DOES THE ACA'S MEDICAID EXPANSION IMPROVE HEALTH?

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Abstract

We estimate the effects of the ACA's Medicaid expansion on health outcomes with a difference-in-differences approach, using restricted geotagged NHANES data from 2007 to 2014. Our results show that the partial Medicaid expansion in 2014 is significantly associated with a decrease of 8.465 mg / dL (4.3%) in total cholesterol and decrease of 5.569 mmHg in systolic blood pressure (4.7%). These are both likely the result of an increase in the use of cholesterol lowering medications, which can affect both of these measures, as there is no corresponding increase in the use of blood pressure medication. Contrastingly, we find no statistically significant effects for diabetes prescriptions or measures.

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I. Introduction

While Medicaid before 2014 provided health coverage to millions of Americans, many low-income adults were largely ineligible. These individuals could not afford to manage chronic conditions due to a lack of health insurance and the resulting unaffordable out-of-pocket medical costs, effectively reducing access to health care services. The Affordable Care Act was intended to close this coverage gap by expanding Medicaid to adults with income of or below 138% of the federal poverty level, making most low-income adults largely eligible.

Prior to 2014 ACA Medicaid expansion, several papers studied the effects of earlier expansions. The 2008 Oregon expansion of traditional Medicaid showed that Medicaid eligibility leads to greater health care utilization, lower out-of-pocket medical expenditures, fewer medical bills, and better self-reported health (Finkelstein et al. 2012); yet it seemed to have no statistically significant effect on hypertension, high cholesterol levels, or high hemoglobin levels (Baicker et al. 2013). Better adult health conditions are also found to be associated with mother's prenatal coverage under Medicaid in their early life (Miller and Wherry 2016). Finally, the prior Medicaid expansions also reduced the Supplemental Security Income (SSI) participation (Burns and Dague 2016), as previously one needed to get onto SSI to get Medicaid.

Despite the intention of the Affordable Care Act, the Supreme Court in 2012 permitted individual states to opt not to expand Medicaid and to decline substantial federal funding. This partial expansion[1] has generated an abundance of research to evaluate the impacts of the Medicaid expansion in numerous aspects. Relative to non-expansion states, expansion states have increases in health insurance coverage for low-income adults (Black and Cohen 2015; Blumberg et al. 2016) and decrease in the uninsured rate (Benitez et al. 2016; Sommers et al.

[1] 27 states expanded Medicaid in 2014, including the District of Columbia. Five more states expanded Medicaid after 2014, which is beyond the scope of this study.

2016). However, multiple other papers find minimal effects on labor supply, measured by employment status, labor force participation, or hours worked (Kaestner et al. 2015; Hamersma and Unel 2015; Leung and Mas 2016; Bradley et al. 2016; Gooptu et al. 2016). There is at least some evidence, though, for a reduction in hours worked for people who working with lower educational attainment (Asako et al. 2016), and a trade-off between full-time and part-time (Aslim 2016). Finally, consistent with the work from the Oregon expansion (Finkelstein et al. 2012), the ACA Medicaid expansion also improves multiple economic outcomes. This includes significant reductions in the number of unpaid bills and the amount of debt (Hu et al. 2016), increased personal credit score and decreased the probability of bankruptcy (Caswell 2016), and a reduction in federal disability program participation (Chatterji and Li 2016).

On the hospital side, the Medicaid expansion has caused a significant increase in Medicaid admissions, as well as a significant decrease in admissions covered by other commercial insurance. (Hempstead and Cantor 2016). Uncompensated care costs have also decreased (Blavin and Holahan 2016), while Medicaid discharges and hospital revenues have been increased (Nikpay 2016). At the individual level, many papers point to improvements of access to health care, such as physician visit, certain dental visit, overnight hospital stays, and breast exam (Wherry and Miller 2016; Simon et al. 2016; Sommers et al. 2016), and utilization of health services (Decker 2016). However, a few papers did not find significant effects on health care access and utilization (Shartzer et al. 2015; Sommers et al. 2016). To our knowledge, however, only one paper has examined health outcomes and found an increase in diagnoses of diabetes by 5.2 percentage points and diagnoses of high cholesterol by 5.7 percentage points (Wherry and Miller 2016).

The primary reason for this lack of research on health outcomes is data limitations. Our paper is the first to use professionally gathered actual health data to study the impact of the Medicaid expansion. The National Health and Nutrition Examination Survey (NHANES) microdata contain the results of a health examination, as well as the interview questions found in other surveys. While this data has not previously been used to study the ACA Medicaid Expansion, one paper has used this data cross-sectionally to examine the correlation between health insurance and the health outcomes using NHANES 1999-2012, showing that health insurance coverage was associated with significant lower Hemoglobin A1c, total cholesterol and systolic blood pressure (Hogan et al. 2015).

In our paper, we seek to be the first to we examine the impacts of the ACA Medicaid expansion in 2014 on direct health measures, including both the diagnoses and measures of diabetes, high blood pressure, and high cholesterol. We will exploit the effects of the state-variation resulting from the partial Medicaid expansion, using a difference-in-differences model. Our paper will improve our understanding of how public policy decisions regarding health coverage impact health outcomes. As many states consider expanding, knowing the benefits and costs to their citizens would allow policy makers and voters to make more informed decisions.

II. Data

As mentioned above, the primary data used in this analysis come from a restricted version of the National Health and Nutrition Examination Survey (NHANES) for the years 1999-2014. The NHANES data is designed to directly and objectively assess the health and nutrition conditions of American adults and children. This survey is a unique data set with both interviews and physical examinations, which provides both professional and self-reported diagnostic health information of individuals in our analysis, as well as demographic and geographic information.

We limit the sample to non-disabled adult age 19 to 64 with high school education or less. This is preferable to defining the sample by income, the Medicaid expansion is targeted at people with income of or less than 138% of Federal Poverty Level (FPL) and so income is endogenous. Educational attainment, on the other hand, is strongly correlated with income but not directly related to Medicaid eligible and so provides a reasonable "intent to treat" subsample. Such sample stratification is used in Kaestner et al. (2015). In addition to this subsample, we also include a separate sample with college graduates as a comparison placebo group.

As described above, the NHANES collects information on both objective and self-reported health outcomes. Objective health outcomes come from the NHANES examination and laboratory tests, while self-reported health information are from individual interview and questionnaire. In our analysis, we focus on three health outcomes: total cholesterol, systolic blood pressure, and hemoglobin A1c, as per Hogan et al. (2015)'s work with the NHANES on the correlation between Medicaid and health. All of these also have the benefit of not needing to be measured while fasting (Sidhu et al. 2012), allowing us to use the larger examination subsample as opposed to the smaller fasting subsample.

In addition to these examination variables, there are also variables for self-reported information from the interviews. This includes three related variables for each condition. One is whether a physician has diagnosed the individual with the condition associated with that variable (i.e., hypercholesterolemia, hypertension, and diabetes, respectively). Another is whether a physician has ever told the individual to take medication for that condition. Finally, the third is whether the individual is currently taking the prescribed medicine for that condition. Additionally, the data set also contains variables on a variety of demographic information on each individuals, as well information on health insurance.

We supplement the NHANES data with public data from BLS's Local Area Unemployment Statistics). This allows us to control for the seasonally unadjusted unemployment rate at the county-month level, as unemployment affects both Medicaid eligibility (through income) and health outcomes (e.g., Ruhm 2000; Cutler et al. 2016).

Finally, the restricted version of the NHANES that at we used for this project contains several non-public variables, including the dates of the examination and interview, the state and county of residence of the respondent, and the annual survey weight (as opposed to the public biennial ones). This allows us to match each observation to whether he or she lived in a treated or control state and whether the expansion was in effect (as described below), and also match in the county-level unemployment rate.

III. Methodology

Our primary source of variation in this paper is whether a surveyed individual lives in a state that was substantially affected by the Medicaid expansion. We use a difference-in-difference (DID) research design, comparing changes in outcomes in the group of treated states to the same changes in the control states. Following Kaestner et al. (2015)'s classification strategy, we group states by expansion status and the implementation of expansions prior to 2014 which is similar to ACA is another piece of information that included in classification criteria. Such classification is more reasonable since early expansion experience would influence the differences in the impacts of ACA before and after the expansion. The treated states fall into one of two categories:

- Treated states that expanded Medicaid in 2014 and had a partial or limited prior expansion similar to the ACA: AZ, CA, CO, CT, HI, IA, IL, MD, MN, NJ, OR RI, and WA.

- Treated states that expanded Medicaid in 2014 and had no prior expansion similar to ACA: AK, KY, MI, NH, NV, NM, ND, OH, and WV.[2]

The control group includes two other groups of states. First, obviously, it includes all non-expansion states in 2014.[3] Secondly, it also includes five Medicaid expansion states had full expansions prior to 2014. These five states are expected to have little change in health outcome and health insurance due to ACA Medicaid expansion. The 29 control states are therefore fall into one of three categories:

- Non-Medicaid expansion states that had no prior expanding experience: AL, AK, FL, GA, ID, KS, LA, MS, MO, MT, NE, NC, OK, PA, SC, SD, TX, UT, VA, and WY.
- Non-Medicaid expansion states that had limited/partial prior expanding experience: IN, ME, TN, and WI.
- Medicaid expansion states that had full/comprehensive prior expanding experience similar to ACA: DE, DC, MA, NY, and VT.

With the above classification, we estimate the effect of ACA Medicaid expansion on health outcomes using the following regression models. In the following equations, *i* is for an individual in the survey, *c* for the county that individual lives in, *s* for the state that individual lives in, and *t* for the time of the interview.

$$\begin{aligned} y_{icst} &= \alpha + \gamma Expansion_s + \delta Implemented_t + \sigma(Expansion_s * Implemented_t) \\ &\quad + \mathbf{X}_{icst}\boldsymbol{\beta} + \mathbf{time}_t + \mathbf{geography}_{cs} + \varepsilon_{icst} \end{aligned}$$

y are the outcomes of interest, including, cholesterol, blood pressure, and diabetes. **X** is a vector individual level demographic controls, including age, gender, racial dummy indicators, family

[2] Note that Michigan expanded Medicaid in April of 2014 and New Hampshire expanded in August of 2014. Following Kasetner et al. (2015), we consider both of them to be treated, as Michigan was an expansion state for most of the year and New Hampshire is a smaller state with so few observations that it is unlikely to matter.

[3] In addition, several states, including Indiana, Pennsylvania, Alaska, Montana and Louisiana, expanded Medicaid after 2014. As 2015 is beyond the scope of this paper, we have considered those states non expansion states here.

income poverty ratio, marital status, family size, household size, citizenship status, and pregnancy status. It also includes the county-time-level unemployment rate control. **time** is a vector of year and month fixed effects (to control for national level differences by year and also for seasonality), and **geography** a vector of state fixed effects (to control for time invariant level differences by geography). σ is the primary coefficient of interest.

Implemented will equal one if the year (of interview or examination, depending on the outcome) is 2014 and zero otherwise. The sample will be limited to those age 19-64 (to avoid confounding the results with programs for children or the elderly), and educational attainment of a high school diploma or less (per Kaestner et al. 2015 and Hu et al. 2016). The years 2007-2013 will be used as control years to be compared to 2014. The regression is weighted using the restricted annual interview or examination weight corresponding to source of the outcome variable.

We also include three sets of placebo analysis. First of all, each observation is missing data for a subset of the variables of interest. Limiting the data to observations that do not have missing values for a bare minimum of our variables reduces the sample size enormous. Nevertheless, we select consistent sample with key health and demographic variables, and run the same DID regression.

Secondly, there is a concern that other trends may be contemporaneous with the Medicaid expansion and be correlated with which states did and did not expand. Per Slusky (2015), this analysis also includes placebo regressions using data back to 1999 with each 7 consequence years of "comparison" data compared to the subsequent "treatment" year (e.g., 1999-2005 vs. 2006).

Finally, we will also repeat the primary analysis on individuals who are college graduates as an additional placebo test, with the hypothesis that they are minimally affected by the Medicaid expansion. The regression results with college graduates will be included in the main results tables in the following section.[4]

IV. Results

Descriptive statistics are presented in Tables 1 and 2. Table 1 shows the counts of observations in our analytical sample for treated and control states before and after the Medicaid expansion took effect.

Table 1: Summary Statistics: Number of Observation with Low Educational Attainment[5]

	2007-2013	**2014**	**Total**
Treated states	2817	248	3065
Control states	3545	526	4071
Total	6362	774	7136

[4] A synthetic control method, per Abadie and Gardeazabal (2003) and as using Kaestner et al. (2015) and Hu et al. (2016), is unfortunately not possible in this analysis because unfortunately in NHANES each state does not appear in every year. We know of no application of this method to a situation such as this with an unbalanced panel of states.

[5] The fact that the interview and examination dates may not be the same for a particular observation can result in the two straddling New Year's Day, such that one but not the other may be before 2007 or after 2014. This table uses the interview date and so these counts may be slightly different for examination variables.

Table 1 shows that there are only 7136 NHANES observations age 19-64 with a high school diploma or less in the years 2007-2014 which have restricted state and county identifiers such they can be matched to our external data.[6] Within this already small sample, only 248 observations are in treated states in 2014. This unfortunately feature of the data results in two large consequences for our analysis: first, since many of our variables of interest have missing values for some observations, we are limited in what we can investigate. Second, our results will be noisy and so while we believe we have come to plausible conclusions, they are less robust than we would like.

Table 2 shows the means of the primary variables from NHANES that we use for each of the four groups of observations in Table 1.

[6] The public NHANES data has 7184 observations that meet these criteria, but a handful (less than 1%) do not match and so are excluded from our analysis.

Table 2: Summary Statistics of NHANES, 2007-2014[7]

Variable	Treatment Group: Before Expansion (2007-2013) Mean	N	Treatment Group: After Expansion 2014 Mean	N	Control Group: Before Expansion (2007-2013) Mean	N	Control Group: After Expansion 2014 Mean	N	p-value for Treatment vs. Control in pre-period
Panel 1: Demographics									
Age	39.68 (12.94)	2,817	38.46 (13.28)	248	40.48 (13.09)	3,545	37.96 (13.15)	526	0.48
U.S. Citizen	0.777	2,790	0.611	248	0.852	3,534	0.872	523	0.00
Family Income Poverty Ratio	2.287 (1.566)	2,440	1.931 (1.419)	217	2.372 (1.563)	3,190	2.147 (1.469)	476	0.26
Male	0.520	2,817	0.526	248	0.543	3,545	0.539	526	0.00
Non-Hispanic White	0.507	2,817	0.372	248	0.558	3,545	0.552	526	0.00
Non-Hispanic Black	0.108	2,817	0.0708	248	0.157	3,545	0.171	526	0.00
Hispanic	0.320	2,817	0.504	248	0.235	3,545	0.216	526	0.00
Pregnant	0.0130	2,191	0.00928	186	0.135	2,715	0.0138	422	0.88
Annual Household Income	8.238 (4.126)	2,609	7.767 (3.633)	236	4.076 (502)	3,337	8.137 (3.982)	502	0.00
Annual Family Income	7.770 (4.151)	2,607	7.377 (3.808)	237	4.119 (504)	3,339	7.762 (4.002)	504	0.00
Panel 2: Insurance Coverage									
Have Health Insurance	0.601	2,817	0.638	247	0.610	3,540	0.689	525	0.26
Medicaid	0.163	1,577	0.245	129	0.146	1,947	0.255	268	0.29
Private Insurance	0.532	2,300	0.570	210	0.562	3,027	0.627	404	0.71

[7] Standard deviation is listed in parenthesis for non-dummy variables.

Panel 3: Objective Health Outcomes									
Total Cholesterol (mm/dL)	195.6 (41.11)	2,549	188.6 (40.98)	251	195.6 (40.29)	3,266	184.7 (38.43)	483	0.03
Systolic Blood Pressure (mmHg)	118.7 (15.56)	2,575	116.5 (14.54)	253	120.7 (15.66)	3,305	121.2 (15.34)	484	0.00
Hemoglobin A1c (%)	5.573 (0.915)	2,570	5.621 (1.061)	254	5.620 (0.943)	3,291	5.531 (1.005)	494	0.97
Panel 4: Self-reported Clinical Health Indicators									
Diagnosis of Hypercholesterolemia ever	0.306	1903	0.234	248	0.314	2347	0.214	524	0.019
Told to take medicine for Hypercholesterolemia	0.162	1,902	0.107	248	0.185	2,348	0.0976	525	0.33
Taking Prescribed Medicine for Hypercholesterolemia	0.139	1,624	0.0571	218	0.155	2,066	0.0751	472	0.79
Diagnosis of Hypertension ever	0.207	2,813	0.225	248	0.233	3,537	0.233	526	0.00
Told to Take Medicine for Hypertension	0.158	2,813	0.137	248	0.184	3,537	0.171	526	0.00
Taking Prescribed Medicine for Hypertension	0.132	2,671	0.0958	232	0.153	3,369	0.147	497	0.00
Diagnosis of Diabetes ever	1.960	2,814	1.959	248	1.956	3,543	1.973	526	0.95
Told to Take Medicine for Diabetes	0.0120	2,817	0.0326	248	0.0156	3,545	0.0120	526	0.56
Taking Prescribed Medicine for Diabetes	0.0381	2,813	0.0383	248	0.0469	3,543	0.0241	526	0.85

Two salient facts emerge from Table 2. First, there are substantial 2014 differences between the treatment and control states. This is not surprising as the decision to expand Medicaid was not random and rather was the result of a partisan political process. These differences necessitate the individual demographic controls that are included in the regressions below. That said, there is no reason to assume that the treatment and control states changed in systematically different ways in 2014, which would confound our results, especially given that our control states include not only non-expansion states but also expansion states that fully implemented the expansion earlier.

Secondly, as mentioned above, the total number of observations with nonblank values for each variable varies enormously, with some like age being populated for the full and sample and others like Medicaid status being populated for a fraction of the sample. The Medicaid variable's high missing value rate is particularly unfortunate, as it makes it impossible to either have Medicaid as an outcome variable or do a two-stage analysis. The regression below are therefore reduced form "intent to treat" estimates.

Tables 3 to 5 show the main results of this paper, one for each medical condition of high cholesterol, high blood pressure, and diabetes. Each contains the results of eight separate regressions: four outcomes on each of two different subsamples. The outcomes are NHANES variables for whether an individual has been diagnosed with a condition by a health professional (e.g., a physician), whether an individual was told to take medication for that condition, whether the individual is now taking prescribed medication for that condition, and then the actual exam variable for that condition. The two subsamples are the primary sample of those with a high school diploma or less in educational attainment and a placebo comparison sample of those who at least college graduates. Those with some college education are excluded in a "donut" approach to better differentiate the groups (Barreca et al. 2011.)

Additionally, as mentioned above, different variables have missing values for different individuals. To maximize our statistical power of our analysis, we have included every observation for each variable that has a non-missing value. While this results in a somewhat non comparable sample, any resulting measurement error should be classical as the missing values are not unlikely to be correlated with Medicaid expansion status.

Table 3: Difference-in-Differences Estimates of Effect of ACA Medicaid Expansion on Cholesterol, 2007-2014

	Diagnosis of High Cholesterol	Told to Take Medicine for High Cholesterol	Now Taking Medicine for High Cholesterol	Total Cholesterol
HS				
Expansion*Implemented	0.033	0.067***	0.073*	-8.465**
	(0.067)	(0.024)	(0.038)	(3.442)
Observations	3,321	3,323	2,915	4,517
R-squared	0.160	0.160	0.165	0.117
COL				
Expansion*Implemented	-0.005	-0.054	0.029	-5.901
	(0.060)	(0.042)	(0.034)	(4.443)
Observations	2,639	2,643	2,224	2,720
R-squared	0.183	0.214	0.238	0.083
Year FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
Demographic controls	YES	YES	YES	YES

Notes: HS = High school diploma or less. COL = College Graduate. Robust standard errors clustered at the state level are in parentheses. Regressions are weighted using the restricted annual weights for either the interview or exam sample. Individual level demographic controls include age, gender, race, family income poverty ratio, marital status, family size, household size, citizenship status, and pregnancy status. Year, month, and state fixed effects are included, as is the seasonally unadjusted monthly county unemployment rate. *** p<0.01, ** p<0.05, * p<0.1

Table 3 has the results for cholesterol. The four coefficients take a consistent, if statistically noisy story. Potentially more individuals are formally diagnosed with high cholesterol. 6.7 percentage points more people are told to take cholesterol medicine, 7.3 are now taking it, and total cholesterol levels are 8.465 mg/dL lower, which is a 4.3% decrease on a pre-2014 treatment state mean of 195.6 mg/dL. The college graduate subsample, on the other hand, show statistically significant or intuitively consistent results, and in general point estimates of smaller magnitude.

Table 4 show analogous results for blood pressure.

Table 4: Difference-in-Differences Estimates of Effect of ACA Medicaid Expansion on Blood Pressure, 2007-2014

		Diagnosis of Hypertension	Told to Take Medicine for Hypertension	Now Taking Medicine for Hypertension	Systolic Blood Pressure
HS					
	Expansion*Implemented	-0.019	-0.018	-0.019	-5.569***
		(0.038)	(0.030)	(0.025)	(1.419)
	Observations	4,879	4,879	4,632	4,557
	R-squared	0.140	0.167	0.169	0.220
COL					
	Expansion*Implemented	-0.077	0.019	0.042	-2.167
		(0.101)	(0.074)	(0.086)	(2.123)
	Observations	2,939	2,939	2,808	2,735
	R-squared	0.143	0.161	0.166	0.231
	Year FE	YES	YES	YES	YES
	State FE	YES	YES	YES	YES
	Demographic controls	YES	YES	YES	YES

Notes: HS = High school diploma or less. COL = College Graduate. Robust standard errors clustered at the state level are in parentheses. Regressions are weighted using the restricted annual weights for either the interview or exam sample. Individual level demographic controls include age, gender, race, family income poverty ratio, marital status, family size, household size, citizenship status, and pregnancy status. Year, month, and state fixed effects are included, as is the seasonally unadjusted monthly county unemployment rate. *** p<0.01, ** p<0.05, * p<0.1

While the first three columns of the high school sample and all of the columns of the college sample show statistically insignificant results, the treated individuals in the high school sample have systolic blood pressure that is 5.569 mmHg lower, which on a pre-2014 treatment state mean of 118.7 mmHg is decrease of 4.7%.

Finally, Table 5 shows the results for diabetes.

Table 5: Difference-in-Differences Estimates of Effect of ACA Medicaid Expansion on Diabetes, 2007-2014

	VARIABLES	Diagnosis of Diabetes	Told to Take Medicine for Diabetes	Now Taking Medicine for Diabetes	Hemoglobin A1c
HS					
	Expansion*Implemented	0.049*	-0.012	0.029	-0.010
		0.026	0.010	0.018	0.074
	Observations	4885	4888	4885	4,549
	R-squared	0.040	0.027	0.062	0.132
COL					
	Expansion*Implemented	-0.005	-0.054	0.029	-5.901
		(0.060)	(0.042)	(0.034)	(4.443)
	Observations	2,639	2,643	2,224	2,720
	R-squared	0.183	0.214	0.238	0.083
	Year FE	YES	YES	YES	YES
	State FE	YES	YES	YES	YES
	Demographic controls	YES	YES	YES	YES

Notes: HS = High school diploma or less. COL = College Graduate. Robust standard errors clustered at the state level are in parentheses. Regressions are weighted using the restricted annual weights for either the interview or exam sample. Individual level demographic controls include age, gender, race, family income poverty ratio, marital status, family size, household size, citizenship status, and pregnancy status. Year, month, and state fixed effects are included, as is the seasonally unadjusted monthly county unemployment rate. *** p<0.01, ** p<0.05, * p<0.1

Here, none of the results are more than marginally statistically significant, nor is there even any kind of consistent story one can tell about the point estimates.

V. Robustness Checks

We run two robustness checks for our main DID regressions with the lower educational attainment subsample. First, we look at a subset of the subsample that has non-missing values for our four key NHANES outcome variables: told to take medication for cholesterol and blood pressure, and total cholesterol and systolic blood pressure. We limit our non-missing restriction to these variables to maintain as much statistical power as possible. Appendix Table 1 shows the results of these four regressions, which are reassuringly largely consistent with the main results from above: more cholesterol medication and lower cholesterol and systolic blood pressure.

Additionally, Appendix Tables 2-4 contain the results of back-in-time placebo regressions, per Slusky (2015). Here we use the same classification of treated and control states as above but we shift the analysis window back in time, with a different pre-2014 year serving as the "treated" year and the previous 7 years as the "control" years. We can do this back to 1999 as that is as far back as there is consistent NHANES data. We use the demographic controls and outcomes for the actual individual observations from those time years and also use the unemployment rates that correspond to those years.

In these tables, we see 1) statistically insignificant placebo coefficients where our main coefficient is statistically significant, 2) statistically significant placebo coefficients where our main coefficient is statistically insignificant, or 3) statistically significant placebo coefficients where our main coefficient is also statistically significant but of the opposite sign. None of these is a major concern for the robustness of our results: the first is obvious, the second is where we are already not rejecting the null hypothesis, and the third would suggest confounding results that are biasing ours toward zero, not away from it.

VI. Discussion

The results from the tables above are that the Medicaid expansion increased individual's propensity to be cholesterol lowering perscriptions, which had the dual effect of lowering total cholesterol and also lowering blood pressure. There was no statistically significant increase in the share of individuals diagnosed with high blood pressure or diabetes nor any changes in medication for those conditions.

At first glance, though, the cholesterol results are somewhat puzzling given a strong increase in the share of individuals taking medicine but a statistically insignificant increase in the share of individuals diagnosed with high cholesterol. However, there is medical literature suggesting that individuals are often prescribed cholesterol lowering medication despite having only borderline high cholesterol or having other general symptom of metabolic disease (Grundy 2014).

Additionally, the blood pressure results appear puzzling as there is a drop in blood pressure despite no change in medication. One potential explanation is that a common side effect of cholesterol lowering medication is lowered blood pressure (Golomb et al. 2008). So it is plausible that the substantial increase in cholesterol lower prescriptions is also lowering blood pressure.

While our results are the first to use direct examination data as opposed to interview data, the interview results themselves are statistically weaker than those of Wherry and Miller (2016) who find using NHIS data that the Medicaid expansion did increase the diagnosis of diabetes. However, the NHIS data is a substantially larger sample size, and so would have far more statistical power than the few hundred observations that we have in the treated states in 2014.

VII. Conclusion

In this paper, we examine whether the ACA Medicaid expansion in 2014 improve health using NHANES data for objectively collected and self-reported health measures, 2007-2014. We limit the sample to be non-disabled adults age 19 to 64 with high school education or less. With the concern endogeneity of income to Medicaid, we use education to stratify the sample. Estimates of Medicaid expansion on health outcomes shows that the ACA Medicaid expansion is associated with a 7 percentage point increase in cholesterol lowering medication usage, a decrease of 8.465 mm/dL in total cholesterol, and a decrease of 5.569 mmHg of systolic blood pressure, likely a side effect of the cholesterol lowering medication.

Overall, this suggests that the Medicaid expansion did result in improved health measures for the affected individuals. Future expansions could therefore be effected to improve the health of the eligible populations of those states.

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Appendix

Appendix Table 1: Difference-in-Differences Estimates of Effect of ACA Medicaid Expansion Consistent Sample, 2007-2014

	Told to Take Medicine for High Cholesterol	Total Cholesterol	Told to Take Medicine for Hypertension	Systolic Blood Pressure
HS				
Expansion*Implemented	0.072**	-7.022*	-0.008	-4.798***
	(0.028)	(4.017)	(0.032)	(1.681)
Observations	2,892	2,892	2,892	2,892
R-squared	0.160	0.127	0.179	0.227

Notes: HS = High school diploma or less. Robust standard errors clustered at the state level are in parentheses. Regressions are weighted using the restricted annual weights for either the interview or exam sample. Individual level demographic controls include age, gender, race, family income poverty ratio, marital status, family size, household size, citizenship status, and pregnancy status. Year, month, and state fixed effects are included, as is the seasonally unadjusted monthly county unemployment rate. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 2: Placebo Analysis Back in Time for Cholesterol Measures, 1999-2014[8]

Treated Year	2014	2013	2012	2011	2010	2009	2008	2007	2006
Control Years	2007-2013	2006-2012	2005-2011	2004-2010	2003-2009	2002-2008	2001-2007	2000-2006	1999-2005
Variable									
Diagnosis of Hypercholesterolemia	0.031 (0.066)	-0.018 (0.050)	0.026 (0.057)	-0.011 (0.040)	-0.122 (0.104)	-0.178** (0.067)	0.038 (0.058)	-0.041 (0.070)	-0.040 (0.071)
N	3,321	3,112	2,861	2,675	2,507	2,468	2,507	2,591	2,501
Told to Take Medicine for High Cholesterol	0.067*** (0.024)	-0.010 (0.037)	0.017 (0.047)	0.013 (0.027)	-0.130*** (0.046)	-0.129* (0.064)	-0.105* (0.056)	-0.065 (0.065)	0.023 (0.062)
N	3,323	3,113	2,860	2,674	2,506	2,467	2,506	2,589	2,500
Now Taking Medicine for High Cholesterol	0.071* (0.038)	0.009 (0.040)	0.078 (0.051)	0.003 (0.033)	-0.151*** (0.050)	-0.074 (0.067)	-0.072 (0.052)	-0.079 (0.065)	0.021 (0.045)
N	2,915	2,708	2,465	2,270	2,081	2,038	2,041	2,089	2,006
Total Cholesterol (mm/dL)	-8.561** (3.550)	-1.650 (3.376)	-4.984 (3.273)	7.107** (2.620)	1.032 (4.584)	-6.382 (4.795)	9.801*** (2.467)	0.140 (4.023)	3.468 (4.463)
N	4,517	4,682	4,886	5,095	5,283	5,390	5,515	5,739	5,566
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Demographic controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors clustered at the state level are in parentheses. Regressions are weighted using the restricted annual weights for either the interview or exam sample. Individual level demographic controls include age, gender, race, family income poverty ratio, marital status, family size, household size, citizenship status, and pregnancy status. Year, month, and state fixed effects are included, as is the seasonally unadjusted monthly county unemployment rate. *** p<0.01, ** p<0.05, * p<0.1

[8] This table also includes restricted cholesterol data from the second examination in 2000.

Appendix Table 3: Placebo Analysis Back in Time for Blood Pressure Measures, 1999-2014

Treated Year	2014	2013	2012	2011	2010	2009	2008	2007	2006
Control Years	2007-2013	2006-2012	2005-2011	2004-2010	2003-2009	2002-2008	2001-2007	2000-2006	1999-2005
Variables									
Diagnosis of Hypertension	-0.020 (0.038)	-0.010 (0.062)	0.067* (0.034)	0.035 (0.029)	-0.043 (0.028)	0.105* (0.057)	-0.044 (0.035)	-0.027 (0.041)	0.024 (0.039)
N	4879	5111	5339	5565	5787	5870	6013	6269	6134
Told to Take Medicine for Hypertension	-0.020 (0.030)	-0.005 (0.048)	0.064** (0.029)	0.027 (0.022)	-0.051** (0.024)	0.085* (0.049)	-0.048 (0.032)	0.011 (0.040)	0.042 (0.037)
N	4879	5111	5565	5339	5787	5870	6013	6269	6134
Now Taking Medicine for Hypertension	-0.019 (0.025)	-0.014 (0.048)	0.012 (0.026)	0.002 (0.025)	-0.000 (0.029)	0.078* (0.045)	-0.046 (0.034)	-0.013 (0.029)	0.016 (0.025)
N	4,632	4,852	5,061	5,271	5,473	5,548	5,663	5,888	5,747
Systolic Blood Pressure	-5.672*** (1.401)	0.512 (3.188)	1.118 (0.949)	2.846 (1.804)	0.542 (1.898)	1.169 (1.647)	-1.495 (0.972)	-1.933 (1.470)	2.152 (2.431)
N	4,557	4,717	4,932	5,140	5,315	5,410	5,544	5,777	5,618
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Demographic controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors clustered at the state level are in parentheses. Regressions are weighted using the restricted annual weights for either the interview or exam sample. Individual level demographic controls include age, gender, race, family income poverty ratio, marital status, family size, household size, citizenship status, and pregnancy status. Year, month, and state fixed effects are included, as is the seasonally unadjusted monthly county unemployment rate. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 4: Placebo Analysis Back in Time for Diabetes Measures, 1999-2014

Treated Year	2014	2013	2012	2011	2010	2009	2008	2007	2006
Control Years	2013-2007	2012-2006	2011-2005	2010-2004	2009-2003	2008-2002	2007-2001	2006-2000	2005-1999
Variables									
	0.049*	-0.049	0.048***	0.018	-0.039*	0.018	0.025	0.045*	-0.013
Diagnosis of Diabetes	(0.026)	(0.042)	(0.017)	(0.028)	(0.021)	(0.025)	(0.019)	(0.024)	(0.014)
N	4,885	5,118	5,349	5,591	5,828	5,946	6,099	6,380	6,266
Told to Take Medicine	-0.011	0.032***	-0.011	-0.016**	-0.005	-0.002	-0.016*	0.005	-0.009
for Diabetes	(0.010)	(0.011)	(0.019)	(0.008)	(0.004)	(0.015)	(0.009)	(0.004)	(0.012)
N	4,888	5,123	5,354	5,597	5,835	5,952	6,106	6,387	5,875
Now Taking Medicine	0.030	-0.006	-0.017*	-0.009	-0.002	-0.031**	-0.013	-0.020	0.037***
for Diabetes	(0.018)	(0.024)	(0.010)	(0.014)	(0.019)	(0.013)	(0.013)	(0.018)	(0.010)
N	4,885	5,118	5,349	5,584	5,816	5,927	6,072	6,342	6,226
Hemoglobin A1c	-0.016	0.064	-0.115	0.103	-0.031	-0.000	-0.053	0.026	0.101
(%)	(0.074)	(0.073)	(0.087)	(0.149)	(0.053)	(0.054)	(0.054)	(0.127)	(0.116)
N	4,549	4,711	4,909	5,115	5,306	5,422	5,557	5,786	5,624
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Demographic controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors clustered at the state level are in parentheses. Regressions are weighted using the restricted annual weights for either the interview or exam sample. Individual level demographic controls include age, gender, race, family income poverty ratio, marital status, family size, household size, citizenship status, and pregnancy status. Year, month, and state fixed effects are included, as is the seasonally unadjusted monthly county unemployment rate. *** p<0.01, ** p<0.05, * p<0.1

Data Appendix

The data used in this paper comes from three sources:

1. Kaestner et al. (2015)'s classification strategy of states into Medicaid Expansion treatment and control groups. Available at http://www.nber.org/papers/w21836

2. Restricted geocoded NHANES data, accessed at a Census Research Data Center (RDC). Proposal information for accessing restricted data is available at http://www.cdc.gov/rdc/b3prosal/pp300.htm. The public data subset is available at http://wwwn.cdc.gov/nchs/nhanes/search/nhanes_continuous.aspx

3. Local unemployment rates from the BLS, available publicly at http://www.bls.gov/lau/