnoses.[41] This is achieved by assigning weights to diagnoses according to their expected use of resources.[41] Therefore, unlike a simple count of other co-morbid conditions to assess disease burden, the CDPS score may reflect the severity of co-morbid conditions by assigning more weights on more costly diseases, which are usually more severe. There is also a modified version for Medicare.[75] It has been previously adapted and used as a measure of co-morbidities.[76] The major limitation of CDPS as measure of physical comorbidities was its reliance on ICD-9 based diagnoses. Diseases not coded in the claims data (first 2 fields in Medicaid and first 10 in Medicare) could not be included in the estimation of CDPS score. Therefore, an individual might have a low CDPS score but high disease burden in reality if the illnesses were not treated or recorded on the medical claim.

Assessment

Chronic Illness and Disability Payment System (CDPS) score in 2004, the ICD-9 based indicator for comorbidity, was estimated using a statistical algorithm developed by researchers at the University of California at San Diego.[41] In estimating CDPS, the ICD-9 codes of diabetes and behavioral health disorders were omitted from the measure so that the analyses can investigate the effect of behavioral health disorders on diabetes outcomes separate from that of other co-morbidities. The scores were then categorized into quartiles for multivariate analyses.

Enabling factors

Types of coverage

Health coverage was classified into three types: 1) Medicare only, 2) Medicaid only and 3) Dual-eligible.

Rationale

Please refer to the section 'Rationale for the selection criteria for study populations' on page 14.

Assessment

Please refer to the section 'Data extraction' on page 21.

Continuity of coverage

Rationale

One of the selection criteria for the study populations was being enrolled for at least 10 months in Medicare Part B or Medicaid to ensure completeness of data. However, one of the requirements for using HEDIS (Health Effectiveness Data and Information Sets) measures of diabetes care is that beneficiaries/enrollees must be

covered for at least 320 days during a year. [36]   Therefore, a measure was created to indicate continuous coverage during the study year.

Assessment

Continuous coverage was defined as having at least 12-month enrollment in Medicare Part B or Medicaid.

Socioeconomic status

Rationale

Previous studies showed that both income and education level are associated with healthcare utilization and diabetes care.[77,78]   In addition, Zaslavsky and colleagues demonstrated that socioeconomic status (income and education) assessed in census data is significantly correlated with HEDIS measures of diabetes care.[79,80]   The use of census data for SES is due to the lack of such variables for individuals in the current administrative dataset.

Assessment

Median household income and the percentage of college graduates in beneficiaries' residential neighborhoods were obtained from Census 2000 data as a proxy measure of the beneficiaries' socioeconomic status. These measures were linked to each beneficiary using their residential zip codes. These measures were further categorized by quartiles.

Limitation of Census Socioeconomic status data

Census data for education level and income can only indicate the approximate socioeconomic status of the individuals' neighborhood at the zip code level. These data

do not represent the individuals' income or education level because these were aggregated data from all the census participants in the zip code area. Using such data to infer individuals' socioeconomic status may be inappropriate.

Concerns about missing Socioeconomic status (SES) data

Two thousand, two hundred and sixty three individuals (about 2% of study populations) had missing SES data. There are 4 reasons for missing data. First, some zip codes listed in Medicare/Medicaid data were of Post Office boxes or 'unique business' (as defined by the Census Bureau) for 1,753 individuals. Second, the zip codes for 274 individuals were not in Massachusetts. Then, 221 individuals had valid residential zip codes in Massachusetts but no census information was collected on these zip codes. Finally, 15 individuals had non-existent zip codes, possibly due to transcription error. These individuals were excluded in the unadjusted analyses because extrapolation of data using imputation was not possible.

Need factors

Pre-existing Diabetes complications

Rationale

Previous studies observed that pre-existing diabetes complications were significantly associated with glycemic control.[71,81] However, the two studies reported contradictory observations. In the study by Paschalides and colleagues,[71] positive correlation between pre-existing complications and improved glycemic control was observed while negative impact of previous complications on glycemic control was found in the study by Ciechanowski et al.[81] The differences in the findings may be due to the

fact that Paschalides' study examined only people with type 2 diabetes[71] while

Ciechanowski's study included people with both type 1 and type 2 diabetes.[81] It is

possible that the association between glycemic control and diabetes complications is

different in people with type 1 diabetes.

Assessment

Pre-existing diabetes complications in 2004 were identified in inpatient,

outpatient, physician, medical and mental health claims from Medicaid data, as well as

claims files from inpatient, outpatient and physician services in Medicare data, using

ICD-9 or CPT (Current Procedural Terminology) codes. They include: a) eye

complications; b) nephropathy; c) ischemic heart disease; d) cerebrovascular disease; e)

neuropathy; and f) lower-limb amputations. Please refer to Appendix II on p.137 for

diagnostic and procedural codes.

Behavior factors

Frequency of outpatient visits

Rationale

In a study using administrative data from Veteran Administration, Frayne and

colleagues observed that frequency of outpatient visits was significantly associated with

the quality of diabetes care among people with diabetes and co-occurring mental or

substance use disorders. [16]

Assessment

Information for this measure was obtained from physician medical services claims

in Medicaid data as well as physician claims in Medicare data. The frequency of

outpatient visits in 2004 was estimated by counting the number of claims that occurred in office settings, regardless of the type of healthcare provider.

Comprehensive diabetes care

Rationale

In the Behavioral Model, part of physician behavior is the provision of 4 tests for diabetes care during a single visit. The rationale was that individuals who received services in a comprehensive diabetes care center were more likely to have multiple testing and examinations performed during a single visit. In a study comparing the quality of care between a diabetes center and a general medical clinic, Huang and colleagues showed that patients of diabetes center were less likely to be hospitalized although the association was not statistically significant.[21]

Assessment

Comprehensive diabetes care was defined as having met two or more quality measures for diabetes care (i.e., HbA1c test, LDL-c test, nephropathy test and eye examinations) within a day in 2004 (see Appendix II on p.137 for CPT codes). However, analysis showed that there was moderately high correlation between having HbA1c tests and LDL-c tests (Pearson correlation: 0.45). Therefore, the co-occurrence of HbA1c and LDL-c tests was treated as having met one quality measure to account for this correlation.

Concerns about the assessment of Comprehensive diabetes care

Originally, the measure was defined as having full adherence to all quality measures within a single visit. However, there were too few individuals (i.e., <11, 0.01%) meeting this criterion in the study population. Therefore, the definition for the

measure was changed so that Comprehensive diabetes care was indicated by achieving at least 2 diabetes quality measures during the same visit.

Number of quality measures met in 2004

Rationale

This variable represented the level of care achieved during the entire year. The analyses were adjusted for number of quality measures achieved in 2004 because the variable, comprehensive diabetes care might be proxy for both the setting and the level of care (see flow diagram on next page). Therefore, a separate variable to represent levels of care was created.

Figure 2.3 Flow Diagram for the proposed relationship between Comprehensive Diabetes Care and Diabetes-related Outcomes

| Receiving Comprehensive Diabetes Care | → | More tests performed and thus better adherence to quality measures | → | Fewer Diabetes-related Complications/ Hospitalizations |
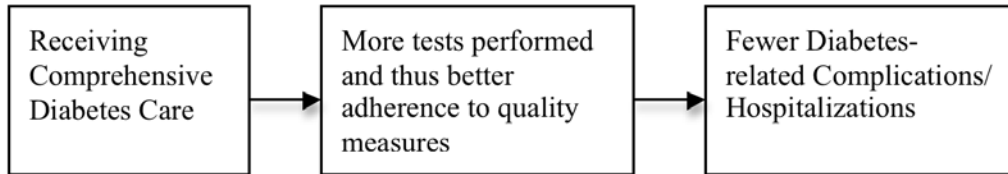
Assessment

The number of quality measures in 2004 was calculated by the sum of the different quality measures (see Appendix II on p.137 for CPT codes of quality measures) that occurred within 2004 for each individual.

Outcomes

Quality Measures for Diabetes Care in 2005

Rationale

The aim of diabetes care is to prevent diabetes-related outcomes through proper clinical monitoring and self-management. Surrogate measures such as laboratory tests and clinical examinations are chosen to evaluate interim quality of care in diabetes. In 2000, the Diabetes Quality Improvement Project[22] team selected the frequencies and/or results of the following as quality measures of diabetes care: 1) hemoglobin A1c test (HbA1c), 2) low-density lipoprotein test (LDL-c), 3) nephropathy screening, 4) eye examination in the past year, 5) foot examination and 6) blood pressure check in the past year. These clinical tests and examinations are also Healthcare Effectiveness Data and Information Set (HEDIS) measures[23] for the quality of diabetes care. Since HEDIS measures have been used in evaluating the quality of care among Medicare/ Medicaid beneficiaries, this study followed the convention in assessing quality of diabetes care.

Assessment

Using Current Procedural Terminology (CPT) codes, quality measures for diabetes care were identified by having at least one occurrence of the following assessments during CY 2005: hemoglobin A1c (HbA1c) tests, low-density lipoprotein

(LDL-c) tests, nephropathy screens and eye examinations. Please refer to Appendix II on p.137 for procedural codes. A summary measure was created to indicate full adherence to quality benchmarks, defined by having all four procedures during CY 2005.   All quality measures were identified using claims files from outpatient, physician, medical and mental health services in Medicaid data, as well as claims files for outpatient and physician services in Medicare data.

Diabetes Complications and Hospitalizations in 2005

Rationale

The types of complications are selected based on information from the Centers for Disease Control and Prevention.[82] They include heart disease, blindness (diabetes retinopathy), kidney disease (nephropathy), nervous system damage (neuropathy) and lower-limb amputations.[82]

Assessment

Using ICD-9 and Current Procedural Terminology (CPT) codes (see Appendix II on p.137 for codes), diabetes-related outcomes were identified during CY 2005: a) eye complications; b) nephropathy; c) ischemic heart disease; d) cerebrovascular disease; and f) lower-limb amputations. Diabetes-related hospitalization was assessed by any inpatient claims with any diabetes-related ICD-9 codes, i.e., diabetes and complications, as the first diagnosis.

Other Covariates

Hospital Service Areas (HSA)

Rationale

Poorer quality of diabetes care might be due to differences in clinical practice, rather than individuals' characteristics such as the presence of BHDs because patterns of diabetes care were shown to be similar within a provider but variable across providers, according to a study by Krein and colleagues.[83] Therefore, the heterogeneous patterns of care due to providers had to be addressed. One potential solution was to cluster patients according to their care providers. Providers could be identified in the current database; however, provider identifiers were different in Medicare and Medicaid data and a crosswalk of identifiers was not available. Without a way to uniquely identify providers, it was possible that the same provider could have one of each identification number. Therefore, the same provider could be counted twice if the patient was dually-eligible. In addition, assigning a specific provider for one patient was problematic because one patient might visit several providers with similar frequencies during the study period. As an alternative, Hospital Service Areas (HSAs) were used as proxy for the patterns of care due to patient-provider clustering.

Even though a given HSA may contain multiple healthcare providers, service utilization represented by HSAs could potentially reflect physician care. Patients usually sought care from local physicians, who were in turn affiliated with the local hospitals.[84] HSAs were defined by the areas where the local residents received most of their hospital care.[84]

Several studies by John Wennberg and colleagues demonstrated that the patterns of inpatient and outpatient health care utilization varied greatly across HSAs but were generally more homogeneous within the area.[85] Such variations were associated with the

quality of care from providers, independent of the rates of illnesses or a variety of other socioeconomic characteristics of the area.[86,87] For example, Medicare reimbursement for outpatient services per enrollee in 2005 ranged from $648 in North Adams, MA to $1614 in Melrose, MA, a difference of 149% within the same state.[88] In addition, Sirovich and colleagues observed that providers in Hospital Referral Regions (aggregates of HSAs representing tertiary care service areas) with higher Medicare expenditures were more likely to advocate medical interventions than those in regions with lower Medicare expenditures.[89] Therefore, in the absence of data on specific providers, HSAs might be a reasonable, partial substitute for provider-based variation in care as well as a practical solution to account for unmeasured correlation among patients within a catchment area of healthcare services.

Assessment

Hospital Service Areas (HSAs) were identified using zip codes and cross-referenced with data from the Dartmouth Atlas website.[42] There were 64 Hospital Service Areas identified in Massachusetts for this study.

Analytic approach

Rationale

Unadjusted, descriptive analyses using chi-squared tests were performed to compare the outcomes (rates of adherence to quality measures, diabetes-related complications and hospitalizations) between people with mental health disorders and those with no mental health disorders, as well as those with substance use disorders (SUD) and those with no SUD, because SUD frequently co-occurs with mental health

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disorders and there is evidence that the quality of diabetes care is poorer for those with

SUD or those with both mental health disorders and co-morbid SUD.[16,66] Because the

study populations were not randomly selected, it was possible that people with BHDs

were different from those without BHDs in terms of demographics, burden of co-

morbidities, source of health coverage, pre-existing diabetes complications and patterns

of care. Previous studies had shown that these population characteristics were associated

with the quality of diabetes care (please refer to sections on Predisposing, Enabling, Need

and Behavior factors). [15-17,55,71-74,81]   Therefore, case-mix adjustments were necessary to

minimize bias. Multivariate logistic regression models with robust clustering were carried

out to estimate the odds of outcomes for any given set of mental (e.g., Schizophrenia/

Paranoid State) or substance use disorders (e.g., Alcohol abuse/ dependence) relative to

no BHDs while adjusting for case-mix and addressing the clustering of patients within

Hospital Services Areas (please refer to section 'Other Covariates: Hospital Services

Areas' on p.43 for rationale and assessment).

Method

Unadjusted analyses:

For Aim 1, unadjusted analyses were performed using χ^2 tests, Kruskal-Wallis

tests or ANOVA to compare the distributions of covariates (Predisposing, Enabling,

Need and Behavior factors) and adherence to quality measures (Full Adherence, HbA1c

test, LDL-c test, nephropathy test and eye examinations) across BHD categories. For

Aim 2, unadjusted analyses were performed using χ^2 tests to compare the distributions of

diabetes outcomes (any complications, eye complications, neuropathy, nephropathy,

ischemic heart disease, cerebrovascular disease, lower-limb amputations and diabetes-related hospitalizations) across BHD categories. Pair-wise comparisons were also performed, e.g., no mental health disorders vs. schizophrenia/ paranoid states and no SUD vs. SUD within each mental disorder category. For Aim 3, χ^2 tests were carried out to compare diabetes outcomes between people with and without comprehensive diabetes care.

Adjusted analyses:

Logistic regressions with robust clustering of Hospital Service Areas were carried out for all aims to examine the effects of BHDs on the individual outcomes as well as the summary measures while adjusting for covariates. Five separate regression models were performed for each outcome: 1) BHDs only; 2) BHDs and other Predisposing factors; 3) model 2 and Enabling factors; 4) model 3 and Need factors; and 5) model 4 and Behavior factor. Here is an example of a logistic model using Full Adherence as outcome:

$$\text{logit(Full Adherence}_{ij}) = \log\left\{\frac{\text{p(Full Adherence)}_{ij}}{1-\text{p(Full Adherence)}_{ij}}\right\} =$$

$$\beta_1 Mental\_Disorders_{ij} + \beta_2 Alc\_abuse_{ij} + \beta_3 Drug\_abuse_{ij} \quad \text{(Model 1)}$$
$$+\beta_4 Age_{ij} + \beta_5 Gender_{ij} + \beta_6 Ethnicity_{ij} + \beta_7 CDPS_{ij} \quad \text{(Model 2)}$$
$$+\beta_8 Coverage\_type_{ij} + \beta_9 Continuous\_coverage_{ij}$$
$$+\beta_{10} Education\_level_{ij} + \beta_{11} Household\_income_{ij} \quad \text{(Model 3)}$$
$$+\beta_{12} No\_complication2004_{ij} + \beta_{13} Eye\_complications2004_{ij}$$
$$+\beta_{14} Nephro2004_{ij} + \beta_{15} Neuro2004_{ij} + \beta_{16} IHD2004_{ij}$$
$$+\beta_{17} Leg\,/\,foot\_amputation2004_{ij} + \beta_{18} CVD2004_{ij} \quad \text{(Model 4)}$$
$$+\beta_{19} Freq\_visit_{ij} + \varepsilon_i \quad \text{(Model 5)}$$

Where i = clusters, i.e., HSA, j = each beneficiary

Also, in adjusted analyses, age was categorized into four groups: <55, 55-64, 65-74, 75 and older while CDPS was divided into quartiles. Levels of statistical significance were set at: 1) $\alpha=0.05$ for unadjusted analyses and adjusted analysis of summary measures such as full adherence; and 2) $\alpha=0.01$ for adjusted analyses of individual outcomes due to multiple comparisons. All statistical analyses were performed using STATA 10.

For Aim 1:

The outcomes for this analysis were the individual quality measures for diabetes care (HbA1c test, LDL-c test, nephropathy test and eye examination) and the summary measure of full adherence.

For Aim 2:

The outcomes for this analysis were the individual diabetes complications (eye complications, nephropathy, ischemic heart disease, cerebrovascular disease and lower-limb amputations) and the two summary measures (any diabetes complications and any diabetes-related hospitalizations). In these regression models, different population selection criteria were applied. Individuals with a particular previous complication were excluded from the analyses using the complication as outcome. For example, people with previous eye complications were excluded from the analysis of eye complications in 2005 as outcome. No individuals were excluded in the analysis with any diabetes complications or diabetes-related hospitalizations as outcome.

For Aim 3:

Logistic regressions with robust clustering of Hospital Service Areas were carried out to examine the effects of comprehensive diabetes care on the diabetes-related outcomes in Aim 2 among people with co-occurring BHDs, adjusting for all covariates. In this analysis, 'co-occurring alcohol abuse/ dependence' and 'co-occurring drug abuse/ dependence' were used to represent substance use disorders co-occurring with mental health disorders (see section on 'Behavioral health disorders: Assessment: For Chapter V' on p.29). In addition to selecting only individuals with any types of BHDs, individuals with a particular previous complication were excluded from the analyses using the complication as outcome. Two sets of regression models were performed for each outcome, i.e., one with comprehensive diabetes care and one without the variable. The analyses with comprehensive diabetes care were also adjusted for number of quality measures in 2004 because the variable, comprehensive diabetes care might be proxy for both the setting and the level of care (see section on Behavior factors: 'Number of quality measures met in 2004' for rationale and assessment). The impact of comprehensive diabetes care was evaluated based on the changes in the effect size of BHDs between the two regression models. Significant impact was defined as a change in effect size by 10%. Here is a sample model using any complication in 2005 as outcome:

$$\text{logit(Any complications}_{ij}) = \log \left\{ \frac{\text{p(Any complications)}_{ij}}{1 - \text{p(Any complications)}_{ij}} \right\} =$$

$\beta_1 Mental\_Disorders_{ij} + \beta_2 Co\_Alc\_abuse_{ij} + \beta_3 Co\_Drug\_abuse_{ij}$

$+ \beta_4 Age_{ij} + \beta_5 Gender_{ij} + \beta_6 Ethnicity_{ij} + \beta_7 CDPS_{ij} + \beta_8 Coverage\_type_{ij}$

$+ \beta_9 Continuous\_coverage_{ij} + \beta_{10} Education\_level_{ij} + \beta_{11} Household\_income_{ij}$

$+ \beta_{12} No\_complication2004_{ij} + \beta_{13} Eye\_complications2004_{ij} + \beta_{14} Nephro2004_{ij}$

$+ \beta_{15} Neuro2004_{ij} + \beta_{16} IHD2004_{ij} + \beta_{17} Leg/foot\_amputation2004_{ij}$

$+ \beta_{18} CVD2004_{ij} + \beta_{19} Freq\_visit_{ij} + \beta_{20} Comprehensive\_care_{ij} + \beta_{21} \#Measures\_2004_{ij} + \varepsilon_i$

Where i = clusters, i.e., HSA, j = each beneficiary

Chapter III. Behavioral health disorders and adherence to quality measures of

diabetes care

Aim

This chapter (Aim 1) describes the research findings on the relationship between BHDs and adherence to quality measures for diabetes care. First, population characteristics were presented and compared across people with various BHDs. Then the rates of adherence to quality measures were compared across the BHDs. Finally, multivariate analyses were performed to illustrate the effects of BHDs on adherence while adjusting for potential confounders.

Results

In 2004, 31,350 or about 30% individuals of the study population with diabetes had any co-occurring BHDs. Among them, 29,772, or 28% individuals in the overall population had co-occurring mental health disorders while the prevalence of substance use disorders was 5.1% (n=5,431). The majority of individuals with mental health disorders had depression/ anxiety (N=19,690, 18%)(see Table 3.1).

Table 3.1 Prevalence of Mental health disorders

	N	(%)
No mental health disorders	76,402	(72)
Schizophrenia/ paranoid states	3,811	(4)
Bipolar disorder	3,151	(3)
Depression/ anxiety	19,690	(18)
Other mental health disorders	3,120	(3)
Total	106,174	(100)

Table 3.2 describes the proportions of people with co-occurring SUD within each mental disorder category. The prevalence of having comorbid SUD was the highest among people with bipolar disorder (26%) and schizophrenia/ paranoid states (22%).

Table 3.2 Proportions of Comorbid Substance use disorders in Mental Disorder Categories

N=106,174	Types of Mental health disorders										Overall (%)	
	No mental health disorders (%)		Schizophrenia/ paranoid states (%)		Bipolar disorder (%)		Depression/ anxiety (%)		Other mental health disorders (%)			
Any Substance use disorders	1,578	(2)	866	(22)	830	(26)	1,995	(10)	172	(6)	5,431	(5)
Alcohol abuse/ dependence	1,008	(1)	542	(14)	505	(16)	1,076	(5)	103	(3)	3,234	(3)
Drug abuse/ dependence	688	(1)	586	(15)	591	(19)	1,280	(7)	89	(3)	3,234	(3)

Table 3.3 showed that on average, people with diabetes and mental health disorders were younger (average age ranged from 52 to 65) than those with diabetes alone (average age: 70 ± 13). Similarly, the average age of people with substance use disorders, SUD, (mean age: 52 ± 14) was lower than those without (mean age: 68 ± 14)(see Table 3.4). The proportions of females with bipolar disorder (64%) and depression/ anxiety (69%) were higher than males (Bipolar: 36%; depression/ anxiety: 31%). However, the prevalence of co-occurring SUD within each mental disorder category was higher among males (see Table 3.4).

Table 3.3 Characteristics of Study Population by Mental Disorder Categories

	Mental health disorders					Overall
	No mental health disorders	Schizophrenia /paranoid states	Bipolar disorder	Depression/ anxiety	Other mental health disorders	
No. of beneficiaries	76,402	3,811	3,151	19,690	3,120	106,174
Mean age (SD)[a,1]	70 (13)	52 (13)[2]	53 (15)[2]	61 (16)[2]	65 (16)[2]	67 (14)
Gender (%)[b,1]		[3]	[2]	[2]	[2]	
Female	41,394 (54)	1,956 (51)	2,020 (64)	13,569 (69)	1,582 (51)	60,521 (57)
Male	35,008 (46)	1,855 (49)	1,131 (36)	6,121 (31)	1,538 (49)	45,653 (43)
Race/ Ethnicity (%)[b,1]		[2]	[2]	[2]	[2]	
Non-Hispanic white	62,933 (82)	2,879 (76)	2,586 (82)	15,653 (80)	2,467 (79)	86,518 (81)
African American	5,534 (7)	570 (15)	236 (7)	1,359 (7)	284 (9)	7,983 (8)
Hispanic	2,716 (4)	148 (4)	119 (4)	1,357 (7)	165 (5)	4,505 (4)
Others	2,634 (3)	85 (2)	40 (1)	507 (3)	72 (2)	3,338 (3)
Unknown	2,585 (3)	129 (3)	170 (5)	814 (4)	132 (4)	3,830 (4)
Mean CDPS score (SD)[c,1]	1.5 (1.1)	1.5 (1.1)[4]	1.8 (1.3)[2]	1.8 (1.3)[2]	1.9 (1.4)[2]	1.6 (1.2)
Disabled (%)[b,1]	16,087 (21)	3,313 (87)[2]	2,258 (72)[2]	9,461 (48)[2]	1,070 (34)[2]	32,189 (30)
Health Coverage (%)[b,1]		[2]	[2]	[2]	[2]	
Medicare only	50,376 (66)	375 (10)	588 (19)	7,205 (37)	1,593 (51)	60,137 (57)
Medicaid only	11,997 (16)	1,472 (39)	1,318 (42)	6,725 (34)	790 (25)	22,302 (21)
Dual-eligible	14,029 (18)	1,964 (52)	1,245 (40)	5,760 (29)	737 (24)	23,735 (22)
With continuous coverage for 12 months (%)[b,1]	73,581 (96)	3,727 (98)[2]	2,969 (94)[2]	18,686 (95)[2]	2,947 (94)[2]	101,910 (96)
Average #Office visits 2004 (SD)[c,1]	7.4 (6.6)	6.5 (7.0)[2]	8.4 (9.1)[4]	8.7 (8.1)[2]	8.4 (7.7)[2]	7.7 (7.1)
Comprehensive Diabetes Care (%)[b,1]	1,445 (1.9)	21 (0.6)[2]	27 (0.9)[2]	217 (1.1)[2]	44 (1.4)[2]	1,754 (1.7)
Any previous complications (%)[b,1]	41,447 (54)	1,279 (34)[2]	1,237 (39)[2]	10,077 (51)[2]	1,806 (58)[2]	55,846 (53)
Eye complications in 2004 (%)[b,1]	13,189 (17)	343 (9)[2]	300 (10)[2]	2,943 (15)[2]	523 (17)[9]	17,298 (16)
Neuropathy in 2004 (%)[b,1]	10,697 (14)	413 (11)[2]	409 (13)[7]	3,138 (16)[2]	531 (17)[2]	15,188 (14)
Nephropathy in 2004 (%)[b,1]	3,946 (5)	126 (3)[2]	103 (3)[2]	984 (5)[8]	205 (7)[3]	5,364 (5)
Lower-limb amputations in 2004 (%)[b,1,]	3,722 (5)	224 (6)[3]	206 (7)[2]	1,346 (7)[2]	286 (9)[2]	5,784 (5)
Ischemic Heart disease in 2004 (%)[b,1]	25,564 (33)	515 (14)[2]	616 (20)[2]	5,785 (29)[2]	1,094 (35)[6]	33,574 (32)
Cerebrovascular disease in 2004 (%)[b,1]	8,117 (11)	150 (4)[2]	218 (7)[2]	2,099 (11)[10]	522 (17)[2]	11,106 (10)

	Mental health disorders					Overall
	No mental health disorders	Schizophrenia /paranoid states	Bipolar disorder	Depression/ anxiety	Other mental health disorders	
Zip code-based neighborhood socioeconomic status						
Average Median Household Income (SD)[a,1]	49,625 (17,605)	43,584 (15,234)[2]	44,928 (15,539)[2]	45,211 (17,163)[2]	48,839 (17,917)[4]	48,427 (17,514)
Average % High School Graduates (SD)[a,1]	82 (11)	79 (12)[2]	80 (12)[2]	79 (12)[2]	82 (11)[7]	82 (11)

Legend:

[a] Student's t-test

[b] χ^2 test

[c] Kruskal-Wallis test

[1] p<0.001 across all mental/substance use disorder categories

[2] p<0.001 in pairwise comparisons with No mental health disorders

[3] p<0.01 in pairwise comparisons with No mental health disorders

[4] p<0.05 in pairwise comparisons with No mental health disorders

[5] p=0.05 in pairwise comparisons with No mental health disorders

[6] p=0.06 in pairwise comparisons with No mental health disorders

[7] p=0.1 in pairwise comparisons with No mental health disorders

[8] p=0.3 in pairwise comparisons with No mental health disorders

[9] p=0.5 in pairwise comparisons with No mental health disorders

[10] p=0.9 in pairwise comparisons with No mental health disorders

Mental health disorders were most prevalent among non-Hispanic whites (range: 76%-82%). However, among African Americans, the prevalence of schizophrenia/ paranoid states was almost twice as high (15%) as other types of mental health disorders (range: 7%-9%). Higher prevalence of SUD was also observed among African Americans (9.6%) than non-Hispanic whites (4.5%), Hispanics (7.6%) and other race/ethnicity (2.2%). Except for people with schizophrenia/ paranoid states (mean CDPS: 1.5 ± 1.1), people with mental health disorders had higher physical disease burden (range of mean CDPS: 1.8-1.9) than those with no mental health disorders (mean CDPS: 1.5 ± 1.1). Higher burden of physical disease was also found among people with SUD (mean CDPS: 2.1 ± 1.6) than those without (mean CDPS: 1.6 ± 1.1). Higher rates of disability (range: 34%-87%) and Medicaid enrollment (range: 25%-42%) were observed in people with mental health disorders than those with no mental health disorders (disability: 21%; Medicaid enrollment: 16%). Similarly, higher proportions of people with SUD had disability (70%) and Medicaid enrollment (51%) than those without (disability: 28%; Medicaid: 19%). Except for people with schizophrenia/ paranoid states (98%), people with mental health disorders had lower rates of 12-month continuous coverage (94%-95%) than those with no mental health disorders (96%).

Table 3.4 Characteristics of Study Population by Mental and Substance Use Disorder Categories

	Mental health disorders										Overall
	No mental health disorders (n=76,402)		Schizophrenia /paranoid states (n=3,811)		Bipolar disorder (n=3,151)		Depression/ anxiety (n=19,690)		Other mental health disorders (n=3,120)		
Substance use disorders	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
No. of beneficiaries	74,824	1,578	2,955	856	2,321	830	17,695	1,995	2,948	172	106,174
Mean age (SD)[a,1]	70 (12)	59 (15)[2]	53 (13)	46 (10)[2]	54 (16)	47 (12)[2]	63 (16)	51 (13)[2]	66 (16)	58 (17)[2]	67 (14)
Gender (%)[b,1]		[2]		[2]		[2]		[2]		[2]	
Female	40,938 (55)	456 (29)	1,646 (56)	310 (36)	1,598 (69)	422 (51)	12,634 (71)	935 (47)	1,534 (52)	48 (28)	60,521 (57)
Male	33,886 (45)	1,122 (71)	1,309 (44)	546 (64)	723 (31)	408 (49)	5,061 (29)	1,060 (53)	1,414 (48)	124 (72)	45,653 (43)
Race/ Ethnicity (%)[b,1]		[2]		[2]				[2]			
Non-Hispanic white	61,819 (83)	1,114 (71)	2,287 (77)	592 (69)	1,960 (84)	626 (75)	14,212 (80)	1,441 (72)	2,342 (79)	125 (73)	86,518 (81)
African American	5,286 (7)	248 (16)	406 (14)	164 (19)	136 (6)	100 (12)	1,133 (6)	226 (11)	255 (9)	29 (17)	7,983 (8)
Hispanic	2,627 (4)	89 (6)	97 (3)	51 (6)	87 (4)	32 (4)	1,194 (7)	163 (8)	158 (5)	N/A*	4,505 (4)
Others	2,615 (3)	19 (1)	71 (2)	14 (2)	30 (1)	N/A*	478 (3)	29 (1)	70 (2)	N/A*	3,338 (3)
Unknown	2,477 (3)	108 (7)	94 (3)	35 (4)	108 (5)	62 (7)	678 (4)	136 (7)	123 (4)	N/A*	3,830 (4)
Mean CDPS score (SD)[c,1]	1.5 (1.1)	2.2 (1.6)[2]	1.5 (1.0)	1.7 (1.2)[2]	1.7 (1.2)	2.0 (1.5)[3]	1.8 (1.3)	2.2 (1.8)[2]	1.9 (1.4)	2.3 (1.6)[2]	1.6 (1.2)
Disabled (%)[b,1]	15,279 (20)	808 (51)[2]	2,507 (85)	806 (94)[2]	1,599 (69)	659 (79)[2]	8,032 (45)	1,429 (72)[2]	984 (33)	86 (50)[2]	32,189 (30)
Health Coverage (%)[b,1]		[2]		[2]		[2]		[2]		[2]	
Medicare only	49,859 (67)	517 (33)	342 (12)	33 (4)	526 (23)	62 (7)	6,918 (39)	287 (14)	1,540 (52)	53 (31)	60,137 (57)
Medicaid only	11,288 (15)	709 (45)	1,078 (36)	394 (46)	842 (36)	476 (57)	5,602 (32)	1,123 (56)	714 (24)	76 (44)	22,302 (21)
Dual-eligible	13,677 (18)	352 (22)	1,535 (52)	429 (50)	953 (41)	292 (35)	5,175 (29)	585 (29)	694 (24)	43 (25)	23,735 (22)
With continuous coverage for 12 months (%)[b,1]	72,148 (96)	1,433 (91)[2]	2,902 (98)	825 (96)[3]	2,220 (96)	749 (90)[2]	16,871 (95)	1,815 (91)[2]	2,789 (95)	158 (92)[7]	101,910 (96)
Average #Office visits 2004 (SD)[c,1]	7.4 (6.6)	7.1 (7.3)[2]	6.5 (6.9)	6.3 (7.2)[6]	8.5 (8.2)	8.0 (11.4)[2]	8.7 (8.0)	8.2 (8.9)[2]	8.4 (7.6)	8.7 (8.8)[11]	7.7 (7.1)
Comprehensive Diabetes Care (%)[b,1]	1,424 (1.9)	21 (1.3)[7]	18 (0.6)	N/A*	18 (0.8)	N/A*	199 (1.1)	18 (0.9)[10]	41 (1.4)	N/A*	1,754 (1.7)
Any previous	40,648	799	1,010	269	924 (40)	313	9,182	895	1,707	99 (58)[14]	55,846

	Mental health disorders										Overall
	No mental health disorders (n=76,402)		Schizophrenia /paranoid states (n=3,811)		Bipolar disorder (n=3,151)		Depression/ anxiety (n=19,690)		Other mental health disorders (n=3,120)		
Substance use disorders	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
complications (%)[b,1]	(54)	(51)[2]	(34)	(31)[7]		(38)[9]	(52)	(45)[2]	(58)		(53)
Eye complications in 2004 (%)[b,1]	13,014 (17)	175 (11)[2]	280 (9)	63 (7)[5]	248 (11)	52 (6)[2]	2,745 (16)	198 (10)[2]	502 (17)	21 (12)[7]	17,298 (16)
Neuropathy in 2004 (%)[b,1]	10,444 (14)	253 (16)[2]	323 (11)	90 (11)[12]	294 (13)	115 (14)[10]	2,808 (16)	330 (17)[10]	498 (17)	33 (19)[10]	15,188 (14)
Nephropathy in 2004 (%)[b,1]	3,839 (5)	107 (7)[2]	108 (4)	18 (2)[4]	77 (3)	26 (3)[13]	883 (5)	101 (5)[14]	193 (7)	12 (7)[13]	5,364 (5)
Lower-limb amputations in 2004 (%)[b,1]	3,535 (5)	187 (12)[2]	150 (5)	74 (9)[2]	127 (5)	79 (10)[2]	1,135 (6)	211 (11)[2]	258 (9)	28 (16)[3]	5,784 (5)
Ischemic Heart disease in 2004 (%)[b,1]	25,137 (34)	427 (27)[2]	422 (14)	93 (11)[4]	482 (21)	134 (16)[3]	5,361 (30)	424 (21)[2]	1,040 (35)	54 (31)[9]	33,574 (32)
Cerebrovascular disease in 2004 (%)[b,1]	7,955 (11)	162 (10)[11]	119 (4)	31 (4)[11]	175 (8)	43 (5)[4]	1,948 (11)	151 (8)[2]	499 (17)	23 (13)[8]	11,106 (10)
Zip code-based neighborhood socioeconomic status											
Average Median Household Income (SD)[a,1]	49,744 (17,620)	43,959[2] (15,909)	44,196 (15,428)	41,472[2] (14,352)	45,702 (15,853)	42,761[2] (14,414)	45,637 (17,326)	41,438[2] (15,125)	49,060 (17,989)	45,041[3] (16,202)	48,427 (17,514)
Average %High School Graduates (SD)[a,1]	82 (11)	79 (12)[2]	79 (12)	77 (12)[2]	80 (12)	78 (12)[2]	79 (12)	77 (12)[2]	82 (11)	80 (11)[3]	82 (11)

Legend:

[a] Student's t-test

[b] χ^2 test

[c] Kruskal-Wallis test

[1] p<0.001 across all mental/substance use disorder categories

In pairwise comparisons of Substance use disorders within each Mental Disorder Category:

[2] p<0.001, [3] p<0.01, [4] p<0.05, [5] p=0.06, [6] p=0.07, [7] p=0.1, [8] p=0.2, [9] p=0.3, [10] p=0.4, [11] p=0.6,

[12] p=0.7, [13] p=0.8, [14] p=0.9

* Per Data Use Agreement, data suppressed due to small cell size (<11). No comparison tests performed.

People with mental health disorders resided in neighborhoods with lower socioeconomic status (lower rates of high school graduates: 79%-82% and lower median household income in 1999: 43,584-48,839) than those with no mental health disorders (rate of high school graduates: 82%, median household income: 49,625). Similar findings were also observed among people with substance use disorders (SUD).

Lower proportions of people with schizophrenia/ paranoid states (34%), bipolar disorder (39%) and depression/ anxiety (51%) had any previous diabetes complications than those with no mental health disorders (54%). However, the rates of having lower-limb amputations were higher among people with mental health disorders (6%-9%) than those with no mental health disorders (5%). Similar observations were also noted in people with SUD.

There were 36,065 (34%) beneficiaries with comprehensive diabetes care, as defined by having met 2 or more quality measures within a visit during 2004. Except for people with schizophrenia/ paranoid states (29%), higher proportions of having comprehensive care were observed in people with bipolar disorder (36%), depression/ anxiety (38%) and other mental health disorders (36%) than those with no mental health disorders (33%). However, the proportions of those having comprehensive care among people with SUD were not significantly different from those with no SUD.

Table 3.5 illustrates the rates of adherence to quality measures for diabetes care across mental health disorders in 2005 and Table 3.6 compares the adherence rates between those with SUD and those without. Table 3.5 shows that people with any mental health disorders were less likely to achieve full adherence (range: 19%-22%) than those

without (25%). The rates of adherence to the HbA1c test guideline were lower among people with any mental health disorders (64%-72%) than those with no mental health disorders (76%). Lower proportions of people with any mental health disorders (61%-65%) had at least one LDL-c tests in 2005 than those with no mental health disorders (73%). Lower rates of adherence to eye examinations were also found among people with any mental health disorders (42%-54%) than those with no mental health disorders (61%). However, a higher proportion of people with any mental health disorders (49%-51%) than those with no mental health disorders (47%) had nephropathy tests. People with SUD had lower rates of adherence to any given quality measures than those without SUD (see Table 3.6). For example, only 13% of people with SUD achieved full adherence to quality measures, compared to the rate of full adherence at 24% for those without SUD. After taking SUD into account, people with any mental health disorders but no SUD still had lower rates of having HbA1c test (67%-74%), LDL-c test (64%-70%) and eye examinations (46%-55%) than those with no mental or substance use disorders (HbA1c: 76%, LDL-c: 73%, eye examinations: 62%).

Table 3.5 Adherence to Quality Measures for Diabetes Care in Study Population by Mental Disorder Categories

	Mental health disorders					Overall
	No mental health disorders	Schizophrenia /paranoid states	Bipolar disorder	Depression/ anxiety	Other mental health disorders	
No. of beneficiaries	76,402	3,811	3,151	19,690	3,120	106,174
Full adherence in 2005 (%)[a,1]	18,962 (25)	717 (19)[2]	586 (19)[2]	4,200 (21)[2]	678 (22)[2]	25,143 (24)
Any HbA1c test 2005 (%)[a,1]	58,175 (76)	2,750 (72)[2]	2,017 (64)[2]	13,405 (68)[2]	2,229 (71)[3]	78,576 (74)
Any Nephropathy test 2005 (%)[a,1]	35,987 (47)	1,903 (50)[3]	1,611 (51)[2]	9,558 (49)[2]	1,505 (48)[4]	50,564 (48)
Any LDL-c test 2005 (%)[a,1]	55,642 (73)	2,586 (68)[2]	1,914 (61)[2]	12,507 (64)[2]	2,013 (65)[2]	74,662 (70)
Any Eye exam 2005 (%)[a,1]	46,726 (61)	1,673 (44)[2]	1,316 (42)[2]	9,984 (51)[2]	1,689 (54)[2]	61,388 (58)

Legend:

[a] χ^2 test

[1] p<0.001 across all mental/substance use disorder categories

[2] p<0.001 in pairwise comparisons with No mental health disorders

[3] p<0.01 in pairwise comparisons with No mental health disorders

[4] p=0.2 in pairwise comparisons with No mental health disorders

Table 3.6 Adherence to Quality Measures for Diabetes Care in Study Population by Mental and Substance Use Disorder Categories

Substance use disorders	Mental health disorders										Overall
	No mental health disorders (n=76,402)		Schizophrenia /paranoid states (n=3,811)		Bipolar disorder (n=3,151)		Depression/ anxiety (n=19,690)		Other mental health disorders (n=3,120)		
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
No. of beneficiaries	74,824	1,578	2,955	856	2,321	830	17,695	1,995	2,948	172	106,174
Full adherence in 2005 (%)[a,1]	18,764 (25)	198 (13)[2]	570 (19)	147 (17)[5]	479 (21)	107 (13)[2]	3,968 (22)	232 (12)[2]	653 (22)	25 (15)[4]	25,143 (24)
Any HbA1c test 2005 (%)[a,1]	57,226 (76)	949 (60)[2]	2,181 (74)	569 (66)[2]	1,559 (67)	458 (55)[2]	12,278 (69)	1,127 (56)[2]	2,122 (72)	107 (62)[3]	78,576 (74)
Any Nephropathy test 2005 (%)[a,1]	35,319 (47)	668 (42)[2]	1,422 (48)	481 (56)[2]	1,188 (51)	423 (51)[6]	8,641 (49)	917 (46)[4]	1,427 (48)	78 (45)[5]	50,564 (48)
Any LDL-c test 2005 (%)[a,1]	54,854 (73)	788 (50)[2]	2,068 (70)	518 (61)[2]	1,488 (64)	426 (51)[2]	11,529 (65)	978 (49)[2]	1,926 (65)	87 (51)[2]	74,662 (70)
Any Eye exam 2005 (%)[a,1]	46,146 (62)	580 (37)[2]	1,364 (46)	309 (36)[2]	1,068 (46)	248 (30)[2]	9,381 (53)	603 (30)[2]	1,624 (55)	65 (38)[2]	61,388 (58)

Legend:

[a] χ^2 test

Across all mental/substance use disorder categories:

[1] $p<0.001$

In pairwise comparisons of Substance use disorders within each Mental Disorder Category:

[2] $p<0.001$, [3] $p<0.01$, [4] $p<0.05$, [5] $p=0.4$, [6] $p=0.9$

In adjusted analyses, the addition of Need and Behavior factors had a significant impact on the relationship between BHDs and adherence to quality measures. Therefore, only the estimates from the logistic regressions adjusted for all covariates (i.e., model 5) are presented in Tables 3.7 and 3.8. Please refer to Appendix XII on p.148 for estimates from other models. After adjusting for covariates, lower rates of adherence to some quality measures persisted in certain BHDs, particularly substance use disorders. However, the associations between the rates of adherence and mental health disorders were not consistent. For example, lower rates of full adherence in 2005 to quality measures were observed in individuals with depression/ anxiety (odds ratio [OR]: 0.95, 95% confidence interval [CI]: 0.90, 1.00), other mental health disorders (odds ratio [OR]: 0.88, 95% confidence interval [CI]: 0.79, 0.98), any alcohol abuse/ dependence (OR: 0.79, 95%CI: 0.71, 0.86) or any drug abuse/ dependence (OR: 0.67, 95%CI: 0.59, 0.76). The odds of having at least one HbA1c test in 2005 were lower among people with depression/ anxiety (OR: 0.89, 95%CI: 0.83, 0.96) while the odds of having a HbA1c test were higher among those with schizophrenia/ paranoid states (OR: 1.51, 95%CI: 1.38, 1.66). Similarly, people with depression/ anxiety (OR: 0.91, 95%CI: 0.85, 0.98), other mental health disorders (OR: 0.84, 95%CI: 0.76, 0.92), any alcohol abuse/ dependence (OR: 0.82, 95%CI: 0.76, 0.89) or any drug abuse/ dependence (OR: 0.84, 95%CI: 0.74, 0.95) had lower odds of LDL-c tests while higher odds of having the LDL-c test were shown among those with schizophrenia/ paranoid states (OR: 1.55, 95%CI: 1.42, 1.69). However, individuals with schizophrenia/ paranoid states (OR: 1.39, 95%CI: 1.28, 1.50), bipolar disorder (OR: 1.34, 95%CI: 1.23, 1.45), depression/ anxiety (OR: 1.10, 95%CI:

1.05, 1.15) or any drug abuse/ dependence (OR: 1.18, 95%CI: 1.09, 1.28) had higher

odds of having a nephropathy test in 2005. Finally, people with any alcohol abuse/

dependence (OR: 0.80, 95%CI: 0.74, 0.86) or any drug abuse/ dependence (OR: 0.71,

95%CI: 0.65, 0.78) had lower likelihoods of having an eye examination while those with

schizophrenia/ paranoid states had higher odds for eye examinations (OR: 1.19, 95%CI:

1.06, 1.33).

There were other factors that increased the likelihoods for adherence. For

example, having continuous health coverage for 12 months was associated with higher

odds for adherence to any measures (OR for full adherence: 1.66, 95%CI 1.51, 1.83).

Similarly, having previous eye complications or neuropathy was related to higher odds

for adherence to most quality measures, except for nephropathy test, which was

significantly associated with previous nephropathy (OR: 1.67, 95%CI: 1.52, 1.83).

Table 3.7 Estimates from logistic regression models for the associations between BHDs and adherence to quality measures

N=106,174	Full Adherence		HbA1c test		LDL-c test	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	1.22**	(1.08, 1.37)	1.51***	(1.38, 1.66)	1.55***	(1.42, 1.69)
Bipolar disorder	1.05	(0.95, 1.15)	0.98	(0.89, 1.07)	1.08	(0.97, 1.19)
Depression/ anxiety	0.95*	(0.90, 1.00)	0.89**	(0.83, 0.96)	0.91*	(0.85, 0.98)
Other mental health disorders	0.88*	(0.79, 0.98)	0.94	(0.86, 1.02)	0.84***	(0.76, 0.92)
Any alcohol abuse/ dependence	0.79***	(0.71, 0.86)	0.92	(0.84, 1.01)	0.82***	(0.76, 0.89)
Any drug abuse/ dependence	0.67***	(0.59, 0.76)	0.90	(0.79, 1.02)	0.84**	(0.74, 0.95)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.42***	(1.34, 1.51)	1.74***	(1.65, 1.84)	1.65***	(1.57, 1.73)
65-74	1.62***	(1.52, 1.73)	1.89***	(1.76, 2.03)	1.90***	(1.79, 2.03)
75 and older	1.39***	(1.30, 1.49)	1.52***	(1.41, 1.64)	1.08*	(1.01, 1.17)
Male Gender	1.04	(0.98, 1.10)	1.05*	(1.00, 1.10)	1.09***	(1.04, 1.13)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	0.91*	(0.84, 0.99)	1.00	(0.93, 1.07)	0.85***	(0.79, 0.92)
Hispanic	1.03	(0.90, 1.19)	0.75***	(0.69, 0.83)	0.77***	(0.67, 0.89)
Others	1.03	(0.94, 1.13)	1.19***	(1.08, 1.31)	1.22***	(1.12, 1.34)
Unknown	0.77***	(0.67, 0.89)	0.82***	(0.74, 0.91)	0.82**	(0.73, 0.93)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.27***	(1.21, 1.32)	0.88***	(0.85, 0.91)	0.92**	(0.88, 0.97)
1.3<=CDPS<=1.9	1.20***	(1.10, 1.30)	0.73***	(0.68, 0.79)	0.69***	(0.65, 0.73)
CDPS>1.9	1.08	(1.00, 1.16)	0.52***	(0.48, 0.55)	0.47***	(0.44, 0.51)
Health coverage type						
Medicare only (ref.)	1		1		1	
Medicaid only	0.53***	(0.46, 0.61)	0.48***	(0.41, 0.57)	0.41***	(0.36, 0.47)
Dual-eligible	0.91*	(0.84, 1.00)	1.23***	(1.12, 1.35)	0.93	(0.86, 1.00)
Continuous 12-month coverage	1.66***	(1.52, 1.83)	1.32***	(1.18, 1.47)	1.63***	(1.51, 1.76)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.00	(0.90, 1.10)	0.95	(0.85, 1.08)	0.87	(0.73, 1.02)
85-90%	1.00	(0.86, 1.17)	0.97	(0.82, 1.14)	0.83	(0.69, 1.01)
>90%	1.07	(0.90, 1.26)	0.94	(0.76, 1.17)	0.83	(0.66, 1.03)
Median Household income 1999						
<$36,44 (ref.)	1		1		1	
$36,448-$45,920	0.95	(0.88, 1.02)	1.10	(0.94, 1.28)	1.22	(0.98, 1.51)
$45,921-$56,813	1.00	(0.90, 1.11)	1.12	(0.96, 1.32)	1.26	(0.97, 1.63)
>$56,813	1.02	(0.89, 1.17)	1.06	(0.86, 1.30)	1.30	(0.98, 1.72)
No Previous Complications	0.96	(0.92, 1.01)	0.92**	(0.87, 0.97)	0.89***	(0.85, 0.93)
Eye complications in 2004	1.63***	(1.53, 1.73)	2.19***	(0.98, 2.43)	1.22***	(1.15, 1.30)
Nephropathy in 2004	1.29***	(1.21, 1.37)	1.60***	(1.43, 1.79)	0.86**	(0.79, 0.95)
Neuropathy in 2004	1.31***	(1.25, 1.38)	1.93***	(1.77, 2.10)	1.10**	(1.03, 1.17)
Ischemic Heart Disease in 2004	1.01	(0.95, 1.08)	0.94*	(0.88, 0.99)	1.20***	(1.13, 1.28)
Lower-limb amputations 2004	0.88***	(0.83, 0.94)	1.21***	(1.13, 1.31)	0.78***	(0.74, 0.83)
Cerebrovascular diseases 2004	0.94*	(0.90, 0.99)	0.93**	(0.88, 0.98)	1.00	(0.95, 1.05)
No. of outpatient visits 2004	1.05***	(1.05, 1.06)	1.07***	(1.06, 1.08)	1.07***	(1.06, 1.07)

* p<0.05 **p<0.01 ***p<0.001

Table 3.8 Estimates from logistic regression models for the associations between BHDs and adherence to quality measures

N=106,174	Nephropathy test		Eye Examination	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.39***	(1.28, 1.50)	1.19**	(1.06, 1.33)
Bipolar disorder	1.34***	(1.23, 1.45)	0.94	(0.87, 1.03)
Depression/ anxiety	1.10***	(1.05, 1.15)	0.93*	(0.87, 0.99)
Other mental health disorders	1.02	(0.94, 1.11)	0.91*	(0.85, 0.98)
Any alcohol abuse/ dependence	1.06	(1.00, 1.14)	0.80***	(0.75, 0.86)
Any drug abuse/ dependence	1.18***	(1.09, 1.28)	0.71***	(0.65, 0.78)
Age Groups				
<55 (ref.)	1		1	
55-64	1.20***	(1.15, 1.25)	1.59***	(1.50, 1.69)
65-74	1.24***	(1.18, 1.31)	2.16***	(2.04, 2.29)
75 and older	1.23***	(1.16, 1.30)	2.23***	(2.11, 2.37)
Male Gender	1.04	(0.97, 1.10)	0.88***	(0.86, 0.91)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.00	(0.94, 1.05)	1.09*	(1.01, 1.18)
Hispanic	0.93	(0.86, 1.01)	0.98	(0.89, 1.08)
Others	1.01	(0.91, 1.12)	0.91*	(0.84, 0.99)
Unknown	0.74***	(0.64, 0.85)	0.84***	(0.77, 0.92)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.22***	(1.16, 1.28)	1.14***	(1.08, 1.20)
1.3<=CDPS<=1.9	1.29***	(1.18, 1.40)	1.06	(0.98, 1.14)
CDPS>1.9	1.41***	(1.30, 1.53)	0.83***	(0.76, 0.90)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.55***	(0.48, 0.63)	0.38***	(0.33, 0.43)
Dual-eligible	1.09**	(1.02, 1.17)	0.81***	(0.73, 0.89)
Continuous 12-month coverage	1.12**	(1.04, 1.20)	1.52***	(1.42, 1.62)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.97	(0.85, 1.11)	1.04	(0.96, 1.14)
85-90%	0.94	(0.79, 1.11)	1.07	(0.97, 1.18)
>90%	0.98	(0.82, 1.17)	1.16**	(1.04, 1.30)
Median Household income 1999				
<$36,44 (ref.)	1		1	
$36,448-$45,920	0.97	(0.88, 1.08)	0.99	(0.92, 1.07)
$45,921-$56,813	1.03	(0.91, 1.16)	1.01	(0.91, 1.12)
>$56,813	1.09	(0.95, 1.27)	0.97	(0.86, 1.10)
No Previous Complications	1.01	(0.97, 1.05)	0.98	(0.94, 1.03)
Eye complications in 2004	1.00	(0.95, 1.05)	2.52***	(2.39, 2.67)
Nephropathy in 2004	1.67***	(1.52, 1.83)	1.12**	(1.04, 1.20)
Neuropathy in 2004	1.03	(0.97, 1.08)	1.29***	(1.23, 1.35)
Ischemic Heart Disease in 2004	1.02	(0.96, 1.08)	0.88***	(0.85, 0.92)
Lower-limb amputations 2004	1.01	(0.95, 1.07)	0.84***	(0.79, 0.91)
Cerebrovascular diseases 2004	0.97	(0.91, 1.02)	0.93***	(0.89, 0.97)
No. of outpatient visits 2004	1.06***	(1.05, 1.07)	1.06***	(1.06, 1.07)

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

Discussion

The analyses showed mixed results of the associations between BHDs and adherence to quality measures. First, the relationships between mental health disorders and adherence to quality measures were inconsistent and dependent on the outcomes of interest. While individuals with schizophrenia/ paranoid states had increased odds of adherence to all quality measures, those with depression/ anxiety or other mental health disorders had lower odds of LDL-c tests and eye examinations. Having bipolar disorder was not significantly associated with adherence to most quality measures, except nephropathy tests. Likewise, no general trend could be drawn on the associations between substance use disorders (SUD) and adherence. While people with substance use disorders had lower odds of having LDL-c tests and eye examinations, their likelihoods of having HbA1c tests were not significantly different from those with diabetes alone. Further, people with drug abuse/ dependence had higher odds of having nephropathy tests. Similar findings on the associations between quality measures, such as LDL-c tests and eye examinations, and BHDs, such as substance use disorders,[15,16,66] depression/ anxiety [15,16] and other mental health disorders [15] have also been reported in previous studies.

Contrary to the findings reported in this study, Frayne and colleagues observed that people with schizophrenia were less likely to achieve adherence.[16] It should be noted that the study population in Frayne's study was from the Veterans Administration and the analysis of schizophrenia did not adjust for the presence of SUD.[16] It is possible that SUD confounded the relationship between Schizophrenia and adherence to quality

measures. Another possible reason is that Frayne and colleagues sampled the cohort in 1999 and since then, clinicians were more aware of treating people with diabetes and co-occurring schizophrenia. For example, clinical practice guidelines for managing physical health among people with schizophrenia have been adopted by the American Diabetes Association and the American Psychiatric Association.[90]

The study also showed that people with SUD had lower odds of adherence to quality measures, except for having nephropathy tests. One possible reason is that managing diabetes may become secondary when an individual has co-morbid SUD. For example, Redelmeier and colleagues observed that patients with chronic illnesses were less likely to receive treatments for other unrelated diseases.[91]. It is also possible that treating individuals with co-morbid SUD may be more difficult and thus full adherence to treatment guidelines may not be feasible. For example, in a study by Krebs et al., physicians were three times as likely to regard a patient visit as difficult if the patient had SUD.[92] In another study, Jackson and colleagues observed that patients were more likely to have unmet expectations, such as having tests or diagnoses, after a difficult encounter with physicians.[93] However, individuals with co-morbid drug abuse/ dependence were more likely to have nephropathy tests. It is possible that physicians may be more inclined to monitor these individuals' SUD with urine drug screen. Since nephropathy tests are performed on urine samples, they may be ordered along with drug screens. Currently, treatment guidelines for medication-assisted treatments of opioid addiction recommended kidney function tests in individuals with both opioid addiction and diabetes.[94] As the analysis suggests, the presence of drug abuse/ dependence was

associated with higher odds for nephropathy tests. However, these patients might be less

likely to receive care on other aspects of their diabetes. Further studies will be helpful to

understand whether individuals with both diabetes and SUD are more likely to adhere to

quality measures of diabetes care after they receive treatments for SUD. On the other

hand, the analyses showed that people with previous complications (i.e., Need factors)

were more likely to adhere to quality measures. A similar observation was reported in a

study by Paschalides et al. It is possible that having previous diabetes complications

increases an individual's awareness of proper care and results in improved adherence.[71]

Therefore, further research is needed to understand the factors that mediate the adherence

to quality measures in people with SUD.

In general, the adherence to quality measures for diabetes care was not optimal in

this population. In general, rates of adherence to quality measures were lower than

national averages. [95] For example, the adherence rate for having at least one LDL-c test

in 2005 was 70% for this population with Medicare/Medicaid in Massachusetts while the

2005 national average rate of LDL-c test in Medicare and Medicaid populations was

93.3% and 80.5% respectively.[95] Therefore, efforts to improve adherence to quality

measures are necessary.

One limitation of this study was the use of administrative data. It is possible that

the study underestimated the adherence rates to quality measures. According to previous

studies comparing the rates of adherence to quality measures between claims data and

medical records, there was evidence for the under-detection of diabetes care services

when only claims data were used.[96,97] For example, the rates of HbA1c tests detected in

claims as a proportion of the gold standard (medical records) ranged from 47.6%[97] to 79.4%.[96] It should be noted that the study by Maclean and colleagues used a population from one HMO with a sample size of 300 and yielded the result of 47.6% for HbA1c detection rate in claims .[97] The low sensitivity may reflect insufficient power or poor reporting of encounters. However, in a separate study, Fowles and colleagues observed high concordance in the rates of HbA1c (Kappa: 0.678) and microalbumin tests (Kappa: 0.748) between claims data and medical records.[98] In addition, they showed that claims data were more sensitive in identifying eye examinations (rate by claims: 46.6%, rate by medical records: 23.7%).[98] Another limitation is the lack of data on HbA1c or LDL-c control. Therefore, it is possible that the lower rates of tests to monitor diabetes may be due to more individuals with proper control in HbA1c or LDL-c. Further investigation of data on HbA1c and LDL-c control is necessary to assess the quality of diabetes care in this population. Another weakness was that the study was not able to assess the socioeconomic status of individual beneficiaries even though data from Census 2000 were used as proxy for neighborhood socioeconomic conditions.

The major strength of the current study is the use of population-based data. This is the first study to date that utilized an integrated Medicare/Medicaid database to examine the associations between behavioral health disorders and adherence to quality measures for diabetes care in a population with publicly sponsored health coverage. Since Medicare and Medicaid data were used, the results might be applicable to other Medicare and Medicaid populations with similar demographic composition and public insurance programs to those in Massachusetts. In addition, the size of study population, a total of

106,174 beneficiaries, provided sufficient confidence in detecting any significant

relationships between the BHDs and adherence to quality measures.

Chapter IV. Behavioral health disorders and diabetes-related health outcomes

Aim

This chapter describes the findings from Aim 2 of the study: the relationship between BHDs and clinical outcomes of diabetes. First, diabetes outcomes in 2005, such as eye complications, diabetic neuropathy, diabetic nephropathy, cerebrovascular diseases, ischemic heart disease, lower-limb complications and diabetes-related hospitalizations, were compared across the BHDs. Finally, multivariate analyses were performed to demonstrate the effects of BHDs on having new diabetes complications and diabetes-related hospitalizations while adjusting for potential confounders.

Results

Prevalent cases of diabetes outcomes were shown in Tables 4.1 and 4.2. In Table 4.1, diabetes outcomes were compared across the five categories of mental health disorders while Table 4.2 compared diabetes outcomes between those with substance use disorders (SUD) and those without.

Table 4.1 Health Outcomes in 2005 for Study Population by Mental Disorder Categories

	Mental health disorders					Overall
	No mental health disorders	Schizophrenia /paranoid states	Bipolar disorder	Depression/ anxiety	Other mental health disorders	
No. of beneficiaries	76,402	3,811	3,151	19,690	3,120	106,174
Any complications in 2005 (%)[a,1]	41,597 (54)	1,218 (32)[2]	1,154 (37)[2]	9,651 (49)[2]	1,687 (54)[2]	55,307 (52)
Eye complications in 2005 (%)[a,1]	13,001 (17)	342 (9)[2]	278 (9)[2]	2,831 (14)[2]	494 (16)[2]	16,946 (16)
Neuropathy in 2005 (%)[a,1]	11,655 (15)	419 (11)[2]	417 (13)[3]	3,120 (16)[4]	535 (17)[2]	16,146 (15)
Nephropathy in 2005 (%)[a,1]	4,487 (6)	122 (3)[2]	115 (4)[2]	1,057 (5)[3]	188 (6)[2]	5,969 (6)
Lower-limb amputations in 2005 (%)[a,1]	3,811 (5)	177 (5)[6]	182 (6)[4]	1,214 (6)[2]	217 (7)[2]	5,601 (5)
Ischemic Heart disease in 2005 (%)[a,1]	25,930 (34)	502 (13)[2]	586 (19)[2]	5,534 (28)[2]	1,024 (33)[2]	33,576 (32)
Cerebrovascular disease in 2005 (%)[a,1]	8,593 (11)	135 (4)[2]	200 (6)[2]	2,015 (10)[2]	423 (14)[2]	11,366 (11)
Diabetes-related hospitalizations in 2005 (%)[a,1]	4,355 (6)	129 (3)[2]	174 (6)[7]	1,173 (6)[5]	214 (7)[2]	6,045 (6)

Legend:

[a] χ^2 test

[1] p<0.001 across all mental/substance use disorder categories

[2] p<0.001 in pairwise comparisons with No mental health disorders

[3] p<0.01 in pairwise comparisons with No mental health disorders

[4] p<0.05 in pairwise comparisons with No mental health disorders

[5] p=0.2 in pairwise comparisons with No mental health disorders

[6] p=0.3 in pairwise comparisons with No mental health disorders

[7] p=0.7 in pairwise comparisons with No mental health disorders

Compared to people with no mental health disorders (54%), the prevalence of any

diabetes complications in 2005 was lower in people with schizophrenia/ paranoid states

(32%), bipolar disorder (37%) or depression/ anxiety (49%).   The rates of eye

complications in 2005 were lower among people with schizophrenia/ paranoid states

(9%), bipolar disorder (9%), depression/ anxiety (14%) or other mental health disorders

(16%) than that of no mental health disorders (17%). Similarly, lower proportions of

people with schizophrenia/ paranoid states (3%), bipolar disorder (4%) and depression/

anxiety (5%) had nephropathy in 2005 than those with no mental health disorders (6%).

The rates of ischemic heart disease (IHD) and cerebrovascular disease (CVD) in 2005

were also lower in people with schizophrenia/ paranoid states (IHD: 13%, CVD: 4%),

bipolar disorder (IHD: 19%, CVD: 6%) and depression/ anxiety (IHD: 28, CVD: 10%)

than that of no mental health disorders (IHD: 34%, CVD: 11%). However, there were

instances where people with mental health disorders had higher rates of diabetes

complications. For example, the rates of neuropathy in 2005 were higher in people with

depression/ anxiety (16%) and other mental health disorders (17%) than that of no mental

health disorders (15%). The proportions of people having lower-limb amputations in

2005 were higher in the bipolar disorder (6%), depression/ anxiety (6%) and other mental

health disorders (7%) groups than that of no mental health disorders (5%).

Except for lower-limb amputations (SUD: 9%, no SUD: 5%) and diabetes-related

hospitalizations (SUD: 7%, no SUD: 6%), rates of diabetes complications were lower in

people with SUD (5-40%) than those of no SUD (6-53%)(see Table 4.2). After

accounting for SUD, the rates of diabetes complications and hospitalizations across

mental disorder categories remained similar to the observations reported above.

Table 4.2 Health Outcomes in 2005 for Study Population by Mental and Substance Use Disorder Categories

Substance use disorders	Mental health disorders										Overall
	No mental health disorders (n=76,402)		Schizophrenia /paranoid states (n=3,811)		Bipolar disorder (n=3,151)		Depression/ anxiety (n=19,690)		Other mental health disorders (n=3,120)		
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
No. of beneficiaries	74,824	1,578	2,955	856	2,321	830	17,695	1,995	2,948	172	106,174
Any complications in 2005 (%)[a,1]	40,855 (55)	742 (47)[2]	963 (33)	255 (30)[8]	874 (38)	280 (34)[4]	8,829 (50)	822 (41)[2]	1,600 (54)	87 (51)[9]	55,307 (52)
Eye complications in 2005 (%)[a,1]	12,832 (17)	169 (11)[2]	282 (10)	60 (7)[4]	231 (10)	47 (6)[2]	2,641 (15)	190 (10)[2]	474 (16)	20 (12)[8]	16,946 (16)
Neuropathy in 2005 (%)[a,1]	11,408 (15)	247 (16)[11]	324 (11)	95 (11)[13]	314 (14)	103 (12)[10]	2,827 (16)	293 (15)[8]	506 (17)	29 (17)[13]	16,146 (15)
Nephropathy in 2005 (%)[a,1]	4,392 (6)	95 (6)[12]	101 (3)	21 (2)[8]	92 (4)	23 (3)[8]	960 (5)	97 (5)[9]	179 (6)	N/A*	5,969 (6)
Lower-limb amputations in 2005 (%)[a,1]	3,647 (5)	164 (10)[2]	119 (4)	58 (7)[3]	109 (5)	73 (9)[2]	1,031 (6)	183 (9)[2]	196 (7)	21 (12)[3]	5,601 (5)
Ischemic Heart disease in 2005 (%)[a,1]	25,522 (34)	408 (26)[2]	416 (14)	86 (10)[3]	450 (19)	136 (16)[5]	5,161 (29)	373 (19)[2]	981 (33)	43 (25)[4]	33,576 (32)
Cerebrovascular disease in 2005 (%)[a,1]	8,461 (11)	132 (8)[2]	111 (4)	24 (3)[2]	158 (7)	42 (5)[7]	1,861 (11)	154 (8)[2]	409 (14)	14 (8)[4]	11,366 (11)
Diabetes-related hospitalizations in 2005(%)[a,1]	4,227 (6)	128 (8)[2]	86 (3)	43 (5)[3]	118 (5)	56 (7)[6]	1,039 (6)	134 (7)[8]	206 (7)	N/A*	6,045 (6)

[a] χ^2 test

Across all mental/substance use disorder categories

[1] p<0.001

In pairwise comparisons of Substance use disorders within each Mental Disorder Category:

[2] p<0.001, [3] p<0.01, [4] p<0.05, [5] p=0.06, [6] p=0.07, [7] p=0.08, [8] p=0.1, [9] p=0.3, [10] p=0.4,

[11] p=0.7, [12] p=0.8, [13] p=0.9

* Per Data Use Agreement, data suppressed due to small cell size (<11). No comparison tests performed.

In adjusted analyses, the addition of Need and Behavior factors had a significant impact on the relationship between BHDs and diabetes outcomes. Therefore, only the estimates from the logistic regressions adjusted for all covariates (i.e., model 5) are presented in Tables 4.3, 4.4 and 4.5. Please refer to Appendix XII on p.148 for estimates from other models. After adjusting for covariates, people with schizophrenia/ paranoid states (OR: 0.72, 95%CI: 0.67, 0.78), bipolar disorder (OR: 0.76, 95%CI: 0.69, 0.84), depression/ anxiety (OR: 0.94, 95%CI: 0.90, 0.98) or other mental health disorders (OR: 0.88, 95%CI: 0.78, 1.00) were less likely to have any diabetes complications in 2005 than those with no mental health disorders. People with bipolar disorder (OR: 0.69, 95%CI: 0.57, 0.83) or any alcohol abuse/ dependence (OR: 0.77, 95%CI: 0.77, 0.91) had lower odds for new eye complications in 2005 than those without mental health disorders or alcohol abuse/ dependence. Lower likelihoods for new nephropathy cases in 2005 were also observed among people with schizophrenia/ paranoid states (OR: 0.60, 95%CI: 0.44, 0.83), bipolar disorder (OR: 0.70, 95%CI: 0.53, 0.91), depression/ anxiety (OR: 0.80, 95%CI: 0.70, 0.90), other mental health disorders (OR: 0.70, 95%CI: 0.55, 0.89) or any alcohol abuse/ dependence (OR: 0.63, 95%CI: 0.50, 0.79) after adjusting for covariates. The presence of schizophrenia/ paranoid states was also associated with lower odds for new cases of ischemic heart disease (OR: 0.74, 95%CI: 0.63, 0.86) and cerebrovascular disease (OR: 0.61, 95%CI: 0.49, 0.77) in 2005. On the contrary, the presence of either any alcohol abuse/ dependence (OR: 1.52, 95%CI 1.27, 1.81) or any drug abuse/ dependence (OR: 1.41, 95%CI 1.20, 1.65) was significantly associated with higher odds

for lower-limb amputations. People with any drug abuse/ dependence had higher odds for diabetes-related hospitalizations (OR: 1.64, 95%CI 1.41-1.92) in 2005.

There were other factors associated with the odds of having diabetes complications and hospitalizations. For example, male gender was correlated with higher likelihoods of having any diabetes complications in 2005 (OR: 1.28, 95%CI: 1.24, 1.33) and having previous eye complications increased the odds for diabetes-related hospitalizations (OR: 1.24, 95%CI: 1.15, 1.34). However, having continuous 12-month health coverage was associated with lower odds for diabetes-related hospitalizations (OR: 0.55, 95%CI: 0.48, 0.62).

Table 4.3 Estimates from logistic regression models for the associations between BHDs and Diabetes Outcomes in 2005

	Any complications		Eye Complications		Nephropathy	
	N=106,174		N=89,943		N=101,924	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.72***	(0.67, 0.78)	0.82*	(0.69, 0.96)	0.58**	(0.42, 0.81)
Bipolar disorder	0.76***	(0.69, 0.84)	0.70***	(0.59, 0.84)	0.70**	(0.53, 0.91)
Depression/ anxiety	0.94**	(0.90, 0.98)	0.93	(0.86, 1.01)	0.79***	(0.70, 0.90)
Other mental health disorders	0.88*	(0.78, 1.00)	0.87	(0.71, 1.05)	0.69**	(0.55, 0.88)
Any alcohol abuse/ dependence	1.04	(0.93, 1.15)	0.79**	(0.67, 0.92)	0.64***	(0.50, 0.81)
Any drug abuse/ dependence	0.97	(0.90, 1.05)	0.92	(0.78, 1.08)	0.81	(0.64, 1.03)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.65***	(1.54, 1.77)	1.45***	(1.29, 1.64)	1.37***	(1.20, 1.57)
65-74	1.69***	(1.55, 1.85)	1.39***	(1.24, 1.56)	1.17	(1.00, 1.37)
75 and older	1.90***	(1.77, 2.04)	1.12	(0.99, 1.26)	1.01	(0.86, 1.19)
Male Gender	1.28***	(1.24, 1.33)	0.94	(0.87, 1.02)	1.39***	(1.28, 1.50)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.02	(0.95, 1.09)	1.36***	(1.20, 1.55)	1.64***	(1.47, 1.84)
Hispanic	0.76***	(0.69, 0.85)	1.19	(0.93, 1.52)	1.03	(0.86, 1.24)
Others	0.72***	(0.66, 0.79)	1.08	(0.92, 1.25)	1.34**	(1.11, 1.63)
Unknown	0.71***	(0.65, 0.78)	0.97	(0.84, 1.12)	0.62**	(0.44, 0.88)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.20***	(1.15, 1.26)	0.97	(0.89, 1.05)	1.36**	(1.13, 1.64)
1.3<=CDPS<=1.9	1.33***	(1.28, 1.39)	0.99	(0.90, 1.08)	1.82***	(1.55, 2.12)
CDPS>1.9	1.41***	(1.33, 1.48)	0.94	(0.85, 1.05)	3.67***	(3.18, 4.24)
Health coverage type						
Medicare only (ref.)	1		1		1	
Medicaid only	0.64***	(0.59, 0.69)	0.68***	(0.57, 0.81)	0.59***	(0.47, 0.74)
Dual-eligible	1.17***	(1.12, 1.23)	1.12**	(1.04, 1.22)	1.51***	(1.38, 1.64)
Continuous 12-month coverage	0.93	(0.85, 1.02)	1.10	(0.96, 1.27)	0.95	(0.79, 1.14)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.01	(0.94, 1.08)	0.83*	(0.69, 0.99)	1.23*	(1.02, 1.49)
85-90%	1.01	(0.90, 1.12)	0.80*	(0.68, 0.95)	1.19	(0.97, 1.47)
>90%	1.00	(0.89, 1.13)	0.74**	(0.60, 0.92)	1.26	(0.96, 1.67)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	1.01	(0.94, 1.09)	1.09	(0.94, 1.25)	0.83*	(0.72, 0.96)
$45,921-$56,813	1.01	(0.91, 1.12)	1.08	(0.91, 1.27)	0.88	(0.74, 1.04)
>$56,813	1.01	(0.89, 1.15)	1.20	(0.98, 1.48)	0.84	(0.67, 1.06)
No Previous Complications	0.43***	(0.39, 0.47)	0.97	(0.87, 1.07)	0.78***	(0.69, 0.88)
Eye complications in 2004	2.99***	(2.75, 3.26)	N/A		2.09***	(1.92, 2.28)
Nephropathy in 2004	2.59***	(2.35, 2.85)	2.03***	(1.83, 2.25)	N/A	
Neuropathy in 2004	3.39***	(3.11, 3.69)	1.88***	(1.74, 2.04)	1.74***	(1.59, 1.90)
Ischemic Heart Disease in 2004	4.07***	(3.73, 4.45)	1.19***	(1.11, 1.28)	1.17**	(1.05, 1.29)
Lower-limb amputations 2004	1.22**	(1.09, 1.37)	1.50***	(1.34, 1.68)	1.53***	(1.34, 1.73)
Cerebrovascular diseases 2004	1.84***	(1.70, 1.98)	1.12*	(1.01, 1.25)	0.90	(0.81, 1.00)
No. of outpatient visits 2004	1.02***	(1.02, 1.03)	1.01*	(1.00, 1.01)	1.01	(1.00, 1.01)

*p<0.05, **p<0.01, ***p<0.001

Note: 17,298 individuals previously had eye complications and were excluded in the analysis for eye complications. 5,364 individuals previously had nephropathy and were excluded in the analysis for nephropathy.

Table 4.4 Estimates from logistic regression models for the associations between BHDs and Diabetes Outcomes in 2005

	Diabetic Neuropathy		Lower-limb Amputations		Ischemic Heart Disease	
	N=92,011		N=101,492		N=73,519	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.79**	(0.67, 0.94)	0.85	(0.72, 1.00)	0.74***	(0.63, 0.87)
Bipolar disorder	0.99	(0.84, 1.17)	0.87	(0.70, 1.10)	0.86	(0.73, 1.01)
Depression/ anxiety	0.99	(0.93, 1.05)	1.00	(0.92, 1.08)	1.00	(0.94, 1.07)
Other mental health disorders	1.00	(0.85, 1.18)	0.99	(0.83, 1.19)	0.98	(0.87, 1.11)
Any alcohol abuse/ dependence	1.05	(0.92, 1.21)	1.53***	(1.29, 1.82)	0.99	(0.85, 1.16)
Any drug abuse/ dependence	1.04	(0.85, 1.27)	1.41***	(1.20, 1.66)	0.91	(0.75, 1.10)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.40***	(1.27, 1.53)	1.16**	(1.04, 1.29)	2.34***	(2.15, 2.56)
65-74	1.08	(0.96, 1.21)	1.00	(0.86, 1.18)	2.68***	(2.42, 2.97)
75 and older	1.05	(0.94, 1.17)	1.29**	(1.11, 1.50)	3.46***	(3.09, 3.86)
Male Gender	1.03	(0.97, 1.10)	1.11***	(1.05, 1.17)	1.39***	(1.32, 1.47)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.22	(1.00, 1.49)	1.03	(0.92, 1.16)	0.86*	(0.76, 0.98)
Hispanic	0.79**	(0.66, 0.94)	0.76**	(0.63, 0.91)	0.74***	(0.64, 0.85)
Others	0.58***	(0.45, 0.74)	0.81*	(0.68, 0.96)	0.70***	(0.60, 0.81)
Unknown	0.67***	(0.56, 0.80)	0.81	(0.63, 1.06)	0.73**	(0.58, 0.92)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.36***	(1.24, 1.49)	1.25***	(1.11, 1.41)	1.26***	(1.19, 1.34)
1.3<=CDPS<=1.9	1.71***	(1.56, 1.88)	1.74***	(1.49, 2.03)	1.55***	(1.45, 1.66)
CDPS>1.9	1.86***	(1.64, 2.11)	2.41***	(2.03, 2.86)	1.92***	(1.75, 2.11)
Health coverage type						
Medicare only (ref.)	1		1		1	
Medicaid only	0.57***	(0.51, 0.64)	0.80*	(0.67, 0.96)	0.62***	(0.56, 0.70)
Dual-eligible	1.34***	(1.25, 1.44)	1.65***	(1.46, 1.85)	1.35***	(1.22, 1.51)
Continuous 12-month coverage	0.95	(0.77, 1.18)	0.70***	(0.61, 0.81)	0.71***	(0.62, 0.82)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.15	(0.96, 1.37)	1.01	(0.86, 1.20)	1.04	(0.94, 1.15)
85-90%	1.35*	(1.00, 1.80)	0.88	(0.72, 1.08)	0.93	(0.82, 1.05)
>90%	1.43*	(1.08, 1.89)	0.86	(0.67, 1.09)	0.93	(0.80, 1.09)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.90	(0.77, 1.05)	1.04	(0.89, 1.20)	1.00	(0.93, 1.09)
$45,921-$56,813	0.84*	(0.72, 0.98)	1.05	(0.88, 1.26)	1.08	(0.97, 1.19)
>$56,813	0.77*	(0.64, 0.94)	1.01	(0.83, 1.22)	1.10	(0.96, 1.27)
No Previous Complications	0.86**	(0.78, 0.95)	0.87**	(0.79, 0.96)	1.01	(0.90, 1.13)
Eye complications in 2004	1.87***	(1.69, 2.07)	1.70***	(1.54, 1.88)	1.12**	(1.04, 1.21)
Nephropathy in 2004	1.82***	(1.60, 2.07)	1.40***	(1.24, 1.59)	1.30***	(1.15, 1.46)
Neuropathy in 2004	N/A		1.75***	(1.58, 1.94)	1.10*	(1.02, 1.18)
Ischemic Heart Disease in 2004	1.01	(0.92, 1.11)	1.16***	(1.08, 1.24)	N/A	
Lower-limb amputations 2004	1.79***	(1.58, 2.03)	N/A		1.04	(0.89, 1.21)
Cerebrovascular diseases 2004	0.97	(0.89, 1.06)	1.12*	(1.01, 1.24)	1.37***	(1.21, 1.54)
No. of outpatient visits 2004	1.02***	(1.01, 1.03)	1.01***	(1.00, 1.01)	1.02***	(1.02, 1.03)

*p<0.05, **p<0.01, ***p<0.001

Note: 15,188 individuals previously had neuropathy and were excluded in the analysis for neuropathy. 5,784 individuals previously had lower-limb amputations and were excluded in the analysis for lower-limb amputations. 33,574 individuals previously had ischemic heart disease and were excluded in the analysis for ischemic heart disease.

Table 4.5 Estimates from logistic regression models for the associations between BHDs and Diabetes Outcomes in 2005

	Cerebrovascular Disease		Diabetes-related Hospitalization	
	N=96,162		N=106,174	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.63***	(0.50, 0.80)	0.75**	(0.63, 0.89)
Bipolar disorder	0.97	(0.78, 1.19)	1.07	(0.91, 1.26)
Depression/ anxiety	1.07	(0.97, 1.17)	1.03	(0.96, 1.10)
Other mental health disorders	1.08	(0.91, 1.27)	1.01	(0.87, 1.17)
Any alcohol abuse/ dependence	1.26*	(1.04, 1.53)	1.08	(0.88, 1.33)
Any drug abuse/ dependence	0.96	(0.78, 1.19)	1.60***	(1.38, 1.86)
Age Groups				
<55 (ref.)	1		1	
55-64	2.27***	(1.96, 2.64)	1.11	(0.98, 1.25)
65-74	2.76***	(2.37, 3.21)	1.13	(1.00, 1.28)
75 and older	3.58***	(3.09, 4.15)	1.26***	(1.11, 1.44)
Male Gender	1.05	(0.98, 1.13)	1.17***	(1.11, 1.24)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.83***	(0.75, 0.92)	1.00	(0.91, 1.11)
Hispanic	0.77***	(0.67, 0.89)	0.77***	(0.66, 0.89)
Others	0.72***	(0.61, 0.84)	0.88	(0.73, 1.07)
Unknown	0.87	(0.66, 1.13)	0.85	(0.64, 1.13)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.26***	(1.15, 1.38)	1.09	(1.00, 1.18)
1.3<=CDPS<=1.9	1.39***	(1.25, 1.54)	1.23***	(1.10, 1.37)
CDPS>1.9	1.57***	(1.41, 1.76)	1.47***	(1.33, 1.63)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.53***	(0.45, 0.61)	0.65***	(0.52, 0.80)
Dual-eligible	1.05	(0.96, 1.15)	1.32***	(1.24, 1.41)
Continuous 12-month coverage	0.64***	(0.54, 0.76)	0.55***	(0.48, 0.62)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.99	(0.91, 1.09)	1.00	(0.90, 1.11)
85-90%	1.02	(0.94, 1.12)	0.93	(0.83, 1.05)
>90%	1.03	(0.91, 1.17)	0.87	(0.76, 1.00)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.93	(0.81, 1.08)	1.01	(0.89, 1.16)
$45,921-$56,813	0.92	(0.78, 1.08)	1.12	(0.96, 1.30)
>$56,813	0.95	(0.80, 1.12)	1.14	(0.99, 1.31)
No Previous Complications	1.01	(0.91, 1.12)	0.70***	(0.63, 0.78)
Eye complications in 2004	1.12*	(1.05, 1.21)	1.24***	(1.15, 1.34)
Nephropathy in 2004	1.23***	(1.11, 1.36)	1.45***	(1.34, 1.57)
Neuropathy in 2004	1.13***	(1.06, 1.21)	1.25***	(1.15, 1.35)
Ischemic Heart Disease in 2004	1.61***	(1.48, 1.75)	1.89***	(1.75, 2.03)
Lower-limb amputations 2004	1.20**	(1.08, 1.33)	1.97***	(1.84, 2.11)
Cerebrovascular diseases 2004	N/A		1.47***	(1.35, 1.61)
No. of outpatient visits 2004	1.02***	(1.01, 1.02)	1.01***	(1.01, 1.01)

*p<0.05, **p<0.01, ***p<0.001
Note: 11,106 individuals previously had cerebrovascular disease and were excluded in the analysis for cerebrovascular disease.

Discussion

Similar to the findings in Aim 1, the associations between BHDs and diabetes outcomes were inconsistent. For example, while the adjusted analyses showed that substance use disorders had a negative impact, i.e., increased odds, on diabetes-related hospitalizations, the presence of schizophrenia/ paranoid states was associated with reduced odds for diabetes-related hospitalizations and the presence of bipolar disorder, depression/ anxiety or other mental health disorders were not associated with such outcome. Further, the relationships between mental health disorders and diabetes outcomes were not consistent and such relationships were dependent on the outcomes of interest. For example, mental health disorders were associated with lower odds for any new complications and nephropathy but they were not significantly correlated with lower-limb amputations. While people with schizophrenia/ paranoid states had lower odds of neuropathy, ischemic heart disease and cerebrovascular disease, their likelihoods for having eye complications was not significant different from those with diabetes alone.

Similar findings on substance use disorders and poor health outcomes in diabetes had been reported in previous studies.[27,28] However, the results did not indicate that mental health disorders increased the likelihood of poor diabetes outcomes, contrary to previous studies.[24,26,27] For example, in a study using administrative data, Krein and colleagues observed that people with diabetes and schizophrenia or bipolar disorder were more likely to be hospitalized (OR: 2.8, 95%CI 2.67-2.94).[26] However, the study by Krein and colleagues did not assess or adjust for the presence of substance use disorders in the analysis.[26] Therefore, the effects on diabetes outcomes in the study by Krein and

colleagues might be due to substance use disorders, which co-occur with schizophrenia and bipolar disorder at high rates (see Table 3.2).

It is worth noting that the prevalence of any new diabetes complications in this population with publicly sponsored healthcare coverage was about 50% in 2005. In general, higher rates of diabetes outcomes were observed in the study population than the national average for people with diabetes. For example, the prevalence of ischemic heart disease in 2005 was 32% in this population, compared to the national figure of 22.3% in 2003.[99] Similarly, the rate of hospitalization with diabetes as the first diagnosis was 56.9 per 1000 persons in the study population, compared to 35.9 per 1000 persons nationally in 2005.[100]

The major limitation of this study was the short duration of observation (i.e., one year). Diabetes complications are generally slow processes and take years to develop. Therefore, the study was unable to capture the natural history of diabetes complications and might have underestimated the incidence of complications. For example, 40% of people with diabetes alone developed eye complications in a study by Black and colleagues[24] whereas only 17% people with diabetes alone had eye complications in the study population. However, the estimates of cases from this study were similar, if not higher than those of national average. Further studies with multi-year data are necessary to accurately estimate the occurrence of diabetes outcomes.

Chapter V. Impact of Comprehensive diabetes care on diabetes-related

complications and hospitalizations

Aim

This chapter reports the findings from Aim 3: the impact of comprehensive

diabetes care on diabetes-related outcomes (i.e., complications and hospitalizations).

Multivariate analyses were performed to demonstrate the effects of comprehensive

diabetes care on diabetes-related outcomes while adjusting for potential confounders.

Results

Among people with any types of BHDs (n=31,350), only 330 individuals, or 1.1%

had comprehensive diabetes care (see Table 5.1). In unadjusted analysis, individuals

with comprehensive care had a lower rate of cerebrovascular disease than those without

comprehensive care (6% vs. 9%, $p < 0.05$) (see Table 5.1). However, there were no

significant differences in the rates of any diabetes complications, eye complications,

neuropathy, nephropathy, lower-limb amputations, ischemic heart disease and diabetes-

related hospitalizations between people with comprehensive diabetes care and those

without.

Table 5.1 Comprehensive Diabetes Care and Diabetes-related Outcomes

N=31,350	Comprehensive Diabetes Care				Overall	
	No		Yes			
Outcomes in 2005	N=31,020		N=330		N=31,350	
Any Complications (%)[a]	14,304	(46)	148	(45)[6]	14,452	(46)
Eye Complications (%)[a]	4,067	(13)	47	(14)[5]	4,114	(13)
Neuropathy (%)[a]	4,696	(15)	42	(13)[3]	4,738	(15)
Nephropathy (%)[a]	1,560	(5)	17	(5)[7]	1,577	(5)
Lower-limb amputations (%)[a]	1,936	(6)	18	(5)[6]	1,954	(6)
Ischemic Heart disease (%)[a]	7,976	(26)	78	(24)[4]	8,054	(26)
Cerebrovascular disease (%)[a]	2,885	(9)	20	(6)[1]	2,905	(9)
Diabetes-related Hospitalizations (%)[a]	1,805	(6)	13	(4)[2]	1,818	(6)

[a] χ^2 tests

Compared to no Comprehensive Diabetes Care:
[1] $p<0.05$, [2] p=0.1, [3] p=0.2, [4] p=0.4, [5] p=0.5, [6] p=0.6, [7] p=0.9

The adjusted analysis indicated a general trend for lower odds of adverse diabetes outcomes in 2005 for people with comprehensive diabetes care (for example, odds ratio [OR] for new cases of eye complications: 0.93, 95% confidence interval [CI]: 0.58, 1.48; OR for neuropathy: 0.64, 95%CI: 0.40, 1.03; OR for lower-limb amputations: 0.81, 95%CI: 0.36, 1.83; and OR for diabetes-related hospitalizations in 2005: 0.71, 95%CI: 0.41, 1.24) although the associations were not statistically significant. However, adherence to quality measures was associated with increased odds of any complications (OR for full adherence: 1.48, 95%CI: 1.31, 1.68), eye complications (OR for full adherence: 2.52, 95%CI: 1.92, 3.31) and neuropathy (OR for full adherence: 2.20, 95%CI: 1.60, 3.03) (see Tables 5.2 to 5.9).

The analysis also showed that comprehensive diabetes care did not significantly affect the relationship between BHDs and diabetes outcomes. For example, after the addition of comprehensive diabetes care, schizophrenia/ paranoid states remained significantly associated with lower odds for any complications (OR: 0.76, no change), nephropathy (OR: 0.82 vs. 0.81), lower-limb amputations (OR: 0.47, no change) and diabetes-related hospitalizations (OR: 0.53, no change) (see tables 5.2 through 5.9). Similarly, no significant changes, i.e., 10% or greater differences in the odds, were observed in the associations between other types of mental health disorders and diabetes outcomes after comprehensive diabetes care was added (see tables 5.2 through 5.9). The presence of co-occurring alcohol abuse/ dependence was significantly associated with higher odds for lower-limb amputations (OR: 1.39, no change) (see table 5.6) and the presence of co-occurring drug abuse/ dependence was correlated with higher odds for

lower-limb amputations (OR: 1.37, no change) and diabetes-related hospitalizations (OR: 1.53, no change) (see tables 5.6 to 5.9).

Table 5.2 Effect of Comprehensive Care on Any Complications in 2005

N=31,350

	Any Complications in 2005			
	Modeled with Comprehensive Care		Modeled without Comprehensive Care	
	OR	95%CI	OR	95%CI
Comprehensive Diabetes Care	1.00	(0.78, 1.27)	N/A	
Quality Measures met in 2004				
0 (ref.)	1		1	
1	1.12*	(1.00, 1.25)	1.12*	(1.00, 1.25)
2	1.31***	(1.16, 1.48)	1.31***	(1.17, 1.48)
3	1.45***	(1.20, 1.63)	1.45***	(1.30, 1.63)
4	1.48***	(1.31, 1.68)	1.48***	(1.31, 1.68)
Mental health disorders				
SUD without mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.76***	(0.66, 0.88)	0.76***	(0.66, 0.88)
Bipolar disorder	0.82**	(0.72, 0.94)	0.82**	(0.72, 0.94)
Depression/ anxiety	1.04	(0.91, 1.20)	1.04	(0.91, 1.20)
Other mental health disorders	0.99	(0.85, 1.16)	0.99	(0.85, 1.16)
Co-occurring alcohol abuse/ dependence	1.10	(0.98, 1.22)	1.10	(0.98, 1.22)
Co-occurring drug abuse/ dependence	0.97	(0.88, 1.05)	0.97	(0.88, 1.05)
Age Groups				
<55 (ref.)	1		1	
55-64	1.57***	(1.44, 1.72)	1.57***	(1.44, 1.72)
65-74	1.68***	(1.49, 1.90)	1.68***	(1.49, 1.90)
75 and older	2.04***	(1.81, 2.30)	2.04***	(1.81, 2.30)
Male Gender	1.23***	(1.16, 1.30)	1.23***	(1.16, 1.30)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.05	(0.95, 1.16)	1.05	(0.95, 1.16)
Hispanic	0.69***	(0.62, 0.78)	0.69***	(0.62, 0.78)
Others	0.81*	(0.70, 0.95)	0.81*	(0.70, 0.95)
Unknown	0.75***	(0.65, 0.88)	0.75***	(0.65, 0.88)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.26**	(1.10, 1.44)	1.26**	(1.10, 1.44)
1.3<=CDPS<=1.9	1.51***	(1.32, 1.74)	1.51***	(1.32, 1.74)
CDPS>1.9	1.64***	(1.45, 1.85)	1.64***	(1.45, 1.85)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.80***	(0.72, 0.88)	0.80***	(0.72, 0.88)
Dual-eligible	1.23***	(1.13, 1.34)	1.23***	(1.13, 1.34)
Continuous 12-month coverage	0.95	(0.83, 1.09)	0.95	(0.83, 1.09)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.00	(0.91, 1.10)	1.00	(0.91, 1.10)
85-90%	0.94	(0.81, 1.08)	0.94	(0.81, 1.08)
>90%	0.94	(0.81, 1.09)	0.94	(0.81, 1.09)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.08	(0.96, 1.21)	1.08	(0.96, 1.21)
$45,921-$56,813	1.01	(0.89, 1.15)	1.01	(0.89, 1.15)
>$56,813	1.06	(0.91, 1.25)	1.06	(0.91, 1.25)
No Previous Complications	0.50***	(0.43, 0.57)	0.50***	(0.43, 0.57)
Eye complications in 2004	2.94***	(2.67, 3.23)	2.94***	(2.67, 3.23)
Nephropathy in 2004	2.70***	(2.25, 3.65)	2.70***	(2.25, 3.24)
Neuropathy in 2004	3.24***	(2.88, 3.65)	3.24***	(2.88, 3.65)
Ischemic Heart Disease in 2004	3.65***	(3.27, 4.08)	3.65***	(3.27, 4.08)
Lower-limb amputations 2004	1.36***	(1.17, 1.58)	1.36***	(1.17, 1.58)
Cerebrovascular diseases 2004	2.07***	(1.86, 2.30)	2.07***	(1.86, 2.30)
No. of outpatient visits 2004	1.01***	(1.01, 1.02)	1.01***	(1.01, 1.02)

* p<0.05 **p<0.01 ***p<0.001

Table 5.3 Effect of Comprehensive Care on New Eye Complications in 2005

N=27,066

| | Eye Complications in 2005 | | | |
| | Modeled with Comprehensive Care | | Modeled without Comprehensive Care | |
	OR	95%CI	OR	95%CI
Comprehensive Diabetes Care	0.93	(0.58, 1.48)	N/A	
Quality Measures met in 2004				
0 (ref.)	1		1	
1	2.07***	(1.57, 2.74)	2.07***	(1.57, 2.74)
2	2.23***	(1.69, 2.94)	2.23***	(1.69, 2.94)
3	2.37***	(1.77, 3.18)	2.37***	(1.77, 3.18)
4	2.52***	(1.92, 3.31)	2.52***	(1.92, 3.30)
Mental health disorders				
SUD without mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.97	(0.69, 1.38)	0.97	(0.69, 1.38)
Bipolar disorder	0.86	(0.59, 1.25)	0.86	(0.59, 1.25)
Depression/ anxiety	1.17	(0.86, 1.57)	1.17	(0.86, 1.57)
Other mental health disorders	1.10	(0.75, 1.61)	1.10	(0.75, 1.61)
Co-occurring alcohol abuse/ dependence	0.85	(0.69, 1.04)	0.85	(0.69, 1.04)
Co-occurring drug abuse/ dependence	0.95	(0.80, 1.13)	0.95	(0.80, 1.13)
Age Groups				
<55 (ref.)	1		1	
55-64	1.26**	(1.09, 1.45)	1.26**	(1.09, 1.45)
65-74	1.27**	(1.10, 1.48)	1.27**	(1.10, 1.48)
75 and older	0.99	(0.84, 1.17)	0.99	(0.84, 1.17)
Male Gender	0.89	(0.78, 1.01)	0.89	(0.78, 1.01)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.19*	(1.03, 1.38)	1.19*	(1.03, 1.38)
Hispanic	1.19	(0.88, 1.60)	1.19	(0.88, 1.60)
Others	1.07	(0.80, 1.43)	1.07	(0.80, 1.43)
Unknown	1.05	(0.83, 1.32)	1.05	(0.83, 1.32)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.20*	(1.00, 1.43)	1.20*	(1.00, 1.43)
1.3<=CDPS<=1.9	1.27*	(1.06, 1.53)	1.27*	(1.06, 1.53)
CDPS>1.9	1.10	(0.91, 1.34)	1.10	(0.91, 1.34)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.77*	(0.62, 0.96)	0.77*	(0.62, 0.96)
Dual-eligible	1.03	(0.89, 1.19)	1.03	(0.89, 1.19)
Continuous 12-month coverage	1.02	(0.79, 1.31)	1.02	(0.79, 1.31)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.79	(0.60, 1.03)	0.79	(0.60, 1.03)
85-90%	0.65**	(0.48, 0.87)	0.65**	(0.48, 0.87)
>90%	0.67*	(0.46, 0.97)	0.67*	(0.46, 0.97)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.10	(0.87, 1.37)	1.10	(0.87, 1.37)
$45,921-$56,813	1.15	(0.93, 1.42)	1.15	(0.93, 1.42)
>$56,813	1.25	(0.88, 1.76)	1.25	(0.88, 1.76)
No Previous Complications	1.02	(0.89, 1.18)	1.02	(0.89, 1.17)
Eye complications in 2004	N/A		N/A	
Nephropathy in 2004	2.19***	(1.70, 2.81)	2.19***	(1.70, 2.81)
Neuropathy in 2004	1.91***	(1.64, 2.22)	1.91***	(1.64, 2.22)
Ischemic Heart Disease in 2004	1.31***	(1.15, 1.48)	1.31***	(1.15, 1.48)
Lower-limb amputations 2004	1.54***	(1.26, 1.89)	1.54***	(1.26, 1.89)
Cerebrovascular diseases 2004	1.11	(0.94, 1.30)	1.11	(0.94, 1.30)
No. of outpatient visits 2004	1.00	(0.99, 1.01)	1.00	(0.99, 1.01)

* p<0.05 **p<0.01 ***p<0.001

Note: 4,284 individuals excluded from the analysis previously had eye complications.

Table 5.4 Effect of Comprehensive Care on New Nephropathy cases in 2005

N=29,825

	Nephropathy in 2005			
	Modeled with Comprehensive Care		Modeled without Comprehensive Care	
	OR	95%CI	OR	95%CI
Comprehensive Diabetes Care	1.38	(0.85, 2.24)	N/A	
Quality Measures met in 2004				
0 (ref.)	1		1	
1	0.99	(0.74, 1.31)	0.99	(0.74, 1.31)
2	1.16	(0.83, 1.61)	1.16	(0.83, 1.62)
3	1.33	(0.94, 1.88)	1.34	(0.95, 1.90)
4	1.32	(0.92, 1.88)	1.33	(0.93, 1.90)
Mental health disorders				
SUD without mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.82	(0.59, 1.13)	0.81	(0.59, 1.13)
Bipolar disorder	0.96	(0.61, 1.50)	0.95	(0.61, 1.49)
Depression/ anxiety	1.04	(0.76, 1.42)	1.04	(0.76, 1.42)
Other mental health disorders	0.90	(0.63, 1.27)	0.90	(0.64, 1.27)
Co-occurring alcohol abuse/ dependence	0.57**	(0.40, 0.80)	0.57**	(0.41, 0.80)
Co-occurring drug abuse/ dependence	0.97	(0.67, 1.41)	0.97	(0.67, 1.41)
Age Groups				
<55 (ref.)	1		1	
55-64	1.35**	(1.14, 1.59)	1.34**	(1.14, 1.59)
65-74	1.42**	(1.10, 1.82)	1.42**	(1.10, 1.83)
75 and older	1.18	(0.81, 1.73)	1.19	(0.81, 1.73)
Male Gender	1.36***	(1.19, 1.55)	1.36***	(1.19, 1.55)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.68***	(1.37, 2.04)	1.67***	(1.37, 2.04)
Hispanic	0.89	(0.62, 1.27)	0.89	(0.62, 1.27)
Others	1.28	(0.83, 1.98)	1.28	(0.83, 1.97)
Unknown	0.65	(0.42, 1.02)	0.66	(0.42, 1.03)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.23	(0.84, 1.78)	1.22	(0.84, 1.78)
1.3<=CDPS<=1.9	1.44	(0.96, 2.18)	1.44	(0.95, 2.17)
CDPS>1.9	2.62***	(1.81, 3.78)	2.61***	(1.80, 3.77)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.82	(0.52, 1.27)	0.82	(0.53, 1.27)
Dual-eligible	1.54***	(1.26, 1.88)	1.54***	(1.26, 1.88)
Continuous 12-month coverage	0.96	(0.68, 1.36)	0.96	(0.68, 1.36)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.27	(0.90, 1.78)	1.27	(0.90, 1.78)
85-90%	1.30	(0.91, 1.86)	1.31	(0.92, 1.86)
>90%	1.36	(0.88, 2.10)	1.36	(0.88, 2.10)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.76	(0.58, 1.00)	0.76*	(0.57, 1.00)
$45,921-$56,813	0.87	(0.63, 1.18)	0.86	(0.63, 1.18)
>$56,813	0.78	(0.51, 1.17)	0.78	(0.51, 1.17)
No Previous Complications	0.72**	(0.59, 0.89)	0.73**	(0.59, 0.89)
Eye complications in 2004	2.05***	(1.73, 2.44)	2.05***	(1.73, 2.43)
Nephropathy in 2004	N/A		N/A	
Neuropathy in 2004	1.86***	(1.62, 2.15)	1.86***	(1.62, 2.15)
Ischemic Heart Disease in 2004	1.30**	(1.10, 1.54)	1.30**	(1.10, 1.54)
Lower-limb amputations 2004	1.77***	(1.52, 2.07)	1.78***	(1.52, 2.08)
Cerebrovascular diseases 2004	0.82	(0.63, 1.07)	0.82	(0.63, 1.07)
No. of outpatient visits 2004	1.01	(1.00, 1.02)	1.01	(1.00, 1.02)

* p<0.05 **p<0.01 ***p<0.001

Note: 1,525 individuals excluded from the analysis previously had nephropathy.

Table 5.5 Effect of Comprehensive Care on New Neuropathy cases in 2005

N=26,606	Neuropathy in 2005			
	Modeled with Comprehensive Care		Modeled without Comprehensive Care	
	OR	95%CI	OR	95%CI
Comprehensive Diabetes Care	0.64	(0.40, 1.03)	N/A	
Quality Measures met in 2004				
0 (ref.)	1		1	
1	1.46*	(1.09, 1.97)	1.46*	(1.08, 1.97)
2	1.79***	(1.33, 2.42)	1.79***	(1.32, 2.42)
3	2.15***	(1.56, 2.97)	2.14***	(1.55, 2.95)
4	2.20***	(1.60, 3.03)	2.18***	(1.58, 3.01)
Mental health disorders				
SUD without mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.73*	(0.54, 0.97)	0.73*	(0.54, 0.98)
Bipolar disorder	0.94	(0.73, 1.22)	0.94	(0.73, 1.22)
Depression/ anxiety	0.98	(0.80, 1.22)	0.99	(0.80, 1.22)
Other mental health disorders	1.00	(0.77, 1.29)	1.00	(0.77, 1.29)
Co-occurring alcohol abuse/ dependence	1.06	(0.90, 1.25)	1.06	(0.90, 1.25)
Co-occurring drug abuse/ dependence	1.04	(0.87, 1.25)	1.04	(0.87, 1.25)
Age Groups				
<55 (ref.)	1		1	
55-64	1.28***	(1.12, 1.45)	1.28***	(1.12, 1.45)
65-74	0.99	(0.83, 1.19)	0.99	(0.83, 1.19)
75 and older	0.93	(0.77, 1.12)	0.93	(0.77, 1.12)
Male Gender	1.05	(0.94, 1.17)	1.05	(0.94, 1.17)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.15	(0.98, 1.34)	1.15	(0.98, 1.34)
Hispanic	0.61***	(0.47, 0.78)	0.61***	(0.47, 0.78)
Others	0.45*	(0.24, 0.85)	0.45*	(0.24, 0.85)
Unknown	0.75	(0.52, 1.09)	0.75	(0.51, 1.09)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.40**	(1.15, 1.70)	1.40**	(1.15, 1.70)
1.3<=CDPS<=1.9	2.16***	(1.83, 2.55)	2.17***	(1.83, 2.56)
CDPS>1.9	2.27***	(1.83, 2.81)	2.28***	(1.83, 2.83)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.71***	(0.59, 0.85)	0.71***	(0.59, 0.85)
Dual-eligible	1.41***	(1.26, 1.58)	1.42***	(1.26, 1.59)
Continuous 12-month coverage	1.05	(0.71, 1.55)	1.05	(0.71, 1.55)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.03	(0.85, 1.25)	1.03	(0.85, 1.24)
85-90%	1.13	(0.82, 1.55)	1.13	(0.82, 1.55)
>90%	1.25	(0.92, 1.69)	1.25	(0.92, 1.68)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.11	(0.91, 1.37)	1.12	(0.91, 1.37)
$45,921-$56,813	0.95	(0.75, 1.21)	0.96	(0.75, 1.22)
>$56,813	0.94	(0.72, 1.23)	0.94	(0.72, 1.23)
No Previous Complications	0.80*	(0.68, 0.95)	0.80*	(0.68, 0.95)
Eye complications in 2004	1.55***	(1.36, 1.75)	1.55***	(1.36, 1.76)
Nephropathy in 2004	1.75***	(1.44, 2.13)	1.75***	(1.44, 2.13)
Neuropathy in 2004	N/A		N/A	
Ischemic Heart Disease in 2004	1.03	(0.87, 1.21)	1.03	(0.87, 1.21)
Lower-limb amputations 2004	1.82***	(1.47, 2.27)	1.82***	(1.46, 2.26)
Cerebrovascular diseases 2004	1.10	(0.94, 1.29)	1.10	(0.94, 1.29)
No. of outpatient visits 2004	1.01	(1.00, 1.02)	1.01	(1.00, 1.02)

* p<0.05 **p<0.01 ***p<0.001
Note: 4,744 individuals excluded from the analysis previously had neuropathy.

Table 5.6 Effect of Comprehensive Care on New cases of Lower-limb Amputations in 2005

N=29,101	Lower-limb Amputations in 2005			
	Modeled with Comprehensive Care		Modeled without Comprehensive Care	
	OR	95%CI	OR	95%CI
Comprehensive Diabetes Care	0.81	(0.36, 1.83)	N/A	
Quality Measures met in 2004				
0 (ref.)	1		1	
1	2.15***	(1.47, 3.15)	2.15***	(1.47, 3.15)
2	2.40***	(1.65, 3.48)	2.39***	(1.65, 3.47)
3	2.63***	(1.86, 3.73)	2.63***	(1.86, 3.70)
4	2.47***	(1.77, 3.45)	2.46***	(1.77, 3.42)
Mental health disorders				
SUD without mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.47***	(0.35, 0.62)	0.47***	(0.36, 0.62)
Bipolar disorder	0.52***	(0.38, 0.69)	0.52***	(0.39, 0.69)
Depression/ anxiety	0.58***	(0.43, 0.78)	0.58***	(0.43, 0.78)
Other mental health disorders	0.56***	(0.42, 0.76)	0.56***	(0.42, 0.76)
Co-occurring alcohol abuse/ dependence	1.39**	(1.15, 1.68)	1.39**	(1.15, 1.68)
Co-occurring drug abuse/ dependence	1.37**	(1.10, 1.70)	1.37**	(1.10, 1.70)
Age Groups				
<55 (ref.)	1		1	
55-64	1.16	(0.96, 1.38)	1.16	(0.96, 1.39)
65-74	1.14	(0.92, 1.42)	1.14	(0.92, 1.42)
75 and older	1.41*	(1.08, 1.83)	1.41*	(1.08, 1.83)
Male Gender	1.24***	(1.12, 1.37)	1.24***	(1.12, 1.37)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.10	(0.91, 1.33)	1.10	(0.91, 1.33)
Hispanic	0.85	(0.66, 1.10)	0.85	(0.66, 1.10)
Others	0.96	(0.70, 1.31)	0.96	(0.70, 1.31)
Unknown	0.82	(0.55, 1.21)	0.82	(0.55, 1.21)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.16	(0.90, 1.51)	1.16	(0.90, 1.51)
1.3<=CDPS<=1.9	1.77***	(1.36, 2.30)	1.77***	(1.37, 2.30)
CDPS>1.9	2.28***	(1.65, 3.16)	2.28***	(1.65, 3.16)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	1.29*	(1.03, 1.61)	1.29*	(1.03, 1.61)
Dual-eligible	1.78***	(1.48, 2.14)	1.78***	(1.48, 2.14)
Continuous 12-month coverage	0.80*	(0.66, 0.98)	0.80*	(0.66, 0.98)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.22	(0.99, 1.51)	1.22	(0.99, 1.51)
85-90%	0.92	(0.73, 1.17)	0.92	(0.73, 1.17)
>90%	1.05	(0.74, 1.51)	1.05	(0.74, 1.51)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.92	(0.73, 1.15)	0.92	(0.73, 1.15)
$45,921-$56,813	0.87	(0.68, 1.11)	0.87	(0.68, 1.11)
>$56,813	0.81	(0.58, 1.13)	0.81	(0.58, 1.12)
No Previous Complications	0.80**	(0.67, 0.94)	0.80**	(0.67, 0.94)
Eye complications in 2004	1.61***	(1.37, 1.88)	1.61***	(1.37, 1.88)
Nephropathy in 2004	1.36**	(1.11, 1.68)	1.36**	(1.11, 1.68)
Neuropathy in 2004	1.72***	(1.50, 1.97)	1.72***	(1.50, 1.97)
Ischemic Heart Disease in 2004	1.18*	(1.03, 1.35)	1.18*	(1.03, 1.35)
Lower-limb amputations 2004	N/A		N/A	
Cerebrovascular diseases 2004	1.10	(0.93, 1.31)	1.10	(0.93, 1.31)
No. of outpatient visits 2004	1.00	(1.00, 1.01)	1.00	(1.00, 1.01)

* p<0.05 **p<0.01 ***p<0.001
Note: 2,249 individuals excluded from the analysis previously had lower-limb amputations.

Table 5.7 Effect of Comprehensive Care on New Ischemic Heart Disease in 2005

N=22,913

	Ischemic Heart Disease in 2005			
	Modeled with Comprehensive Care		Modeled without Comprehensive Care	
	OR	95%CI	OR	95%CI
Comprehensive Diabetes Care	0.86	(0.50, 1.50)	N/A	
Quality Measures met in 2004				
0 (ref.)	1		1	
1	1.18	(0.87, 1.60)	1.18	(0.87, 1.59)
2	1.28*	(1.00, 1.63)	1.28*	(1.00, 1.63)
3	1.35**	(1.08, 1.70)	1.35*	(1.07, 1.69)
4	1.36*	(1.08, 1.72)	1.35*	(1.07, 1.71)
Mental health disorders				
SUD without mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.82	(0.62, 1.09)	0.82	(0.62, 1.09)
Bipolar disorder	0.95	(0.75, 1.21)	0.95	(0.75, 1.22)
Depression/ anxiety	1.11	(0.89, 1.37)	1.11	(0.89, 1.37)
Other mental health disorders	1.13	(0.92, 1.39)	1.13	(0.92, 1.39)
Co-occurring alcohol abuse/ dependence	1.20	(0.98, 1.47)	1.20	(0.98, 1.47)
Co-occurring drug abuse/ dependence	0.86	(0.71, 1.03)	0.86	(0.71, 1.03)
Age Groups				
<55 (ref.)	1		1	
55-64	2.32***	(2.07, 2.60)	2.32***	(2.07, 2.60)
65-74	2.77***	(2.38, 3.22)	2.77***	(2.38, 3.22)
75 and older	3.98***	(3.39, 4.68)	3.98***	(3.39, 4.68)
Male Gender	1.18***	(1.09, 1.27)	1.18***	(1.09, 1.27)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.96	(0.76, 1.26)	0.96	(0.74, 1.26)
Hispanic	0.75**	(0.61, 0.92)	0.75**	(0.61, 0.92)
Others	0.84	(0.63, 1.11)	0.84	(0.63, 1.11)
Unknown	0.88	(0.63, 1.25)	0.88	(0.63, 1.25)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.11	(0.91, 1.35)	1.11	(0.91, 1.35)
1.3<=CDPS<=1.9	1.46**	(1.17, 1.83)	1.46**	(1.17, 1.83)
CDPS>1.9	1.86***	(1.55, 2.23)	1.86***	(1.55, 2.24)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.79**	(0.67, 0.92)	0.78**	(0.67, 0.92)
Dual-eligible	1.44***	(1.20, 1.73)	1.44***	(1.20, 1.73)
Continuous 12-month coverage	0.78*	(0.64, 0.96)	0.78*	(0.64, 0.96)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.16	(0.98, 1.37)	1.16	(0.97, 1.37)
85-90%	0.98	(0.84, 1.15)	0.98	(0.84, 1.15)
>90%	0.99	(0.80, 1.22)	0.99	(0.80, 1.22)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.98	(0.82, 1.16)	0.98	(0.82, 1.16)
$45,921-$56,813	0.93	(0.77, 1.13)	0.93	(0.77, 1.13)
>$56,813	0.96	(0.80, 1.17)	0.96	(0.79, 1.17)
No Previous Complications	1.11	(0.94, 1.32)	1.11	(0.94, 1.32)
Eye complications in 2004	1.10	(0.93, 1.29)	1.10	(0.93, 1.30)
Nephropathy in 2004	1.49***	(1.23, 1.79)	1.49***	(1.23, 1.79)
Neuropathy in 2004	1.18*	(1.04, 1.34)	1.18*	(1.04, 1.34)
Ischemic Heart Disease in 2004	N/A		N/A	
Lower-limb amputations 2004	1.04	(0.84, 1.29)	1.04	(0.84, 1.29)
Cerebrovascular diseases 2004	1.35***	(1.17, 1.55)	1.35***	(1.17, 1.55)
No. of outpatient visits 2004	1.02***	(1.02, 1.03)	1.02***	(1.02, 1.03)

* p<0.05 **p<0.01 ***p<0.001

Note: 8,437 individuals excluded from the analysis previously had ischemic heart disease.

Table 5.8 Effect of Comprehensive Care on New Cerebrovascular Disease in 2005

N=28,199	Cerebrovascular Disease in 2005			
	Modeled with Comprehensive Care		Modeled without Comprehensive Care	
	OR	95%CI	OR	95%CI
Comprehensive Diabetes Care	0.76	(0.43, 1.37)	N/A	
Quality Measures met in 2004				
0 (ref.)	1		1	
1	0.89	(0.65, 1.22)	0.89	(0.65, 1.22)
2	1.02	(0.81, 1.27)	1.01	(0.81, 1.27)
3	0.96	(0.74, 1.23)	0.95	(0.74, 1.23)
4	1.04	(0.81, 1.33)	1.03	(0.81, 1.32)
Mental health disorders				
SUD without mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.61**	(0.44, 0.85)	0.61**	(0.44, 0.85)
Bipolar disorder	0.92	(0.67, 1.25)	0.92	(0.67, 1.25)
Depression/ anxiety	1.02	(0.80, 1.30)	1.02	(0.80, 1.30)
Other mental health disorders	1.05	(0.84, 1.31)	1.05	(0.84, 1.31)
Co-occurring alcohol abuse/ dependence	1.29*	(1.02, 1.64)	1.29*	(1.02, 1.64)
Co-occurring drug abuse/ dependence	1.12	(0.85, 1.48)	1.12	(0.85, 1.48)
Age Groups				
<55 (ref.)	1		1	
55-64	2.25***	(1.81, 2.80)	2.25***	(1.81, 2.80)
65-74	3.34***	(2.62, 4.26)	3.34***	(2.62, 4.26)
75 and older	3.80***	(3.01, 4.78)	3.80***	(3.01, 4.78)
Male Gender	1.01	(0.90, 1.13)	1.01	(0.90, 1.13)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.79**	(0.67, 0.94)	0.80**	(0.67, 0.94)
Hispanic	0.82	(0.67, 1.01)	0.82	(0.67, 1.01)
Others	0.67	(0.42, 1.07)	0.67	(0.42, 1.07)
Unknown	1.01	(0.75, 1.37)	1.01	(0.75, 1.37)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.68***	(1.26, 2.25)	1.68***	(1.26, 2.25)
1.3<=CDPS<=1.9	1.92***	(1.45, 2.55)	1.93***	(1.45, 2.56)
CDPS>1.9	2.22***	(1.62, 3.05)	2.22***	(1.62, 3.05)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.50***	(0.40, 0.62)	0.50***	(0.40, 0.62)
Dual-eligible	1.01	(0.87, 1.17)	1.01	(0.87, 1.17)
Continuous 12-month coverage	0.69**	(0.55, 0.87)	0.69**	(0.54, 0.87)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.89	(0.75, 1.06)	0.89	(0.75, 1.05)
85-90%	0.93	(0.77, 1.12)	0.93	(0.77, 1.12)
>90%	0.89	(0.69, 1.15)	0.89	(0.69, 1.15)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.01	(0.80, 1.26)	1.01	(0.80, 1.26)
$45,921-$56,813	0.88	(0.68, 1.13)	0.88	(0.68, 1.13)
>$56,813	1.00	(0.73, 1.35)	1.00	(0.73, 1.35)
No Previous Complications	1.12	(0.94, 1.32)	1.12	(0.94, 1.32)
Eye complications in 2004	1.11	(0.93, 1.33)	1.11	(0.93, 1.33)
Nephropathy in 2004	0.95	(0.79, 1.15)	0.95	(0.79, 1.15)
Neuropathy in 2004	1.17*	(1.04, 1.32)	1.17*	(1.04, 1.32)
Ischemic Heart Disease in 2004	1.61***	(1.43, 1.82)	1.61***	(1.43, 1.82)
Lower-limb amputations 2004	1.29*	(1.04, 1.60)	1.29*	(1.03, 1.60)
Cerebrovascular diseases 2004	N/A		N/A	
No. of outpatient visits 2004	1.01***	(1.01, 1.02)	1.01***	(1.01, 1.02)

* p<0.05 **p<0.01 ***p<0.001

Note: 3,151 individuals excluded from the analysis previously had cerebrovascular disease.

Table 5.9 Effect of Comprehensive Care on Diabetes-related Hospitalizations in 2005

N=31,350	Modeled with Comprehensive Care		Modeled without Comprehensive Care	
	OR	95%CI	OR	95%CI
Comprehensive Diabetes Care	0.71	(0.41, 1.24)	N/A	
Quality Measures met in 2004				
0 (ref.)	1		1	
1	2.05***	(1.41, 2.98)	2.05***	(1.41, 2.98)
2	2.19***	(1.54, 3.10)	2.19***	(1.54, 3.10)
3	2.11***	(1.54, 2.89)	2.10***	(1.54, 2.88)
4	1.86***	(1.34, 2.59)	1.85***	(1.33, 2.57)
Mental health disorders				
SUD without mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.53***	(0.40, 0.69)	0.53***	(0.41, 0.69)
Bipolar disorder	0.78	(0.57, 1.09)	0.79	(0.57, 1.09)
Depression/ anxiety	0.75	(0.56, 1.01)	0.75	(0.56, 1.01)
Other mental health disorders	0.73*	(0.53, 1.00)	0.73*	(0.53, 1.00)
Co-occurring alcohol abuse/ dependence	0.90	(0.72, 1.12)	0.90	(0.72, 1.12)
Co-occurring drug abuse/ dependence	1.53***	(1.27, 1.84)	1.53***	(1.27, 1.84)
Age Groups				
<55 (ref.)	1		1	
55-64	0.95	(0.81, 1.12)	0.95	(0.81, 1.12)
65-74	1.01	(0.89, 1.14)	1.01	(0.89, 1.14)
75 and older	1.04	(0.89, 1.22)	1.04	(0.89, 1.22)
Male Gender	1.20***	(1.10, 1.32)	1.20***	(1.09, 1.32)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.19	(0.97, 1.46)	1.19	(0.97, 1.47)
Hispanic	0.61***	(0.48, 0.77)	0.61***	(0.48, 0.76)
Others	0.93	(0.69, 1.26)	0.93	(0.69, 1.26)
Unknown	0.95	(0.69, 1.33)	0.95	(0.69, 1.33)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.22	(0.99, 1.50)	1.22	(0.99, 1.50)
1.3<=CDPS<=1.9	1.52**	(1.20, 1.92)	1.52***	(1.20, 1.92)
CDPS>1.9	1.69***	(1.36, 2.10)	1.70***	(1.37, 2.11)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.83	(0.67, 1.01)	0.83	(0.67, 1.01)
Dual-eligible	1.27***	(1.12, 1.45)	1.27***	(1.12, 1.45)
Continuous 12-month coverage	0.66***	(0.54, 0.81)	0.66***	(0.54, 0.81)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.01	(0.86, 1.19)	1.01	(0.86, 1.19)
85-90%	0.91	(0.77, 1.08)	0.91	(0.76, 1.08)
>90%	0.88	(0.74, 1.06)	0.88	(0.74, 1.06)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.98	(0.80, 1.19)	0.98	(0.80, 1.19)
$45,921-$56,813	1.01	(0.82, 1.25)	1.02	(0.82, 1.25)
>$56,813	1.06	(0.87, 1.29)	1.06	(0.87, 1.29)
No Previous Complications	0.67***	(0.56, 0.80)	0.67***	(0.56, 0.80)
Eye complications in 2004	1.29***	(1.13, 1.48)	1.29***	(1.13, 1.48)
Nephropathy in 2004	1.49***	(1.32, 1.69)	1.49***	(1.32, 1.69)
Neuropathy in 2004	1.37***	(1.20, 1.56)	1.37***	(1.20, 1.56)
Ischemic Heart Disease in 2004	2.09***	(1.83, 2.38)	2.09***	(1.83, 2.38)
Lower-limb amputations 2004	2.28***	(2.07, 2.50)	2.28***	(2.07, 2.50)
Cerebrovascular diseases 2004	1.50***	(1.28, 1.75)	1.50***	(1.29, 1.75)
No. of outpatient visits 2004	1.01***	(1.01, 1.02)	1.01***	(1.01, 1.02)

* p<0.05 **p<0.01 ***p<0.001

Discussion

The prevalence of people with comprehensive diabetes care, as defined by the study criteria, was low in this study population. The analysis showed that there was a general trend of lower odds for adverse diabetes outcomes in people with comprehensive diabetes care but the associations were not statistically significant.   Such findings were consistent with those in the study by Huang et al., in which patients treated at the diabetes center had lower, though not statistically significant, odds of hospitalizations than those of the general medical clinic (adjusted OR: 0.88, 95%CI: 0.52, 1.49).[21] Although in a previous study, Rubin and colleagues observed that people with comprehensive diabetes care had improved adherence to quality measures of diabetes care in a managed care population,[20] this was not part of the aim in the current study and thus no analysis was conducted to examine the association between comprehensive diabetes care and adherence to quality measures. Therefore, further investigations are necessary.

It is noticed that the adherence to quality measures in the previous year was not associated with better health outcomes. In fact, it was linked to increased odds for some diabetes complications. Since the measure, 'Quality measures met in 2004', was created to indicate the intensity of care, it is possible that individuals who were adherent had worse health and thus required higher levels of care. For example, this study reported that people with previous eye complications, neuropathy or nephropathy were more likely to adhere to quality measures (see Chapter III, section 'Results' on p.51).   Other studies have also observed that people with higher disease burden were more likely to have higher levels of care. [67,101]

Aside from comprehensive diabetes care, there are others factors influencing adverse diabetes outcomes. One such factor is diabetes self-care, which is essential in maintaining proper level of HbA1c.[102-104] However, the current study was not able to assess self-care due to the lack of data. Aside from patient self-care behaviors, physician attitudes may also affect how diabetes is managed in people with behavioral health disorders. In a study by Krebs et al., physicians were three times as likely to regard a patient visit as difficult if the patient had substance use disorders.[92] In another study, Jackson and colleagues observed that patients were more likely to have unmet expectations, such as having tests or diagnoses, after a difficult encounter with physicians.[93] Therefore, it is possible that early signs of diabetes complications may be overlooked by physicians during ambulatory visits with patients with SUD and diabetes if difficult physician-patient encounters occur on a regular basis for patients with SUD. Consequently, such patients may not receive the necessary interventions and may have needed to be hospitalized when complications worsened.

The current study had several limitations. First, comprehensive diabetes care was a proxy measure because it was not possible to identify the type of care facilities that provided comprehensive diabetes care, e.g., Joslin Diabetes Clinic, in the current data. Second, the study was unable to assess health data such as HbA1c and LDL-c levels, which had been shown associated with diabetes complications.[105,106] Third, information on self-care behavior, an important part of diabetes care, was not assessed as mentioned above. Last, the study period of one year might not be sufficient to assess diabetes complications, which usually take years to develop. Therefore, the non-significant results

might be due to lack of outcomes and further studies using multi-year longitudinal data

are necessary.

Chapter VI. Final Summary and Discussion

Summary of Evidence

This study examined the quality of diabetes care as well as diabetes-related outcomes among people with diabetes and co-occurring behavioral health disorders (BHDs) in a population with publicly sponsored health coverage. Results showed that individuals with schizophrenia/ paranoid states were more likely to attain adherence to all quality measures ($p<0.01$) and less likely to have adverse diabetes outcomes ($p<0.05$) while those with substance use disorders had poorer adherence to having LDL-c tests and eye examinations ($p<0.001$) and higher rates of diabetes-related hospitalizations ($p<0.001$), even after adjusting for demographics, comorbidities and healthcare utilization. There is some evidence that the mode of care delivery, as represented by the measure "Comprehensive Diabetes Care", might be associated with lower odds for adverse diabetes outcomes while adherence to quality measures was associated with increased odds of certain diabetes complications ($p<0.05$) (see Chapter V, p.86). The analysis of comprehensive diabetes care failed to completely explain the disparity in health outcomes, especially for individuals with SUD. It is possible that having comprehensive diabetes care alone may not be sufficient to improve health outcomes in diabetes. In addition, such observation indicates that unmeasured confounders exist. For example, this study was unable to assess self-care activities such as smoking and adherence to diabetes medications. Proper control of HbA1c through medications and smoking cessation are crucial in preventing diabetes-related complications. [55,105,107]

The analyses also showed that the addition of previous diabetes complications (Need factors) reduced the significance of association between mental health disorders and full adherence to quality measures while increasing the odds of diabetes-related hospitalizations for drug abuse/ dependence (see Appendix XII, p.148). It is possible that such a change in association was related to the lower prevalence of previous diabetes complications among people with mental and substance use disorders (see Tables 3.1 on p.52 and 3.2 on p.54). Because having previous complications increased the odds of adherence, lower odds of adherence among individuals with mental health disorders might have been confounded by lower rates of previous complications. However, previous complications could also indicate poorly managed diabetes and increase the odds for new complications (see Chapter IV, p.74). Therefore, the unadjusted, lower odds of diabetes-related hospitalizations in the drug abuse/ dependence group were possibly confounded by lower prevalence of previous complications.

Study Limitations

The limitations of this study were related to the use of administrative data. First, the exclusion of Medicare beneficiaries with other health coverage (except Medicaid) might underestimate the adherence to quality benchmarks among Medicare beneficiaries. The rates of adherence to quality measures might have been different if beneficiaries with Medicare Advantage plans were included. However, the data for service use under HMO plans were not available in this dataset. Therefore, generalizability of this study is limited to those with Medicare fee-for-service coverage alone. Further, the exclusion of individuals with less than 300 days of enrollment in Medicare Part B or Medicaid also

limited the study's generalizability. As observed in Table 6.1, all of the individual characteristics (except age) were significantly different between those enrolled for 300 days or more and those with less than 300-day enrollment. Individuals excluded from this study might have significantly adverse outcomes. Therefore, the observations from this study can only be applied to individuals with stable healthcare coverage.

Table 6.1 Comparison of Characteristics between Populations with different lengths of enrollment

	Length of Enrollment		Overall (n=135,770)
	<300 days (n=23,235)	≥300 days (n=112,535)	
Mean age (SD)[a,3]	67 (16)	67 (15)	67 (15)
Gender (%)[b,1]			
Female	12,447 (54)	64,481 (57)	76,928 (57)
Male	10,788 (46)	48,054 (43)	58,842 (43)
Race/ Ethnicity (%)[b,1]			
Non-Hispanic white	17,380 (75)	91,866 (82)	109,266 (80)
African American	2,072 (9)	8,430 (7)	10,502 (8)
Hispanic	1,274 (5)	4,708 (4)	5,982 (4)
Others	1,088 (5)	3,464 (3)	4,552 (3)
Unknown	1,421 (6)	4,047 (4)	5,468 (4)
Mean CDPS score (SD)[c,1]	2.5 (2.2)	1.6 (1.2)	1.8 (1.4)
Disabled (%)[b,1]	5,924 (26)	34,055 (30)	39,979 (29)
Health Coverage (%)[b,1]			
Medicare	8,565 (37)	61,573 (55)	70,138 (52)
Medicaid	4,428 (19)	23,445 (21)	27,873 (21)
Dual-eligible	10,242 (44)	27,517 (24)	37,759 (28)
Average #Office visits 2004 (SD)[c,1]	5.1 (6.5)	7.5 (7.0)	7.1 (7.0)
Average length of stay in nursing homes in days (SD)[c,1]	32.5 (83.8)	12.9 (61.6)	16.2 (66.4)
Mental health disorders [b,1]			
Schizophrenia/ paranoid states	698 (3)	4,684 (4)	5,382 (4)
Bipolar disorder	779 (3)	3,551 (3)	4,330 (3)
Depression/ anxiety	5,773 (25)	21,733 (19)	27,506 (20)
Other mental health disorders	1,162 (5)	3,452 (3)	4,614 (3)
No mental health disorders	14,823 (64)	79,115 (70)	93,938 (69)
Substance use disorders[b,1]	1,591 (7)	5,870 (5)	7,461 (6)
Any previous complications (%)[b,1]	13,206 (57)	59,717 (53)	72,923 (54)
Eye complications in 2004 (%)[b,1]	2,896 (12)	18,318 (16)	21,214 (16)
Neuropathy in 2004 (%)[b,2]	3,272 (14)	16,080 (14)	19,352 (14)
Nephropathy in 2004 (%)[b,1]	1,736 (7)	5,715 (5)	7,451 (5)
Lower-limb complications in 2004 (%)[b,1]	2,294 (10)	6,380 (6)	8.674 (6)
Ischemic Heart disease in 2004 (%)[b,1]	8,813 (38)	35,912 (32)	44,725 (33)
Cerebrovascular disease in 2004 (%)[b,1]	3,604 (16)	12,406 (11)	16,010 (12)
Zip code-based neighborhood socioeconomic status			
Average Median Household Income (SD)[a,1]	47,393 (17,098)	48,436 (17,525)	48,257 (17,457)
Average %High School Graduates (SD)[a,1]	81 (11)	82 (11)	81 (11)

[a] Student's t-test [b] χ^2 test [c] Kruskal-Wallis test

[1] $p<0.001$, [2] $p=0.4$, [3] $p=1.0$

Second, it was possible that those classified as 'no BHDs' might actually have BHDs because their BHDs were undiagnosed by clinicians,[108] recorded inaccurately in the database[109] or substituted by other medical diagnoses in coding.[110] Therefore, it was very likely that the study might underestimate the prevalence of BHDs. For example, Kessler and colleagues observed that patients who tended to consider their psychiatric symptoms as manifestations of somatic diseases were less likely to be diagnosed with mental health disorders in primary care settings.[108] If claims data were less sensitive in case detection, the associations between BHDs and outcomes would have been biased towards the null because the effect of having no BHDs, e.g., better adherence rates, would be reduced by those with BHDs. However, the study attempted to compensate for the low diagnostic sensitivity of ICD-9 codes by using any claims diagnoses in case detection, instead of using only primary diagnoses. For example, about 30% of the Medicaid population in this study is identified as having depression/anxiety, compared to 13% in Gilmer's study.[111] In addition, this study explored other case detection methods, such as Medicaid Rx models, whether they could improve sensitivity. The analyses showed that both methods, Medicaid Rx and ICD-9 codes, identified different cases (see Appendices III through XI, p.138-147). Further study using a gold standard is needed to determine the sensitivity and specificity of case detection methods.

Low specificity due to false positives was also possible, especially when pharmacy data are used in case detection.[69] However, the associations between BHDs and outcomes would be biased towards the null. This was because the effect of BHDs on the outcomes would have been diluted if some people without BHDs were grouped into

those with BHDs and their rates of adherence and complications were different from those of people with BHDs. Furthermore, other studies have suggested the accuracy of diagnoses in claims data is comparable to clinical assessments or medical chart review. In a study that examined the accuracy of diagnoses in Medicaid claims data, Lurie and colleagues used the same assessment method as in this study.[112] They observed that about 87% of patients with treatments for schizophrenia in claims data were classified as having schizophrenia by psychiatrists' assessments.[112] In addition, Walkup and colleagues compared psychiatric diagnoses (schizophrenia and affective disorders) identified in New York Medicaid claims data to those in medical records.[113] They found that 96% of psychiatric diagnoses from medical records were correctly identified with primary and secondary diagnoses in claims data.[113] Therefore, misclassification bias due to wrong diagnoses might be minimal.

Third, the use of the hierarchical system assumed that particular groups of mental health disorders, such as schizophrenia/paranoid, were more severe and hence had more influence on the quality of care. For example, people who were classified as having schizophrenia/paranoid disorders might also have other comorbid mental health disorders. If poor quality of diabetes care was actually associated with the higher burden of comorbidities in schizophrenia/paranoid, the use of hierarchical system would bias the relationship between schizophrenia/paranoid and quality of diabetes care towards association. However, the analysis adjusted for the burden of comorbidities using the Chronic Illness and Disability Payment System (CDPS). Therefore, the confounding effects by comorbidities were minimized.

Similarly, the combined grouping of depression and anxiety may have been problematic. The two diseases might have different influences on the quality of diabetes care and other diabetes outcomes. Thus combining them in analysis might bias the results towards the null. However, literature to date did not indicate significant differences between depression and anxiety on the quality of diabetes care (see Chapter II, section on 'Behavioral Health Disorders: the Rationale for BHD categorization' on p.26). Therefore, the categorization of BHDs was appropriate in addressing the study objectives.

Fourth, the study was unable to assess the quality of diabetes care among more specific BHD diagnoses, e.g., major depression versus dysthymia, due to the hierarchical system of classifying mental health disorders (see Chapter II, section on Behavioral Health Disorders on p.26 for rationale). An additional weakness of the study was the inability to address patient self-care. Since part of proper diabetes care relies on patients' own self-care activities, such as self-monitoring of blood glucose, the clinical outcomes of diabetes may also be influenced by self-management. However, self-care could not be assessed in this study because there was no information about self-care available in the database.

Fifth, the measures for neighborhood socioeconomic status might not be appropriate to address the effects of SES on the quality of diabetes care as evidenced in their lack of associations with the outcomes. In addition, the assessment of Hospital Service Areas (HSAs) might not fully account for provider differences in the patterns of health care. Heterogeneity of health care might persist among beneficiaries after

adjustment because HSAs did not represent individual providers and each provider might have different practice pattern. However, patients usually sought care from local physicians, who were in turn affiliated with the local hospitals.[84] HSAs are defined by the areas where the local residents receive most of their hospital care.[84] Service utilization represented by HSAs could potentially reflect similarity in physician care practices.

Several studies by John Wennberg and colleagues demonstrated that the patterns of inpatient and outpatient health care utilization varied greatly across HSAs but are generally more homogeneous within the area.[85] Such variations were associated with the quality of care from providers, independent of the rates of illnesses or a variety of other socioeconomic characteristics of the area.[86,87] For example, Medicare reimbursement for outpatient services per enrollee in 2005 ranged from $648 in North Adams, MA to $1614 in Melrose, MA, a difference of 149%.[88] In addition, Sirovich and colleagues observed that providers in Hospital Referral Regions (aggregates of HSAs) with higher Medicare expenditures were more likely to advocate medical interventions than those in regions with lower Medicare expenditures.[89] Therefore, in the absence of data on specific providers, HSAs might be a reasonable, partial substitute for provider-based variation in care as well as a practical solution to account for unmeasured correlation among patients within a catchment area of healthcare services.

Last, the study was limited by the short observation period of one year. More powerful statistical inference could be made to examine the incidence rates of complications and hospitalizations with longitudinal data because diabetes outcomes,

such as complications, are time-dependent. However, the objective of the study was to determine whether having BHDs and meeting quality benchmarks for diabetes care were associated with diabetes complications and hospitalizations. The study did not aim to assess any temporal relationships. Thus, the design was sufficient to address the specific aims.

Strengths of the Study

Despite the limitations, this study had several methodological strengths. The main strength of this study was the use of population-based data. Since Medicare and Medicaid data were used, the results might be applicable to other Medicare and Medicaid populations with demographic composition and public insurance programs similar to those in Massachusetts. The likelihood of selection bias was reduced since the entire populations of Medicare, Medicaid and Dual-eligibles with diabetes were included in the study. In addition, the size of study population, a total of 106,174 beneficiaries, provided sufficient confidence in detecting any significant relationships between the BHDs and diabetes outcomes.

In summary, this study investigated the adherence to quality benchmarks for diabetes care and diabetes complications among people with BHDs, compared to those without BHDs in the Medicare and Medicaid populations of Massachusetts. Such analysis had not been carried out in studies to date. Therefore, the results from this study will increase our understanding of diabetes care.

Conclusion

Despite study limitations, some conclusions can be made from the analyses with confidence. In this population with relatively stable health coverage, having the diagnoses of substance use disorders (SUD) adversely impacted the odds of having LDL-c tests, as well as eye examinations, while it increased the likelihoods of poor diabetes outcomes, such as lower-limb amputations and diabetes-related hospitalizations ($p<0.05$). However, individuals with schizophrenia/ paraoid states consistently had higher likelihoods of adherence to quality measures and lower odds of having nephropathy, neuropathy, ischemic heart disease, cerebrovascular disease and diabetes-related hospitalizations ($p<0.01$). While the observations of people with SUD in this study were consistent with previous studies[15,16,27,66], the results of individuals with schizophrenia/ paranoid states were unexpected and warranted further investigation.

It is unlikely that such results were caused by misidentification of BHDs because in most cases, the misclassification of BHDs or outcomes will bias the results towards the null and the analyses showed consistently significant associations between SUD and outcome measures, as well as those between schizophrenia/ paranoid states and outcomes. However, there are other possible reasons for these observations. For example, there has been growing awareness of managing diabetes in people with schizophrenia, as demonstrated by the clinical practice guidelines put forth by the American Psychiatric Association and the American Diabetes Association.[90] Thus, providers were more inclined to monitor diabetes in people with schizophrenia/ paranoid states. It is also possible that beneficiairies with Medicaid in Massachusetts had better access to physical or mental health care through case management for mental health

patients.[114] Consequently, the quality of diabetes care and health outcomes improved among people with schizophrenia/ paranoid states. In contrast, the reasons for poorer quality of diabetes care and health outcomes among individuals with SUD are different. First, people with SUD might be less adherent to treatment guidelines of diabetes, such as self-care activities.[115] Therefore, their diabetes was not properly managed and they developed complications as a result. Another possible explanation is that the presence of SUD among these people created difficulties in patient-provider communications[92] and thus the quality of care suffered.[93]

Implications for Future Studies

Future studies should further investigate the underlying factors between people with diabetes and co-occurring substance use disorders (SUD) or schizophrenia/ paranoid states and diabetes outcomes because factors such as self-care activities and treatments for SUD or schizophrenia/ paranoid states were not accounted for in this study. It is also essential for future studies to examine data from other states because observations made in this study may only reflect healthcare access and quality of care in Massachusetts. Therefore, the quality of diabetes care for people with SUD or schizophrenia/ paranoid states may be different in other states with fewer behavioral health services. The results from this study suggested that the mode of care delivery might improve diabetes outcomes; however, it did not completely mediate the relationship between substance use disorders and poor diabetes outcomes. Longitudinal studies should be conducted to examine how comprehensive diabetes care, delivered by specialty providers such as the Joslin Diabetes Clinic, improves diabetes outcomes. Future studies should also examine

how the treatments of behavioral health disorders (e.g., SUD and schizophrenia/ paranoid states), as well as the types of treatment (e.g., methadone for SUD and antipsychotics for schizophrenia), among people with diabetes and co-morbid BHDs affect the quality of diabetes care and diabetes outcomes. If study results show improvements in diabetes (quality of care and outcomes) following treatment of SUD, policies should be developed to encourage broader access to SUD treatment, such as opioid-substitution therapies for individuals with opioid addiction.

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicare Only

N=60,137	Full Adherence 2005		HbA1c test 2005		LDL-c test 2005	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.74*	(0.58, 0.96)	0.80	(0.63, 1.02)	0.79	(0.62, 1.00)
Bipolar disorder	0.81	(0.66, 1.01)	0.82	(0.67, 1.02)	0.83	(0.69, 1.00)
Depression/ anxiety	0.84***	(0.78, 0.90)	0.81***	(0.77, 0.85)	0.81***	(0.77, 0.86)
Other mental health disorders	0.82**	(0.72, 0.93)	0.98	(0.86, 1.13)	0.84*	(0.74, 0.96)
Any alcohol abuse/ dependence	0.63***	(0.50, 0.80)	0.69***	(0.58, 0.82)	0.59***	(0.50, 0.70)
Any drug abuse/ dependence	0.60**	(0.44, 0.81)	0.66**	(0.51, 0.84)	0.62***	(0.47, 0.81)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.52***	(1.27, 1.82)	1.69***	(1.36, 2.11)	1.84***	(1.51, 2.23)
65-74	2.06***	(1.76, 2.42)	1.99***	(1.65, 2.41)	2.48***	(2.08, 2.95)
75 and older	1.74***	(1.49, 2.04)	1.60***	(1.32, 1.94)	1.37***	(1.16, 1.62)
Male Gender	1.10***	(1.04, 1.15)	1.04	(0.99, 1.09)	1.05*	(1.00, 1.09)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	0.88*	(0.78, 0.99)	0.95	(0.86, 1.06)	0.73***	(0.62, 0.86)
Hispanic	0.75	(0.55, 1.03)	0.71	(0.46, 1.09)	0.67*	(0.45, 0.99)
Others	0.82*	(0.69, 0.98)	0.91	(0.73, 1.15)	1.07	(0.89, 1.28)
Unknown	1.16	(0.69, 1.96)	1.39	(0.67, 2.90)	0.79	(0.45, 1.40)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.31***	(1.25, 1.37)	0.97	(0.92, 1.03)	1.05	(0.99, 1.12)
1.3<=CDPS<=1.9	1.30***	(1.20, 1.41)	0.87**	(0.80, 0.95)	0.81***	(0.75, 0.88)
CDPS>1.9	1.21***	(1.12, 1.32)	0.66***	(0.59, 0.74)	0.56***	(0.50, 0.62)
Continuous 12-month coverage	2.86***	(2.19, 3.75)	1.87***	(1.48, 2.36)	3.55***	(2.91, 4.32)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.04	(0.95, 1.13)	1.02	(0.82, 1.28)	0.80	(0.63, 1.01)
85-90%	1.02	(0.86, 1.20)	1.02	(0.77, 1.36)	0.73*	(0.55, 0.96)
>90%	1.11	(0.92, 1.33)	1.00	(0.72, 1.40)	0.72*	(0.52, 0.99)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.94	(0.83, 1.06)	1.00	(0.81, 1.24)	1.36	(0.99, 1.88)
$45,921-$56,813	1.01	(0.87, 1.18)	1.00	(0.81, 1.23)	1.42*	(1.01, 2.00)
>$56,813	1.03	(0.85, 1.25)	0.93	(0.71, 1.23)	1.48	(1.00, 2.18)
No Previous Complications	0.96	(0.90, 1.03)	0.84***	(0.77, 0.92)	0.90**	(0.85, 0.96)
Eye complications in 2004	1.59***	(1.50, 1.69)	3.07***	(2.77, 3.41)	1.26***	(1.18, 1.36)
Nephropathy in 2004	1.36***	(1.24, 1.49)	2.06***	(1.78, 2.38)	0.93	(0.81, 1.07)
Neuropathy in 2004	1.33***	(1.24, 1.41)	2.35***	(2.13, 2.60)	1.17***	(1.09, 1.25)
Ischemic Heart Disease in 2004	0.99	(0.92, 1.06)	0.94	(0.86, 1.03)	1.32***	(1.23, 0.42)
Lower-limb amputations 2004	0.82***	(0.75, 0.89)	1.10	(0.97, 1.25)	0.72***	(0.66, 0.78)
Cerebrovascular diseases 2004	0.94*	(0.88, 1.00)	0.91**	(0.85, 0.97)	1.04	(0.98, 1.11)
No. of outpatient visits 2004	1.05***	(1.04, 1.05)	1.03***	(1.03, 1.04)	1.04***	(1.03, 1.05)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicare Only

N=	Nephropathy test 2005		Eye examination 2005	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.26*	(1.05, 1.51)	0.64***	(0.51, 0.80)
Bipolar disorder	1.15	(0.98, 1.35)	0.70**	(0.56, 0.88)
Depression/ anxiety	1.03	(0.97, 1.09)	0.80***	(0.76, 0.85)
Other mental health disorders	0.97	(0.88, 1.07)	0.83**	(0.73, 0.95)
Any alcohol abuse/ dependence	0.80**	(0.70, 0.91)	0.68***	(0.57, 0.81)
Any drug abuse/ dependence	0.93	(0.72, 1.20)	0.70**	(0.54, 0.91)
Age Groups				
<55 (ref.)	1		1	
55-64	1.31**	(1.12, 1.52)	1.65***	(1.39, 1.96)
65-74	1.51***	(1.31, 1.73)	2.74***	(2.34, 3.21)
75 and older	1.46***	(1.27, 1.68)	2.84***	(2.44, 3.30)
Male Gender	1.16***	(1.09, 1.24)	0.83***	(0.81, 0.86)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.98	(0.92, 1.04)	0.95	(0.86, 1.05)
Hispanic	0.86	(0.65, 1.14)	0.80	(0.57, 1.13)
Others	0.81**	(0.70, 0.95)	0.78**	(0.66, 0.93)
Unknown	1.45	(0.85, 2.50)	1.10	(0.66, 1.85)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.26***	(1.20, 1.33)	1.24***	(1.17, 1.31)
1.3<=CDPS<=1.9	1.41***	(1.31, 1.52)	1.28***	(1.19, 1.39)
CDPS>1.9	1.72***	(1.59, 1.86)	1.04	(0.97, 1.12)
Continuous 12-month coverage	0.92	(0.79, 1.07)	2.72***	(2.32, 3.18)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.02	(0.88, 1.18)	1.13**	(1.04, 1.23)
85-90%	0.95	(0.79, 1.14)	1.20***	(1.09, 1.32)
>90%	1.04	(0.86, 1.26)	1.33***	(1.18, 1.49)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.92	(0.79, 1.07)	0.95	(0.86, 1.04)
$45,921-$56,813	0.98	(0.83, 1.15)	0.95	(0.86, 1.04)
>$56,813	1.05	(0.87, 1.25)	0.91	(0.82, 1.02)
No Previous Complications	1.03	(0.97, 1.10)	1.01	(0.95, 1.08)
Eye complications in 2004	1.01	(0.96, 1.07)	2.72***	(2.52, 2.94)
Nephropathy in 2004	1.60***	(1.40, 1.83)	1.20***	(1.09, 1.32)
Neuropathy in 2004	1.04	(0.99, 1.11)	1.31***	(1.23, 1.40)
Ischemic Heart Disease in 2004	0.98	(0.92, 1.04)	0.90***	(0.84, 0.95)
Lower-limb amputations 2004	0.84***	(0.77, 0.92)	0.75***	(0.66, 0.84)
Cerebrovascular diseases 2004	0.96	(0.90, 1.02)	0.92**	(0.87, 0.97)
No. of outpatient visits 2004	1.04***	(1.04, 1.05)	1.05***	(1.04, 1.06)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicare Only

	Any complications 2005 N=60,137		Eye Complications 2005 N=49,674		Nephropathy 2005 N=57,095	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.78*	(0.61, 0.98)	0.70*	(0.49, 0.99)	0.29**	(0.14, 0.63)
Bipolar disorder	0.66***	(0.54, 0.81)	0.90	(0.69, 1.19)	0.53	(0.23, 1.19)
Depression/ anxiety	0.89***	(0.83, 0.95)	0.91	(0.82, 1.01)	0.80**	(0.70, 0.91)
Other mental health disorders	0.88	(0.74, 1.03)	0.84	(0.65, 1.07)	0.79	(0.60, 1.04)
Any alcohol abuse/ dependence	0.87	(0.70, 1.08)	0.73	(0.53, 1.02)	0.54**	(0.37, 0.79)
Any drug abuse/ dependence	0.57***	(0.42, 0.78)	0.77	(0.51, 1.17)	0.54	(0.27, 1.06)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.53***	(1.27, 1.84)	1.63**	(1.16, 2.30)	0.71	(0.45, 1.13)
65-74	1.55***	(1.28, 1.89)	1.39	(0.98, 1.96)	0.60*	(0.39, 0.90)
75 and older	1.75***	(1.46, 2.09)	1.12	(0.78, 1.60)	0.51**	(0.34, 0.75)
Male Gender	1.38***	(1.32, 1.44)	0.93	(0.86, 1.01)	1.39***	(1.25, 1.54)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.03	(0.92, 1.16)	1.49***	(1.27, 1.76)	1.70***	(1.31, 2.21)
Hispanic	0.98	(0.62, 1.54)	1.55	(0.67, 3.60)	0.79	(0.30, 2.08)
Others	0.78*	(0.64, 0.95)	1.19	(0.87, 1.63)	1.63*	(1.06, 2.51)
Unknown	1.02	(0.53, 1.97)	1.01	(0.35, 2.86)	2.19	(0.83, 5.79)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.22***	(1.15, 1.29)	0.98	(0.88, 1.09)	1.68***	(1.32, 2.14)
1.3<=CDPS<=1.9	1.34***	(1.26, 1.43)	1.06	(0.94, 1.19)	2.39***	(1.91, 3.01)
CDPS>1.9	1.43***	(1.33, 1.53)	1.08	(0.94, 1.24)	5.06***	(4.03, 6.36)
Continuous 12-month coverage	0.38***	(0.31, 0.48)	1.67**	(1.16, 2.39)	0.59**	(0.41, 0.84)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.03	(0.94, 1.12)	0.90	(0.72, 1.11)	1.29*	(1.04, 1.60)
85-90%	1.03	(0.91, 1.17)	0.86	(0.70, 1.05)	1.23	(0.98, 1.56)
>90%	1.03	(0.90, 1.18)	0.77*	(0.61, 0.98)	1.32	(0.97, 1.80)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	1.00	(0.91, 1.09)	1.04	(0.87, 1.24)	0.89	(0.72, 1.09)
$45,921-$56,813	1.00	(0.89, 1.12)	1.01	(0.81, 1.27)	0.88	(0.69, 1.14)
>$56,813	1.01	(0.87, 1.16)	1.17	(0.90, 1.52)	0.86	(0.63, 1.16)
No Previous Complications	0.45***	(0.41, 0.51)	0.98	(0.86, 1.11)	0.87	(0.72, 1.04)
Eye complications in 2004	3.29***	(2.98, 3.63)	N/A		2.05***	(1.81, 2.31)
Nephropathy in 2004	2.58***	(2.21, 3.00)	2.02***	(1.75, 2.32)	N/A	
Neuropathy in 2004	3.62***	(3.23, 4.05)	1.89***	(1.70, 2.09)	1.69***	(1.49, 1.92)
Ischemic Heart Disease in 2004	4.68***	(4.22, 5.19)	1.19**	(1.08, 1.31)	1.12	(0.99, 1.27)
Lower-limb amputations 2004	1.06	(0.90, 1.24)	1.39***	(1.24, 1.57)	1.48***	(1.23, 1.77)
Cerebrovascular diseases 2004	1.87***	(1.69, 2.08)	1.12	(1.00, 1.25)	0.88	(0.78, 1.00)
No. of outpatient visits 2004	1.03***	(1.02, 1.03)	1.00	(1.00, 1.01)	1.00	(0.99, 1.01)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicare Only

	Diabetic Neuropathy 2005 N=50,594		Lower-limb Amputations 2005 N=57,092		Ischemic Heart Disease 2005 N=36,332	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.94	(0.65, 1.35)	0.84	(0.46, 1.56)	1.28	(0.83, 1.99)
Bipolar disorder	1.22	(0.89, 1.67)	0.87	(0.59, 1.29)	0.66*	(0.48, 0.91)
Depression/ anxiety	0.97	(0.88, 1.07)	0.94	(0.80, 1.09)	0.96	(0.87, 1.05)
Other mental health disorders	1.09	(0.91, 1.29)	0.93	(0.74, 1.17)	0.95	(0.78, 1.15)
Any alcohol abuse/ dependence	0.75	(0.53, 1.07)	1.37	(0.95, 1.97)	0.75*	(0.59, 0.95)
Any drug abuse/ dependence	0.69	(0.42, 1.13)	1.02	(0.57, 1.84)	0.63*	(0.43, 0.94)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.05	(0.76, 1.44)	0.83	(0.56, 1.23)	2.03***	(1.48, 2.78)
65-74	0.85	(0.67, 1.08)	0.64**	(0.45, 0.89)	2.40***	(1.80, 3.20)
75 and older	0.84	(0.65, 1.09)	0.84	(0.60, 1.17)	3.09***	(2.34, 4.08)
Male Gender	1.08	(1.00, 1.16)	1.11**	(1.03, 1.20)	1.48***	(1.40, 1.58)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.28	(1.03, 1.60)	1.12	(0.83, 1.51)	0.83	(0.66, 1.04)
Hispanic	1.36	(0.68, 2.72)	0.90	(0.44, 1.83)	0.40*	(0.18, 0.88)
Others	0.53**	(0.36, 0.78)	1.22	(0.82, 1.83)	0.94	(0.73, 1.19)
Unknown	0.61	(0.20, 1.84)	1.62	(0.56, 4.64)	1.25	(0.58, 2.67)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.36***	(1.20, 1.54)	1.17	(0.99, 1.39)	1.24***	(1.15, 1.34)
1.3<=CDPS<=1.9	1.74***	(1.48, 2.06)	1.66***	(1.35, 2.04)	1.52***	(1.40, 1.66)
CDPS>1.9	1.97***	(1.67, 2.33)	2.52***	(2.03, 3.12)	1.89***	(1.71, 2.09)
Continuous 12-month coverage	0.91	(0.67, 1.24)	0.38***	(0.29, 0.49)	0.27***	(0.22, 0.35)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.19	(0.96, 1.47)	0.96	(0.78, 1.19)	1.02	(0.89, 1.17)
85-90%	1.45*	(1.09, 1.93)	0.87	(0.67, 1.15)	0.92	(0.78, 1.07)
>90%	1.53**	(1.14, 2.04)	0.88	(0.65, 1.19)	0.93	(0.78, 1.11)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.81*	(0.67, 0.99)	0.94	(0.75, 1.19)	1.03	(0.91, 1.16)
$45,921-$56,813	0.77**	(0.64, 0.93)	0.96	(0.75, 1.24)	1.11	(0.97, 1.27)
>$56,813	0.69***	(0.56, 0.86)	0.93	(0.71, 1.22)	1.17	(0.99, 1.38)
No Previous Complications	0.88*	(0.79, 0.99)	0.85*	(0.72, 0.99)	1.02	(0.89, 1.18)
Eye complications in 2004	1.97***	(1.77, 2.21)	1.77***	(1.57, 1.99)	1.17**	(1.05, 1.30)
Nephropathy in 2004	1.82***	(1.58, 2.11)	1.41***	(1.19, 1.69)	1.23*	(1.03, 1.45)
Neuropathy in 2004	N/A		1.69***	(1.49, 1.93)	1.07	(0.98, 1.18)
Ischemic Heart Disease in 2004	0.99	(0.88, 1.12)	1.14**	(1.04, 1.25)	N/A	
Lower-limb amputations 2004	1.53***	(1.29, 1.80)	N/A		1.05	(0.90, 1.23)
Cerebrovascular diseases 2004	0.93	(0.84, 1.03)	1.06	(0.94, 1.19)	1.34***	(1.17, 1.53)
No. of outpatient visits 2004	1.02***	(1.02, 1.02)	1.00	(1.00, 1.01)	1.02***	(1.02, 1.03)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicare Only

	Cerebrovascular Disease 2005 N=51,972		Diabetes-related Hospitalizations 2005 N=60,137	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.04	(0.72, 1.48)	0.91	(0.59, 1.40)
Bipolar disorder	0.98	(0.68, 1.41)	1.23	(0.92, 1.64)
Depression/ anxiety	1.10	(0.99, 1.23)	1.04	(0.95, 1.14)
Other mental health disorders	1.16	(0.90, 1.49)	1.06	(0.89, 1.28)
Any alcohol abuse/ dependence	1.13	(0.86, 1.48)	0.91	(0.69, 1.19)
Any drug abuse/ dependence	0.89	(0.58, 1.35)	1.17	(0.82, 1.67)
Age Groups				
<55 (ref.)	1		1	
55-64	1.57*	(1.10, 2.23)	1.08	(0.72, 1.62)
65-74	2.02***	(1.45, 2.82)	1.09	(0.75, 1.58)
75 and older	2.62***	(1.89, 3.63)	1.22	(0.85, 1.76)
Male Gender	1.09*	(1.02, 1.16)	1.14***	(1.07, 1.22)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.83**	(0.74, 0.94)	0.86	(0.73, 1.00)
Hispanic	1.38	(0.79, 2.40)	1.52	(0.96, 2.40)
Others	0.93	(0.62, 1.38)	0.95	(0.67, 1.35)
Unknown	1.64	(0.82, 3.30)	1.60	(0.62, 4.12)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.30***	(1.18, 1.44)	1.07	(0.95, 1.21)
1.3<=CDPS<=1.9	1.45***	(1.27, 1.65)	1.25**	(1.09, 1.43)
CDPS>1.9	1.62***	(1.38, 1.89)	1.50***	(1.31, 1.71)
Continuous 12-month coverage	0.41***	(0.33, 0.51)	0.26***	(0.21, 0.33)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.06	(0.92, 1.23)	1.03	(0.86, 1.22)
85-90%	1.14	(0.99, 1.30)	0.96	(0.78, 1.20)
>90%	1.14	(1.00, 1.30)	0.93	(0.75, 1.16)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.85*	(0.74, 0.99)	0.92	(0.79, 1.08)
$45,921-$56,813	0.82*	(0.70, 0.97)	0.98	(0.82, 1.17)
>$56,813	0.84*	(0.72, 0.99)	1.02	(0.83, 1.24)
No Previous Complications	1.05	(0.92, 1.20)	0.78**	(0.66, 0.93)
Eye complications in 2004	1.09	(0.99, 1.18)	1.25***	(1.13, 1.38)
Nephropathy in 2004	1.29***	(1.13, 1.48)	1.33***	(1.17, 1.53)
Neuropathy in 2004	1.14**	(1.05, 1.25)	1.22***	(1.10, 1.35)
Ischemic Heart Disease in 2004	1.63***	(1.46, 1.82)	1.89***	(1.72, 2.08)
Lower-limb amputations 2004	1.10	(0.97, 1.26)	1.69***	(1.48, 1.94)
Cerebrovascular diseases 2004	N/A		1.54***	(1.41, 1.69)
No. of outpatient visits 2004	1.01***	(1.01, 1.02)	1.00	(1.00, 1.01)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicare Only

	Any Complications in 2005 N=60,137		Eye Complications in 2005 N=49,674		Nephropathy in 2005 N=57,095	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.79	(0.63, 1.01)	0.71	(0.49, 1.02)	0.30**	(0.14, 0.64)
Bipolar disorder	0.67***	(0.54, 0.81)	0.91	(0.69, 1.20)	0.53	(0.23, 1.20)
Depression/ anxiety	0.90**	(1.86, 0.95)	0.92	(0.83, 1.02)	0.81**	(0.70, 0.92)
Other mental health disorders	0.88	(0.75, 1.04)	0.84	(0.66, 1.07)	0.79	(0.60, 1.04)
Any alcohol abuse/ dependence	0.91	(0.73, 1.12)	0.76	(0.54, 1.05)	0.56**	(0.38, 0.82)
Any drug abuse/ dependence	0.58**	(0.43, 0.80)	0.78	(0.52, 1.18)	0.55	(0.28, 1.10)
Comprehensive Diabetes Care	0.86	(0.74, 1.00)	1.03	(0.85, 1.25)	1.23	(0.90, 1.68)
Quality Measures met in 2004						
0 (ref.)	1		1		1	
1	1.32**	(1.09, 1.59)	1.13	(0.83, 1.54)	1.06	(0.72, 1.56)
2	1.76***	(1.49, 2.09)	1.57**	(1.22, 2.04)	1.29	(0.85, 1.95)
3	1.88***	(1.60, 2.20)	1.56**	(1.20, 2.01)	1.55*	(1.05, 2.28)
4	1.89***	(1.61, 2.21)	1.65***	(1.28, 2.14)	1.50	(1.00, 2.27)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.48***	(1.23, 1.79)	1.59**	(1.13, 2.24)	0.69	(0.43, 1.09)
65-74	1.46***	(1.20, 1.77)	1.32	(0.93, 1.85)	1.56**	(0.38, 0.85)
75 and older	1.66***	(1.39, 1.98)	1.07	(0.75, 1.53)	0.48***	(0.33, 0.72)
Male Gender	1.39***	(1.33, 1.45)	0.93	(0.87, 1.01)	1.39***	(1.25, 1.54)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.05	(0.94, 1.17)	1.51***	(1.28, 1.78)	1.72***	(1.32, 2.24)
Hispanic	1.00	(0.64, 1.56)	1.58	(0.68, 3.64)	0.80	(0.30, 2.11)
Others	0.79*	(0.65, 0.95)	1.19	(0.87, 1.63)	1.63*	(1.05, 2.53)
Unknown	1.02	(0.53, 1.97)	0.99	(0.35, 2.82)	2.17	(0.81, 5.80)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.21***	(1.14, 1.28)	0.97	(0.87, 1.08)	1.65***	(1.29, 2.12)
1.3<=CDPS<=1.9	1.34***	(1.26, 1.42)	1.05	(0.93, 1.18)	2.36***	(1.88, 2.97)
CDPS>1.9	1.44***	(1.34, 1.55)	1.08	(0.94, 1.24)	5.07***	(4.03, 6.37)
Continuous 12-month coverage	0.37***	(0.30, 0.47)	1.63**	(1.13, 2.34)	0.57**	(0.39, 0.82)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.03	(0.93, 1.12)	0.90	(0.72, 1.12)	1.30*	(1.05, 1.60)
85-90%	1.03	(0.92, 1.17)	0.86	(0.70, 1.05)	1.24	(0.98, 1.56)
>90%	1.03	(0.90, 1.18)	0.77*	(0.60, 0.98)	1.32	(0.97, 1.79)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.99	(0.90, 1.08)	1.03	(0.87, 1.23)	0.88	(0.72, 1.08)
$45,921-$56,813	0.99	(0.88, 1.11)	1.00	(0.80, 1.26)	0.88	(0.68, 1.13)
>$56,813	1.00	(0.87, 1.15)	1.17	(0.90, 1.51)	0.85	(0.63, 1.15)
No Previous Complications	0.45***	(0.40, 0.50)	0.98	(0.86, 1.11)	0.87	(0.73, 1.04)
Eye complications in 2004	3.15***	(2.85, 3.49)	N/A		1.96***	(1.48, 1.90)
Nephropathy in 2004	2.52***	(2.16, 2.93)	1.98***	(1.72, 2.28)	N/A	
Neuropathy in 2004	3.58***	(3.20, 4.01)	1.87***	(1.68, 2.08)	1.68***	(0.99, 1.27)
Ischemic Heart Disease in 2004	4.70***	(4.23, 5.21)	1.19**	(1.08, 1.31)	1.12	(1.25, 1.80)
Lower-limb amputations 2004	1.08	(0.93, 1.27)	1.42***	(1.26, 1.60)	1.50***	(0.78, 1.00)
Cerebrovascular diseases 2004	1.87***	(1.69, 2.08)	1.12	(1.00, 1.25)	0.88*	(0.39, 0.82)
No. of outpatient visits 2004	1.02***	(1.02, 1.03)	1.00	(1.00, 1.01)	1.00	(0.99, 1.01)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicare Only

	Diabetic Neuropathy in 2005 N=50,594		Lower-limb Amputations in 2005 N=57,092		Ischemic Heart Disease in 2005 N=36,332	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.96	(0.67, 1.39)	0.83	(0.45, 1.54)	1.27	(0.82, 1.97)
Bipolar disorder	1.22	(0.89, 1.68)	0.88	(0.60, 1.28)	0.66*	(0.48, 0.91)
Depression/ anxiety	0.98	(0.88, 1.08)	0.93	(0.80, 1.09)	0.95	(0.87, 1.05)
Other mental health disorders	1.09	(0.92, 1.29)	0.93	(0.73, 1.17)	0.95	(0.78, 1.15)
Any alcohol abuse/ dependence	0.78	(0.55, 1.12)	1.35	(0.94, 1.95)	0.74*	(0.58, 0.95)
Any drug abuse/ dependence	0.71	(0.43, 1.16)	1.01	(0.56, 1.80)	0.63*	(0.43, 0.93)
Comprehensive Diabetes Care	0.79	(0.61, 1.03)	0.72	(0.46, 1.13)	0.85	(0.66, 1.07)
Quality Measures met in 2004						
0 (ref.)	1		1		1	
1	1.17	(0.84, 1.62)	1.42	(0.94, 2.15)	0.92	(0.70, 1.23)
2	1.49*	(1.09, 2.04)	1.32	(0.87, 2.02)	0.98	(0.74, 1.28)
3	1.66**	(1.24, 2.24)	1.26	(0.86, 1.86)	0.95	(0.74, 1.21)
4	1.71***	(1.27, 2.31)	1.14	(0.76, 1.72)	0.93	(0.70, 1.23)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.02	(0.74, 1.40)	0.83	(0.56, 1.24)	2.03***	(1.48, 2.79)
65-74	0.80	(0.63, 1.02)	0.65*	(0.46, 0.90)	2.42***	(1.81, 3.23)
75 and older	0.80	(0.62, 1.04)	0.85	(0.61, 1.17)	3.11***	(2.36, 4.12)
Male Gender	1.08*	(1.00, 1.16)	1.11**	(1.03, 1.20)	1.49***	(1.40, 1.58)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.30*	(1.04, 1.62)	1.12	(0.82, 1.51)	0.83	(0.66, 1.04)
Hispanic	1.39	(0.70, 2.77)	0.88	(0.44, 1.79)	0.40*	(0.18, 0.88)
Others	0.53**	(0.36, 0.78)	1.23	(0.82, 1.83)	0.93	(0.73, 1.19)
Unknown	0.60	(0.20, 1.80)	1.64	(0.57, 4.74)	1.27	(0.59, 2.72)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.34***	(1.17, 1.52)	1.18	(0.99, 1.41)	1.25***	(1.16, 1.35)
1.3<=CDPS<=1.9	1.71***	(1.45, 2.03)	1.68***	(1.37, 2.07)	1.53***	(1.40, 1.67)
CDPS>1.9	1.96***	(1.65, 2.33)	2.54***	(2.05, 3.14)	1.90***	(1.71, 2.10)
Continuous 12-month coverage	0.89	(0.65, 1.21)	0.39***	(0.30, 0.51)	0.27***	(0.22, 0.35)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.19	(0.96, 1.47)	0.97	(0.78, 1.20)	1.02	(0.89, 1.17)
85-90%	1.45*	(1.08, 1.92)	0.88	(0.67, 1.15)	0.92	(0.79, 1.07)
>90%	1.52**	(1.14, 2.03)	0.88	(0.65, 1.19)	0.93	(0.78, 1.11)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.81*	(0.67, 0.98)	0.94	(0.74, 1.19)	1.03	(0.91, 1.16)
$45,921-$56,813	0.77**	(0.63, 0.93)	0.97	(0.75, 1.25)	1.11	(0.97, 1.27)
>$56,813	0.69**	(0.56, 0.86)	0.93	(0.71, 1.22)	1.17	(1.00, 1.38)
No Previous Complications	0.88*	(0.79, 0.99)	0.84*	(0.72, 0.99)	1.02	(0.89, 1.18)
Eye complications in 2004	1.89***	(1.69, 2.11)	1.81***	(1.60, 2.04)	1.18**	(1.06, 1.31)
Nephropathy in 2004	1.80***	(1.55, 2.08)	1.42***	(1.19, 1.70)	1.23*	(1.03, 1.46)
Neuropathy in 2004	N/A		1.70***	(1.50, 1.94)	1.07	(0.98, 1.18)
Ischemic Heart Disease in 2004	0.99	(0.88, 1.11)	1.14**	(1.04, 1.25)	N/A	
Lower-limb amputations 2004	1.54***	(1.30, 1.82)	N/A		1.05	(0.90, 1.23)
Cerebrovascular diseases 2004	0.93	(0.84, 1.03)	1.06	(0.94, 1.19)	1.34***	(1.17, 1.53)
No. of outpatient visits 2004	1.02***	(1.01, 1.02)	1.00	(1.00, 1.01)	1.02***	(1.02, 1.03)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicare Only

	Cerebrovascular Disease in 2005 N=51,972		Diabetes-related Hospitalizations in 2005 N=60,137	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.03	(0.71, 1.48)	0.90	(0.59, 1.38)
Bipolar disorder	0.98	(0.68, 1.40)	1.22	(0.91, 1.64)
Depression/ anxiety	1.10	(0.99, 1.23)	1.04	(0.94, 1.14)
Other mental health disorders	1.16	(0.90, 1.49)	1.06	(0.88, 1.27)
Any alcohol abuse/ dependence	1.12	(0.85, 1.47)	0.89	(0.68, 1.17)
Any drug abuse/ dependence	0.89	(0.59, 1.35)	1.16	(0.82, 1.65)
Comprehensive Diabetes Care	1.14	(0.95, 1.35)	0.79	(0.57, 1.10)
Quality Measures met in 2004				
0 (ref.)	1		1	
1	0.68**	(0.52, 0.90)	1.09	(0.82, 1.45)
2	0.78	(0.61, 1.00)	1.01	(0.78, 1.31)
3	0.74*	(0.57, 0.95)	0.96	(0.75, 1.21)
4	0.73**	(0.57, 0.92)	0.93	(0.73, 1.18)
Age Groups				
<55 (ref.)	1		1	
55-64	1.58*	(1.12, 2.25)	1.09	(0.73, 1.64)
65-74	2.08***	(1.50, 2.88)	1.11	(0.76, 1.61)
75 and older	2.68***	(1.94, 3.71)	1.24	(0.86, 1.79)
Male Gender	1.09*	(1.02, 1.16)	1.14***	(1.07, 1.22)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.83**	(0.74, 0.94)	0.86	(0.73, 1.00)
Hispanic	1.39	(0.79, 2.43)	1.50	(0.95, 2.39)
Others	0.93	(0.62, 1.38)	0.95	(0.67, 1.35)
Unknown	1.65	(0.82, 3.30)	1.62	(0.63, 4.19)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.31***	(1.18, 1.46)	1.08	(0.95, 1.22)
1.3<=CDPS<=1.9	1.46***	(1.28, 1.66)	1.26**	(1.10, 1.44)
CDPS>1.9	1.63***	(1.39, 1.90)	1.50***	(1.31, 1.72)
Continuous 12-month coverage	0.41***	(0.33, 0.52)	0.38***	(0.21, 0.34)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.06	(0.91, 1.23)	1.03	(0.86, 1.22)
85-90%	1.14	(0.99, 1.30)	0.96	(0.78, 1.20)
>90%	1.14	(1.00, 1.30)	0.93	(0.75, 1.16)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.85*	(0.74, 0.99)	0.92	(0.79, 1.08)
$45,921-$56,813	0.82*	(0.70, 0.97)	0.98	(0.82, 1.17)
>$56,813	0.84*	(0.72, 0.99)	1.02	(0.83, 1.25)
No Previous Complications	1.05	(0.92, 1.20)	0.78**	(0.66, 0.93)
Eye complications in 2004	1.10*	(1.00, 1.20)	1.27***	(1.14, 1.41)
Nephropathy in 2004	1.30***	(1.13, 1.49)	1.34***	(1.17, 1.53)
Neuropathy in 2004	1.15**	(1.05, 1.25)	1.22***	(1.10, 1.36)
Ischemic Heart Disease in 2004	1.63***	(1.46, 1.82)	1.89***	(1.71, 2.07)
Lower-limb amputations 2004	1.10	(0.97, 1.25)	1.69***	(1.48, 1.93)
Cerebrovascular diseases 2004	N/A		1.54***	(1.40, 1.69)
No. of outpatient visits 2004	1.01***	(1.01, 1.02)	1.01*	(1.00, 1.01)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicaid Only

N=22,302	Full Adherence 2005		HbA1c test 2005		LDL-c test 2005	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	1.83***	(1.47, 2.28)	1.85***	(1.61, 2.12)	2.00***	(1.76, 2.27)
Bipolar disorder	1.21*	(1.03, 1.42)	1.02	(0.86, 1.20)	1.26**	(1.07, 1.47)
Depression/ anxiety	1.15*	(1.02, 1.29)	0.95	(0.82, 1.10)	1.04	(0.90, 1.21)
Other mental health disorders	1.00	(0.73, 1.37)	0.89	(0.75, 1.04)	0.99	(0.82, 1.19)
Any alcohol abuse/ dependence	0.94	(0.78, 1.14)	1.11	(0.99, 1.25)	1.02	(0.91, 1.13)
Any drug abuse/ dependence	0.61***	(0.49, 0.75)	0.92	(0.77, 1.11)	0.79***	(0.69, 0.89)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.58***	(1.45, 1.74)	1.76***	(1.66, 1.87)	1.72***	(1.59, 1.86)
65-74	2.15***	(1.83, 2.54)	2.75***	(2.22, 3.40)	2.74***	(2.29, 3.27)
75 and older	1.85***	(1.34, 2.53)	2.26***	(1.82, 2.80)	2.05***	(1.72, 2.44)
Male Gender	0.77**	(0.64, 0.93)	1.14**	(1.04, 1.24)	1.15***	(1.07, 1.25)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	0.82**	(0.70, 0.95)	1.00	(0.91, 1.10)	0.86**	(0.76, 0.96)
Hispanic	0.92	(0.75, 1.13)	0.72***	(0.65, 0.80)	0.69***	(0.57, 0.84)
Others	1.01	(0.72, 1.42)	1.19*	(1.02, 1.39)	1.29**	(1.10, 1.51)
Unknown	0.86	(0.74, 1.00)	0.87**	(0.79, 0.96)	0.86**	(0.76, 0.96)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	0.98	(0.87, 1.11)	0.65***	(0.61, 0.70)	0.71***	(0.66, 0.77)
1.3<=CDPS<=1.9	0.79***	(0.70, 0.89)	0.48***	(0.43, 0.53)	0.52***	(0.47, 0.58)
CDPS>1.9	0.62***	(0.56, 0.70)	0.33***	(0.29, 0.36)	0.35***	(0.31, 0.39)
Continuous 12-month coverage	1.20*	(1.04, 1.38)	1.07	(0.98, 1.17)	1.15**	(1.05, 1.25)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	0.90	(0.79, 1.03)	0.83	(0.69, 1.01)	0.84	(0.69, 1.03)
85-90%	0.88	(0.72, 1.06)	0.92	(0.74, 1.14)	0.92	(0.75, 1.13)
>90%	0.77	(0.58, 1.04)	0.82	(0.64, 1.06)	0.92	(0.73, 1.17)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	1.07	(0.95, 1.20)	1.23	(0.95, 1.59)	1.21	(0.94, 1.57)
$45,921-$56,813	1.22*	(1.01, 1.47)	1.38*	(1.04, 1.83)	1.28	(0.95, 1.73)
>$56,813	1.20	(0.91, 1.59)	1.42*	(1.02, 1.99)	1.37	(0.97, 1.93)
No Previous Complications	0.97	(0.84, 1.12)	0.81**	(0.70, 0.92)	0.78***	(0.71, 0.86)
Eye complications in 2004	1.80***	(1.55, 2.09)	1.15	(0.99, 1.32)	0.97	(0.84, 1.12)
Nephropathy in 2004	1.19	(0.87, 1.64)	0.98	(0.80, 1.19)	0.79	(0.60, 1.05)
Neuropathy in 2004	1.09	(0.91, 1.30)	1.06	(0.93, 1.22)	0.80**	(0.71, 0.91)
Ischemic Heart Disease in 2004	1.03	(0.89, 1.19)	0.77***	(0.70, 0.85)	0.95	(0.85, 1.07)
Lower-limb amputations 2004	1.22*	(1.02, 1.46)	1.17*	(1.03, 1.33)	0.86*	(0.76, 0.97)
Cerebrovascular diseases 2004	0.88	(0.70, 1.10)	0.85*	(0.72, 0.99)	0.81	(0.66, 1.01)
No. of outpatient visits 2004	1.08***	(1.07, 1.10)	1.18***	(1.16, 1.20)	1.15***	(1.13, 1.17)

* p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicaid Only

N=22,302	Nephropathy test 2005		Eye examination 2005	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.76***	(1.53, 2.02)	1.62***	(1.36, 1.93)
Bipolar disorder	1.46***	(1.30, 1.64)	1.02	(0.89, 1.17)
Depression/ anxiety	1.11	(0.99, 1.25)	1.04	(0.95, 1.14)
Other mental health disorders	1.05	(0.88, 1.25)	0.91	(0.75, 1.11)
Any alcohol abuse/ dependence	1.30***	(1.14, 1.49)	0.86	(0.72, 1.01)
Any drug abuse/ dependence	1.28***	(1.15, 1.42)	0.69***	(0.61, 0.79)
Age Groups				
<55 (ref.)	1		1	
55-64	1.17***	(1.11, 1.23)	1.68***	(1.58, 1.79)
65-74	1.34**	(1.13, 1.61)	2.80***	(2.30, 3342)
75 and older	1.36**	(1.12, 1.64)	3.07***	(2.49, 3.80)
Male Gender	0.76***	(0.71, 0.82)	0.91	(0.82, 1.02)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.93	(0.83, 1.05)	0.98	(0.89, 1.08)
Hispanic	0.85	(0.74, 0.98)	0.82***	(0.74, 0.91)
Others	1.02	(0.88, 1.17)	0.99	(0.76, 1.28)
Unknown	0.81**	(0.71, 0.93)	0.90*	(0.81, 0.99)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	0.87*	(0.78, 0.97)	0.91*	(0.84, 0.99)
1.3<=CDPS<=1.9	0.77***	(0.67, 0.88)	0.70***	(0.62, 0.78)
CDPS>1.9	0.69***	(0.62, 0.78)	0.49***	(0.43, 0.56)
Continuous 12-month coverage	1.04	(0.96, 1.13)	1.19**	(1.08, 1.31)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.90	(0.77, 1.05)	0.91	(0.78, 1.07)
85-90%	0.98	(0.82, 1.17)	0.84*	(0.71, 0.99)
>90%	0.85	(0.70, 1.03)	0.83	(0.67, 1.04)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.15	(0.98, 1.36)	1.15	(0.94, 1.41)
$45,921-$56,813	1.23*	(1.01, 1.51)	1.29*	(1.01, 1.65)
>$56,813	1.26	(0.98, 1.62)	1.31	(1.00, 1.71)
No Previous Complications	0.87	(0.76, 1.01)	0.88*	(0.79, 0.99)
Eye complications in 2004	0.83*	(0.72, 0.96)	1.87***	(1.62, 2.17)
Nephropathy in 2004	1.43**	(1.11, 1.84)	0.86	(0.73, 1.02)
Neuropathy in 2004	0.83*	(0.69, 0.99)	1.03	(0.94, 1.14)
Ischemic Heart Disease in 2004	0.98	(0.85, 1.14)	0.91	(0.82, 1.01)
Lower-limb amputations 2004	1.31**	(1.12, 1.52)	1.12*	(1.01, 1.25)
Cerebrovascular diseases 2004	0.83*	(0.69, 0.99)	0.90	(0.77, 1.06)
No. of outpatient visits 2004	1.12***	(1.11, 1.14)	1.11***	(1.09, 1.12)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicaid Only

	Any complications 2005 N=22,302		Eye Complications 2005 N=19,853		Nephropathy 2005 N=21,593	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.87*	(0.77, 0.98)	1.04	(0.79, 1.36)	0.91	(0.49, 1.69)
Bipolar disorder	0.94	(0.82, 1.09)	0.71*	(0.55, 0.92)	0.80	(0.43, 1.48)
Depression/ anxiety	1.07	(1.00, 1.16)	1.05	(0.91, 1.23)	0.89	(0.73, 1.08)
Other mental health disorders	1.01	(0.85, 1.21)	0.96	(0.62, 1.48)	0.72	(0.32, 1.61)
Any alcohol abuse/ dependence	1.01	(0.82, 1.23)	0.85	(0.65, 1.12)	0.35**	(0.19, 0.66)
Any drug abuse/ dependence	1.00	(0.90, 1.11)	0.88	(0.73, 1.06)	0.85	(0.53, 1.36)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.67***	(0.54, 1.83)	1.44***	(1.28, 1.63)	1.33*	(1.04, 1.69)
65-74	1.47*	(1.07, 2.01)	1.75***	(1.29, 2.38)	1.63**	(1.14, 2.35)
75 and older	1.20	(0.92, 1.56)	1.28	(0.71, 2.33)	1.26	(0.72, 2.20)
Male Gender	1.21***	(1.12, 1.31)	1.12	(0.99, 1.27)	1.35**	(1.10, 1.65)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	0.99	(0.93, 1.06)	1.01	(0.84, 1.22)	1.66***	(1.37, 2.02)
Hispanic	0.68***	(0.59, 0.79)	0.90	(0.68, 1.20)	0.82	(0.53, 1.25)
Others	0.53***	(0.40, 0.71)	0.82	(0.46, 1.45)	0.72	(0.37, 1.41)
Unknown	0.74***	(0.67, 0.82)	0.95	(0.80, 1.12)	0.60**	(0.43, 0.85)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.03	(0.89, 1.21)	1.05	(0.84, 1.30)	1.04	(0.56, 1.92)
1.3<=CDPS<=1.9	1.10	(0.94, 1.28)	0.87	(0.69, 1.09)	1.03	(0.54, 1.94)
CDPS>1.9	1.12	(0.96, 1.32)	0.66**	(0.51, 0.84)	1.67*	(1.02, 2.75)
Continuous 12-month coverage	1.04	(0.94, 1.16)	0.97	(0.77, 1.21)	1.18	(0.81, 1.72)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	0.93	(0.80, 1.09)	0.67*	(0.48, 0.95)	0.90	(0.63, 1.28)
85-90%	0.97	(0.77, 1.23)	0.68	(0.46, 1.02)	1.08	(0.67, 1.73)
>90%	0.89	(0.69, 1.15)	0.73	(0.44, 1.22)	1.11	(0.62, 1.96)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	1.10	(0.97, 1.25)	1.29	(0.93, 1.78)	0.79	(0.55, 1.13)
$45,921-$56,813	1.02	(0.85, 1.24)	1.32	(0.94, 1.85)	0.99	(0.64, 1.52)
>$56,813	1.16	(0.92, 1.46)	1.29	(0.77, 2.16)	0.99	(0.59, 1.72)
No Previous Complications	0.35***	(0.30, 0.41)	0.85	(0.67, 1.07)	0.60**	(0.42, 0.85)
Eye complications in 2004	2.85***	(2.47, 3.28)	N/A		2.25***	(1.52, 3.31)
Nephropathy in 2004	2.44***	(1.99, 2.99)	1.84**	(1.22, 2.77)	N/A	
Neuropathy in 2004	3.32***	(2.82, 3.90)	2.14***	(1.73, 2.64)	2.31***	(1.77, 3.00)
Ischemic Heart Disease in 2004	2.88***	(2.51, 3.31)	1.19	(0.96, 1.48)	1.26	(0.96, 1.65)
Lower-limb amputations 2004	1.47***	(1.25, 1.74)	1.80***	(1.35, 2.42)	1.73**	(1.19, 2.52)
Cerebrovascular diseases 2004	2.17***	(1.82, 2.58)	1.12	(0.80, 1.57)	0.59	(0.30, 1.15)
No. of outpatient visits 2004	1.03***	(1.02, 1.03)	1.02***	(1.01, 1.03)	1.02***	(1.01, 1.03)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicaid Only

	Diabetic Neuropathy 2005 N=20,494		Lower-limb Amputations 2005 N=21,244		Ischemic Heart Disease 2005 N=19,708	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.88	(0.64, 1.20)	1.04	(0.80, 1.35)	0.79	(0.58, 1.07)
Bipolar disorder	0.85	(0.65, 1.10)	1.23	(0.87, 1.73)	1.12	(0.82, 1.54)
Depression/ anxiety	1.03	(0.85, 1.24)	1.09	(0.92, 1.30)	1.09	(0.95, 1.26)
Other mental health disorders	1.07	(0.69, 1.69)	1.40	(0.99, 1.98)	1.19	(0.89, 1.60)
Any alcohol abuse/ dependence	1.03	(0.84, 1.26)	1.58**	(1.18, 2.11)	1.17	(0.78, 1.77)
Any drug abuse/ dependence	1.08	(0.80, 1.45)	1.43**	(1.10, 1.86)	0.83	(0.62, 1.10)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.41***	(1.20, 1.65)	1.14	(1.00, 1.31)	2.45***	(2.21, 2.72)
65-74	0.99	(0.66, 1.48)	0.92	(0.57, 1.51)	2.44***	(1.65, 3.60)
75 and older	0.58*	(0.33, 0.99)	1.22	(0.49, 3.04)	2.36**	(1.44, 3.87)
Male Gender	1.15*	(1.03, 1.29)	1.24*	(1.03, 1.49)	1.27***	(1.13, 1.42)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.26*	(1.01, 1.57)	1.00	(0.84, 1.20)	0.86	(0.68, 1.07)
Hispanic	0.69*	(0.50, 0.95)	0.62*	(0.42, 0.93)	0.67**	(0.52, 0.86)
Others	0.25***	(0.13, 0.50)	0.36	(0.13, 1.01)	0.58**	(0.41, 0.83)
Unknown	0.69***	(0.58, 0.82)	0.88	(0.69, 1.14)	0.84	(0.62, 1.14)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	0.93	(0.73, 1.19)	0.99	(0.69, 1.42)	0.94	(0.72, 1.24)
1.3<=CDPS<=1.9	1.11	(0.86, 1.43)	1.25	(0.85, 1.83)	1.04	(0.76, 1.42)
CDPS>1.9	1.21	(0.88, 1.66)	1.15	(0.80, 1.64)	1.43*	(1.06, 1.93)
Continuous 12-month coverage	1.19	(0.88, 1.60)	1.03	(0.78, 1.34)	1.06	(0.83, 1.35)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.08	(0.71, 1.66)	1.00	(0.74, 1.36)	1.03	(0.85, 1.23)
85-90%	1.31	(0.63, 2.73)	1.00	(0.65, 1.52)	1.05	(0.86, 1.30)
>90%	1.25	(0.56, 2.80)	0.57	(0.32, 1.02)	0.99	(0.76, 1.30)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	1.11	(0.70, 1.76)	1.29	(0.97, 1.73)	0.93	(0.79, 1.10)
$45,921-$56,813	0.96	(0.52, 1.78)	1.26	(0.77, 2.06)	0.96	(0.78, 1.20)
>$56,813	1.13	(0.53, 2.40)	1.48	(0.93, 2.36)	0.81	(0.63, 1.05)
No Previous Complications	0.94	(0.67, 1.33)	1.00	(0.72, 1.39)	0.91	(0.65, 1.27)
Eye complications in 2004	1.92***	(1.53, 2.42)	1.61***	(1.27, 2.05)	0.97	(0.76, 1.23)
Nephropathy in 2004	1.95***	(1.34, 2.84)	1.44*	(1.08, 1.90)	1.17	(0.71, 1.94)
Neuropathy in 2004	N/A		2.29***	(1.72, 3.05)	1.17	(0.93, 1.47)
Ischemic Heart Disease in 2004	1.43*	(1.07, 1.90)	1.19	(0.88, 1.61)	N/A	
Lower-limb amputations 2004	2.79***	(1.84, 4.25)	N/A		1.01	(0.69, 1.50)
Cerebrovascular diseases 2004	1.06	(0.77, 1.46)	1.77**	(1.24, 2.51)	1.99**	(1.20, 3.31)
No. of outpatient visits 2004	1.04***	(1.02, 1.05)	1.03***	(1.02, 1.04)	1.04***	(1.03, 1.05)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicaid Only

	Cerebrovascular Disease 2005 N=21,512		Diabetes-related Hospitalizations 2005 N=22,302	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.59*	(0.38, 0.90)	1.11	(0.83, 1.48)
Bipolar disorder	0.58	(0.32, 1.05)	1.15	(0.67, 1.98)
Depression/ anxiety	0.99	(0.78, 1.27)	1.13	(0.94, 1.35)
Other mental health disorders	0.91	(0.44, 1.85)	0.86	(0.56, 1.30)
Any alcohol abuse/ dependence	1.45	(0.98, 2.16)	1.10	(0.73, 1.65)
Any drug abuse/ dependence	1.12	(0.79, 1.59)	1.45*	(1.05, 2.01)
Age Groups				
<55 (ref.)	1		1	
55-64	2.52***	(1.99, 3.21)	1.14	(0.92, 1.41)
65-74	3.19***	(2.15, 4.75)	1.26	(0.83, 1.92)
75 and older	3.61***	(1.98, 6.57)	1.21	(0.71, 2.05)
Male Gender	1.01	(0.80, 1.27)	1.53***	(1.34, 1.74)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.88	(0.62, 1.26)	1.38***	(1.17, 1.64)
Hispanic	0.40**	(0.22, 0.73)	0.53***	(0.40, 0.72)
Others	0.31**	(0.14, 0.67)	0.56*	(0.32, 0.98)
Unknown	0.89	(0.68, 1.18)	0.92	(0.66, 1.28)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.23	(0.82, 1.87)	0.89	(0.62, 1.28)
1.3<=CDPS<=1.9	1.17	(0.85, 1.60)	0.79	(0.60, 1.05)
CDPS>1.9	1.27	(0.84, 1.91)	1.01	(0.74, 1.38)
Continuous 12-month coverage	0.93	(0.64, 1.35)	0.80*	(0.66, 0.97)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.81	(0.62, 1.05)	0.94	(0.75, 1.19)
85-90%	0.85	(0.59, 1.21)	1.07	(0.79, 1.45)
>90%	0.83	(0.49, 1.42)	0.73	(0.49, 1.09)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.10	(0.78, 1.54)	1.19	(0.85, 1.65)
$45,921-$56,813	0.90	(0.60, 1.34)	1.19	(0.84, 1.70)
>$56,813	0.96	(0.59, 1.56)	1.69**	(1.17, 2.46)
No Previous Complications	0.93	(0.67, 1.29)	0.63*	(0.40, 0.97)
Eye complications in 2004	1.43*	(1.06, 1.92)	1.15	(0.91, 1.45)
Nephropathy in 2004	0.70	(0.42, 1.15)	1.41*	(1.05, 1.89)
Neuropathy in 2004	1.00	(0.74, 1.36)	1.60***	(1.33, 1.93)
Ischemic Heart Disease in 2004	2.11***	(1.49, 2.99)	1.71***	(1.36, 2.15)
Lower-limb amputations 2004	1.41*	(1.01, 1.98)	3.08***	(2.42, 3.94)
Cerebrovascular diseases 2004	N/A		1.68**	(1.23, 2.31)
No. of outpatient visits 2004	1.03***	(1.01, 1.05)	1.03***	(1.02, 1.05)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicaid Only

	Any Complications in 2005 N=22,302		Eye Complications in 2005 N=19,853		Nephropathy in 2005 N=21,593	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.85**	(0.75, 0.96)	0.94	(0.72, 1.22)	0.90	(0.48, 1.67)
Bipolar disorder	0.94	(0.81, 1.09)	0.71*	(0.55, 0.93)	0.81	(0.44, 1.51)
Depression/ anxiety	1.08	(1.00, 1.16)	1.06	(0.91, 1.23)	0.90	(0.74, 1.09)
Other mental health disorders	1.02	(0.86, 1.21)	0.98	(0.64, 1.51)	0.72	(0.32, 1.60)
Any alcohol abuse/ dependence	1.01	(0.82, 1.24)	0.85	(0.64, 1.12)	0.35**	(0.19, 0.66)
Any drug abuse/ dependence	1.00	(0.90, 1.12)	0.89	(0.73, 1.08)	0.85	(0.53, 1.37)
Comprehensive Diabetes Care	1.06	(0.71, 1.59)	0.87	(0.55, 1.38)	2.27*	(1.08, 4.76)
Quality Measures met in 2004						
0 (ref.)	1		1		1	
1	1.10	(0.97, 1.24)	1.80***	(1.40, 2.30)	1.09	(0.73, 1.64)
2	1.19***	(1.09, 1.31)	2.14***	(1.71, 2.68)	1.10	(0.73, 1.66)
3	1.30***	(1.16, 1.46)	2.85***	(2.27, 3.59)	1.26	(0.92, 1.72)
4	1.32***	(1.14, 1.53)	2.25***	(1.66, 3.05)	1.24	(0.86, 1.79)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.64***	(1.51, 1.79)	1.35***	(1.19, 1.53)	1.31*	(1.02, 1.68)
65-74	1.40*	(1.04, 1.87)	1.49*	(1.10, 2.02)	1.57*	(1.06, 2.33)
75 and older	1.15	(0.89, 1.48)	1.09	(0.40, 2.01)	1.20	(0.69, 2.10)
Male Gender	1.21***	(1.12, 1.31)	1.12	(0.98, 1.27)	1.35**	(1.10, 1.67)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.00	(0.93, 1.06)	1.02	(0.84, 1.22)	1.68***	(1.38, 2.03)
Hispanic	0.69***	(0.60, 0.80)	0.94	(0.71, 1.24)	0.82	(0.54, 1.26)
Others	0.52***	(0.39, 0.70)	0.80	(0.45, 1.41)	0.71	(0.36, 1.40)
Unknown	0.74***	(0.67, 0.82)	0.94	(0.80, 1.11)	0.60**	(0.42, 0.85)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.05	(0.89, 1.23)	1.11	(0.88, 1.40)	1.05	(0.56, 1.98)
1.3<=CDPS<=1.9	1.13	(0.96, 1.33)	0.97	(0.76, 1.23)	1.06	(0.54, 2.08)
CDPS>1.9	1.19*	(1.01, 1.39)	0.79	(0.61, 1.01)	1.77*	(1.04, 3.03)
Continuous 12-month coverage	1.04	(0.94, 1.16)	0.97	(0.76, 1.22)	1.17	(0.81, 1.72)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	0.94	(0.80, 1.11)	0.70*	(0.49, 0.98)	0.91	(0.63, 1.30)
85-90%	0.98	(0.77, 1.24)	0.69	(1.46, 1.04)	1.09	(0.68, 1.76)
>90%	0.89	(0.69, 1.15)	0.73	(0.43, 1.23)	1.12	(0.62, 2.01)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	1.09	(0.96, 1.24)	1.23	(0.89, 1.69)	0.78	(0.54, 1.12)
$45,921-$56,813	1.00	(0.83, 1.22)	1.23	(0.88, 1.72)	0.97	(0.62, 1.50)
>$56,813	1.14	(0.90, 1.44)	1.23	(0.73, 2.06)	0.97	(0.56, 1.69)
No Previous Complications	0.35***	(0.30, 0.41)	0.86	(0.68, 1.09)	0.60**	(0.43, 0.85)
Eye complications in 2004	2.81***	(1.44, 3.24)	N/A		2.22***	(1.48, 3.35)
Nephropathy in 2004	2.45***	(2.01, 3.00)	1.90**	(1.23, 2.94)	N/A	
Neuropathy in 2004	3.35***	(2.86, 3.93)	2.20***	(1.79, 2.70)	2.33***	(1.79, 3.04)
Ischemic Heart Disease in 2004	2.91***	(2.53, 3.34)	1.21	(0.97, 1.52)	1.28	(0.98, 1.68)
Lower-limb amputations 2004	1.47***	(1.25, 1.73)	1.80***	(1.35, 2.41)	1.72**	(1.18, 2.50)
Cerebrovascular diseases 2004	2.18***	(1.83, 2.61)	1.13	(0.81, 1.58)	0.59	(0.30, 1.15)
No. of outpatient visits 2004	1.02***	(1.01, 1.03)	1.00	(0.99, 1.01)	1.02*	(1.00, 1.03)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicaid Only

	Diabetic Neuropathy in 2005 N=20,494		Lower-limb Amputations in 2005 N=21,244		Ischemic Heart Disease in 2005 N=19,708	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.81	(0.58, 1.14)	0.95	(0.74, 1.21)	0.75	(0.55, 1.02)
Bipolar disorder	0.85	(0.65, 1.10)	1.22	(0.88, 1.69)	1.11	(0.81, 1.53)
Depression/ anxiety	1.03	(0.86, 1.24)	1.09	(0.91, 1.30)	1.09	(0.95, 1.26)
Other mental health disorders	1.09	(0.69, 1.72)	1.43*	(1.00, 2.03)	1.21	(0.90, 1.63)
Any alcohol abuse/ dependence	1.05	(0.86, 1.28)	1.58**	(1.19, 2.09)	1.18	(0.78, 1.78)
Any drug abuse/ dependence	1.10	(0.82, 1.49)	1.45**	(1.13, 1.85)	0.85	(0.63, 1.13)
Comprehensive Diabetes Care	0.94	(0.43, 2.06)	0.73	(0.32, 1.64)	0.66	(0.27, 1.62)
Quality Measures met in 2004						
0 (ref.)	1		1		1	
1	1.42**	(1.12, 1.80)	2.10***	(1.56, 2.84)	1.21	(0.81, 1.81)
2	1.82***	(1.40, 2.37)	1.80***	(1.30, 2.50)	1.50*	(1.05, 2.14)
3	2.07***	(1.56, 2.73)	2.27***	(1.61, 3.22)	1.45	(1.00, 2.10)
4	2.14***	(1.43, 3.20)	2.14***	(1.43, 3.22)	1.95***	(1.43, 2.66)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.33***	(1.14, 1.56)	1.08	(0.93, 1.26)	2.36***	(2.12, 2.62)
65-74	0.85	(0.58, 1.25)	0.79	(0.48, 1.31)	2.20***	(1.55, 3.12)
75 and older	0.51*	(0.29, 0.88)	1.06	(0.41, 2.73)	2.16**	(1.37, 3.42)
Male Gender	1.16*	(1.03, 1.30)	1.23*	(1.02, 1.48)	1.28***	(1.14, 1.44)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.29*	(1.04, 1.61)	1.00	(0.84, 1.20)	0.86	(0.69, 1.08)
Hispanic	0.71*	(0.52, 0.99)	0.65*	(0.44, 0.94)	0.68**	(0.53, 0.87)
Others	0.25***	(0.12, 0.49)	0.35*	(0.12, 0.99)	0.58**	(0.41, 0.82)
Unknown	0.69***	(0.57, 0.82)	0.88	(0.68, 1.14)	0.84	(0.62, 1.14)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	0.96	(0.76, 1.22)	1.03	(0.71, 1.48)	0.96	(0.73, 1.27)
1.3<=CDPS<=1.9	1.20	(0.93, 1.53)	1.35	(0.92, 1.97)	1.08	(0.80, 1.47)
CDPS>1.9	1.38	(0.99, 1.91)	1.32	(0.93, 1.87)	1.55**	(1.16, 2.06)
Continuous 12-month coverage	1.19	(0.89, 1.59)	1.06	(0.80, 1.40)	1.06	(0.83, 1.34)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.12	(0.74, 1.70)	1.04	(0.77, 1.41)	1.05	(0.84, 1.27)
85-90%	1.33	(0.64, 2.78)	1.02	(0.67, 1.56)	1.06	(0.87, 1.31)
>90%	1.27	(0.57, 2.82)	0.59	(0.33, 1.04)	1.01	(0.77, 1.32)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	1.07	(0.67, 1.70)	1.22	(0.93, 1.60)	0.91	(0.77, 1.07)
$45,921-$56,813	0.91	(0.49, 1.69)	1.16	(0.72, 1.88)	0.93	(0.75, 1.16)
>$56,813	1.07	(0.51, 2.26)	1.38	(0.86, 2.20)	0.78	(0.61, 1.01)
No Previous Complications	0.97	(0.68, 1.37)	1.03	(0.72, 1.46)	0.93	(0.66, 1.29)
Eye complications in 2004	1.87***	(1.49, 2.34)	1.61***	(1.27, 2.04)	0.92	(0.72, 1.19)
Nephropathy in 2004	1.97***	(1.35, 2.89)	1.47*	(1.09, 1.96)	1.17	(0.71, 1.92)
Neuropathy in 2004	N/A		2.33***	(1.75, 3.11)	1.18	(0.94, 1.50)
Ischemic Heart Disease in 2004	1.46*	(1.09, 1.95)	1.22	(0.89, 1.66)	N/A	
Lower-limb amputations 2004	2.75***	(1.83, 4.13)	N/A		1.01	(0.68, 1.49)
Cerebrovascular diseases 2004	1.08	(0.79, 1.48)	1.81**	(1.25, 2.63)	2.01**	(1.22, 3.31)
No. of outpatient visits 2004	1.02**	(1.01, 1.03)	1.01*	(1.00, 1.02)	1.02***	(1.01, 1.03)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Medicaid Only

	Cerebrovascular Disease in 2005 N=21,217		Diabetes-related Hospitalizations in 2005 N=22,302	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.57**	(0.37, 0.87)	1.00	(0.74, 1.35)
Bipolar disorder	0.58	(0.33, 1.04)	1.18	(0.69, 2.01)
Depression/ anxiety	0.99	(0.77, 1.26)	1.15	(0.95, 1.40)
Other mental health disorders	0.91	(0.45, 1.86)	0.88	(0.59, 1.31)
Any alcohol abuse/ dependence	1.47	(0.99, 2.18)	1.07	(0.73, 1.56)
Any drug abuse/ dependence	1.13	(0.81, 1.59)	1.43*	(1.05, 1.93)
Comprehensive Diabetes Care	Dropped	(Predicts failure completely)	0.48	(0.15, 1.50)
Quality Measures met in 2004				
0 (ref.)	1		1	
1	Dropped	(Predicts failure completely)	3.82***	(2.55, 5.73)
2	1.09	(0.82, 1.44)	3.37***	(2.15, 5.29)
3	1.06	(0.79, 1.42)	3.67***	(2.48, 5.43)
4	1.43*	(1.07, 1.93)	2.98***	(1.91, 4.67)
Age Groups				
<55 (ref.)	1		1	
55-64	1.28	(0.91, 1.80)	1.07	(0.86, 1.33)
65-74	2.47***	(1.93, 3.15)	1.02	(0.69, 1.51)
75 and older	3.02***	(2.05, 4.47)	0.98	(0.57, 1.68)
Male Gender	3.45***	(1.89, 6.27)	1.52	(1.35, 1.72)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.02	(0.81, 1.28)	1.41***	(1.21, 1.63)
Hispanic	0.89	(0.62, 1.27)	0.56***	(0.42, 0.75)
Others	0.41**	(0.22, 0.74)	0.55*	(0.32, 0.95)
Unknown	0.31**	(0.14, 0.67)	0.92	(0.66, 1.28)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	0.90	(0.68, 1.19)	0.95	(0.65, 1.39)
1.3<=CDPS<=1.9	1.22	(0.81, 1.84)	0.89	(0.67, 1.19)
CDPS>1.9	1.17	(0.85, 1.61)	1.24	(0.89, 1.73)
Continuous 12-month coverage	1.42*	(1.02, 1.99)	0.85	(0.70, 1.04)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.92	(0.63, 1.35)	0.98	(0.76, 1.26)
85-90%	0.82	(0.63, 1.07)	1.10	(0.79, 1.51)
>90%	0.86	(0.60, 1.22)	0.75	(0.51, 1.12)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.82	(0.48, 1.40)	1.11	(0.79, 1.58)
$45,921-$56,813	1.08	(0.77, 1.52)	1.07	(0.74, 1.56)
>$56,813	0.87	(0.58, 1.31)	1.55*	(1.06, 2.26)
No Previous Complications	1.29	(0.86, 1.93)	0.65	(0.42, 1.01)
Eye complications in 2004	0.95	(0.69, 1.32)	1.21	(0.97, 1.53)
Nephropathy in 2004	1.39*	(1.04, 1.85)	1.49**	(1.11, 1.99)
Neuropathy in 2004	0.71	(0.42, 1.18)	1.65***	(1.36, 1.99)
Ischemic Heart Disease in 2004	1.01	(0.75, 1.37)	1.77***	(1.41, 2.21)
Lower-limb amputations 2004	2.13***	(1.51, 3.02)	3.06***	(2.41, 3.89)
Cerebrovascular diseases 2004	N/A		1.73**	(1.26, 2.37)
No. of outpatient visits 2004	0.95	(0.58, 1.55)	1.02*	(1.00, 1.03)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Dual Eligibles

N=23,735	Full Adherence 2005		HbA1c test 2005		LDL-c test 2005	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	1.17*	(1.03, 1.34)	1.20*	(1.00, 1.45)	1.30**	(1.07, 1.57)
Bipolar disorder	1.17	(0.98, 1.39)	0.85*	(0.74, 0.97)	0.97	(0.85, 1.10)
Depression/ anxiety	1.05	(0.96, 1.15)	0.89**	(0.82, 0.96)	0.91**	(0.85, 0.98)
Other mental health disorders	1.01	(0.85, 1.19)	0.90	(0.77, 1.06)	0.71***	(0.62, 0.82)
Any alcohol abuse/ dependence	0.83**	(0.73, 0.93)	0.79*	(0.66, 0.95)	0.70***	(0.62, 0.79)
Any drug abuse/ dependence	0.72**	(0.57, 0.92)	0.76***	(0.66, 0.87)	0.77*	(0.63, 0.95)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.23***	(1.11, 1.36)	1.45***	(1.30, 1.61)	1.38***	(1.24, 1.54)
65-74	1.28***	(1.17, 1.40)	1.35***	(1.22, 1.50)	1.28***	(1.13, 1.44)
75 and older	1.15*	(1.03, 1.28)	1.06	(0.95, 1.18)	0.78***	(0.71, 0.87)
Male Gender	0.93	(0.87, 1.00)	0.88**	(0.82, 0.95)	1.03	(0.96, 1.10)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.01	(0.88, 1.17)	0.99	(0.88, 1.12)	0.88*	(0.78, 1.00)
Hispanic	1.22**	(1.06, 1.41)	0.97	(0.82, 1.16)	1.00	(0.89, 1.12)
Others	1.24***	(1.10, 1.40)	1.28***	(1.14, 1.45)	1.27***	(1.12, 1.43)
Unknown	0.36*	(0.14, 0.92)	0.95	(0.54, 1.65)	1.11	(0.69, 1.77)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.31***	(1.20, 1.42)	1.03	(0.94, 1.12)	0.97	(0.89, 1.05)
1.3<=CDPS<=1.9	1.20**	(1.06, 1.36)	0.965	(0.84, 1.07)	0.77***	(0.71, 0.83)
CDPS>1.9	1.22*	(1.04, 1.43)	0.76***	(0.66, 0.88)	0.62***	(0.56, 0.69)
Continuous 12-month coverage	1.41***	(1.20, 1.64)	1.35***	(1.18, 1.54)	1.61***	(1.41, 1.85)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.01	(0.85, 1.19)	1.05	(0.91, 1.22)	1.00	(0.87, 1.15)
85-90%	1.10	(0.83, 1.44)	1.03	(0.85, 1.25)	0.99	(0.82, 1.21)
>90%	1.10	(0.82, 1.47)	1.11	(0.90, 1.36)	1.02	(0.79, 1.32)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.91	(0.83, 1.00)	1.01	(0.86, 1.20)	1.01	(0.87, 1.18)
$45,921-$56,813	0.86	(0.68, 1.08)	0.99	(0.85, 1.15)	1.00	(0.78, 1.28)
>$56,813	0.91	(0.73, 1.13)	0.89	(0.74, 1.06)	0.96	(0.75, 1.23)
No Previous Complications	0.98	(0.91, 1.06)	0.87**	(0.79, 0.96)	0.93	(0.82, 1.05)
Eye complications in 2004	1.70***	(1.57, 1.85)	2.29***	(1.95, 2.69)	1.35***	(1.22, 1.49)
Nephropathy in 2004	1.10	(1.00, 1.22)	1.55***	(1.24, 1.93)	0.75***	(0.67, 0.85)
Neuropathy in 2004	1.36***	(1.26, 1.46)	1.95***	(1.67, 2.28)	1.16*	(1.01, 1.33)
Ischemic Heart Disease in 2004	1.11*	(1.02, 1.20)	0.88**	(0.80, 0.97)	1.19***	(1.08, 1.30)
Lower-limb amputations 2004	0.92	(0.84, 1.01)	1.32***	(1.14, 1.52)	0.82***	(0.73, 0.91)
Cerebrovascular diseases 2004	0.97	(0.86, 1.11)	0.89*	(0.80, 0.98)	1.01	(0.92, 1.10)
No. of outpatient visits 2004	1.04***	(1.04, 1.05)	1.02***	(1.02, 1.03)	1.03***	(1.03, 1.04)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Dual Eligibles

N=23,735	Nephropathy test 2005		Eye examination 2005	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.14*	(1.03, 1.26)	1.12	(0.99, 1.26)
Bipolar disorder	1.22**	(1.06, 1.40)	1.07	(0.92, 1.26)
Depression/ anxiety	1.14***	(1.06, 1.21)	1.02	(0.93, 1.13)
Other mental health disorders	1.08	(0.94, 1.25)	1.08	(0.95, 1.24)
Any alcohol abuse/ dependence	1.07	(0.93, 1.23)	0.78***	(0.71, 0.86)
Any drug abuse/ dependence	1.20*	(1.05, 1.39)	0.65***	(0.55, 0.78)
Age Groups				
<55 (ref.)	1		1	
55-64	0.95	(0.87, 1.04)	1.38***	(1.29, 1.47)
65-74	0.95	(0.86, 1.05)	1.75***	(1.63, 1.87)
75 and older	0.99	(0.90, 1.09)	1.70***	(1.57, 1.84)
Male Gender	0.87***	(0.81, 0.94)	0.91***	(0.87, 0.95)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.06	(0.96, 1.17)	1.27**	(1.10, 1.45)
Hispanic	1.24***	(1.11, 1.39)	1.27***	(1.11, 1.44)
Others	1.19**	(1.05, 1.36)	1.00	(0.91, 1.11)
Unknown	0.57*	(0.37, 0.88)	0.60*	(0.39, 0.94)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.40***	(1.31, 1.50)	1.13*	(1.02, 1.26)
1.3<=CDPS<=1.9	1.63***	(1.43, 1.86)	1.01	(0.90, 1.13)
CDPS>1.9	2.11***	(1.80, 2.47)	0.96	(0.82, 1.11)
Continuous 12-month coverage	1.04	(0.90, 1.19)	1.29***	(1.17, 1.43)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.98	(0.83, 1.15)	1.07	(0.96, 1.20)
85-90%	0.99	(0.80, 1.22)	1.09	(0.95, 1.26)
>90%	0.96	(0.76, 1.22)	1.10	(0.96, 1.27)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.89*	(0.81, 0.98)	0.94	(0.86, 1.02)
$45,921-$56,813	0.96	(0.85, 1.09)	0.95	(0.85, 1.06)
>$56,813	1.00	(0.84, 1.21)	0.87	(0.75, 1.00)
No Previous Complications	1.04	(0.96, 1.12)	0.93	(0.85, 1.02)
Eye complications in 2004	1.06	(0.98, 1.14)	2.65***	(2.41, 2.91)
Nephropathy in 2004	1.64***	(1.41, 1.91)	1.00	(0.89, 1.12)
Neuropathy in 2004	1.04	(0.94, 1.14)	1.31***	(1.20, 1.43)
Ischemic Heart Disease in 2004	1.14**	(1.05, 1.24)	0.87***	(0.81, 0.94)
Lower-limb amputations 2004	1.08	(0.98, 1.19)	0.85**	(0.77, 0.93)
Cerebrovascular diseases 2004	1.02	(0.91, 1.16)	0.93*	(0.86, 1.00)
No. of outpatient visits 2004	1.04***	(1.04, 1.05)	1.04***	(1.03, 1.05)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Dual Eligibles

	Any complications 2005 N=23,735		Eye Complications 2005 N=19,349		Nephropathy 2005 N=22,122	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.61***	(0.52, 0.70)	0.70**	(0.56, 0.87)	0.52***	(0.39, 0.71)
Bipolar disorder	0.65***	(0.55, 0.77)	0.57***	(0.43, 0.77)	0.73	(0.52, 1.03)
Depression/ anxiety	0.88*	(0.79, 0.98)	0.85*	(0.74, 0.99)	0.74*	(0.58, 0.94)
Other mental health disorders	0.79*	(0.64, 0.97)	0.85	(0.68, 1.06)	0.48*	(0.26, 0.88)
Any alcohol abuse/ dependence	1.16*	(1.01, 1.34)	0.74*	(0.59, 0.93)	0.87	(0.64, 1.20)
Any drug abuse/ dependence	0.99	(0.83, 1.18)	1.01	(0.74, 1.38)	0.90	(0.63, 1.28)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.58***	(1.43, 1.75)	1.17	(0.98, 1.40)	1.27**	(1.06, 1.53)
65-74	1.75***	(1.53, 2.00)	1.26**	(1.07, 1.47)	1.14	(0.97, 1.34)
75 and older	1.91***	(1.68, 2.18)	0.99	(0.83, 1.18)	1.04	(0.86, 1.25)
Male Gender	1.10*	(1.02, 1.18)	0.83*	(0.71, 0.97)	1.40***	(1.20, 1.63)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.03	(0.95, 1.12)	1.45***	(1.25, 1.68)	1.61***	(1.40, 1.85)
Hispanic	0.88*	(0.78, 0.98)	1.44**	(1.11, 1.86)	1.25*	(1.02, 1.54)
Others	0.77***	(0.70, 0.86)	1.09	(0.93, 1.27)	1.39**	(1.10, 1.74)
Unknown	0.60	(0.34, 1.05)	0.57	(0.15, 2.17)	1.16	(0.34, 4.00)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.29***	(1.21, 1.39)	1.01	(0.90, 1.14)	1.21	(1.00, 1.47)
1.3<=CDPS<=1.9	1.57***	(1.43, 1.72)	1.05	(0.88, 1.25)	1.61***	(1.31, 1.97)
CDPS>1.9	1.80***	(1.63, 1.97)	1.08	(0.90, 1.31)	3.43***	(2.76, 4.27)
Continuous 12-month coverage	1.02	(0.89, 1.17)	0.92	(0.74, 1.16)	0.98	(0.74, 1.30)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.06	(0.98, 1.15)	0.83*	(0.71, 0.97)	1.30	(0.98, 1.72)
85-90%	1.03	(0.91, 1.15)	0.83*	(0.69, 0.99)	1.21	(0.91, 1.59)
>90%	1.05	(0.87, 1.27)	0.84	(0.65, 1.07)	1.22	(0.81, 1.84)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.99	(0.89, 1.09)	1.07	(0.91, 1.25)	0.79*	(0.65, 0.97)
$45,921-$56,813	1.01	(0.87, 1.18)	1.08	(0.88, 1.32)	0.90	(0.72, 1.13)
>$56,813	0.94	(0.78, 1.14)	1.09	(0.86, 1.39)	0.85	(0.61, 1.18)
No Previous Complications	0.47***	(0.42, 0.52)	1.06	(0.88, 1.27)	0.84	(0.66, 1.08)
Eye complications in 2004	2.60***	(2.30, 2.93)	N/A		2.19***	(1.85, 2.59)
Nephropathy in 2004	2.55***	(2.09, 3.10)	1.97***	(1.69, 2.29)	N/A	
Neuropathy in 2004	3.04***	(2.63, 3.52)	1.74***	(1.52, 1.99)	1.70***	(1.46, 1.98)
Ischemic Heart Disease in 2004	3.61***	(3.27, 3.99)	1.24**	(1.08, 1.42)	1.34**	(1.12, 1.61)
Lower-limb amputations 2004	1.22*	(1.01, 1.46)	1.52***	(1.24, 1.85)	1.50***	(1.25, 1.79)
Cerebrovascular diseases 2004	1.68***	(1.49, 1.90)	1.12	(0.91, 1.37)	1.05	(0.88, 1.25)
No. of outpatient visits 2004	1.02***	(1.01, 1.02)	1.00	(0.99, 1.01)	1.00	(0.99, 1.02)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Dual Eligibles

	Diabetic Neuropathy 2005 N=19,898		Lower-limb Amputations 2005 N=22,054		Ischemic Heart Disease 2005 N=16,560	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.66***	(0.54, 0.81)	0.70**	(0.55, 0.89)	0.58***	(0.48, 0.70)
Bipolar disorder	0.88	(0.67, 1.17)	0.64*	(0.45, 0.90)	0.76*	(0.59, 0.99)
Depression/ anxiety	0.95	(0.84, 1.09)	0.99	(0.86, 1.15)	0.99	(0.87, 1.12)
Other mental health disorders	0.80	(0.60, 1.08)	0.88	(0.62, 1.23)	0.95	(0.68, 1.32)
Any alcohol abuse/ dependence	1.22	(0.96, 1.55)	1.49***	(1.20, 1.85)	1.05	(0.85, 1.29)
Any drug abuse/ dependence	1.04	(0.78, 1.39)	1.47*	(1.05, 2.05)	1.02	(0.75, 1.38)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.27**	(1.11, 1.46)	1.02	(0.84, 1.23)	2.05***	(1.80, 2.33)
65-74	1.05	(0.90, 1.23)	1.05	(0.87, 1.27)	2.56***	(2.22, 2.95)
75 and older	0.95	(0.80, 1.13)	1.22	(0.94, 1.60)	3.27***	(2.81, 3.80)
Male Gender	0.87	(0.78, 0.98)	1.02	(0.91, 1.14)	1.23***	(1.12, 1.34)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.15	(0.93, 1.41)	0.98	(0.85, 1.12)	0.90	(0.77, 1.06)
Hispanic	0.88	(0.70, 1.09)	0.93	(0.75, 1.14)	0.86	(0.73, 1.01)
Others	0.66**	(1.49, 0.89)	0.79	(0.59, 1.06)	0.67***	(0.57, 0.79)
Unknown	0.70	(0.32, 1.51)	1.00	(0.41, 2.44)	0.22**	(0.07, 0.68)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.58***	(1.36, 1.84)	1.52***	(1.23, 1.87)	1.44***	(1.27, 1.63)
1.3<=CDPS<=1.9	2.13***	(1.85, 2.45)	2.24***	(1.72, 2.90)	2.03***	(1.72, 2.41)
CDPS>1.9	2.18***	(1.73, 2.74)	3.56***	(2.67, 4.75)	2.40***	(2.00, 2.88)
Continuous 12-month coverage	0.75	(0.56, 1.00)	0.68***	(0.55, 0.84)	0.82	(0.64, 1.06)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.13	(1.00, 1.29)	1.07	(0.86, 1.34)	1.09	(0.92, 1.28)
85-90%	121	(0.99, 1.48)	0.85	(0.62, 1.17)	0.94	(0.80, 1.09)
>90%	1.43**	(1.14, 1.79)	0.93	(0.59, 1.47)	0.89	(0.70, 1.13)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.91	(0.75, 1.11)	1.02	(0.86, 1.22)	1.04	(0.92, 1.18)
$45,921-$56,813	0.85	(0.70, 1.04)	1.09	(0.87, 1.36)	1.12	(0.92, 1.34)
>$56,813	0.79	(0.58, 1.09)	0.88	(0.63, 1.18)	1.10	(0.88, 1.38)
No Previous Complications	0.85*	(0.72, 1.00)	0.90	(0.76, 1.06)	1.04	(0.88, 1.24)
Eye complications in 2004	1.68***	(1.45, 1.96)	1.63***	(1.40, 1.90)	1.10	(0.94, 1.29)
Nephropathy in 2004	1.70***	(1.33, 2.18)	1.20	(1.00, 1.44)	1.39***	(1.17, 1.65)
Neuropathy in 2004	N/A		1.70***	(1.44, 2.01)	1.14	(0.99, 1.32)
Ischemic Heart Disease in 2004	0.99	(0.89, 1.11)	1.15	(1.00, 1.32)	N/A	
Lower-limb amputations 2004	1.88***	(1.54, 2.31)	N/A		0.99	(0.77, 1.27)
Cerebrovascular diseases 2004	1.06	(0.91, 1.24)	1.12	(0.95, 1.32)	1.33**	(1.12, 1.57)
No. of outpatient visits 2004	1.01	(0.99, 1.02)	1.00	(0.99, 1.01)	1.02***	(1.01, 1.02)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Dual Eligibles

	Cerebrovascular Disease 2005 N=21,584		Diabetes-related Hospitalizations 2005 N=23,735	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.45***	(0.32, 0.62)	0.52***	(0.41, 0.66)
Bipolar disorder	1.00	(0.76, 1.31)	0.88	(0.69, 1.12)
Depression/ anxiety	0.97	(0.85, 1.10)	0.97	(0.84, 1.10)
Other mental health disorders	0.86	(0.60, 1.23)	0.94	(0.67, 1.32)
Any alcohol abuse/ dependence	1.35	(0.92, 1.97)	1.09	(0.87, 1.36)
Any drug abuse/ dependence	0.90	(0.60, 1.36)	1.75***	(1.35, 2.26)
Age Groups				
<55 (ref.)	1		1	
55-64	1.79***	(1.45, 2.21)	0.93	(0.81, 1.08)
65-74	2.32***	(1.86, 2.89)	1.01	(0.86, 1.18)
75 and older	2.95***	(2.42, 3.58)	1.03	(0.87, 1.23)
Male Gender	0.92	(0.80, 1.06)	1.12*	(1.01, 1.24)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.80**	(0.70, 0.92)	0.95	(0.77, 1.16)
Hispanic	0.93	(0.77, 1.11)	0.91	(0.72, 1.14)
Others	0.70***	(0.59, 0.82)	0.93	(0.71, 1.22)
Unknown	0.56	(0.17, 1.86)	1.20	(0.60, 2.40)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	0.24*	(1.03, 1.49)	1.23**	(1.07, 1.41)
1.3<=CDPS<=1.9	1.42***	(1.22, 1.67)	1.47***	(1.25, 1.72)
CDPS>1.9	1.77***	(1.48, 2.11)	1.81***	(1.55, 2.11)
Continuous 12-month coverage	0.74*	(0.57, 0.96)	0.75**	(0.61, 0.91)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.96	(0.79, 1.17)	0.95	(0.81, 1.11)
85-90%	0.87	(0.73, 1.04)	0.85*	(0.72, 0.99)
>90%	0.90	(0.68, 1.18)	0.77	(0.59, 1.02)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.02	(0.82, 1.27)	1.07	(0.89, 1.29)
$45,921-$56,813	1.16	(0.91, 1.48)	1.38**	(1.11, 1.71)
>$56,813	1.21	(0.92, 1.58)	1.15	(0.87, 1.51)
No Previous Complications	1.01	(0.86, 1.20)	0.72***	(0.60, 0.86)
Eye complications in 2004	1.19*	(1.04, 1.37)	1.32***	(1.15, 1.52)
Nephropathy in 2004	1.14	(0.96, 1.37)	1.62***	(1.38, 1.91)
Neuropathy in 2004	1.14	(0.97, 1.35)	1.25***	(1.11, 1.40)
Ischemic Heart Disease in 2004	1.50***	(1.33, 1.68)	2.14***	(1.81, 2.52)
Lower-limb amputations 2004	1.34**	(1.10, 1.62)	2.04***	(1.77, 2.34)
Cerebrovascular diseases 2004	N/A		1.33***	(1.13, 1.55)
No. of outpatient visits 2004	1.01***	(1.01, 1.02)	1.00	(1.00, 1.01)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Dual Eligibles

	Any Complications in 2005 N=23,735		Eye Complications in 2005 N=19,349		Nephropathy in 2005 N=22,122	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.60***	(0.51, 0.69)	0.69**	(0.55, 0.86)	0.52***	(0.38, 0.70)
Bipolar disorder	0.65***	(0.55, 0.77)	0.57***	(0.43, 0.76)	0.73	(0.52, 1.03)
Depression/ anxiety	0.87*	(0.79, 0.98)	0.85*	(0.74, 0.98)	0.74*	(0.58, 0.94)
Other mental health disorders	0.79*	(0.65, 0.97)	0.86	(0.69, 1.07)	0.48*	(0.26, 0.89)
Any alcohol abuse/ dependence	1.18*	(1.2, 1.36)	0.75*	(0.59, 0.94)	0.88	(0.64, 1.21)
Any drug abuse/ dependence	1.02	(0.85, 1.21)	1.04	(0.76, 1.42)	0.92	(0.65, 1.29)
Comprehensive Diabetes Care	0.75*	(0.57, 0.97)	0.87	(0.57, 1.33)	1.00	(0.62, 1.63)
Quality Measures met in 2004						
0 (ref.)	1		1		1	
1	1.21*	(1.02, 1.44)	1.33	(0.91, 1.94)	1.24	(0.62, 2.49)
2	1.44***	(1.22, 1.70)	1.52*	(1.04, 2.21)	1.34	(0.70, 2.56)
3	1.62***	(1.40, 1.87)	1.52*	(1.06, 2.19)	1.48	(0.75, 2.93)
4	1.63***	(1.40, 1.91)	1.93***	(1.37, 2.73)	1.54	(0.78, 3.06)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.56***	(1.41, 1.72)	1.15	(0.97, 1.37)	1.26*	(1.05, 1.51)
65-74	1.72***	(1.51, 1.97)	1.23*	(1.05, 1.44)	1.13	(0.96, 1.33)
75 and older	1.90***	(1.66, 2.16)	0.97	(0.82, 1.15)	1.03	(0.85, 1.24)
Male Gender	1.11**	(1.03, 1.19)	0.84*	(0.72, 0.98)	1.41***	(1.20, 1.65)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.03	(0.95, 1.12)	1.45***	(1.25, 1.67)	1.61***	(1.40, 1.85)
Hispanic	0.87*	(0.77, 0.98)	1.42**	(1.10, 1.83)	1.25*	(1.02, 1.53)
Others	0.76***	(0.68, 0.85)	1.07	(0.92, 1.25)	1.37**	(1.09, 1.72)
Unknown	0.59	(0.34, 1.05)	0.56	(0.15, 2.15)	1.17	(0.34, 4.02)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.28***	(1.19, 1.38)	1.00	(0.89, 1.12)	1.20	(0.98, 1.46)
1.3<=CDPS<=1.9	1.56***	(1.43, 1.71)	1.03	(0.87, 1.24)	1.60***	(1.30, 1.96)
CDPS>1.9	1.80***	(1.64, 1.97)	1.08	(0.89, 1.29)	3.42***	(2.76, 4.25)
Continuous 12-month coverage	1.00	(0.87, 1.15)	0.90	(0.72, 1.13)	0.97	(0.74, 1.29)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.06	(0.98, 1.15)	0.83*	(0.71, 0.97)	1.30	(0.99, 1.72)
85-90%	1.02	(0.91, 1.15)	0.82*	(0.68, 0.98)	1.20	(0.91, 1.58)
>90%	1.05	(0.87, 1.26)	0.83	(0.64, 1.06)	1.22	(0.81, 1.83)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.98	(0.89, 1.08)	1.07	(0.91, 1.25)	0.79*	(0.65, 0.97)
$45,921-$56,813	1.01	(0.87, 1.18)	1.09	(0.89, 1.32)	0.90	(0.72, 1.13)
>$56,813	0.94	(0.78, 1.14)	1.10	(0.87, 1.39)	0.85	(0.61, 1.18)
No Previous Complications	0.47***	(0.42, 0.52)	1.07	(0.89, 1.28)	0.84	(0.66, 1.08)
Eye complications in 2004	2.47***	(2.19, 2.78)	N/A		2.10***	(1.73, 2.54)
Nephropathy in 2004	2.50***	(2.05, 3.05)	1.93***	(1.65, 2.25)	N/A	
Neuropathy in 2004	3.00***	(2.61, 3.46)	1.72***	(1.51, 1.97)	1.68***	(1.45, 1.95)
Ischemic Heart Disease in 2004	3.64***	(3.30, 4.01)	1.25**	(1.09, 1.43)	1.35**	(1.13, 1.61)
Lower-limb amputations 2004	1.22*	(1.01, 1.47)	1.52***	(1.24, 1.87)	1.50***	(1.26, 1.80)
Cerebrovascular diseases 2004	1.70***	(1.51, 1.92)	1.12	(0.91, 1.38)	1.06	(0.89, 1.26)
No. of outpatient visits 2004	1.01**	(1.00, 1.02)	1.00	(0.99, 1.01)	1.00	(0.99, 1.02)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Dual Eligibles

	Diabetic Neuropathy in 2005 N=19,898		Lower-limb Amputations in 2005 N=22,054		Ischemic Heart Disease in 2005 N=16,560	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.65***	(0.53, 0.80)	0.69**	(0.54, 0.89)	0.58***	(0.48, 0.69)
Bipolar disorder	0.87	(0.66, 1.16)	0.63**	(0.45, 0.89)	0.76*	(0.59, 0.99)
Depression/ anxiety	0.94	(0.83, 1.08)	0.99	(0.85, 1.15)	0.99	(0.87, 1.12)
Other mental health disorders	0.81	(0.60, 1.09)	0.87	(0.53, 1.23)	0.95	(0.68, 1.32)
Any alcohol abuse/ dependence	1.23	(0.97, 1.58)	1.50***	(1.20, 1.86)	1.05	(0.85, 1.30)
Any drug abuse/ dependence	1.07	(0.80, 1.42)	1.47*	(1.05, 2.05)	1.02	(0.75, 1.38)
Comprehensive Diabetes Care	0.46**	(0.27, 0.81)	0.29*	(0.11, 0.77)	0.74	(0.49, 1.14)
Quality Measures met in 2004						
0 (ref.)	1		1		1	
1	1.00	(0.66, 1.52)	1.34	(0.86, 2.08)	1.10	(0.74, 1.65)
2	1.03	(0.74, 1.45)	1.45	(0.99, 2.13)	1.21	(0.80, 1.83)
3	1.32	(0.89, 1.95)	1.41	(0.96, 2.06)	1.22	(0.84, 1.77)
4	1.38	(0.95, 2.00)	1.29	(0.87, 1.89)	1.16	(0.80, 1.70)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.25**	(1.09, 1.44)	1.01	(0.84, 1.23)	2.04***	(1.80, 2.32)
65-74	1.03	(0.88, 1.21)	1.05	(0.86, 1.28)	2.56***	(2.22, 2.95)
75 and older	0.94	(0.79, 1.12)	1.22	(0.93, 1.60)	3.27***	(2.81, 3.80)
Male Gender	0.88*	(0.78, 0.99)	1.02	(0.91, 1.14)	1.23***	(1.12, 1.35)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	1.15	(0.93, 1.42)	0.98	(0.85, 1.12)	0.91	(0.77, 1.06)
Hispanic	0.87	(0.70, 1.09)	0.92	(0.75, 1.13)	0.86	(0.72, 1.01)
Others	0.66**	(0.48, 0.90)	0.80	(0.59, 1.08)	0.67***	(0.57, 0.79)
Unknown	0.70	(0.33, 1.51)	0.99	(0.41, 2.40)	0.22**	(0.07, 0.67)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.56***	(1.35, 1.80)	1.52***	(1.23, 1.88)	1.44***	(1.27, 1.63)
1.3<=CDPS<=1.9	2.10***	(1.83, 2.40)	2.25***	(1.73, 2.92)	2.04***	(1.73, 2.40)
CDPS>1.9	2.16***	(1.73, 2.69)	3.58***	(2.67, 4.78)	2.41***	(2.00, 2.91)
Continuous 12-month coverage	0.73*	(0.55, 0.99)	0.67***	(0.54, 0.83)	0.82	(0.63, 1.06)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	1.14	(1.00, 1.29)	1.08	(0.86, 1.35)	1.09	(0.92, 1.28)
85-90%	1.21	(0.98, 1.49)	0.86	(0.63, 1.18)	0.94	(0.80, 1.10)
>90%	1.41**	(1.13, 1.78)	0.93	(0.59, 1.47)	0.89	(0.70, 1.14)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.91	(0.75, 1.11)	1.02	(0.85, 1.22)	1.04	(0.92, 1.17)
$45,921-$56,813	0.86	(0.70, 1.05)	1.08	(0.86, 1.36)	1.11	(0.92, 1.34)
>$56,813	0.80	(0.58, 1.09)	0.88	(0.65, 1.18)	1.10	(0.87, 1.38)
No Previous Complications	0.85*	(0.73, 1.00)	0.90	(0.76, 1.06)	1.05	(0.88, 1.24)
Eye complications in 2004	1.57***	(1.36, 1.81)	1.65***	(1.43, 1.90)	1.09	(0.93, 1.28)
Nephropathy in 2004	1.67***	(1.29, 2.16)	1.20	(1.00, 1.44)	1.39***	(1.17, 1.64)
Neuropathy in 2004	N/A		1.70***	(1.44, 2.01)	1.14	(0.99, 1.31)
Ischemic Heart Disease in 2004	0.99	(0.89, 1.11)	1.15*	(1.00, 1.32)	N/A	
Lower-limb amputations 2004	1.87***	(1.53, 2.29)	N/A		0.99	(0.77, 1.26)
Cerebrovascular diseases 2004	1.06	(0.91, 1.24)	1.12	(0.95, 1.32)	1.33**	(1.12, 1.58)
No. of outpatient visits 2004	1.00	(0.99, 1.02)	1.00	(0.99, 1.01)	1.02***	(1.01, 1.02)

*p<0.05 **p<0.01 ***p<0.001

Appendix I. Analyses of diabetes outcomes by type of health coverage: Dual Eligibles

	Cerebrovascular Disease in 2005 N=21,584		Diabetes-related Hospitalizations in 2005 N=23,735	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.45***	(0.32, 0.62)	0.52***	(0.41, 0.67)
Bipolar disorder	0.99	(0.75, 1.31)	0.88	(0.69, 1.12)
Depression/ anxiety	0.97	(0.85, 1.10)	0.97	(0.85, 1.10)
Other mental health disorders	0.86	(0.60, 1.23)	0.93	(0.66, 1.32)
Any alcohol abuse/ dependence	1.35	(0.92, 1.97)	1.09	(0.86, 1.37)
Any drug abuse/ dependence	0.90	(0.60, 1.35)	1.72***	(1.33, 2.22)
Comprehensive Diabetes Care	0.85	(0.38, 1.88)	0.76	(0.33, 1.73)
Quality Measures met in 2004				
0 (ref.)	1		1	
1	0.96	(0.64, 1.44)	0.74	(0.54, 1.01)
2	0.94	(0.64, 1.38)	0.83	(0.64, 1.09)
3	0.89	(0.59, 1.34)	0.78*	(0.61, 0.99)
4	0.96	(0.67, 1.37)	0.68***	(0.55, 0.83)
Age Groups				
<55 (ref.)	1		1	
55-64	1.80***	(1.46, 2.21)	0.94	(0.81, 1.08)
65-74	2.32***	(1.87, 2.89)	1.02	(0.87, 1.19)
75 and older	2.94***	(2.42, 3.58)	1.04	(0.87, 1.24)
Male Gender	0.92	(0.80, 1.06)	1.11*	(1.01, 1.23)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.80**	(0.70, 0.92)	0.95	(0.77, 1.16)
Hispanic	0.92	(0.77, 1.11)	0.91	(0.72, 1.15)
Others	0.70***	(0.59, 0.82)	0.94	(0.72, 1.23)
Unknown	0.56	(0.17, 1.84)	1.20	(0.60, 2.39)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.24*	(1.03, 1.48)	1.24**	(1.08, 1.42)
1.3<=CDPS<=1.9	1.42***	(1.22, 1.66)	1.49***	(1.27, 1.74)
CDPS>1.9	1.76***	(1.47, 2.10)	1.83***	(1.56, 2.14)
Continuous 12-month coverage	0.74*	(0.56, 0.96)	0.75**	(0.62, 0.91)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.96	(0.79, 1.17)	0.95	(0.81, 1.12)
85-90%	0.87	(0.73, 1.04)	0.85*	(0.73, 1.00)
>90%	0.90	(0.68, 1.18)	0.78	(0.59, 1.02)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.02	(0.82, 1.28)	1.07	(0.89, 1.29)
$45,921-$56,813	1.16	(0.91, 1.48)	1.37***	(1.11, 1.69)
>$56,813	1.21	(0.92, 1.59)	1.15	(0.87, 1.51)
No Previous Complications	1.01	(0.86, 1.19)	0.72***	(0.60, 0.86)
Eye complications in 2004	1.19*	(1.04, 1.37)	1.38***	(1.21, 1.58)
Nephropathy in 2004	1.15	(0.96, 1.37)	1.63***	(1.39, 1.92)
Neuropathy in 2004	1.14	(0.97, 1.34)	1.25***	(1.11, 1.40)
Ischemic Heart Disease in 2004	1.49***	(1.33, 1.68)	2.13***	(1.81, 2.51)
Lower-limb amputations 2004	1.34**	(1.10, 1.62)	2.03***	(1.76, 2.34)
Cerebrovascular diseases 2004	N/A		1.33**	(1.13, 1.55)
No. of outpatient visits 2004	1.01***	(1.01, 1.02)	1.01	(1.00, 1.01)

*p<0.05 **p<0.01 ***p<0.001

Appendix II. ICD-9 and CPT codes for study measures

Disorders/ Procedures	ICD-9 / CPT codes
Diabetes	250.00, 357.2, 362.0, 362.01, 362.02, 366.41, 648.0
Type 1 Diabetes	250.41, 250.43, 250.51, 250.53, 250.61, 250.63, 250.01, 250.03, 250.21, 250.23, 250.31, 250.33
Type 2 Diabetes	250.20, 250.22, 250.30, 250.32, 250.1, 250.2, 250.3, 250.4, 250.40, 250.42, 250.5, 250.50, 250.52, 250.6, 250.60, 250.62, 250.0, 250.00, 250.02, 250.7, 250.70, 250.72, 250.8, 250.80, 250.82, 250.9, 250.90, 250.92
Schizophrenia/ paranoid states	
Schizophrenia	295
Paranoid states	297
Bipolar disorder	296.0, 296.1, 296.4, 296.5, 296.6, 296.7
Depression/ anxiety	
Major Depression	296.2, 296.3
Other Depressions	298.0, 300.4, 309.0, 309.1, 311
Anxiety states	300.01, 300.02
Post-Traumatic Stress Disorder	309.81
Other mental health disorders	
Psychosis ex. Schizophrenia, Paranoid states	298.1-298.4, 298.8-298.9
Hysteria	300.1
Phobic disorders	300.2
Obsessive Compulsive Disorders	300.3
Neurasthenia	300.5
Depersonalization syndrome	300.6
Neurotic disorders	300.7-300.9
Personality disorders	301
Sexual deviations and disorders	302
Physiological malfunction from mental factors	306
Special syndrome, NOS	307
Adjustment reactions	308, 309.2-309.4, 309.82, 309.83, 309.89, 309.9
Disturbance of conduct or emotions	312, 313
Hyperkinetic syndrome of childhood	314
Specific delays in development	315
Psychic factors	316
Alcohol abuse/ dependence	
Alcoholic psychoses	291
Alcohol abuse	305.0
Alcohol gastritis	303
Alcoholic liver diseases	571.0-571.3
Drug abuse/ dependence	
Drug psychoses	292
Drug abuse	305.2-305.9
Drug dependence	304, 648.3
Quality Measures for Diabetes Care (CPT)	
HbA1c test	83036
LDL-c test	80061, 83715, 83716, 83721
Nephropathy test	81050, 84156, 84160, 84165, 84166, 83518
Eye examination (CPT)	67101, 67105, 67107, 67108, 67110, 67112, 67141, 67145, 67208, 67210, 67218, 67227, 67228, 92002, 92004, 92012, 92014, 92018, 92019, 92225, 92226, 92230, 92235, 92240, 92250, 92260, 92287, S0625, S3000, S0620, S0621
	If providers are optometrists or ophthalmologists: 99203, 99204, 99205, 99213, 99214, 99215, 99242, 99243, 99244, 99245
Eye examination (ICD-9 procedure codes)	14.1-14.5, 14.9, 95.02-95.04, 95.11, 95.12, 95.16, V720
Diabetes complications	
Eye complications	250.5, 362.0
Neuropathy	250.6
Nephropathy	250.4
Ischemic Heart Disease	410, 411, 412, 413, 414
Cerebrovascular Disease	431, 432, 433, 434, 435, 436, v1254
Lower-limb amputations	ICD-9: 250.8, v497; CPT: 27880, 27882, 27886, 28800, 28805, 28810, 28820, 28825

Appendix III. Description of sub-analysis using Medicaid Rx models

In this analysis, the mental disorder categories, i.e., psychotic/bipolar disorders (mrx40) and depression/anxiety disorders (mrx9), generated by Medicaid Rx are hierarchical. This means that individuals identified with psychotic/bipolar disorders and depression or an anxiety disorder would not be classified as having depression/anxiety under Medicaid Rx classification and vice versa. Individuals who were in neither of the groups were classified as having 'No mental health disorders' because the Medicaid Rx models cannot identify people with other types of mental health disorders, such as personality disorders, which do not use distinct medications (e.g., antipsychotics for schizophrenia or bipolar disorder and antidepressants for depression).   The main purpose of this analysis was to compare the rates of full adherence to quality measures of diabetes care assessed among the three methods of classifying mental health disorders: 1) ICD-9 codes only; 2) Medicaid Rx models only and 3) combination of both.

Selection Criteria for sub-analysis:

Beneficiaries with Medicaid only were enrolled in Medicaid for at least 10 months during both years. For dual-eligibility, beneficiaries were enrolled in Medicare Part A and Medicaid for at least 10 months during both years. Beneficiaries with Medicare Advantage or in nursing homes for 90 days or more were excluded. Beneficiaries with Medicare only were also excluded because there were no medication data available for them in CY2005. This analysis included 46,073 individuals.

Classification of Mental health disorders with the combination method, ICD-9 and

Medicaid Rx

In this classification scheme (see Appendix IV on next page), individuals with any diagnoses of psychotic/bipolar disorders identified by either method were labeled as such while those identified as having depression/ anxiety did not have any Psychotic/Bipolar disorders identified by either method. Individuals were classified as having 'other mental health disorders' if they only had other mental health disorders identified by ICD-9 codes but no psychotic/bipolar or depression/anxiety disorders detected by either method. Individuals without any diagnoses by both methods were considered as having 'No mental health disorders'.

Appendix IV. Classification System of Mental health disorders with the combination method

ICD-9 Diagnosis	Medicaid Rx Group	Decision on mental health disorder
Schizophrenia, bipolar disorder	Psychotic/ bipolar, depression/ anxiety, or none	Psychotic/ bipolar disorders
Depression/ anxiety	Psychotic/ bipolar	Psychotic/ bipolar disorders
Depression/ anxiety	Depression/ anxiety, or none	Depression/ anxiety
Other mental health disorders	Depression/ anxiety	Depression/ anxiety
Other mental health disorders	None	Other mental health disorders

Appendix V. Results from sub-analysis using Medicaid Rx models

Unadjusted analyses showed a general trend for higher rates of full adherence to quality measures among people with psychotic/bipolar or depression/anxiety disorders, than those of people with diabetes alone, regardless of the method used for identifying mental health disorders (see Appendices VII to IX). Further, such associations remained statistically significant even after adjusting for substance use disorders and other covariates in the logistic models, regardless of the methods used in assessing mental health disorders (see Appendix X).

Appendix VI. Comparison of <u>Mental Disorder Prevalence among the Three Methods</u>

N= 46,037

	Case Detection Methods		
	ICD-9 only	Medicaid Rx only	ICD-9 & Medicaid Rx
No mental health disorders (%)	26,026 (57)	24,929 (54)	19,267 (42)
Psychotic/bipolar disorder (%)	5,999 (13)	7,270 (16)	8,861 (19)
Depression/ anxiety (%)	12,485 (27)	13,838 (30)	17,072 (37)
Other mental health disorders (%)	1,527 (3)	NA	837 (2)

Appendix VII. Adherence to Quality Measures in Condensed Mental Disorder Groups by ICD-9 codes*

	Condensed Mental Disorder Groups				Overall
	No mental health disorders	Psychotic/ bipolar	Depression/ anxiety	Other mental health disorders	
No. of beneficiaries	26,026	5,999	12,485	1,527	46,037
Full adherence in 2005 (%)[a,3]	4,426 (17)	1,085 (18)[5]	2,234 (18)[5,11]	254 (17)[7,9,14]	7,999 (17)
Any HbA1c test 2005 (%)[a,1]	17,467 (67)	4,071 (68)[6]	7,855 (63)[4,8]	952 (62)[4,8,15]	30,345 (66)
Any Nephropathy test 2005 (%)[a,1]	10,198 (39)	2,965 (49)[4]	5,555 (44)[4,8]	642 (42)[5,8,13]	19,360 (42)
Any LDL-c test 2005 (%)[a,1]	15,814 (61)	3,834 (64)[4]	7,186 (58)[4,8]	831 (54)[4,8,12]	27,665 (60)
Any Eye exam 2005 (%)[a,1]	11,603 (45)	2,454 (41)[4]	5,173 (41)[4,10]	633 (41)[5,11,16]	19,863 (43)

* Beneficiaries with Medicare only excluded.

[a] χ^2test

Across all mental disorder categories:

[1] $p<0.001$, [2] $p<0.01$, [3] $p=0.06$

In pairwise comparisons, No mental health disorders vs. Psychotic/Bipolar, depression/ anxiety or other mental health disorders:

[4] $p<0.001$, [5] $p<0.05$, [6] $p=0.3$, [7] $p=0.7$

In pairwise comparisons, Psychotic/Bipolar vs. depression/ anxiety or other mental health disorders:

[8] $p<0.001$, [9] $p=0.2$, [10] $p=0.5$, [11] $p=0.7$

In pairwise comparisons between depression/ anxiety and other mental health disorders:

[12] $p<0.05$, [13] $p=0.06$, [14] $p=0.2$, [15] $p=0.7$, [16] $p=1.0$

Appendix VIII. Adherence to Quality Measures in Mental Disorder Groups by Medicaid Rx only*

	Medicaid Rx Mental Disorder Groups			Overall
	No mental health disorders	Psychotic/ bipolar	Depression/ anxiety	
No. of beneficiaries (%)	24,929	7,270	13,838	46,037
Full adherence in 2005 (%)[a,1]	3,555 (14)	1,444 (20)[2]	3,000 (22)[2,4]	7,999 (17)
Any HbA1c test 2005 (%)[a,1]	14,516 (58)	5,393 (74)[2]	10,436 (75)[2,5]	30,345 (66)
Any Nephropathy test 2005 (%)[a,1]	8,478 (34)	3,873 (53)[2]	7,009 (51)[2,3]	19,360 (42)
Any LDL-c test 2005 (%)[a,1]	13,079 (52)	5,007 (69)[2]	9,579 (69)[2,6]	27,665 (60)
Any Eye exam 2005 (%)[a,1]	9,549 (54)	3,293 (45)[2]	7,021 (51)[2,3]	19,863 (43)

* Beneficiaries with Medicare only excluded.
[a] χ^2 test
Across all mental disorder categories:
[1] $p<0.001$
In pairwise comparisons, i.e., Psychotic/Bipolar vs. No mental health disorders or depression/ anxiety vs. No mental health disorders:
[2] $p<0.001$
In pairwise comparisons between Psychotic/Bipolar and depression/ anxiety:
[3] $p<0.001$, [4] $p<0.01$, [5] $p<0.05$, [6] $p=0.6$

Appendix IX. Adherence to Quality Measures in Mental Disorder Groups by Combination Method of ICD-9 and Medicaid Rx*

	Medicaid Rx/ICD-9 Mental Disorder Groups				Overall
	No mental health disorders	Psychotic/ bipolar	Depression/ anxiety	Other mental health disorders	
No. of beneficiaries	19,267	8,861	17,072	837	46,037
Full adherence in 2005 (%)[a,1]	3,002 (16)	1,646 (19)[2]	3,237 (19)[2,7]	114 (14)[3,6,8]	7,999 (17)
Any HbA1c test 2005 (%)[a,1]	12,331 (64)	6,159 (70)[2]	11,426 (67)[2,6]	429 (51)[2,6,8]	30,345 (66)
Any Nephropathy test 2005 (%)[a,1]	6,933 (36)	4,470 (50)[2]	7,659 (45)[2,6]	298 (36)[4,6,8]	19,360 (42)
Any LDL-c test 2005 (%)[a,1]	11,136 (58)	5,740 (65)[2]	10,416 (61)[2,6]	373 (45)[2,6,8]	27,665 (60)
Any Eye exam 2005 (%)[a,1]	8,153 (42)	3,746 (42)[5]	7,670 (45)[2,6]	294 (35)[2,6,8]	19,863 (43)

* Beneficiaries with Medicare only excluded.
[a] χ^2 test
Across all mental disorder categories:
[1] $p < 0.001$
In pairwise comparisons, No mental health disorders vs. Psychotic/Bipolar, depression/ anxiety or other mental health disorders:
[2] $p < 0.001$, [3] $p = 0.1$, [4] $p = 0.8$, [5] $p = 0.9$
In pairwise comparisons, Psychotic/Bipolar vs. depression/ anxiety or other mental health disorders:
[6] $p < 0.001$, [7] $p = 0.5$
In pairwise comparisons between depression/ anxiety and other mental health disorders:
[8] $p < 0.001$

Appendix X. Comparisons of logistic models using different case detection methods with Full Adherence in 2005 as outcome

N=46,037	ICD-9 only		Medicaid Rx Only		ICD-9 & Medicaid Rx	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Psychotic/ bipolar disorders	1.35***	(1.22, 1.50)	1.50***	(1.33, 1.70)	1.36***	(1.23, 1.51)
Depression/ anxiety	1.10*	(1.02, 1.17)	1.27***	(1.17, 1.39)	1.12**	(1.05, 1.19)
Other mental health disorders	1.01	(0.85, 1.20)	N/A		0.95	(0.74, 1.21)
Any alcohol abuse/ dependence	0.87**	(0.79, 0.97)	0.87**	(0.78, 0.96)	0.87**	(0.78, 0.96)
Any drug abuse/ dependence	0.66***	(0.56, 0.79)	0.66***	(0.55, 0.79)	0.66***	(0.55, 0.79)
Age Groups						
<55 (ref.)	1		1		1	
55-64	1.47***	(1.38, 1.57)	1.46***	(1.37, 1.57)	1.47***	(1.37, 1.57)
65-74	1.50***	(1.39, 1.62)	1.55***	(1.43, 1.67)	1.52***	(1.40, 1.64)
75 and older	1.33***	(1.22, 1.46)	1.39***	(1.27, 1.52)	1.35***	(1.24, 1.47)
Male Gender	0.90*	(0.82, 0.98)	0.91*	(0.83, 1.00)	0.90*	(0.83, 0.98)
Race/ethnicity						
Non-Hispanic white (ref.)	1		1		1	
African American	0.97	(0.87, 1.08)	0.99	(0.88, 1.11)	0.988	(0.88, 1.09)
Hispanic	1.087	(0.94, 1.24)	1.09	(0.94, 1.25)	1.08	(0.94, 1.24)
Others	1.20***	(1.09, 1.32)	1.22***	(1.11, 1.35)	1.21***	(1.10, 1.33)
Unknown	0.82**	(0.71, 0.95)	0.82**	(0.72, 0.95)	0.82**	(0.71, 0.95)
CDPS score in 2004						
CDPS<0.8 (ref.)	1		1		1	
0.8<=CDPS<1.3	1.19***	(1.10, 1.30)	1.19***	(1.09, 1.29)	1.19***	(1.10, 1.30)
1.3<=CDPS<=1.9	1.04	(0.91, 1.18)	1.04	(0.91, 1.18)	1.04	(0.91, 1.19)
CDPS>1.9	0.92	(0.80, 1.06)	0.93	(0.81, 1.06)	0.93	(0.81, 1.06)
Health coverage type						
Medicaid only (ref.)	1		1		1	
Dual-eligible	1.76***	(1.59, 1.95)	1.70***	(1.55, 1.87)	1.75***	(1.58, 1.93)
Continuous 12-month coverage	1.37***	(1.24, 1.51)	1.35***	(1.22, 1.49)	1.36***	(1.23, 1.50)
Percent of High School Graduate						
<75% (ref.)	1		1		1	
75-84%	0.97	(0.84, 1.11)	0.97	(0.84, 1.12)	0.97	(0.84, 1.12)
85-90%	1.01	(0.81, 1.26)	1.01	(0.82, 1.26)	1.02	(0.82, 1.26)
>90%	0.98	(0.78, 1.22)	0.99	(0.79, 1.23)	0.99	(0.79, 1.23)
Median Household income 1999						
<$36,448 (ref.)	1		1		1	
$36,448-$45,920	0.96	(0.90, 1.03)	0.96	(0.90, 1.03)	0.96	(0.90, 1.03)
$45,921-$56,813	0.96	(0.81, 1.14)	0.96	(0.81, 1.13)	0.96	(0.80, 1.14)
>$56,813	0.99	(0.83, 1.18)	0.99	(0.83, 1.18)	0.99	(0.82, 1.18)
No Previous Complications	0.98	(0.92, 1.05)	0.98	(0.92, 1.05)	0.98	(0.92, 1.05)
Eye complications in 2004	1.74***	(1.61, 1.88)	1.76***	(1.62, 1.90)	1.74***	(1.62, 1.88)
Nephropathy in 2004	1.19***	(1.09, 1.30)	1.19***	(1.09, 1.30)	1.19***	(1.09, 1.30)
Neuropathy in 2004	1.30***	(1.20, 1.41)	1.29***	(1.19, 1.39)	1.29***	(1.20, 1.40)
Ischemic Heart Disease in 2004	1.09*	(1.00, 1.19)	1.09*	(1.00, 1.18)	1.09*	(1.00, 1.18)
Lower-limb amputations 2004	1.03	(0.94, 1.12)	1.02	(0.94, 1.11)	1.02	(0.94, 1.11)
Cerebrovascular diseases 2004	0.96	(0.86, 1.07)	0.95	(0.86, 1.06)	0.96	(0.86, 1.06)
No. of outpatient visits 2004	1.06***	(1.06, 1.07)	1.06***	(1.05, 1.06)	1.06***	(1.05, 1.06)

* p<0.05 **p<0.01 ***p<0.001

Appendix XI. Cross-tabulation of Cases between ICD-9 codes and Medicaid Rx

| *Key* |
| Frequency (N) |
| Row percentage |
| Column percentage |

| Mental health disorders by ICD-9 codes | Mental health disorders by Medicaid Rx | | | |
	No mental health disorders	Psychotic/ bipolar disorder	Depression/ anxiety disorder	Total
No mental health disorders	19,694	481	6,409	26,584
	74.08	1.81	24.11	100.00
	77.22	6.44	45.31	56.43
Psychotic/ bipolar disorder	922	4,513	727	6,162
	14.96	73.24	11.80	100.00
	3.61	60.46	5.14	13.08
Depression/ anxiety disorder	4,027	2,301	6,470	12,798
	31.47	17.98	50.55	100.00
	15.79	30.83	45.74	27.16
Other mental health disorders	862	169	538	1,569
	54.94	10.77	34.29	100.00
	3.38	2.26	3.80	3.33
Total	25,505	7,464	14,144	47,113
	54.14	15.84	30.02	100.00
	100.00	100.00	100.00	100.00

Appendix XII. Analytic models used in the study (Outcome: Full Adherence in 2005)

N=106,174	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.80***	(0.72, 0.88)	1.15*	(1.02, 1.29)	1.02	(0.91, 1.14)
Bipolar disorder	0.81***	(0.72, 0.90)	1.06	(0.97, 1.17)	0.98	(0.90, 1.07)
Depression/ anxiety	0.86**	(0.79, 0.94)	0.97	(0.92, 1.03)	0.96	(0.91, 1.01)
Other mental health disorders	0.86**	(0.77, 0.95)	0.89*	(0.81, 0.99)	0.88*	(0.79, 0.97)
Any alcohol abuse/ dependence	0.67***	(0.61, 0.73)	0.71***	(0.65, 0.78)	0.71***	(0.65, 0.78)
Any drug abuse/ dependence	0.48***	(0.42, 0.54)	0.65***	(0.57, 0.73)	0.67***	(0.59, 0.76)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			1.83***	(1.72, 1.95)	1.56***	(1.47, 1.66)
65-74			2.76***	(2.50, 3.05)	1.69***	(1.58, 1.80)
75 and older			2.34***	(2.09, 2.61)	1.41***	(1.31, 1.51)
Male Gender	N/A		1.07*	(1.02, 1.12)	1.02	(0.98, 1.07)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			0.78***	(0.68, 0.90)	0.82**	(0.72, 0.94)
Hispanic			0.78***	(0.69, 0.89)	0.91	(0.79, 1.04)
Others			0.87**	(0.79, 0.96)	0.93	(0.85, 1.00)
Unknown			0.42***	(0.38, 0.47)	0.66***	(0.57, 0.77)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.55***	(1.49, 1.62)	1.57***	(1.50, 1.65)
1.3<=CDPS<=1.9			1.72***	(1.60, 1.85)	1.80***	(1.66, 1.95)
CDPS>1.9			1.82***	(1.71, 1.95)	1.96***	(1.83, 2.10)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.46***	(0.38, 0.55)
Dual-eligible					0.97	(0.90, 1.05)
Continuous 12-month coverage	N/A		N/A		1.79***	(1.63, 1.96)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					0.99	(0.90, 1.09)
85-90%					1.00	(0.85, 1.19)
>90%					1.06	(0.89, 1.28)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					0.94	(0.87, 1.02)
$45,921-$56,813					1.00	(0.90, 1.11)
>$56,813					1.02	(0.89, 1.16)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Full Adherence in 2005)

N=106,174	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.13*	(1.01, 1.27)	1.22**	(1.08, 1.37)
Bipolar disorder	1.07	(0.98, 1.18)	1.05	(0.95, 1.15)
Depression/ anxiety	0.99	(0.94, 1.04)	0.95*	(0.90, 1.00)
Other mental health disorders	0.90*	(0.81, 1.00)	0.88*	(0.79, 0.98)
Any alcohol abuse/ dependence	0.75***	(0.69, 0.83)	0.79***	(0.71, 0.86)
Any drug abuse/ dependence	0.69***	(0.60, 0.78)	0.67***	(0.59, 0.76)
Age Groups				
<55 (ref.)	1		1	
55-64	1.46***	(1.38, 1.55)	1.42***	(1.34, 1.51)
65-74	1.61***	(1.51, 1.72)	1.62***	(1.52, 1.73)
75 and older	1.38***	(1.28, 1.48)	1.39***	(1.30, 1.49)
Male Gender	1.01	(0.96, 1.06)	1.04	(0.98, 1.10)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.79***	(0.69, 0.90)	0.91*	(0.84, 0.99)
Hispanic	0.92	(0.79, 1.06)	1.03	(0.90, 1.19)
Others	0.94	(0.87, 1.02)	1.03	(0.94, 1.13)
Unknown	0.68***	(0.58, 0.79)	0.77***	(0.67, 0.89)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.42***	(1.36, 1.48)	1.27***	(1.21, 1.32)
1.3<=CDPS<=1.9	1.51***	(1.40, 1.62)	1.20***	(1.10, 1.30)
CDPS>1.9	1.50***	(1.42, 1.60)	1.08	(1.00, 1.16)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.50***	(0.42, 0.60)	0.53***	(0.46, 0.61)
Dual-eligible	0.93*	(0.87, 0.99)	0.91*	(0.84, 1.00)
Continuous 12-month coverage	1.74***	(1.58, 1.91)	1.66***	(1.52, 1.83)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.00	(0.90, 1.10)	1.00	(0.90, 1.10)
85-90%	1.02	(0.85, 1.21)	1.00	(0.86, 1.17)
>90%	1.09	(0.90, 1.32)	1.07	(0.90, 1.26)
Median Household income 1999				
<$36,44 (ref.)	1		1	
$36,448-$45,920	0.95	(0.87, 1.04)	0.95	(0.88, 1.02)
$45,921-$56,813	1.00	(0.90, 1.11)	1.00	(0.90, 1.11)
>$56,813	1.01	(0.88, 1.17)	1.02	(0.89, 1.17)
No Previous Complications	0.97	(0.92, 1.02)	0.96	(0.92, 1.01)
Eye complications in 2004	1.64***	(1.54, 1.74)	1.63***	(1.53, 1.73)
Nephropathy in 2004	1.29***	(1.22, 1.35)	1.29***	(1.21, 1.37)
Neuropathy in 2004	1.36***	(1.30, 1.42)	1.31***	(1.25, 1.38)
Ischemic Heart Disease in 2004	1.10**	(1.03, 1.17)	1.01	(0.95, 1.08)
Lower-limb amputations 2004	0.92**	(0.86, 0.97)	0.88***	(0.83, 0.94)
Cerebrovascular diseases 2004	0.97	(0.93, 1.02)	0.94*	(0.90, 0.99)
No. of outpatient visits 2004	N/A		1.05***	(1.05, 1.06)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having at least 1 HbA1c test in 2005)

N=106,174	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.94	(0.86, 1.02)	1.66***	(1.50, 1.84)	1.28***	(1.16, 1.41)
Bipolar disorder	0.66***	(0.59, 0.74)	1.11	(0.98, 1.25)	0.92	(0.83, 1.02)
Depression/ anxiety	0.70***	(0.61, 0.81)	0.98	(0.90, 1.06)	0.91**	(0.85, 0.98)
Other mental health disorders	0.80***	(0.72, 0.89)	1.00	(0.91, 1.09)	0.95	(0.87, 1.04)
Any alcohol abuse/ dependence	0.75***	(0.68, 0.82)	0.88*	(0.80, 0.97)	0.85**	(0.77, 0.94)
Any drug abuse/ dependence	0.53***	(0.49, 0.58)	0.85**	(0.76, 0.95)	0.89	(0.78, 1.01)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			2.33***	(2.21, 2.46)	2.01***	(1.90, 2.12)
65-74			3.62***	(3.14, 4.17)	1.99***	(1.87, 2.12)
75 and older			2.93***	(2.48, 3.46)	1.57***	(1.46, 1.68)
Male Gender	N/A		1.11***	(1.05, 1.16)	1.05*	(1.00, 1.09)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			0.99**	(0.84, 0.97)	0.90*	(0.84, 0.98)
Hispanic			0.58***	(0.52, 0.65)	0.64***	(0.58, 0.70)
Others			1.07	(0.98, 1.17)	1.03	(0.94, 1.14)
Unknown			0.45***	(0.41, 0.49)	0.69***	(0.62, 0.77)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.07**	(1.03, 1.11)	1.15***	(1.11, 1.19)
1.3<=CDPS<=1.9			1.00	(0.93, 1.08)	1.16***	(1.10, 1.23)
CDPS>1.9			0.84***	(0.78, 0.90)	1.02	(0.97, 1.08)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.41***	(0.37, 0.49)
Dual-eligible					1.30***	(1.20, 1.40)
Continuous 12-month coverage	N/A		N/A		1.48***	(1.33, 1.65)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					0.94	(0.85, 1.05)
85-90%					0.97	(0.85, 1.11)
>90%					0.93	(0.76, 1.14)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					1.10	(0.97, 1.24)
$45,921-$56,813					1.14	(0.99, 1.30)
>$56,813					1.07	(0.88, 1.30)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having at least 1 HbA1c test in 2005)

N=106,174	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.45***	(1.32, 1.59)	1.51***	(1.38, 1.66)
Bipolar disorder	1.02	(0.92, 1.12)	0.98	(0.89, 1.07)
Depression/ anxiety	0.94	(0.88, 1.01)	0.89**	(0.83, 0.96)
Other mental health disorders	0.96	(0.87, 1.06)	0.94	(0.86, 1.02)
Any alcohol abuse/ dependence	0.89*	(0.81, 0.98)	0.92	(0.84, 1.01)
Any drug abuse/ dependence	0.91	(0.79, 1.05)	0.90	(0.79, 1.02)
Age Groups				
<55 (ref.)	1		1	
55-64	1.84***	(1.75, 1.94)	1.74***	(1.65, 1.84)
65-74	1.92***	(1.79, 2.05)	1.89***	(1.76, 2.03)
75 and older	1.55***	(1.44, 1.66)	1.52***	(1.41, 1.64)
Male Gender	1.02	(0.98, 1.07)	1.05*	(1.00, 1.10)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.85***	(0.78, 0.93)	1.00	(0.93, 1.07)
Hispanic	0.66***	(0.60, 0.72)	0.75***	(0.69, 0.83)
Others	1.08	(0.98, 1.19)	1.19***	(1.08, 1.31)
Unknown	0.72***	(0.64, 0.80)	0.82***	(0.74, 0.91)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.00	(0.96, 1.05)	0.88***	(0.85, 0.91)
1.3<=CDPS<=1.9	0.92*	(0.87, 0.98)	0.73***	(0.68, 0.79)
CDPS>1.9	0.71***	(0.67, 0.75)	0.52***	(0.48, 0.55)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.46***	(0.38, 1.56)	0.48***	(0.41, 0.57)
Dual-eligible	1.22***	(1.14, 1.31)	1.23***	(1.12, 1.35)
Continuous 12-month coverage	1.42***	(1.27, 1.60)	1.32***	(1.18, 1.47)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.95	(0.84, 1.06)	0.95	(0.85, 1.08)
85-90%	0.98	(0.84, 1.14)	0.97	(0.82, 1.14)
>90%	0.96	(0.77, 1.19)	0.94	(0.76, 1.17)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.11	(0.96, 1.28)	1.10	(0.94, 1.28)
$45,921-$56,813	1.14	(0.98, 1.33)	1.12	(0.96, 1.32)
>$56,813	1.07	(0.86, 1.32)	1.06	(0.86, 1.30)
No Previous Complications	0.93*	(0.88, 0.98)	0.92**	(0.87, 0.97)
Eye complications in 2004	2.20***	(1.98, 2.45)	2.19***	(0.98, 2.43)
Nephropathy in 2004	1.59***	(1.44, 1.75)	1.60***	(1.43, 1.79)
Neuropathy in 2004	2.01***	(1.85, 2.18)	1.93***	(1.77, 2.10)
Ischemic Heart Disease in 2004	1.04	(0.98, 1.10)	0.94*	(0.88, 0.99)
Lower-limb amputations 2004	1.27***	(1.18, 1.36)	1.21***	(1.13, 1.31)
Cerebrovascular diseases 2004	0.98	(0.93, 1.03)	0.93**	(0.88, 0.98)
No. of outpatient visits 2004	N/A		1.07***	(1.06, 1.08)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having at least 1 LDL-c test in 2005)

N=106,174	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.94	(0.87, 1.01)	1.68***	(1.51, 1.87)	1.39***	(1.27, 1.52)
Bipolar disorder	0.70***	(0.63, 0.78)	1.21***	(1.09, 1.34)	1.07	(0.96, 1.18)
Depression/ anxiety	0.69***	(0.60, 0.79)	0.98	(0.91, 1.06)	0.95	(0.88, 1.02)
Other mental health disorders	0.69***	(0.63, 0.77)	0.88**	(0.81, 0.97)	0.86**	(0.78, 0.94)
Any alcohol abuse/ dependence	0.66***	(0.62, 0.71)	0.79***	(0.73, 0.84)	0.77***	(0.72, 0.83)
Any drug abuse/ dependence	0.48***	(0.43, 0.53)	0.79***	(0.70, 0.90)	0.83**	(0.72, 0.95)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			2.18***	(2.10, 2.26)	1.86***	(1.77, 1.95)
65-74			4.09***	(3.61, 4.62)	2.07***	(1.94, 2.20)
75 and older			2.46***	(2.17, 2.80)	1.20***	(1.13, 1.29)
Male Gender	N/A		1.18***	(1.13, 1.23)	1.10***	(1.06, 1.15)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			0.67***	(0.62, 0.73)	0.72***	(0.65, 0.81)
Hispanic			0.55***	(0.50, 0.61)	0.66***	(0.58, 0.76)
Others			0.98	(0.89, 1.07)	1.06	(0.97, 1.16)
Unknown			0.44***	(0.40, 0.49)	0.70***	(0.61, 0.81)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.09***	(1.04, 1.14)	1.13***	(1.08, 1.18)
1.3<=CDPS<=1.9			0.91**	(0.84, 0.97)	0.99	(0.94, 1.05)
CDPS>1.9			0.67***	(0.62, 0.73)	0.77***	(0.72, 0.82)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.36***	(0.31, 0.43)
Dual-eligible					0.95	(0.89, 1.01)
Continuous 12-month coverage	N/A		N/A		1.76***	(1.62, 1.91)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					0.86	(0.73, 1.01)
85-90%					0.84	(0.68, 1.03)
>90%					0.83	(0.64, 1.07)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					1.22	(0.99, 1.50)
$45,921-$56,813					1.28*	(1.00, 1.63)
>$56,813					1.31	(0.99, 1.73)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having at least 1 LDL-c test in 2005)

N=106,174	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.49***	(1.37, 1.62)	1.55***	(1.42, 1.69)
Bipolar disorder	1.11*	(1.00, 1.23)	1.08	(0.97, 1.19)
Depression/ anxiety	0.96	(0.89, 1.03)	0.91*	(0.85, 0.98)
Other mental health disorders	0.86**	(0.78, 0.94)	0.84***	(0.76, 0.92)
Any alcohol abuse/ dependence	0.79***	(0.74, 0.85)	0.82***	(0.76, 0.89)
Any drug abuse/ dependence	0.85*	(0.74, 0.98)	0.84**	(0.74, 0.95)
Age Groups				
<55 (ref.)	1		1	
55-64	1.73***	(1.65, 1.82)	1.65***	(1.57, 1.73)
65-74	1.92***	(1.80, 2.04)	1.90***	(1.79, 2.03)
75 and older	1.10**	(1.03, 1.18)	1.08*	(1.01, 1.17)
Male Gender	1.06**	(1.03, 1.10)	1.09***	(1.04, 1.13)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.73***	(0.65, 0.82)	0.85***	(0.79, 0.92)
Hispanic	0.68***	(0.59, 0.79)	0.77***	(0.67, 0.89)
Others	1.11*	(1.01, 1.21)	1.22***	(1.12, 1.34)
Unknown	0.72***	(0.62, 0.83)	0.82**	(0.73, 0.93)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.03	(0.99, 1.07)	0.92**	(0.88, 0.97)
1.3<=CDPS<=1.9	0.86***	(0.81, 0.90)	0.69***	(0.65, 0.73)
CDPS>1.9	0.64***	(0.60, 0.67)	0.47***	(0.44, 0.51)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.39***	(0.33, 0.46)	0.41***	(0.36, 0.47)
Dual-eligible	0.92*	(0.87, 0.98)	0.93	(0.86, 1.00)
Continuous 12-month coverage	1.73***	(1.60, 1.88)	1.63***	(1.51, 1.76)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.86	(0.73, 1.01)	0.87	(0.73, 1.02)
85-90%	0.85	(0.69, 1.04)	0.83	(0.69, 1.01)
>90%	0.85	(0.66, 1.09)	0.83	(0.66, 1.03)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.22	(0.99, 1.49)	1.22	(0.98, 1.51)
$45,921-$56,813	1.27	(1.00, 1.60)	1.26	(0.97, 1.63)
>$56,813	1.30	(0.99, 1.70)	1.30	(0.98, 1.72)
No Previous Complications	0.90***	(0.86, 0.94)	0.89***	(0.85, 0.93)
Eye complications in 2004	1.25***	(1.17, 1.32)	1.22***	(1.15, 1.30)
Nephropathy in 2004	0.88***	(0.81, 0.94)	0.86**	(0.79, 0.95)
Neuropathy in 2004	1.16***	(1.10, 1.22)	1.10**	(1.03, 1.17)
Ischemic Heart Disease in 2004	1.31***	(1.23, 1.39)	1.20***	(1.13, 1.28)
Lower-limb amputations 2004	0.82***	(0.77, 0.88)	0.78***	(0.74, 0.83)
Cerebrovascular diseases 2004	1.04	(0.99, 1.10)	1.00	(0.95, 1.05)
No. of outpatient visits 2004	N/A		1.07***	(1.06, 1.07)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having at least 1 Nephropathy test in 2005)

N=106,174	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	1.13**	(1.05, 1.23)	1.48***	(1.37, 1.61)	1.26***	(1.17, 1.36)
Bipolar disorder	1.19**	(1.06, 1.34)	1.46***	(1.32, 1.62)	1.31***	(1.20, 1.43)
Depression/ anxiety	1.06	(0.96, 1.18)	1.17***	(1.11, 1.23)	1.13***	(1.07, 1.19)
Other mental health disorders	1.05	(0.98, 1.13)	1.06	(0.98, 1.15)	1.03	(0.95, 1.11)
Any alcohol abuse/ dependence	0.99	(0.93, 1.05)	1.01	(0.95, 1.08)	1.00	(0.93, 1.07)
Any drug abuse/ dependence	0.94	(0.87, 1.00)	1.12**	(1.03, 1.21)	1.17***	(1.07, 1.27)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			1.48***	(1.41, 1.56)	1.29***	(1.24, 1.35)
65-74			1.99***	(1.78, 2.22)	1.28***	(1.21, 1.34)
75 and older			1.98***	(1.76, 2.23)	1.25***	(1.18, 1.32)
Male Gender	N/A		1.07*	(1.01, 1.13)	1.03	(0.98, 1.08)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			0.85***	(0.78, 0.93)	0.87***	(0.80, 0.94)
Hispanic			0.74***	(0.69, 0.79)	0.81***	(0.74, 0.88)
Others			0.92	(0.81, 1.04)	0.91	(0.83, 1.00)
Unknown			0.45***	(0.41, 0.50)	0.64***	(0.54, 0.75)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.37***	(1.31, 1.43)	1.42***	(1.35, 1.49)
1.3<=CDPS<=1.9			1.59***	(1.48, 1.71)	1.72***	(1.59, 1.85)
CDPS>1.9			1.95***	(1.82, 2.08)	2.18***	(2.05, 2.33)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.50***	(0.42, 0.59)
Dual-eligible					1.12***	(1.07, 1.18)
Continuous 12-month coverage	N/A		N/A		1.21***	(1.12, 1.30)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					0.98	(0.85, 1.12)
85-90%					0.95	(0.79, 1.15)
>90%					1.00	(0.83, 1.22)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					0.97	(0.87, 1.09)
$45,921-$56,813					1.03	(0.92, 1.17)
>$56,813					1.09	(0.95, 1.26)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having at least 1 Nephropathy test in 2005)

N=106,174	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.31***	(1.22, 1.42)	1.39***	(1.28, 1.50)
Bipolar disorder	1.36***	(1.24, 1.49)	1.34***	(1.23, 1.45)
Depression/ anxiety	1.14***	(1.09, 1.20)	1.10***	(1.05, 1.15)
Other mental health disorders	1.04	(0.96, 1.12)	1.02	(0.94, 1.11)
Any alcohol abuse/ dependence	1.01	(0.95, 1.09)	1.06	(1.00, 1.14)
Any drug abuse/ dependence	1.18***	(1.08, 1.29)	1.18***	(1.09, 1.28)
Age Groups				
<55 (ref.)	1		1	
55-64	1.26***	(1.21, 1.31)	1.20***	(1.15, 1.25)
65-74	1.26***	(1.20, 1.32)	1.24***	(1.18, 1.31)
75 and older	1.24***	(1.17, 1.31)	1.23***	(1.16, 1.30)
Male Gender	1.01	(0.96, 1.07)	1.04	(0.97, 1.10)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.86***	(0.79, 0.93)	1.00	(0.94, 1.05)
Hispanic	0.82***	(0.75, 0.89)	0.93	(0.86, 1.01)
Others	0.92	(0.84, 1.01)	1.01	(0.91, 1.12)
Unknown	0.65***	(0.55, 0.76)	0.74***	(0.64, 0.85)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.37***	(1.31, 1.43)	1.22***	(1.16, 1.28)
1.3<=CDPS<=1.9	1.61***	(1.51, 1.72)	1.29***	(1.18, 1.40)
CDPS>1.9	1.91***	(1.79, 2.04)	1.41***	(1.30, 1.53)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.52***	(0.43, 0.62)	0.55***	(0.48, 0.63)
Dual-eligible	1.10***	(1.05, 1.15)	1.09**	(1.02, 1.17)
Continuous 12-month coverage	1.20***	(1.11, 1.29)	1.12**	(1.04, 1.20)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.97	(0.85, 1.11)	0.97	(0.85, 1.11)
85-90%	0.95	(0.79, 1.14)	0.94	(0.79, 1.11)
>90%	1.00	(0.82, 1.22)	0.98	(0.82, 1.17)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.98	(0.88, 1.10)	0.97	(0.88, 1.08)
$45,921-$56,813	1.04	(0.92, 1.18)	1.03	(0.91, 1.16)
>$56,813	1.10	(0.95, 1.27)	1.09	(0.95, 1.27)
No Previous Complications	1.02	(0.97, 1.06)	1.01	(0.97, 1.05)
Eye complications in 2004	1.02	(0.97, 1.08)	1.00	(0.95, 1.05)
Nephropathy in 2004	1.65***	(1.53, 1.78)	1.67***	(1.52, 1.83)
Neuropathy in 2004	1.07**	(1.02, 1.13)	1.03	(0.97, 1.08)
Ischemic Heart Disease in 2004	1.11***	(1.05, 1.17)	1.02	(0.96, 1.08)
Lower-limb amputations 2004	1.05	(0.99, 1.11)	1.01	(0.95, 1.07)
Cerebrovascular diseases 2004	1.01	(0.96, 1.06)	0.97	(0.91, 1.02)
No. of outpatient visits 2004	N/A		1.06***	(1.05, 1.07)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having at least 1 Eye Examination in 2005)

N=106,174	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.59***	(0.54, 0.65)	1.18**	(1.06, 0.31)	1.01	(0.91, 1.12)
Bipolar disorder	0.56***	(0.50, 0.64)	0.99	(0.89, 1.10)	0.89**	(0.82, 0.97)
Depression/ anxiety	0.70***	(0.62, 0.79)	0.95	(0.89, 1.01)	0.94*	(0.89, 0.99)
Other mental health disorders	0.77***	(0.71, 0.83)	0.93*	(0.87, 0.99)	0.91**	(0.85, 0.98)
Any alcohol abuse/ dependence	0.59***	(0.55, 0.63)	0.74***	(0.69, 0.79)	0.73***	(0.68, 0.78)
Any drug abuse/ dependence	0.41***	(0.38, 0.44)	0.68***	(0.63, 0.74)	0.71***	(0.65, 0.77)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			2.07***	(1.95, 2.20)	1.75***	(1.64, 1.87)
65-74			4.31***	(3.86, 4.81)	2.18***	(2.07, 2.31)
75 and older			4.41***	(3.90, 4.98)	2.16***	(2.04, 2.29)
Male Gender	N/A		0.93***	(0.90, 0.96)	0.86***	(0.84, 0.88)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			0.88**	(0.80, 0.97)	0.98	(0.88, 1.08)
Hispanic			0.68***	(0.62, 0.76)	0.86**	(0.78, 0.95)
Others			0.73***	(0.68, 0.79)	0.83***	(0.76, 0.90)
Unknown			0.43***	(0.40, 0.46)	0.72***	(0.65, 0.80)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.38***	(1.33, 1.44)	1.40***	(1.35, 1.46)
1.3<=CDPS<=1.9			1.44***	(1.36, 1.51)	1.53***	(1.46, 1.61)
CDPS>1.9			1.26***	(1.19, 1.33)	1.40***	(1.33, 1.46)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.34***	(0.29, 0.40)
Dual-eligible					0.85***	(0.79, 0.92)
Continuous 12-month coverage	N/A		N/A		1.67***	(1.57, 1.77)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					1.02	(0.95, 1.10)
85-90%					1.06	(0.97, 1.16)
>90%					1.14*	(1.01, 1.28)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					0.99	(0.93, 1.05)
$45,921-$56,813					1.02	(0.94, 1.10)
>$56,813					0.98	(0.88, 1.08)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having at least 1 Eye Examination in 2005)

N=106,174	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	1.12*	(1.01, 1.24)	1.19**	(1.06, 1.33)
Bipolar disorder	0.98	(0.90, 1.06)	0.94	(0.87, 1.03)
Depression/ anxiety	0.97	(0.92, 1.03)	0.93*	(0.87, 0.99)
Other mental health disorders	0.93*	(0.87, 1.00)	0.91*	(0.85, 0.98)
Any alcohol abuse/ dependence	0.77***	(0.72, 0.82)	0.80***	(0.75, 0.86)
Any drug abuse/ dependence	0.73***	(0.67, 0.80)	0.71***	(0.65, 0.78)
Age Groups				
<55 (ref.)	1		1	
55-64	1.66***	(1.56, 1.76)	1.59***	(1.50, 1.69)
65-74	2.15***	(2.03, 2.27)	2.16***	(2.04, 2.29)
75 and older	2.20***	(2.08, 2.34)	2.23***	(2.11, 2.37)
Male Gender	0.86***	(0.84, 0.89)	0.88***	(0.86, 0.91)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.93	(0.84, 1.02)	1.09*	(1.01, 1.18)
Hispanic	0.86**	(0.78, 0.94)	0.98	(0.89, 1.08)
Others	0.83***	(0.77, 0.90)	0.91*	(0.84, 0.99)
Unknown	0.73***	(0.66, 0.81)	0.84***	(0.77, 0.92)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.28***	(1.23, 1.34)	1.14***	(1.08, 1.20)
1.3<=CDPS<=1.9	1.33***	(1.27, 1.40)	1.06	(0.98, 1.14)
CDPS>1.9	1.14***	(1.07, 1.20)	0.83***	(0.76, 0.90)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.36***	(0.30, 0.43)	0.38***	(0.33, 0.43)
Dual-eligible	0.81***	(0.75, 0.88)	0.81***	(0.73, 0.89)
Continuous 12-month coverage	1.61***	(1.51, 1.72)	1.52***	(1.42, 1.62)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.04	(0.96, 1.12)	1.04	(0.96, 1.14)
85-90%	1.08	(0.98, 1.20)	1.07	(0.97, 1.18)
>90%	1.18*	(1.03, 1.34)	1.16**	(1.04, 1.30)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.00	(0.93, 1.08)	0.99	(0.92, 1.07)
$45,921-$56,813	1.02	(0.93, 1.12)	1.01	(0.91, 1.12)
>$56,813	0.98	(0.86, 1.11)	0.97	(0.86, 1.10)
No Previous Complications	0.99	(0.94, 1.03)	0.98	(0.94, 1.03)
Eye complications in 2004	2.51***	(2.38, 2.66)	2.52***	(2.39, 2.67)
Nephropathy in 2004	1.11**	(1.04, 1.20)	1.12**	(1.04, 1.20)
Neuropathy in 2004	1.34***	(1.29, 1.40)	1.29***	(1.23, 1.35)
Ischemic Heart Disease in 2004	0.97	(0.93, 1.00)	0.88***	(0.85, 0.92)
Lower-limb amputations 2004	0.88***	(0.82, 0.95)	0.84***	(0.79, 0.91)
Cerebrovascular diseases 2004	0.97	(0.93, 1.01)	0.93***	(0.89, 0.97)
No. of outpatient visits 2004	N/A		1.06***	(1.06, 1.07)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Any Diabetes Complications in 2005)

N=106,174	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.42***	(0.38, 0.46)	0.62***	(0.57, 0.67)	0.47***	(0.43, 0.51)
Bipolar disorder	0.52***	(0.46, 0.59)	0.71***	(0.63, 0.79)	0.58***	(0.53, 0.64)
Depression/ anxiety	0.82***	(0.76, 0.89)	0.96	(0.92, 1.00)	0.89***	(0.86, 0.92)
Other mental health disorders	0.99	(0.90, 1.10)	0.95	(0.85, 1.07)	0.90	(0.80, 1.01)
Any alcohol abuse/ dependence	0.98	(0.89, 1.08)	0.91	(0.81, 1.02)	0.86*	(0.76, 0.98)
Any drug abuse/ dependence	0.66***	(0.61, 0.71)	0.83***	(0.78, 0.90)	0.87**	(0.81, 0.95)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			2.78***	(2.66, 2.90)	2.39***	(2.26, 2.52)
65-74			3.88***	(3.65, 4.14)	2.41***	(2.23, 2.59)
75 and older			4.51***	(4.24, 4.81)	2.75***	(2.58, 2.94)
Male Gender	N/A		1.56***	(1.49, 1.63)	1.53***	(1.46, 1.60)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			1.02	(0.92, 1.13)	0.98	(0.91, 1.04)
Hispanic			0.63***	(0.55, 0.71)	0.64***	(0.59, 0.70)
Others			0.68***	(0.61, 0.75)	0.61***	(0.54, 0.69)
Unknown			0.38***	(0.24, 0.42)	0.59***	(0.55, 0.64)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			2.10***	(2.00, 2.19)	2.24***	(2.16, 2.33)
1.3<=CDPS<=1.9			3.26***	(3.00, 3.54)	3.77***	(3.54, 4.02)
CDPS>1.9			4.89***	(4.44, 5.39)	6.07***	(5.62, 6.55)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.43***	(0.39, 0.47)
Dual-eligible					1.45***	(1.39, 1.51)
Continuous 12-month coverage	N/A		N/A		1.10*	(1.01, 1.19)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					0.98	(0.90, 1.06)
85-90%					0.94	(0.84, 1.05)
>90%					0.90	(0.79, 1.02)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					1.02	(0.93, 1.12)
$45,921-$56,813					1.06	(0.94, 1.20)
>$56,813					1.08	(0.94, 1.25)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Any Diabetes Complications in 2005)

N=106,174	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.71***	(0.65, 0.77)	0.72***	(0.67, 0.78)
Bipolar disorder	0.77***	(0.70, 0.85)	0.76***	(0.69, 0.84)
Depression/ anxiety	0.96*	(0.92, 1.00)	0.94**	(0.90, 0.98)
Other mental health disorders	0.89*	(0.78, 1.00)	0.88*	(0.78, 1.00)
Any alcohol abuse/ dependence	1.02	(0.91, 1.13)	1.04	(0.93, 1.15)
Any drug abuse/ dependence	0.98	(0.90, 1.05)	0.97	(0.90, 1.05)
Age Groups				
<55 (ref.)	1		1	
55-64	1.68***	(1.57, 1.80)	1.65***	(1.54, 1.77)
65-74	1.70***	(1.56, 1.86)	1.69***	(1.55, 1.85)
75 and older	1.90***	(1.78, 2.04)	1.90***	(1.77, 2.04)
Male Gender	1.27***	(1.22, 1.31)	1.28***	(1.24, 1.33)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.96	(0.91, 1.01)	1.02	(0.95, 1.09)
Hispanic	0.73***	(0.66, 0.80)	0.76***	(0.69, 0.85)
Others	0.69***	(0.63, 0.76)	0.72***	(0.66, 0.79)
Unknown	0.67***	(0.62, 0.73)	0.71***	(0.65, 0.78)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.27***	(1.20, 1.34)	1.20***	(1.15, 1.26)
1.3<=CDPS<=1.9	1.47***	(1.39, 1.56)	1.33***	(1.28, 1.39)
CDPS>1.9	1.60***	(1.51, 1.70)	1.41***	(1.33, 1.48)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.62***	(0.57, 0.68)	0.64***	(0.59, 0.69)
Dual-eligible	1.18***	(1.13, 1.23)	1.17***	(1.12, 1.23)
Continuous 12-month coverage	0.96	(0.88, 1.05)	0.93	(0.85, 1.02)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.01	(0.94, 1.07)	1.01	(0.94, 1.08)
85-90%	1.01	(0.92, 1.11)	1.01	(0.90, 1.12)
>90%	1.01	(0.90, 1.13)	1.00	(0.89, 1.13)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.01	(0.95, 1.08)	1.01	(0.94, 1.09)
$45,921-$56,813	1.01	(0.92, 1.11)	1.01	(0.91, 1.12)
>$56,813	1.02	(0.90, 1.15)	1.01	(0.89, 1.15)
No Previous Complications	0.43***	(0.40, 0.47)	0.43***	(0.39, 0.47)
Eye complications in 2004	3.00***	(2.76, 3.26)	2.99***	(2.75, 3.26)
Nephropathy in 2004	2.58***	(2.34, 2.85)	2.59***	(2.35, 2.85)
Neuropathy in 2004	3.45***	(3.17, 3.75)	3.39***	(3.11, 3.69)
Ischemic Heart Disease in 2004	4.20***	(3.82, 4.61)	4.07***	(3.73, 4.45)
Lower-limb amputations 2004	1.24***	(1.11, 1.39)	1.22**	(1.09, 1.37)
Cerebrovascular diseases 2004	1.86***	(1.72, 2.01)	1.84***	(1.70, 1.98)
No. of outpatient visits 2004	N/A		1.02***	(1.02, 1.03)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Eye Complications in 2005)

N=88,876	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.72***	(0.62, 0.83)	0.85*	(0.73, 0.99)	0.72***	(0.62, 0.85)
Bipolar disorder	0.63***	(0.52, 0.75)	0.73**	(0.61, 0.88)	0.65***	(0.54, 0.78)
Depression/ anxiety	0.92	(0.84, 1.00)	0.97	(0.90, 1.04)	0.92*	(0.85, 1.00)
Other mental health disorders	0.90	(0.75, 1.09)	0.91	(0.76, 1.11)	0.89	(0.73, 1.08)
Any alcohol abuse/ dependence	0.78**	(0.66, 0.92)	0.78**	(0.66, 0.92)	0.76**	(0.64, 0.90)
Any drug abuse/ dependence	0.78**	(0.67, 0.91)	0.91	(0.78, 1.06)	0.92	(0.78, 1.08)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			1.79***	(1.59, 2.01)	1.58***	(1.40, 1.78)
65-74			1.99***	(1.76, 2.26)	1.49***	(1.32, 1.67)
75 and older			1.63***	(1.45, 1.83)	1.21**	(1.07, 1.37)
Male Gender	N/A		1.00	(0.92, 1.08)	0.98	(0.91, 1.07)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			1.47***	(1.27, 1.69)	1.40***	(1.23, 1.60)
Hispanic			1.10	(0.83, 1.47)	1.10	(0.86, 1.40)
Others			1.07	(0.92, 1.25)	1.01	(0.86, 1.19)
Unknown			0.67***	(0.59, 0.77)	0.89	(0.77, 1.03)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.08*	(1.00, 1.16)	1.13**	(1.05, 1.21)
1.3<=CDPS<=1.9			1.21***	(1.11, 1.32)	1.32***	(1.22, 1.42)
CDPS>1.9			1.37***	(1.25, 1.50)	1.53***	(1.41, 1.66)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.60***	(0.50, 0.71)
Dual-eligible					1.22***	(1.13, 1.32)
Continuous 12-month coverage	N/A		N/A		1.13	(0.98, 1.30)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					0.84	(0.71, 1.00)
85-90%					0.82*	(0.70, 0.97)
>90%					0.76*	(0.62, 0.94)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					1.08	(0.94, 1.24)
$45,921-$56,813					1.08	(0.91, 1.28)
>$56,813					1.20	(0.97, 1.47)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Eye Complications in 2005)

N=88,876	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.81*	(0.69, 0.95)	0.82*	(0.69, 0.96)
Bipolar disorder	0.71***	(0.59, 0.85)	0.70***	(0.59, 0.84)
Depression/ anxiety	0.94	(0.87, 1.01)	0.93	(0.86, 1.01)
Other mental health disorders	0.87	(0.71, 1.05)	0.87	(0.71, 1.05)
Any alcohol abuse/ dependence	0.78**	(0.66, 0.92)	0.79**	(0.67, 0.92)
Any drug abuse/ dependence	0.92	(0.78, 1.09)	0.92	(0.78, 1.08)
Age Groups				
<55 (ref.)	1		1	
55-64	1.46***	(1.30, 1.65)	1.45***	(1.29, 1.64)
65-74	1.39***	(1.24, 1.56)	1.39***	(1.24, 1.56)
75 and older	1.11	(0.99, 1.26)	1.12	(0.99, 1.26)
Male Gender	0.94	(0.86, 1.01)	0.94	(0.87, 1.02)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.34***	(1.17, 1.53)	1.36***	(1.20, 1.55)
Hispanic	1.17	(0.91, 1.50)	1.19	(0.93, 1.52)
Others	1.06	(0.91, 1.24)	1.08	(0.92, 1.25)
Unknown	0.95	(0.83, 1.10)	0.97	(0.84, 1.12)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	0.98	(0.90, 1.07)	0.97	(0.89, 1.05)
1.3<=CDPS<=1.9	1.01	(0.92, 1.12)	0.99	(0.90, 1.08)
CDPS>1.9	0.98	(0.89, 1.09)	0.94	(0.85, 1.05)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.67***	(0.56, 0.80)	0.68***	(0.57, 0.81)
Dual-eligible	1.12**	(1.04, 1.22)	1.12**	(1.04, 1.22)
Continuous 12-month coverage	1.11	(0.97, 1.28)	1.10	(0.96, 1.27)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.83*	(0.69, 0.99)	0.83*	(0.69, 0.99)
85-90%	0.81*	(0.68, 0.95)	0.80*	(0.68, 0.95)
>90%	0.75**	(0.60, 0.92)	0.74**	(0.60, 0.92)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.09	(0.95, 1.25)	1.09	(0.94, 1.25)
$45,921-$56,813	1.08	(0.92, 1.27)	1.08	(0.91, 1.27)
>$56,813	1.20	(0.98, 1.47)	1.20	(0.98, 1.48)
No Previous Complications	0.97	(0.87, 1.07)	0.97	(0.87, 1.07)
Eye complications in 2004	N/A		N/A	
Nephropathy in 2004	2.03***	(1.83, 2.25)	2.03***	(1.83, 2.25)
Neuropathy in 2004	1.89***	(1.75, 2.04)	1.88***	(1.74, 2.04)
Ischemic Heart Disease in 2004	1.20***	(1.12, 1.29)	1.19***	(1.11, 1.28)
Lower-limb amputations 2004	1.51***	(1.34, 1.69)	1.50***	(1.34, 1.68)
Cerebrovascular diseases 2004	1.13*	(1.02, 1.25)	1.12*	(1.01, 1.25)
No. of outpatient visits 2004	N/A		1.01*	(1.00, 1.01)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Nephropathy in 2005)

N=100,810	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.60**	(0.45, 0.81)	0.63**	(0.47, 0.86)	0.48***	(0.34, 0.67)
Bipolar disorder	0.75*	(0.58, 0.97)	0.75*	(0.58, 0.97)	0.61***	(0.47, 0.80)
Depression/ anxiety	0.90	(0.80, 1.01)	0.84*	(0.74, 0.96)	0.77***	(0.69, 0.87)
Other mental health disorders	0.89	(0.72, 1.12)	0.74*	(0.58, 0.94)	0.70**	(0.55, 0.89)
Any alcohol abuse/ dependence	0.82	(0.64, 1.04)	0.62***	(0.49, 0.79)	0.59***	(0.46, 0.75)
Any drug abuse/ dependence	0.86	(0.68, 1.09)	0.79*	(0.63, 0.99)	0.81	(0.64, 1.02)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			2.00***	(1.75, 2.29)	1.60***	(1.36, 1.87)
65-74			2.04***	(1.76, 2.36)	1.33**	(1.12, 1.59)
75 and older			1.73***	(1.47, 2.03)	1.12	(0.93, 1.35)
Male Gender	N/A		1.43***	(1.33, 1.54)	1.41	(1.32, 1.35)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			1.76***	(1.54, 2.00)	1.69***	(1.50, 1.90)
Hispanic			0.96	(0.75, 1.22)	0.98	(0.81, 1.20)
Others			1.37**	(1.12, 1.66)	1.24*	(1.02, 1.50)
Unknown			0.36***	(0.27, 0.50)	0.57**	(0.41, 0.81)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.62***	(1.35, 1.94)	1.76***	(1.46, 2.11)
1.3<=CDPS<=1.9			2.40***	(2.03, 2.85)	2.78***	(2.36, 3.27)
CDPS>1.9			5.11***	(4.41, 5.93)	6.24***	(5.42, 7.20)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.48***	(0.38, 0.61)
Dual-eligible					1.61***	(1.48, 1.76)
Continuous 12-month coverage	N/A		N/A		1.01	(0.85, 1.21)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					1.20	(0.98, 1.46)
85-90%					1.16	(0.93, 1.44)
>90%					1.19	(0.90, 1.57)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					0.83*	(0.71, 0.97)
$45,921-$56,813					0.90	(0.75, 1.08)
>$56,813					0.87	(0.68, 1.10)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Nephropathy in 2005)

N=100,810	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.58**	(0.42, 0.81)	0.58**	(0.42, 0.81)
Bipolar disorder	0.70*	(0.53, 0.92)	0.70**	(0.53, 0.91)
Depression/ anxiety	0.80***	(0.71, 0.90)	0.79***	(0.70, 0.90)
Other mental health disorders	0.70**	(0.55, 0.88)	0.69**	(0.55, 0.88)
Any alcohol abuse/ dependence	0.63***	(0.50, 0.80)	0.64***	(0.50, 0.81)
Any drug abuse/ dependence	0.81	(0.64, 1.03)	0.81	(0.64, 1.03)
Age Groups				
<55 (ref.)	1		1	
55-64	1.38***	(1.20, 1.58)	1.37***	(1.20, 1.57)
65-74	1.17	(1.00, 1.37)	1.17	(1.00, 1.37)
75 and older	1.01	(0.86, 1.19)	1.01	(0.86, 1.19)
Male Gender	1.39***	(1.28, 1.50)	1.39***	(1.28, 1.50)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.61***	(1.44, 1.80)	1.64***	(1.47, 1.84)
Hispanic	1.02	(0.85, 1.21)	1.03	(0.86, 1.24)
Others	1.33**	(1.10, 1.61)	1.34**	(1.11, 1.63)
Unknown	0.61**	(0.43, 0.86)	0.62**	(0.44, 0.88)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.38**	(1.13, 1.67)	1.36**	(1.13, 1.64)
1.3<=CDPS<=1.9	1.86***	(1.59, 2.22)	1.82***	(1.55, 2.12)
CDPS>1.9	3.82***	(3.26, 4.47)	3.67***	(3.18, 4.24)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.58***	(0.46, 0.74)	0.59***	(0.47, 0.74)
Dual-eligible	1.50***	(1.38, 1.64)	1.51***	(1.38, 1.64)
Continuous 12-month coverage	0.96	(0.80, 1.15)	0.95	(0.79, 1.14)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.23*	(1.02, 1.49)	1.23*	(1.02, 1.49)
85-90%	1.20	(0.97, 1.47)	1.19	(0.97, 1.47)
>90%	1.27	(0.96, 1.67)	1.26	(0.96, 1.67)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.83*	(0.72, 0.96)	0.83*	(0.72, 0.96)
$45,921-$56,813	0.88	(0.75, 1.04)	0.88	(0.74, 1.04)
>$56,813	0.84	(0.67, 1.06)	0.84	(0.67, 1.06)
No Previous Complications	0.78***	(0.69, 0.88)	0.78***	(0.69, 0.88)
Eye complications in 2004	2.10***	(1.92, 2.29)	2.09***	(1.92, 2.28)
Nephropathy in 2004	N/A		N/A	
Neuropathy in 2004	1.75***	(1.60, 1.91)	1.74***	(1.59, 1.90)
Ischemic Heart Disease in 2004	1.18**	(1.06, 1.31)	1.17**	(1.05, 1.29)
Lower-limb amputations 2004	1.53***	(1.35, 1.74)	1.53***	(1.34, 1.73)
Cerebrovascular diseases 2004	0.90	(0.81, 1.01)	0.90	(0.81, 1.00)
No. of outpatient visits 2004	N/A		1.01	(1.00, 1.01)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Diabetic Neuropathy in 2005)

N=90,986	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.81**	(0.70, 0.94)	0.87	(0.74, 1.01)	0.68***	(0.58, 0.80)
Bipolar disorder	1.02	(0.86, 1.20)	1.05	(0.90, 1.23)	0.88	(0.75, 1.04)
Depression/ anxiety	1.02	(0.96, 1.09)	1.01	(0.95, 1.07)	0.95	(0.89, 1.00)
Other mental health disorders	1.13	(0.96, 1.32)	1.05	(0.89, 1.23)	1.00	(0.84, 1.18)
Any alcohol abuse/ dependence	1.12	(0.98, 1.28)	1.03	(0.91, 1.18)	0.98	(0.87, 1.11)
Any drug abuse/ dependence	0.89	(0.73, 1.07)	0.96	(0.80, 1.15)	1.00	(0.83, 1.21)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			1.81***	(1.65, 1.99)	1.53***	(1.39, 1.68)
65-74			1.73***	(1.54, 1.94)	1.16*	(1.04, 1.61)
75 and older			1.65***	(1.48, 1.85)	1.10	(0.98, 1.23)
Male Gender	N/A		1.07*	(1.02, 1.14)	1.05	(0.99, 1.11)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			1.23	(1.00, 1.52)	1.21*	(1.01, 1.44)
Hispanic			0.73**	(0.58, 0.92)	0.76**	(0.64, 0.91)
Others			0.62***	(0.49, 0.79)	0.57***	(0.44, 0.73)
Unknown			0.42***	(0.35, 0.50)	0.62***	(0.52, 0.74)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.51***	(1.37, 1.67)	1.61***	(1.46, 1.77)
1.3<=CDPS<=1.9			2.02***	(1.79, 2.28)	2.28***	(2.07, 2.52)
CDPS>1.9			2.54***	(2.20, 2.92)	2.97***	(2.63, 3.36)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.50***	(0.45, 0.56)
Dual-eligible					1.44***	(1.34, 1.55)
Continuous 12-month coverage	N/A		N/A		1.00	(0.81, 1.23)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					1.12	(0.95, 1.33)
85-90%					1.30	(0.99, 1.71)
>90%					1.36*	(1.05, 1.76)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					0.90	(0.76, 1.05)
$45,921-$56,813					0.85	(0.72, 1.00)
>$56,813					0.79*	(0.64, 0.97)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Diabetic Neuropathy in 2005)

N=90,986	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.78**	(0.66, 0.92)	0.79**	(0.67, 0.94)
Bipolar disorder	1.01	(0.85, 1.18)	0.99	(0.84, 1.17)
Depression/ anxiety	1.00	(0.95, 1.07)	0.99	(0.93, 1.05)
Other mental health disorders	1.01	(0.86, 1.18)	1.00	(0.85, 1.18)
Any alcohol abuse/ dependence	1.04	(0.91, 1.18)	1.05	(0.92, 1.21)
Any drug abuse/ dependence	1.04	(0.86, 1.27)	1.04	(0.85, 1.27)
Age Groups				
<55 (ref.)	1		1	
55-64	1.42***	(1.29, 1.55)	1.40***	(1.27, 1.53)
65-74	1.08	(0.97, 1.21)	1.08	(0.96, 1.21)
75 and older	1.05	(0.94, 1.18)	1.05	(0.94, 1.17)
Male Gender	1.02	(0.97, 1.08)	1.03	(0.97, 1.10)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.15	(0.95, 1.40)	1.22	(1.00, 1.49)
Hispanic	0.76**	(0.63, 0.91)	0.79**	(0.66, 0.94)
Others	0.56***	(0.43, 0.72)	0.58***	(0.45, 0.74)
Unknown	0.64***	(0.53, 0.76)	0.67***	(0.56, 0.80)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.42***	(1.29, 1.56)	1.36***	(1.24, 1.49)
1.3<=CDPS<=1.9	1.87***	(1.68, 2.07)	1.71***	(1.56, 1.88)
CDPS>1.9	2.09***	(1.85, 2.37)	1.86***	(1.64, 2.11)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.56***	(0.50, 0.62)	0.57***	(0.51, 0.64)
Dual-eligible	1.35***	(1.25, 1.45)	1.34***	(1.25, 1.44)
Continuous 12-month coverage	0.97	(0.79, 1.20)	0.95	(0.77, 1.18)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.14	(0.96, 1.36)	1.15	(0.96, 1.37)
85-90%	1.35*	(1.02, 1.79)	1.35*	(1.00, 1.80)
>90%	1.45**	(1.10, 1.89)	1.43*	(1.08, 1.89)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.90	(0.77, 1.05)	0.90	(0.77, 1.05)
$45,921-$56,813	0.84*	(0.72, 0.98)	0.84*	(0.72, 0.98)
>$56,813	0.77*	(0.63, 0.94)	0.77*	(0.64, 0.94)
No Previous Complications	0.86**	(0.78, 0.95)	0.86**	(0.78, 0.95)
Eye complications in 2004	1.88***	(1.71, 2.08)	1.87***	(1.69, 2.07)
Nephropathy in 2004	1.83***	(1.61, 2.08)	1.82***	(1.60, 2.07)
Neuropathy in 2004	N/A		N/A	
Ischemic Heart Disease in 2004	1.05	(0.96, 1.15)	1.01	(0.92, 1.11)
Lower-limb amputations 2004	1.81***	(1.60, 2.05)	1.79***	(1.58, 2.03)
Cerebrovascular diseases 2004	0.99	(0.91, 1.07)	0.97	(0.89, 1.06)
No. of outpatient visits 2004	N/A		1.02***	(1.01, 1.03)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Lower-limb Amputations in 2005)

N=100,390	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.85*	(0.73, 0.99)	0.90	(0.77, 1.05)	0.71***	(0.60, 0.85)
Bipolar disorder	0.93	(0.76, 1.13)	0.92	(0.73, 1.15)	0.78*	(0.63, 0.97)
Depression/ anxiety	1.11*	(1.02, 1.20)	1.04	(0.96, 1.13)	0.96	(0.89, 1.04)
Other mental health disorders	1.15	(0.97, 1.37)	1.01	(0.84, 1.21)	0.97	(0.81, 1.17)
Any alcohol abuse/ dependence	1.65***	(1.39, 1.96)	1.47***	(1.25, 1.73)	1.39***	(1.17, 1.65)
Any drug abuse/ dependence	1.35***	(1.16, 1.58)	1.32**	(1.12, 1.55)	1.35***	(1.15, 1.60)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			1.52***	(1.38, 1.68)	1.33***	(1.20, 1.47)
65-74			1.37***	(1.21, 1.56)	1.14	(0.98, 1.33)
75 and older			1.68***	(1.45, 1.94)	1.41***	(1.22, 1.63)
Male Gender	N/A		1.12***	(1.06, 1.19)	1.14***	(1.07, 1.20)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			1.23***	(1.13, 1.35)	1.08	(0.96, 1.22)
Hispanic			0.81*	(0.68, 0.96)	0.73**	(0.60, 0.87)
Others			0.93	(0.78, 1.11)	0.76**	(0.64, 0.91)
Unknown			0.59***	(0.45, 0.76)	0.75*	(0.58, 0.98)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.43***	(1.26, 1.63)	1.56***	(1.37, 1.78)
1.3<=CDPS<=1.9			2.19***	(1.84, 2.60)	2.54***	(2.14, 3.03)
CDPS>1.9			3.40***	(2.80, 4.13)	4.09***	(3.38, 4.96)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.66***	(0.56, 0.78)
Dual-eligible					1.76***	(1.57, 1.98)
Continuous 12-month coverage	N/A		N/A		0.75***	(0.66, 0.86)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					1.02	(0.86, 1.20)
85-90%					0.89	(0.73, 1.09)
>90%					0.85	(0.67, 1.08)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					1.01	(0.88, 1.17)
$45,921-$56,813					1.05	(0.89, 1.24)
>$56,813					1.01	(0.84, 1.20)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Lower-limb Amputations in 2005)

N=100,390	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.84*	(0.71, 1.00)	0.85	(0.72, 1.00)
Bipolar disorder	0.88	(0.70, 1.11)	0.87	(0.70, 1.10)
Depression/ anxiety	1.00	(0.93, 1.09)	1.00	(0.92, 1.08)
Other mental health disorders	1.00	(0.83, 1.19)	0.99	(0.83, 1.19)
Any alcohol abuse/ dependence	1.52***	(1.28, 1.81)	1.53***	(1.29, 1.82)
Any drug abuse/ dependence	1.42***	(1.20, 1.67)	1.41***	(1.20, 1.66)
Age Groups				
<55 (ref.)	1		1	
55-64	1.17**	(1.04, 1.30)	1.16**	(1.04, 1.29)
65-74	1.00	(0.86, 1.18)	1.00	(0.86, 1.18)
75 and older	1.29**	(1.10, 1.50)	1.29**	(1.11, 1.50)
Male Gender	1.11***	(1.05, 1.17)	1.11***	(1.05, 1.17)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	1.01	(0.89, 1.14)	1.03	(0.92, 1.16)
Hispanic	0.74**	(0.62, 0.90)	0.76**	(0.63, 0.91)
Others	0.79**	(0.67, 0.95)	0.81*	(0.68, 0.96)
Unknown	0.80	(0.63, 1.03)	0.81	(0.63, 1.06)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.27***	(1.13, 1.44)	1.25***	(1.11, 1.41)
1.3<=CDPS<=1.9	1.80***	(1.54, 2.10)	1.74***	(1.49, 2.03)
CDPS>1.9	2.53***	(2.13, 3.00)	2.41***	(2.03, 2.86)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.79**	(0.66, 0.94)	0.80*	(0.67, 0.96)
Dual-eligible	1.64***	(1.46, 1.86)	1.65***	(1.46, 1.85)
Continuous 12-month coverage	0.71***	(0.62, 0.81)	0.70***	(0.61, 0.81)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.01	(0.86, 1.20)	1.01	(0.86, 1.20)
85-90%	0.88	(0.72, 1.08)	0.88	(0.72, 1.08)
>90%	0.86	(0.68, 1.10)	0.86	(0.67, 1.09)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.04	(0.89, 1.20)	1.04	(0.89, 1.20)
$45,921-$56,813	1.05	(0.88, 1.26)	1.05	(0.88, 1.26)
>$56,813	1.01	(0.83, 1.22)	1.01	(0.83, 1.22)
No Previous Complications	0.88**	(0.80, 0.96)	0.87**	(0.79, 0.96)
Eye complications in 2004	1.70***	(1.54, 1.88)	1.70***	(1.54, 1.88)
Nephropathy in 2004	1.41***	(1.25, 1.59)	1.40***	(1.24, 1.59)
Neuropathy in 2004	1.76***	(1.59, 1.95)	1.75***	(1.58, 1.94)
Ischemic Heart Disease in 2004	1.17***	(1.10, 1.26)	1.16***	(1.08, 1.24)
Lower-limb amputations 2004	N/A		N/A	
Cerebrovascular diseases 2004	1.13*	(1.02, 1.24)	1.12*	(1.01, 1.24)
No. of outpatient visits 2004	N/A		1.01***	(1.00, 1.01)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Ischemic Heart Disease in 2005)

N=72,600	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.49***	(0.43, 0.57)	0.82*	(0.71, 0.96)	0.69***	(0.58, 0.81)
Bipolar disorder	0.62***	(0.51, 0.75)	0.96	(0.81, 1.13)	0.83*	(0.71, 0.98)
Depression/ anxiety	0.84***	(0.78, 0.91)	1.06	(1.00, 1.14)	1.01	(0.95, 1.08)
Other mental health disorders	0.96	(0.86, 1.08)	1.04	(0.92, 1.17)	1.00	(0.89, 1.12)
Any alcohol abuse/ dependence	0.99	(0.86, 1.14)	0.99	(0.85, 1.15)	0.96	(0.82, 1.11)
Any drug abuse/ dependence	0.61***	(0.51, 0.74)	0.88	(0.73, 1.07)	0.91	(0.75, 1.10)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			2.70***	(2.47, 2.94)	2.46***	(2.25, 2.68)
65-74			3.62***	(3.29, 3.98)	2.76***	(1.50, 3.05)
75 and older			4.68***	(4.24, 5.17)	3.55***	(3.19, 3.94)
Male Gender	N/A		1.38***	(1.31, 1.46)	1.38***	(1.31, 1.46)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			0.87*	(0.76, 0.99)	0.82**	(0.71, 0.95)
Hispanic			0.72***	(0.63, 0.81)	0.70***	(0.61, 0.80)
Others			0.74***	(0.63, 0.83)	0.66***	(0.57, 0.77)
Unknown			0.51***	(0.41, 0.63)	0.67**	(0.53, 0.85)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.33***	(1.26, 1.40)	1.40***	(1.32, 1.48)
1.3<=CDPS<=1.9			1.72***	(1.60, 1.84)	1.89***	(1.76, 2.02)
CDPS>1.9			2.26***	(2.12, 2.41)	2.57***	(2.38, 2.77)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.58***	(0.51, 0.65)
Dual-eligible					1.39***	(1.26, 1.53)
Continuous 12-month coverage	N/A		N/A		0.75***	(0.65, 0.85)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					1.04	(0.94, 1.14)
85-90%					0.93	(0.82, 1.05)
>90%					0.94	(0.80, 1.09)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					1.00	(0.93, 1.08)
$45,921-$56,813					1.08	(0.98, 1.18)
>$56,813					1.10	(0.97, 1.26)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Ischemic Heart Disease in 2005)

N=72,600	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.72***	(0.61, 0.84)	0.74***	(0.63, 0.87)
Bipolar disorder	0.86	(0.73, 1.02)	0.86	(0.73, 1.01)
Depression/ anxiety	1.02	(0.95, 1.09)	1.00	(0.94, 1.07)
Other mental health disorders	0.99	(0.88, 1.11)	0.98	(0.87, 1.11)
Any alcohol abuse/ dependence	0.97	(0.84, 1.13)	0.99	(0.85, 1.16)
Any drug abuse/ dependence	0.91	(0.75, 1.11)	0.91	(0.75, 1.10)
Age Groups				
<55 (ref.)	1		1	
55-64	2.39***	(2.19, 2.61)	2.34***	(2.15, 2.56)
65-74	2.69***	(2.43, 2.96)	2.68***	(2.42, 2.97)
75 and older	3.45***	(3.10, 3.84)	3.46***	(3.09, 3.86)
Male Gender	1.37***	(1.30, 1.45)	1.39***	(1.32, 1.47)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.81**	(0.69, 0.94)	0.86*	(0.76, 0.98)
Hispanic	0.70***	(0.61, 0.81)	0.74***	(0.64, 0.85)
Others	0.67***	(0.57, 0.77)	0.70***	(0.60, 0.81)
Unknown	0.68**	(0.54, 0.87)	0.73**	(0.58, 0.92)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.33***	(1.26, 1.41)	1.26***	(1.19, 1.34)
1.3<=CDPS<=1.9	1.73***	(1.61, 1.85)	1.55***	(1.45, 1.66)
CDPS>1.9	2.22***	(2.04, 2.40)	1.92***	(1.75, 2.11)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.60***	(0.54, 0.68)	0.62***	(0.56, 0.70)
Dual-eligible	1.36***	(1.23, 1.50)	1.35***	(1.22, 1.51)
Continuous 12-month coverage	0.74***	(0.64, 0.84)	0.71***	(0.62, 0.82)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.04	(0.94, 1.14)	1.04	(0.94, 1.15)
85-90%	0.94	(0.83, 1.06)	0.93	(0.82, 1.05)
>90%	0.94	(0.81, 1.10)	0.93	(0.80, 1.09)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.01	(0.93, 1.09)	1.00	(0.93, 1.09)
$45,921-$56,813	1.08	(0.98, 1.18)	1.08	(0.97, 1.19)
>$56,813	1.10	(0.97, 1.26)	1.10	(0.96, 1.27)
No Previous Complications	1.01	(0.90, 1.13)	1.01	(0.90, 1.13)
Eye complications in 2004	1.13**	(1.05, 1.22)	1.12**	(1.04, 1.21)
Nephropathy in 2004	1.31***	(1.18, 1.46)	1.30***	(1.15, 1.46)
Neuropathy in 2004	1.12**	(1.05, 1.20)	1.10*	(1.02, 1.18)
Ischemic Heart Disease in 2004	N/A		N/A	
Lower-limb amputations 2004	1.05	(0.91, 1.22)	1.04	(0.89, 1.21)
Cerebrovascular diseases 2004	1.38***	(1.23, 1.56)	1.37***	(1.21, 1.54)
No. of outpatient visits 2004	N/A		1.02***	(1.02, 1.03)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Cerebrovascular Diseases in 2005)

N=95,068	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.32***	(0.26, 0.41)	0.61***	(0.47, 0.77)	0.55***	(0.44, 0.70)
Bipolar disorder	0.61***	(0.50, 0.74)	0.97	(0.79, 1.20)	0.90	(0.74, 1.10)
Depression/ anxiety	0.88**	(0.82, 0.96)	1.09	(0.99, 1.20)	1.06	(0.97, 1.17)
Other mental health disorders	1.01	(0.84, 1.21)	1.09	(0.92, 1.30)	1.07	(0.90, 1.28)
Any alcohol abuse/ dependence	1.06	(0.88, 1.28)	1.20	(0.98, 1.47)	1.17	(0.97, 1.41)
Any drug abuse/ dependence	0.57***	(0.48, 0.68)	0.94	(0.77, 1.16)	0.96	(0.78, 1.18)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			2.91***	(2.52, 3.36)	2.53***	(2.17, 2.95)
65-74			4.50***	(3.84, 5.27)	3.07***	(2.62, 3.59)
75 and older			5.94***	(5.20, 5.80)	4.01***	(3.44, 4.66)
Male Gender	N/A		1.14***	(1.07, 1.22)	1.12**	(1.05, 1.20)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			0.79***	(0.71, 0.87)	0.78***	(0.70, 0.86)
Hispanic			0.71***	(0.61, 0.81)	0.72***	(0.63, 0.83)
Others			0.68***	(0.58, 0.79)	0.67***	(0.57, 0.78)
Unknown			0.55***	(0.43, 0.70)	0.80	(0.61, 1.04)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.43***	(1.31, 1.56)	1.47***	(1.34, 1.60)
1.3<=CDPS<=1.9			1.75***	(1.58, 1.92)	1.83***	(1.66, 2.02)
CDPS>1.9			2.25***	(2.02, 2.51)	2.39***	(2.14, 2.67)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.46***	(0.39, 0.53)
Dual-eligible					1.11*	(1.01, 1.22)
Continuous 12-month coverage	N/A		N/A		0.65***	(0.54, 0.77)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					0.99	(0.91, 1.08)
85-90%					1.01	(0.94, 1.10)
>90%					1.01	(0.90, 1.14)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					0.94	(0.81, 1.08)
$45,921-$56,813					0.94	(0.80, 1.10)
>$56,813					0.97	(0.82, 1.15)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Cerebrovascular Diseases in 2005)

N=95,068	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.62***	(0.49, 0.78)	0.63***	(0.50, 0.80)
Bipolar disorder	0.97	(0.79, 1.20)	0.97	(0.78, 1.19)
Depression/ anxiety	1.08	(0.98, 1.18)	1.07	(0.97, 1.17)
Other mental health disorders	1.08	(0.91, 1.27)	1.08	(0.91, 1.27)
Any alcohol abuse/ dependence	1.23*	(1.01, 1.50)	1.26*	(1.04, 1.53)
Any drug abuse/ dependence	0.97	(0.78, 1.20)	0.96	(0.78, 1.19)
Age Groups				
<55 (ref.)	1		1	
55-64	2.30***	(1.98, 2.67)	2.27***	(1.96, 2.64)
65-74	2.77***	(2.37, 3.22)	2.76***	(2.37, 3.21)
75 and older	3.58***	(3.08, 4.15)	3.58***	(3.09, 4.15)
Male Gender	1.05	(0.98, 1.12)	1.05	(0.98, 1.13)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.79***	(0.72, 0.88)	0.83***	(0.75, 0.92)
Hispanic	0.75***	(0.65, 0.86)	0.77***	(0.67, 0.89)
Others	0.70***	(0.60, 0.82)	0.72***	(0.61, 0.84)
Unknown	0.83	(0.64, 1.09)	0.87	(0.66, 1.13)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.31***	(1.19, 1.43)	1.26***	(1.15, 1.38)
1.3<=CDPS<=1.9	1.49***	(1.35, 1.65)	1.39***	(1.25, 1.54)
CDPS>1.9	1.74***	(1.56, 1.95)	1.57***	(1.41, 1.76)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.51***	(0.44, 0.60)	0.53***	(0.45, 0.61)
Dual-eligible	1.05	(0.95, 1.16)	1.05	(0.96, 1.15)
Continuous 12-month coverage	0.65***	(0.55, 0.77)	0.64***	(0.54, 0.76)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	0.99	(0.91, 1.08)	0.99	(0.91, 1.09)
85-90%	1.03	(0.95, 1.12)	1.02	(0.94, 1.12)
>90%	1.04	(0.92, 1.18)	1.03	(0.91, 1.17)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	0.93	(0.80, 1.08)	0.93	(0.81, 1.08)
$45,921-$56,813	0.92	(0.78, 1.08)	0.92	(0.78, 1.08)
>$56,813	0.95	(0.80, 1.13)	0.95	(0.80, 1.12)
No Previous Complications	1.01	(0.92, 1.12)	1.01	(0.91, 1.12)
Eye complications in 2004	1.13**	(1.05, 1.22)	1.12*	(1.05, 1.21)
Nephropathy in 2004	1.23***	(1.12, 1.36)	1.23***	(1.11, 1.36)
Neuropathy in 2004	1.14***	(1.07, 1.22)	1.13***	(1.06, 1.21)
Ischemic Heart Disease in 2004	1.64***	(1.51, 1.79)	1.61***	(1.48, 1.75)
Lower-limb amputations 2004	1.21***	(1.09, 1.34)	1.20**	(1.08, 1.33)
Cerebrovascular diseases 2004	N/A		N/A	
No. of outpatient visits 2004	N/A		1.02***	(1.01, 1.02)

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Diabetes-related Hospitalizations in 2005)

N=106,174	Model 1		Model 2		Model 3	
	OR	95%CI	OR	95%CI	OR	95%CI
Mental health disorders						
No mental health disorders (ref.)	1		1		1	
Schizophrenia/ paranoid states	0.54***	(0.46, 0.63)	0.69***	(0.59, 0.81)	0.57***	(0.48, 0.67)
Bipolar disorder	0.89	(0.76, 1.04)	1.04	(0.88, 1.24)	0.91	(0.77, 1.07)
Depression/ anxiety	1.02	(0.96, 1.08)	1.07	(1.00, 1.14)	1.01	(0.94, 1.08)
Other mental health disorders	1.20*	(1.03, 1.42)	1.10	(0.96, 1.26)	1.06	(0.92, 1.22)
Any alcohol abuse/ dependence	1.13	(0.92, 1.38)	1.03	(0.84, 1.27)	0.98	(0.78, 1.23)
Any drug abuse/ dependence	1.37***	(1.20, 1.57)	1.51***	(1.31, 1.74)	1.57***	(1.35, 1.82)
Age Groups						
<55 (ref.)	N/A		1		1	
55-64			1.67***	(1.49, 1.88)	1.42***	(1.26, 1.59)
65-74			2.01***	(1.76, 2.29)	1.45***	(1.27, 1.65)
75 and older			2.27***	(1.99, 2.60)	1.64***	(1.42, 1.88)
Male Gender	N/A		1.34***	(1.28, 1.41)	1.33***	(1.26, 1.40)
Race/ethnicity						
Non-Hispanic white (ref.)	N/A		1		1	
African American			1.02	(0.92, 1.12)	0.96	(0.87, 1.05)
Hispanic			0.71***	(0.62, 0.81)	0.69***	(0.60, 0.80)
Others			0.89	(0.75, 1.06)	0.78*	(0.65, 0.95)
Unknown			0.51***	(0.40, 0.64)	0.74*	(0.55, 0.99)
CDPS score in 2004						
CDPS<0.8 (ref.)	N/A		1		1	
0.8<=CDPS<1.3			1.44***	(1.32, 1.57)	1.53***	(1.40, 1.66)
1.3<=CDPS<=1.9			2.01***	(1.81, 2.23)	2.24***	(2.03, 2.47)
CDPS>1.9			3.17***	(2.89, 3.48)	3.62***	(3.31, 3.95)
Health coverage type						
Medicare only (ref.)	N/A		N/A		1	
Medicaid only					0.48***	(0.38, 0.60)
Dual-eligible					1.50***	(1.41, 1.60)
Continuous 12-month coverage	N/A		N/A		0.56***	(0.49, 0.63)
Percent of High School Graduate						
<75% (ref.)	N/A		N/A		1	
75-84%					0.99	(0.89, 1.11)
85-90%					0.91	(0.81, 1.03)
>90%					0.84*	(0.74, 0.97)
Median Household income 1999						
<$36,448 (ref.)	N/A		N/A		1	
$36,448-$45,920					1.02	(0.89, 1.16)
$45,921-$56,813					1.14	(0.99, 1.32)
>$56,813					1.18*	(1.03, 1.35)
No Previous Complications	N/A		N/A		N/A	
Eye complications in 2004	N/A		N/A		N/A	
Nephropathy in 2004	N/A		N/A		N/A	
Neuropathy in 2004	N/A		N/A		N/A	
Ischemic Heart Disease in 2004	N/A		N/A		N/A	
Lower-limb amputations 2004	N/A		N/A		N/A	
Cerebrovascular diseases 2004	N/A		N/A		N/A	
No. of outpatient visits 2004	N/A		N/A		N/A	

* p<0.05 **p<0.01 ***p<0.001

Appendix XII. Analytic models used in the study (Outcome: Having Diabetes-related Hospitalizations in 2005)

N=106,174	Model 4		Model 5	
	OR	95%CI	OR	95%CI
Mental health disorders				
No mental health disorders (ref.)	1		1	
Schizophrenia/ paranoid states	0.74**	(0.63, 0.88)	0.75**	(0.63, 0.89)
Bipolar disorder	1.08	(0.91, 1.27)	1.07	(0.91, 1.26)
Depression/ anxiety	1.04	(0.97, 1.11)	1.03	(0.96, 1.10)
Other mental health disorders	1.01	(0.87, 1.17)	1.01	(0.87, 1.17)
Any alcohol abuse/ dependence	1.07	(0.87, 1.32)	1.08	(0.88, 1.33)
Any drug abuse/ dependence	1.60***	(1.38, 1.87)	1.60***	(1.38, 1.86)
Age Groups				
<55 (ref.)	1		1	
55-64	1.12	(0.99, 1.26)	1.11	(0.98, 1.25)
65-74	1.13	(1.00, 1.28)	1.13	(1.00, 1.28)
75 and older	1.26***	(1.11, 1.43)	1.26***	(1.11, 1.44)
Male Gender	1.17***	(1.10, 1.23)	1.17***	(1.11, 1.24)
Race/ethnicity				
Non-Hispanic white (ref.)	1		1	
African American	0.97	(0.88, 1.08)	1.00	(0.91, 1.11)
Hispanic	0.75***	(0.65, 0.87)	0.77***	(0.66, 0.89)
Others	0.87	(0.72, 1.05)	0.88	(0.73, 1.07)
Unknown	0.83	(0.62, 1.11)	0.85	(0.64, 1.13)
CDPS score in 2004				
CDPS<0.8 (ref.)	1		1	
0.8<=CDPS<1.3	1.11*	(1.02, 1.21)	1.09	(1.00, 1.18)
1.3<=CDPS<=1.9	1.28***	(1.15, 1.42)	1.23***	(1.10, 1.37)
CDPS>1.9	1.56***	(1.42, 1.72)	1.47***	(1.33, 1.63)
Health coverage type				
Medicare only (ref.)	1		1	
Medicaid only	0.64***	(0.51, 0.80)	0.65***	(0.52, 0.80)
Dual-eligible	1.32***	(1.24, 1.41)	1.32***	(1.24, 1.41)
Continuous 12-month coverage	0.55***	(0.49, 0.63)	0.55***	(0.48, 0.62)
Percent of High School Graduate				
<75% (ref.)	1		1	
75-84%	1.00	(0.90, 1.11)	1.00	(0.90, 1.11)
85-90%	0.94	(0.83, 1.06)	0.93	(0.83, 1.05)
>90%	0.88	(0.77, 1.01)	0.87	(0.76, 1.00)
Median Household income 1999				
<$36,448 (ref.)	1		1	
$36,448-$45,920	1.01	(0.88, 1.16)	1.01	(0.89, 1.16)
$45,921-$56,813	1.11	(0.96, 1.30)	1.12	(0.96, 1.30)
>$56,813	1.14	(0.99, 1.31)	1.14	(0.99, 1.31)
No Previous Complications	0.70***	(0.63, 0.78)	0.70***	(0.63, 0.78)
Eye complications in 2004	1.25***	(1.16, 1.35)	1.24***	(1.15, 1.34)
Nephropathy in 2004	1.45***	(1.34, 4.56)	1.45***	(1.34, 1.57)
Neuropathy in 2004	1.26***	(1.16, 1.36)	1.25***	(1.15, 1.35)
Ischemic Heart Disease in 2004	1.91***	(1.78, 2.06)	1.89***	(1.75, 2.03)
Lower-limb amputations 2004	1.98***	(1.85, 2.12)	1.97***	(1.84, 2.11)
Cerebrovascular diseases 2004	1.48***	(1.36, 1.62)	1.47***	(1.35, 1.61)
No. of outpatient visits 2004	N/A		1.01***	(1.01, 1.01)

* p<0.05 **p<0.01 ***p<0.001

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