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Coverage Instability and Implications for Adults Living with Diabetes in the US, 2010-2016

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Coverage Instability and Implications for Adults Living with Diabetes in the US, 2010-2016

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Health Policy and Management

by

Diane Tan

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ABSTRACT OF THE DISSERTATION

Coverage Instability and

Implications for Adults Living with Diabetes

in the US, 2010-2016

by

Diane Tan

Doctor of Philosophy in Health Policy and Management

University of California, Los Angeles, 2021

Professor Arturo Vargas Bustamante

While it has long been understood that regular access to care is important for those living with serious chronic medical conditions such as diabetes, there is little information on how much coverage instability affects access to care and medical expenditures, how this effect may differ by race/ethnicity, and how major provisions of the Affordable Care Act (ACA) implemented in 2014 may have affected its impact on these outcomes. This dissertation aimed to address gaps in the literature by developing a comprehensive and valid index measure of coverage instability based on previous research and applying this measure to examine the differential effect of coverage instability on access to care and medical expenditures for adults living with diabetes in the US by race/ethnicity and pre/post ACA.

To develop a comprehensive and valid index measure of coverage instability among non-Medicare adults in the US, month-to-month coverage data from the Medical Expenditure Panel Survey (MEPS) were used in a non-linear principal component analysis (PCA). This resulted in a single component, which cumulatively retained 79.6% of the variance explained by the original input variables measuring major aspects of coverage instability. Bivariate results suggest that the measure behaves as expected.

To evaluate the moderating effects of *race/ethnicity* and the *ACA* on *coverage instability* and *access-to-care outcomes* among non-Medicare adults with diabetes, MEPS data were used in multivariable probit models. As coverage instability increased, the probability of experiencing any delay in care was greatest for non-Hispanic Whites (NHW) and the probability of ER use was lowest for Hispanics. We also found a greater probability of having a usual source of care after the ACA.

To evaluate the moderating effects of *race/ethnicity* and the *ACA* on *coverage instability* and *medical expenditures* among non-Medicare adults with diabetes, MEPS data were used in two-part models. As coverage instability increased, access and utilization of ambulatory services remained unchanged among NHW but decreased among racial/ethnic minorities. However, Hispanics had greater ER expenses as coverage instability increased. We also found that OOP expenses and expenses for prescription drugs did not increase but remained relatively stable after the ACA even when coverage instability increased.

This dissertation of Diane Tan is approved.

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Arturo Vargas Bustamante, Committee Chair

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2021

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Chapter 1: Introduction to the dissertation

Overview

Due to the high cost of health care in the US, many depend on health insurance to gain access to more affordable health care for themselves and their family members in order to maintain their health and financial security from unexpected medical events.[1] However, because health insurance coverage is not "guaranteed" for those under the age of 65 in the US, some are left without coverage despite needing or wanting coverage.[2] As a result, those who lack consistent coverage often face worse health outcomes due to disruptions in care, delays in needed care or treatment, inadequate use of important preventive services, and lack of having a usual source of care.[3-9] Even those who experience a change in coverage without an episode of uninsurance are still susceptible to disruptions in care, delays in care or treatment, lack of having a usual source of care, lower quality of care received, and worse overall health.[3,4] In addition, those with unstable coverage often face higher absolute charges due to lack of coverage, greater out-of-pocket expenses, and greater medical debt compared to those with more stable coverage.[3,5,10,11]

While it is understood that regular access to care is important for those living with serious chronic medical conditions such as diabetes,[12-16] there is little information on how much coverage instability affects access to care and medical expenses, how this effect may differ by race/ethnicity, and how major provisions of the Affordable Care Act (ACA) implemented in 2014 may have affected coverage instability's impact on these outcomes. This dissertation aims to address these gaps in the literature by first developing a more comprehensive and valid measure of coverage instability based on previous research and applying this measure to examine

the differential effect of coverage instability on access to care and medical expenditures for adults living with diabetes in the US by race/ethnicity and pre/post ACA.

Background

Diabetes in the US

Diabetes is a chronic medical condition in which the body is unable to adequately process and utilize glucose in the blood for energy.[17] When left unchecked over time, the accumulation of glucose in the blood can lead to a number of serious health complications, including heart disease, nerve damage, eye problems, foot problems, skin infections, kidney damage, and stroke.[18,19] In general, there are two main types of diabetes: type 1 and type 2.[20] With type 1, the body is unable to make insulin, which is a hormone produced by the pancreas to regulate glucose in the body.[21,22] With type 2, the body might be able to produce insulin but is unable to use it properly.[23] Type 2 is the most common form of diabetes in the US – over 90% of adults with diabetes have type 2.[20,24] While treatment options may differ for the two types of diabetes, proper control and management of the disease requires regular follow-up visits with a primary care clinician.[12-16]

Due to a number of individual, social, and policy factors, diabetes has become one of the leading causes of morbidity and mortality among adults in the US, much of which can be manageable if not entirely preventable given adequate care and treatment.[25,26] In 2018, approximately 13.0% (34.1 million) of the US adult population (ages 18 and over) had diabetes, where 10.2% were estimated to be diagnosed and 2.8% were estimated to be undiagnosed.[27] However, at the county level, the prevalence of diagnosed diabetes ranged from as low as 1.5% to as high as 33.0%, and greater prevalence tended to coincide with counties found within

southern states.[27] Diabetes is the seventh leading cause of death in the US and is a major cause of kidney failure, blindness, and leg amputations.[27,28] In light of the current COVID-19 pandemic that began in early 2020, those with diabetes who contract SARS-CoV-2 (i.e., the virus that causes COVID-19) may also be at least three times at greater risk for hospitalization from COVID-19-related complications compared to those without diabetes who contract the virus.[29-32] Additionally, diabetes is currently the most expensive chronic disease in the US, with annual total direct costs amounting to $237 billion and annual total indirect costs of $90 billion for a grand total of $327 billion per year.[33-35] The burden of diabetes is expected to grow as the US population ages and become more racially and ethnically diverse over the next few decades,[36,37] with the prevalence of diagnosed diabetes projected to nearly double among adults by 2060.[36]

Racial/ethnic disparities in diabetes

Racial and ethnic minority communities bear the greatest burden caused by diabetes in the US.[38] In 2018, non-Hispanic American Indians/Alaskan Natives (AIAN) had the highest prevalence of diagnosed diabetes among adults ages 18 and over (14.7%) followed by Hispanics/Latinos (hereafter "Hispanics," 12.5%) and non-Hispanic Blacks/African Americans (NHB, 11.7%) compared to 7.5% for non-Hispanic Whites (NHW) and 9.2% for non-Hispanic Asians (hereafter "Asians").[27] However, Asians had the highest rate of undiagnosed diabetes (4.7%) followed by Hispanics (4.1%), NHB (3.0%), and NHW (2.2%).[27] Hispanics (9.7) and NHB (8.2) also had the highest incidence of diagnoses (per 1,000) among adults ages 18 and older in 2018 followed by Asians (7.4) and NHW (5.0).[27] Estimates for non-Hispanic Native Hawaiian and other Pacific Islanders (NHPI) were not available due to small sample sizes.

Racial/ethnic minorities also experience complications from diabetes at higher rates than NHW, especially NHB, AIAN, and NHPI.[39] Among adults ages 18 and older with diabetes in 2016, NHB had by far the highest rate of hospital admissions (per 100,000) for uncontrolled diabetes without complications (NHB: 116.7, Hispanics: 38.8, NHW: 36.8, Asians: 18.1), the highest rate of hospital admissions (per 100,000) for lower extremity amputations (NHB: 53.5, Hispanics: 26.2, NHW: 23.0, Asians: 7.4), and the highest incidence (per 100,000) of end-stage renal disease (ESRD) due to diabetes (NHB: 337.2, Hispanics: 214.7, Asians: 171.5, NHW: 144.0).[40] While rates of complications for NHPI and AIAN were unavailable due to small sample sizes, both groups had the highest rates of death due to diabetes (per 100,000) in 2016 (NHPI: 51.2, AIAN: 46.1, NHB: 38.7, Hispanics: 25.5, NHW: 18.8, Asians: 16.5).[40]

Racial/ethnic disparities in access to care

In addition, racial/ethnic minorities are more likely to lack access to reliable health insurance coverage, which has been linked to poorer disease management among those with diabetes and has more generally been identified as a major contributing factor to racial/ethnic disparities in health in the US .[14,15,41-44] In particular, NHB and Hispanics are more likely to lack access to reliable health insurance coverage throughout adulthood compared to NHW.[45] This disparity persists even among patients diagnosed with diabetes.[42,44] Among a sample of patients with diabetes, Hispanic patients were more likely to lack health insurance compared to NHW patients.[44]

Health insurance coverage in the US

In the US, health care is financed by either public or private sources of coverage.[46] Public sources of coverage include Medicaid for the poor and Medicare for those ages 65 and over and those under age 65 who are disabled.[47] Private sources of coverage in the US heavily rely on employer-sponsored health plans followed by individual plans purchased through the individual non-group marketplace.[48]

In 2010, the Patient Protection and Affordable Care Act (ACA) was signed into law under the Obama Administration, which aimed to expand access to both public and private sources of coverage. Since 2014, states have had the option of expanding Medicaid under the ACA to low-income individuals whose incomes are at or below 138% of the federal poverty level (FPL), thus widening access to public coverage for many low-income individuals who had previously remained uninsured due to categorical ineligible and not being able to afford private non-group coverage.[49-52] As of November 2020, 39 states including the District of Columbia have adopted the expansion of Medicaid while 12 states, which make up most of the South and part of the Midwest, still have not.[53,54] Also since 2014, individual plans could be purchased with federal financial assistance for qualifying individuals in the health insurance exchanges established within each state.[5,51] Through other provisions of the law, the ACA also improved access to private sources of coverage by reforming the individual and small group health insurance markets (e.g., no pre-existing conditions), boosting employer-sponsored coverage, and reducing adverse selection into coverage by requiring nearly all individuals to maintain a minimum form of coverage under its individual mandate.[5]

Prior to the ACA, the rate of uninsurance (i.e., the state of being uninsured) in the US among individuals under the age of 65 had reached 17.8% in 2010.[5] By 2016, the rate of

uninsurance had dropped to 10.0% -- the lowest it had been in decades.[5] This inflection point in the uninsured rate was largely the result of a series of major economic and policy changes that had taken place in the US during this time. First, the economic downturn of the Great Recession from 2007 to 2009 had caused significant loses in income, employment, and employer-sponsored coverage for nearly five million individuals in the US during this period.[55,56] Prior to the Great Recession, the uninsured rate (i.e., currently uninsured) had remained relatively stable around 16.6% for all individuals ages 0-64 and around 19% for all adults ages 18-64 between 1998 to 2007.[49,57] During the Great Recession, however, the uninsured rate steadily rose to 17.8% among all individuals ages 0-64 and 22.3% among all adults ages 18-64 in 2010.[5,49,57-59] In response to this major economic crisis, the federal government passed the American Recovery and Reinvestment Act in 2009 to help stabilize the economy followed by the ACA in 2010 to help improve access to health insurance coverage.[60,61] The uninsured rate then began dropping precipitously each year and reached 10.0% among all individuals ages 0-64 and 12.4% among all adults ages 18-64 in 2016.[5,58,59] This remarkable downward trend in the uninsured rate from 2010 to 2016 has largely been attributed to the provisions set forth by the ACA.[62-65] From 2010 through early 2016, nearly 20 million adults under age 65 had gained coverage as a result of the ACA.[5,66,67]

However, since 2017, the uninsured rate has slowly begun increasing again due to a number of factors, including the removal of the tax penalty associated with the individual mandate, rollbacks in ACA enrollment efforts, and a number of policy changes that have resulted in reduced enrollment in Medicaid under the Trump Administration.[68] By 2019, the uninsured rate was 10.9% among all individuals under age 65 and 14.7% among all adults under age 65.[69,70] While the uninsured rate for 2020 is still unknown, it is expected to be even higher than

that of the previous year due to high rates of unemployment (4.4% in March, 14.7% in April, 6.9% in October) spurred on by the COVID-19 pandemic, which was officially declared in March of 2020.[68,71]

Racial/ethnic disparities in health insurance coverage

While the ACA has significantly reduced racial/ethnic disparities in health insurance coverage especially in expansion states,[59,72,73] Hispanics still disproportionately experience higher rates of uninsurance relative to other groups.[73] That is, while absolute disparities (i.e., the difference in percentages uninsured between two groups) in coverage by race/ethnicity have become smaller since 2014, some relative disparities (i.e., the ratio of percentages uninsured between two groups) by race/ethnicity have not, especially for Hispanics in Medicaid expansion states suggesting continued systemic and structural barriers.[73,74] In 2016, there were three times more Hispanics (28.1%) who were currently uninsured compared to NHW among adults ages 18-64 (8.8%).[59] This was slightly higher compared to what it was in 2010: there were 2.7 times more Hispanics (43.3%) who were currently uninsured compared to NHW adults (16.3%).[59] NHB (14.5%) and other non-Hispanic races (16.3%), including AIAN, also still had higher rates of uninsurance compared to NHW (8.8%) in 2016 among adults ages 18-64.[59,75] Since lack of health insurance is one of the most important factors contributing to racial/ethnic disparities in access to care and subsequently health outcomes in the US,[41] we may continue to see racial/ethnic disparities persist in health until access to coverage becomes available regardless of one's income, employment, or state of residence.

Current gaps in the literature

Each year, a number of federal agencies release reports on the current state of health care across the US. These annual reports document the findings of four national surveys conducted by these very agencies: the Current Population Survey (CPS) and the Survey of Income and Program Participation (SIPP) both conducted by the US Census Bureau, the Medical Expenditure Panel Survey (MEPS) by the Agency for Healthcare Research and Quality (AHRQ), and the National Health Interview Survey (NHIS) by the National Center for Health Statistics (NCHS).[76] One of the main outcomes assessed in each report is the rate of uninsurance in the US.[77] The definition used for the uninsured rate varies by agency but generally reflects three types: ever uninsured in the past year, point-in-time or current uninsurance, and calendar-year uninsurance (i.e., lacking health insurance coverage for an entire calendar year).[77]

Based on CPS data, the US Census Bureau reported 11.9% (23.4 million) of adults ages 18-64 had been uninsured for the entire year in 2016.[78] Using data from MEPS, AHRQ reported the calendar-year uninsured rate as 10.8% (20.6 million) and the ever uninsured rate as 22.0% (42.3 million) in 2016 for adults ages 18-64.[79,80] From NHIS data, the long-term uninsured rate (i.e., uninsured for more than one year) was 7.6% (14.9 million), the ever uninsured rate (i.e., uninsured for at least part of the past year including for an entire year) was 17.0% (33.4 million), and the current uninsured rate was 12.4% (24.5 million) in 2016 for adults ages 18-64.[81] While SIPP data do provide information on all three types of uninsured rates, the frequency with which the survey is now conducted occurs less frequently than MEPS, which may partly be due to its longer survey period (i.e., follows households up to four years for SIPP compared to just two years for MEPS) and non-overlapping panels.[82] As a result, fewer reports on health insurance

coverage using this data source have been released, with the latest report covering data from 2013-2014.[83]

Despite these various definitions for the uninsured rate, these measures do not fully capture the experiences of those who have ever been uninsured, which can be diverse in terms of not only lengths of uninsurance but also frequencies of being uninsured and general changes in coverage over time.[84-87] In two related studies examining patterns of uninsurance among individuals under age 65 in the US who had ever been uninsured over a four-year period (1996-1999 and 2004-2007), seven distinct patterns of uninsurance emerged: (1) always uninsured, (2) transitioned into coverage, (3) transitioned out of coverage, (4) had a single gap in coverage, (5) had a temporary episode of coverage, (6) had frequent changes in coverage (i.e., one spell of uninsurance with changes in different sources of coverage), and (7) had repeated episodes of uninsurance (i.e., at least two episodes of uninsurance and at least two episodes of coverage).[85,88] The first five patterns of uninsurance were categorized as being "relatively stable" since they exhibited few changes in coverage over time, while the last two patterns were considered "unstable" since they demonstrated more than two changes in coverage during the study period.[85] In both studies, the most common pattern of uninsurance consisted of repeated episodes of uninsurance over a period of time.[85,88]

The underlying mechanism driving these patterns of uninsurance is known as "churn," which is a phenomenon in which individuals move between different sources and states of coverage over time.[89] Frequent and constant churning between different sources and states of coverage over time can thus result in highly unstable coverage, which is not fully captured by the uninsured rates alone. Figure 1.1 illustrates the many pathways in which adult individuals may

move between different states and sources of coverage before and after major provisions of the ACA took effect in 2014.

The use of insufficient measures may not only underestimate the true prevalence of unstable coverage but also obscure the unique struggles faced by those with unstable coverage in accessing care compared to the stably insured and chronically uninsured.[8,85,88,90-92] Taken together, there is a clear need for a more comprehensive measure of unstable coverage in order to better understand the true magnitude and significance of unstable coverage in the US and its role in perpetuating racial/ethnic disparities in health.

Conceptual framework

To guide this dissertation in addressing its research aims, a conceptual framework was developed by adapting the Andersen Behavioral Model of Health Services Use to address coverage instability. This was done by acknowledging all relationships between factors within a domain and further characterizing factors within each domain as being either individual- or structural-level factors. This conceptual framework is depicted in Figure 1.2. While Figure 1.2 demonstrates the intricate and often complicated relationships occurring between and among the different factors of each domain affecting access to health care, this dissertation will first focus on the factors associated with coverage instability and then the effect of coverage instability on access to care and medical expenditures and whether and by how much the effect differs by racial/ethnic group and pre/post ACA while controlling for all the other factors.

The Andersen model, which has been widely used in health services research to better understand health care use in the US since it was first introduced in 1968 and later updated in 1995,[93] suggests that an individual's health care use is determined by three general domains: (1)

predisposing (i.e., demographic characteristics, social structure factors, and health beliefs and attitudes), (2) enabling (i.e., personal and community factors), and (3) need (i.e., perceived and actual) factors.[94,95] The latest version of the Andersen model also includes environmental factors (i.e., national health policy, health care system) as a fourth domain, which were hypothesized to have a direct effect on access to care and health outcomes as well as health status and behavioral outcomes (i.e., perceived and actual/evaluated) after utilization of services which in turn affect mutable predisposing and enabling factors (e.g., health beliefs and attitudes, health insurance coverage).[95]

According to the Andersen model, certain demographic characteristics, such as age and sex, determine use through actual or evaluated need due to a biological impetus to seek care.[94] For example, risk for certain chronic conditions tend to increase with age and certain conditions and procedures are sex-specific, such as pregnancy for females and prostate cancer for males.[96,97] The model also suggests that predisposing factors related to social status (e.g. race/ethnicity, education, employment) indirectly influence use through enabling factors, such as income/poverty status, health insurance coverage, and having a usual source of care.[94,95] Additionally, the model implies that beliefs and attitudes about health and health care in general, which themselves can be shaped by demographic and social structure factors, can influence use through perceived need (i.e., how one experiences and deals with one's symptoms and/or illness) for acute care or through need factors and then enabling factors for ambulatory or acute care in some cases, such as health insurance coverage.[94,95] Finally, several of the factors in the Andersen model have also been known to indirectly influence health expenditures through utilization.[94,95,98,99]

However, unlike the Andersen model, the conceptual framework for this dissertation does not include a fourth domain for environmental factors. Instead, health policy and health care system factors are incorporated into the original three domains by separately categorizing factors within the domains as being either structural- or individual-level factors. Additionally, social structure factors were reclassified as socioeconomic factors to reflect more current terminology used in public health research. In addition to education and employment, marital status was added as a socioeconomic factor since marital status can affect individual-level financial resources and thus enable use (e.g., gaining health insurance coverage through a spouse).[100] Race/ethnicity was grouped with age and sex/gender and reclassified as sociodemographic factors within the predisposing domain since they all affect social status in the US to some extent.[101] Language spoken in the home was added as a sociodemographic factor since language can be a barrier to accessing care.[101] The conceptual framework also includes usual source of care as an outcome rather than an enabling factor, which can affect and be affected by utilization.[102] In this dissertation, the effect of usual source of care on utilization was not examined.

Thus, individual-level predisposing factors include sociodemographic characteristics, health beliefs and attitudes, and socioeconomic factors. Individual-level need characteristics include actual/evaluated (e.g., disease comorbidity, severity) and perceived health (e.g., self-reported health status). Individual-level enabling factors include financial resources for use (i.e., health insurance coverage, coverage stability, and income/poverty status). Structural-level predisposing factors include federal- and state-level health policies, which are measured as pre/post ACA and geographic region. Structural-level enabling factors include factors affecting accessibility of providers and facilities, which can be measured as the ratio or health care

providers per capita.[103] In the conceptual framework for this dissertation, structural-level predisposing factors, such as the individual mandate under the ACA and a state's decision to expand Medicaid, can influence health care use through the improvement of individual- and structural -level enabling resources by increasing access to additional sources of coverage.[62,63] All outcomes are measured at the individual level.

The conceptual framework for this dissertation also acknowledges relationships between factors found within the same domain, factors that affect the relationship between other factors (i.e., moderating factors), and other relationships not mentioned in the Andersen model. For example, the conceptual framework acknowledges that sociodemographic factors, such as age and sex/gender, can not only affect actual/evaluated need but also perceived need. In a survey of 588 community-residing adults ages 65 and over in Los Angeles, older age was associated with lower expectations regarding aging (i.e., more ailments with age and lower quality of life were expected), which in turn was associated with not believing it was important to seek health care even after controlling for sociodemographic and health characteristics.[104] Additionally, men and women have been found to perceive, evaluate, and treat mild and prolonged conditions differently, where men may be more likely to take more risks with their health and adopt fewer health-promoting behaviors compared to women .[105] This difference in health-seeking behavior (or lack thereof) by gender may be due to perceived expectations of one's gender in society within the context of health.[106]

The conceptual framework also asserts that language spoken in the home is largely determined by race/ethnicity in the US, education can influence one's employment prospects, and sociodemographic characteristics collectively can sometimes influence one's socioeconomic opportunities. The conceptual framework also asserts that income/poverty can both directly and

indirectly affect health insurance coverage and its stability by moderating the effect of health need on coverage.

In his paper describing his updated model, Andersen also discussed a major goal of the model, which is to assess the various forms of health care access (i.e., potential, realized, and equitable/inequitable access).[95] Potential access is defined as simply having enabling resources for accessing care while realized access is defined as actual health care use, and equitable/inequitable access occurs when realized access is affected by predisposing, enabling, and/or need factors.[95] According to the CDC, inequitable access may also be measured as having an unmet health need resulting from a delay in needed care or treatment, being unable to access preventative services, being financially burdened by needed care or treatment, or experiencing a preventable hospitalization.[107] It is for this reason that any delay in needed care and any delay in needed treatment are included as outcomes in the conceptual framework for this dissertation.

Dissertation aims

This dissertation was driven by the following three aims:

Aim I) Develop a comprehensive and valid measure of coverage instability that encompasses both frequency and duration of events linked to unstable coverage

Aim II) Evaluate the moderating effects of race/ethnicity and the ACA on the relationship between coverage instability and access to care among adults ages 18-64 living with diabetes (Red arrows in Figure 1.2)

Aim III) Examine the moderating effects of race/ethnicity and the ACA on the relationship between coverage instability and medical expenditures among adults ages 18-64 living with diabetes (Green arrows in Figure 1.2)

All three aims used data from the Medical Expenditure Panel Survey (MEPS), which is a national two-year panel survey of families and individuals, their medical providers and employers across the US.[108] The survey consists of five rounds during which data on demographic characteristics, health care use, and charges and sources of payment for health care are collected from a nationally representative sample of the non-institutionalized civilian US population.[108] More specifically, this dissertation used data from the household component of the survey from 2010 to 2016, which provides data from a nationally representative subsample of households that participated in the prior year's National Health Interview Survey (NHIS) conducted by the National Center for Health Statistics (NCHS).[108]

To achieve Aim I, month-to-month coverage data from MEPS was used in a non-linear Principal Component Analysis (PCA) to create a single measure of coverage instability that accounted for both frequency and duration of events linked to unstable coverage in previous research. The analysis was limited to all adults ages 18-64 who had completed the survey and were not enrolled in Medicare. To assess the validity of this new measure, bivariate tests were used to determine important associations between the newly developed coverage instability index and predisposing and health need factors associated with other measures of unstable coverage in previous research. These results were then compared to results found in other studies on coverage and coverage instability. Chapter 2 of this dissertation provides greater detail on the procedures and results found from this analysis.

To achieve Aim II, multivariable probit regression models were used to estimate the moderating effects of race/ethnicity and the ACA on the relationship between coverage instability and outcomes measuring access to care. Access-to-care outcomes included any delay in needed care, any delay in needed prescriptions, any ER visit, any overnight hospitalization, having a usual source of care each year and having at least one medical visit each year during the survey period. Results from this analysis are presented and discussed in Chapter 3 of this dissertation. It is hypothesized that among adults living with diabetes, the negative effect of coverage instability on access to care will be greater for Hispanics and NHB compared to other racial/ethnic groups and smaller in magnitude after the ACA.

Lastly, two-part models were used to estimate the moderating effects of race/ethnicity and the ACA on coverage instability and medical expenditure outcomes, which included both total and out-of-pocket (OOP) costs. Service-specific costs within each type of cost included those for medical visits, ER visits, overnight hospital stays, and prescription refills. All expense outcomes were adjusted to 2016 dollars. Results from this analysis are presented and discussed in Chapter 4 of this dissertation. It is hypothesized that among adults living with diabetes, the negative effect of coverage instability on total and OOP expenses will be greater for Hispanics and NHB compared to other racial/ethnic groups and smaller in magnitude after the ACA.

The dissertation concludes with Chapter 5, which provides a summary of key findings from this dissertation and offers thoughts on how the findings may inform future research and practice in public health and health policy especially in light of current of events.

Figures

Figure 1.1. Sources of health insurance coverage and churn pathways for adults ages 18-64 in the US.

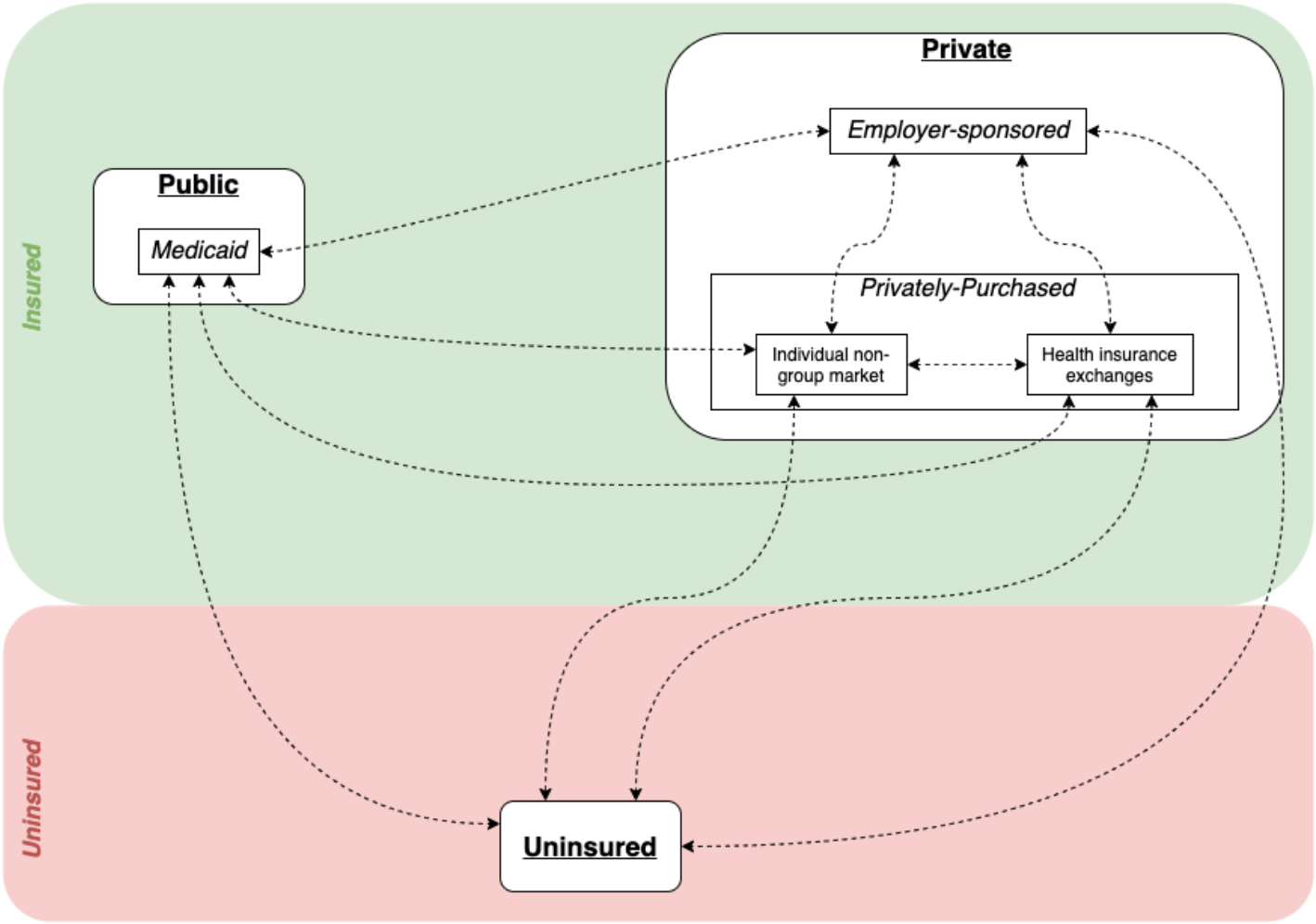
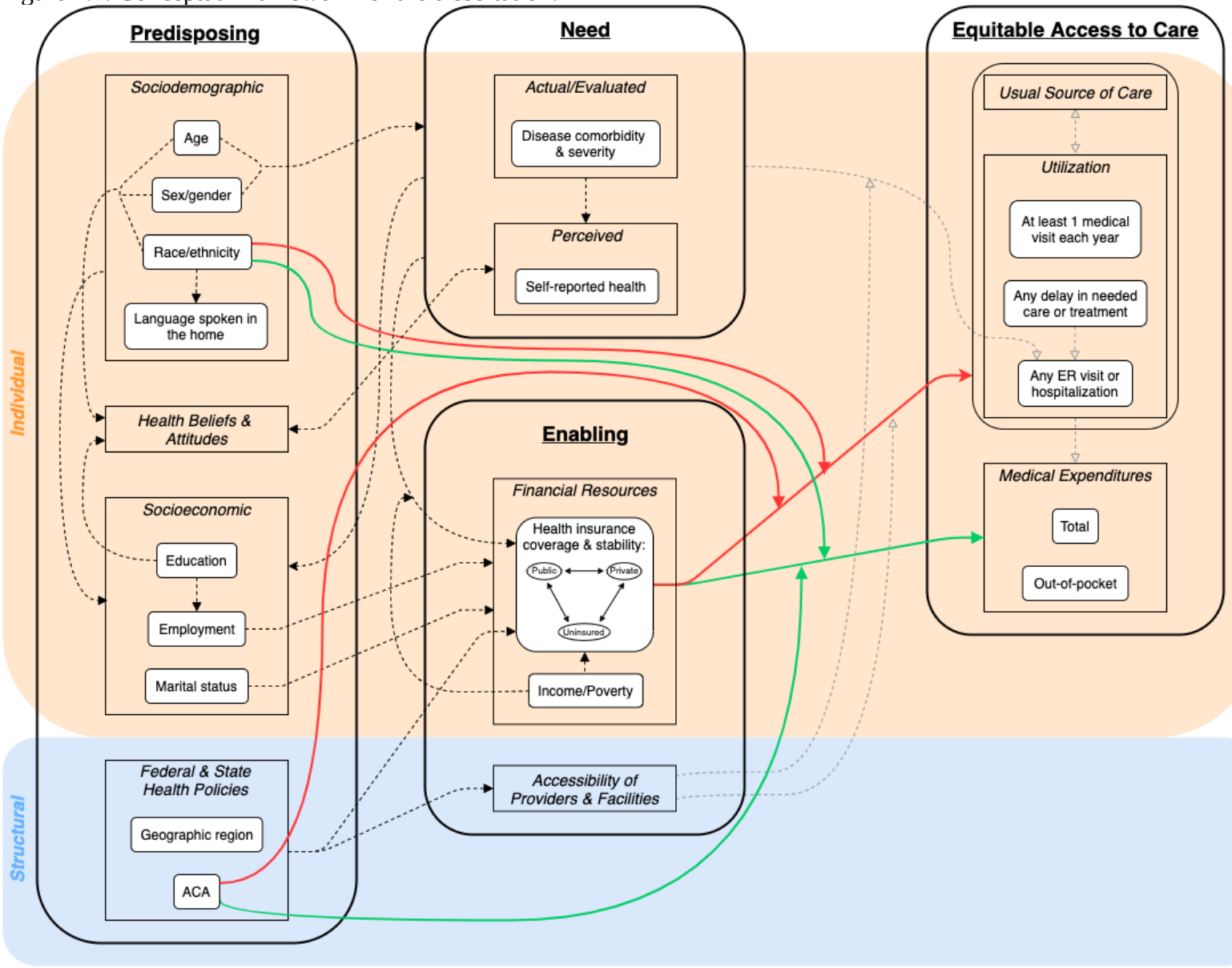


Figure 1.2. Conceptual framework for the dissertation.



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Chapter 2: Developing an index for measuring unstable health insurance coverage among adults in the US, 2010-2016

Introduction

Each year, a number of federal agencies release reports on the current state of health care across the US. These annual reports document the findings of four national surveys conducted by these very agencies: the Current Population Survey (CPS) and the Survey of Income and Program Participation (SIPP) both conducted by the US Census Bureau, the Medical Expenditure Panel Survey (MEPS) by the Agency for Healthcare Research and Quality (AHRQ), and the National Health Interview Survey (NHIS) by the National Center for Health Statistics (NCHS).[1] One of the main outcomes assessed in each report is the rate of uninsurance in the US.[2] The definition used for the uninsured rate varies by agency but generally reflects three types: ever uninsured in the past year, point-in-time or current uninsurance, and calendar-year uninsurance (i.e., lacking health insurance coverage for an entire calendar year).[2]

Based on CPS data, the US Census Bureau reported 11.9% (23.4 million) of adults ages 18-64 had been uninsured for the entire year in 2016.[3] Using data from MEPS, AHRQ reported the calendar-year uninsured rate as 10.8% (20.6 million) and the ever uninsured rate as 22.0% (42.3 million) in 2016 for adults ages 18-64.[4,5] From NHIS data, the long-term uninsured rate (i.e., uninsured for more than one year) was 7.6% (14.9 million), the ever uninsured rate (i.e., uninsured for at least part of the past year including for an entire year) was 17.0% (33.4 million), and the current uninsured rate was 12.4% (24.5 million) in 2016 for adults ages 18-64.[6] While SIPP data do provide information on all three types of uninsured rates, the frequency with which the survey is now conducted occurs less frequently than MEPS, which may partly be due to its

longer survey period (i.e., follows households up to four years for SIPP compared to two years for MEPS) and non-overlapping panels.[7] As a result, fewer reports on health insurance coverage using this data source have been released, with the latest report covering data from 2013-2014.[8]

Despite these various definitions for the uninsured rate, these measures do not fully capture the experiences of those who have ever been uninsured, which can be quite diverse in terms of not only lengths of uninsurance but also frequencies of being uninsured and general changes in coverage over time.[9-12] In two related studies examining patterns of uninsurance among individuals under age 65 in the US who had ever been uninsured over a four-year period (1996-1999 and 2004-2007), seven distinct patterns of uninsurance emerged: (1) always uninsured, (2) transitioned into coverage, (3) transitioned out of coverage, (4) had a single gap in coverage, (5) had a temporary episode of coverage, (6) had frequent changes in coverage (i.e., one spell of uninsurance with changes in different sources of coverage), and (7) had repeated episodes of uninsurance (i.e., at least two episodes of uninsurance and at least two episodes of coverage).[10,13] The first five patterns of uninsurance were categorized as being "relatively stable" since they exhibited few changes in coverage over time, while the last two patterns were considered "unstable" since they demonstrated more than two changes in coverage during the study period.[10] In both studies, the most common pattern of uninsurance consisted of repeated episodes of uninsurance over a period of time.[10,13]

The underlying mechanism driving these patterns of uninsurance is often referred to as "churn," which is a phenomenon in which individuals move between different sources of coverage and states of uninsurance over time.[14] Frequent and constant churning between different sources and states of coverage over time can thus result in highly unstable coverage, which is not fully captured by the uninsured rates alone. A major reason why churn is possible in

the US is because health care is financed by different public and private sources of coverage.[15] Public sources of coverage include Medicaid for the poor and Medicare for those ages 65 and over and those under age 65 who are disabled.[16] Private sources of coverage in the US heavily rely on employer-sponsored health plans followed by individual plans purchased through the individual non-group marketplace.[17] Prior to 2014 when major provisions of the Affordable Care Act (ACA) took effect, it was possible for non-Medicare adults to experience churn in and out of Medicaid, employer-sponsored coverage, privately purchased non-group coverage, and episodes of uninsurance after gaining, losing or switching between these different sources and states of coverage over time. After 2014, it was also possible to experience churn in and out of the health insurance exchanges, which were established in each state under the ACA to provide access to more affordable options for individual non-group plans.[18,19] Additionally under the ACA, Medicaid eligibility was expanded to low-income individuals whose incomes were at or below 138% of the federal poverty level (FPL) in 39 states including the District of Columbia as of November 2020,[20,21] thus widening access to public coverage for many low-income individuals who had previously remained uninsured due to categorical ineligible and not being able to afford private non-group coverage on their own.

While each measure of coverage discussed thus far may not alone adequately reflect the true experiences of health insurance coverage in the US, they may still be able to help us more precisely characterize each individual's experience with coverage when assessed together. In this paper, we describe the processes and methods used to create and validate a composite measure of coverage instability using month-to-month coverage data from MEPS while taking into account the new coverage options offered under the ACA.

Methods

Data: The Medical Expenditure Panel Survey (MEPS) is a national two-year survey, which consists of five rounds of interviews of families and individuals, their medical providers and employers across the US.[22] This survey collects data on demographic characteristics, the types of health services used, frequency of health care use, and their charges and sources of payment from a nationally representative sample of the non-institutionalized civilian population in the US.[22]

In terms of the coverage data specifically, each panel includes monthly coverage data for each respondent over a two-year survey period. This enables us to look at the various types of changes in coverage that can take place over the course of more than just a year. In addition to documenting whether a respondent was insured for a particular month, the survey also asks about the source of coverage. Public sources of coverage include Medicaid and Medicare while private sources include employer-sponsored coverage or other type of group coverage (i.e., union-related or coverage purchased directly from a group or association), non-group coverage, and coverage obtained through a holder outside of the reporting unit (i.e., an individual or group of individuals within a sampled unit who have familial ties to one another).[23] Some non-group coverage options were coded separately, including coverage purchased through the exchanges starting in 2014 and non-group coverage for someone who was self-employed. Sources of civilian health coverage for returning active duty and retired services members, disabled veterans, and their spouses and dependent children include TRICARE and CHAMPVA. Five sets of panel data (Panel 15: 2010-2011, Panel 16: 2011-2012, Panel 17: 2012-2013, Panel 19: 2014-2015, Panel 20: 2015-2016) were used to create the final data set.

Study population: The analysis was limited to adults ages 18-64 who completed the two-year survey. Those younger than age 65 who were enrolled in Medicare were excluded from the analysis. We refer to the study population throughout as adults for those ages 18-64 who were not eligible for Medicare. This resulted in an unweighted sample of 33,043 observations.

Measures – Index development: Overall duration of uninsurance was measured as the total number of months out of 24 months spent uninsured during a two-year survey period, which ranged from 0-100% of the time. Frequency of uninsurance was measured as the number of times a respondent lost or gained coverage more than once. Frequency of switches in coverage between consecutive months was measured as the number of times a respondent had a different source of coverage compared to the previous month. Observations that had multiple sources of coverage between two consecutive months were examined individually to determine any discernable patterns of coverage instability (unweighted n=41).

Measures – Index validation: Using the Andersen behavioral model of health services use as a general framework,[24] predisposing (sociodemographic: age, sex, race/ethnicity, language most spoken in the home; socioeconomic: education, employment status, marital status), enabling (individual-level resources: poverty status; structural-level resources: accessibility to providers and facilities using geographic region and pre/post ACA as proxy measures), and health need characteristics (actual/evaluated: disease comorbidity, whether they had a serious chronic health condition; perceived: self-reported health status and perceived need for health insurance coverage) were used to validate the resulting index measuring coverage instability, which itself is considered an enabling factor. Within this framework, predisposing factors may influence use indirectly through need or enabling factors, enabling factors may directly influence

use of ambulatory and acute services, while need factors may directly influence use of acute services but indirectly influence use of ambulatory services through enabling factors.

Disease comorbidity was assessed by first linking the MEPS medical conditions data to the panel data and then using the algorithm described by D'Hoore and colleagues to compute the Charlson Comorbidity Index (CCI).[25] Serious chronic health conditions included heart disease, diabetes, cancer, asthma, chronic obstructive pulmonary disease (COPD), stroke, arthritis, hypertension, and hyperlipidemia.[26-28] Higher scores on the CCI indicate greater disease comorbidity. An indicator variable for pre/post ACA was created by defining the pre-ACA period as any time before 2014 and the post-ACA period as any time from 2014 and onward. As such, respondents from panels 15-17 (2010-2013) were classified as being in the pre-ACA sample while respondents from panels 19-20 (2014-2016) were classified as being in the post-ACA sample. Panel years were also included to assess potential time trends.

Statistical analysis – Index development: The variables created for overall duration of uninsurance, frequency of uninsurance, and frequency of switches in coverage between consecutive months were used in a principal component analysis (PCA) to determine the weights of each in measuring coverage instability. PCA is a statistical method for reducing the number of variables that are highly correlated with one another but independent from other variables in a data set by assigning weights to each input variable based on the variance explained in the resulting index.[29] The final data set and index were created using SAS 9.4.

Non-parametric approaches were used to address the non-normally distributed input variables. Specifically, Spearman's rank correlation coefficients were used to initially determine the correlation between each of the input variables, and a non-linear PCA was applied to create the coverage instability index. To perform the non-linear PCA in SAS, the input variables were

first transformed to optimize for maximum total variance so that the first principal component can be produced.[30] This was done using the PRINQUAL procedure with the monotone option, which indicates a non-linear multidimensional preference (MDPREF) scaling method, and the MTV optimization method to maximize total variance.[30] Observations with missing data for any of the input variables were excluded from the analysis. This was then followed by the FACTOR procedure, which uses the transformed input variables to generate the resulting component(s). In our case, a single resulting component would indicate one comprehensive measure of coverage instability that accounts for duration of uninsurance, frequency of uninsurance, and frequency of switching coverage between consecutive months.

From the non-linear PCA, weights for each of the transformed input variables in the single resulting principal component were obtained and used to create an index score for coverage instability:[31]

$$\text{Coverage Instability Score} = w_1X_1 + w_2X_2 + w_3X_3,$$

where w_i represents the weight of input variable X_i.

The index score for coverage instability was then re-scaled by: (1) subtracting all raw scores by the minimum raw score, (2) dividing this difference by the difference between the maximum and minimum raw scores, and (3) then multiplying this by 100. This resulted in a range of 0-100, where higher scores indicate greater coverage instability and a score of 0 represents stable and continuous coverage while a score of 100 represents the highest degree of instability observed relative to other individuals in the sample during the study period (i.e., 2010-2016).

Statistical analysis – Index validation: Bivariate tests of association were then used to assess the validity of the coverage instability index by comparing scores across the predisposing, enabling, and health need factors. Chi-squared tests were used for categorical variables and *t*

tests were used for continuous variables. Survey weights were applied to account for the complex survey design of MEPS. Index validation was performed using Stata 16.

Results: Index development

Table 2.1 lists the different sources of coverage for adults in the US by panel years and provides results comparing estimates right before and after 2014. On average, the majority (76.0%) of adults had been covered by any private health insurance. In contrast, 13.7% had been on Medicaid at any time and 2.4% had coverage through TRICARE/CHAMPVA at any time. The rate of any private coverage stayed relatively stable around 74.0% from 2010-2011 until 2014-2015 when it increased to 78.2% and 80.2% in 2015-2016 ($p<.001$). This increase in private coverage may have largely been due to gains in coverage through the exchanges starting in 2014, which contributed 5.7% in 2014-2015 and 7.5% in 2015-2016. Rates for other private sources of coverage remained relatively stable throughout. The slight increase in any employer-sponsored coverage from 68.8% in 2012-2013 to 70.3% in 2014-2015 may have resulted from the mandate placed under the ACA requiring employers with 50 or more full-time employees to provide affordable coverage to their employees or face a penalty.[19] The slight decrease in any non-group coverage purchased in the individual non-group market from 4.5% in 2012-2013 to 3.2% in 2014-2015 may have been due to individuals electing to purchase subsidized coverage through the exchanges starting in 2014. Between 2012-2013 and 2014-2015, the rate of any public coverage through Medicaid also increased from 12.2% to 16.6% ($p<.001$) as a result of the expansion of Medicaid starting in 2014.[20,21]

In Table 2.2, the three coverage variables (i.e., overall duration of uninsurance, frequency of uninsurance, and frequency of switching coverage between any two months) generated using

the monthly coverage data available in MEPS are listed by panel years. The mean percentage of time spent uninsured among adults during a 24-month survey period was 18.6% of the time. From 2010-2013, the mean percentage of months spent uninsured steadily increased: 20.5% for 2010-2011, 21.3% for 2011-2012, and 22.4% for 2013-2014. For 2014-2015, the mean percentage of months spent uninsured decreased to 15.3% ($p<.001$) and continued to decrease to 12.4% for 2015-2016. Again, this may have been due to gains in coverage through Medicaid expansion, the establishment of the exchanges and other major ACA provisions that took effect in 2014.

When categorized into four mutually exclusive categories of coverage during a two-year survey period, 64.7% had been insured throughout with no change in coverage, 3.6% had been insured throughout but had experienced a switch in coverage between any two months, 20.9% had experienced any change in coverage with an episode of uninsurance, and 10.9% had been uninsured throughout. The greatest changes between 2012-2013 and 2014-2015 were observed for the percentage who had been insured throughout but had experienced a change in coverage (0.9% to 7.7%, $p<.001$) and the percentage who had been uninsured throughout (14.4% to 7.4%, $p<.001$). The former could be due to individuals attempting to avoid periods of uninsurance under the individual mandate of the ACA, which penalized individuals for not having a minimum level of health insurance coverage and had been in effect since 2014 until more recently in 2019.[19,32,33] The latter could be explained by the expansion of Medicaid in several states to previously ineligible adults and the establishment of the exchanges in each state under the ACA starting in 2014.

Among those with any coverage during their survey period, the majority had not lost or gained coverage more than once (i.e., 79.1% had not lost or gained coverage and 13.0% lost or

gained coverage only once) and this remained relatively stable from 2010-2016. However, 8.8% of adults had lost or gained coverage more than once between 2010-2016. This increased from 8.3% in 2012-2013 to 9.6% in 2015-2016. This slight increase may reflect the coverage changes, which were mostly gains in coverage, that had occurred starting in 2014 under the ACA. Only 1.4% of adults had lost or gained coverage three times, and only 0.5% had experienced this more than three times.

Similarly, the majority had not experienced a switch in coverage between any two months (94.7%). Only 2.1% of adults had experienced one switch in coverage, while 2.3% had experienced two switches and 0.9% had experienced three or more switches. Across all levels, these estimates remained stable until 2014. Between 2012-2013 to 2014-2015, the percentage of those with any coverage who experienced no switches significantly decreased from 98.6% to 88.9% ($p<.001$).

To test the correlation between the coverage instability input variables (i.e., overall duration of uninsurance, frequency of uninsurance, and frequency of switching coverage between any two months), Spearman's rank correlation coefficients were examined. The resulting correlation coefficients indicated that greater duration of uninsurance was significantly correlated with greater frequency of uninsurance ($r=0.2643$, $p<0.001$), greater duration of uninsurance was significantly correlated with fewer switches and vice versa ($r=-0.0745$, $p<0.001$), and greater frequency of uninsurance was significantly correlated with greater frequency of switches ($r=0.0162$, $p=0.003$). While the observed correlations for frequency of switches could be considered weak,[34] the literature points to the significant contribution of switching in coverage instability and access to care.[35,36]

However, since the analysis would not converge using the continuous forms of the input variables due to their skewed distributions (i.e., bimodal for duration of uninsurance and right-skewed for frequency of uninsurance and switches in coverage), categorical versions of the input variables were used in a non-linear PCA instead. Overall duration of uninsurance was categorized into insured throughout with no change, any change in coverage, and uninsured throughout. Since the large majority of respondents did not lose or gain coverage more than once, frequency of uninsurance was categorized into: "Yes, lost or gained coverage more than once," and "No, did not lose or gain coverage more than once." Similarly, since most of the respondents did not experience a switch in coverage between any two months, frequency of switching was categorized as: "Yes, experienced a switch," and "No, did not experience a switch."

The final non-linear PCA using the three coverage instability input variables resulted in one single component that retained 79.6% of the variance explained by the input variables after just two iterations. Figure 2.1 illustrates the relationships between the transformed input variables through their projection onto a 2D plane. Each group of points (i.e., blue circles) represents respondents who share similar coverage instability characteristics. Those clustered in the upper right corner of the plot tend to experience greater levels of coverage instability while those in the lower left tended to experience little to no levels of coverage instability. The relatively equal vector lengths indicate comparable fit on the same plane and thus same measure, which can be classified as coverage instability.

For the resulting single component (Table 2.3), the non-linear PCA had assigned the greatest weight to length of uninsurance (0.8276) followed by frequency of uninsurance (0.6909) and frequency of switching coverage between any two months (0.4984).

Results: Index validation

Overall, adults had a coverage instability score of 13.6 out of 100. Table 2.4 provides results from the bivariate tests of association between the coverage instability index and predisposing, enabling, health need, and time characteristics. Based on these results, the index appears to behave as expected. Higher scores were significantly associated with younger age, with those ages 18-25 having scores nearly twice as large as those ages 50-64 (21.0 vs 10.0, $p<.001$). Females had significantly higher coverage instability scores on average compared to males (13.9 vs. 13.2, $p<.01$) although this statistical difference may not be clinically meaningful. Non-Hispanic Whites and non-Hispanic Asians had the lowest coverage instability scores, while Hispanics had the highest followed by non-Hispanic Blacks and then other races of non-Hispanic origin. Compared to non-Hispanic Whites (12.1), Hispanics had coverage instability scores that were nearly six points higher (17.7), and non-Hispanic Blacks and other non-Hispanic races had scores that were nearly five points higher (16.9) ($p<.001$). Non-Hispanic Asians did not differ in terms of coverage instability compared to non-Hispanic Whites. Those whose most spoken language in the home was not English had coverage instability scores that were five points higher on average than those whose most spoken language in the home was English (18.1 vs. 12.8, $p<.001$).

Greater coverage instability was also significantly associated with not being married, completing less education, not being employed, living in greater poverty, residing in certain geographic regions (South and West), having fewer comorbidities, having a poorer perceived health status, and believing they were healthy enough to not need health insurance. Those who reported never being married at baseline had the highest coverage instability scores with an

average of 18.7 out of 100 while those who reported being married or separated had the lowest scores with an average of 10.4 out of 100 ($p<.001$). Those who with less than a high school education had coverage instability scores that were more than twice as large as those who had completed college or more (20.9 vs. 9.4, $p<.001$). On average, those unemployed at baseline had scores that were five points higher than those who were not (17.8 vs. 12.4, $p<.001$). Those with incomes at or below 138% FPL (<100% FPL: 22.3 out of 100, 100-138% FPL: 23.3 out of 100) had coverage instability scores that were more than three times as large as those with incomes 400% FPL or more (7.2 out of 100) ($p<.001$). Those residing in the South and West regions of the US had an average score of 14.2 out of 100, while those residing in the Midwest had an average score of 13.6 out of 100 and those in the Northeast with 11.6 out of 100 ($p<.001$).

Additionally, greater coverage instability was significantly associated with experiencing any major life change, including any change in marital status, any change in geographic region, and any change in employment status. In all cases, coverage instability scores were more than twice as large for those who experienced any of these major life changes compared to those who did not ($p<.001$). While those who consistently had incomes below 200% FPL had the highest coverage instability scores (i.e., 21.2 to 24.0 out of 100), those who experienced any change in their status (for better or for worse) had scores nearly just as high (i.e., 17.9 to 18.4 out of 100). However, those with incomes that remained between 100 to 138% FPL still had the highest coverage instability scores on average compared to the other groups (i.e., 24.0 out of 100).

In terms of health, greater disease comorbidity ($p<.001$) and having a serious chronic health condition (12.2 vs. 15.2 out of 100, $p<.001$) was associated with lower coverage instability scores on average ($p<.001$), while poorer perceived health status was associated with higher coverage instability scores ($p<.001$). The perception of not needing health insurance was

also associated with higher coverage instability scores on average compared to those who did not hold this perception (i.e., 17.3 vs. 13.0 out of 100, $p<.001$). Coverage instability also appeared to increase with time ($p<.001$), especially after 2014 when major provisions of the ACA took effect ($p<.001$).

Discussion

Based on these results and previous research, our coverage instability index appears to behave as expected. That is, greater coverage instability was significantly associated with younger age,[10,13,37,38] historically disadvantaged racial/ethnic groups (Hispanics, non-Hispanic Blacks, and other or multiple races of non-Hispanic origin),[37-40] changes in major life events,[41,42] never being married,[38,43] certain geographic regions of the country (South and West),[37,40] lower socioeconomic status,[10,38,43] and poorer perceived health.[37] While there is lack of research on the relationship between disease comorbidities and coverage instability, our study finds a positive association between fewer comorbidities and greater coverage instability. This finding may be the result of individuals with fewer conditions choosing not to have health insurance. Conversely, it may also be possible that individuals with fewer realized conditions do not have access to health care in which they can be diagnosed due to lack of stable coverage. Most notably, the greatest differences in coverage instability were observed by income, education, and changes in major life events.

Those in the post-2014 cohorts also demonstrated greater coverage instability scores compared to those in the pre-2014 cohorts. However, greater instability after the ACA does not necessarily mean coverage for individuals became worse. Rather, this reflects the large gains in coverage, especially for those who had been continuously uninsured, and a period in which

individuals are learning to navigate enrollment requirements and new coverage options made available under the ACA. In our examination of the elements that contribute to coverage instability, we found that the mean percentage of time spent uninsured and percentage of adults who remained uninsured throughout significantly decreased and the percentage of adults who remained insured throughout even with a switch in coverage significantly increased after 2014. This is consistent with previous research which found large gains in coverage after 2014, especially among young adults (ages 19-25), racial/ethnic minorities, low-income adults and those living in expansion states.[44-46]

One limitation of this study includes relying on self-reported data, which is often a major limitation when using survey data. However, standard medical record abstraction among a subsample of survey respondents has been used to validate and verify the self-reported utilization data in MEPS. [47] From the data, we were also not able to infer whether a change in coverage resulted in a change in provider, which is also important for continuity of care especially for patients with serious chronic health conditions such as diabetes.[48,49] However, a change in provider is more likely to occur for those going from private to public coverage since fewer providers may choose to take on publicly insured patients due to lower reimbursement rates.[50] In our study, only 1.4% of respondents had ever experienced a switch from a private to public source of coverage. Our study was also not able to address the growing issue of underinsurance, which has grown more prevalent in recent years since 2017 due to looser regulations for "skinny" or short-term health plans in the marketplace.[51] As additional post-ACA data is continued to be released, many of these issues may be addressed in future research efforts.

Our study provides a practical framework for measuring and quantifying unstable health insurance coverage in the US. It also highlights the importance of understanding health insurance

coverage – at least in the current US health care system – as a dynamic process in which various aspects of one's life may affect access to coverage and thus to essential health care services. Additionally, our study demonstrates the need to investigate strategies to further reduce unstable coverage as nearly a fifth of the adult US population report having a serious chronic health condition and continue to experience episodes of uninsurance.

Tables and figures

Table 2.1. Sources of coverage among adults in the US (ages 18-64), 2010-2016 (n=33,043).†						
	Estimate (95% CI)					
		Panel Years				
Variables	Total	2010-2011	2011-2012	2012-2013	2014-2015	2015-2016
Any private coverage (%) ***	77.7 (76.6, 78.7)	76.4 (74.7, 78.0)	76.3 (74.9, 77.7)	74.9 (72.9, 76.9)	79.6 (78.0, 81.2)	81.7 (80.1, 83.1)
Group:						
Employer-sponsored	69.9 (68.8, 71.0)	70.4 (68.5, 72.2)	69.8 (68.2, 71.4)	68.6 (66.5, 70.6)	70.3 (68.5, 72.0)	70.6 (68.8, 72.4)
Other‡	1.4 (1.2, 1.6)	1.1 (0.7, 1.6)	1.4 (1.1, 1.8)	1.5 (1.1, 2.0)	1.5 (1.1, 2.1)	1.6 (1.2, 2.1)
Non-group/individual:						
From individual marketplace	3.8 (3.5, 4.2)	3.7 (3.0, 4.5)	4.3 (3.6, 5.1)	4.5 (3.7, 5.5)	3.2 (2.4, 4.3)	3.3 (2.7, 4.1)
For self-employment (firm size=1)	0.4 (0.3, 0.5)	0.5 (0.3, 0.9)	0.5 (0.3, 0.9)	0.3 (0.2, 0.6)	0.3 (0.2, 0.8)	0.1 (0.07, 0.3)
From federal or state exchange	6.6 (5.9, 7.4)	--	--	--	5.7 (4.8, 6.8)	7.5 (6.5, 8.7)
Any public coverage (%)						
Medicaid ***	13.7 (12.8, 14.7)	11.9 (10.6, 13.3)	12.0 (10.8, 13.4)	12.2 (11.1, 13.5)	16.6 (14.9, 18.4)	16.2 (14.6, 18.0)
Any other coverage (%)						
TRICARE/CHAMPVA	2.4 (2.1, 2.7)	2.6 (2.0, 3.4)	2.5 (2.0, 3.1)	2.2 (1.7, 2.8)	2.6 (2.0, 3.3)	1.9 (1.4, 2.5)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

† Tests compare estimates from MEPS Panel 17 (2012-2013) with those from MEPS Panel 19 (2014-2015)
‡ Union-related or coverage purchased directly from a group or association

Table 2.2. Elements of coverage instability among adults in the US (ages 18-64), 2010-2016 (n=33,043). †						
	Estimate (95% CI)					
		Panel Years				
Variables	Total	2010-2011	2011-2012	2012-2013	2014-2015	2015-2016
Overall duration of uninsurance:						
Percentage of time spent uninsured (mean, range: 0-100) ***	18.6 (17.7, 19.4)	20.5 (19.2, 21.9)	21.3 (20.0, 22.7)	22.4 (20.8, 24.1)	15.3 (14.1, 16.5)	12.4 (11.2, 13.7)
Coverage history (%)						
Insured throughout with no change	64.7 (63.6, 65.7)	66.3 (64.5, 68.0)	65.6 (63.7, 67.4)	63.7 (61.6, 65.8)	61.8 (59.8, 63.7)	65.9 (63.9, 67.9)
Insured throughout with any change ***	3.6 (3.3, 3.9)	0.8 (0.5, 1.2)	0.9 (0.6, 1.3)	0.9 (0.6, 1.5)	7.7 (6.7, 8.8)	8.5 (7.5, 9.6)
Any change in coverage with episode of uninsurance *	20.9 (20.2, 21.6)	20.5 (19.2, 21.9)	20.5 (19.1, 21.8)	21.0 (19.7, 22.4)	23.2 (21.7, 24.7)	19.2 (17.9, 20.7)
Uninsured throughout ***	10.9 (10.2, 11.6)	12.5 (11.4, 13.6)	13.1 (12.1, 14.3)	14.4 (13.0, 15.9)	7.4 (6.4, 8.4)	6.4 (5.5, 7.3)
Frequency of uninsurance:						
Number of times lost or gained coverage more than once (among those with any coverage) (%)						
0	91.2 (90.7, 91.7)	91.6 (90.5, 92.6)	91.5 (90.5, 92.5)	91.7 (90.7, 92.7)	90.4 (89.3, 91.4)	90.8 (89.5, 92.0)
2	6.9 (6.5, 7.4)	6.6 (5.7, 7.5)	6.8 (6.0, 7.8)	6.6 (5.7, 7.5)	7.5 (6.5, 8.5)	7.2 (6.2, 8.5)
3	1.4 (1.2, 1.6)	1.4 (1.1, 1.8)	1.3 (1.0, 1.6)	1.3 (1.0, 1.7)	1.6 (1.2, 2.1)	1.3 (1.0, 1.7)

4+	0.5 (0.4, 0.6)	0.4 (0.2, 0.6)	0.4 (0.2, 0.6)	0.4 (0.3, 0.7)	0.5 (0.3, 0.9)	0.6 (0.4, 1.0)
Frequency of switches in coverage between consecutive months:						
Number of switches (among those with any coverage) (%)						
0 ***	94.7 (94.3, 95.1)	98.9 (98.4, 99.2)	98.8 (98.2, 99.1)	98.6 (98.0, 99.0)	88.9 (87.6, 90.2)	88.1 (86.8, 89.4)
1***	2.1 (1.9, 2.4)	0.6 (0.4, 0.9)	0.8 (0.5, 1.2)	0.7 (0.5, 1.1)	3.8 (3.0, 4.9)	4.5 (3.8, 5.4)
2 ***	2.3 (2.0, 2.6)	0.5 (0.2, 0;9)	0.5 (0.2, 0.8)	0.6 (0.3, 1.0)	5.2 (4.5, 6.1)	4.7 (3.9, 5.6)
3+ ***	0.9 (0.8, 1.1)	0.03 (0.004, 0.2)	0	0.09 (0.02, 0.4)	2.0 (1.5, 2.6)	2.7 (2.2, 3.3)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

† Tests compare estimates from MEPS Panel 17 (2012-2013) with those from MEPS Panel 19 (2014-2015)

Figure 2.1. Non-linear principal component analysis (PCA) biplot of coverage instability elements.

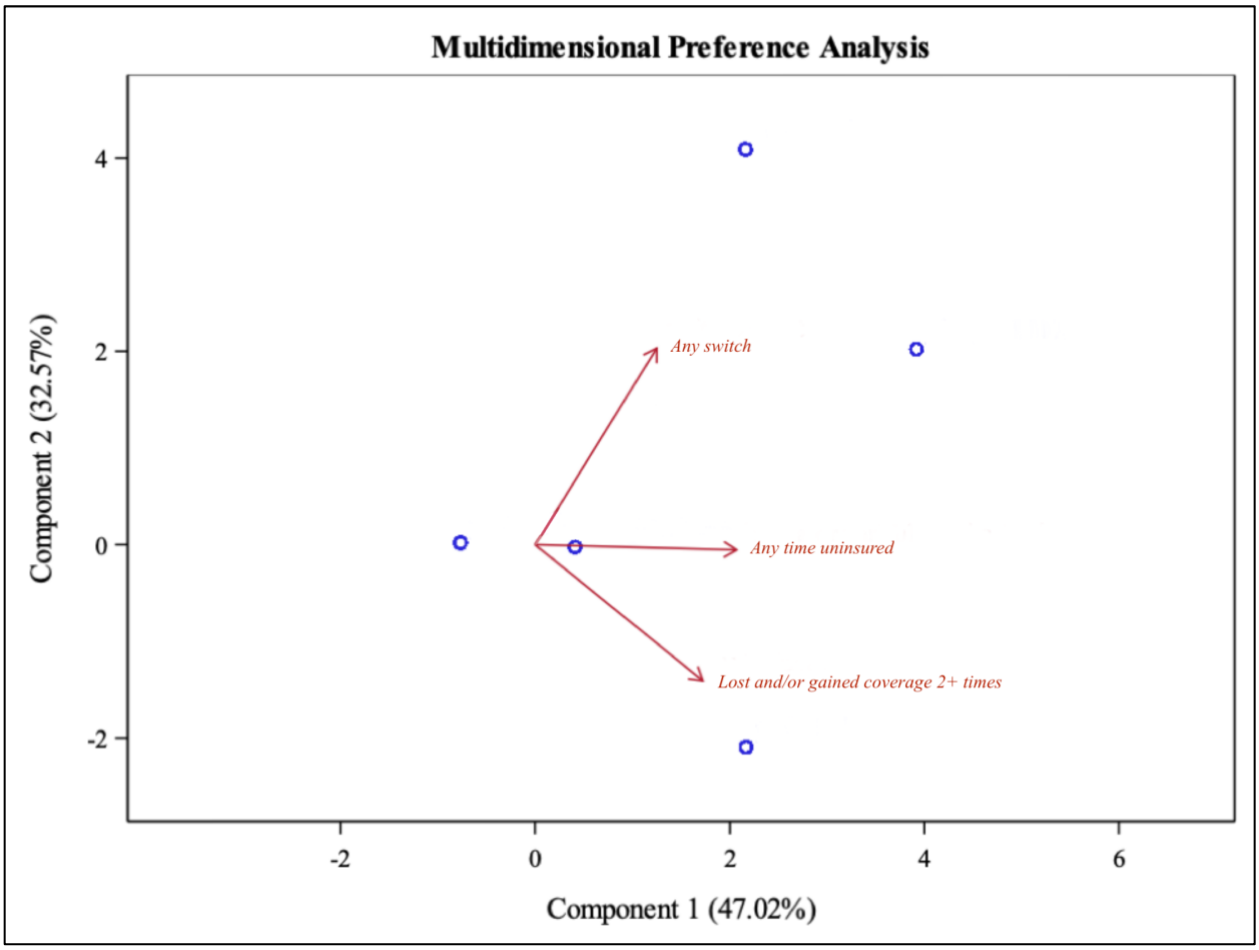

Table 2.3. Results from the non-linear principal component analysis (PCA).	
Variables	Factor Score
Length of uninsurance: Spent any time uninsured during	0.8276
Frequency of uninsurance: Lost or gained coverage more than once	0.6909
Frequency of switching: Any switch in coverage between consecutive	0.4984

Table 2.4. Estimated mean coverage instability index scores by predisposing, enabling, health need characteristics among adults in the US (ages 18-64), 2010-2016.			
Variables	Unweighted n	Mean	95% CI
Overall coverage instability index score (range: 0-100)	33,043	13.6	(13.2, 14.0)
Predisposing			
Sociodemographic:			
Baseline age ***			
18-25	5,469	21.0	(20.1, 21.8)
26-39	10,628	14.7	(14.0, 15.4)
40-49	7,590	11.2	(10.5, 11.9)
50-64	9,356	10.0	(9.5, 10.6)
Sex **			
Female	18,738	13.9	(13.4, 14.4)
Male	14,305	13.2	(12.7, 13.7)
Race/ethnicity ***			
Non-Hispanic White	14,496	12.1	(11.6, 12.6)
Hispanic	8,984	17.7	(17.0, 18.4)
Non-Hispanic Black	6,316	16.9	(16.1, 17.7)
Non-Hispanic Asian	2,384	12.1	(10.9, 12.3)
Non-Hispanic other or multiple races	863	16.9	(14.6, 19.3)
Language most spoken in the home ***			
English	24,416	12.8	(12.3, 13.2)
Not English	8,627	18.1	(17.3, 18.8)
Socioeconomic:			
Baseline education level ***			
Less than high school	1,997	20.9	(19.7, 22.1)
9-12th grade, no high school diploma, no GED	3,358	18.4	(17.3, 19.6)
High school diploma or GED	9,773	15.3	(14.7, 16.0)
Some college or Associate's degree	9,210	14.8	(14.1, 15.4)
4-year college degree or more	8,705	9.4	(8.8, 10.0)
Baseline employment status ***			
Employed	24,245	12.4	(11.9, 12.8)
Unemployed	8,703	17.8	(17.2, 18.5)
Employment history ***			
Continuously employed	21,855	11.4	(10.9, 11.8)
Continuously unemployed	5,422	14.6	(13.8, 15.4)
Any change in employment status	5,447	22.9	(22.0, 23.8)
Baseline marital status ***			
Married or separated	17,926	10.4	(9.9, 10.8)
Divorced or widowed	4,081	15.3	(14.5, 16.2)
Never married	11,036	18.7	(18.1, 19.3)

Marital history during survey period ***			
Continuously married or separated	17,326	10.1	(9.6, 10.5)
Continuously widowed or divorced	3,843	15.3	(14.4, 16.1)
Continuously never married	10,259	18.4	(17.8, 19.0)
Any change in marital status	1,593	20.5	(18.9, 22.2)
Enabling			
Individual-level resources:			
Baseline poverty level ***			
<100% FPL	5,949	22.3	(21.4, 23.3)
100 to 138% FPL	2,702	23.3	(21.9, 24.7)
139 to <200% FPL	4,200	21.2	(20.0, 22.3)
200 to <400% FPL	9,985	14.3	(13.6, 15.0)
400%+ FPL	10,207	7.2	(6.6, 7.7)
Poverty level history during survey period ***			
Continuously <100% FPL	3,900	21.3	(20.2, 22.5)
Continuously 100 to 138% FPL	731	24.0	(21.6, 26.4)
Continuously 139 to <200% FPL	1,506	20.2	(18.4, 22.0)
Continuously 200 to <400% FPL	6,115	13.6	(12.7, 14.4)
Continuously 400%+ FPL	8,325	6.2	(5.7, 6.8)
Any change: worse	5,517	17.9	(16.9, 18.9)
Any change: better	6,949	18.4	(17.6, 19.3)
Structural-level resources:			
Baseline Census region ***			
South	12,020	14.2	(13.4, 14.9)
Northeast	5,175	11.6	(10.5, 12.7)
Midwest	6,824	13.6	(12.7, 14.5)
West	9,024	14.2	(13.5, 14.9)
Census region history during survey period ***			
Continuously lived in the South	11,861	14.0	(13.3, 14.8)
Continuously lived in the Northeast	5,051	11.1	(10.1, 12.2)
Continuously lived in the Midwest	6,617	13.2	(12.3, 14.1)
Continuously lived in the West	8,900	13.9	(13.2, 14.6)
Moved from one from one region to another	614	26.5	(22.9, 30.2)
Pre/post ACA ***			
Pre-ACA (2010-2013)	21,074	11.9	(11.4, 12.4)
Post-ACA (2014-2016)	11,969	16.4	(15.7, 17.1)
Health Need			
Actual/evaluated:			
Charlson Comorbidity Index ***			
0	26,582	13.8	(13.4, 14.3)
1	2,553	13.5	(12.4, 14.7)
2	2,944	11.5	(10.5, 12.6)

3+	964	12.9	(11.2, 14.5)
Has a serious chronic condition† ***			
Yes	17,964	12.2	(11.8, 12.7)
No	15,079	15.2	(14.7, 15.8)
Perceived:			
Mean self-reported health status score ***			
1-1.99 (Excellent)	10,218	12.3	(11.7, 12.9)
2-2.99 (Very good)	14,067	13.3	(12.8, 13.9)
3-3.99 (Good)	7,036	15.8	(15.0, 16.6)
4-4.99 (Fair)	1,575	17.7	(16.4, 19.0)
5 (Poor)	147	16.5	(12.4, 20.5)
"I'm healthy enough that I really don't need health insurance" ***			
Yes (Strongly agree, agree somewhat)	4,308	17.3	(16.4, 18.1)
No (Disagree strongly, disagree somewhat or uncertain)	28,735	13.0	(12.6, 13.5)
Time			
Panel years***			
2010-2011	5,929	11.6	(10.9, 12.3)
2011-2012	7,543	11.8	(11.1, 12.5)
2012-2013	7,602	12.2	(11.5, 13.0)
2014-2015	5,935	16.8	(15.8, 17.7)
2015-2016	6,034	16.0	(15.0, 16.9)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

† Serious chronic health conditions include: heart disease, diabetes, cancer, asthma, COPD, stroke, arthritis, hypertension, and hyperlipidemia

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Chapter 3: The moderating effects of race/ethnicity and the Affordable Care Act on the relationship between coverage instability and access to care among adults with diabetes, 2010-2016

Introduction

Diabetes is a chronic medical condition in which the body is unable to adequately process and utilize glucose in the blood for energy.[1] In general, there are two types of diabetes (i.e., type 1 and type 2); however, over 90% of adults with diabetes in the US have type 2.[2] When left unchecked over time, the accumulation of glucose in the blood can lead to serious health consequences, including heart disease – the leading cause of death in the US.[3,4] Previous research has demonstrated the importance of regular access to care for individuals living with diabetes to help maintain proper glycemic control and prevent the development of serious complications from uncontrolled diabetes.[5-8]

Due to a number of individual, social, and policy factors, diabetes has become one of the leading causes of morbidity and mortality among adults in the US.[1,9,10] In 2018, an estimated 13.0% (34.1 million) of the adult US population (ages 18 and over) had diabetes, where 21.5% of all diabetes cases were estimated to be undiagnosed.[11] Diabetes is the seventh leading cause of death in the US and a leading cause of end-stage renal disease (ESRD) and recent blindness among adults.[4,11] The burden of diabetes is expected to grow as the US population ages and becomes more racially and ethnically diverse,[12,13] with the prevalence of diagnosed diabetes projected to nearly double among adults by 2060.[12]

Racial and ethnic (hereafter racial/ethnic) minority communities bear the greatest burden caused by diabetes. Non-Hispanic American Indians/Alaskan Natives had the highest prevalence

of diagnosed diabetes among adults ages 18 and over in 2017-2018 (14.7%), followed by Hispanics (12.5%) , and non-Hispanic Blacks (11.7%), compared to 7.5% for non-Hispanic Whites and 9.2% for non-Hispanic Asians.[11] Additionally, Hispanics (9.7) and non-Hispanic Blacks (8.2) also had the highest incidence of diagnoses (per 1,000) among adults ages 18 and older in 2017-2018 compared to non-Hispanic Asians (7.4) and non-Hispanic Whites (5.0).[11] Non-Hispanic Asians had the highest rate of undiagnosed diabetes (4.7%) followed by Hispanics (4.1%), non-Hispanic Blacks (3.0%), and non-Hispanic Whites (2.2%).[11]

Racial/ethnic minorities are also more likely to experience complications from diabetes. In previous research using data from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases, Hispanics and non-Hispanic Blacks were found to be at significantly higher risk for preventable 180-day hospital readmissions for diabetes-related complications.[14] The authors of the study suggest that this disparity in 180-day vs. 30-day hospital readmissions for diabetes-related complications is most likely due to the outpatient management of diabetes rather than the quality of care received while hospitalized.[14] In a study examining disparities in diabetes complications by race/ethnicity in the Northeast, Hispanics with diabetes had significantly higher rates of retinopathy and nephropathy compared to non-Hispanic Blacks and higher rates of heart disease compared to non-Hispanic Whites.[15] Compared to other groups, non-Hispanic Blacks and Hispanics are also more likely to lack access to reliable health insurance coverage throughout adulthood,[16] which itself has been linked to poorer disease management and the development of complications from diabetes.[6,7,17-19]

In 2010, the Patient Protection and Affordable Care Act (ACA) was enacted to improve access to health insurance coverage. Three major provisions of the law took effect on January 1st, 2014: (1) an individual mandate requiring all individuals to carry a minimum level coverage or

face a tax penalty, (2) the expansion of Medicaid to nearly all low-income individuals whose incomes are no more than 138% of the federal poverty level (FPL), and (3) the establishment of federally- or state-run health insurance exchanges in each state where qualifying individuals are able to purchase private non-group coverage with financial assistance from the federal government.[20] While the individual mandate remained in effect until 2019,[21] a Supreme Court ruling in 2012 made the expansion of Medicaid in states voluntary.[22] As of November 2020, 39 states including the District of Columbia have adopted Medicaid expansion.[23,24]

While previous research has indicated a slight increase in unstable coverage after major provisions of the ACA took effect in 2014, this increase was largely due to a shift of the long-term uninsured towards being insured with shorter periods of uninsurance under the ACA.[25] Among adults ages 18-64, 10.3% (20.1 million) had been uninsured for a year or less and 12.3% (23.9 million) had been uninsured for more than a year in 2014,[26] 9.0% (17.7 million) had been uninsured for a year or less and 9.1% (17.8 million) had been uninsured for more than a year in 2015,[27] and 9.4% (18.5 million) had been uninsured for a year or less and 7.6% (14.9 million) had been uninsured for more than a year in 2016.[28]

Furthermore, while the ACA has significantly contributed to the narrowing of racial/ethnic disparities in health insurance coverage,[29-31] Hispanics continue to experience higher rates of uninsurance relative to other groups.[29,30] That is, while absolute disparities (i.e., the difference in percentage uninsured between two groups) in coverage by race/ethnicity have become smaller since 2014, some relative disparities (i.e., the ratio of percentage uninsured between two groups) have not, especially for Hispanics in Medicaid expansion states which suggests continued systemic and structural barriers to accessing care.[30,32]

In this paper, we use data from the Medical Expenditure Panel Survey (MEPS) from 2010-2016 and adapt the Andersen behavioral model of health services use to guide us in examining the effect of coverage instability on access to care among adults with diabetes and determining whether this effect differs by race/ethnicity and pre/post 2014 when major provisions of the ACA took effect.

Methods

Data: MEPS is a national two-year survey, which consists of five rounds of interviews.[33] Demographic characteristics, information on health services used, and medical expenses were collected from a nationally representative sample of the non-institutionalized civilian population in the US.[33]

In terms of coverage data specifically, each panel includes monthly coverage data for each respondent over a two-year survey period. This enables us to look at the various types of changes in coverage that can take place over the course of more than just a year. In addition to documenting whether a respondent was insured for a particular month, the survey also asks about the source of coverage. Public sources of coverage include Medicaid and Medicare while private sources include employer-sponsored coverage. Other types of private coverage include group coverage which could be union-related or coverage that had been purchased directly from a group or association, non-group coverage, and coverage obtained through a holder outside of the reporting unit (i.e., an individual or group of individuals within a sampled unit who have familial ties to one another).[34] Some non-group coverage options were coded separately, such as coverage purchased through the health insurance exchanges starting in 2014 and non-group coverage purchased for someone who reported being self-employed. Sources of civilian health

coverage for returning active duty and retired services members, disabled veterans, and their spouses and dependent children include TRICARE and CHAMPVA.

Five sets of panel data were used to create the final data set: Panel 15 (2010-2011), Panel 16 (2011-2012), Panel 17 (2012-2013), Panel 19 (2014-2015), and Panel 20 (2015-2016). To compare outcomes pre/post 2014, those in Panels 15 to 17 (2010-2013) were categorized as being in the pre-ACA sample while those in Panels 19 to 20 (2014-2016) were categorized as being in the post-ACA sample. Panel 18 was not included in the analyses since the survey period for this panel spanned both 2013 and 2014.

Study population: The study was limited to adults ages 18-64 who reported a diabetes diagnosis and completed all five rounds of the two-year survey. Those younger than age 65 who qualified for Medicare were excluded from the study. This resulted in an unweighted sample of 2,555 observations.

Measures: Outcomes for this study included: (1) any delay in needed care, (2) any delay in needed prescriptions, (3) any emergency room (ER) visit, (4) any overnight hospitalization, (5) having a usual source of care each year, and (6) having at least one medical visit each year during a two-year survey period. A usual source of care was defined as having a particular medical professional or place to which the respondent would usually go if they felt ill or needed advice about their health. Any office-based or outpatient visit with a physician or nurse practitioner was considered a medical visit in this study.

The primary regressor of interest was coverage instability, which was measured as an index accounting for duration of uninsurance (i.e., state of being uninsured), frequency of uninsurance, and switches in source of coverage between any two months over a two-year period. A non-linear principal component analysis (PCA) was used to create this index. Details

on the construction and validation of this index can be found in Chapter 2. Raw index scores were re-scaled so that index scores could range from 0 to 100, with higher scores indicating greater coverage instability. A score of 0 would indicate stable and continuous coverage while a score of 100 would indicate having the highest level of unstable coverage observed relative to everyone else in the study sample.

Race/ethnicity and an indicator for pre/post ACA were used as moderating variables. Racial/ethnic categories were based on the categories used by the US Census and the Office of Management and Budget (OMB) and include: Hispanic/Latino (hereafter, Hispanic), non-Hispanic White (NHW), non-Hispanic Black/African American (NHB), non-Hispanic Asian, and other or multiple races of non-Hispanic origin (e.g., American Indian or Alaskan Native and Native Hawaiian or other Pacific Islander).[35] However, due to small sample sizes, the non-Hispanic Asian and non-Hispanic other/multiple race categories were collapsed into one category (NHA/OM). Pre-ACA observations were defined as those occurring before 2014 while post-ACA observations were defined as those occurring during or after 2014.

Using the Andersen behavioral model of health services use as a general framework (Figure 1.2),[36] predisposing (sociodemographic: age, sex, race/ethnicity, language most spoken in the home; socioeconomic: education, marital status), enabling (individual-level resources: poverty; structural-level accessibility to providers and facilities: geographic region, pre/post ACA), and health need characteristics (actual/evaluated: disease comorbidity, severity; perceived: self-reported health status and perceived need for health insurance coverage) were used as control variables. Within this framework, predisposing factors may influence use indirectly through need or enabling factors, enabling factors may directly influence use of ambulatory and acute services, while need factors may directly influence use of acute services

but indirectly influence use of ambulatory services through enabling factors. Thus, coverage instability is considered an enabling factor within this framework. Categories for baseline marital status included being married, which included those who might have been separated or living apart but still legally married, and not being married (i.e., never married, divorced, or widowed).

Disease comorbidity was assessed by first linking the MEPS medical conditions data to the panel data and then computing the Charlson Comorbidity Index (CCI) using the algorithm described by D'Hoore and colleagues.[37] Higher scores on the CCI indicate greater disease comorbidity. Severity of diabetes was determined by the complexity of a respondent's treatment for diabetes. Any mention of insulin injections as part of their treatment indicated the greatest severity of diabetes followed by oral medication (i.e., oral medication only or oral medication with diet modification), diet modification only, and no treatment.[38,39] Self-reported health status was measured during each interview round on a five-point Likert scale from "1=Excellent," "2=Very good," "3=Good," 4=Fair," to "5=Poor health". The mean score from all five rounds was computed and then categorized using the same five levels of perceived health (i.e., "1-1.99=Excellent" to "5= Poor health"). Perceived need for health insurance was assessed by asking respondents how strongly they disagreed or agreed with the following statement: "I'm healthy enough that I really don't need health insurance." Those who agreed with the statement were categorized as lacking perceived need for health insurance coverage.

Statistical analyses: To assess bivariate associations between the primary regressor and the outcomes, chi-square tests for categorical variables were used. Multivariable probit regression models were then used to estimate the differential effect of coverage instability on each of the access-to-care outcomes by race/ethnicity and pre/post ACA (Equations 1 and 2, respectively):

Equation 1) $$Y_i = \beta_0 + \beta_1 X_{cii} + \beta_2 X_{re} + \beta_3 X_{cii} * X_{re} + \beta_4 X_i + u$$

Equation 2) $$Y_i = \beta_0 + \beta_1 X_{cii} + \beta_2 X_{aca} + \beta_3 X_{cii} * X_{aca} + \beta_4 X_i + u$$

In both equations, Y_i indicates whether the outcome is true (yes/no), X_{cii} represents the coverage instability index score, X_i represents the control variables, β_i represents the coefficients, and u represents the error term. In Equation 1, which we will refer to as the race/ethnicity analysis, X_{re} represents race/ethnicity (NHW (ref), Hispanic, NHB, NHA/OM). In Equation 2, which represents the ACA analysis, X_{aca} represents an indicator variable for whether a respondent was in the pre- or post-ACA sample.

Marginal effects were then estimated for significant interactions between each moderating variable and coverage instability. That is, for the race/ethnicity analysis, the predicted probabilities of the outcomes were estimated when the coverage instability scores were set at 0, 25, 50, 75, and 100 for each race/ethnicity, and the difference between the predicted probabilities at each point were compared between NHW and the other racial/ethnic groups. Similarly, for the ACA analysis, the predicted probabilities of the outcomes were estimated when coverage instability scores were set at 0, 25, 50, 75, and 100 for each pre/post ACA period, and the difference between the predicted probabilities at each point were compared between pre- and post-ACA periods. Survey weights were applied to account for the complex survey design of MEPS. All analyses were performed at the 5% significance level using Stata 16.

Specification tests: To account for potential endogeneity of coverage instability due to potential selection bias in coverage, an instrumental variables (IV) approach was considered. If

endogeneity was present and valid instruments could be identified, then an IV probit model would be estimated instead of a naïve probit model.

Endogeneity was tested using the augmented regression approach (also known as the Durbin-Wu-Hausman test), which involved: 1) running each first-stage regression by regressing each endogenous variable (i.e., coverage instability and its interaction terms) on all of the exogenous covariates (including instruments and their interaction terms) in an ordinary least squares (OLS) model, 2) obtaining the residuals from each first-stage regression, 3) adding the residuals to the second-stage regression as predictors, and 3) testing for the joint significance of these residuals using an F test.[40] A significant F test would indicate the presence of endogeneity and thus inconsistent estimates would be obtained from the naïve probit model.[40]

Since the majority of individuals in the US obtain health insurance through employer-sponsored coverage,[41-43] employment characteristics (e.g., industry, occupation, whether firm has more than one location, usual number of hours worked per week at current main job, firm size, whether in a labor union, whether insurance is offered to anyone at current main job, and whether respondent is eligible for offered health insurance at current main job) were assessed as potential instruments for coverage instability. Previous research has also demonstrated the use of Census region and self-employment status as instruments for coverage.[44-46]

To be considered a valid instrument, a variable must demonstrate both instrument relevance (i.e., instrument *Z* is correlated with endogenous variable *X*) as well as instrument exogeneity (i.e., instrument *Z* can only affect outcome *Y* through endogenous *X* in the first stage and cannot be correlated with the error term in the second stage).[40] To test the first assumption of instrument relevance, we ran each first-stage regression.[40,47] An F test was then used to determine the significance and strength of these instruments.[40,47] An F statistic less than 10

generally indicates weak correlation to the endogenous regressor and subsequently is considered to be a weak instrument.[48]

If the first assumption is met, the second assumption of instrument exogeneity (also known as excludability) can be tested by including one set of instruments in the first-stage regression(s) and the other set in the second-stage regression as predictors.[40] If the instruments are significant in the second stage, then the exclusion restriction criteria is not met.[40] However, excludability cannot be determined if only one valid instrument is available.[40]

Results

Descriptive: Table 3.1 presents descriptive statistics and results from bivariate tests of association between the access-to-care outcomes and sociodemographic, socioeconomic, and health need factors. Overall, the majority of the sample were older, NHW, married, and resided in the South or Midwest. The average age of the sample was around 49. More than half (59.5%) of the sample were between the ages of 50-64. The sample was evenly split by sex. More than half of the respondents in the sample were NHW (56.5%), 18.6% were Hispanic, 16.7% were NHB, and 8.2% were NHA/OM. Approximately two thirds (67.3%) of the sample reported being married at baseline. Less than half of the sample resided in the South (43.4%) while nearly a quarter (22.8%) lived in the Midwest, 19.2% lived in the West, and 14.6% lived in the Northeast. Nearly 40% of the sample had participated in the survey during or after 2014.

Respondents in the sample also tended to be highly educated, have higher incomes, and be native English speakers. The majority of the sample had at least a high school diploma or GED (85.6%), with 30.8% completing some college or an Associate's degree and 19.9% completing a four-year college degree or more. Less than a quarter of the sample (21.3%) had

incomes at or below 138% of the federal poverty level (FPL). English was the language most spoken in the home for the majority of the sample (81.5%).

Most of the sample also had a comorbid condition, treated their diabetes with an oral medication or diet modification, and reported their health to be in good condition. The average CCI score was 2.4, with nearly the entire sample scoring 2 or more (94.9%). A third of the sample (33.8%) treated their diabetes using insulin injections while more than half of the sample (57.9%) took an oral medication, 7.0% modified their diet only, and 1.3% indicated being on no treatment. On average, most respondents reported being in "good" health or better (84.2%) over a two-year survey period, with 17.4% ever reporting being in poor health. Only 4.4% of the sample reported believing they were healthy enough to avoid health insurance. The mean coverage instability index score was 12.9 out of 100, with 65.3% of the sample insured throughout with no change in coverage, 23.2% with any change in coverage, and 11.5% uninsured throughout.

Most of the sample did not report having a delay in needed care or needed prescription refills, any ER visit, or any overnight hospital stay. Only about 11.4% of the sample reported having any delay in needed medical care, 13.2% reported any delay in needed prescription refills, 34.8% reported any ER visits, and 20.7% reported any overnight hospital stays. Most of the sample did however report having a usual source of care each year (84.5%) and at least one medical visit each year (83.3%). An expanded version of Table 3.1 can be found in Appendix 3.1.

Bivariate: From bivariate tests, greater coverage instability was significantly associated with any delay in needed care, any delay in needed prescription refills, and any ER visit while lower coverage instability was significantly associated with having a usual source of care and

having regular medical visits (Table 3.1). On average, those who reported any delay in needed care had coverage instability index scores that were 8.9 points higher (20.8 out of 100) than those who did not (11.9 out of 100) ($p<.001$). Those who reported any delay in needed prescription refills had coverage instability index scores that were 8.5 points higher (20.3 out of 100) than those who did not (11.8 out of 100) ($p<.001$). Those that reported any ER visit had coverage instability index scores that were 3.8 points higher (15.4 out of 100) compared to those who did not (11.6 out of 100) ($p=.002$). In contrast, those who reported having a usual source of care had coverage instability index scores that were 7.6 points lower (11.8 out of 100) than those who did not (19.4 out of 100) ($p<.001$), and those who reported at least one medical visit each year had coverage instability index scores that were 4.9 points lower (12.1 out of 100) than those who did not (17.0 out of 100) on average ($p<.001$). Those who reported any overnight hospital stay had coverage instability index scores that were 0.6 points higher (13.4 out of 100) than those who did not (12.8 out of 100); however, this was not statistically significant ($p=.624$).

Race/ethnicity was significantly associated with any delay in needed prescription refills, any overnight hospitalization, usual source of care, and at least one medical visit each year. Any delay in needed prescription refills was associated with greater proportions of NHW and NHB ($p=.013$). Similarly, any overnight hospitalization was associated with greater proportions of NHW and NHB ($p=.049$). Having a usual source of care was associated with greater proportions of NHW, NHB, and other or multiple races of non-Hispanic origin ($p<.001$), while having at least one medical visit each year was associated with just greater proportions of NHW ($p<.001$). Being in the post-ACA sample was not significantly associated with any of the outcomes at the bivariate level.

Multivariable: Results from the race/ethnicity analysis are presented in Table 3.2 and Figure 3.1. The differential effect of coverage instability by race/ethnicity on any delay in needed care was statistically significant ($p<.05$). Among those with the most unstable coverage (i.e., coverage instability index=100 out of 100), Hispanics were 26% less likely ($p=.014$) and NHB were 30% ($p=.007$) less likely than NHW to report any delay in needed care even after accounting for other factors. According to Figure 3.1a, the mean predicted probability of any delay in needed care increased for all racial/ethnic groups as coverage instability increased. This shift was most profound for NHW, increasing from 9% to 44% as coverage went from most stable (i.e., coverage instability index=0 out of 100) to most unstable. In contrast, the mean predicted probability gradually increased from 6% to 17% for Hispanics, from 10% to 14% for NHB, and from 12% to 13% for NHA/OM even as coverage instability increased from most stable to most unstable.

The effect of coverage instability on any ER visits also significantly varied by race/ethnicity ($p<.05$). Among those with the most unstable coverage, Hispanics were 28% less likely to report any ER visit compared to NHW ($p=.008$). In Figure 3.1b, the mean predicted probability *increased* from 34% to 50% for NHW, *decreased* from 34% to 22% for Hispanics, *remained* at 38% for NHB, and *increased* from 26% to 44% for NHA/OM as coverage instability increased from most stable to most unstable.

Table 3.3 and Figure 3.2 provide results from ACA analysis. As coverage instability increased, those in the post-ACA sample were more likely to report having a usual source of care each year compared to those in the pre-ACA sample even after controlling for other factors ($p=.018$). Those in the post-ACA sample with the most unstable coverage were 25% more likely to report having access to a usual source of care each year compared to those with the most

unstable coverage in the pre-ACA sample (p=.006). The graph in Figure 3.2 further illustrates the mitigating effect of the ACA on coverage instability and access to care for those living with diabetes. While the mean predicted probability of having a usual source of care decreased as coverage instability increased for both pre- and post-ACA samples, the decline was not as steep after 2014.

Specification tests: Results from the specification tests indicated potential endogeneity bias in the ACA analysis pertaining to any delay in needed care (F=7.31, p=.001). Out of the 10 instruments considered, only one (i.e., eligibility for the health insurance offered at one's current main job) was found to be valid and strong for the ACA analysis ($Z_{instrum}$: F=14.45, p<.001, $Z_{instrum} \cdot X_{aca}$: F=19.01, p<.001). However, since only one valid instrument could be identified, we were unable to test its excludability from the second-stage regression. Nevertheless, we ran an IV probit model using eligibility for employer-sponsored coverage as an instrument for coverage instability. A summary of the results from the specification tests can be found throughout Appendix 3.4.

Discussion

Our study sheds light on the issue of coverage instability among adults living with diabetes in the US. Consistent with previous research, most adults living with diabetes in our study had some form of health insurance coverage at some point during the survey (88.5%).[49] However, more than a quarter (26.2%) of those with any coverage had unstable coverage. As previous research has indicated, regular access to care is an important element in helping individuals living with diabetes manage and control their chronic illness.[5-8]

Our study also demonstrates the differential effect that coverage instability has on access to care for those living with diabetes by race/ethnicity. This differential effect appears greatest for delays in needed care and ER use. While we did find that greater coverage instability increased the likelihood of experiencing any delay in needed care overall as previous research has done,[50,51] we also found that Hispanic and NHB adults in particular were significantly less likely to report any delay in needed care compared to NHW even as coverage instability increased and after accounting for other factors. That is, while the probability of reporting any delay in care increased for all groups as coverage instability increased, this increase was greatest for NHW but lowest for Hispanics and NHB in our study. In terms of being able to access care when needed, this finding suggests that NHW adults with diabetes are most affected by coverage instability compared to other groups.

However, the lower than expected estimates for any delay in care among Hispanics and NHB in our study could also be seen as a reflection of the generally lower use of preventive diabetes care among Hispanics and NHB compared to other groups due to various socioeconomic and cultural factors.[52,53] That is, this lower use of health care among Hispanics and NHB may itself be due to a number of overlapping socioeconomic and cultural factors that may influence how "needed care" is perceived and prioritized. For instance, in the US, low-wage workers tend to lack access to stable sources of coverage and are more likely to be racial/ethnic minorities.[54] Many who work part-time or who may be juggling multiple low-paying jobs to make ends meet are often not offered or do not qualify for coverage through their employers and sometimes cannot afford coverage even when they do qualify.[55-57] Moreover, in non-expansion states, many low-wage workers are excluded from Medicaid eligibility.[58] Besides lacking stable sources of coverage and having less income, low-wage workers often cannot afford to take time

off from work, even for their health until they experience serious symptoms and their situation becomes dire.[59] One US-based study found that Hispanics were actually twice as likely to report an unmet need compared to NHW when the unmet need was symptom specific.[60] However, unlike in their study, the question asked in MEPS about any delay in care was not symptom specific and thus could be another reason why estimates were much lower than expected for Hispanics in our study.

We also found that Hispanic adults living with diabetes were significantly less likely to report ER use compared to other groups, even as coverage instability increased. This finding is consistent with the latest report on emergency department visits in the US in 2017, which lists Hispanics/Latinos with the second smallest percentage of use (15.9%) after other races of non-Hispanic origin (3.5%) compared to 55.5% for NHW and 25.1% for NHB.[61] Lower use among Hispanics again may be tied to socioeconomic and cultural factors that limit access to coverage as well as language and immigration factors. This may be especially true for those who may be recent immigrants with limited English proficiency and may not be as familiar with navigating the already complex US health care system, and those who may fear deportation for lacking proper documentation.[62-64] Within our own study sample, about half (49.3%) of Hispanic respondents had completed their survey in English while over 90% of NHW, NHB and NHA/OM respondents had completed their survey in English. Similarly, about half (54.3%) of Hispanic respondents within our sample reported speaking English very well or well compared to 88.5% for NHW, 97.3% for NHB, and 80.7% for NHA/OM. While information on citizenship status was not available in the data, nativity and number of year in the US indicates that more than half of Hispanics (59.4%) and NHA/OM (56.4%) in the sample were not born in the US but

were also not recent immigrants – among foreign-born respondents, only 3.0% of NHW, 1.2% of Hispanics, 1.1% of NHB, and 3.3% of NHA/OM had been in the US for less than five years.

In our second set of analyses looking at the effect of coverage instability on access to care before and after the ACA, we found that the negative effect of coverage instability on access to care for adults living with diabetes in the US was mitigated by the major provisions of the ACA that took effect in 2014. This effect was most prominent for having a usual source of care. That is, regardless of coverage instability, the predicted probability of having a usual source of care was significantly higher after 2014 compared to before. Previous research suggests that after having stable health insurance coverage, having a usual source of care is an important factor in determining continuity of care, which in turn is important for maintaining proper glycemic control for those with diabetes.[5,65]

Some limitations of this study include relying on self-report data, a common limitation when using survey data. However, standard medical record abstraction among a subsample of survey respondents has been used to validate and verify the self-reported utilization data in MEPS.[66] We were also not able to infer from the data whether a change in coverage had resulted in a change in provider, which is also important for continuity of care.[67,68] However, a change in provider is more likely to occur among those going from private to public coverage since fewer providers may choose to take on publicly insured patients due to lower reimbursement rates.[69] In our study, only 1.8% of the respondents had ever switched from a private to public source of coverage.

Due to a limited number of observations for some racial/ethnic groups, we also were not able to directly test the effect of the ACA on reducing racial/ethnic disparities in coverage instability, which could have been achieved using a triple difference analysis. A larger sample

size would allow us to do this as well as to further investigate and account for potential endogeneity bias in the rest of the analyses by increasing our statistical power. More observations would also allow us to separately look at the effect of coverage instability for other racial/ethnic groups greatly affected by diabetes and coverage instability, such as American Indians and Alaskan Natives who have the highest rates of diagnosed diabetes in the US.[11] Despite this limitation, our findings from both analyses still provide further support indicating the ACA's role in narrowing racial/ethnic disparities in coverage and access to care especially since racial/ethnic minorities as well as young adults and low-income adults living in expansion states demonstrated the greatest gains in coverage under the ACA.[29-31]

Our study was also not able to address the growing issue of underinsurance, which has grown more prevalent in recent years due to the relaxing of regulations for short-term health plans.[70,71] Lastly, the ACA effects observed in this study may be understated since state-level data were not available to help us distinguish those living on expansion versus non-expansion states during the post-ACA period. However, as additional post-ACA data is continued to be released, many of these issues may be addressed in future research efforts. Furthermore, because our study is limited to adults with diabetes, our results may not be generalizable to the overall US population or to other groups.

Despite these limitations, our study provides further insight on coverage instability among adults living with diabetes in the US and its differential effect on access to care by race/ethnicity. Our study also highlights the importance of continuing efforts to expand coverage beyond what currently is possible under the ACA and to reduce the mechanisms that contribute to unstable health insurance coverage and churn within our society. If we are to truly address the

racial/ethnic disparities that persist in health, we must strive to make stable coverage feasible and attainable for all individuals regardless of one's characteristics or state of residence.

Tables, figures, and appendices

Table 3.1. Estimated access-to-care outcomes by demographic characteristics for adults ages 18-64 with diabetes, 2010-2016 (n=2,555).

	Estimate (95% CI)						
	Total	Any delay in needed medical care	Any delay in needed prescription refills	Any ER visit	Any overnight hospital stays	Had usual source of care each year	At least one medical visit each year
	(100%)	(11.4%)	(13.2%)	(34.8%)	(20.7%)	(84.5%)	(83.3%)
Variables	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Predisposing							
Baseline age (%)						***	***
18-39	15.7 (13.9, 17.7)	11.4 (7.0, 17.9)	12.7 (8.7, 18.3)	18.1 (15.2, 21.5)	15.5 (11.7, 20.1)	13.7 (11.8, 15.7)	13.9 (12.1, 16.0)
40-49	24.8 (22.4, 27.3)	27.5 (21.3, 34.7)	27.3 (21.2, 34.3)	23.4 (19.3, 28.0)	23.7 (19.4, 28.7)	24.5 (21.8, 27.5)	23.4 (20.9, 26.2)
50-64	59.5 (56.9, 61.9)	61.2 (53.3, 68.5)	60.0 (52.4, 67.1)	58.5 (53.6, 63.2)	60.8 (55.4, 65.9)	61.8 (58.8, 64.8)	62.6 (59.8, 65.3)
Sex: Female (%)	51.1 (48.6, 53.6)	61.1* (53.7, 67.9)	62.6*** (55.6, 69.2)	56.4** (51.6, 61.1)	53.8 (47.5, 60.0)	51.4 (48.6, 54.1)	52.9** (50.1, 55.6)
Race/ethnicity (%)			*		*	***	***
NHW	56.5 (53.3, 59.7)	63.1 (55.9, 69.8)	64.4 (57.4, 70.9)	58.0 (53.1, 62.8)	60.8 (55.0, 66.3)	57.9 (54.5, 61.2)	60.1 (56.8, 63.3)
Hispanic	18.6 (16.2, 21.3)	11.8 (8.2, 16.7)	12.6 (8.8, 17.6)	17.1 (13.9, 20.9)	14.8 (11.6, 18.6)	16.8 (14.5, 19.5)	16.3 (14.0, 18.9)
NHB	16.7 (14.6, 19.1)	17.6 (13.1, 23.2)	17.2 (13.4, 21.8)	18.9 (15.6, 22.7)	18.1 (14.1, 23.0)	17.1 (14.8, 19.6)	16.2 (14.0, 18.6)
NHA/OM	8.2 (6.5, 10.3)	7.5 (4.0, 13.7)	5.8 (3.5, 9.4)	5.9 (3.4, 10.1)	6.3 (4.1, 9.7)	8.2 (6.3, 10.6)	7.4 (5.8, 9.4)
Language most spoken in the home: English (%)	81.5 (79.1, 83.7)	87.7** (83.3, 91.2)	89.4** (84.3, 93.0)	84.2* (80.6, 87.3)	85.1* (81.3, 88.2)	82.9*** (80.5, 85.1)	83.0*** (80.6, 85.2)

Baseline education (%)			*	*		**	**
Less than high school	7.0 (5.8, 8.3)	5.9 (3.7, 9.4)	3.5 (2.1, 5.8)	6.6 (5.1, 8.5)	5.9 (4.3, 8.1)	6.1 (4.9, 7.6)	6.5 (5.3, 7.9)
9-12th grade, no high school diploma, no GED	8.5 (7.3, 9.9)	7.2 (4.9, 10.3)	6.5 (4.3, 9.7)	9.7 (7.8, 11.9)	8.8 (6.6, 11.6)	8.4 (7.1, 10.0)	7.8 (6.5, 9.4)
High school diploma or GED	33.9 (31.4, 36.5)	33.2 (25.7, 41.6)	36.6 (30.0, 43.7)	36.6 (32.9, 40.5)	35.2 (29.8, 41.0)	33.8 (31.1, 36.5)	33.0 (30.2, 36.0)
Some college or Associate's degree	30.8 (28.1, 33.6)	34.2 (26.8, 42.5)	37.5 (30.4, 45.2)	31.1 (26.9, 35.7)	33.0 (26.7, 40.0)	31.3 (28.4, 34.4)	32.1 (29.1, 35.3)
Four-year college degree or more	19.9 (17.5, 22.5)	19.5 (13.6, 27.3)	15.9 (10.9, 22.7)	16.0 (12.7, 20.1)	17.0 (12.2, 23.2)	20.4 (17.7, 23.3)	20.6 (17.9, 23.5)
Baseline marital status (%): Married	67.3 (64.8, 69.8)	54.6*** (47.1, 61.9)	50.7*** (43.4, 58.0)	63.7* (59.6, 67.6)	64.4 (58.7, 69.7)	68.6* (65.8, 71.2)	66.7 (63.9, 69.5)
Enabling							
Coverage instability index (mean, range: 0-100)	12.9 (11.8, 14.1)	20.8*** (17.1, 24.5)	20.3*** (17.0, 23.6)	15.4** (13.3, 17.6)	13.4 (11.2, 15.6)	11.8*** (10.6, 13.0)	12.1*** (10.8, 13.4)
Baseline poverty (%)		**		***	**	***	**
<100% FPL	14.5 (12.7, 16.5)	20.9 (15.8, 27.1)	18.9 (14.1, 24.8)	20.5 (17.2, 24.2)	21.3 (17.4, 25.9)	12.9 (11.1, 15.0)	13.7 (11.9, 15.7)
100 to 138% FPL	6.8 (5.5, 8.3)	10.2 (6.0, 17.0)	6.6 (3.8, 11.4)	7.0 (5.5, 9.0)	7.0 (5.0, 9.8)	6.2 (4.9, 7.7)	6.2 (4.9, 7.8)
139 to <200% FPL	11.9 (10.3, 13.8)	14.9 (10.6, 20.6)	14.1 (10.1, 19.2)	14.5 (11.6, 17.8)	13.3 (10.7, 16.5)	11.8 (10.0, 13.9)	11.7 (10.0, 13.7)
200 to <400% FPL	31.3 (28.7, 34.1)	30.7 (23.2, 39.3)	31.7 (24.3, 40.0)	28.9 (24.9, 33.2)	30.3 (24.2, 37.2)	31.7 (28.8, 34.8)	31.3 (28.4, 34.3)
400%+ FPL	35.5 (32.7, 38.4)	23.2 (17.2, 30.6)	28.8 (22.0, 36.7)	28.9 (24.9, 33.2)	28.0 (22.7, 34.0)	37.4 (34.3, 40.6)	37.1 (34.0, 40.3)
Baseline Census region (%)						*	**
South	43.4 (40.3, 46.7)	47.5 (39.5, 55.7)	41.3 (33.6, 49.5)	45.6 (40.8, 50.5)	44.1 (37.9, 50.5)	41.9 (38.4, 45.6)	43.0 (40.0, 46.3)
Northeast	14.6 (12.7, 16.6)	11.8 (7.3, 18.6)	16.8 (11.7, 23.6)	14.9 (12.2, 18.1)	17.3 (13.8, 21.6)	14.8 (12.9, 17.0)	15.1 (13.1, 17.3)

Midwest	22.8 (20.0, 25.8)	24.7 (18.4, 32.3)	22.5 (16.3, 30.1)	24.0 (19.6, 29.0)	22.9 (18.2, 28.3)	24.0 (21.0, 27.4)	24.1 (21.1, 27.3)
West	19.2 (17.0, 21.7)	16.0 (11.1, 22.3)	19.4 (13.9, 26.5)	15.5 (12.4, 19.2)	15.7 (11.1, 21.7)	19.2 (16.9, 21.7)	17.9 (15.6, 20.5)
Post-ACA sample (%)	38.4 (35.6, 41.2)	36.7 (29.6, 44.4)	40.8 (33.3, 48.9)	38.8 (34.0, 43.8)	37.2 (31.9, 42.8)	39.1 (35.9, 42.3)	38.3 (35.3, 41.5)
Health Need							
Actual/Evaluated:							
Charlson Comorbidity Index (%)		***	***	***	***	***	
0-1	5.1 (4.1, 6.3)	4.1 (2.0, 8.2)	3.7 (1.7, 7.8)	6.6 (4.6, 9.4)	6.3 (3.9, 10.2)	4.2 (3.2, 5.4)	3.5 (2.7, 4.6)
2	68.9 (66.0, 71.6)	56.1 (48.5, 63.4)	56.7 (49.0, 64.1)	59.1 (54.3, 63.8)	53.8 (48.1, 59.4)	68.9 (65.7, 72.0)	67.5 (64.5, 70.4)
3+	26.0 (23.4, 28.8)	39.8 (32.5, 47.7)	39.6 (32.5, 47.2)	34.3 (29.7, 39.2)	39.9 (34.6, 45.3)	26.9 (24.0, 30.0)	29.0 (26.0, 32.0)
Diabetes disease severity proxy (%)			***	***	***	***	*
Insulin injections	33.8 (31.8, 36.0)	37.7 (30.2, 45.8)	47.9 (40.7, 55.3)	39.5 (35.6, 43.4)	44.9 (39.1, 50.8)	34.5 (32.2, 36.9)	36.5 (34.2, 39.0)
Oral medication	57.9 (55.6, 60.2)	52.3 (44.7, 59.9)	49.6 (42.6, 56.6)	51.1 (46.9, 55.2)	46.3 (40.8, 52.0)	58.8 (56.2, 61.5)	57.6 (55.0, 60.1)
Diet modification	7.0 (5.8, 8.5)	8.4 (4.6, 14.8)	2.4 (1.0, 5.7)	8.1 (6.0, 10.9)	8.3 (5.5, 12.6)	6.0 (4.8, 7.5)	5.2 (4.1, 6.6)
No treatment	1.3 (0.9, 1.8)	1.6 (0.6, 4.0)	0.1 (0.01, 0.8)	1.4 (0.9, 2.0)	0.5 (0.2, 1.2)	0.7 (0.4, 1.0)	0.7 (0.4, 1.3)
Perceived:							
Mean self-reported health status (%)		***	***	***	***		**
Excellent (1-1.99)	5.9 (4.7, 7.4)	2.1 (0.9, 5.1)	2.8 (1.5, 4.9)	4.8 (2.6, 8.5)	2.3 (1.0, 5.1)	5.9 (4.5, 7.7)	5.5 (4.3, 7.1)

Very good (2-2.99)	34.8 (32.1, 37.6)	22.9 (16.3, 31.3)	24.1 (17.9, 31.5)	25.1 (20.9, 29.7)	19.1 (14.2, 25.2)	35.4 (32.4, 38.4)	33.3 (30.4, 36.4)
Good (3-3.99)	43.5 (41.1, 46.0)	44.8 (37.3, 52.6)	44.7 (37.5, 52.2)	45.8 (41.7, 50.0)	49.2 (43.5, 54.9)	43.2 (40.5, 45.9)	44.7 (42.1, 47.3)
Fair (4-4.99)	14.1 (12.4, 16.1)	25.1 (19.0, 32.4)	23.7 (17.8, 30.7)	21.3 (18.2, 24.9)	25.2 (20.3, 30.8)	13.9 (12.0, 15.9)	14.6 (12.7, 16.7)
Poor (5)	1.6 (1.1, 2.6)	5.0 (2.8, 8.8)	4.8 (2.5, 9.0)	3.0 (1.6, 5.4)	4.2 (2.1, 8.2)	1.7 (1.0, 2.7)	1.9 (1.2, 2.9)
Lack of perceived need for health insurance (%)	4.4 (3.6, 5.4)	2.0 (0.8, 5.0)	1.2** (0.5, 2.9)	4.0 (2.5, 6.2)	2.6* (1.5, 4.3)	3.8** (2.9, 4.8)	3.2*** (2.4, 4.1)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01, *** p<.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Table 3.2. Multivariable probit regression models of access-to-care outcomes on coverage instability and race/ethnicity for adults ages 18-64 with diabetes, 2010-2016 (n=2,555).

	Estimate (95% CI)					
	Any delay in needed medical care	Any delay in needed prescription refills	Any ER visit	Any overnight hospital stays	Had usual source of care each year	At least one medical visit each year
Variables	(a)	(b)	(c)	(d)	(e)	(f)
Coverage instability index **X** Race/ethnicity (ref=Coverage instability index **X** NHW)						
Coverage instability index **X** Hispanic	-.006 (-.013, .001)	-.002 (-.011, .007)	-.008* (-.016, -.001)	-.001 (-.009, .006)	-.005 (-.012, .001)	.001 (-.006, .008)
Coverage instability index **X** NHB	-.010* (-.020, -.001)	-.005 (-.012, .003)	-.004 (-.011, .002)	.005 (-.004, .014)	.004 (-.003, .012)	-.005 (-.012, .001)
Coverage instability index **X** NHA/OM	-.012 (-.030, .006)	-.002 (-.014, .010)	.001 (-.010, .011)	.003 (-.013, .018)	.006 (-.007, .019)	.003 (-.008, .013)
Coverage instability index	.013*** (.007, .018)	.011*** (.006, .016)	.005 (-.0003, .009)	-.003 (-.009, .002)	-.008** (-.012, -.003)	-.004 (-.009, .001)
Race/ethnicity (ref=NHW)						
Hispanic	-.209 (-.473, .056)	-.169 (-.473, .136)	.009 (-.255, .273)	-.223 (-.491, .046)	-.112 (-.361, .138)	-.505*** (-.751, -.260)
NHB	.057 (-.223, .338)	-.048 (-.295, .200)	.119 (-.086, .324)	-.057 (-.352, .237)	.075 (-.166, .315)	-.215 (-.445, .014)
NHA/OM	.171 (-.316, .659)	-.111 (-.540, .318)	-.227 (-.622, .167)	-.177 (-.572, .217)	-.086 (-.503, .331)	-.422* (-.775, -.069)

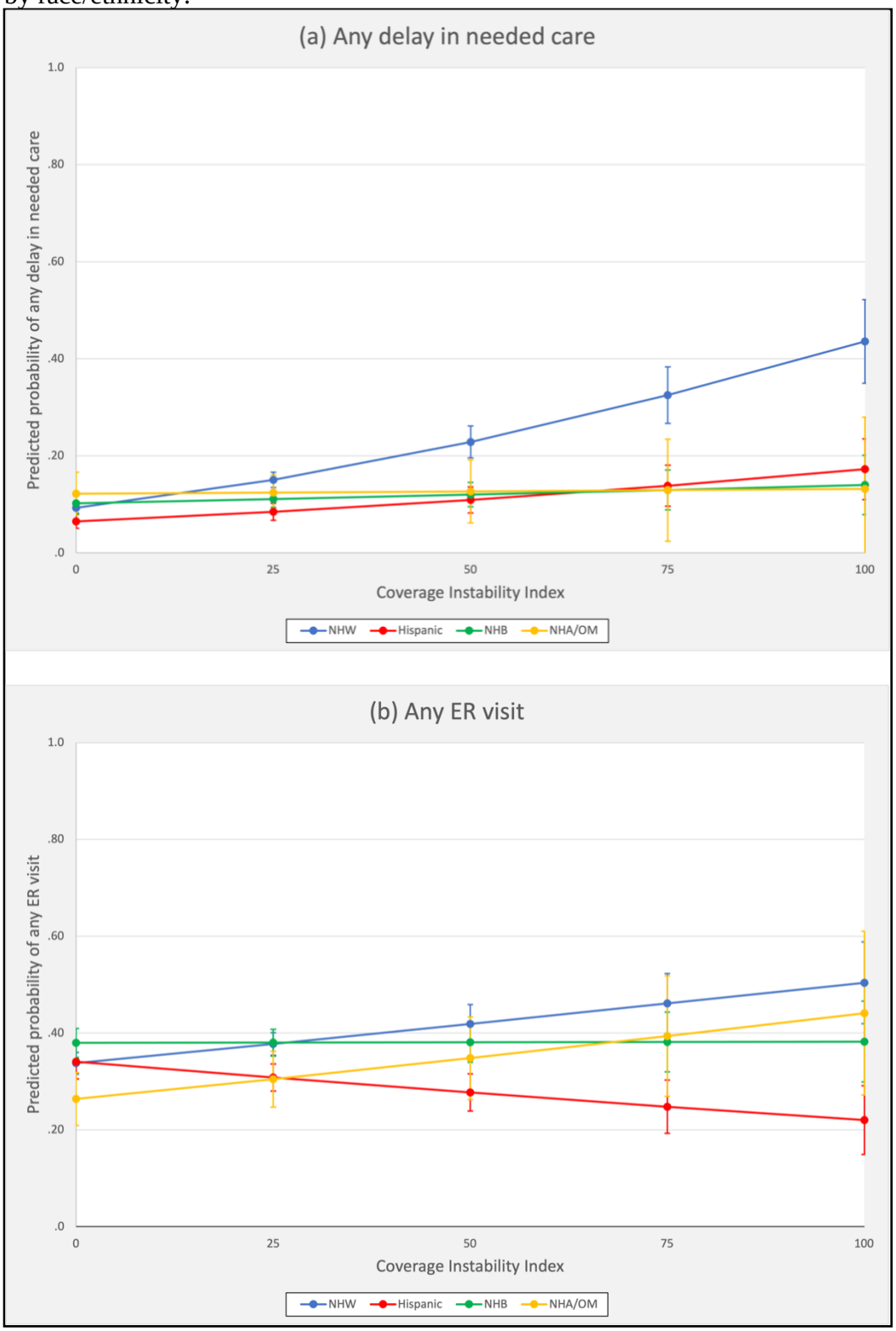
Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01, *** p<.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Note: Control variables included: predisposing (baseline age, sex, language most spoken in the home, baseline education, baseline marital status), enabling (baseline poverty, baseline Census region, pre-/post-ACA sample indicator), actual/evaluated health need (disease comorbidity, diabetes disease severity), and perceived health need factors (self-reported health status, and perceived need for health insurance). Please see Appendix 3.2 for full regression results.

Figure 3.1. Marginal effects of coverage instability on any delay in needed care and any ER visit by race/ethnicity.



Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

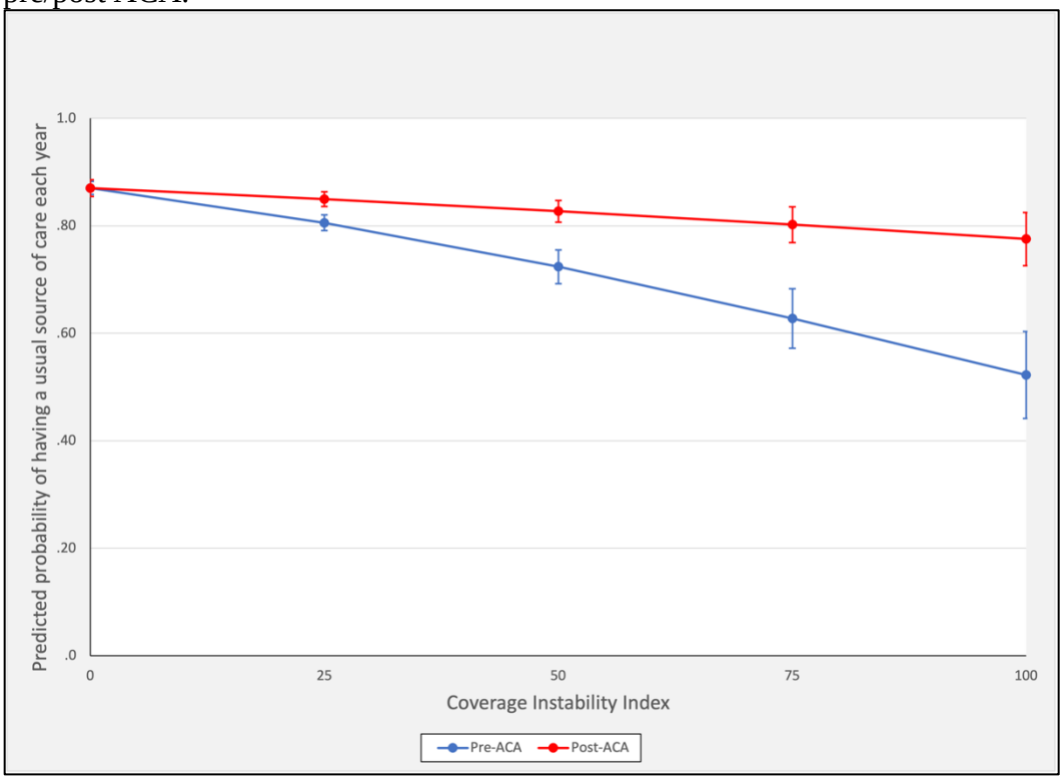
Table 3.3. Multivariable probit regression models of access-to-care outcomes on coverage instability and pre/post ACA for adults ages 18-64 with diabetes, 2010-2016 (n=2,555).						
	Estimate (95% CI)					
Variables	Any delay in needed medical care (a)	Any delay in needed prescription refills (b)	Any ER visit (c)	Any overnight hospital stays (d)	Had usual source of care each year (e)	At least one medical visit each year (f)
Coverage instability index **X** Pre/Post 2014 (ref=Coverage instability index **X** Pre-ACA)	-.003 (-.011, .005)	-.007 (-.015, .001)	-.001 (-.007, .006)	-.008 (-.015, .0001)	.007* (.001, .014)	.003 (-.004, .009)
Coverage instability index	.011*** (.005, .016)	.014*** (.008, .019)	.003 (-.002, .007)	.002 (-.003, .007)	-.011*** (-.016, -.007)	-.006** (-.011, -.002)
Post-ACA sample (ref=Pre-ACA sample)	-.037 (-.274, .201)	.166 (-.037, .369)	.053 (-.132, .238)	.127 (-.105, .359)	-.001 (-.199, .196)	-.030 (-.225, .165)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01, *** p<.001

Note: Control variables included: predisposing (baseline age, sex, race/ethnicity, language most spoken in the home, baseline education, baseline marital status), enabling (baseline poverty, baseline Census region), actual/evaluated health need (disease comorbidity, diabetes disease severity), and perceived health need factors (self-reported health status, and perceived need for health insurance). Please see Appendix 3.3 for full regression results.

Figure 3.2. Marginal effect of coverage instability on having a usual source of care each year pre/post ACA.



Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

Appendix 3.1. Additional bivariate results.

Estimated access-to-care outcomes by demographic characteristics for adults ages 18-64 with diabetes, 2010-2016 (n=2,555).													
	Estimate (95% CI)												
	Total	Any delay in needed medical care		Any delay in needed prescription refills		Any ER visit		Any overnight hospital stays		Had usual source of care each year		At least one medical visit each year	
	(a)	(b)		(c)		(d)		(e)		(f)		(g)	
Variables	(100%)	Yes (11.4%)	No (88.6%)	Yes (13.2%)	No (86.8%)	Yes (34.8%)	No (65.2%)	Yes (20.7%)	No (79.3%)	Yes (84.5%)	No (15.5%)	Yes (83.3%)	No (16.7%)
Predisposing													
Baseline age (%)											***		***
18-39	15.7 (13.9, 17.7)	11.4 (7.0, 17.9)	16.3 (14.4, 18.5)	12.7 (8.7, 18.3)	16.2 (14.3, 18.4)	18.1 (15.2, 21.5)	14.5 (12.3, 17.1)	15.5 (11.7, 20.1)	15.8 (13.8, 18.0)	13.7 (11.8, 15.7)	26.7 (21.4, 32.8)	13.9 (12.1, 16.0)	24.7 (20.2, 29.9)
40-49	24.8 (22.4, 27.3)	27.5 (21.3, 34.7)	24.5 (21.9, 27.2)	27.3 (21.2, 34.3)	24.4 (21.8, 27.2)	23.4 (19.3, 28.0)	25.5 (22.9, 28.4)	23.7 (19.4, 28.7)	25.1 (22.6, 27.8)	24.5 (21.8, 27.5)	25.4 (20.9, 30.5)	23.4 (20.9, 26.2)	31.5 (26.2, 37.2)
50-64	59.5 (56.9, 61.9)	61.2 (53.3, 68.5)	59.2 (56.5, 61.9)	60.0 (52.4, 67.1)	59.4 (56.6, 62.1)	58.5 (53.6, 63.2)	60.0 (56.8, 63.1)	60.8 (55.4, 65.9)	59.1 (56.4, 61.8)	61.8 (58.8, 64.8)	47.9 (42.2, 53.6)	62.6 (59.8, 65.3)	43.8 (38.4, 49.4)
Sex (%)			*		***		**						**
Female	51.1 (48.6, 53.6)	61.1 (53.7, 67.9)	49.8 (47.0, 52.6)	62.6 (55.6, 69.2)	49.3 (46.6, 52.1)	56.4 (51.6, 61.1)	48.3 (45.5, 51.1)	53.8 (47.5, 60.0)	50.4 (47.9, 52.9)	51.4 (48.6, 54.1)	49.6 (42.9, 56.3)	52.9 (50.1, 55.6)	42.4 (36.6, 48.4)
Male	48.9 (46.4, 51.4)	38.9 (32.1, 46.3)	50.2 (47.4, 53.0)	37.4 (30.8, 44.4)	50.7 (47.9, 53.4)	43.6 (38.9, 48.4)	51.7 (48.9, 54.5)	46.2 (40.0, 52.5)	49.6 (47.1, 52.1)	48.6 (45.9, 51.4)	50.4 (43.7, 57.1)	47.1 (44.4, 49.9)	57.6 (51.6, 63.4)
Race/ethnicity (%)					*				*		***		***
NHW	56.5	63.1	55.7	64.4	55.3	58.0	55.7	60.8	55.4	57.9	48.9	60.1	38.7

	(53.3, 59.7)	(55.9, 69.8)	(52.2, 59.0)	(57.4, 70.9)	(51.9, 58.7)	(53.1, 62.8)	(52.1, 59.3)	(55.0, 66.3)	(52.1, 58.7)	(54.5, 61.2)	(42.6, 55.3)	(56.8, 63.3)	(32.4, 45.4)
Hispanic	18.6 (16.2, 21.3)	11.8 (8.2, 16.7)	19.5 (16.9, 22.3)	12.6 (8.8, 17.6)	19.5 (17.0, 22.3)	17.1 (13.9, 20.9)	19.4 (16.8, 22.2)	14.8 (11.6, 18.6)	19.6 (17.0, 22.5)	16.8 (14.5, 19.5)	28.9 (23.4, 35.2)	16.3 (14.0, 18.9)	29.9 (24.5, 35.9)
NHB	16.7 (14.6, 19.1)	17.6 (13.1, 23.2)	16.6 (14.4, 19.1)	17.2 (13.4, 21.8)	16.6 (14.4, 19.1)	18.9 (15.6, 22.7)	15.5 (13.4, 18.0)	18.1 (14.1, 23.0)	16.3 (14.1, 18.9)	17.1 (14.8, 19.6)	14.2 (10.8, 18.4)	16.2 (14.0, 18.6)	19.4 (15.2, 24.5)
NHA/OM	8.2 (6.5, 10.3)	7.5 (4.0, 13.7)	8.3 (6.5, 10.5)	5.8 (3.5, 9.4)	8.5 (6.7, 10.9)	5.9 (3.4, 10.1)	9.4 (7.6, 11.6)	6.3 (4.1, 9.7)	8.7 (6.8, 10.9)	8.2 (6.3, 10.6)	8.0 (4.9, 12.7)	7.4 (5.8, 9.4)	12.0 (8.2, 17.2)
Language most spoken in the home: English (%)			**		**		*		*		***		***
Yes	81.5 (79.1, 83.7)	87.7 (83.3, 91.2)	80.7 (78.2, 83.0)	89.4 (84.3, 93.0)	80.3 (77.8, 82.6)	84.2 (80.6, 87.3)	80.1 (77.4, 82.5)	85.1 (81.3, 88.2)	80.6 (78.0, 82.9)	82.9 (80.5, 85.1)	75.1 (70.1, 79.4)	83.0 (80.6, 85.2)	74.0 (68.9, 78.5)
No	18.5 (16.3, 20.9)	12.3 (9.0, 16.7)	19.3 (17.0, 21.8)	10.6 (7.0, 15.7)	19.7 (17.4, 22.2)	15.8 (12.7, 19.4)	19.9 (17.5, 22.6)	14.9 (11.8, 18.7)	19.4 (17.1, 22.0)	17.1 (14.9, 19.5)	24.9 (20.6, 29.9)	17.0 (14.8, 19.4)	26.0 (21.5, 31.1)
Baseline education (%)					*		*				**		**
Less than high school	7.0 (5.8, 8.3)	5.9 (3.7, 9.4)	7.1 (5.9, 8.5)	3.5 (2.1, 5.8)	7.5 (6.3, 8.9)	6.6 (5.1, 8.5)	7.2 (5.9, 8.7)	5.9 (4.3, 8.1)	7.2 (6.0, 8.7)	6.1 (4.9, 7.6)	12.1 (9.5, 15.4)	6.5 (5.3, 7.9)	9.3 (7.3, 11.8)
9-12th grade, no high school diploma, no GED	8.5 (7.3, 9.9)	7.2 (4.9, 10.3)	8.7 (7.4, 10.2)	6.5 (4.3, 9.7)	8.9 (7.5, 10.4)	9.7 (7.8, 11.9)	8.0 (6.4, 9.8)	8.8 (6.6, 11.6)	8.5 (7.2, 10.0)	8.4 (7.1, 10.0)	9.3 (7.0, 12.4)	7.8 (6.5, 9.4)	12.1 (9.7, 15.0)
High school diploma or	33.9	33.2	33.9	36.6	33.4	36.6	32.4	35.2	33.5	33.8	33.8	33.0	37.9

GED	(31.4, 36.5)	(25.7, 41.6)	(31.4, 36.6)	(30.0, 43.7)	(30.8, 36.2)	(32.9, 40.5)	(29.0, 36.0)	(29.8, 41.0)	(30.9, 36.2)	(31.1, 36.5)	(27.9, 40.3)	(30.2, 36.0)	(32.2, 44.0)
Some college or Associate's degree	30.8 (28.1, 33.6)	34.2 (26.8, 42.5)	30.3 (27.7, 33.1)	37.5 (30.4, 45.2)	29.8 (27.2, 32.5)	31.1 (26.9, 35.7)	30.6 (27.5, 33.8)	33.0 (26.7, 40.0)	30.2 (27.4, 33.1)	31.3 (28.4, 34.4)	28.6 (23.3, 34.7)	32.1 (29.1, 35.3)	24.3 (19.2, 30.3)
Four-year college degree or more	19.9 (17.5, 22.5)	19.5 (13.6, 27.3)	19.9 (17.5, 22.5)	15.9 (10.9, 22.7)	20.5 (18.0, 23.1)	16.0 (12.7, 20.1)	21.9 (19.0, 25.1)	17.0 (12.2, 23.2)	20.6 (18.1, 23.4)	20.4 (17.7, 23.3)	16.1 (11.6, 21.9)	20.6 (17.9, 23.5)	16.4 (12.1, 21.7)
Baseline marital status (%)			***		***		*				*		
Married or separated	67.3 (64.8, 69.8)	54.6 (47.1, 61.9)	69.0 (66.4, 71.5)	50.7 (43.4, 58.0)	69.9 (67.4, 72.3)	63.7 (59.6, 67.6)	69.3 (66.3, 72.1)	64.4 (58.7, 69.7)	68.1 (65.5, 70.6)	68.6 (65.8, 71.2)	60.6 (54.9, 66.1)	66.7 (63.9, 69.5)	70.4 (65.2, 75.2)
Widowed, divorced or has never married	32.7 (30.2, 35.2)	45.4 (38.1, 52,9)	31.0 (28.5, 33.6)	49.3 (42.0, 56.6)	30.1 (27.7, 32.6)	36.3 (32.4, 40.4)	30.7 (27.9, 33.7)	35.6 (30.3, 41.3)	31.9 (29.4, 34.5)	31.4 (28.8, 34.2)	39.4 (33.9, 45.1)	33.3 (30.5, 36.1)	29.6 (24.8, 34.8)
Enabling			***		***		**				***		***
Coverage instability index (mean, 0-100)	12.9 (11.8, 14.1)	20.8 (17.1, 24.5)	11.9 (10.8, 13.1)	20.3 (17.0, 23.6)	11.8 (10.6, 13.0)	15.4 (13.3, 17.6)	11.6 (10.3, 12.8)	13.4 (11.2, 15.6)	12.8 (11.4, 14.1)	11.8 (10.6, 13.0)	19.4 (16.9, 21.9)	12.1 (10.8, 13.4)	17.0 (14.4, 19.5)
Baseline poverty (%)			**				***		**		***		**
<100% FPL	14.5 (12.7, 16.5)	20.9 (15.8, 27.1)	13.7 (11.8, 15.8)	18.9 (14.1, 24.8)	13.8 (12.0, 16.0)	20.5 (17.2, 24.2)	11.3 (9.6, 13.3)	21.3 (17.4, 25.9)	12.7 (10.9, 14.8)	12.9 (11.1, 15.0)	23.5 (18.5, 29.3)	13.7 (11.9, 15.7)	18.4 (14.7, 22.9)
100 to 138% FPL	6.8 (5.5, 8.3)	10.2 (6.0, 17.0)	6.4 (5.2, 7.8)	6.6 (3.8, 11.4)	6.8 (5.5, 8.4)	7.0 (5.5, 9.0)	6.7 (5.2, 8.6)	7.0 (5.0, 9.8)	6.8 (5.3, 8.6)	6.2 (4.9, 7.7)	10.7 (7.1, 15.8)	6.2 (4.9, 7.8)	10.0 (6.8, 14.3)
130 to <200% FPL	11.9 (10.3, 13.8)	14.9 (10.6, 20.6)	11.5 (9.9, 13.4)	14.1 (10.1, 19.2)	11.6 (9.8, 13.6)	14.5 (11.6, 17.8)	10.5 (8.6, 12.9)	13.3 (10.7, 16.5)	11.5 (9.7, 13.7)	11.8 (10.0, 13.9)	12.7 (9.4, 16.9)	11.7 (10.0, 13.7)	12.7 (9.4, 17.1)

200 to <400% FPL	31.3 (28.7, 34.1)	30.7 (23.2, 39.3)	31.4 (28.7, 34.2)	31.7 (24.3, 40.0)	31.2 (28.5, 34.1)	29.2 (25.2, 33.5)	32.4 (29.2, 35.9)	30.3 (24.2, 37.2)	31.6 (28.7. 34.5)	31.7 (28.8, 34.8)	30.1 (24.7, 36.1)	31.3 (28.4, 34.3)	31.4 (26.1, 37.2)
400%+ FPL	35.5 (32.7, 38.4)	23.2 (17.2, 30.6)	37.1 (34.2, 40.0)	28.8 (22.0, 36.7)	36.5 (33.7, 39.4)	28.9 (24.9, 33.2)	39.0 (35.8, 42.3)	28.0 (22.7, 34.0)	37.4 (34.3, 40.7)	37.4 (34.3, 40.6)	23.1 (17.6, 29.6)	37.1 (34.0, 40.3)	27.5 (22.3, 33.4)
Baseline Census region (%)											*		**
South	43.4 (40.3, 46.7)	47.5 (39.5, 55.7)	42.9 (39.7, 46.2)	41.3 (33.6, 49.5)	43.8 (40.5, 47.1)	45.6 (40.8, 50.5)	42.3 (38.9, 45.8)	44.1 (37.9, 50.5)	43.3 (40.0, 46.7)	41.9 (38.4, 45.6)	50.2 (44.1, 56.3)	43.0 (40.0, 46.3)	45.9 (39.5, 52.4)
Northeast	14.6 (12.7, 16.6)	11.8 (7.3, 18.6)	14.9 (12.9, 17.2)	16.8 (11.7, 23.6)	14.2 (12.4, 16.3)	14.9 (12.2, 18.1)	14.4 (12.2, 16.9)	17.3 (13.8, 21.6)	13.8 (11.8, 16.2)	14.8 (12.9, 17.0)	12.7 (8.5, 18.6)	15.1 (13.1, 17.3)	12.0 (7.6, 18.3)
Midwest	22.8 (20.0, 25.8)	24.7 (18.4, 32.3)	22.5 (19.7, 25.6)	22.5 (16.3, 30.1)	22.8 (20.0, 25.9)	24.0 (19.6, 29.0)	22.1 (19.1, 25.5)	22.9 (18.2, 28.3)	22.8 (19.9, 26.0)	24.0 (21.0, 27.4)	17.2 (12.5, 23.0)	24.1 (21.1, 27.3)	16.4 (12.2, 21.6)
West	19.2 (17.0, 21.7)	16.0 (11.1, 22.3)	19.6 (17.3, 22.2)	19.4 (13.9, 26.5)	19.2 (16.9, 21.7)	15.5 (12.4, 19.2)	21.2 (18.6, 24.0)	15.7 (11.1, 21.7)	20.1 (17.8, 22.7)	19.2 (16.9, 21.7)	19.9 (15.7, 24.8)	17.9 (15.6, 20.5)	25.8 (21.2, 30.9)
Post-ACA sample (%)													
Yes	38.4 (35.6, 41.2)	36.7 (29.6, 44.4)	38.6 (35.7, 41.6)	40.8 (33.3, 48.9)	38.0 (35.2, 41.0)	38.8 (34.0, 43.8)	38.2 (35.1, 41.3)	37.2 (31.9, 42.8)	38.7 (35.6, 41.9)	39.1 (35.9, 42.3)	35.9 (31.0, 41.2)	38.3 (35.3, 41.5)	38.6 (33.6, 43.9)
No	61.6 (58.8, 64.4)	63.3 (55.6, 70.4)	61.4 (58.4, 64.3)	59.2 (51.1, 66.7)	62.0 (59.0, 64.8)	61.2 (56.2, 66.0)	61.8 (58.7, 64.9)	62.8 (57.2, 68.1)	61.3 (58.1, 64.4)	60.9 (57.7, 64.1)	64.1 (58.8, 69.0)	61.7 (58.5, 64.7)	61.4 (56.1, 66.4)
Health Need													
Actual/Evaluated :													

Charlson Comorbidity Index			***		***		***		***		***		
0-1	5.1 (4.1, 6.3)	4.1 (2.0, 8.2)	5.2 (4.2, 6.5)	3.7 (1.7, 7.8)	5.3 (4.2, 6.6)	6.6 (4.6, 9.4)	4.3 (3.2, 5.8)	6.3 (3.9, 10.2)	4.8 (3.7, 6.2)	4.2 (3.2, 5.4)	10.3 (6.9, 15.0)	3.5 (2.7, 4.6)	12.8 (9.2, 17.6)
2	68.9 (66.0, 71.6)	56.1 (48.5. 63.4)	70.5 (67.4, 73.4)	56.7 (49.0, 64.1)	70.7 (67.6, 73.7)	59.1 (54.3, 63.8)	74.1 (70.6, 77.2)	53.8 (48.1, 59.4)	72.8 (69.5, 75.9)	68.9 (65.7, 72.0)	66.9 (60.5, 72.6)	67.5 (64.5, 70.4)	75.6 (69.6, 80.8)
3+	26.0 (23.4, 28.8)	39.8 (32.5, 47.7)	24.3 (21.5, 27.2)	39.6 (32.5, 47.2)	24.0 (21.2, 27.0)	34.3 (29.7, 39.2)	21.6 (18.8, 24.8)	39.9 (34.6, 45.3)	22.4 (19.6, 25.5)	26.9 (24.0, 30.0)	22.8 (17.7, 29.0)	29.0 (26.0, 32.0)	11.5 (8.1, 16.1)
Diabetes disease severity proxy (%)					***		***		***		***		*
Insulin injections	33.8 (31.8, 36.0)	37.7 (30.2, 45.8)	33.3 (31.1, 35.6)	47.9 (40.7, 55.3)	31.7 (29.3, 34.2)	39.5 (35.6, 43.4)	30.8 (28.2, 33.6)	44.9 (39.1, 50.8)	31.0 (28.4, 33.7)	34.5 (32.2, 36.9)	29.8 (24.8, 35.3)	36.5 (34.2, 39.0)	20.4 (16.9, 24.3)
Oral medication	57.9 (55.6, 60.2)	52.3 (44.7, 59.9)	58.6 (56.0, 61.1)	49.6 (42.6, 56.6)	59.1 (56.5, 61.8)	51.1 (46.9, 55.2)	61.5 (58.5, 64.5)	46.3 (40.8, 52.0)	60.9 (58.1, 63.7)	58.8 (56.2, 61.5)	54.1 (48.4, 59.7)	57.6 (55.0, 60.1)	59.5 (54.3, 64.5)
Diet modification	7.0 (5.8, 8.5)	8.4 (4.6, 14.8)	6.8 (5.5, 8.4)	2.4 (1.0, 5.7)	7.7 (6.3, 9.4)	8.1 (6.0, 10.9)	6.4 (4.9, 8.4)	8.3 (5.5, 12.6)	6.7 (5.4, 8.3)	6.0 (4.8, 7.5)	11.7 (7.7, 17.3)	5.2 (4.1, 6.6)	16.2 (11.9, 21.6)
No treatment	1.3 (0.9, 1.8)	1.6 (0.6, 4.0)	1.2 (0.8, 1.8)	0.1 (0.01, 0.8)	1.4 (1.0, 2.0)	1.4 (0.9, 2.0)	1.2 (0.7, 2.0)	0.5 (0.2, 1.2)	1.5 (1.0, 2.1)	0.7 (0.4, 1.0)	4.5 (2.6, 7.4)	0.7 (0.4, 1.3)	4.0 (2.5, 6.3)
Perceived:													
Mean self-reported health status score			***		***		***		***				**
Excellent	5.9	2.1	6.4	2.8	6.4	4.8	6.6	2.3	6.9	5.9	6.0	5.5	7.9

(1-1.99)	(4.7, 7.4)	(0.9, 5.1)	(5.1, 8.1)	(1.5, 4.9)	(5.1, 8.1)	(2.6, 8.5)	(5.2, 8.2)	(1.0, 5.1)	(5.6, 8.5)	(4.5, 7.7)	(3.7, 9.5)	(4.3, 7.1)	(5.5, 11.3)
Very good (2-2.99)	34.8 (32.1, 37.6)	22.9 (16.3, 31.3)	36.3 (33.5, 39.2)	24.1 (17.9, 31.5)	36.4 (33.5, 39.4)	25.1 (20.9, 29.7)	39.9 (36.9, 43.0)	19.1 (14.2, 25.2)	38.9 (35.9, 41.9)	35.4 (32.4, 38.4)	29.9 (24.4, 36.1)	33.3 (30.4, 36.4)	41.8 (35.8, 48.1)
Good (3-3.99)	43.5 (41.1, 46.0)	44.8 (37.3, 52.6)	43.3 (40.8, 45.9)	44.7 (37.5, 52.2)	43.3 (40.7, 46.0)	45.8 (41.7, 50.0)	42.3 (39.4, 45.2)	49.2 (43.5, 54.9)	42.0 (39.4, 44.7)	43.2 (40.5, 45.9)	45.8 (39.2, 52.6)	44.7 (42.1, 47.3)	37.6 (32.0, 43.5)
Fair (4-4.99)	14.1 (12.4, 16.1)	25.1 (19.0, 32.4)	12.7 (11.1, 14.6)	23.7 (17.8, 30.7)	12.7 (11.1, 14.6)	21.3 (18.2, 24.9)	10.3 (8.6, 12.4)	25.2 (20.3, 30.8)	11.3 (9.5, 13.3)	13.9 (12.0, 15.9)	16.5 (12.6, 21.3)	14.6 (12.7, 16.7)	12.0 (9.1, 15.7)
Poor (5)	1.6 (1.1, 2.6)	5.0 (2.8, 8.8)	1.2 (0.7, 2.2)	4.8 (2.5, 9.0)	1.2 (0.7, 2.1)	3.0 (1.6, 5.4)	0.9 (0.5, 1.6)	4.2 (2.1, 8.2)	1.0 (0.6, 1.6)	1.7 (1.0, 2.7)	1.8 (0.7, 4.6)	1.9 (1.2, 2.9)	0.6 (0.1, 2.7)
Lack of perceived need for health insurance (%)					**				*		**		***
Yes	4.4 (3.6, 5.4)	2.0 (0.8, 5.0)	4.7 (3.8, 5.8)	1.2 (0.5, 2.9)	4.8 (3.9, 6.0)	4.0 (2.5, 6.2)	4.6 (3.6, 5.9)	2.6 (1.5, 4.3)	4.8 (3.9, 6.1)	3.8 (2.9, 4.8)	7.4 (5.2, 10.6)	3.2 (2.4, 4.1)	10.4 (7.3, 14.6)
No	95.6 (94.6, 96.4)	98.0 (95.0, 99.2)	95.3 (94.2, 96.2)	98.8 (97.1, 99.5)	95.2 (94.0, 96.1)	96.0 (93.8, 97.5)	95.4 (94.1, 96.4)	97.4 (95.7, 98.5)	95.2 (93.9, 96.1)	96.2 (95.2, 97.1)	92.6 (89.4, 94.8)	96.8 (95.9, 97.6)	89.6 (85.4, 92.7)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01, *** p<.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 3.2.1. Full probit model estimates for the race/ethnicity analysis.

Multivariable probit regressions of access-to-care outcomes on coverage instability and race/ethnicity for adults ages 18-64 with diabetes, 2010-2016 (n=2,555).						
	Estimate (95% CI)					
Variables	Any delay in needed medical care (a)	Any delay in needed prescription refills (b)	Any ER visit (c)	Any overnight hospital (d)	Had usual source of care each year (e)	At least one medical visit each year (f)
Main regressors						
Coverage instability index **X** Race/ethnicity (ref=Coverage instability index **X** NHW)						
Coverage instability index **X** Hispanic	-.006 (-.013, .001)	-.002 (-.011, .007)	-.008* (-.016, -.001)	-.001 (-.009, .006)	-.005 (-.012, .001)	.001 (-.006, .008)
Coverage instability index **X** NHB	-.010* (-.020, -.001)	-.005 (-.012, .003)	-.004 (-.011, .002)	.005 (-.004, .014)	.004 (-.003, .012)	-.005 (-.012, .001)
Coverage instability index **X** NHA/OM	-.012 (-.030, .006)	-.002 (-.014, .010)	.001 (-.010, .011)	.003 (-.013, .018)	.006 (-.007, .019)	.003 (-.008, .013)
Coverage instability index	.013*** (.007, .018)	.011*** (.006, .016)	.005 (-.0003, .009)	-.003 (-.009, .002)	-.008** (-.012, -.003)	-.004 (-.009, .001)
Race/ethnicity (ref=NHW)						
Hispanic	-.209 (-.473, .056)	-.169 (-.473, .136)	.009 (-.255, .273)	-.223 (-.491, .046)	-.112 (-.361, .138)	-.505*** (-.751, -.260)
NHB	.057 (-.223, .338)	-.048 (-.295, .200)	.119 (-.086, .324)	-.057 (-.352, .237)	.075 (-.166, .315)	-.215 (-.445, .014)
NHA/OM	.171 (-.316, .659)	-.111 (-.540, .318)	-.227 (-.622, .167)	-.177 (-.572, .217)	-.086 (-.503, .331)	-.422* (-.775, -.069)

Predisposing						
Baseline age (ref=18-39)						
40-49	.389* (.055, .722)	.324* (.017, .631)	-.128 (-.341, .085)	.003 (-.242, .248)	.326* (.077, .574)	.231* (.006, .456)
50-64	.335* (.014, .655)	.238 (-.052, .528)	-.090 (-.287, .107)	.035 (-.178, .249)	.412*** (.195, .629)	.451*** (.243, .659)
Sex: Female (ref=Male)	.136 (-.045, .318	.247** (.072, .422)	.125 (-.027, .277)	.016 (-.147, .179)	.116 (-.053, .284)	.265** (.106, .425)
Language most spoken in the home: English (ref=Not English)	.106 (-.157, .370)	.253 (-.024, .530)	.088 (-.170, .347)	.014 (-.223, .252)	.021 (-.194, .236)	-.076 (-.325, .174)
Baseline education (ref=Less than high school)						
9-12th grade, no high school diploma, no GED	-.095 (-.464, .274)	.126 (-.280, .533)	.040 (-.233, .314)	.025 (-.266, .316)	.297 (-.010, .604)	-.180 (-.467, .107)
High school diploma or GED	.078 (-.274, .430)	.352 (.0004, .703)	.093 (-.158, .345)	.137 (-.108, .382)	.188 (-.086, .462)	-.091 (-.362, .181)
Some college or Associate's degree	.164 (-.188, .517)	.413* (.044, .782)	.060 (-.192, .312)	.237 (-.053, .527)	.220 (-.072, .513)	.175 (-.130, .480)
4-year college degree or more	.311 (-.086, .709)	.291 (-.143, .724)	.010 (-.291, .311)	.227 (-.096, .551)	.221 (-.138, .581)	.104 (-.221, .429)
Baseline marital status: Married (ref=Not married)	-.256** (-.437, -.076)	-.407*** (-.589, -.225)	.009 (-.134, .152)	.068 (-.147, .179)	.132 (-.033, .297)	-.174 (-.351, .002)
Enabling						
Baseline poverty (ref=<100% FPL)						
100 to 138% FPL	.072 (-.256, .401)	-.075 (-.448, .297)	-.289* (-.551, -.027)	-.209 (-.466, .047)	.072 (-.237, .381)	-.056 (-.358, .247)
139 to <200% FPL	-.068 (-.346, .209)	-.009 (-.313, .296)	-.117 (-.355, .121)	-.147 (-.368, .075)	.284* (.007, .561)	.082 (-.160, .325)
200 to <400% FPL	-.181 (-.458, .095)	-.019 (-.298, .260)	-.355** (-.573, -.136)	-.307* (-.539, -.074)	.252* (.005, .499)	.089 (-.133, .311)

400%+ FPL	-.341* (-.626, -.056)	-.009 (-.296, .278)	-.371*** (-.578, -.165)	-.411*** (-.641, -.182)	.313 (-.008, .633)	.148 (-.077, .373)
Baseline Census region (ref=South)						
Northeast	-.252 (-.551, .046)	.080 (-.168, .328)	-.044 (-.236, .148)	.096 (-.122, .314)	.205 (-.056, .467)	.113 (-.197, .423)
Midwest	-.104 (-.326, .117)	-.082 (-.323, .159)	-.007 (-.194, .180)	-.041 (-.225, .142)	.260* (.045, .474)	.105 (-.110, .320)
West	-.099 (-.332, .134)	.142 (-.086, .370)	-.166 (-.378, .045)	-.047 (-.309, .215)	.245* (.055, .436)	-.111 (-.299, .078)
Post-ACA sample (ref=Pre-ACA sample)	-.106 (-.292, .079)	.047 (-.126, .220)	.038 (-.122, .199)	.030 (-.142, .202)	.127 (-.032, .285)	.004 (-.150, .159)
Health Need						
Actual/Evaluated:						
Charlson Comorbidity Index (ref=0-1)						
2	.218 (-.315, .752)	-.248 (-.763, .267)	-.374 (-.764, .016)	-.418 (-.843, .008)	.224 (-.160, .609)	.253 (-.082, .588)
3+	.448 (-.132, 1.029)	-.030 (-.556, .496)	-.116 (-.539, .308)	-.127 (-.572, .317)	.264 (-.153, .681)	.673** (.298, 1.048)
Diabetes disease severity proxy (ref=Insulin injections)						
Oral medication	.019 (-.168, .205)	-.223* (-.410, -.036)	-.150* (-.298, -.003)	-.258** (-.423, -.092)	-.127 (-.294, .040)	-.352*** (-.512, -.193)
Diet modification	.273 (-.191, .737)	-.899** (-1.428, -.370)	-.039 (-.316, .284)	-.075 (-.442, .291)	-.386* (-.738, -.035)	-.892*** (-1.210, -.574)
No treatment	.298 (-.383, .980)	-1.449** (-2.369, -.529)	-.082 (-.561, .398)	-.789** (-1.345, -.234)	-.939*** (-1.430, -.448)	-1.001*** (-1.509, -.494)
Perceived:						
Mean self-reported health status (Ref=Excellent (1-1.99))						

Very good (2-2.99)	.272 (-.195, .739)	.218 (-.210, .646)	-.079 (-.463, .305)	.233 (-.183, .649)	.101 (-.268, .269)	.074 (-.231, .379)
Good (3-3.99)	.481* (.017, .944)	.357 (-.014, .729)	.183 (-.216, .583)	.654** (.242, 1.066)	.001 (-.372, .374)	.279 (-.003, .560)
Fair (4-4.99)	.720** (.226, 1.214)	.549* (.110, .988)	.444 (-.004, .892)	.927*** (.440, 1.415)	-.012 (-.391, .367)	.183 (-.143, .509)
Poor (5)	.992** (.342, 1.643)	1.038** (.415, 1.661)	.622 (-.094, 1.339)	1.248*** (.586, 1.910)	.031 (-.635, .697)	.436 (-.593, 1.465)
Lack of perceived need for health insurance (ref=No)	-.398 (-.830, .033)	-.591* (-1.037, -.146)	-.035 (-.347, .276)	-.233 (-.571, .105)	-.255 (-.548, .037)	-.514** (-.814, -.214)
Constant	-2.237 (-3.194, -1.280)	-1.874 (-2.720, -1.028)	.003 (-.693, .698)	-.804 (-1.464, -.144)	-.032 (-.692, .629)	.691 (.039, 1.342)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01, *** p<.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 3.2.2. Full probit model post-estimates for the race/ethnicity analysis.

Mean predicted probability and risk difference of any delay in needed care and any ER visit by race/ethnicity and coverage instability.										
	Coverage Instability Index:									
	0/100		25/100		50/100		75/100		100	
Outcome & race/ethnicity	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)
Any delay in needed care:										
NHW (ref)	.09	--	.15	--	.23	--	.33	--	.44	--
Hispanic	.06	-.03 (-.06, .01)	.08	-.07** (-.11, -.02)	.11	-.12** (-.20, -.03)	.14	-.19* (-.33, -.04)	.17	-.26* (-.47, -.05)
NHB	.10	+.01 (-.04, .05)	.11	-.04 (-.08, .004)	.12	-.11* (-.19, -.03)	.13	-.20** (-.34, -.05)	.14	-.30** (-.51, -.08)
NHA/OM	.12	+.03 (-.06, .12)	.12	-.03 (-.11, .05)	.13	-.10 (-.25, .04)	.13	-.20 (-.43, .04)	.13	-.30 (-.64, .03)
Any ER visit:										
NHW (ref)	.34	--	.38	--	.42	--	.46	--	.50	--
Hispanic	.34	+.003 (-.09, .09)	.31	-.07 (-.15, .01)	.28	-.14* (-.25, -.03)	.25	-.21** (-.37, -.06)	.22	-.28** (-.49, -.08)
NHB	.38	+.04 (-.03, .11)	.38	+.003 (-.06, .07)	.38	-.04 (-.14, .06)	.38	-.08 (-.24, .08)	.38	-.12 (-.34, .09)
NHA/OM	.26	-.07 (-.20, .05)	.30	-.07 (-.20, .06)	.35	-.07 (-.26, .12)	.39	-.07 (-.34, .21)	.44	-.06 (-.43, .30)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01, *** p<.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American

NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 3.3.1. Full probit model estimates for the ACA analysis.

Multivariable probit regressions of access-to-care outcomes on coverage instability and pre/post ACA for adults ages 18-64 with diabetes, 2010-2016 (n=2,555).						
	Estimate (95% CI)					
Variables	Any delay in needed care	Any delay in needed prescription refills	Any ER visit	Any overnight hospital stays	Had usual source of care each year	At least one medical visit each year
Main regressors						
Coverage instability index **X** Pre/Post 2014 (ref=Coverage instability index **X** Pre-ACA)	-.003 (-.011, .005)	-.007 (-.015, .001)	-.001 (-.007, .006)	-.008 (-.015, .0001)	.007* (.001, .014)	.003 (-.004, .009)
Coverage instability index	.011*** (.005, .016)	.014*** (.008, .019)	.003 (-.002, .007)	.002 (-.003, .007)	-.011*** (-.016, -.007)	-.006** (-.011, -.002)
Post-ACA sample (ref=Pre-ACA sample)	-.037 (-.274, .201)	.166 (-.037, .369)	.053 (-.132, .238)	.127 (-.105, .359)	-.001 (-.199, .196)	-.030 (-.225, .165)
Predisposing						
Baseline age (ref=18-39)						
40-49	.380* (.048, .712)	.320* (.015, .626)	-.138 (-.351, .075)	-.003 (-.250, .245)	.327* (.075, .578)	.237* (.014, .460)
50-64	.335* (.020, .651)	.243 (-.045, .531)	-.101 (-.300, .098)	.031 (-.182, .244)	.400*** (.181, .618)	.456*** (.252, .660)
Sex: Female (ref=Male)	.151 (-.031, .332)	.254** (.078, .429)	.130 (-.019, .280)	.021 (-.142, .184)	.115 (-.053, .283)	.263** (.105, .421)
Race/ethnicity (ref=NHW)						
Hispanic	-.321* (-.592, -.050)	-.206 (-.482, .071)	-.108 (-.332, .116)	-.247* (-.485, -.008)	-.204 (-.444, .035)	-.483*** (-.727, -.238)
NHB	-.115	-.127	.060	-.003	.163	-.299**

	(-.343, .114)	(-.338, .084)	(-.114, .234)	(-.222, .216)	(-.040, .365)	(-.493, -.105)
NHA/OM	-.012 (-.407, .382)	-.153 (-.520, .213)	-.209 (-.578, .160)	-.140 (-.446, .166)	.014 (-.329, .356)	-.388* (-.682, -.095)
Language most spoken in the home: English (ref=Not English)	.121 (-.145, .387)	.251 (-.033, .535)	.107 (-.149, .364)	.022 (-.213, .257)	.023 (-.191, .236)	-.076 (-.323, .171)
Baseline education (ref=Less than high school)						
9-12th grade, no high school diploma, no GED	-.114 (-.489, .261)	.115 (-.292, .523)	.047 (-.225, .319)	.039 (-.253, .330)	.309 (-.001, .620)	-.193 (-.476, .091)
High school diploma or GED	.074 (-.279, .426)	.345 (-.003, .694)	.108 (-.143, .358)	.137 (-.108, .382)	.207 (-.068, .481)	-.096 (-.365, .173)
Some college or Associate's degree	.171 (-.187, .529)	.425* (.065, .786)	.085 (-.165, .334)	.246 (-.044, .535)	.231 (-.060, .523)	.172 (-.130, .473)
4-year college degree or more	.318 (-.079, .716)	.288 (-.142, .719)	.024 (-.276, .324)	.229 (-.096, .554)	.228 (-.130, .587)	.095 (-.228, .417)
Baseline marital status: Married (ref=Not married)	-.247** (-.430, -.064)	-.401*** (-.582, -.219)	.011 (-.132, .154)	.070 (-.084, .224)	.124 (-.043, .290)	-.177 (-.355, .001)
Enabling						
Baseline poverty (ref=<100% FPL)						
100 to 138% FPL	.081 (-.254, .416)	-.076 (-.447, .296)	-.284* (-.545, -.024)	-.195 (-.452, .063)	.065 (-.250, .379)	-.068 (-.372, .236)
139 to <200% FPL	-.039 (-.323, .246)	.008 (-.297, .312)	-.110 (-.349, .129)	-.142 (-.365, .081)	.268 (-.009, .545)	.080 (-.162, .322)
200 to <400% FPL	-.170 (-.450, .110)	-.006 (-.284, .273)	-.354** (-.573, -.135)	-.293* (-.525, -.061)	.235 (-.011, .481)	.080 (-.142, .303)
400%+ FPL	-.332* (-.623, -.041)	.010 (-.276, .296)	-.371** (-.580, -.163)	-.391** (-.622, -.159)	.301 (-.017, .619)	.133 (-.093, .359)
Baseline Census region (ref=South)						
Northeast	-.229	.085	-.041	.091	.196	.113

	(-.533, .075)	(-.162, .333)	(-.231, .148)	(-.124, .306)	(-.065, .458)	(-.197, .424)
Midwest	-.090 (-.312, .131)	-.073 (-.313, .167)	-.004 (-.192, .184)	-.043 (-.227, .142)	.253* (.037, .468)	.103 (-.110, .316)
West	-.074 (-.308, .159)	.156 (-.076, .388)	-.164 (-.371, .043)	-.043 (-.303, .218)	.230* (.044, .415)	-.115 (-.304, .074)
Health Need						
Actual/Evaluated:						
Charlson Comorbidity Index (ref=0-1)						
2	.209 (-.326, .745)	-.247 (-.764, .270)	-.383 (-.778, .013)	-.400 (-.825, .025)	.214 (-.168, .597)	.241 (-.096, .578)
3+	.440 (-.147, 1.028)	-.033 (-.558, .492)	-.124 (-.554, .307)	-.112 (-.558, .333)	.257 (-.159, .673)	.659*** (.282, 1.037)
Diabetes disease severity proxy (ref=Insulin injections)						
Oral medication	.025 (-.161, .210)	-.225* (-.416, -.035)	-.152* (-.301, -.004)	-.258** (-.424, -.093)	-.129 (-.295, .037)	-.355*** (-.515, -.195)
Diet modification	.284 (-.182, .751)	-.902** (-1.446, -.358)	-.045 (-.371, .281)	-.078 (-.446, .291)	-.399* (-.759, -.038)	-.898*** (-1.220, -.576)
No treatment	.342 (-.344, 1.027)	-1.412** (-2.291, -.533)	-.088 (-.571, .394)	-.617** (-1.353, -.254)	-.968*** (-1.457, -.480)	-1.001*** (-1.502, -.499)
Perceived:						
Mean self-reported health status score (Ref=Excellent (1-1.99))						
Very good (2-2.99)	.306 (-.157, .768)	.243 (-.196, .681)	-.065 (-.448, .318)	.232 (-.173, .636)	.087 (-.291, .465)	.081 (-.221, .383)
Good (3-3.99)	.512* (.048, .977)	.380 (-.004, .764)	.194 (-.204, .592)	.655** (.257, 1.054)	-.007 (-.390, .376)	.283* (.006, .560)

Fair (4-4.99)	.761** (.270, 1.253)	.581* (.134, 1.027)	.458* (.012, .904)	.932*** (.461, 1.403)	-.030 (-.416, .355)	.183 (-.138, .505)
Poor (5)	1.031** (.381, 1.681)	1.054** (.422, 1.687)	.645 (-.070, 1.361)	1.235*** (.578, 1.892)	.050 (-.616, .715)	.434 (-.583, 1.451)
Lack of perceived need for health insurance (ref=No)	-.422 (-.870, .026)	-.555* (-1.034, -.077)	-.024 (-.340, .292)	-.228 (-.570, .115)	-.242 (-.536, .052)	-.511** (-.813, -.210)
Constant	-2.283 (-3.239, -1.327)	-1.955 (-2.822, 1.088)	-.013 (-.696, .671)	-.897 (-1.547, -.248)	.052 (-.626, .730)	.740 (.089, 1.391)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01, *** p<.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 3.3.2. Full probit model post-estimates for the ACA analysis.

Mean predicted probability and risk difference of usual source of care by pre/post ACA and coverage instability.										
	Coverage Instability Index:									
	0/100		25/100		50/100		75/100		100	
	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)
Usual source of care:										
Pre-ACA (ref)	.87	--	.81	--	.72	--	.63	--	.52	--
Post-ACA	.87	-.0003 (-.04, .04)	.85	+.04* (.01, .08)	.83	+.10** (.03, .17)	.80	+.17** (.05, .29)	.78	+.25** (.08, .43)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01,*** p<.001

Appendix 3.4.1. Outline for specification tests.

IV probit model of access to care outcomes
Note: Main regressors of interest are emphasized in bold in the 2nd-stage regressions.

For race/ethnicity analysis:

Y_i = Outcome is true (Yes/No)

X_{cii} = Coverage instability index score
X_{re} = Race/ethnicity (non-Hispanic White (ref); Hispanic/Latino; non-Hispanic Black; non-Hispanic Asian, other or multiple races)
X_{re_2} = Dummy variable for Hispanic/Latino
X_{re_3} = Dummy variable for non-Hispanic Black
X_{re_4} = Dummy variable for non-Hispanic Asian, other or multiple races
X_i = Covariates

Z_i = Instrument

βi = Estimated coefficient
u_i = First-stage error terms
v_i = Second-stage error term

- First-stage regressions of endogenous regressors:
  - (1) $X_{cii} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_1$
  - (2) $X_{cii}{\cdot}X_{re\_2} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_2$
  - (3) $X_{cii}{\cdot}X_{re\_3} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_3$
  - (4) $X_{cii}{\cdot}X_{re\_4} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_4$
- Second-stage regression:
  - (1) $Y_i = \beta_0 + \beta_1 X_{re} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii}{\cdot}X_{re\_2}} + \beta_4 \boldsymbol{X_{cii}{\cdot}X_{re\_3}} + \beta_5 \boldsymbol{X_{cii}{\cdot}X_{re\_4}} + \beta_6 X_i + v_1$

For ACA analysis:

Y_i = Outcome is true (Yes/No)

X_{cii} = Coverage instability index score
X_{aca} = Pre/post ACA
X_i = Covariates

Z_i = Instrument

βi = Estimated coefficient
u_i = First-stage error terms
v_i = Second-stage error term

- First-stage regressions of endogenous regressors:
  - (1) $X_{cii} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_i + \beta_3 Z_i \cdot X_{aca} + \beta_4 X_i + u_1$
  - (2) $X_{cii} \cdot X_{aca} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_i + \beta_3 Z_i \cdot X_{aca} + \beta_4 X_i + u_2$
- Second-stage regression:
  - (1) $Y_i = \beta_0 + \beta_1 X_{aca} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii} \cdot X_{aca}} + \beta_4 X_i + v_1$

Appendix 3.4.2. List of potential instruments.

Instruments	n	Percent or Mean (Range)
Self-employment status (Z_1, %)		
Incorporated	53	1.75
Proprietorship	145	4.79
Partnership	14	0.46
Not self-employed	2,789	92.17
Missing	25	0.83
Industry category (Z_2, %)		
Natural resources	29	0.96
Mining	10	0.33
Construction	94	3.11
Manufacturing	244	8.06
Wholesale & retail trade	237	7.83
Transportation & utilities	137	4.53
Information	23	0.76
Financial activities	101	3.34
Professional & business services	178	5.88
Education, health & social services	500	16.52
Leisure & hospitality	155	5.12
Other services	88	2.91
Public administration	127	4.20
Military	0	0.00
Unclassified	5	0.17
Unemployed	1,043	34.47
Missing	55	1.82
Occupation category (Z_3, %)		
Management, business & financial	240	7.93
Professional & related	308	10.18
Services	454	15.00
Sales & related	165	5.45
Office & administrative support	235	7.77
Farming, fishing & forestry	20	0.66
Construction, extraction & maintenance	150	4.96
Production, transportation, material moving	336	11.1
Military specific	0	0.00
Unclassified	20	0.66
Unemployed	1,043	34.47
Missing	55	1.82

Firm has more than one location (Z_4, %)		
Yes	1,137	37.57
No	502	16.59
Inapplicable, unemployed	1,043	34.47
Inapplicable, self-employed (firm size=1)	212	7.01
Missing	132	4.36
Usual hours worked per week at current main job (Z_5, mean)	2,959	25.56 (0-125)
Firm size at current main job (Z_6, mean)	2,773	80.08 (0-500)
In a labor union (Z_7, %)		
Yes	237	7.83
No	1,660	54.86
Inapplicable, unemployed	1,043	34.47
Missing	86	2.84
Insurance is offered to anyone at current main job (Z_8, %)		
Yes	1,320	43.62
No	350	11.57
Inapplicable, unemployed	1,043	34.47
Inapplicable, self-employed (firm size=1)	126	4.16
Missing	187	6.18
Respondent is eligible for offered health insurance at current main job (Z_9, %)		
Yes	1,221	40.35
No	498	16.46
Inapplicable, unemployed	1,043	34.47
Inapplicable, self-employed (firm size=1)	126	4.16
Missing	138	4.56
Census region (Z_{10}, %)		
South	1,294	42.76
Northeast	436	14.41
Midwest	539	17.81
West	757	25.02

Note: All measured at baseline

Appendix 3.4.3. Testing IV assumption 1 (instrument relevance) for the race/ethnicity analysis.

Note: F statistic from first-stage > 10 indicates a strong instrument

- First-stage regressions of endogenous regressors:

(1) $X_{cii} = \beta_0 + \beta_1 X_{re} + \beta_2 \mathbf{Z_i} + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_1$

(2) $X_{cii}{\cdot}X_{re\_2} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 \mathbf{Z_i{\cdot}X_{re\_2}} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_2$

(3) $X_{cii}{\cdot}X_{re\_3} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 \mathbf{Z_i{\cdot}X_{re\_3}} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_3$

(4) $X_{cii}{\cdot}X_{re\_4} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 \mathbf{Z_i{\cdot}X_{re\_4}} + \beta_6 X_i + u_4$

	With interaction terms		Without interaction terms	
Instruments used	F	p-value	F	p-value
Self-employment status (Z_1)	2.48	.086	1.11	.333
$Z_1{\cdot}X_{re}$ (ref=$Z_1{\cdot}X_{re\_1}$)				
$Z_1{\cdot}X_{re\_2}$	5.35	.001	--	--
$Z_1{\cdot}X_{re\_3}$	37.55	<.001	--	--
$Z_1{\cdot}X_{re\_4}$	16.48	<.001	--	--
Industry category (Z_2)	6.53	<.001	2.40	.005
$Z_2{\cdot}X_{re}$ (ref=$Z_2{\cdot}X_{re\_1}$)				
$Z_2{\cdot}X_{re\_2}$	1.69	.059	--	--
$Z_2{\cdot}X_{re\_3}$	62.12	<.001	--	--
$Z_2{\cdot}X_{re\_4}$	66.64	<.001	--	--
Occupation category (Z_3)	4.09	<.001	1.21	.289
$Z_3{\cdot}X_{re}$ (ref=$Z_3{\cdot}X_{re\_1}$)				
$Z_3{\cdot}X_{re\_2}$	1.75	.080	--	--
$Z_3{\cdot}X_{re\_3}$	4.90	<.001	--	--
$Z_3{\cdot}X_{re\_4}$	23.67	<.001	--	--
Firm has more than one location (Z_4)	3.74	.012	4.53	.004
$Z_4{\cdot}X_{re}$ (ref=$Z_4{\cdot}X_{re\_1}$)				
$Z_4{\cdot}X_{re\_2}$	3.62	.014	--	--
$Z_4{\cdot}X_{re\_3}$	7.93	<.001	--	--
$Z_4{\cdot}X_{re\_4}$	1.46	.227	--	--
Usual hours worked per week at current main job (Z_5)	0.29	.588	0.60	.440
$Z_5{\cdot}X_{re}$ (ref=$Z_5{\cdot}X_{re\_1}$)				
$Z_5{\cdot}X_{re\_2}$	5.96	.016	--	--
$Z_5{\cdot}X_{re\_3}$	18.20	<.001	--	--
$Z_5{\cdot}X_{re\_4}$	1.61	.206	--	--
Firm size at current main job (Z_6)	9.32	.003	17.41	<.001

$Z_6 \cdot X_{re}$ (ref=$Z_6 \cdot X_{re\_1}$)				
$Z_6 \cdot X_{re\_2}$	2.35	.127	--	--
$Z_6 \cdot X_{re\_3}$	55.72	<.001	--	--
$Z_6 \cdot X_{re\_4}$	16.07	<.001	--	--
In a labor union (Z_7)	0.21	.644	1.50	.222
$Z_7 \cdot X_{re}$ (ref=$Z_7 \cdot X_{re\_1}$)				
$Z_7 \cdot X_{re\_2}$	2.98	.053	--	--
$Z_7 \cdot X_{re\_3}$	13.29	<.001	--	--
$Z_7 \cdot X_{re\_4}$	7.65	<.001	--	--
Insurance offered to employees at current main job (Z_8)	6.24	.086	15.58	<.001
$Z_8 \cdot X_{re}$ (ref=$Z_8 \cdot X_{re\_1}$)				
$Z_8 \cdot X_{re\_2}$	10.76	<.001	--	--
$Z_8 \cdot X_{re\_3}$	14.08	<.001	--	--
$Z_8 \cdot X_{re\_4}$	6.20	<.001	--	--
Eligible for insurance offered at current main job (Z_9)	9.53	<.001	20.62	<.001
$Z_9 \cdot X_{re}$ (ref=$Z_9 \cdot X_{re\_1}$)				
$Z_9 \cdot X_{re\_2}$	15.07	<.001	--	--
$Z_9 \cdot X_{re\_3}$	14.97	<.001	--	--
$Z_9 \cdot X_{re\_4}$	6.26	<.001	--	--
Census region (Z_{10})	1.73	.162	2.01	.113
$Z_{10} \cdot X_{re}$ (ref=$Z_{10} \cdot X_{re\_1}$)				
$Z_{10} \cdot X_{re\_2}$	0.19	.903	--	--
$Z_{10} \cdot X_{re\_3}$	1.13	.337	--	--
$Z_{10} \cdot X_{re\_4}$	3.03	.030	--	--

Only industry category (Z_2), occupation category (Z_3), firm has more than one location (Z_4), firm size at current main job (Z_6), and eligibility for insurance offered at current main job (Z_9) were significantly associated with the endogenous regressor coverage instability. However, they would be considered weak instruments for coverage instability since their F statistics are less than 10.

Appendix 3.4.4. Testing IV assumption 1 (instrument relevance) for the ACA analysis.

Note: F statistic from first-stage > 10 indicates a strong instrument

For ACA analysis:

- First-stage regressions of endogenous regressors:
  - (1) $X_{cii} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_i + \beta_3 Z_i \cdot X_{aca} + \beta_4 X_i + u_1$
  - (2) $X_{cii} \cdot X_{aca} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_i + \beta_3 Z_i \cdot X_{aca} + \beta_4 X_i + u_2$

Instruments used	With interaction terms		Without interaction terms	
	F	p-value	F	p-value
Self-employment status (Z_1)	0.69	.501	1.11	.333
$Z_1 \cdot X_{aca}$	1.19	.313	--	--
Industry category (Z_2)	2.42	.004	2.60	.002
$Z_2 \cdot X_{aca}$	3.90	<.001	--	--
Occupation category (Z_3)	2.15	.027	1.21	.289
$Z_3 \cdot X_{aca}$	6.09	<.001	--	--
Firm has more than one location (Z_4)	4.25	.006	4.53	.004
$Z_4 \cdot X_{aca}$	5.99	.001	--	--
Usual hours worked per week at current main job (Z_5)	0.04	.839	0.60	.440
$Z_5 \cdot X_{aca}$	16.17	<.001	--	--
Firm size at current main job (Z_6)	2.28	.133	17.41	<.001
$Z_6 \cdot X_{aca}$	61.55	<.001	--	--
In a labor union (Z_7)	0.58	.449	1.50	.222
$Z_7 \cdot X_{aca}$	6.83	.001	--	--
Insurance offered to employees at current main job (Z_8)	8.85	<.001	15.58	<.001
$Z_8 \cdot X_{aca}$	15.82	<.001	--	--
Eligible for insurance offered at current main job (Z_9)	**14.45**	**<.001**	20.62	<.001
$Z_9 \cdot X_{aca}$	**19.01**	**<.001**	--	--
Census region (Z_{10})	0.31	.817	2.01	.113
$Z_{10} \cdot X_{aca}$	1.90	.131	--	--

Since we need as many instruments as there are endogenous regressors in a model (which includes the interaction between the ACA variable and coverage instability),[40] only Z_9 and $Z_9 \cdot$

X_{aca} meet the first IV assumption in this analysis and have demonstrated a strong correlation to coverage instability and its interaction term.

Appendix 3.4.5. Testing IV assumption 2 (instrument exogeneity/excludability) for both analyses.

- No viable instruments were found for the race/ethnicity analysis.

- However, for the ACA analysis, one instrument was found to strongly correlated with coverage instability: Z_9 (eligible for health insurance at current main job). Since we only have one instrument, we cannot test its exogeneity.[40]

Appendix 3.4.6. Endogeneity tests.

For ACA analysis:

- First-stage regressions of endogenous regressors:
  - (1) $X_{cii} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_9 + \beta_3 Z_9 \cdot X_{aca} + \beta_4 X_i + u_1 \rightarrow u_1$
  - (2) $X_{cii} \cdot X_{aca} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_9 + \beta_3 Z_9 \cdot X_{aca} + \beta_4 X_i + u_2 \rightarrow u_2$
- Second-stage regression:
  - (1) $Y_i = \beta_0 + \beta_1 X_{aca} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii} \cdot X_{aca}} + \beta_4 X_i + (\boldsymbol{u_1} + \boldsymbol{u_2}) + v_1$

H_o: If $(u_1 + u_2) = 0$, then the regressors are exogenous.
H_A: If $(u_1 + u_2) \neq 0$, then the regressors are endogenous.

Endogeneity test results for ACA analysis using eligibility for employer-sponsored coverage as an instrument (Z_9) for coverage instability.		
Outcomes:	F	p-value
Any delay in care	7.31	**.001**
Any delay in prescription refills	1.16	.317
Any ER visit	2.23	.110
Any overnight hospital stays	1.98	.140
Had usual source of care each year	2.99	.052
Had at least one medical visit each year	1.47	.231

Appendix 3.4.7. IV probit regression of any delay in needed care on coverage instability in the ACA analysis.

	Estimate (95% CI)		
	First-stage regressions		Second-stage regression
	CII	CII **X** Post-ACA	Any delay in needed care
Variables	(a)	(b)	(c)
Main regressors			
CII **X** Post-ACA (ref=CII **X** Pre-ACA)	--	--	-.042** (-.067, -.017)
Coverage instability index (CII)	--	--	.050*** (.032, .068)
Post-ACA sample (ref=Pre-ACA sample)	9.989*** (7.079, 12.899)	5.394** (2.066, 8.723)	.372 (-.101, .845)
Instruments			
Eligible for insurance offered at current main job (ref=Yes)			
No	-1.638** (-2.676, -.601)	4.981*** (-1.508, 11.471)	--
No, unemployed	-2.169** (-3.668, -.669)	3.168* (.443, 5.892)	--
No, self-employed (firm size=1)	-.396 (-1.506, .714)	12.097*** (6.982, 17.213)	--
Eligible for insurance offered at current main job: No **X** Post-ACA (ref=Yes **X** Pre-ACA)	17.093*** (11.101, 23.084)	4.981 (-1.508, 11.471)	--
Eligible for insurance offered at current main job: No, unemployed **X** Post-ACA (ref=Yes **X** Pre-ACA)	12.956*** (8.375, 17.536)	4.321 (-.895, 9.536)	--
Eligible for insurance offered at current main job: No, self-employed (firm size=1) **X** Post-ACA (ref=Yes **X** Pre-ACA)	13.144 (-.292, 26.580)	.864 (-14.237, 15, 964)	--
Predisposing			
Baseline age (ref=18-39)			
40-49	-1.916 (-4.573, .741)	-1.524 (-5.384, 2.335)	.348* (.007, .689)
50-64	-1.454 (-3.775, .867)	-2.117 (-5.645, 1.411)	.349* (.029, .669)
Sex: Female (ref=Male)	.627	0.384	.152

	(-.772, 2.026)	(-1.427, 2.196)	(-.015, .318)
Race/ethnicity (ref=NHW)			
Hispanic	-.533 (-3.047, 1.982)	.705 (-2.573, 3.983)	-.345* (-.614, -.077)
NHB	-.766 (-2.893, 1.362)	1.286 (-1.230, 3.802)	-.182 (-.382, .017)
NHA/OM	-1.441 (-4.251, 1.369)	-2.013 (-5.417, 1.391)	-.088 (-.476, .299)
Language most spoken in the home: English (ref=Not English)	.222 (-2.818, 3.263)	-.693 (-4.202, 2.815)	.139 (-.121, .398)
Baseline education (ref=Less than high school)			
9-12th grade, no high school diploma, no GED	-1.000 (-4.465, 2.465)	-2.455 (-6.832, 1.921)	.016 (-.347, .379)
High school diploma or GED	-.445 (-3.250, 2.360)	-0.385 (-4.034, 3.265)	.128 (-.174, .431)
Some college or Associate's degree	1.900 (-1.192, 4.992)	1.378 (-2.511, 5.267)	.218 (-.097, .533)
4-year college degree or more	.080 (-3.222, 3.381)	-.431 (-4.685, 3.823)	.366* (.005, .727)
Baseline marital status: Married (ref=Not married)	1.508 (-0.201, 3.218)	.911 (-1.264, 3.086)	-.203* (-.380, -.025)
Enabling			
Baseline poverty (ref=<100% FPL)			
100 to 138% FPL	1.559 (-1.522, 4.640)	1.038 (-3.204, 5.280)	.089 (-.269, .446)
139 to <200% FPL	1.667 (-1.902, 5.236)	.851 (-3.508, 5.210)	-.007 (-.283, .269)
200 to <400% FPL	-1.520 (-4.680, 1.640)	-5.186** (-8.908, 1.464)	.017 (-.257, .290)
400%+ FPL	-4.458** (-7.816, -1.101)	-10.864*** (-14.891, -6.838)	.022 (-.371, .414)
Baseline Census region (ref=South)			
Northeast	-.625 (-3.341, 2.090)	-1.094 (-4.669, 2.480)	-.172 (-.349, .197)
Midwest	2.278* (.033, 4.523)	3.324* (0.615, 6.033)	-.128 (-.333, .076)
West	1.454 (-.955, 3.863)	.789 (-2.002, 3.580)	-.008 (-.202, .217)
Health Need			

Actual/Evaluated:			
Charlson Comorbidity Index (ref=0-1)			
2	-2.371 (-6.037, 1.295)	-5.876* (-10.832, -.921)	.304 (-.191, .263)
3+	-2.566 (-6.457, 1.325)	-5.479* (-10.476, -.482)	.472 (-.051, .994)
Diabetes disease severity proxy (ref=Insulin injections)			
Oral medication	-1.563 (-3.576, .451)	-2.572* (-4.840, -.303)	.087 (-.090, .263)
Diet modification	-1.817 (-5.651, 2.018)	-1.353 (-6.184, 3.477)	-.239 (-.249, .727)
No treatment	-.420 (-5.980, 5.140)	-.029 (-6.530, 6.472)	-.118 (-.409, .645)
Perceived:			
Mean self-reported health status (Ref=Excellent (1-1.99))			
Very good (2-2.99)	1.554 (-1.464, 4.571)	.996 (-3.326, 5.317)	.275 (-.187, .737)
Good (3-3.99)	1.705 (-1.186, 4.595)	1.510 (-2.599, 5.618)	.444 (-.024, .912)
Fair (4-4.99)	3.960* (.342, 7.578)	3.846 (-.949, 8.641)	.651* (.106, 1.196)
Poor (5)	.743 (-3.070, 4.557)	.667 (-7.832, 9.167)	.903* (.167, 1.639)
Lack of perceived need for health insurance (ref=No)	.713 (-2.398, 3.823)	.712 (-3.171, 4.595)	-.523* (-.957, -.088)
Constant	3.102 (-2.541, 8.745)	18.178 (9.116, 27.239)	-2.799 (-3.736, -1.862)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01,*** p<.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 3.4.8. Mean predicted probability and risk difference of any delay in care in care before and after the ACA by coverage instability.

	Coverage Instability Index:									
	0/100		25/100		50/100		75/100		100	
	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)	Pred. Prob.	Diff. (95% CI)
Any delay in needed care:										
Pre-ACA (ref)	.05	--	.36	--	.79	--	.96	--	.99	--
Post-ACA	.09	+.04 (-.02, .14)	.16	-.20*** (-.34, -.11)	.25	-.54*** (-.79, -.33)	.36	-.60** (-.92, -.20)	.48	-.51* (-.97, -.06)

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p<.05, ** p<.01,*** p<.001

Note: Standard errors were bootstrapped using 1,000 bootstrap replications

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Chapter 4: The moderating effects of race/ethnicity and the Affordable Care Act on the association between coverage instability and medical expenditures among adults with diabetes, 2010-2016

Introduction

Diabetes has become the most costly chronic disease in the US in terms of both direct costs due to growing prevalence and rising medical costs of care and treatment as well as indirect costs due to lost productivity.[1] Total direct costs linked to diabetes amount to $237 billion each year while total indirect costs amount to $90 billion, which add up to nearly $327 billion each year.[1-3] In 2018, about 13.0% (34.1 million) of the adult US population were estimated to have diabetes.[4] In the US, diabetes is the seventh leading cause of death and is a major cause of kidney failure, blindness, and leg amputations.[4,5] The burden of diabetes is expected to increase nearly two-fold by 2060 as the US population grows older and becomes more racially and ethnically diverse.[6,7]

The prevalence and incidence of diabetes is greatest among racial and ethnic minority communities. As of 2018, Non-Hispanic American Indians/Alaskan Natives had the highest prevalence of diagnosed diabetes among adults (14.7%), followed by Hispanics/Latinos (12.5%), non-Hispanic Blacks (11.7%), non-Hispanic Asians (9.2%), and non-Hispanic Whites (7.5%).[4] Hispanics and non-Hispanic Blacks also had the highest rates of new diagnoses.[4]

Racial/ethnic minorities are also more likely to lack access to reliable health insurance coverage, which has been linked to poorer disease management for those with diabetes and has more generally been identified as a major contributing factor to racial/ethnic disparities in health in the US.[8-13] This disparity in coverage persists even among patients diagnosed with diabetes.[9,11]

However, little is known about the interactive effects of race/ethnicity and the ACA on coverage instability and medical expenditures for those living with diabetes.

As an extension of the analyses described in Chapter 3, which looked at the differential effect of coverage instability on access to care among adults with diabetes before and after the ACA and by race/ethnicity, this chapter will examine the effect of coverage instability on total and out-of-pocket (OOP) medical expenses.

Methods

Data: The data used in this study comes from the Medical Expenditure Panel Survey (MEPS). MEPS is a national survey of the non-institutionalized civilian US population and consists of five rounds of interviews over a two-year period.[14] Survey data collected include demographic characteristics, the types of health services used, frequency of health services used, and charges and sources of payment for these services.[14]

Each panel of data also includes monthly information on health insurance coverage, which enables us to look at time spent uninsured, changes in sources of coverage, and changes in states of coverage over a two-year survey period. Public sources of coverage include Medicaid and Medicare while private sources include employer-sponsored coverage, other group coverage (e.g., union-related, coverage purchased directly from a group or association), and non-group coverage.[15] Some non-group coverage options were coded separately, such as coverage purchased through the exchanges starting in 2014 and non-group coverage purchased for someone who was self-employed. TRICARE and CHAMPVA represent sources of civilian health insurance coverage for returning active duty and retired services members, disabled veterans, and their dependents.

Five sets of panel data were used to create the final data set. Panels 15 to 17 (2010-2013) were categorized as being in the pre-ACA sample while those in Panels 19 to 20 (2014-2016) were categorized as being in the post-ACA sample. Panel 18 was not included in this study since the survey period for this panel covered both 2013 and 2014.

Study population: Analyses were limited to adults who self-reported a diabetes diagnosis, were between the ages of 18 and 64 at baseline, and who completed all five rounds of the two-year survey. Those younger than age 65 who qualified for Medicare were excluded from the study. This resulted in an unweighted sample of 2,555 observations.

Measures: Outcomes for this study included total and OOP expenses for medical visits, emergency room visits (ER), overnight hospital stays (IP), and prescription drugs (Rx) during a two-year survey period. Any office-based or outpatient visit with a physician or nurse practitioner was counted as a medical visit in this study. All expenditure outcomes were adjusted to 2016 dollars using National Health Expenditures Accounts (NHEA) methodology.[16]

Coverage instability was the primary regressor in this study. It was measured as an index, which accounts for duration of uninsurance, frequency of uninsurance, and switches in source of coverage between two consecutive months over a two-year period. Details on the construction and validation of this index can be found in Chapter 2. Raw index scores were re-scaled, so index scores can range from 0 to 100. Higher index scores indicate greater coverage instability. An index score of 0 would indicate stable and continuous coverage while an index score of 100 would indicate having the highest level of unstable coverage relative to other individuals in the sample.

Race/ethnicity and an indicator for pre/post ACA were used as moderating variables. Racial/ethnic categories used by the US Census and the Office of Management and Budget

(OMB) were also used in this study: Hispanic/Latino (hereafter, Hispanic), non-Hispanic White (NHW), non-Hispanic Black/African American (NHB), non-Hispanic Asian, and other or multiple races of non-Hispanic origin (e.g., American Indian or Alaskan Native and Native Hawaiian or other Pacific Islander).[17] However, due to small sample sizes, the non-Hispanic Asian and non-Hispanic other/multiple race categories were collapsed into one category (NHA/OM). Pre-ACA observations were defined as those occurring before 2014 while post-ACA observations were defined as those occurring during or after.

The Andersen behavioral model of health services use was adapted and used as a general framework for this study (Figure 1.2).[18] In this framework, individual- and structural-level predisposing, enabling, health need factors were used as control variables. Individual-level predisposing factors included sociodemographic characteristics (i.e., age, sex, race/ethnicity, language most spoken in the home) and socioeconomic characteristics (i.e., baseline education, and baseline marital status). Individual-level enabling factors included financial resources/status (i.e., baseline poverty status, coverage instability) and structural-level enabling factors included accessibility to providers and facilities (i.e., baseline Census region and pre/post ACA). Individual-level health need factors included actual/evaluated health (i.e., baseline disease comorbidity, disease severity) and perceived health (i.e., average self-reported health status and baseline perceived need for health insurance coverage). According to this framework, predisposing factors may influence use indirectly through need or enabling factors, enabling factors may directly influence use of ambulatory and acute services, while need factors may directly influence use of acute services but indirectly influence use of ambulatory services through enabling factors.

The Charlson Comorbidity Index (CCI) was used to measure disease comorbidity.[19] Higher CCI scores indicate greater disease comorbidity. The complexity of a respondent's treatment for diabetes was used to determine the severity of a respondent's diabetic condition, where receiving any insulin injections for treatment indicated having severe diabetes followed by any oral medication, diet modification only, and no treatment.[20,21] A five-point Likert scale from "1=Excellent" to "5=Poor health" was used to measure self-reported health status. Since self-reported health status was asked at all five rounds of the survey, the mean score was calculated and then recategorized using the same five levels of perceived health (i.e., "1-1.99=Excellent" to "5=Poor"). Perceived need for health insurance coverage was assessed by asking respondents how strongly they disagreed or agreed with the following statement: "I'm healthy enough that I really don't need health insurance." Those who agreed with the statement were categorized as lacking perceived need for health insurance coverage.

Statistical analyses: To assess bivariate associations between covariates and the outcomes, chi-square tests for categorical variables were used. Multivariable two-part models (TPM) were used to estimate the differential effect of coverage instability on medical expenditure outcomes by race/ethnicity and pre/post ACA (Models A and B, respectively):

Model A)
$$\Pr(Y_i > 0) = \beta_0 + \beta_1 X_{cii} + \beta_2 X_{re} + \beta_3 X_{cii} * X_{re} + \beta_4 X_i + u_1 \quad (1)$$
$$Y_i = \beta_0 + \beta_1 X_{cii} + \beta_2 X_{re} + \beta_3 X_{cii} * X_{re} + \beta_4 X_i + u_2 \, , Y_i \mid Y_i > 0 \quad (2)$$

Model B)
$$\Pr(Y_i > 0) = \beta_0 + \beta_1 X_{cii} + \beta_2 X_{aca} + \beta_3 X_{cii} * X_{aca} + \beta_4 X_i + u_1 \quad (1)$$
$$Y_i = \beta_0 + \beta_1 X_{cii} + \beta_2 X_{aca} + \beta_3 X_{cii} * X_{aca} + \beta_4 X_i + u_2 \, , Y_i \mid Y_i > 0 \quad (2)$$

TPM were chosen since our medical expenditure outcomes are continuous and have non-negative values with a mass of zero spending and positive conditional values that are skewed in distribution.[22,23] In both models, Y_i indicates the outcome, X_{cii} represents the coverage instability index score, X_i represents the control variables, β_i represents the coefficients, and u_i represents the error terms. In Model A (hereafter referred to as the race/ethnicity analysis), X_{re} represents race/ethnicity (NHW (ref), Hispanic, NHB, NHA/OM). In Model B (hereafter referred to as the ACA analysis), X_{aca} represents an indicator variable for pre/post ACA.

For each TPM, the first equation was a probit model estimating any spending ($Y_i > 0$) and the second equation was a general linear model (GLM) estimating conditional cost ($Y_i \mid Y_i > 0$). The link and family functions of the GLM equation were determined using the link test and the Park test respectively.[22,24,25] In all cases, the log link and gamma distribution were found to fit the data best. Marginal effects were then estimated for significant interactions between each moderating variable and coverage instability. That is, for the race/ethnicity analysis, expenses were estimated when the coverage instability scores were set at 0, 25, 50, 75, and 100 for each racial and ethnic group. Similarly, for the ACA analysis, expenses were estimated when coverage instability scores were set at 0, 25, 50, 75, and 100 before and after 2014. Survey weights were applied to all analyses to account for the complex survey design of MEPS, and statistical significance was assessed at the 5% significance level. All analyses were performed using Stata 16.

Specification tests: To account for potential endogeneity of coverage instability, an instrumental variables (IV) approach was considered. If endogeneity was present and valid instrument(s) could be identified, then an extended two-part model (ETPM) would be estimated as demonstrated by Deb, Munkin, and Trivedi (2006) and Wooldridge (2010).[23,26] In an ETPM,

the first-stage equations would consist of regressions of the endogenous variables on all of the exogenous variables (including instruments of the endogenous variables and their interaction terms) while the second-stage equations would consist of the two equations from the TPM (i.e., the choice or hurdle equation and the conditional expenditure equation).[26] Endogeneity bias can be assessed by applying the augmented regression approach (also known as the Durbin-Wu-Hausman test) to the ETPM by obtaining residuals from each of the first-stage equations and then including them as predictors in each of the second-stage equations .[26,27] If the residuals included in the second-stage equations are jointly significantly different, then endogeneity bias is present and the ETPM would be preferred over the TPM in order to produce both consistent and efficient estimates.[26]

Since the majority of individuals in the US obtain health insurance through employer-sponsored coverage,[28-30] employment characteristics (e.g., industry, occupation, whether firm has more than one location, usual number of hours worked per week at current main job, firm size, whether in a labor union, whether insurance is offered to anyone at current main job, and whether the respondent is eligible for offered health insurance at current main job) were assessed as potential instruments for coverage instability. Previous research has also demonstrated the use of Census region and self-employment status as instruments for coverage.[31-33]

To be considered a valid instrument, a variable must demonstrate both instrument relevance (i.e., instrument *Z* is correlated with endogenous variable *X*) as well as instrument exogeneity (i.e., instrument *Z* can only affect outcome *Y* through endogenous *X* in the first stage and cannot be correlated with the error term in the second stage).[27] To test the first assumption of instrument relevance, we ran each first-stage regression and used an F test to determine the significance and strength of each instrument in estimating the endogenous variables.[27,34] A

statistically significant instrument with an F statistic less than 10 generally indicates inadequate correlation of the instrument to the endogenous regressor and subsequently is considered to be a weak instrument.[35,36]

Once the first IV assumption is met, the second assumption of instrument exogeneity (also referred to as excludability) can be tested by including one set of instruments in the first-stage regressions and the other set of instruments in the second-stage regressions as predictors.[27] If the instruments are significant in the second stage, then the exclusion restriction criteria is not met.[27] However, excludability cannot be determined if only one valid instrument is available.[27]

Results

Descriptive: Over a two-year period, nearly everyone in the sample had some medical expenses (99.3%). The mean total for overall medical expenses was $19,164. On average, approximately half of all total expenses were for prescription drugs (49.0%, $8,061), more than a third were for medical visits (35.6%, $5,570), 10.2% were for overnight hospital stays ($4,812), and 5.2% were for ER visits ($721). Nearly everyone in the sample also had any expenses for medical visits (97.1%) and for prescription drugs (98.4%), a third had any expenses for ER visits (33.0%), and 20.6% had any expenses for overnight hospital stays. Among those with any medical expenses, the mean conditional values were $19,287 for total cost, $23,329 for any overnight hospital stays, $8,191 for any prescribed medications, $5,737 for any medical visits, and $2,182 for any ER visits.

Nearly everyone in the sample also had OOP medical expenses (97.3%). Over a two-year period, the mean total for OOP medical expenses was $2,092. On average, OOP expenses represented less than a quarter of overall medical expenses (22.6%). Of the total OOP expenses

paid, most of it went towards drug costs (65.3%, $1,300), followed by medical visits (29.1%, $603), ER visits (3.0%, $76), and overnight hospital stays (2.7%, $113). Among those with any OOP medical expenses, respondents spent $2,149 out of pocket overall, $1,353 out of pocket for prescription drugs, $1,137 out of pocket for overnight hospital stays, $721 out of pocket for medical visits, and $465 out of pocket for ER visits on average.

Bivariate: Greater coverage instability was significantly associated with higher conditional total medical expenses ($p=0.011$), lower conditional inpatient costs ($p<0.001$), higher conditional drug costs ($p<0.001$), and conditional total OOP expenses for any ER visits ($p<0.001$).

Race/ethnicity was significantly associated with conditional total medical expenses ($p<0.001$), conditional costs for medical visits ($p<0.001$), conditional drug costs ($p=0.002$), conditional OOP expenses ($p<0.001$), conditional OOP expenses for medical visits ($p<0.001$), and conditional OOP expenses for prescription drugs ($p<0.001$). For nearly all types of expenses except for OOP costs for overnight hospital stays, NHW tended to have the greatest expenses on average while Hispanics and NHB tended to have the lowest except for ER visits. Conditional total medical expenses over a two-year period were greatest for NHW ($22,982) followed by NHA/OM ($17,384), NHB ($14,908), and Hispanics ($12,791). Similarly, conditional total costs for medical visits were greatest for NHW ($6,643) followed by NHA/OM ($6,188), NHB ($4,806), and Hispanics ($3,507). Conditional total drug costs were greatest for NHW ($,10,127) followed by NHA/OM ($7,478), Hispanics ($5,315), and NHB ($5,016). Conditional total OOP expenses were greatest for NHW ($2,543) followed by NHA/OM ($2,064), NHB ($1,566), and Hispanics ($1,477). Conditional OOP expenses for medical visits were highest for NHW ($873) followed by NHA/OM ($636), Hispanics ($462), and NHB ($438). Finally, conditional OOP

drug expenses were highest for NHW ($1,565) followed by NHA/OM ($1,395), NHB ($1,012), and Hispanics ($968).

The ACA was associated with lower conditional total OOP costs and lower conditional OOP drug costs. The mean conditional total OOP cost for those in the post-ACA sample was $1,929 compared to $2,282 for those in the pre-ACA sample (p=0.012). The mean conditional OOP drug cost for those in the post-ACA sample was $1,121 compared to $1,494 for those in the pre-ACA sample (p<.001). Additional bivariate results can be found in Appendix 4.1.

Multivariable: Based on the TPM results, there were significant racial/ethnic differences in the effect of coverage instability on total medical expenses, ER costs, and drug costs even after controlling for other factors. Full regression results can be found in Appendix 4.2. Table 4.1 and Figure 4.1 present the estimated conditional expenses by coverage instability and race/ethnicity. As coverage instability increases, conditional total medical costs for NHW stayed relatively constant for incomes above $21,000 throughout while Hispanics, NHB, and NHA/OM all demonstrated incrementally lower conditional total costs (Figure 4.1a). Among those with the most unstable coverage (i.e., coverage instability=100), the mean conditional total was $21,637 for NHW, $10,419 for Hispanics, $9,526 for NHB, and $6,494 for NHA/OM. Compared to NHW, Hispanics had $11,218 lower expenses (p=0.031), NHB had $12,110 lower expenses (p=0.016), and NHA/OM had $15,143 lower expenses (p=0.006).

For all groups, conditional total drug costs tended to decrease as coverage instability increased. However, the effect of coverage instability on conditional drug costs appears to be greatest for NHA/OM as indicated by the steepest slope in Figure 4.1c. Among those with the most unstable coverage, the mean conditional total cost for prescription drugs was $8,459 for

NHW, $4,968 for Hispanics, $3,195 for NHB, an $2,443 for NHA/OM. Compared to NHW, only NHA/OM had significantly lower conditional drug costs (p=0.035).

Conditional total ER costs also decreased as coverage instability increased for all racial/ethnic groups except Hispanics, which had higher expenses as coverage instability increased (Figure 4.1b). Among those with the most unstable coverage with any ER visits, the mean conditional total ER cost was $3,040 for Hispanics, $1,259 for NHW, $1,229 for NHB, and $305 for NHA/OM. Compared to NHW, only NHA/OM had significantly lower conditional ER costs (p=0.030).

For conditional OOP expenses for ER visits, racial/ethnic differences became more apparent as coverage instability increased, with Hispanics and NHB experiencing the greatest effect (Figure 4.1d). Among those with the most unstable coverage, the mean conditional OOP expenses for ER visits was $490 for NHW, $6,445 for Hispanics, $3,179 for NHB, and $10 for NHA/OM.

The TPM results also indicated significant differences in the effect of coverage instability on medical expenses pre/post ACA, especially for those paid out of pocket and expenses for prescription drugs. Full regression results for this analysis can be found in Appendix 4.3. Table 4.2 and Figure 4.2 present estimated mean conditional expenses by coverage instability and pre/post ACA. As coverage instability increased, those in the post-ACA sample experienced relatively stable conditional drug costs around $10,000, while those in the pre-ACA sample experienced significantly lower conditional drug spending (Figure 4.2a). Among those with the most unstable coverage, the mean conditional drug cost was $3,167 for those in the pre-ACA sample and $10,324 for those in the post-ACA sample (p=0.007).

In contrast, conditional OOP expenses after the ACA remained stable even as coverage instability increased. As coverage instability increased, those in the pre-ACA sample experienced greater conditional OOP expenses while those in the post-ACA sample had conditional OOP expenses that remained relatively stable (Figure 4.2b). Among those with the most unstable coverage, the mean conditional OOP expense was $5,622 for those in the pre-ACA sample and $1,971 for those in the post-ACA sample (p=0.002), the mean conditional OOP expense for medical visits was $1,510 for those in the pre-ACA sample and $738 for those in the post-ACA sample (p=0.090), the mean conditional OOP ER expense was $2,190 for those in the pre-ACA sample and $327 for those in the post-ACA sample (p=0.165), and the mean OOP expense for prescription drugs was $3,133 for those in the pre-ACA sample and $1,216 for those in the post-ACA sample (p=0.011).

Specification tests: These results can be found in Appendix 4.4. Results from the specification tests indicate potential endogeneity bias in the ACA analysis pertaining to OOP expenses for overnight hospital stays (F=9.46, p=.002). Out of the 10 instruments considered, only one (i.e., eligibility for the health insurance offered at one's current main job) was found to be valid and strong for the ACA analysis ($Z_{instrum}$: F=14.45, p<.001, $Z_{instrum} \cdot X_{aca}$: F=19.101, p<.001). However, since we only have one valid instrument, we were unable to test its excludability. Nevertheless, we ran an extended two-part model (ETPM) using eligibility for employer-sponsored coverage as an instrument for coverage instability to examine the moderating effect of the ACA on the relationship between OOP expenses for overnight hospital stays and coverage instability. These results did not differ from the TPM results, which also did not show a differential effect of coverage instability on conditional OOP inpatient expenses pre/post ACA.

Discussion

The results of our study suggest that the effect of coverage instability on medical expenditures is greater for racial/ethnic minorities. While a recent study found lower medical spending among racial/ethnic minority patients with diabetes compared to White patients with diabetes,[37] our study also found that coverage instability further hinders access to care and widens this disparity. Hispanics in particular faced greater ER costs (total and OOP) as coverage instability increased. This could be the result of postponing needed care until a medical emergency required a trip to the ER, which seems plausible since Hispanics in our sample had the highest rates of unstable coverage compared to all other groups – 27.2% of Hispanics had coverage with at least one episode of uninsurance during their two-year survey period compared to 15.8% for NHW, 23.1% for NHB, and 17.3% for NHA/OM; and 22.4% of Hispanics remained uninsured throughout their survey period compared to 8.2% for NHW, 10.0% for NHB, and 12.5% for NHA/OM.

When examining the moderating effect of the ACA on coverage instability and medical expenses, we also found that expenses for prescription drugs and OOP costs became less sensitive to coverage instability after the ACA. That is, those with the most unstable coverage not only had lower expenses for prescription drugs and OOP expenses after the ACA, they also had expenses that were on par with those with the most stable coverage. Lower OOP expenses after the ACA was also consistent with previous research.[38] This suggests that the ACA provided greater access to needed care and treatment even for those with unstable coverage. Three mechanisms under the ACA that may have made this possible include the expansion of Medicaid in several states, the authorization by the Food and Drug Administration (FDA) to accelerate the

approval of generic drugs, and tax credits and subsidies made available through the exchanges for qualifying persons and families.[39-43] That is, under the ACA, those with household incomes of 100% to 250% FPL who qualify for premium tax credits and purchase a silver-level plan through the exchanges are eligible to receive a cost-sharing subsidy, which helps to reduce a person's or family's OOP expenses when using health care services.[40]

Some limitations of this study include relying on self-reported data, which is often a common limitation when using survey data due to potential recall and social desirability biases.[44] However, standard medical record abstraction among a subsample of survey respondents has been used to validate and verify the self-reported utilization data in MEPS.[45] From the data, we were also not able to infer whether a change in coverage also resulted in a change in provider, which could greatly affect continuity of care.[46,47] However, a change in provider is more likely to occur when going from private to public coverage since fewer providers may choose to take on publicly insured patients due to lower reimbursement rates.[48] In our study, only 1.8% of respondents had ever switched from a private to public source of coverage during their survey period.

We were also not able to directly test the effect of the ACA on reducing racial/ethnic disparities in coverage instability among adults living with diabetes due to limited observations by race/ethnicity, which could have been accomplished using a triple difference analysis if we had enough observations. Having more observations would also allow us to separately examine the effect of coverage instability for other and multiple races of non-Hispanic origin, such as American Indians and Alaskan Natives who have the highest rates of diagnosed diabetes in the US.[4] Our study was also not able to address the growing issue of underinsurance, which has grown more prevalent in recent years due to looser regulations for "skinny" or short-term health

plans.[49,50] The ACA effects observed in this study may also be understated since state-level data were not available to help us distinguish those living in expansion states vs. non-expansion states during the post-ACA period. Future research efforts will greatly benefit from the addition of state-level data, which hopefully will become more accessible to researchers in the near future. Furthermore, because our analyses were limited to adults with diabetes, our results may not be generalizable to the overall US population or to other groups.

Despite these limitations, our study provides further insight on coverage instability among adults living with diabetes in the US and its differential effect on total and OOP medical expenses by race/ethnicity. From our study, we also found that expanded coverage under the ACA helped make needed prescription drugs accessible even to those with unstable coverage. This is an especially important achievement for those living with diabetes as most rely on some form of medication to help control their diabetes – in our study, 33.8% reported taking insulin and 57.9% reported taking oral medications to help control their diabetes.

Our study also highlights the importance of continuing efforts to expand coverage and to reduce mechanisms that contribute to coverage instability within our society. Compared to other high-income countries, the US consistently spends the most money on health care yet continues to have worse health outcomes.[51] While expanding coverage alone will not entirely solve all the problems we face within our health care system (e.g., high cost of medical education; fragmented financial organization of health care; low supply of doctors and nurses, medical technology, and hospital beds per capita especially in rural areas; high administrative costs; and issues related to drug pricing),[52] it is an issue that has gained traction across the political spectrum in the past few decades and is expected to continue being a relevant issue with the current ongoing COVID-19

pandemic and its related economic recession that has caused millions to lose their jobs and, subsequently, their employer-sponsored coverage as well.

Tables, figures, and appendices

Table 4.1. Estimated mean conditional medical expenses by race/ethnicity and coverage instability (in constant 2016 $).										
	Coverage Instability Index:									
	0		25		50		75		100	
Outcome & race/ethnicity	Pred. cost	Diff.	Pred. cost	Diff.	Pred. cost	Diff.	Pred. cost	Diff.	Pred. cost	Diff.
(a) Total overall										
NHW (ref)	$21,669	--	$21,661	--	$21,653	--	$21,645	--	$21,637	--
Hispanic	$14,866	-$6,804 ***	$13,602	-$8,059 ***	$12,445	-$9,208 **	$11,387	-$10,258 *	$10,419	-$11,218 *
NHB	$17,716	-$3,953	$15,171	-$6,490 ***	$12,991	-$8,662 **	$11,125	-$10,520 **	$9,526	-$12,110 *
NHA/OM	$21,442	-$228	$15,906	-$5,755*	$11,800	-$9,853 **	$8,753	-$12,891 **	$6,494	-$15,143 **
(b) Total: ER visits										
NHW (ref)	$2,556	--	$2,141	--	$1,794	--	$1,503	--	$1,259	--
Hispanic	$1,473	-$1,083*	$1,766	-$376	$2,116	+$322	$2,536	+$1,034	$3,040	+$1,781
NHB	$2,775	+$219	$2,263	+$122	$1,846	+$52	$1,506	+$3	$1,229	-$30
NHA/OM	$2,634	+$78	$1,536	-$605	$896	-$898*	$522	-$980*	$305	-$954*
(c) Total: Rx										
NHW (ref)	$9,337	--	$9,109	--	$8,887	--	$8,671	--	$8,459	--
Hispanic	$6,783	-$2,554*	$6,275	-$2,834*	$5,805	-$3,082	$5,370	-$3,301	$4,968	-$3,492
NHB	$6,261	-$3,076 ***	$5,292	-$3,818 ***	$4,473	-$4,415 **	$3,780	-$4,890*	$3,195	-$5,264
NHA/OM	$8,450	-$887	$6,196	-$2,913*	$4,544	-$4,343 **	$3,332	-$5,339*	$2,443	-$6,016*
(d) OOP: ER visits										

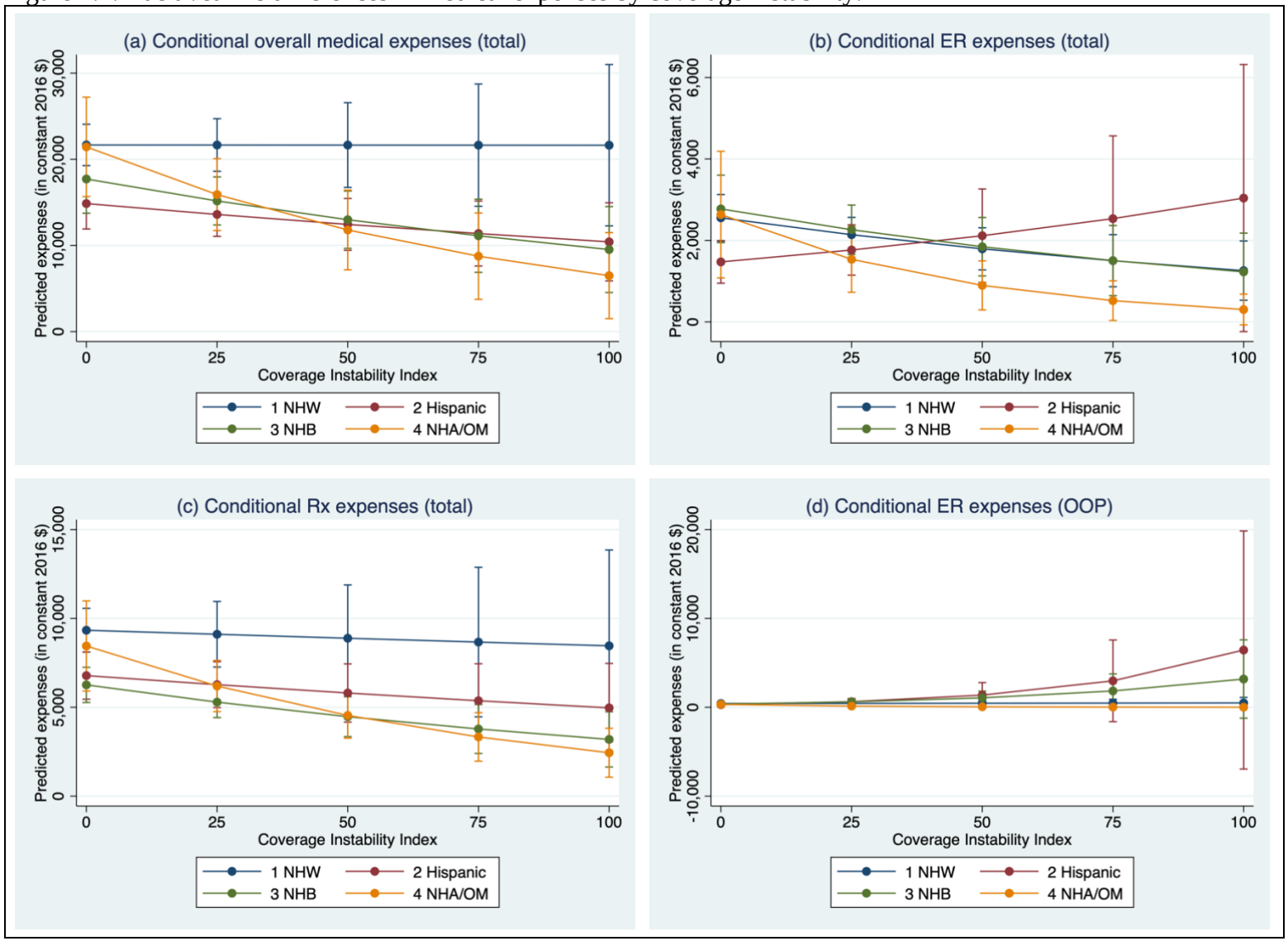
NHW (ref)	$426	--	$441	--	$457	--	$473	--	$490	--
Hispanic	$294	-$133	$635	+$194	$1,375	+$919	$2,978	+$2,504	$6,445	+$5,956
NHB	$357	-$70	$616	+$175	$1,065	+$608	$1,840	+$1,367	$3,179	+$2,689
NHA/OM	$331	-$96	$138	-$303***	$58	-$399**	$24	-$449*	$10	-$480

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Figure 4.1. Racial/ethnic differences in medical expenses by coverage instability.



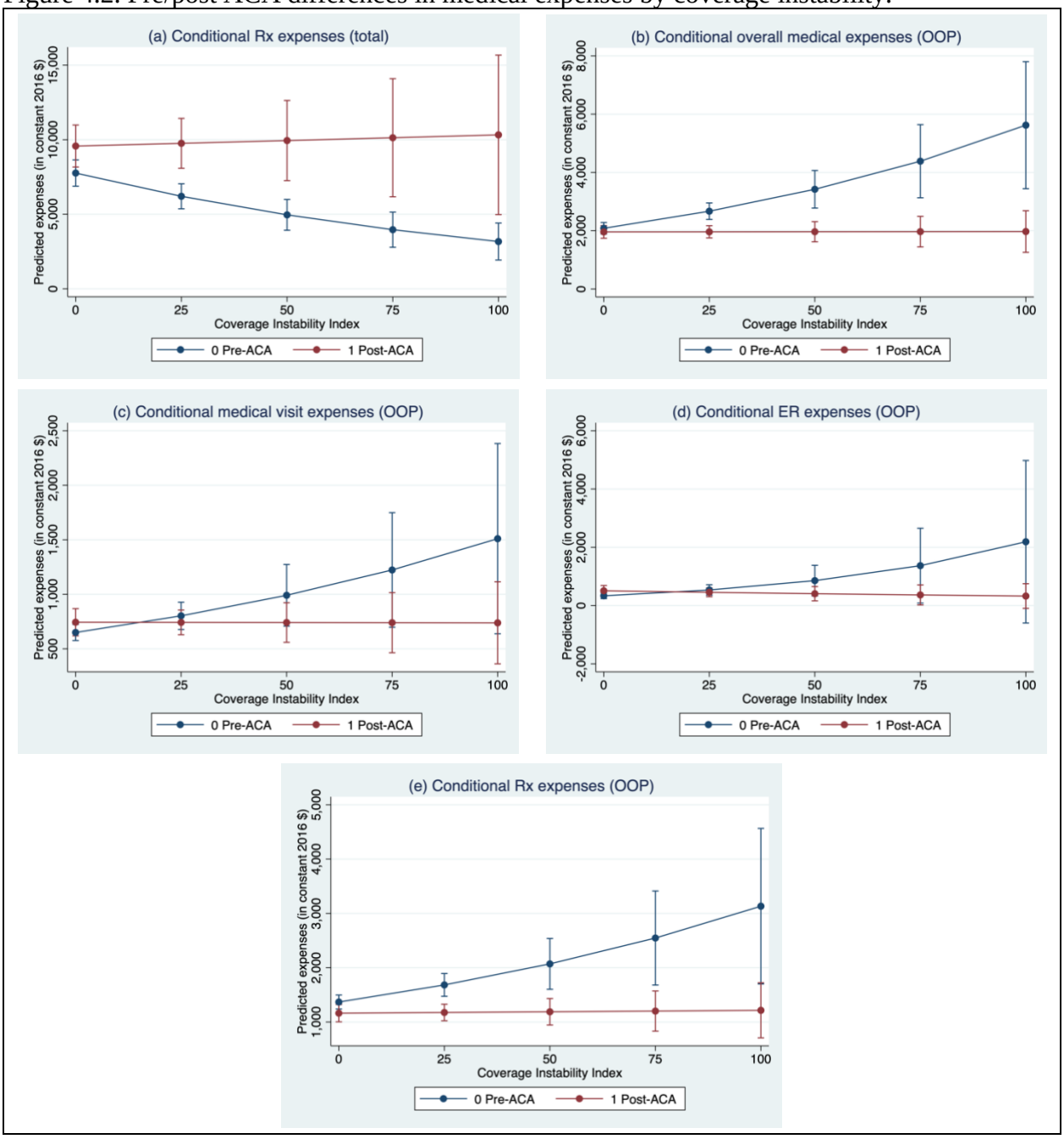
Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

Table 4.2. Estimated mean conditional medical expenses by pre/post ACA and coverage instability (in constant 2016 $).										
	Coverage Instability Index:									
	0		25		50		75		100	
Outcome & race/ethnicity	Pred. cost	Diff. (95% CI)	Pred. cost	Diff. (95% CI)	Pred. cost	Diff. (95% CI)	Pred. cost	Diff. (95% CI)	Pred. cost	Diff. (95% CI)
(a) Total: Rx										
Pre-ACA (ref)	$7,762	--	$6,203	--	$4,958	--	$3,962	--	$3,167	--
Post-ACA	$9,575	+$1,709 *	$9,757	+$3,457 ***	$9,942	+$4,823 ***	$10,131	+$5,890 ***	$10,324	+$6,724 **
(b) OOP: Total										
Pre-ACA (ref)	$2,082	--	$2,669	--	$3,422	--	$4,386	--	$5,622	--
Post-ACA	$1,958	-$124	$1,961	-$708 ***	$1,965	-$1,457 ***	$1,968	-$2,418 ***	$1,971	-$3,651 **
(c) OOP: Medical visits										
Pre-ACA (ref)	$650	--	$803	--	$991	--	$1,223	--	$1,510	--
Post-ACA	$744	+$94	$742	-$60	$741	-$250	$740	-$484	$738	-$772
(d) OOP: ER visits										
Pre-ACA (ref)	$335	--	$536	--	$857	--	$1,370	--	$2,190	--
Post-ACA	$508	+$173	$455	-$81	$408	-$449	$365	-$1,005	$327	-$1,863
(e) OOP: Rx										
Pre-ACA (ref)	$1,368	--	$1,683	--	$2,071	--	$2,547	--	$3,133	--
Post-ACA	$1,163	-$206*	$1,176	-$507 ***	$1,189	-$882 ***	$1,202	-$1,345 **	$1,216	$1,917*

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

Figure 4.2. Pre/post ACA differences in medical expenses by coverage instability.



Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

Appendix 4.1. Additional bivariate results.

Estimated conditional total and OOP expenses (in 2016 $) by predisposing, enabling and need characteristics for adults ages 18-64 with diabetes, 2010-2016 (n=2,555).										
	Conditional total expenses					Conditional OOP expenses				
Variables	Total overall (a)	Medical visits (b)	ER visits (c)	IP hospital stays (d)	Rx (e)	Total OOP (f)	Medical visits (g)	ER visits (h)	IP hospital stays (i)	Rx (j)
Predisposing										
Baseline age:	***	***		*		***	***			
18-39	$15,341	$4,860	$2,139	$17,562	$6,184	$1,820	$522	$559	$942	$1,227
40-49	$15,138	$3,810	$2,138	$21,668	$6,636	$1,731	$493	$494	$1,110	$1,207
50-64	$22,042	$6,742	$2,215	$25,446	$9,340	$2,402	$855	$432	$1,185	$1,444
Sex:										
Female	$20,410	$5,923	$2,213	$23,332	$8,726	$2,185	$761	$541	$1,158	$1,310
Male	$18,132	$5,540	$2,142	$23,327	$7,626	$2,111	$679	$376	$1,113	$1,398
Race/ethnicity:	***	***			**	***	***			***
NHW	$22,982	$6,643	$2,321	$24,616	$10,127	$2,543	$873	$431	$932	$1,565
Hispanic	$12,791	$3,507	$1,915	$22,091	$5,315	$1,477	$462	$689	$1,017	$968
NHB	$14,908	$4,806	$2,076	$20,160	$5,016	$1,566	$438	$451	$1,548	$1,012
NHA/OM	$17,384	$6,188	$1,946	$22,878	$7,478	$2,064	$636	$303	$2,266	$1,395
Language most spoken in the home: English		**				***	***			***
Yes	$19,757	$6,079	$2,168	$23,636	$7,978	$2,289	$770	$408	$1,132	$1,440
No	$17,254	$4,186	$2,254	$21,561	$9,148	$1,512	$478	$795	$1,166	$951
Baseline education:	**	***			***	***	***			***
Less than high school	$14,023	$3,151	$2,976	$29,560	$4,848	$1,276	$444	$416	$546	$877
9-12th grade, no high school diploma, no GED	$14,532	$3,357	$1,468	$23,350	$6,038	$1,411	$387	$394	$758	$1,031
High school diploma or GED	$18,301	$5,682	$2,075	$21,923	$7,381	$2,067	$650	$571	$1,223	$1,310

Some college or Associate's degree	$22,190	$6,998	$2,237	$24,023	$9,152	$2,197	$779	$349	$1,018	$1,342
Four-year college degree or more	$20,408	$5,738	$2,408	$22,717	$10,171	$2,813	$924	$466	$1,424	$1,743
Baseline marital status:		*					*			
Married or separated	$19,787	$6,178	$2,071	$23,901	$8,455	$2,183	$764	$452	$1,134	$1,338
Widowed, divorced or never married	$18,280	$4,824	$2,372	$22,299	$7,642	$2,076	$623	$492	$1,144	$1,386
Enabling										
Coverage instability index:	*			***	***			***		
0-24	$19,746	$5,815	$2,246	$24,353	$8,487	$2,124	$741	$348	$964	$1,334
25-49	$14,754	$4,657	$2,180	$21,674	$4,647	$2,163	$593	$664	$1,513	$1,406
50-74	$25,910	$6,996	$1,952	$22,350	$13,938	$2,302	$870	$622	$1,517	$1,385
75-100	$41,692	$18,806	$1,350	$6,854	$19,724	$1,620	$783	$30	$737	$849
Baseline poverty:						***	***			*
<100% FPL	$18,534	$5,506	$2,211	$17,287	$6,895	$1,450	$543	$345	$871	$1,034
100 to 138% FPL	$17,398	$5,632	$1,926	$26,809	$6,002	$1,645	$489	$673	$1,728	$1,075
139 to <200% FPL	$18,618	$5,304	$2,289	$25,172	$6,720	$2,155	$594	$655	$1,366	$1,380
200 to <400% FPL	$17,916	$5,561	$2,139	$24,409	$6,938	$2,086	$665	$478	$917	$1,317
400%+ FPL	$21,419	$6,149	$2,210	$25,050	$10,736	$2,561	$883	$383	$1,247	$1,548
Baseline Census region:	***	***	*		***	**				
South	$16,876	$5,010	$1,761	$19,916	$7,247	$2,254	$713	$514	$1,415	$1,395
Northeast	$27,645	$8,012	$1,862	$25,506	$12,881	$1,909	$714	$436	$1,106	$1,182
Midwest	$22,977	$7,079	$2,527	$29,013	$9,112	$2,422	$830	$451	$853	$1,521
West	$13,999	$3,996	$3,205	$22,240	$5,585	$1,753	$603	$340	$825	$1,178
Post-ACA sample:						*				***
2010-2013	$17,618	$5,245	$2,136	$23,596	$6,864	$2,282	$709	$434	$1,313	$1,494
2014-2016	$21,985	$6,514	$2,252	$22,875	$10,307	$1,929	$741	$511	$854	$1,121
Health Need										

Actual/Evaluated:										
Charlson Comorbidity Index:	***	***			***	***			*	***
0-1	$11,126	$2,644	$1,944	$21,837	$1,887	$1,268	$679	$298	$1,620	$565
2	$15,025	$4,954	$2,149	$20,998	$6,209	$2,007	$691	$527	$1,396	$1,213
3+	$32,024	$8,326	$2,280	$26,699	$14,385	$2,668	$809	$371	$684	$1,839
Diabetes disease severity proxy:	***	***			***	***				***
Insulin injections	$29,330	$6,948	$2,341	$26,867	$14,201	$2,803	$694	$517	$901	$1,989
Oral medication	$14,392	$5,221	$2,008	$20,312	$5,344	$1,836	$729	$422	$1,223	$1,062
Diet modification	$12,632	$4,433	$2,497	$20,842	$2,406	$1,479	$767	$348	$1,966	$544
No treatment	$9,163	$2,626	$2,231	$26,803	$4,597	$2,425	$920	$1,573	$585	$1,650
Perceived:										
Mean self-reported health status:	***	***		*	***	*	**	*		*
Excellent (1-1.99)	$10,344	$3,300	$1,467	$23,396	$5,008	$1,956	$1,000	$254	$700	$1,075
Very good (2-2.99)	$11,680	$3,986	$1,952	$17,475	$5,439	$1,841	$630	$561	$724	$1,184
Good (3-3.99)	$20,817	$5,821	$2,014	$21,535	$9,379	$2,336	$751	$518	$1,500	$1,433
Fair (4-4.99)	$34,468	$9,964	$2,778	$30,959	$11,865	$2,359	$786	$278	$785	$1,559
Poor (5)	$40,318	$12,043	$3,514	$24,760	$13,202	$2,545	$457	$299	$1,341	$1,968
Lack of perceived need for health insurance:				**	***	**				***
Yes	$13,617	$8,360	$1,798	$14,767	$3,370	$1,343	$645	$813	$1,338	$626
No	$19,556	$5,620	$2,198	$23,540	$8,407	$2,184	$724	$448	$1,130	$1,385

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

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

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 4.2.1. Full two-part model estimates of total medical expenses for the race/ethnicity analysis.

	Total overall expenses (a)		Medical visits (b)		ER visits (c)		Overnight hospital stays (d)		Prescription drugs (e)	
	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0
Variables	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Main regressors										
Coverage instability index X Race/ethnicity (ref=Coverage instability index X NHW)										
Coverage instability index X Hispanic	.003	-.004	.003	-.008	-.009*	.014*	-.002	-.004	.007	-.002
Coverage instability index X NHB	.021*	-.006*	.002	-.008	-.006	-.001	.005	-.008	.018	-.006
Coverage instability index X NHA/OM	-.015	-.012**	-.009	-.012	.0002	-.014	.000005	-.003	-.004	-.011*
Coverage instability index	-.016*	-.00002	-.004	.004	.005*	-.008*	-.003	-.001	-.013	-.001
Race/ethnicity (ref=NHW)										
Hispanic	-.110	-.377***	-.426	-.360*	.065	-.551*	-.222	.117	-.836*	-.320*
NHB	-.204	-.201*	-.451*	-.126	.139	.082	-.058	.129	-.962**	-.400***
NHA/OM	.426	-.011	-.194	-.096	-.213	.030	-.172	.279	-.688	-.100
Predisposing										
Baseline age (ref=18-39)										
40-49	.166	.010	-.173	-.071	-.092	-.175	-.005	.177	-.027	.192

50-64	.870**	.308***	.164	.386**	-.035	-.084	.031	.300	.545	.381***
Sex: Female (ref=Male)	.310	.128*	.336**	.207*	.086	.104	.013	.039	.293	.103
Language most spoken in the home: English (ref=Not English)	.935*	.066	.403	-.008	.078	-.100	.003	.318	.756*	.006
Baseline education (ref=Less than high school)										
9-12th grade, no high school diploma, no GED	1.139	.032	-.173	.100	.001	-.562*	.008	-.294	.266	.175
High school diploma or GED	.350	.173	-.152	.372*	.137	-.295	.134	-.320	.008	.202
Some college or Associate's degree	.356	.397***	.250	.673***	.109	-.298	.238	-.283	.119	.257*
4-year college degree or more	.606	.387***	.420	.666***	.018	-.165	.228	-.417	.140	.489***
Baseline marital status: Married (ref=Not married)	.574**	.056	.064	.203**	-.003	-.066	.065	.007	.253	-.094
Enabling										
Baseline poverty (ref=<100% FPL)										
100 to 138% FPL	.204	.030	-.147	.080	-.316*	.118	-.253	.570*	-.002	.108
139 to <200% FPL	1.093*	.030	.289	.021	-.139	.258	-.149	.363*	.270	.018
200 to <400% FPL	.219	-.034	.283	.013	-.368**	.126	-.316**	.429*	.116	.122
400%+ FPL	-.205	.177	.153	.148	-.395***	.174	-.419***	.560**	-.272	.313**
Baseline Census region (ref=South)										
Northeast	.846	.313**	.583**	.443**	-.067	.051	.098	.283	.406	.232

Midwest	.600*	.109	.372	.282**	-.011	.267*	-.048	.303	.633**	-.007
West	.327	-.105	.348*	-.028	-.190	.558**	-.043	.225	-.029	-.232**
Post-ACA sample (ref=Pre-ACA sample)	.485**	.195**	.304*	.130	.046	.087	.026	-.023	.375*	.317***
Health Need										
Actual/Evaluated:										
Charlson Comorbidity Index (ref=0-1)										
2	.975**	.107	.245	.358	-.287	-.058	-.426	-.065	1.209***	.535**
3+	--	.549**	.287	.706**	-.022	-.032	-.137	.087	1.705***	1.014***
Diabetes disease severity proxy (ref=Insulin injections)										
Oral medication	-.573	-.560***	-.241	-.134	-.151	-.037	-.257**	-.205	-.718*	-.897***
Diet modification	-1.231*	-.706***	-1.116***	-.206	-.061	.158	-.071	-.113	-1.606***	-1.541***
No treatment	-1.250	-.652**	-.979**	-.093	.008	.135	-.786**	.196	-2.032***	-.837
Perceived:										
Mean self-reported health status (Ref=Excellent (1-1.99))										
Very good (2-2.99)	.527	.154	.387*	.165	-.103	.237	.228	-.311	.323	.106
Good (3-3.99)	.451	.629***	.510**	.614**	.166	.311	.656**	-.118	.454	.378**
Fair (4-4.99)	.577	1.060***	.576*	1.056***	.384	.716*	.935***	.231	.744	.630***
Poor (5)	--	1.310	.817	1.210	.654	.784*	1.231	-.088	--	1.198

		***		***				***				***
Lack of perceived need for health insurance (ref=No)	-.004	-.208	.157	.292	.018	.100	-.280	-.304	.077	-.581 ***
Constant	-.113	8.661	.832	6.541	-.138	7.563	-.763	9.408	1.099	7.770

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 4.2.2. Full two-part model estimates of OOP medical expenses for the race/ethnicity analysis.

	Total OOP (a)		OOP: Medical visits (b)		OOP: ER visits (c)		OOP: Overnight hospital stays (d)		OOP: Prescription drugs (e)	
	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0
Variables	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Main regressors										
Coverage instability index X Race/ethnicity (ref=Coverage instability index X NHW)										
Coverage instability index X Hispanic	.002	.006	.004	.0002	-.004	.030*	.001	-.009	.007	.006
Coverage instability index X NHB	.005	.001	-.006	.001	-.002	.020*	.002	.012	-.003	-.0002
Coverage instability index X NHA/OM	-.004	-.005	-.003	.009	-.008	-.036*	-.002	-.014	-.002	-.008
Coverage instability index	.001	.003	.001	.003	.003	.001	-.0005	.005	-.002	.003
Race/ethnicity (ref=NHW)										
Hispanic	-.039	-.372**	-.242	-.195	-.166	-.373	-.180	.729	-.263	-.363**
NHB	-.186	-.399***	-.377**	-.559***	-.121	-.179	-.020	.209	-.208	-.303**
NHA/OM	-.298	-.101	-.485**	-.324*	-.258	-.254	-.067	.661	-.417	-.046
Predisposing										
Baseline age (ref=18-39)										
40-49	-.016	.061	-.057	-.031	-.031	.084	-.193	.021	.045	.197
50-64	.373*	.322**	.190	.419**	.080	-.079	.102	.294	.401**	.317**

Sex: Female (ref=Male)	-.009	.118*	.289***	.229**	.066	.256	.075	.066	.106	.017
Language most spoken in the home: English (ref=Not English)	.161	.071	.141	.166	-.051	-.737**	-.065	-.195	.185	.092
Baseline education (ref=Less than high school)										
9-12th grade, no high school diploma, no GED	.119	.099	-.043	-.095	-.116	.045	.187	.506	.116	.101
High school diploma or GED	.341	.290**	.015	.193	.187	.525	.243	1.078*	.290	.155
Some college or Associate's degree	.254	.380**	.248	.379	.076	.269	.316	.724	.235	.193
4-year college degree or more	.398	.564***	.575**	.552*	.151	.311	.334	.705	.035	.374**
Baseline marital status: Married (ref=Not married)	.381**	.030	.148	.142	.005	.061	.037	.052	.215	-.036
Enabling										
Baseline poverty (ref=<100% FPL)										
100 to 138% FPL	.345	.120	.284*	.068	.132	-.099	.068	.015	.418	.213
139 to <200% FPL	.495*	.329*	.675***	.125	.168	.148	.410**	.212	.546**	.284
200 to <400% FPL	.840***	.329**	.982***	.176	.097	-.0004	.368*	-.169	.771***	.370**
400%+ FPL	.751**	.472***	1.098***	.329	.149	.031	.399**	.327	.718***	.469***
Baseline Census region (ref=South)										
Northeast	.429*	-.193*	-.166	-.028	-.393**	-.225	-.026	-.497	.414*	-.143
Midwest	.271	-.066	-.086	.052	-.030	-.096	-.071	-.160	.251	-.042

West	-.360*	-.228**	-.282*	.053	-.211	-.258	.003	-.689*	-.505***	-.182
Post-ACA sample (ref=Pre-ACA sample)	-.441***	-.184**	.002	.031	.036	.125	-.007	-.672**	-.410***	-.257***
Health Need										
Actual/Evaluated:										
Charlson Comorbidity Index (ref=0-1)										
2	.787**	.268	.453*	.285	-.331	.649	.020	-.249	.922***	.210
3+	1.138***	.345*	.292	.230	-.315	.656	.178	-.970	1.005***	.447*
Diabetes disease severity proxy (ref=Insulin injections)										
Oral medication	-.035	-.470***	-.173*	.012	-.125	-.353	-.261**	.264	-.123	-.652***
Diet modification	-.446*	-.702***	-.388*	.128	-.002	.168	.046	.251	-.533**	-1.335***
No treatment	-.173	.265	-.062	.870*	-.086	1.451**	-.632	-.795	-.622*	.169
Perceived:										
Mean self-reported health status (Ref=Excellent (1-1.99))										
Very good (2-2.99)	.210	-.049	.300*	-.363*	-.176	.537	.889**	.366	-.038	.027
Good (3-3.99)	.187	.212	.294*	-.130	.041	.114	1.156***	1.161	.133	.188
Fair (4-4.99)	.271	.225	.265	.016	.212	-.481	1.395***	.887	.266	.159
Poor (5)	.461	.438	.375	-.331	-.004	-.203	1.066**	.509	.461	.628*

Lack of perceived need for health insurance (ref=No)	.050	-.210	-.261	.012	.161	.815	.071	-.450	.081	-.508 ***
Constant	.083	6.729	-.563	5.330	-.734	5.457	-2.854	5.528	.205	6.563

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 4.3.1. Full two-part model estimates of total medical expenses for the ACA analysis.

	Total overall expenses (a)		Medical visits (b)		ER visits (c)		Overnight hospital stays (d)		Prescription drugs (e)	
	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0
Variables	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Main regressors										
Coverage instability index X ACA (ref=Coverage instability index X Pre-ACA)	-.006	.002	.004	-.002	.0005	.005	-.008*	.001	-.003	.010*
Coverage instability index	-.011	-.004*	-.005	.001	.002	-.008*	.002	-.004	-.006	-.009***
Post-ACA sample (ref=Pre-ACA sample)	.605*	.182**	.227	.174	.047	.021	.131	-.030	.379	.210*
Predisposing										
Baseline age (ref=18-39)										
40-49	.119	.00005	-.170	-.129	-.101	-.122	-.014	.169	-.060	.188
50-64	.836**	.299***	.172	.346*	-.047	-.029	.024	.292	.536	.384***
Sex: Female (ref=Male)	.247	.135*	.328**	.230*	.092	.087	.020	.038	.274	.087
Race/ethnicity (ref=NHW)										
Hispanic	-.078	-.412***	-.383	-.458**	-.060	-.393*	-.263*	.060	-.698	-.295*
NHB	.123	-.271**	-.402*	-.238	.064	.089	-.001	.015	-.655*	-.439***
NHA/OM	-.042	-.136	-.381	-.232	-.200	-.191	-.168	.252	-.750	-.207

Language most spoken in the home: English (ref=Not English)	.868*	.076	.376	.024	.098	-.232	.014	.328	.710*	.032
Baseline education (ref=Less than high school)										
9-12th grade, no high school diploma, no GED	1.122	.033	-.181	.108	.006	-.619*	.024	-.273	.232	.155
High school diploma or GED	.373	.178	-.148	.381**	.152	-.331	.134	-.290	.048	.196
Some college or Associate's degree	.398	.402***	.235	.687***	.134	-.332	.248	-.267	.148	.241*
4-year college degree or more	.618	.395***	.428	.673***	.031	-.195	.232	-.401	.160	.494***
Baseline marital status: Married (ref=Not married)	.634**	.061	.067	.214**	-.001	-.056	.068	.006	.263	-.104
Enabling										
Baseline poverty (ref=<100% FPL)										
100 to 138% FPL	.224	.044	-.130	.083	-.312*	.065	-.235	.593*	.010	.107
139 to <200% FPL	1.094*	.057	.296	.060	-.131	.273	-.140	.389*	.289	.021
200 to <400% FPL	.252	-.021	.290	.032	-.369**	.116	-.299*	.421*	.153	.126
400%+ FPL	-.158	.191*	.154	.177	-.396***	.162	-.394**	.543**	-.245	.302**
Baseline Census region (ref=South)										
Northeast	.777	.330**	.607**	.464**	-.063	.052	.095	.291	.336	.251
Midwest	.598*	.112	.380	.279*	-.008	.265*	-.049	.315*	.608*	-.009
West	.354	-.105	.348*	-.022	-.188	.583**	-.036	.225	-.019	-.234**

Health Need										
Actual/Evaluated:										
Charlson Comorbidity Index (ref=0-1)										
2	1.000**	.098	.243	.336	-.298	-.103	-.407	-.064	1.245***	.490**
3+	--	.538**	.288	.664**	-.032	-.083	-.121	.081	1.721***	.978***
Diabetes disease severity proxy (ref=Insulin injections)										
Oral medication	-.507	-.558***	-.235	-.131	-.153	-.056	-.257**	-.192	-.678*	-.891***
Diet modification	-1.121**	-.700***	-1.100***	-.209	-.067	.105	-.070	-.112	-1.538***	-1.542***
No treatment	-1.119	-.612*	-.941**	-.083	.004	.135	-.795**	.250	-1.943***	-.804
Perceived:										
Mean self-reported health status (Ref=Excellent (1-1.99))										
Very good (2-2.99)	.472	.158	.390*	.181	-.087	.169	.227	-.294	.246	.110
Good (3-3.99)	.390	.638***	.510**	.630***	.178	.257	.658**	-.112	.360	.380**
Fair (4-4.99)	.561	1.074***	.586*	1.093***	.399	.628	.943***	.262	.709	.636***
Poor (5)	--	1.350***	.880	1.265***	.681	.746	1.223***	-.039	--	1.243***
Lack of perceived need for health insurance (ref=No)	-.009	-.221	.147	.237	.030	.023	-.278	-.333	.108	-.591***

Constant	-.236	8.665	.857	6.530	-.140	7.811	-.866	9.405	.984	7.860

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 4.3.2. Full two-part model estimates of OOP medical expenses for the ACA analysis.

	Total OOP (a)		OOP: Medical visits (b)		OOP: ER visits (c)		OOP: Overnight hospital stays (d)		OOP: Prescription drugs (e)	
	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0	Y>0	Y|Y>0
Variables	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Main regressors										
Coverage instability index X ACA (ref=Coverage instability index X Pre-ACA)	-.001	-.010**	-.003	-.009*	-.005	-.023**	-.003	-.010	.002	-.008*
Coverage instability index	.002	.010***	.002	.135	.005	.019**	.002	.013	-.003	.008**
Post-ACA sample (ref=Pre-ACA sample)	-.434**	-.062	.053	.008**	.103	.417	.033	-.553*	-.444**	-.163*
Predisposing										
Baseline age (ref=18-39)										
40-49	-.020	.071	-.048	-.038	-.040	.085	-.196	-.061	.064	.203
50-64	.374*	.345**	.205	.427**	.076	-.014	.101	.239	.427**	.339**
Sex: Female (ref=Male)	-.012	.121*	.289***	.234**	.073	.305	.078	.038	.097	.019
Race/ethnicity (ref=NHW)										
Hispanic	-.019	-.290**	-.179	-.176	-.221	.153	-.166	.729*	-.143	-.287**
NHB	-.106	-.406***	-.483***	-.557***	-.157	.127	.003	.387	-.263	-.318**
NHA/OM	-.369	-.159	-.532**	-.219	-.351	-.527	-.090	.570	-.450*	-.135

Language most spoken in the home: English (ref=Not English)	.158	.071	.137	.178	-.039	-.722**	-.065	-.112	.166	.088
Baseline education (ref=Less than high school)										
9-12th grade, no high school diploma, no GED	.112	.086	-.055	-.105	-.122	-.219	.188	.670	.104	.101
High school diploma or GED	.337	.258*	.006	.197	.182	.333	.236	1.245*	.283	.126
Some college or Associate's degree	.243	.353**	.244	.400	.085	.133	.312	.919	.221	.165
4-year college degree or more	.394	.554***	.567**	.564**	.157	.260	.330	.994	.034	.365**
Baseline marital status: Married (ref=Not married)	.384**	.039	.148	.143	.010	.131	.038	.066	.207	-.028
Enabling										
Baseline poverty (ref=<100% FPL)										
100 to 138% FPL	.356	.118	.274*	.026	.146	.121	.073	-.107	.398	.217
139 to <200% FPL	.500*	.339*	.680***	.091	.187	.036	.413**	.122	.534**	.303*
200 to <400% FPL	.850***	.374**	.982***	.166	.114	.155	.376*	-.227	.761***	.408**
400%+ FPL	.764***	.514***	1.094***	.324	.171	.133	.411**	.337	.700**	.509***
Baseline Census region (ref=South)										
Northeast	.440*	-.205*	-.162	-.016	-.386**	-.185	-.025	-.532*	.418*	-.152
Midwest	.278	-.065	-.085	.054	-.023	-.094	-.074	-.191	.253	-.043
West	-.350*	-.228**	-.274*	.022	-.201	-.206	.005	-.745**	-.509***	-.172

Health Need										
Actual/Evaluated:										
Charlson Comorbidity Index (ref=0-1)										
2	.790**	.299	.450*	.294	-.327	.746*	.032	-.181	.918***	.242
3+	1.140***	.367*	.284	.215	-.314	.689	.187	-.899	1.005***	.473*
Diabetes disease severity proxy (ref=Insulin injections)										
Oral medication	-.033	-.474***	-.173*	-.002	-.125	-.390*	-.262**	.216	-.129	-.647***
Diet modification	-.450*	-.693***	-.382*	.116	.000	.062	.049	.258	-.524*	-1.317***
No treatment	-.163	.295	-.042	.847*	-.061	1.470**	-.624	-.810	-.600*	.203
Perceived:										
Mean self-reported health status (Ref=Excellent (1-1.99))										
Very good (2-2.99)	.200	-.047	.313*	-.355	-.166	.402	.889**	.402	-.032	.034
Good (3-3.99)	.177	.216	.303*	-.110	.049	.023	1.156***	1.230	.130	.197
Fair (4-4.99)	.270	.230	.280	.051	.229	-.673	1.399***	.981	.256	.166
Poor (5)	.488	.421	.376	-.317	.005	-.254	1.045**	.231	.440	.646*
Lack of perceived need for health insurance (ref=No)	.045	-.214	-.263	.032	.156	.873	.066	-.372	.077	-.520
Constant	.068	6.606	-.575	5.254	-.795	5.232	-2.891	5.159	.243	6.448

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

Appendix 4.4.1. Outline for specification tests.

Extended two-part model of total and out-of-pocket (OOP) expenses
Note: Main regressors of interest are emphasized in bold in the 2nd-stage regressions.

For race/ethnicity analysis:

Y_1 = Has expenses greater than 0 (Yes/No)
Y_2 = Conditional expenses

X_{cii} = Coverage instability index score
X_{re} = Race/ethnicity (non-Hispanic White (ref); Hispanic/Latino; non-Hispanic Black; non-Hispanic Asian, other or multiple races)
X_{re_2} = Dummy variable for Hispanic/Latino
X_{re_3} = Dummy variable for non-Hispanic Black
X_{re_4} = Dummy variable for non-Hispanic Asian, other or multiple races
X_i = Covariates

Z_i = Instrument

β_1 = Estimated coefficient
u_i = First-stage error terms
v_i = Second-stage error terms

- First-stage regressions of endogenous regressors:
  - (5) $X_{cii} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_1$
  - (6) $X_{cii}{\cdot}X_{re\_2} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_2$
  - (7) $X_{cii}{\cdot}X_{re\_3} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_3$
  - (8) $X_{cii}{\cdot}X_{re\_4} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_4$
- Second-stage regressions:
  - (1) $Y_1 = \beta_0 + \beta_1 X_{re} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii}{\cdot}X_{re\_2}} + \beta_4 \boldsymbol{X_{cii}{\cdot}X_{re\_3}} + \beta_5 \boldsymbol{X_{cii}{\cdot}X_{re\_4}} + \beta_6 X_i + v_1$
  - (2) $Y_2 = \beta_0 + \beta_1 X_{re} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii}{\cdot}X_{re\_2}} + \beta_4 \boldsymbol{X_{cii}{\cdot}X_{re\_3}} + \beta_5 \boldsymbol{X_{cii}{\cdot}X_{re\_4}} + \beta_6 X_i + v_2$

For ACA analysis:

Y_1 = Has expenses greater than 0 (Yes/No)
Y_2 = Conditional expenses

X_{cii} = Coverage instability index score
X_{aca} = Pre/post ACA
X_i = Covariates

Z_i = Instrument

βi = Estimated coefficient
u_i = First-stage error terms
v_i = Second-stage error terms

- First-stage regressions of endogenous regressors:
  - (3) $X_{cii} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_i + \beta_3 Z_i \cdot X_{aca} + \beta_4 X_i + u_1$
  - (4) $X_{cii} \cdot X_{aca} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_i + \beta_3 Z_i \cdot X_{aca} + \beta_4 X_i + u_2$
- Second-stage regressions:
  - (2) $Y_1 = \beta_0 + \beta_1 X_{aca} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii} \cdot X_{aca}} + \beta_4 X_i + v_1$
  - (3) $Y_2 = \beta_0 + \beta_1 X_{aca} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii} \cdot X_{aca}} + \beta_4 X_i + v_2$

Appendix 4.4.2. List of potential instruments.

Instruments	n	Percent or mean (range)
Self-employment status (Z_1, %)		
Incorporated	53	1.75
Proprietorship	145	4.79
Partnership	14	0.46
Not self-employed	2,789	92.17
Missing	25	0.83
Industry category (Z_2, %)		
Natural resources	29	0.96
Mining	10	0.33
Construction	94	3.11
Manufacturing	244	8.06
Wholesale & retail trade	237	7.83
Transportation & utilities	137	4.53
Information	23	0.76
Financial activities	101	3.34
Professional & business services	178	5.88
Education, health & social services	500	16.52
Leisure & hospitality	155	5.12
Other services	88	2.91
Public administration	127	4.20
Military	0	0.00
Unclassified	5	0.17
Unemployed	1,043	34.47
Missing	55	1.82
Occupation category (Z_3, %)		
Management, business & financial	240	7.93
Professional & related	308	10.18
Services	454	15.00
Sales & related	165	5.45
Office & administrative support	235	7.77
Farming, fishing & forestry	20	0.66
Construction, extraction & maintenance	150	4.96
Production, transportation, material moving	336	11.1
Military specific	0	0.00
Unclassified	20	0.66
Unemployed	1,043	34.47
Missing	55	1.82

Firm has more than one location (Z_4, %)		
Yes	1,137	37.57
No	502	16.59
Inapplicable, unemployed	1,043	34.47
Inapplicable, self-employed (firm size=1)	212	7.01
Missing	132	4.36
Usual hours worked per week at current main job (Z_5, mean)	2,959	25.56 (0-125)
Firm size at current main job (Z_6, mean)	2,773	80.08 (0-500)
In a labor union (Z_7, %)		
Yes	237	7.83
No	1,660	54.86
Inapplicable, unemployed	1,043	34.47
Missing	86	2.84
Insurance is offered to anyone at current main job (Z_8, %)		
Yes	1,320	43.62
No	350	11.57
Inapplicable, unemployed	1,043	34.47
Inapplicable, self-employed (firm size=1)	126	4.16
Missing	187	6.18
Respondent is eligible for offered health insurance at current main job (Z_9, %)		
Yes	1,221	40.35
No	498	16.46
Inapplicable, unemployed	1,043	34.47
Inapplicable, self-employed (firm size=1)	126	4.16
Missing	138	4.56
Census region (Z_{10}, %)		
South	1,294	42.76
Northeast	436	14.41
Midwest	539	17.81
West	757	25.02

Note: All measured at baseline

Appendix 4.4.3. Testing IV assumption 1 (instrument relevance) for the race/ethnicity analysis.

Note: F statistic from first-stage > 10 indicates a strong instrument

- First-stage regressions of endogenous regressors:

(5) $X_{cii} = \beta_0 + \beta_1 X_{re} + \beta_2 \mathbf{Z_i} + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_1$

(6) $X_{cii}{\cdot}X_{re\_2} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 \mathbf{Z_i{\cdot}X_{re\_2}} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_2$

(7) $X_{cii}{\cdot}X_{re\_3} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 \mathbf{Z_i{\cdot}X_{re\_3}} + \beta_5 Z_i{\cdot}X_{re\_4} + \beta_6 X_i + u_3$

(8) $X_{cii}{\cdot}X_{re\_4} = \beta_0 + \beta_1 X_{re} + \beta_2 Z_i + \beta_3 Z_i{\cdot}X_{re\_2} + \beta_4 Z_i{\cdot}X_{re\_3} + \beta_5 \mathbf{Z_i{\cdot}X_{re\_4}} + \beta_6 X_i + u_4$

	With interaction terms		Without interaction terms	
Instruments used	F	p-value	F	p-value
Self-employment status (Z_1)	2.48	.086	1.11	.333
$Z_1{\cdot}X_{re}$ (ref=$Z_1{\cdot}X_{re\_1}$)				
$Z_1{\cdot}X_{re\_2}$	5.35	.001	--	--
$Z_1{\cdot}X_{re\_3}$	37.55	<.001	--	--
$Z_1{\cdot}X_{re\_4}$	16.48	<.001	--	--
Industry category (Z_2)	6.53	<.001	2.40	.005
$Z_2{\cdot}X_{re}$ (ref=$Z_2{\cdot}X_{re\_1}$)				
$Z_2{\cdot}X_{re\_2}$	1.69	.059	--	--
$Z_2{\cdot}X_{re\_3}$	62.12	<.001	--	--
$Z_2{\cdot}X_{re\_4}$	66.64	<.001	--	--
Occupation category (Z_3)	4.09	<.001	1.21	.289
$Z_3{\cdot}X_{re}$ (ref=$Z_3{\cdot}X_{re\_1}$)				
$Z_3{\cdot}X_{re\_2}$	1.75	.080	--	--
$Z_3{\cdot}X_{re\_3}$	4.90	<.001	--	--
$Z_3{\cdot}X_{re\_4}$	23.67	<.001	--	--
Firm has more than one location (Z_4)	3.74	.012	4.53	.004
$Z_4{\cdot}X_{re}$ (ref=$Z_4{\cdot}X_{re\_1}$)				
$Z_4{\cdot}X_{re\_2}$	3.62	.014	--	--
$Z_4{\cdot}X_{re\_3}$	7.93	<.001	--	--
$Z_4{\cdot}X_{re\_4}$	1.46	.227	--	--
Usual hours worked per week at current main job (Z_5)	0.29	.588	0.60	.440
$Z_5{\cdot}X_{re}$ (ref=$Z_5{\cdot}X_{re\_1}$)				
$Z_5{\cdot}X_{re\_2}$	5.96	.016	--	--
$Z_5{\cdot}X_{re\_3}$	18.20	<.001	--	--
$Z_5{\cdot}X_{re\_4}$	1.61	.206	--	--
Firm size at current main job (Z_6)	9.32	.003	17.41	<.001

$Z_6 \cdot X_{re}$ (ref=$Z_6 \cdot X_{re\_1}$)				
$Z_6 \cdot X_{re\_2}$	2.35	.127	--	--
$Z_6 \cdot X_{re\_3}$	55.72	<.001	--	--
$Z_6 \cdot X_{re\_4}$	16.07	<.001	--	--
In a labor union (Z_7)	0.21	.644	1.50	.222
$Z_7 \cdot X_{re}$ (ref=$Z_7 \cdot X_{re\_1}$)				
$Z_7 \cdot X_{re\_2}$	2.98	.053	--	--
$Z_7 \cdot X_{re\_3}$	13.29	<.001	--	--
$Z_7 \cdot X_{re\_4}$	7.65	<.001	--	--
Insurance offered to employees at current main job (Z_8)	6.24	<.001	15.58	<.001
$Z_8 \cdot X_{re}$ (ref=$Z_8 \cdot X_{re\_1}$)				
$Z_8 \cdot X_{re\_2}$	10.76	<.001	--	--
$Z_8 \cdot X_{re\_3}$	14.08	<.001	--	--
$Z_8 \cdot X_{re\_4}$	6.20	<.001	--	--
Eligible for insurance offered at current main job (Z_9)	9.53	<.001	20.62	<.001
$Z_9 \cdot X_{re}$ (ref=$Z_9 \cdot X_{re\_1}$)				
$Z_9 \cdot X_{re\_2}$	15.07	<.001	--	--
$Z_9 \cdot X_{re\_3}$	14.97	<.001	--	--
$Z_9 \cdot X_{re\_4}$	6.26	<.001	--	--
Census region (Z_{10})	1.73	.162	2.01	.113
$Z_{10} \cdot X_{re}$ (ref=$Z_{10} \cdot X_{re\_1}$)				
$Z_{10} \cdot X_{re\_2}$			--	--
$Z_{10} \cdot X_{re\_3}$			--	--
$Z_{10} \cdot X_{re\_4}$			--	--

Industry category (Z_2), occupation category (Z_3), firm has more than one location (Z_4), firm size at current main job (Z_6), insurance offered to employees at current main job (Z_8), and eligibility for insurance offered at current main job (Z_9) were significantly associated with the coverage instability. However, since their F statistics are all less than 10, they would be considered weak instruments in this analysis.

Appendix 4.4.4. Testing IV assumption 1 (instrument relevance) for the ACA analysis.

Note: F statistic from first-stage > 10 indicates a strong instrument

- First-stage regressions of endogenous regressors:
  (1) $X_{cii} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_i + \beta_3 Z_i \cdot X_{aca} + \beta_4 X_i + u_1$
  (2) $X_{cii} \cdot X_{aca} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_i + \beta_3 Z_i \cdot X_{aca} + \beta_4 X_i + u_2$

	With interaction terms		Without interaction terms	
Instruments used	F	p-value	F	p-value
Self-employment status (Z_1)	0.69	.501	1.11	.333
$Z_1 \cdot X_{aca}$	1.19	.313	--	--
Industry category (Z_2)	2.42	.004	2.60	.002
$Z_2 \cdot X_{aca}$	3.90	<.001	--	--
Occupation category (Z_3)	2.15	.027	1.21	.289
$Z_3 \cdot X_{aca}$	6.09	<.001	--	--
Firm has more than one location (Z_4)	4.25	.006	4.53	.004
$Z_4 \cdot X_{aca}$	5.99	<.001	--	--
Usual hours worked per week at current main job (Z_5)	0.04	.839	0.60	.440
$Z_5 \cdot X_{aca}$	16.17	<.001	--	--
Firm size at current main job (Z_6)	2.28	.133	17.41	<.001
$Z_6 \cdot X_{aca}$	61.55	<.001	--	--
In a labor union (Z_7)	0.58	.449	1.50	.222
$Z_7 \cdot X_{aca}$	6.83	.001	--	--
Insurance offered to employees at current main job (Z_8)	8.85	<.001	15.58	<.001
$Z_8 \cdot X_{aca}$	15.82	<.001	--	--
Eligible for insurance offered at current main job (Z_9)	**14.45**	**<.001**	20.62	<.001
$Z_9 \cdot X_{aca}$	**19.01**	**<.001**	--	--
Census region (Z_{10})	0.31	.817	2.01	.113
$Z_{10} \cdot X_{aca}$	1.90	.131	--	--

Industry category (Z_2), occupation category (Z_3), firm has more than one location (Z_4), insurance offered to employees at current main job (Z_8), and eligibility for insurance offered at current main job (Z_9) were significantly associated with the coverage instability. However, only

eligibility for insurance offered at current main job (Z_9) had an F statistic greater than 10. Additionally, since we need as many instruments as there are endogenous regressors in a model (which includes the interaction between the ACA variable and coverage instability),[27] only Z_9 and $Z_9 \cdot X_{aca}$ meet the first IV assumption in this analysis as strong and valid instruments for coverage instability and its interaction terms.

Appendix 4.4.5. Testing IV assumption 2 (instrument exogeneity/excludability) for both analyses.

- No viable instruments were found for the race/ethnicity analysis.

- However, for the ACA analysis, one instrument was found to be strongly correlated with coverage instability: Z_9 (eligible for health insurance at current main job). Since we only have one instrument, we cannot test its exogeneity.[27]

Appendix 4.4.6. Endogeneity tests.

For ACA analysis:

- First-stage regressions of endogenous regressors:
  - (3) $X_{cii} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_9 + \beta_3 Z_9 \cdot X_{aca} + \beta_4 X_i + u_1 \rightarrow u_1$
  - (4) $X_{cii} \cdot X_{aca} = \beta_0 + \beta_1 X_{aca} + \beta_2 Z_9 + \beta_3 Z_9 \cdot X_{aca} + \beta_4 X_i + u_2 \rightarrow u_2$
- Second-stage regression:
  - (2) $Y_1 = \beta_0 + \beta_1 X_{aca} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii} \cdot X_{aca}} + \beta_4 X_i + (\boldsymbol{u_1} + \boldsymbol{u_2}) + v_1$
  - (3) $Y_2 = \beta_0 + \beta_1 X_{aca} + \beta_2 X_{cii} + \beta_3 \boldsymbol{X_{cii} \cdot X_{aca}} + \beta_4 X_i + (\boldsymbol{u_1} + \boldsymbol{u_2}) + v_2$

H_o: If $Y_1(u_1 + u_2) = Y_2(u_1 + u_2)$, then the regressors are exogenous.
H_A: If $Y_1(u_1 + u_2) \neq Y_2(u_1 + u_2)$, then the regressors are endogenous.

Endogeneity test results for ACA analysis using eligibility for employer-sponsored coverage as an instrument (Z_9) for coverage instability.		
Outcomes:	F	p-value
Total overall medical expenses	3.57	.060
Medical visits	0.37	.545
ER visits	2.29	.132
Overnight hospital stays	0.64	.424
Prescription drugs	0.01	.906
Total OOP expenses	0.44	.510
Medical visits	3.55	.061
ER visits	0.04	.833
Overnight hospital stays	9.46	**.002**
Prescription drugs	0.36	.548

Appendix 4.4.7. Extended two-part model of OOP expenses for overnight hospital stays in the ACA analysis.

	OOP: Overnight hospital stays	
	Y>0	Y|Y>0
Variables	Coef.	Coef.
Main regressors		
Coverage instability index X ACA (ref=Coverage instability index X Pre-ACA)	-.026	.031
Coverage instability index	.007	.051
Post-ACA sample (ref=Pre-ACA sample)	.387	-1.489
Predisposing		
Baseline age (ref=18-39)		
40-49	-.271	.272
50-64	.030	.486
Sex: Female (ref=Male)	.082	.041
Race/ethnicity (ref=NHW)		
Hispanic	-.185	.895*
NHB	-.008	.557
NHA/OM	-.099	.756
Language most spoken in the home: English (ref=Not English)	-.072	.237
Baseline education (ref=Less than high school)		
9-12th grade, no high school diploma, no GED	.141	.559
High school diploma or GED	.223	1.073*
Some college or Associate's degree	.349	.713
4-year college degree or more	.379	.949
Baseline marital status: Married (ref=Not married)	.052	-.133
Enabling		
Baseline poverty (ref=<100% FPL)		
100 to 138% FPL	.100	-.403
139 to <200% FPL	.490***	-.004
200 to <400% FPL	.396*	.148
400%+ FPL	.377	1.057
Baseline Census region (ref=South)		
Northeast	-.020	-.244
Midwest	-.078	-.295
West	.004	-.739*

Health Need		
Actual/Evaluated:		
Charlson Comorbidity Index (ref=0-1)		
2	.023	.071
3+	.217	-.713
Diabetes disease severity proxy (ref=Insulin injections)		
Oral medication	-.279*	.271
Diet modification	-.009	.751
No treatment	-.589	-1.084
Perceived:		
Mean self-reported health status (Ref=Excellent (1-1.99))		
Very good (2-2.99)	.872**	.316
Good (3-3.99)	1.159***	1.086
Fair (4-4.99)	1.421***	.717
Poor (5)	1.106**	.049
Lack of perceived need for health insurance (ref=No)	.130	-.506
u_{cii}	-.006	-.035
u_{cii_aca}	.024	-.052
Constant	-2.894	3.939

Sources: MEPS Panels 15-17 (2010-2013), 19-20 (2014-2016)

* p <.05, ** p <.01, *** p <.001

Hispanic: Hispanic/Latino
NHW: Non-Hispanic White
NHB: Non-Hispanic Black/African American
NHA/OM: Non-Hispanic Asian or other or multiple races

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Chapter 5: Conclusion to the dissertation

Summary of key findings

This dissertation focused on the issue of measuring coverage instability and evaluating its differential effect on access to care and medical expenditures among adults living with diabetes by race/ethnicity and pre/post ACA. Throughout the dissertation, the same five sets of panel data from the Medical Expenditure Panel Survey (MEPS) spanning from 2010 to 2016 were used.

In Chapter 2, we described the processes and methods used to create and validate a composite measure of coverage instability using month-to-month coverage data from MEPS while considering the new coverage options offered under the Affordable Care Act (ACA). When creating the index for coverage instability, we limited the sample to all adults between the ages 18 to 64 so that we could compare our validation results with previous research. The resulting index measure appears to behave as expected, with higher scores (greater instability) significantly associated with younger age, historically disadvantaged racial/ethnic groups (Hispanics, NHB, and other or multiple races of non-Hispanic origin), changes in major life events, never being married, residing in certain geographic regions of the country (South and West), lower socioeconomic status, having fewer comorbidities, and having poorer self-reported health status. Coverage instability was also significantly higher after 2014 compared to before. This reflects the large gains in coverage through the expansion of Medicaid and subsidized coverage options made available through the health insurance exchanges for qualifying individuals after 2014 rather than a pattern of repeatedly losing and gaining coverage over time. This index demonstrates validity and offers a way to measure and observe the dynamic nature of health insurance coverage in the US in a more comprehensive way.

In Chapter 3, we used the newly developed and validated index measure of coverage instability to examine its differential effect on access to care by race/ethnicity and pre/post ACA among adults ages 18-64 living with diabetes. In this analysis, we found that coverage instability affects access to care differently for different racial/ethnic groups. In particular, while we did find that the probability of experiencing any delay in care generally increased for all groups as coverage instability increased, this increase was greatest for NHW but smallest for Hispanics and NHB. Even among those with the most unstable coverage, the probability of reporting any delay in needed care was much lower for Hispanics and NHB compared to NHW. The literature suggests this may be due to generally lower use of preventative medical care among Hispanics and NHB compared to other groups even among those with diabetes. This pattern of lower utilization among Hispanics and NHB itself may be due to a number of overlapping socioeconomic factors affecting perceived need for care and the ability to prioritize seeking care, such as being more likely to be a low-wage worker that is not offered coverage or feels like they are unable to take time off to address concerns about their health. Compared to the other groups, Hispanics in our study were also less likely to report ER use even as coverage instability increased. This may be due to additional barriers that some Hispanic patients face when seeking care, such as limited English proficiency or fears of deportation if they are undocumented immigrants.

We also found that the negative effect of coverage instability on access to care was significantly reduced after the ACA, which further supports previous research indicating the narrowing of racial/ethnic disparities in coverage instability and access to care after the ACA. This effect was greatest for having a usual source of care. Even as coverage instability increased, the probability of having a usual source of care was significantly higher after the ACA. This is

particularly important for patients with diabetes since regular access to care is needed to properly manage and control their diabetes.

In Chapter 4, we also used the newly developed and validated index measure of coverage instability to examine its differential effect on total and out-of-pocket (OOP) expenditures among adults ages 18-64 living with diabetes by race/ethnicity and pre/post ACA. In this study, we found significant racial/ethnic differences in the effect of coverage instability on total medical, prescription drug, and ER costs even after controlling for covariates. As coverage instability increased, conditional total medical expenses and conditional total prescription drug costs remained relatively stable among NHW but decreased among racial/ethnic minorities suggesting less access and utilization. We also found that Hispanics had greater ER expenses (total and OOP) as coverage instability increased unlike for other groups. This most likely is due to the higher rates of uninsurance and unstable coverage among Hispanic patients.

In this study, we also found the effect of coverage instability on medical expenses to significantly differ before and after the ACA, especially for expenses paid out of pocket and for prescription drug costs. Even as coverage instability increased, conditional drug costs and conditional OOP expenses remained relatively stable for those in the post-ACA sample. Specifically, those with the most unstable coverage not only had lower expenses for prescription drugs and OOP expenses after the ACA, they also had expenses that were on par with those with the most stable coverage. This further supports that greater access was made possible under the ACA even for those with unstable coverage.

Implications and future directions for health policy and research

Despite some limitations, such as having limited observations by race/ethnicity and lacking state-level data, our findings offer additional insight on coverage instability and how it affects individuals living with diabetes when accessing care. In particular, they demonstrate how coverage instability affects racial/ethnic groups differently in terms of access to care and medical costs. The results also shed light on how the ACA may have addressed these issues through the expansion of Medicaid and the establishment of the health insurance exchanges. These findings also support the idea that the expansion of Medicaid by the 12 remaining non-expansion states could further improve access and reduce disparities by race/ethnicity, especially for Hispanics who continue to face the highest rates of uninsurance and unstable coverage compared to other groups even after the ACA. While we do not have information on each person's state of residence, we do know from the data that the majority of Hispanics in our sample resided in either the West (42.5%) or the South (35.7%). In the West, all but three out of the 13 states in the region (i.e., Idaho, Wyoming, and Utah) had expanded Medicaid by the end of 2016,[1-3] including California which has the largest Hispanic population in the US (26.3%).[4] In the South, only seven out of the 17 states in the region including the District of Columbia had expanded Medicaid by then.[1-3] This did not include Texas (with the second largest Hispanic population in the US, 19.0%) or Florida (with the third largest Hispanic population in the US, 9.1%).[1-4]

In addition to the continued expansion of Medicaid for the needy, other health policies that aim to expand beyond the ACA have also been proposed. Currently, these proposals fall into five categories: (1) Medicare-for-All, (2) Medicare-for-All with an option to opt out for those with qualified coverage, (3) a federal public option made available through the health insurance exchanges, (4) a Medicare buy-in option for older individuals not yet eligible for Medicare, and

(5) a Medicaid buy-in option that states can choose to offer through the health insurance exchanges.[5] Medicare-for-All would establish a single national health insurance program for all US residents with taxpayers being the single payer. Medicare-for-All with an opt-out option would also establish a national program for all US residents but would also allow for employers to offer qualified group plans and would only eliminate premiums and cost sharing for those below 200% FPL.[6] All public option proposals would offer a federal public option similar to Medicare that non-Medicaid and non-Medicare eligible individuals could purchase through the exchanges with the help of enhanced subsidies in lieu of having employer-sponsored coverage or purchasing private coverage; but they vary in terms of whether they would include undocumented immigrants, allow for employers to provide group coverage through the public option, enhance existing exchange subsidies, or automatically enroll eligible individuals living in non-expansion states.[5,6] The Medicare buy-in proposals would offer a Medicare-like public option through the exchanges to those ages 50 to 64 in one proposal or ages 55 to 64 in the other proposal both for which subsidies could be used by qualifying individuals.[7] A Medicaid buy-in plan would allow states to offer Medicaid as a public option through the exchanges to uninsured individuals of all income levels with the help of subsidies.[7] Under this type of plan, enhanced subsidies would be offered for private plans in the exchanges, and states would be allowed to set premiums and cost sharing amounts based on the same factors used by private plans in the exchanges (e.g., geography, age, smoking status) and receive federal matching payments to cover any losses.[6,7]

In terms of reducing coverage instability, a Medicare-for-All plan would be an ideal solution since it would replace our currently fragmented health care system with a single national program funded by taxpayers rather than by employers, households, and states (for Medicaid).

Nearly all of the mechanisms that currently cause coverage instability (e.g., loss or change of employment, change in income, and change in marital status) would no longer have influence on coverage under a Medicare-for-All plan. Medicare-for-All would also provide coverage to all individuals regardless of one's age, income, state of residence, or citizenship.[7] A Medicare-for-All plan with an option to opt out for qualifying plans would be the next best option, but lapses and changes in coverage could still occur under this plan since individuals can still opt out for qualifying employer-sponsored group plans after all other private coverage have been phased out after 2023.[8] The next best solution would be a federal public option plan since most of these plans aim to expand coverage beyond the ACA by enhancing exchange subsidies and auto-enrolling eligible individuals living in non-expansion states. While not ideal in the context of reducing coverage instability, a federal public option plan could help reduce the amount of time spent uninsured during episodes of uninsurance; however, changes in major life events (e.g., change in employment, income, marital status) could still result in individuals churning in of different sources and states of coverage.

A Medicare buy-in option plan would be the next best plan for addressing coverage instability followed by a Medicaid buy-in option plan. While a Medicare buy-in option plan would expand coverage to older adults not quite yet eligible for Medicare nationwide and a Medicaid buy-in option plan would expand coverage to those in states that choose to offer this option in the exchanges, both plans are limited in their expansion of coverage and do not address factors affecting coverage instability. However, in addition to implications for expanding stable coverage, other factors such as how quickly a plan can be implemented and how much a plan would cost even after accounting for savings might outweigh a policymaker's decision to support what might be the most ideal plan for addressing coverage instability in the US. In light of the

current COVID-19 pandemic and economic recession where millions have lost their employer-sponsored coverage, the issue of expanding coverage is more pertinent and urgent than ever.

While this dissertation was able to demonstrate the ability to measure coverage instability in a new and more comprehensive way and apply such a measure to examine its impact on access to care and medical expenses, there is still room for improvement through future research efforts that aim to address the limitations discussed in the previous chapters. One such improvement could be to repeat the analyses using additional data that have been released for MEPS. However, due to changes in policies affecting the ACA after 2016, future research efforts may need to account for two kinds of post-ACA periods – one that covers 2014 to 2016 and another that covers 2017 until the next time a change in national health policy occurs. While it would be up to the national agencies that collect the survey data to include such a measure in their surveys and to make it more accessible to researchers, another major improvement would be to add state-level data to the analyses to be able to understand the full effect of the ACA by distinguishing those living in expansion vs. non-expansion states. Similarly, the addition of information and observations for racial/ethnic subgroups would greatly improve our understanding of how coverage instability affects particularly vulnerable groups not often represented in research due to limited sample sizes (e.g., American Indians and Alaskan Natives), and how coverage instability may affect groups within the same racial/ethnic subgroups differently.

In terms of future research efforts that move beyond improving the research presented in this dissertation, it would be interesting to see how coverage instability affects other groups of individuals that also require regular access to care. For example, individuals living with mental health conditions may need regular access to counselling and treatment in order to manage their

conditions, and individuals at high risk for contracting infectious diseases, such as HIV and COVID-19, would need regular access to testing. It would also be greatly informative to learn more about how comprehensive and affordable an individual's coverage is and how these factors may affect coverage instability.

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