Association Between Insurance Gaps and Continued Antihypertension Medication Usage in a US National Representative Population

Yunwei Gai¹ and Ning Yan Gu²

BACKGROUND
Medication persistence is important for adequate control of blood pressure. In this article, we assess the association between gaps in insurance coverage and continued antihypertensive medication usage using a US national representative sample.

METHODS
We used three recent panels from the Medical Expenditure Panel Survey (MEPS). Our sample included hypertensive individuals 18–65 years of age. We identified four insurance categories: (i) continuous coverage by private insurance, (ii) continuous coverage by public insurance, (iii) single or multiple gaps in coverage, and (iv) continuously uninsured. Binary logit models were used to analyze the association between interruptions in medication and insurance after controlling for socioeconomic factors. Patients with continuous private insurance were used as the reference group. Results were weighted to adjust for oversampling and clustering in the survey.

RESULTS
There was no statistically significant difference in the probability of medication persistence between individuals with continuous private insurance (the reference group) and individuals with continuous public insurance (adjusted odds ratio (AOR) 1.324, 95% confidence interval (CI) 0.774–2.266, P = 0.304). Compared to the reference group, individuals with insurance gaps had lower odds of continuing their medication (AOR 0.636, 95% CI 0.418–0.969, P = 0.035). Continuously uninsured individuals had even lower odds of medication persistence (AOR 0.462, 95% CI 0.282–0.757, P = 0.002). Age, marital status, body mass index (BMI) change, and years of education were also associated with continued medication usage.

CONCLUSION
Studies focusing on current insurance status may underestimate the impact of health insurance gaps and the population at risk. Continuous insurance coverage is needed to increase continued antihypertensive medication usage.


Hypertension is a prevalent chronic condition among Americans. It is estimated that about 29% of adult Americans had hypertension in 1999–2000, a 3.7% increase from the early 1990s (ref. 1). Hypertension is a leading cause of various heart conditions and cardiovascular mortality; it also complicates the treatment of many other chronic conditions such as diabetes.²–⁴ Despite its severe consequences and the availability of prescription drugs, a large number of individuals diagnosed with hypertension either go untreated or do not adhere to their medication regimen.⁵–⁸ Disruptions in drug therapy decrease treatment effectiveness and increase the risk of cardiovascular mortality.⁸,⁹ After controlling for demographic and income information, previous works attributed the lack of treatment and the interruption in medication to a lack of health insurance.⁵,⁶,¹⁰,¹¹

The impacts of health insurance on hypertension treatment can be manifested through three channels. First, people without health insurance are less likely to have their blood pressure tested and to initiate drug therapy.¹,⁵,¹²,¹³ Second, patients’ insurance status affects physicians’ prescription decisions, which affects patients’ access to antihypertension drugs.⁶,¹⁰ Finally, lack of insurance increases interruptions in the medication treatment regimen.¹,¹³–¹⁵ Hajjar et al. found that patients with full insurance coverage were two and a half times more likely to complete a 1-year drug therapy treatment.¹

One problem that has not been examined thus far is how insurance instability affects hypertension patients’ medication persistence. According to Short and Graefe,¹⁶ only 4% of Americans were continuously uninsured from 1996 to 1999, but one-third of the population in United States had at least one gap in insurance coverage. Studies focusing on current insurance status may underestimate the impact of health insurance and the population at risk. Several studies have focused on health insurance dynamics and investigated how interruptions in health insurance affected health-care behavior. Sudano and Baker¹⁷ found that insurance gaps decreased individuals’ utilization of preventative services. Two recent studies

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by Cassidy et al.\textsuperscript{18} and Halterman et al.\textsuperscript{19} found that children with intermittent noncoverage were less likely to have a usual source of care and it took a long period to re-establish regular health-care patterns. The objective of this paper is to investigate the association between insurance instability and interruption in hypertensive patients’ medication usage. We hypothesize that intermittent noncoverage in health insurance is linked to interruptions in patients’ medication treatment. We further hypothesize that prolonged periods of noncoverage have a larger impact than small gaps in insurance coverage.

\textbf{METHODS}

\textit{Data source and study population.} The data in this study were extracted from the three latest panels of the Medical Expenditure Panel Survey (panel 7, 8, and 9 from 2002 to 2005). Each panel interviewed the same household and noninstitutionalized individuals five times over a two-and-a-half-year period. Since 2002, MEPS began to oversample low income and Asian households in addition to the oversampling of blacks and Hispanics in previous years. MEPS has three major components: (i) the household component, which is the core survey that collects data on family and individual demographic characteristics, medical expenses, medical conditions, health service utilization including emergency room visits, physician services and prescribed medications, employment status, and health insurance status for each month; (ii) the medical provider component, which collects information from hospitals, doctors, home health-care providers, and pharmacies to compare and supplement the information from the household component; and (iii) the insurance component, which is an independent survey of employers on the health insurance they provide to their employees. Details can be found on http://www.meps.ahrq.gov.

Our sample included 3,679 hypertensive individuals age 18–65, who were identified by two methods. First, we included individuals with essential hypertension (Clinical Classification Code: 98) and hypertension with complications and secondary complications (Clinical Classification Code: 99) from the Medical Conditions File. This follows the definition used by Miller et al.\textsuperscript{20} Second, we identified hypertensive adults based on whether a doctor or a health professional had ever told the person that they had hypertension, which was a new survey question added into MEPS after 2000.

\textit{Variable definitions and summary statistics.} The dependent variable is a binary variable for continued antihypertensive medication. It equals one if an individual reported using the medication in each of the five rounds of surveys during the two-and-a-half-year period. We identified five commonly used classes of antihypertension drugs as listed by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Joint National Committee VII): diuretics, β-blockers, calcium channel blockers, angiotensin-converting enzyme inhibitors, and angiotensin II receptor blockers. The five classes were identified by the Multum therapeutic classification system in the MEPS Prescribed Medicines Files, which obtained the prescription drug usage information for every respondent in the panel.

We selected demographic, socioeconomic variables, and general health status as covariates. Demographic variables included age (mean ± s.d., 51.8 ± 8.9), gender (female as the reference category in the logistic model), race, census region, and marital status. Race was divided into three categories: white, black, and other (other race as the reference category in the logistic model). Marital status was classified into five categories: married, single, widowed, divorced, and separated, where single was used as the reference group. Socioeconomic variables included income and years of education (mean ± s.d., 12.3 ± 3.2). Income was categorized into three groups: low income (<200% Federal Poverty Limit), middle income (between 200% and 400% Federal Poverty Limit), and high income (above 400% Federal Poverty Limit). The high-income group was used as the reference category. Years of education were used as a continuous variable in the model. The change of body mass index (BMI) was used as a proxy for health status or lifestyle change\textsuperscript{10,21} given the correlation between overweight, hypertension, and prescription drug usage.\textsuperscript{1,6,12,21}

The key independent variable is the insurance status of the respondent. MEPS tracks individual insurance status in each month and categorizes it into three groups: public insurance, private insurance, and uninsured. Public insurance includes Medicare, Medicaid/SCHIP, Medicaid waiver programs, CHAMPUS/CHAMPVA (now TRICARE/CHAMPVA), and other government programs. Private insurance includes employer-provided coverage and non-employer-provided coverage (i.e., purchased through a group, association, school, insurance company, etc.). During the sampling period, if an individual had months without coverage, a dummy variable of insurance gaps was set to one. We created two other dummy variables for continuous coverage by public or private insurance. The dummy variable of no insurance was equal to one if the respondent had no insurance for the entire sampling period. In addition to measuring insurance status as categorical variables, we used the number of insurance gaps as a continuous variable in the model.

Binary logistic regression was used to model the association between continued medication and insurance gaps. \textsc{Stata} command, \texttt{svy logit}, was used to adjust for the complex survey design of MEPS.

\textbf{RESULTS}

Table 1 lists the odds ratios from binary logit models after adjusting for survey weights. We also estimated probit models as a robustness test. The coefficient estimates and standard errors are comparable between the two models. Among demographic variables, gender and race are insignificant. Older patients have higher odds of continuing their medication (adjusted odds ratio (AOR) 1.058, 95% confidence interval (CI) 1.042–1.073, \( P < 0.001 \)). Married respondents have almost two times higher odds of continuing their medication
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AOR 1.932, 95% CI 1.280–2.917, \( P = 0.002 \) compared to those who are single. However, there are no statistically significant differences in the odds among unmarried individuals including single, widowed, divorced, and separated. Residents in the South and Midwest have a higher odds compared to residents in the West coast.

For socioeconomic variables, each additional year of education is associated with a 6.7% increase in the odds of maintaining their drug regimen (AOR 1.067, 95% CI 1.016–1.120, \( P = 0.009 \)). We do not find any effect of income on continuous medication usage. The odds ratio between high and low income is 1.094 (95% CI 0.774–2.266, \( P = 0.304 \)). Compared to the reference group, individuals with insurance gaps have lower odds of continued medication usage (AOR 0.636, 95% CI 0.418–0.969, \( P = 0.035 \)). Uninsured individuals have even lower odds of medication persistence (AOR 0.462, 95% CI 0.282–0.757, \( P = 0.002 \)).

We find comparable results when the number of insurance gaps is used as a continuous variable. Each additional month of noncoverage decreases the odds of medication continuation by 4\% (AOR 0.96, 95% CI 0.943–0.977, \( P < 0.001 \)). This further confirms our hypothesis that increased periods of noncoverage have larger impact than small insurance gaps.

There is no statistically significant difference in the probability of medication persistence between the reference group (individuals with continuous private insurance) and individuals with continuous public insurance (AOR 1.324, 95% CI 0.774–2.266, \( P = 0.304 \)). Compared to the reference group, individuals with insurance gaps have lower odds of continued medication usage (AOR 0.636, 95% CI 0.418–0.969, \( P = 0.035 \)). Uninsured individuals have even lower odds of medication persistence (AOR 0.462, 95% CI 0.282–0.757, \( P = 0.002 \)).

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Table 1 | Odds ratio from logistic regression

<table>
<thead>
<tr>
<th>Variables</th>
<th>Odds ratio</th>
<th>s.e.</th>
<th>t</th>
<th>P &gt; t</th>
<th>[95% CI]</th>
<th>Variables</th>
<th>Odds ratio</th>
<th>s.e.</th>
<th>t</th>
<th>P &gt; t</th>
<th>[95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.972</td>
<td>0.146</td>
<td>–0.190</td>
<td>0.849</td>
<td>0.722–1.307</td>
<td>Male</td>
<td>0.977</td>
<td>0.148</td>
<td>–0.150</td>
<td>0.879</td>
<td>0.725–1.317</td>
</tr>
<tr>
<td>White</td>
<td>1.116</td>
<td>0.300</td>
<td>0.410</td>
<td>0.683</td>
<td>0.658–1.894</td>
<td>White</td>
<td>1.106</td>
<td>0.295</td>
<td>0.380</td>
<td>0.707</td>
<td>0.653–1.871</td>
</tr>
<tr>
<td>Black</td>
<td>1.259</td>
<td>0.427</td>
<td>0.680</td>
<td>0.498</td>
<td>0.645–2.456</td>
<td>Black</td>
<td>1.241</td>
<td>0.420</td>
<td>0.640</td>
<td>0.524</td>
<td>0.637–2.419</td>
</tr>
<tr>
<td>Years of education</td>
<td>1.067</td>
<td>0.026</td>
<td>2.620</td>
<td>0.009</td>
<td>1.016–1.120</td>
<td>Years of education</td>
<td>1.062</td>
<td>0.026</td>
<td>2.490</td>
<td>0.013</td>
<td>1.013–1.114</td>
</tr>
<tr>
<td>BMI change</td>
<td>1.011</td>
<td>0.007</td>
<td>1.620</td>
<td>0.107</td>
<td>0.998–1.026</td>
<td>BMI change</td>
<td>1.011</td>
<td>0.007</td>
<td>1.610</td>
<td>0.109</td>
<td>0.997–1.026</td>
</tr>
<tr>
<td>Age</td>
<td>1.058</td>
<td>0.008</td>
<td>7.570</td>
<td>0.000</td>
<td>1.042–1.073</td>
<td>Age</td>
<td>1.058</td>
<td>0.008</td>
<td>7.770</td>
<td>0.000</td>
<td>1.043–1.074</td>
</tr>
<tr>
<td>Married</td>
<td>1.932</td>
<td>0.404</td>
<td>3.150</td>
<td>0.002</td>
<td>1.280–2.917</td>
<td>Married</td>
<td>1.913</td>
<td>0.387</td>
<td>3.200</td>
<td>0.002</td>
<td>1.284–2.851</td>
</tr>
<tr>
<td>Widowed</td>
<td>1.957</td>
<td>0.744</td>
<td>1.770</td>
<td>0.079</td>
<td>0.925–4.140</td>
<td>Widowed</td>
<td>1.973</td>
<td>0.757</td>
<td>1.770</td>
<td>0.078</td>
<td>0.926–4.200</td>
</tr>
<tr>
<td>Divorced</td>
<td>1.067</td>
<td>0.252</td>
<td>0.280</td>
<td>0.783</td>
<td>0.670–1.700</td>
<td>Divorced</td>
<td>1.079</td>
<td>0.252</td>
<td>0.320</td>
<td>0.746</td>
<td>0.680–1.710</td>
</tr>
<tr>
<td>Separated</td>
<td>1.344</td>
<td>0.536</td>
<td>0.740</td>
<td>0.459</td>
<td>0.612–2.948</td>
<td>Separated</td>
<td>1.332</td>
<td>0.526</td>
<td>0.730</td>
<td>0.469</td>
<td>0.612–2.898</td>
</tr>
<tr>
<td>Northeast</td>
<td>1.345</td>
<td>0.286</td>
<td>1.400</td>
<td>0.164</td>
<td>0.885–2.044</td>
<td>Northeast</td>
<td>1.345</td>
<td>0.282</td>
<td>1.410</td>
<td>0.159</td>
<td>0.890–2.034</td>
</tr>
<tr>
<td>Midwest</td>
<td>1.447</td>
<td>0.304</td>
<td>1.760</td>
<td>0.080</td>
<td>0.957–2.188</td>
<td>Midwest</td>
<td>1.463</td>
<td>0.309</td>
<td>1.800</td>
<td>0.073</td>
<td>0.965–2.217</td>
</tr>
<tr>
<td>South</td>
<td>1.403</td>
<td>0.255</td>
<td>1.860</td>
<td>0.064</td>
<td>0.981–2.006</td>
<td>South</td>
<td>1.439</td>
<td>0.263</td>
<td>1.990</td>
<td>0.048</td>
<td>1.004–2.063</td>
</tr>
<tr>
<td>Low income</td>
<td>1.094</td>
<td>0.245</td>
<td>0.400</td>
<td>0.691</td>
<td>0.703–1.702</td>
<td>Low income</td>
<td>1.226</td>
<td>0.255</td>
<td>0.980</td>
<td>0.328</td>
<td>0.814–1.848</td>
</tr>
<tr>
<td>Middle income</td>
<td>1.120</td>
<td>0.227</td>
<td>0.560</td>
<td>0.577</td>
<td>0.751–1.670</td>
<td>Middle income</td>
<td>1.147</td>
<td>0.229</td>
<td>0.690</td>
<td>0.493</td>
<td>0.774–1.700</td>
</tr>
<tr>
<td>Cont. public insurance</td>
<td>1.324</td>
<td>0.361</td>
<td>1.030</td>
<td>0.304</td>
<td>0.774–2.266</td>
<td>Total gaps</td>
<td>0.960</td>
<td>0.009</td>
<td>–4.570</td>
<td>0.000</td>
<td>0.943–0.977</td>
</tr>
<tr>
<td>Multiples gaps</td>
<td>0.636</td>
<td>0.136</td>
<td>–2.120</td>
<td>0.035</td>
<td>0.418–0.969</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uninsured</td>
<td>0.462</td>
<td>0.116</td>
<td>–3.080</td>
<td>0.002</td>
<td>0.282–0.757</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The odds ratios are the exponential of the estimated coefficients in the logistic model. An odds ratio of 0.462 for uninsured individuals indicates that their odds of medication persistence is 46.2% relative to the reference group, i.e., individuals with continued private insurance. The other odds ratios can be interpreted similarly.

BMI, body mass index; CI, confidence interval; PSU, primary sampling unit.
insurance during the entire sample period leads to the worst outcome compared to intermittent noncoverage.

DISCUSSION
Previous studies used cross-sectional data and treated health insurance as a static variable.6,10–12 In this study, we focused on the dynamic nature of health insurance and examined the impacts of prolonged noncoverage on antihypertensive medication usage. It has been shown in other areas that individuals with a history of intermittent noncoverage often exhibit difficulty in using appropriate preventative services and have poor health outcomes.8,18,20 This study finds the same result in drug treatment for hypertension.

Our findings are generally consistent with earlier studies. For example, McWilliams et al.22 found that uninsured adults with hypertension had significantly lower usage of health services before they became eligible for Medicare. Duru et al.11 found that among participants receiving pharmacologic antihypertensive treatment, the uninsured had lower odds of adequate blood pressure control. The authors suggested that “the difference in hypertension control explained by insurance status may not be due to a lack of initiating medications for the uninsured, but rather to a failure to appropriately titrate medication regimens, or increased rates of nonadherence to prescribed antihypertensive therapy among the uninsured.” Our study, using panel data, provides strong empirical support for this hypothesis. Individuals with no insurance and those with long periods of intermittent noncoverage run higher risk of interrupting their antihypertensive drug therapy, which might lead to inadequate blood pressure control.

In terms of demographics, earlier studies found that gender, race, and ethnicity are important determinants of initiating antihypertensive drug therapy.6,10,12 Once the treatment has started, individuals of different gender and race have similar probability of remaining on the therapy after controlling for their education, age, health insurance, and other factors. Furthermore, income may affect initial choice of treatment, but it does not affect medication persistence after controlling for health insurance and other socioeconomic factors. Our paper also provides empirical support for the suggestion that lifestyle modification is an important factor for controlling hypertension.21 The decrease of BMI, a proxy for lifestyle change, lowers the need for medication.

This study has several limitations. First, medication interruptions could be due to side effects of hypertension drugs.13,15 Nevertheless, if patients change their medication due to side effects, we may still identify them as under treatment since we are focusing on a broad range of drugs. Furthermore, our estimate of the effect of insurance gaps should not be biased because it is unlikely that there is a correlation between insurance status and side effects. Second, we are unable to identify individuals who may have stopped drug therapy by controlling their blood pressure through diet and exercise. The change of BMI, adopted in the model, can partially capture these lifestyle changes. Third, although MEPS is a panel survey, we only observe patients’ medication usage in five rounds of interviews. As a result, the focus of the paper is the persistence of patients’ medication, not the clinical definition of medication adherence. The latter requires detailed daily information on the dosage of the medication. This is a promising area for future research.

Finally, more detailed information on the types and coverage of health insurance is needed in future research. Health insurances differ in co-payment arrangement and coverage on prescription medication. Individuals may not have adequate coverage for medication even though they report as being insured in the survey. This measurement error could bias our estimates and overstate the association between insurance gaps and medication persistence.

This study has important policy implications. First, although the control rate of high blood pressure has been improving,24,25 the prevalence is getting worse and the control rate is still about 50% below the target in the initiative Healthy People 2010 (refs. 20,23). Our study has shown that continued health insurance is an important determinant for patients to stay on the prescribed treatment regimen and thus an important policy tool for reaching the targeted hypertension control rate.

Second, our findings highlight the importance of providing universal access to health insurance as a means for improving health-care outcomes. Policy makers should consider the sustainability and continuity of the health insurance reform. Policies that focus only on the current insurance status may neglect the dynamic nature of health insurance and its impact on health-care outcomes.

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