FORGOING MEDICAL CARE DUE TO COSTS:
THE CAUSAL EFFECT OF HEALTH CARE BURDENS ON HEALTH

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By

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ABSTRACT

This paper uses data from the Medical Expenditure Panel Survey, years 2005-2008, to investigate the effect of underinsurance on health. In this analysis, those who are insured for the entire year but admitted to forgoing medical care because of costs are considered underinsured. It is often difficult to measure the impact of forgoing medical care on health outcomes since both may be correlated with unobservable patient severity. Analysis in this paper controls for such endogeneity using the out-of-pocket health care costs of other family members as an instrumental variable predicting one’s own forgoing of care. Results show a significant bias due to unobservable severity in that patients with more severe health problems are less likely to forgo care due to costs. Thus, the relationship between underinsurance and bad outcomes will be underestimated in models that do not control for unobservable severity.

Overall, findings indicate that one third of people in the U.S. who forewent medical care due to costs were insured for the entire year. Among the insured, the estimated probability of a bad outcome (asthma attack, diabetic complication, pneumonia, heart attack, congestive heart failure, stroke, chronic obstructive pulmonary disease, or renal failure) one year after forgoing care was 36% compared to 4% for those who did not forgo. Without controlling for unobservable severity, the probability of a bad outcome will be underestimated as 7% for forgoers compared to 4% for non-forgoers.
Thank you to my thesis advisor, Bill Encinosa, for all your support and guidance, to Professor Schone, for your endless encouragement, and to the faculty and staff at Georgetown Public Policy Institute, for your commitment and dedication.
# Table of Contents

Introduction .......................................................................................................................... 1  

Literature Review and Conceptual Framework ................................................................. 2  

Data ........................................................................................................................................ 6  
  Data Source ......................................................................................................................... 6  
  Measures ............................................................................................................................. 7  
  Descriptive Evidence .......................................................................................................... 9  
    Table 1. Distribution of Outcomes by Insurance Status ................................................ 10  

Methods ................................................................................................................................ 11  
  Models .................................................................................................................................. 14  

Results ................................................................................................................................... 16  
  Descriptive Statistics ........................................................................................................... 16  
    Table 2. Descriptive Statistics ............................................................................................ 17  
  Regression Results .............................................................................................................. 18  
    Table 3. Forgoing Medical Care Due to Costs as a Determinant of Health Outcomes, Simple Probit Results .............................................................................................................. 20  
    Table 4. Estimated Impact of Forgoing Care Due to Costs on Health Outcomes ............................................................................................................................. 22  
    Table 5. Estimated Probability of a Bad Outcome Attributable to Forgoing Care Due to Costs ........................................................................................................................... 23  

Discussion ............................................................................................................................. 24  

References ............................................................................................................................... 27
INTRODUCTION

The Patient Protection and Affordable Care Act of 2010 will ensure near universal health insurance coverage in the United States by 2014. Following this massive coverage expansion, one issue that will remain is the poor coverage adequacy of some health insurance policies, particularly those sold in the individual insurance market. Despite provisions in the Affordable Care Act for the creation of state insurance exchanges and increased regulation of the private insurance market, in 2014, many individuals purchasing insurance plans may still be underinsured, or subject to high out-of-pocket health care costs relative to income. Over the next few years, as policymakers work to design and implement the state health insurance exchanges and other key provisions of the Affordable Care Act, understanding the consequences of underinsurance will be critical.

This study estimates the impact of underinsurance on health outcomes. Previous research has shown an association between being underinsured and forgoing medical care, and some studies have shown that those who are underinsured are more likely to experience worse health outcomes. However, few studies have investigated a causal relationship between underinsurance and bad health outcomes, and no study to date has used regression analysis to investigate this possibility. The present study uses data from years 2005-2008 of the Medical Expenditure Panel Survey to identify the extent to which underinsurance causes negative health outcomes. Findings from bivariate probit specifications provide new information about the relationship between underinsurance and health outcomes and suggest the importance of improved coverage adequacy for many insured Americans.
LITERATURE REVIEW & CONCEPTUAL FRAMEWORK

There is a shortage of research on underinsurance in part because the concept is difficult to define and to measure. At a basic level, there is no universal agreement on what constitutes “underinsurance”; definitions are inherently based on normative assumptions about what level of coverage is adequate (Bashshur et al. 1992). Several existing studies of underinsurance define coverage adequacy in economic terms, counting as “underinsured” those whose out-of-pocket burdens exceed a given threshold relative to income (Blewett et al. 2006). For example, Schoen et al. (2005) and Collins et al. (2005) define the underinsured as individuals who have insurance coverage all year but have medical expenses that exceed 10% of income or 5% of income for low-income adults, or those who have deductibles greater than or equal to 5% of income. Since any set threshold is somewhat arbitrary, this paper does not use a threshold to define the underinsured, but instead considers underinsured those who were insured all year but forewent medical care because of cost.

Underinsurance and Out-of-Pocket Burdens

Studies on the financial burdens of the underinsured show that out-of-pocket burdens tend to be higher among the privately insured and have been increasing in recent years. According to Banthin and Bernard (2006), high out-of-pocket burdens are much more common among those with private non-group coverage – these individuals were almost 3 times as likely as those with group coverage, those on public plans, or the uninsured to have high total health care burdens (premiums and out-of-pocket costs). Banthin, Cunningham and Bernard (2008)
found that from 2001-2004, increases in out-of-pocket medical expenses led to significant growth in the health care burdens for families and especially for those with private coverage. According to their study, 20 percent of middle-income (200-399 percent of the poverty level), privately insured Americans spent more than ten percent of income on health care from 2001 to 2004. Health care burdens increased by more than one-third for families covered by non-group plans over this period.

Results from a study by Cunningham et al. (2008) demonstrate that even seemingly small health care burdens can be problematic for families. They found that of families with medical bill problems, approximately half spent 2.5 percent or less of family income on out-of-pocket expenses and over two-thirds spent 5 percent or less. This is concerning given evidence that for almost 20 percent of Americans, total out-of-pocket spending (including premiums) on health care was greater than or equal to 10 percent of family income (Banthin and Bernard 2006).

Other studies show significant health care burdens for those with chronic conditions. For example, Cunningham et al. (2008) found that compared to healthy individuals, those with chronic medical conditions are more likely to experience problems paying medical bills. Banthin and Bernard (2006) show that that those with common chronic conditions, including diabetes, heart disease, cancer, mental illness and other conditions, were more likely to accumulate high burdens for medical care. This study also demonstrated a significant association between having high out-of-pocket burdens and postponing or foregoing medical care for financial reasons.
Out-of-pocket Burdens and Access to Medical Care

An underlying assumption in this analysis that high-out-pocket burdens (due to inadequate insurance coverage, chronic conditions that require regular care/medications, or both) lead people to forgo medical care. Previous studies offer support for this idea. For example, copayments can be a barrier to medical care and prescription drugs for low-income patients (Ku 2005), and out-of-pocket costs can prevent even those in middle-income families from seeking medical care (Cunningham et al. 2008). Kogan et al. (2010) found that compared to children with adequate insurance, underinsured and uninsured children were more likely to experience barriers to health care and to receive lower quality medical care. A study by Goldman et al. (2004) found that doubling copayments for drugs in typical 2-tier health plans was associated with reduced use of prescription drugs for eight of the most commonly prescribed classes of medications.

A number of studies have demonstrated that high-out-pocket burdens lead those with chronic conditions to reduce their utilization of medical care. For example, according to Schoen et al. (2005), substantial proportions of underinsured adults with chronic conditions or with self-reported poor health restricted their use of medical care due to cost. Almost half did not adhere to medications, 38 percent refrained from visiting a doctor when sick and one third did not pursue diagnostic treatment or care as advised by their physicians. Another study of patients with acute myocardial infarction (heart attack) found that the uninsured and those who were insured but had financial concerns about accessing care were more likely to delay seeking emergency care compared to those without financial concerns about accessing care (Smolderen et al. 2010).
For those with chronic conditions, foregoing routine medical care or prescription medications can lead to worse health and to increased use of more high cost emergency medical care (Ku 2005). For example, Tamblyn et al. (2001) found that the introduction of copayments for prescription drugs among welfare recipients and the elderly in Quebec led to decreased use of essential medications, and these reductions in medications were associated with an increase in adverse health outcomes and emergency room visits.

**Insurance Coverage and Health Outcomes**

Several studies show associations between insurance coverage and health outcomes (Baker et al. 2001; Bravemen et al. 1994; Rahimi et al. 2007; Heisler et al. 2004). However, few studies attempt to identify a causal relationship between underinsurance and health outcomes. A review of the literature by Freeman et al. (2008) identified only 14 studies estimating a causal relationship between having health insurance coverage and either health outcomes or utilization of care. These studies provide some empirical evidence that having health insurance increases utilization of health care and improves health, but they do not investigate the extent to which the adequacy of insurance coverage affects health outcomes. Given the findings that high out-of-pocket expenses can lead people to forgo or delay seeking medical care, understanding if there is a causal relationship between underinsurance and poor health outcomes is important.
DATA

Data Source

This paper uses data from the Household Component of the Medical Expenditure Panel Survey (MEPS), sponsored by the Agency for Health Care Research and Quality. MEPS is a stratified and clustered random sample of U.S. households and is weighted to create a nationally representative sample of the non-institutionalized population. The Household Component (HC) of MEPS contains person-level data, with variables indicating demographic characteristics, medical conditions, health status, employment, income, insurance coverage, and utilization of medical care. This information, reported by members of individual households, is supplemented with data from medical providers. Variables measuring health outcomes come from the inpatient hospital events data files of the HC.

The HC uses an overlapping panel design, with a new panel selected each year and followed for two calendar years. Each panel is interviewed through five rounds over a two-and-a-half-year period. I use data from years 2005 - 2008, with an overall sample of 33,854 observations of people tracked over a two-year period. I have dropped people with no other household members, since my instrumental variables approach, described later, will be based on other family members’ medical costs.

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Measures

The goal of this research is to explore the effect of underinsurance on health outcomes. Below are the variables used in this investigation. Each person is observed over a two-year period, and I will refer to year one and year two to identify which year the variables below are observed.

Independent Variable of Interest

The independent variable of interest in this analysis is forewent medical care due to cost. This is a binary variable equal to 1 for individuals who reported forgoing or delaying medical care due to costs in year one of the survey, and 0 otherwise. Participants who had health insurance coverage for all of year one but reported forgoing medical care due to costs are considered underinsured.

Dependent Variables

Since the purpose of this research is to understand the impact of underinsurance on health, the dependent variables in this analysis are two different types of health outcomes in year two: (1) hospitalization; and (2) adverse health outcome. Hospitalization is a binary variable equal to 1 for individuals who went to an emergency room or were hospitalized. Adverse health outcome is a binary variable equal to 1 for individuals who experienced any of the following acute health outcomes in year two: asthma attack, diabetic complication, pneumonia, heart attack, congestive heart failure, stroke, chronic obstructive pulmonary disease, or renal failure.
Control Variables

All regressions contain year two control variables, including age, race, sex, year of the survey (2005-2008), poverty, education, number of chronic conditions, insurance coverage, and region of the country.

Poverty is an indicator variable set equal to 1 for individuals at or below the federal poverty line.

Education is an ordinal variable, with categories indicating the highest level of education participants obtained prior to entering into MEPS. Categories are high school graduate, college graduate, and some graduate school, with less than a high school education as the reference category.

Number of Chronic conditions is an aggregate of the individual’s chronic conditions from year one. Medical conditions used to construct this variable include diabetes, high cholesterol, high blood pressure, emphysema, asthma, arthritis, heart disease, angina, past heart attack, and past stroke. The variable is top-coded so that individuals with more than four chronic conditions are set equal to four.

Insurance coverage for year two is a categorical variable, with categories including Medicare, Medicaid, and uninsured. The reference category is private insurance coverage. Year one insurance status will not be used as a control variable since regressions will be performed over each year one insurance status class (i.e., full interaction effects of year one insurance).
Region indicates the region of the country in which each survey participant lived. Regions include the Midwest, the South, and the West, with the Northeast as the reference category.

**Descriptive Evidence**

Table 1 shows the distribution of the two dependent variables – hospitalization and adverse health outcomes from year two. Distributions are presented by insurance status in year one and by the explanatory variable of interest – forewent medical care due to costs in year one. Approximately 54 percent of the sample who forewent medical care because of costs were uninsured for the entire year one. About 67 percent were uninsured all or part of the year one. The remaining 33 percent who forewent medical care because of cost are considered insured for all of year one.

In the overall sample and in both subsets (the insured population and the uninsured population), the mean number of hospitalizations and adverse outcomes is substantially larger for those who reported forgoing medical care due to costs. Two percent of the overall sample reported forgoing medical care due to costs, and of those, over 20 percent were hospitalized or went to the emergency room, while almost 7 percent had an adverse outcome. Interestingly, the rates of hospitalization and adverse outcomes were highest for the insured population who forewent medical care due to costs: 21 percent of these individuals were hospitalized and 8 percent had an adverse outcome. Of the uninsured who forewent medical care due to cost, almost 18 percent were hospitalized or went the emergency room, while 5 percent had an adverse health outcome.
These figures suggest that the insured who forgo medical care are at greater risk of experiencing negative health outcomes than the uninsured who forgo care, a trend that can likely be explained by adverse selection. Given that sicker individuals are more likely to select into health insurance, it is likely that compared to the uninsured, a larger proportion of those with health insurance coverage have medical conditions that predispose them to adverse health outcomes. Similarly, in all insurance categories, those who report forgoing medical care due to costs are more likely to have underlying health conditions that predispose them to adverse health outcomes, while also exposing them to high out-of-pocket expenses that make them more likely to forgo medical care because of costs. Healthy individuals who forgo medical care due to costs are less likely to experience adverse health outcomes, regardless of insurance status. This would suggest that on average, the underinsured are sicker than the uninsured and those with more comprehensive insurance coverage, and therefore, forgoing medical care for the underinsured is more detrimental. In view of the trends in the raw data and the conceptual analysis above, this paper uses probit and bivariate probit regressions to investigate the effect of underinsurance on health outcomes.
METHODS

The hypothesis of this paper is that out-of-pocket burdens lead people to forgo medical care, and forgoing medical care due to costs causes bad health outcomes. In investigating this topic, there are two sources of endogeneity that could bias results. First, any correlation between forgoing care and bad outcomes may simply reflect reverse causality. That is, poor health may cause an individual to spend money out-of-pocket on medical care, and he/she may subsequently forgo medical care due to costs already spent. To mitigate concerns about such reverse causality, I observe survey participants over a two-year period and investigate how forgoing care in the first year causes a bad outcome in the second year. Since I lag the forwent medical care due to costs variable, I can be more certain of the direction of the causal relationship - a bad outcome in year two could not have caused the financial barrier to medical care in year one.

A second issue is that, even after controlling for reverse causality, a correlation between forgoing medical care and experiencing bad health outcomes still might not imply causation. Any observed relationship could instead be due to unobservable heterogeneity among patients. For example, naïve regression analyses might show a positive correlation if patients who are unobservably very sick are more apt to forgo care due to costs compared to other people (perhaps because they are too sick to drive to the doctor and cannot afford the cost of a taxi), and more apt to have a bad outcome at the same time. Alternatively, results could show a negative correlation if unobservably very sick patients are less likely to forgo care due to costs but are more likely to have bad outcomes, or if healthier patients are more willing and able to forgo care due to costs (and save the money for leisure), and more likely to have good health outcomes.
This paper uses multivariate analysis to try to eliminate any bias resulting from these selection issues.

Cost-sharing for medical care is one important aspect of insurance coverage adequacy. Though previous studies have used different thresholds for out-of-pocket spending to measure underinsurance, this analysis assumes that the underinsured are those with out-of-pocket burdens that lead them to forgo medical care due to costs. Previous research has shown a positive association between high out-of-pocket burdens and forgoing medical care. However, as discussed above, determining a causal relationship between high-out-of-pocket burdens and health outcomes requires analysis to deal with selection bias. In view of this issue, regression models in this paper use two instruments for an individual’s decision to forgo care due to costs.

Out-of-pocket burden is a measure of the individual’s out-of-pocket spending as a proportion of household income. In the models used in this analysis, it is possible that an individual’s out-of-pocket burden is endogenous, or there is an unobserved characteristic correlated with out-of-pocket burden and forgoing medical care due to costs. For example, a severe episode of an illness in a given year would likely cause a higher out-of-pocket burden due to higher utilization of medical care, and could also lead someone to forgo some medical care because of his/her medical expenses. Although we observe out-of-pocket burdens and health outcomes in two different years, it is possible that for some patients, high out-of-pocket burdens in year one reflect unobservable severity of illness that spans both years of the survey. In this case, unobservable greater severity of illness would cause both higher out-of-pocket burdens in year one and a higher propensity for negative health outcomes in year two.
In order to address this issue, I use instruments to estimate individuals’ out-of-pocket burdens. Valid instruments are variables that are strongly correlated with an individual’s out-of-pocket burden but have no direct correlation with the likelihood of experiencing a hospitalization or adverse health outcome. Two variables that meet this criteria are other out-of-pocket burden and risky.

*Other out-of-pocket burden* is an aggregate of the out-of-pocket health care burdens of other members of the individual’s household as a proportion of household income. Results from a simple probit regression confirm that this instrument is correlated with forgoing medical care due to costs. As shown in Column 1 of Table 3, the coefficient estimate is 0.1336 and is significant at the 0.10 level (p=0.061). Probit regressions also show that *other out-of-pocket burden* does not have a statistically significant correlation with either outcome variable – hospitalization or adverse outcome – at any conventional level. This makes sense intuitively, since a person is likely to forgo care if another family member has high medical costs. Yet, the high medical cost of the other family member is due to the severity of health of that family member, which is not directly correlated with the individual’s own health (except in the case of rare genetic diseases among family members). Thus, by using other family members’ costs, this instrument breaks the direct link between individuals’ own costs and their own health.

The second instrument, *risky*, is an indicator variable equal to one for individuals who reported being more likely to take risks. Probit regression results as reported in Table 3 show that the coefficient estimate on risky is 0.1498 and is statistically significant at the 0.01 level (p=0.001), indicating that risky is a strong predictor of forgoing medical care due to costs. However, risky does not determine health outcomes directly and therefore cannot be correlated
with unobservable factors that would influence an individual’s probability of experiencing a bad health outcome.

**Models**

Below are the models used in this analysis.

**Simple Probit Models:**

1. \[ \text{Forewent Medical Care}_{\text{year 1}} = f(\text{other out-of-pocket burden}_{\text{year 1}}, \text{risky}_{\text{year 1}}, x, u_1) \]

2. \[ \text{Hospitalization}_{\text{year 2}} = f(\text{forewent medical care}_{\text{year 1}}, \text{other out-of-pocket burden}_{\text{year 1}}, x, u_2) \]

3. \[ \text{Adverse Outcome}_{\text{year 2}} = f(\text{forewent medical care}_{\text{year 1}}, \text{other out-of-pocket burden}_{\text{year 1}}, \text{risky}_{\text{year 1}}, x, u_3) \]

**Bivariate Probit Models:**

4. \[ \text{Forewent Medical Care}_{\text{year 2}} = f(\text{other out-of-pocket burden}_{\text{year 1}}, \text{risky}_{\text{year 1}}, x, u_4) \]
   \[ \text{Hospitalization}_{\text{year 2}} = f(\text{forewent}_{\text{year 1}}, x, u_5) \]

5. \[ \text{Forewent Medical Care}_{\text{year 2}} = f(\text{other out-of-pocket burden}_{\text{year 1}}, \text{risky}_{\text{year 1}}, x, u_6) \]
   \[ \text{Adverse Outcome}_{\text{year 2}} = f(\text{forewent}_{\text{year 1}}, x, u_7) \]
Model (1) is a simple probit estimation of the effect of out-of-pocket burdens in year one, as measured by the two instruments, on the probability that an individual forewent medical care due to cost in year one. Model (2) and Model (3) are simple probit estimations of each of the two health outcome variables, hospitalization and adverse health outcome, in year two, as a function of forgoing medical care due to cost in year one. Model (4) and Model (5) use bivariate probit specifications to estimate the health outcome and forgoing medical care equations simultaneously as a system of equations. In all five models, x is included as a vector of relevant controls, and u is the error term.
RESULTS

Descriptive Statistics

Table 2 contains the distribution of those who forewent medical care across the dependent and independent variables used in the simple probit and bivariate probit regressions. Results show that the mean age of those who forewent medical care is 37 years, which is slightly older than that of those who did not forgo medical care (33 years). Those living at or below the federal poverty line represent approximately 23 percent of those who forewent medical care due to cost and only 11 percent of those who did not forgo care. Interestingly, the proportion of those forgoing medical care does not differ significantly across the different levels of educational attainment. The only significant difference is between those who attended graduate school, which made up less than 4 percent of those who forewent medical care, and those with less than a high school education, which represented more than half of those who forewent care (54.45%).

People who forgo medical care generally have a higher number of chronic conditions. The uninsured account for 54 percent of those who forewent medical care due to cost, while Medicaid recipients account for 13 percent, Medicare enrollees for almost 4 percent, and the privately insured for almost 28 percent. Interestingly, there is substantial geographical variation in the percentages of participants who forewent medical care. Almost half (47 percent) of those forgoing medical care lived in the South, compared to just 25 percent in the West, 18 percent in the Midwest and less than 10 percent in the Northeast.
Table 2. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Forewent Medical Care&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Hospitalization&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.19%***</td>
</tr>
<tr>
<td>Adverse Outcome&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.90%**</td>
</tr>
<tr>
<td>Age</td>
<td>37.57***</td>
</tr>
<tr>
<td>Black</td>
<td>8.78%*</td>
</tr>
<tr>
<td>Hispanic</td>
<td>17.72%</td>
</tr>
<tr>
<td>Female</td>
<td>1.61%***</td>
</tr>
<tr>
<td>Poverty</td>
<td>23.21%***</td>
</tr>
<tr>
<td>Less than High School</td>
<td>54.45%</td>
</tr>
<tr>
<td>High School</td>
<td>31.45%</td>
</tr>
<tr>
<td>Some College/College Graduate</td>
<td>19.71%</td>
</tr>
<tr>
<td>Graduate School</td>
<td>3.62%**</td>
</tr>
<tr>
<td>No Chronic Conditions</td>
<td>57.00%**</td>
</tr>
<tr>
<td>One Chronic Condition</td>
<td>17.78%**</td>
</tr>
<tr>
<td>Two Chronic Conditions</td>
<td>12.17%***</td>
</tr>
<tr>
<td>Three Chronic Conditions</td>
<td>7.25%***</td>
</tr>
<tr>
<td>Four or More Chronic Conditions</td>
<td>5.797%*</td>
</tr>
<tr>
<td>Uninsured</td>
<td>54.20%***</td>
</tr>
<tr>
<td>Medicaid</td>
<td>14.49%***</td>
</tr>
<tr>
<td>Medicare</td>
<td>3.62%***</td>
</tr>
<tr>
<td>Private</td>
<td>27.69%***</td>
</tr>
<tr>
<td>Northeast</td>
<td>9.71%</td>
</tr>
<tr>
<td>Midwest</td>
<td>17.83%</td>
</tr>
<tr>
<td>South</td>
<td>47.10%***</td>
</tr>
<tr>
<td>West</td>
<td>25.36%</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>33,854</td>
</tr>
</tbody>
</table>

<sup>a</sup>Hospitalization includes hospitalization or emergency room visit in year two of the survey.

<sup>b</sup>Adverse Outcome includes asthma attack, diabetes, pneumonia, heart attack, congestive heart failure, stroke, renal failure, and chronic obstructive pulmonary disease in year two of the survey.

<sup>c</sup>Forewent Medical Care indicates an individual forewent medical care due to costs in year one of the survey.

*** Forgo and Non-Forgo significantly different at the 1% level.

** Forgo and Non-Forgo significantly different at the 5% level.

* Forgo and Non-Forgo significantly different at the 10% level.
Regression Results

Simple Probit Analysis

Tables 3 and 4 contain results from simple and bivariate probit estimates of the effect of forgoing medical care due to cost on health outcomes. As a preliminary step, Model (1) predicts the probability of forgoing medical care as a function of out-of-pocket burdens for medical care, number of chronic conditions, and demographic characteristics. As expected, coefficient estimates of the impact of out-of-pocket burdens on the probability of forgoing medical care are positive and statistically significant, indicating that as out-of-pocket burdens increase, individuals are more likely to forgo medical care due to costs, holding relevant controls constant. Blacks and Hispanics are significantly less likely to forgo medical care compared to whites, and women are significantly more likely to forgo care compared to men (p=0.10). As educational attainment increases, the probability of forgoing medical care decreases. As the number of chronic conditions increases, the likelihood of forgoing care increases. Medicaid recipients and the uninsured in year two are significantly more likely to forgo medical care than those with private insurance in year two, while Medicare patients are less likely to forgo care. Full results of this probit regression are shown in column 1 of Table 3.

Table 3 also includes results from simple probit regressions of forgoing medical care in year one on health outcomes in year two. As expected, results of these models indicate that forgoing medical care in year one is associated with a significantly higher probability of being hospitalized or experiencing an adverse health outcome in year two (p=0.10). Coefficient estimates show that as the number of chronic conditions increases, the likelihood of a hospitalization or emergency room visit or an adverse health outcome increases. Interestingly,
individuals at or below the poverty line are significantly more likely to be hospitalized or visit an emergency room, but they are not significantly more likely to have an adverse health outcome. Those uninsured in year two are not significantly more likely to be hospitalized or visit an emergency room, but they are significantly less likely to have an adverse health outcome compared to those with private insurance (p=0.05). Relative to the privately insured, those with Medicare or Medicaid are more likely to be hospitalized, visit an emergency room or have an adverse health outcome. Full results are presented in columns 2 and 3 of Table 3.
Table 3. Forgoing Medical Care Due to Costs as a Determinant of Health Outcomes, Simple Probit Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Forewent Medical Care</th>
<th>Hospitalization (^{b})</th>
<th>Adverse Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forewent Medical Care</td>
<td>0.212***</td>
<td>0.331***</td>
<td></td>
</tr>
<tr>
<td>Other Out-of-pocket Burden</td>
<td>0.134*</td>
<td>-0.048</td>
<td>0.094</td>
</tr>
<tr>
<td>Risky</td>
<td>0.1498***</td>
<td>0.031</td>
<td>-0.043</td>
</tr>
<tr>
<td>Age</td>
<td>0.051***</td>
<td>-0.001</td>
<td>-0.032***</td>
</tr>
<tr>
<td>Age-Squared</td>
<td>-0.001***</td>
<td>0.000</td>
<td>0.000***</td>
</tr>
<tr>
<td>Black</td>
<td>-0.197***</td>
<td>0.027</td>
<td>-0.052</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.237***</td>
<td>-0.063**</td>
<td>-0.095**</td>
</tr>
<tr>
<td>Female</td>
<td>0.108***</td>
<td>0.077***</td>
<td>0.119***</td>
</tr>
<tr>
<td>Poverty</td>
<td>0.118***</td>
<td>0.167***</td>
<td>0.051</td>
</tr>
<tr>
<td>High School</td>
<td>-0.069</td>
<td>0.138***</td>
<td>-0.076***</td>
</tr>
<tr>
<td>Some College/College Graduate</td>
<td>-0.206***</td>
<td>0.089***</td>
<td>-0.067</td>
</tr>
<tr>
<td>College Plus</td>
<td>-0.257***</td>
<td>0.077*</td>
<td>-0.056</td>
</tr>
<tr>
<td>One Chronic Condition</td>
<td>0.1298**</td>
<td>0.250***</td>
<td>1.565***</td>
</tr>
<tr>
<td>Two Chronic Conditions</td>
<td>0.259***</td>
<td>0.389***</td>
<td>1.617***</td>
</tr>
<tr>
<td>Three Chronic Conditions</td>
<td>0.374***</td>
<td>.455***</td>
<td>1.847***</td>
</tr>
<tr>
<td>Four or More Chronic Conditions</td>
<td>0.371***</td>
<td>0.813***</td>
<td>2.291***</td>
</tr>
<tr>
<td>Uninsured</td>
<td>0.783***</td>
<td>0.045</td>
<td>-0.118**</td>
</tr>
<tr>
<td>Medicaid</td>
<td>0.318***</td>
<td>.254***</td>
<td>0.1198***</td>
</tr>
<tr>
<td>Medicare</td>
<td>-0.056</td>
<td>.210***</td>
<td>0.122*</td>
</tr>
<tr>
<td>Midwest</td>
<td>0.0898</td>
<td>0.072**</td>
<td>-0.038</td>
</tr>
<tr>
<td>South</td>
<td>0.138**</td>
<td>0.01</td>
<td>-0.065</td>
</tr>
<tr>
<td>West</td>
<td>0.051</td>
<td>-0.097***</td>
<td>-0.012</td>
</tr>
</tbody>
</table>

N: 33,854

* Significantly different from zero at the 1% level.
** Significantly different from zero at the 5% level.
\(^{a}\) Hospitalization includes hospitalization or emergency room visit in year two of the survey.
\(^{b}\) Adverse Outcome includes asthma attack, diabetes, pneumonia, heart attack, congestive heart failure, stroke, renal failure, and chronic obstructive pulmonary disease in year two of the survey.
\(^{c}\) Forewent Medical Care indicates an individual forewent medical care due to costs in year one of the survey.
Bivariate Probit Analysis

Model (4) and Model (5) use bivariate probit specifications to estimate the probability of forgoing medical care in period one and each of the two dependent variables (hospitalization and adverse health outcome) in period two simultaneously. These bivariate probit models can control for unobservable factors, such as severity of health conditions, in the error term of the “Forewent Medical Care” equation that are correlated with unobservable factors in the error term of the outcome equations. Table 4 compares the results of the two bivariate probit models to the simple probit. In both bivariate probit models, the statistical significance of the coefficient estimates on forgoing medical care due to cost is greater than in the simple probit models. Estimates of the magnitude of the effect of forgoing medical care are substantially larger than in the simple probit models as well. For the overall sample, the impact of forgoing care on the probability of either outcome is roughly double in the bivariate probit model. For the subsample that includes only those with health insurance, the size of the coefficient estimates is roughly three times as large.
### Table 4. Estimated Impact of Forgoing Care Due to Costs on Health Outcomes

<table>
<thead>
<tr>
<th>Models</th>
<th>All</th>
<th>Insured All/Part of the Year</th>
<th>Insured All Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hospitalization</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Coefficient Estimates of Forgoing Medical Care&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probit</td>
<td>0.212***</td>
<td>0.281***</td>
<td>0.251**</td>
</tr>
<tr>
<td></td>
<td>(0.057)</td>
<td>(0.084)</td>
<td>(0.112)</td>
</tr>
<tr>
<td>Biprobit&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.458*</td>
<td>0.834**</td>
<td>1.263**</td>
</tr>
<tr>
<td></td>
<td>(0.257)</td>
<td>(0.384)</td>
<td>(0.681)</td>
</tr>
<tr>
<td><strong>Adverse Outcome</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probit</td>
<td>0.331***</td>
<td>0.382***</td>
<td>0.386**</td>
</tr>
<tr>
<td></td>
<td>(0.087)</td>
<td>(0.118)</td>
<td>(0.155)</td>
</tr>
<tr>
<td>Biprobit&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.683*</td>
<td>1.357*</td>
<td>1.717**</td>
</tr>
<tr>
<td></td>
<td>(0.401)</td>
<td>(0.528)</td>
<td>(0.754)</td>
</tr>
</tbody>
</table>

N 33,854 28,129 26,007

*** Significantly different from zero at the 1% level.
** Significantly different from zero at the 5% level.
* Significantly different from zero at the 10% level.

<sup>a</sup>Hospitalization includes hospitalization or emergency room visit in year two of the survey.
<sup>b</sup>Adverse Outcome includes asthma attack, diabetes, pneumonia, heart attack, congestive heart failure, stroke, renal failure, and chronic obstructive pulmonary disease in year two of the survey.
<sup>c</sup>Forewent Medical Care indicates an individual forewent medical care due to costs in year one of the survey.
<sup>d</sup>The instruments in the bivariate models are “other family members’ out-of-pocket” and “risk taker.”

The magnitude of the coefficient estimates from the bivariate probit analysis is difficult to interpret directly. Therefore, since data from MEPS is carefully weighted to be representative of the non-institutionalized U.S. population, the coefficient estimates from the two bivariate probit models can be used to predict the probability that an American will experience a hospitalization or adverse health outcome due to forgoing medical care because of costs. Results of these simulations are presented in Table 5.

For the overall U.S. population, those who forewent medical care due to costs in year one have a 26 percent chance of being hospitalized or visiting an emergency room in the following year, compared to only 14 percent among those who did not forgo care. Those who forewent
medical care in year one had an 11 percent probability of an adverse health outcome, compared to only four percent for those who did not forgo care. For the subset of the U.S. population with health insurance coverage for all or part of the year, those who forewent medical care due to cost had a 40 percent chance of hospitalization and a 25 percent chance of an adverse outcome, compared to 14 percent and four percent for those who did not forgo care. Of those who were insured the entire year, those who forewent care had a 56 percent chance of hospitalization, compared to 14 percent for those who did not forgo care, and a 36 percent chance of an adverse outcome, compared to just four percent for those did not forgo care.

<table>
<thead>
<tr>
<th>Health Outcome</th>
<th>All</th>
<th>Insured All/Part of the Year</th>
<th>Insured All Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forewent Medical Care</td>
<td>Forewent Medical Care</td>
<td>Forewent Medical Care</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>26.01%</td>
<td>13.91%</td>
<td>39.68%</td>
</tr>
<tr>
<td>Adverse Outcome</td>
<td>10.59%</td>
<td>3.60%</td>
<td>25.45%</td>
</tr>
</tbody>
</table>

Notes: These results are simulated from the biprobit results in Table 4.

Adverse Outcome includes asthma attack, diabetes, pneumonia, heart attack, congestive heart failure, stroke, renal failure, and chronic obstructive pulmonary disease in year two of the survey.

Forewent Medical Care indicates an individual forewent medical care due to costs in year one of the survey.


**DISCUSSION**

Previous research has shown that the underinsured are exposed to significant financial burdens for medical care and are more likely to forgo medical care due to costs. Past studies have also shown that underinsurance and medical bill burdens are associated with worse health outcomes. This study has attempted to address endogeneity issues related to forgoing medical care and health outcomes in order to estimate a causal effect of underinsurance on health.

As expected, simple probit regressions show that high out-of-pocket burdens for medical care strongly predict forgoing medical care due to cost. Results also show that those who forgo medical care due to costs are significantly more likely to experience hospitalizations or adverse health outcomes. However, comparing naïve probit with bivariate probit estimates, this study finds that coefficient estimates on the forewent medical care variable in the naïve probit models substantially underestimate the effect of forgoing medical care on the probability of experiencing a negative health outcome. Among the insured, the estimated probability of an adverse outcome (asthma attack, diabetes complication, pneumonia, heart attack, congestive heart failure, chronic obstructive pulmonary disease, or renal failure) one year after forgoing care was 36 percent compared to four percent for those who did not forgo. The probability of a hospitalization or emergency room visit was 56 percent one year after forgoing care compared to 14 percent for those who did not forgo medical care. Without controlling for unobservable severity in the naïve probit regressions, the probability of a bad outcome will be underestimated as 7 percent for forgoers compared to four percent for non-forgoers. The probability of a hospitalization will be underestimated as 21 percent for forgoers compared to 14 percent for non-forgoers.
The finding of this bias is consistent with the endogeneity concern described above - that those who do not forgo medical care due to costs are those with higher unobserved severity of illness. This bias is also a possible indication that the instruments are controlling for measurement error in the variable indicating those who forewent medical care due to cost. Since this variable is self-reported, it may be poorly measured, in which case, measurement error could cause attenuation in the naïve probit. However, the bivariate probit specification controls for this possible measurement error, and therefore, produces coefficient estimates that are much larger in magnitude and that more accurately reflect the true effect of forgoing medical care due to costs on health outcomes.

Another important finding is that the effect of forgoing medical care on health outcomes is stronger among the insured population than the uninsured population (as inferred from Table 4). Moreover, the bias of the naïve estimation increases among the insured. This indicates that the very sick (with unobservable high severity) are less likely to forgo when they are insured than uninsured. Alternatively, it could indicate that the insured are sicker than the uninsured, and that the underinsured behave similarly to uninsured in terms of handling financial burdens for medical care. Like the uninsured, the underinsured are apt to forgo medical care, but because they are much sicker on average than expected, forgoing medical care puts them at significantly higher risk of experiencing worse health outcomes.

It is important to note a few limitations of this study. First, the Medical Expenditure Panel Survey only follows survey participants for two years, so it does not allow us to determine long-term effects of out-of-pocket burdens on health. Short-term effects of health care burdens may be quite different from long-term effects, especially for people with chronic health
conditions that require ongoing medical care. Another limitation is that the majority of MEPS participants are healthy, and since some variables for chronic conditions contain small numbers of observations, analyses on these variables may not be valid for the general population with these conditions.

Despite these limitations, this study attempts to disentangle some of the selection issues inherent to research on health insurance in order to accurately estimate the causal effect of underinsurance on health. There are a few important policy implications of this study. Results presented above show that the financial barriers to medical care among the insured have significant impacts on health. Findings suggest that those with insurance coverage tend to be sicker on average compared to the uninsured, and they are forgoing medical care in a way that is detrimental to their health. Given the finding that those with high out-of-pocket burdens are more likely to forgo medical care and to experience bad health outcomes in the following year, it is possible that underinsurance leads to inefficient use of medical care. That is, those who forgo medical care and subsequently experience a bad health outcome may end up with much higher medical expenses in the long run. In view of these issues, as federal and state governments work to implement health reform over the next several years, it will be critical to design health insurance policies that ensure adequate coverage and that protect against high out-of-pocket expenses for medical care.
REFERENCES


