The Effect of Medicaid Expansion on Substance Use Disorder Treatment Utilization: Evidence from the Affordable Care Act

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Abstract

In this paper, I investigate the effect of expansion of Medicaid under the Affordable Care Act (ACA) on substance use disorder (SUD) treatment utilization using pooled-panel data on SUD treatment rates from 2008 to 2017. Using a difference-in-differences regression model, I find that states that expanded under the ACA experienced a small yet statistically insignificant increase in SUD treatment rates. Moreover, in the event-study analysis, I observe that the increase in SUD treatment rates increased over the post-expansion period, becoming statistically significant 3 years after the expansion. I also find that expansion states with a more severe SUD problem prior to the expansions experience a larger increase after the implementation of Medicaid expansion relative to expansion states with a less severe SUD problem.

Keywords

Medicaid, SUD Treatment, Affordable Care Act, Difference-in-Differences, Event-study

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1 Introduction

Substance use disorder (SUD) is an illness that affects millions of Americans irrespective of age, race and social standing. It is common, with about 10 percent of Americans having had a SUD at some time in their lives (National Institutes of Health (NIH) 2015), and often co-occurs with a range of mental health disorders (SAMHSA). According to the 2018 National Survey on Drug Use and Health (NSDUH) by the Substance Abuse and Mental Health Services Administration (SAMHSA 2018), approximately 20.3 million people aged 12 or older had a SUD related to their use of alcohol or illicit drugs in 2017, with 14.8 million people with an alcohol use disorder and 8.1 million people with an illicit drug use disorder. The 2014 NSDUH reports that approximately 5 million uninsured individuals have a SUD, 8 million have a mental health disorder, and around 2 million have both substance use and mental health disorder (SAMHSA 2014).

Despite the development of effective treatments for SUD (Connery 2015; Connor et al.2016), only a very small fraction of the patients receive treatments—with only around 25 percent of the needed population receiving any form of treatment (NIH 2015). Commonly cited reasons among the insured population for not receiving SUD treatments are stigma, lack of readiness to stop using substances, not perceiving a need for treatment, and doubt about treatment effectiveness (Ali et al. 2016; Olfson et al. 2018). For the uninsured population, financial barriers, such as lack of health insurance or not being able to afford the cost of treatment, was the most prominent reason for not receiving SUD treatments (Ali et al. 2016).

Signed into law under President Obama's administration in 2010 and fully implemented in 2014, the Affordable Care Act (ACA) expanded Medicaid eligibility to provide coverage for all US citizens and legal residents whose income does not exceed 138% of the federal poverty line (FPL). Moreover, under the Act, Essential Health Benefits (EHBs) was created as a part of Medicaid to provide insurees with access to full coverage of SUD screening and treatment services. By the end of 2014, 26 states and the District of Columbia implemented the Medicaid expansion. Before the passage of the ACA, most uninsured people were low-income families, and adults were more likely to be uninsured than children (KFF 2019). Therefore, with the new requirements and changes, the ACA allowed SUD patients, who are historically from low-income backgrounds, with greater access to health care and SUD treatment.

In this paper, I study the effects of the Medicaid expansion under the ACA on SUD treatment utilization. Given that the states adopted Medicaid expansion at different times with some states not having adopted at all, I exploit this state-level variation to establish a causal relationship between the Medicaid expansion and SUD treatment utilization rate.

I use the National Survey of Substance Abuse Treatment Services (N-SSATS) from SAMHSA, which provided annual state data on SUD treatment counts from 2008 to 2017 with 2014 and 2016 missing. I

couple this administrative data set with difference-in-differences regression and event-study models.

My findings suggest that states that expanded Medicaid under the ACA did not experience an increase in SUD treatment rates compared to non-expanding states. Expansion states experienced a 0.6 percent increase in the total SUD treatment rate, a 0.6 percent decrease in both (drug and alcohol) treatment rate, a 2.4 percent increase in drug-only treatment rate, and a 1 percent increase in alcohol-only treatment rate. But none of these are statistically significant. However, results from the event-study models suggest that the small increase in SUD treatment rates in the expansion states is due to a lag in Medicaid expansion taking effect: the increase in the total SUD treatment rate was a statistically significant 7 percent for the binned second and third post-expansion years compared to the insignificant 1.5 percent increase in the binned zero and first post-expansion years. Similarly, for the drug-only SUD treatment rate, expansion states saw a statistically significant 18.9 percent increase in the drug-only treatment rate for the binned second and third post-expansion years, and a statistically significant 9.8 percent increase in the binned zero and first post-expansion years.

In addition to the main analysis, I classify states with higher than the median drug-overdose related deaths as "problem" states and estimate models allowing for different effects in problem versus non-problem states in the period before the Medicaid Expansion. I find that states with larger substance use related issues prior to the Medicaid expansion experienced a larger increase in all four types of SUD treatment rates. Additionally, in order to capture the full extent of the effect of the Medicaid expansion on the SUD treatment rate, I redefine states' Medicaid expansion year according to whether a state had a prior Medicaid expansion before the passage of ACA. I apply the same difference-in-difference model and find the magnitude of the increase is larger in this specification than the main one. Moreover, I also limit the focus to states that expanded in 2014, excluding states that expanded in 2015 and 2016, for the event-study model and find a very similar result.

There is a growing literature examining the effects of the Medicaid expansion under the ACA on insurance coverage, general health outcomes, and healthcare use (Kaestner et al. 2017; Simon et al.2017; Miller and Wherry 2017). For example, Kaestner et al. (2017) find the Medicaid expansions are associated with large increases in Medicaid coverage, with a 50 percent increase for childless adults, and corresponding decreases in the proportion uninsured. Miller and Wherry (2017), using difference-in-difference models, also find that uninsurance rates were reduced in expansion states relative to non-expansion states.

Studies document varying findings regarding the effect of the Medicaid expansion on general healthcare use. Kirby and Vistnes (2016) find that compared to people who remained uninsured in 2014, people who gained Medicaid coverage saw an increased receipt of annual checkups, blood pressure screening, and flu shots. Pines et al. (2014) document a 27 percent increase in Medicaid paid visits in Emergency departments

in expansion states compared to those in non-expansion states during the first year of expansion.

My paper aims to contribute to filling the gap in the literature by examining the causal relationship between Medicaid expansion and crime rates using the ACA as my instrumental variable. Several published papers estimate the effects of health insurance on criminal behaviors, but there are only a few studies that examine the direct impact of public health insurance policy on crime reduction.

The literature on the Medicaid expansions under the ACA and receipt of SUD treatment is small. There are studies documenting an increase in Medicaid paid prescription drug utilization (Mulcahy et al. 2016; Ghosh et al. 2017), but relatively few studies examine the utilization of SUD treatment. Wen et al. (2017) employ the Medicaid State Drug Utilization Data to examine the changes in use of buprenorphine between expansion and non-expansion states through 2014, and find a 70% increase in use of buprenorphine in expansion states relative to their counterparts. Although Wen et al. study is important, it only looks at a single treatment method (buprenorphine) for a single substance abuse (opioids). However, in my study, I look at four different SUD treatment categories, providing a broader perspective to the effect of the Medicaid expansion on SUD treatment utilization.

Maclean and Saloner examine Medicaid expansion on specialty SUD treatment utilization and financing using the Treatment Episode Data Set (TEDS) from 2010 to 2015. Using a difference-in-differences design, they find that admissions did not significantly change in expansion states relative to non-expansion states, and observe increases in Medicaid payment for SUD treatments and Medicaid-reimbursed prescriptions for medications to treat SUD outpatients in the expansion states. While this paper does demonstrate the effect of Medicaid expansion on SUD treatments, in my paper, I use more recent data which includes 2017 and have more pre-treatment periods. This is relevant as the ACA is a recent policy change, and thus having more post-treatment data provides a more comprehensive narrative of the effect of the Medicaid expansion. Moreover, by looking at four different categories of SUD treatment (total, both drug and alcohol, drug only, and alcohol only), I contribute to the literature on the Medicaid expansion and SUD utilization by showing the varying effects Medicaid expansion has on different SUD treatments.

This paper contributes to the literature on public health insurance and substance abuse disorder treatment. It reveals the potential for public health programs as an effective tool to tackle the nation's widespread substance abuse disorder. Since the lower-income population is especially vulnerable to SUD and traditionally have limited access to health insurance, providing SUD treatment as part of health insurance can be particularly beneficial. This is especially relevant as "Medicare-for-all" is one of the most debated topics in the upcoming 2020 presidential election. The effect of the public health insurance expansion on SUD utilization rate should be of interest not only for researchers but also for policy-makers.

The remainder of the paper is structured as follows. Section 2 provides background information on

Medicaid and the Affordable Care Act, and the conceptual framework, and prior research. Section 3 provides a description of data and variables, and Section 4 details the empirical strategy and models. Section 5 describes the results of the main analysis. Lastly, Section 6 concludes by summarizing the findings, and discusses the policy implications.

2 Background and Conceptual Framework

2.1 Medicaid and the Affordable Care Act

Created under the Social Security Amendment of 1965, Medicaid is a federal and state health insurance program that is designed to help people with limited resources and income to afford health care. It is the largest and most used source of health insurance program for populations with low income in the United States, providing free or low-cost medical and health-related services to 74 million eligible United States residents or citizens as of 2017 (Gottlieb 2017). Medicaid is jointly funded by the state and federal governments, and the amount of funds allocated for Medicaid expenses is decided by individual states. Moreover, before the passage of the ACA, each state mostly determined its own eligibility criteria for Medicaid—although all insurees have to be US citizens or qualified non-citizens, and criteria should target low-income families, pregnant women, and people with certain disabilities—and meeting federal poverty line for income alone did not make qualify an individual for Medicaid.

The Affordable Care Act, or formerly named as the Patient Protection and Affordable Care Act, significantly broadened the eligibility criteria for Medicaid and increased federal funding for the program. The legislative was signed into law in 2010 by President Obama (hence the colloquial term, Obamacare) but did not come into force until 2014. Under the Act, Medicaid eligibility expanded to provide coverage for all US citizens and legal residents whose income does not exceed 138% of the federal poverty line (FPL)[1][2]. The most important change is that, unlike before, with the passage of the ACA, adults without dependent children who meet the income level criteria received Medicaid coverage. Another major change under the ACA is the creation of Essential Health Benefits (EHBs), which is a set of benefits spanning ten different categories that must be provided for insurees. EHBs include "ambulatory patient services; emergency services; hospitalization; maternity and newborn care; mental health and substance use disorder services, including behavioral health treatment; prescription drugs; rehabilitative and habilitative services and devices; laboratory services; preventive and wellness services and chronic disease management; and pediatric services, including oral and vision care" (HealthCare 2019). Therefore, with the new requirements and changes, the ACA allowed SUD

1. Which is equivalent to $16,612 for family size of two in 2019 FPL guidelines (Federal Poverty Level amounts are higher in Alaska and Hawaii.)
2. See Table 1 for further information about the cutoff.

patients, who are traditionally from low-income background, with greater access to health care and SUD treatment [3].

The implementation of Medicaid expansion varies across states and over time as after the enactment of the legislation, twenty-eight states filed lawsuits citing that the ACA violates state sovereignty under the constitution (Dharapak, 2010). The Supreme Court of the United States ruled in National Federation of Independent Business v. Sebelius that states do not have to implement the expansion to continue receiving previously established levels of Medicaid funding. As a result, in December of 2014, only 27 states including the District of Columbia had adopted, 4 planned on adopting at a later date, and 20 states had not adopted. Over time, more states adopted the ACA, and as of 2019, 37 states (including DC) have adopted and 14 states have not (Kaiser Family Foundation 2019).

2.2 Conceptual Framework

By lowering the out-of-pocket cost for individuals, insurance is predicted to increase the demand for health-care services. Therefore, the Medicaid expansion, holding all else equal, should also increase the demand for SUD treatment. However, there are several factors pertaining to the patients seeking SUD treatment and the facilities providing such services that may potentially offset the predicted increase in demand.

On the demand side, individuals may not seek SUD treatment, or choose not to receive SUD treatment, due to reasons other than not having insurance or financial barriers. Individuals may be reluctant to seek SUD treatment due to associated stigma, or concerns about adverse impact on employment prospects (Ali et al. 2017). The literature indicates that approximately 97% of adults with a SUD do not perceive a need for SUD treatment (Ali et al. 2017). Moreover, even prior to the Medicaid expansion in 2014, some states provided discounted or even free SUD treatments for patients with limited financial resources. In 2009 (pre-ACA period), approximately half of specialty SUD treatment facilities offered free care to patients who could not afford the services, and around 60% offered sliding scale discounts (Maclean,Popovici et. al 2017). Therefore, the existence of safety net care may lead to a small estimated effect of the Medicaid expansion. On the other hand, individuals, now with the access to SUD treatment, may become more inclined to engage in substance use (moral hazard). However, Courtemanche et al. find no statistically significant changes in risky behaviors, including substance use, in the two years following the implementation of ACA (Courtemanche et al. 2018).

On the supply side, in the short term, limited funding and capacity of SUD treatment facilities may lead

3. There is a concern that the creation of EHBs affected expansion and non-expansion differently and therefore impact the anaysis in the paper. I address this concern and support the validity of using non-expansion as control group by utilizing an event-study model to test for the parallel trend in the pre-treatment period. I find no discernible differences in trends between the expansion and non-expansion states.

to an inability to respond to the growing demand. Between 2012-2013 and 2016, appointment availability for primary care physicians has increased for Medicaid patients under the ACA, but Medicaid acceptance still lags behind private coverage (Polsky et al. 2017). Patients also reported experiencing waiting times after the Medicaid expansion, suggesting challenges in access persist (Miller and Wherry 2017). Moreover, the total number of facilities that offer SUD treatment did not change as a result of the Medicaid expansion (Grooms and Ortega 2019).

Considering the aforementioned factors, I test the following hypothesis in this paper:

Following the Medicaid expansion, SUD treatment utilization rate in expansion states will be larger relative to non-expansion states.

3 Data

3.1 Description of the Data

My data is a pooled cross-sectional data of observations at the state-level recorded annually between 2008 and 2017. The main data comes from the National Survey of Substance Abuse Treatment Services (N-SSATS).

The N-SSATS is "an annual census designed to collect information from all facilities within the 50 States, the District of Columbia, and the U.S. territories, both public and private, that provide substance abuse treatment" (Substance Abuse and Mental Health Data Archive SAMHDA). SAMHDA also provides data on the number of facilities that provide SUD treatment services. It is designed to collect three types of information from facilities: i) characteristics of individual facilities, including types of treatment provided and services offered; ii) client count information, including counts of clients for each type of service provided; iii) general information, such as license and certification.

Beginning in 2014, N-SSATS began using an abbreviated questionnaire that collected facility characteristics but no client counts every even year (2014 included). Annual N-SSATS report for the previous year is released on the SAMHSA website every September the following year, and therefore no data on 2019 was available when this paper was written. Hence, only two years (2015 and 2017) were used for post-expansion data. Since there are 50 states and the District of Columbia over eight years, I have a sample size of 408.

The N-SSATS provides client counts by state or jurisdiction on SUD treatment services provided. Additional to the total client count for total SUD treatment provided, it also reports both drug and alcohol abuse treatment count, drug abuse treatment count only, and alcohol abuse treatment count only. One limitation of the client count in the N-SSATS is that it does not provide any demographic information on the clients.

I augment the main data using five different sources: the National Survey of Substance Abuse Treatment

Services (N-SSATS), Kaiser Family Foundation (KFF) , the Bureau of Labor Statistics, the Census Bureau, the University of Kentucky Center for Poverty Research (UKCPR), and Brooking and Urban Institutes' Tax Policy Center. State Medicaid expansion status and drug overdose mortality by state were obtained from the Kaiser Family Foundation website[4][5].

Seasonally adjusted annual unemployment rate from 2008 to 2017 was from the Bureau of Labor Statistics, and population by state was obtained from the Census. Other state demographics were obtained from the UKCPR. Alcohol excise tax from 2008 to 2017 was from Brooking and Urban Institutes' Tax Policy Center[6].

3.2 Outcome Variable: SUD Treatment Rate[7]

State-level SUD treatment client counts were collected annually by SAMHDA for the N-SSATS annually between 2008 to 2013, and every two years beginning in 2015, and were calculated based on the number of clients that received SUD treatment(s) within each given state s over an entire calendar year t. I denote it as $SUD_{s,t}$.

For my paper, I used log SUD treatment rate instead of pure client counts. The variable is constructed by dividing the SUD treatment client counts for a given state in a given year by the total state population for that year and taking the natural logarithm of the rate.

N-SSATS state-level data are available for four SUD treatment categories: total SUD treatment client counts (sum of both drug-and-alcohol, drug-only, and alcohol-only SUD treatments), both-drug-and-alcohol abuse treatment counts, drug abuse only treatment counts, and alcohol abuse only treatment counts.

I estimate models for each four variables.

3.3 Primary Independent Variable: Medicaid Expansion Implementation

I rely on data from both KFF and Simon et al. (2016) to construct the Medicaid expansion variable ($Medicaid_{s,t}$). Table 2 shows the classification of expansion and non-expansion states. The majority of expansion states adopted Medicaid expansion in 2014, coinciding with when the ACA came into full effect. Three states (Alaska, Indiana, and Pennsylvania) expanded in 2015, and two more states (Louisiana and

4. Medicaid expansion decisions interactive map on Kaiser Family Foundation website provides the most recent updates on the Medicaid expansion status and has a description of each state's expansion activity.

5. Drug overdose mortality by state on Kaiser Family Foundation summarizes data that comes from Centers for Disease Control and Prevention's (CDC) National Vital Statistics System. The website also provides an explanation of construction of summary data.

6. Alcohol Excise Tax Rate from Tax Policy Center provides excise tax rates on different types of alcohol from 1982 to 2020 for 50 states including DC.

7. Defining the outcome variable as a rate may be a problem if population is endogenous to Medicaid expansion. However, in my case, I can rule out a migration effect that might affect the number of Medicaid recipients in expansion states because Goodman (2017) shows that there was no statistically significant difference between migration from non-expansion states to expansion states and migration in the reverse direction.

Montana) expanded in 2016. Six states (California, Connecticut, DC,New Jersey, Minnesota, and Washington) had some Medicaid expansions prior to 2014, but I only classify four states (excluding Connecticut and New Jersey) as "early-expansion states." Connecticut's income eligibility cutoff was 56% FPL, and New Jersey's was 23% for pre-2014 expansion. All the other states had at least 133% FPL cutoff. Considering the income eligibility cutoff was 138% FPL, I consider the effect of Medicaid expansion for Connecticut and New Jersey was closer to states that did not have prior expansion than to early-expansion states [8] [9]. To implement a difference-in-differences model including early-expansion states, I create a separate variable called ($ComprehensiveMedicaid_{s,t}$) which includes classification for early-expansion states.

$Medicaid_{s,t}$ is a dummy variable equalling 1 if the state s has adopted Medicaid expansion in year t, and 0 otherwise. Similarly, $ComprehensiveMedicaid_{s,t}$ assigns 1 if the state s has adopted Medicaid expansion in year t, and 0 otherwise. For $Medicaid_{s,t}$, all states have 0 before 2014, and whereas for $ComprehensiveMedicaid_{s,t}$, the early-expansion states have 1 starting their corresponding expansion year (even before 2014).

3.4 Indicator for states with a more severe SUD problem: $I(severe)$

To study whether Medicaid expansion had a different effect on expansion states with a more severe SUD issue than expansion states with lesser SUD issue prior to expansion, I created an indicator called $I(severe)$ to capture the differing SUD problem across states.

I use the drug-overdose mortality rate as a proxy for state's SUD severity. Using the median of 2007 drug-overdose mortality rate as the reference, $I(severe)$ assigns 1 to states with higher-than-median drug overdose mortality rate across states and 0 otherwise for all years.

I used the un-weighted median because I am more interested in seeing state-level SUD severity, rather than individual-level SUD severity.

3.5 Controls

As my controls, I have included state-year covariates $X_{s,t}$ including unemployment rate, poverty rate, and average race and ethnicity. I also include an indicator for whether the Governor is a Democrat[10] to control for state attitudes toward welfare, and beer excise tax rate to reflect state attitudes towards substance use.

8. Table 3 summarizes classification and displays states with their respective expansion years.

9. Most of the papers on Medicaid expansion consider 2014, when the ACA was fully implemented, as the first year of Medicaid expansion even if states had prior expansion (He 2018; Vogler 2018; Grooms and Ortega 2019).

10. I use the mayor of DC as the *de facto* Governor following Maclean and Saloner (2017).

3.6 Summary Statistics

Table 3 presents the summary statistics of for expansion and non-expansion states. The means are weighted by population. The weighted means of all SUD treatment rates are larger for expansion states than those of non-expansion states. For total and alcohol-only, the weighted means for expansion states are almost twice as large as the weighted means for non-expansion states. Expansion states have a lower weighted mean poverty rate than non-expansion states, and on average, expansion states are more likely to have a Democrat Governor and have a lower beer excise tax. On average, expansion-states have a similar proportion of white and Hispanic populations as non-expansion states, and have a smaller black population and a larger Asian population than non-expansion states. Expansion-states have a higher weighted unemployment rate mean than non-expansion states. There are more expansion states than non-expansion states.

4 Empirical Strategy

4.1 Difference-in-Differences

My main empirical analysis uses the state-level variation and compares the change in SUD treatment rates in expansion states to non-expansion states before and after the implementation of the Medicaid expansion. I estimate the effect using the following difference-in-differences regression model:

$$SUD_{s,t} = \beta_0 + \beta_1 Medicaid_{s,t} + \gamma X_{s,t} + \tau_t + \eta_s + e_{s,t} \tag{1}$$

$SUD_{s,t}$ is defined as the log SUD treatment rate in state s in time t. There are four types of SUD treatment rates: total, both, drug-only, and alcohol-only. The main coefficient of interest is β_1 on $Medicaid_{s,t}$ which takes the value of 1 if state s expanded Medicaid in time t and 0 otherwise. $X_{s,t}$ are vectors of state-level characteristics of unemployment rate, poverty rate, race and ethnicity, indicator for Democrat Governor, and beer excise tax rate. τ_t and η_s are controls for time and state fixed effects that allow me to capture time-invariant state-specific unobservables and national trends over time. $e_{s,t}$ represents the error term.

The regression is weighted using population as the weight as I am interested in looking at the effect of Medicaid expansion on SUD treatment rate on the population level rather than state level. Therefore, it would not make sense to weigh a small state, such as Rhode Island, the same as a large state, such as California. I also cluster standard errors at the state level, assuming error independence across states.

4.1.1 Event-study Design

The difference-in-differences framework I present in Equation 1 relies on the necessary assumption that in the absence of treatment (i.e., Medicaid expansion under the ACA), the treatment (i.e., expansion states) and the comparison (i.e., non-expansion states) are following the same trends. In other words, the decision to expand Medicaid should be independent of trends in SUD treatment. Many other papers (Barrilleaux and Rainey 2014; Lanford and Quadagno 2016) show that the ACA Medicaid expansion decision was highly correlated with the partisanship of state governors and the generosity of the Medicaid program in a given state before 2010. In this paper, I utilize an event-study model and look at the parallel trends in the pre-treatment period to check for such exogenous shock.

I define an event-study model as following:

$$SUD_{s,t} = \sum_{t=-5, t\neq[-1,-2]}^{[2,3]} \lambda_t Treatment_{s,t} + X_{s,t}\gamma_1 + \tau_t + \eta_s + e_{s,t} \tag{2}$$

$Treatment_{s,t}$ is a dummy variable that takes on a value of 1 if state s is an expansion state and 0 otherwise. λ's are the coefficient of interest.

Because of the change in N-SSATS data collection form, I do not have data for 2014 and 2016. Therefore, using eventtime structure, for states that expanded in 2014, I have missing values for $t = 0$ and $t = 2$, and for states that expanded in 2015, I have missing values for $t = -1$ and $t = 1$. Moreover, I dropped states that expanded in 2016 for a balanced panel (they did not have $t = 3$). To maximize the use of available data, I bin event times as [-1,-2], [0,1], and [2,3], and omitted [-1,-2], "one year" before treatment, in the analysis. I have included Table 4 for further clarification.

Additionally, I have also applied the same event-study model focusing only on states that expanded in 2014. For this approach, I will omit $t = -1$ (year 2013), and have $t = 2$ (year 2016) missing.

This specification allows me to check for presence of confounding pre-trends. Quantitatively, if I cannot reject the null hypothesis that λ_t's for the pre-treatment period are zero, then this finding provides support that my data satisfies the parallel trends assumption. Graphically, if the pre-treatment coefficients form a relatively flat line without any visible trend, then I can assume I have the necessary parallel trend.

4.2 I(severe)

Taking the same structure and assumption from the difference-in-difference model in Equation 1, I now add an interaction term $I(severe) * Medicaid_{s,t}$:

$$SUD_{s,t} = \alpha_0 + \alpha_1 Medicaid_{s,t} + \alpha_2 Medicaid_{s,t} * I(severe_s) + \gamma X_{s,t} + \tau_t + \eta_s + e_{s,t} \quad (3)$$

α_1 captures the effect of the Medicaid expansion for expansion states with below-the-median SUD problem, and $\alpha_1 + \alpha_2$ shows the effect of the Medicaid expansion for expansion states with above-the-median SUD problem. The coefficient on the interaction term, α_2, shows the difference between the effect of the Medicaid expansion for expansion states with above-the-median relative to those with below-the-median SUD problem. I include the same set of state-level characteristics as I did for the difference-in-differences model.

5 Results

5.1 Main Findings

In this section, I discuss results based on the empirical strategy presented in the previous section. I first begin by looking at the difference-in-differences results in Table 5. There are four types of outcome variables: total, drug and alcohol, drug only, and alcohol only treatment rates. All the outcome variables are in natural logs of the rates, and the presented standard errors in parentheses are clustered at state level. This, and all subsequent specifications, includes state-level controls and fixed effects for year and state, and are weighted by population. Column (1) shows a statistically insignificant increase of 0.6 percent in total SUD treatment rate. Similarly, drug-only and alcohol-only SUD treatment rates also experienced statistically insignificant increases of 2.5 percent and 1.0 percent respectively. Interestingly, SUD treatment rate for drug and alcohol saw a small statistically insignificant decrease of 0.06 percent, explaining the relatively small increase in total SUD treatment rate compared to drug only and alcohol only SUD treatment rates. The small magnitude in the difference-in-differences coefficient is due to the lag in the effect of Medicaid expansion, and I will be exploring this further in the section below. Taken together, the sign of the coefficient aligns with my hypothesis: the Medicaid expansion leads to an increase in SUD treatment rate.

Table 6 presents the findings from the same difference-in-differences model but using $Medicaid_comprehensive_{s,t}$, which includes early-expansion states, as its primary independent variable. The first notable difference is that all the coefficients now have a positive sign, further supporting my hypothesis that the Medicaid expansion led to an increase in SUD treatment utilization. Moreover, total SUD treatment rate experienced a statistically insignificant increase of 1.2 percent. Drug and alcohol treatment rate also saw a statistically insignificant increase of 1.8 percent, a large increase compared to the decrease in rate from the previous specification. For drug only and alcohol only treatment rates, there were 1.6 percent and 0.08 percent in-

creases respectively, but they were smaller increases compared to the results from the previous specification. Overall, the results from difference-in-differences model indicate that states that adopted the Medicaid expansion have experienced a small, but not statistically significant, increase in SUD treatment rates relative to non-expansion states in the three years after the expansion.

Figures 1a through 1d plot estimates of the event-study analysis defined by Equation 2, and Table 7 contains the corresponding event-study estimates. These figures show how the SUD treatment rates changed over time in the years before and after the implementation of the Medicaid expansion under the ACA. For all four outcome variables, the pre-treatment coefficients (i.e., λ's in Equation 2) are not statistically different from zero, providing evidence for the parallel trend assumption (Table 7).

Graphically, Figure 1a shows the parallel trend for total SUD treatment. Despite the slight dip around $t = -4$, it exhibits a relatively flat line before the expansion, and shows the expected upward slope after the expansion. Moreover, the increase in the second post-treatment period (i.e., t= [2,3]) is larger (a statistically significant increase of 7.0 percent) than in the first post-treatment period (i.e., t= [0,1]) (a statistically insignificant increase of 1.5 percent), suggesting that the increase in SUD treatment rates may take time to result. Similarly, Figure 1c shows the parallel trend for drug only treatment rate. It almost completely aligns with the dotted horizontal line, providing strong evidence for parallel trend assumption. Moreover, drug only treatment rate graph also shows a positive slope after the expansion, with a bigger increase in the second post-treatment period. The increases of 9.8 percent and 18.9 percent, respectively, in both of the post-treatment periods are statistically significant.

The coefficients on both drug and alcohol treatment rate in the post-expansion periods are very close to zero, and for alcohol only treatment rate, the post-expansion years coefficients are actually negative (but not statistically significant), contradicting my hypothesis. Graphically, drug and alcohol treatment rate has a slight dip around $t = -4$ and a flat line after the expansion, showing that there is no change in SUD utilization (Figure 1b. For alcohol only treatment rate, Figure 1d shows an upward trend in the pre-treatment periods, and a slight dip in the post-treatment periods, displaying a very different trend compared to the other three graphs. Taken together, the increase in the total SUD treatment rate seems to be driven by the increase in the drug only treatment rate.

Figures 2a through 2d and Table 8 display results for event-study analysis that focuses only on the states with 2014 expansion year. Figure 2a shows the plot of total SUD treatment rate, showing the parallel trend in the pre-treatment period and the upward trend in the post-treatment period. None of the coefficients in the pre-treatment periods are statistically significant. States that expanded in 2014 saw an increase of 1.4 percent in 2015, and an increase of 6.6 percent in 2017 (both are statistically insignificant). In the drug-only analysis, there was a statistically insignificant increase of 9.1 percent in 2015, and a statistically

significant increase of 18.3 percent in 2017, further supporting the lag in the effects of Medicaid expansion. Figure 2c shows the parallel trend for drug only treatment rate. Moreover, the flat line in the post-treatment periods in figure 2b shows that there was almost no change in drug and alcohol treatment rate, and column (2) in Table 8 shows the corresponding coefficients. Interestingly, the coefficients for alcohol only are all negative (statistically insignificant) in all years in included in the analysis, and Figure 2d demonstrates this finding. The findings are similar in when narrowing the focus to states with 2014 expansion year: I find clear increases for total and durg-only treatment rates, no change for the drug and alcohol treatment rate, and a slight decrease for the alcohol-only treatment rates in the post-treatment periods.

5.2 I(severe)

In this specification I proposed in Equation 3, I am interested in looking at whether Medicaid expansion has different effects on expansion states with varying severity of SUD issue prior to expansion. Table 9 displays the results from the analysis. The first row shows the estimated effect of the Medicaid expansion on expansion states with below-the-median SUD problem. The sum of the first and the second row is the estimated effect of the Medicaid expansion on expansion states with above-the-median SUD problem. Then, the second row, is the difference in the Medicaid expansion effects between expansion states with below-the-median SUD problem and expansion states with above-the-median SUD problem (defined as α_2 in Equation 3). For all four outcome variables, expansion states with below-the-median SUD problem experienced small yet statistically insignificant decreases in SUD treatment rates, with the biggest decrease in drug and alcohol SUD treatment rate. The differences between the states with below-the-median and above-the-median are not statistically significant except for drug only treatment rate, which has the coefficient estimate of 0.061. Taken together, states with a more severe SUD problem seem to experience a bigger increase in SUD treatment rates upon implementation of Medicaid expansion.

6 Conclusion

In this study, I investigate the effects of Medicaid expansions under the Affordable Care Act on substance use disorder (SUD) treatment utilization. After the passage of the Act in 2010, by 2014 27 states including the District of Columbia, and by 2017, which is the last year included in my analysis, 32 including DC expanded income eligibility for Medicaid up to 138% of the FPL. Moreover, the ACA created Essential Health Benefits, which provides insurees with access to full coverage of SUD screening and treatment services. These expansions granted access to general healthcare and SUD treatments for the traditionally uninsured population—childless adults from low income backgrounds. In my analysis, although I find small increases

in SUD treatment rates, the coefficients are not statistically significant. Event-study analysis shows that the total and drug-only treatment rates saw a larger increase in the second period in post-expansion relative to the first period, suggesting that the policy effect may be delayed.

There are several possible explanations for my findings. First, the capacity constraints within the SUD treatment delivery system may limit the increase in SUD treatment utilization rate. If the providers initially lack the space to allow for additional patients into treatment, then regardless of the growing demand for SUD treatment, no increase in SUD treatment rate will be observed (Saloner 2017). Considering there is a substantial increase in Medicaid as payment source in SUD treatments (Maclean and Saloner 2017), I conjecture that Medicaid expansion did lead to an increase in demand for SUD treatment, but because of the lack of available space for additional SUD treatment, I fail to observe the increase in the SUD treatment actually received (since my data is limited to the SUD treatment provided, and does not capture the unmet demand). Moreover, this explanation also explains why I observe a bigger increase in the later post-expansion periods than the earlier periods—facilities require time to expand their capacity to meet the new growing demand. The policy implication for this explanation is that states may need to look at ways to support existing facilities in expanding, and possibly granting subsidies in opening up additional new SUD treatment facilities. In the same paper by Maclean and Saloner (2017), the authors find that in the expansion states after the expansion, the number of prescriptions for SUD treatment medications approved by the Food and Drug Administration has increased by 43% in outpatient settings reimbursed by Medicaid. This finding suggests that patients may receive SUD treatment via a private physician's office rather than through treatment facility setting. Since my data does not provide information on SUD treatment provided in private physicians' offices, I am not able to capture the all dimension of the effects Medicaid expansion has on the SUD treatment rate across all settings.

My study is not without limitation. First, because of the change in N-SSATS questionnaire in 2014, no data on SUD treatment is available for even years (in my case, 2014 and 2016). Hence, I am relying on only two years of post-expansion data for all but the early expansion states. An alternative to N-SSATS is the National Survey on Drug Use and Health (NSDUH). However, due to privacy concerns, a state variable is not included in public-release datasets. Second, since state's implementation of Medicaid expansion does not occur at the beginning of the calendar year, states that expanded in the first quarter will have a longer exposure to the expansion than states that expanded in the last quarter do. Hence, rather than expansion year, one can also look at expansion quarter or even expansion month for a more precise estimation. Third, some states already had prior Medicaid expansion with varying income eligibility. Rather than using a binary indicator for Medicaid expansion as I did in my paper, one can adopt a continuous right hand side variable, and implement a simulated eligibility approach (Currie et al. 1996). Finally, this paper focuses

on the short term effect between SUD treatment utilization rate and health insurance eligibility. As more post-expansion data are becoming available, it will be worthwhile to study the medium or long term effect of Medicaid expansion on SUD treatment rate, and whether Medicaid coverage had positive impacts on health of populations receiving SUD treatment, and on their residing communities.

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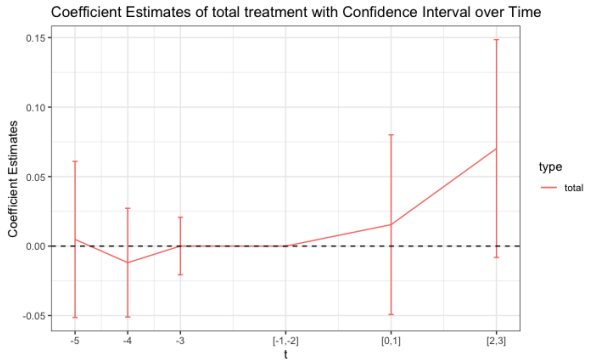
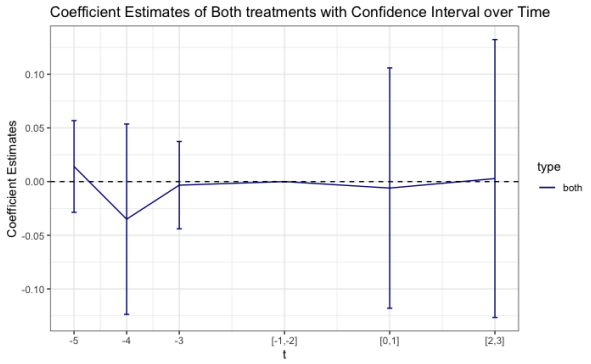
Figure 1: Event-study Plots of Medicaid Expansion on SUD Treatment Rates

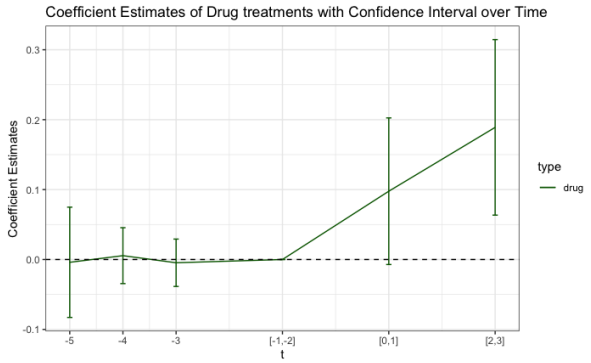
(a) Total SUD Treatment Rate



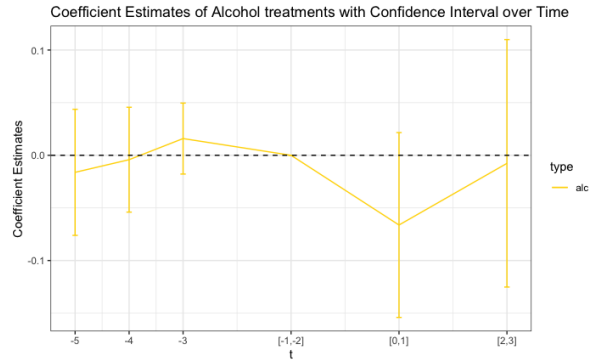
(b) Both Drug and Alcohol SUD Treatment Rate



(c) Drug Only SUD Treatment Rate



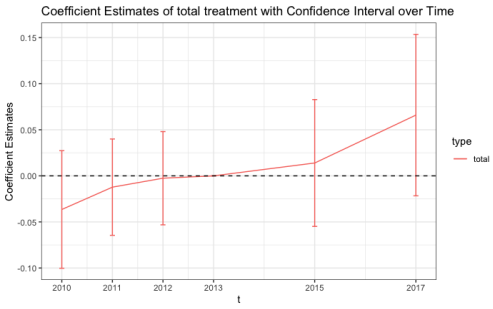
(d) Alcohol Only SUD Treatment Rate



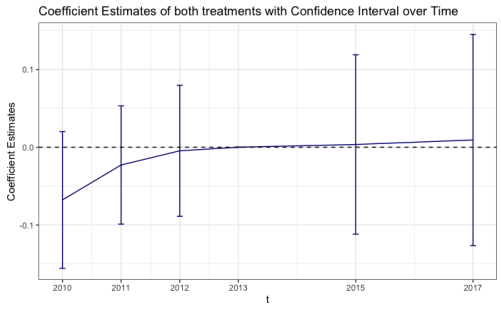
Notes: All four figures plot coefficients from an event-study analysis. Event time is defined as number of years from when the Medicaid expansion is implemented in the state. States included in the analysis have expansion years of either 2014 or 2015. Because data from 2014 and 2016 are missing due to a change in data collection questionnaire—see Section 3, event times are binned accordingly to create a balanced panel. See the text for a description of the model.

Figure 2: Event-study Plots of Medicaid Expansion on SUD Treatment Rates
(States with 2014 Expansion Year Only)

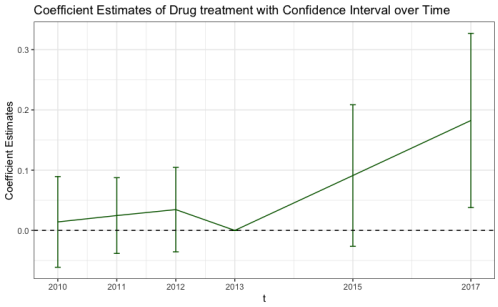
(a) Total SUD Treatment Rate



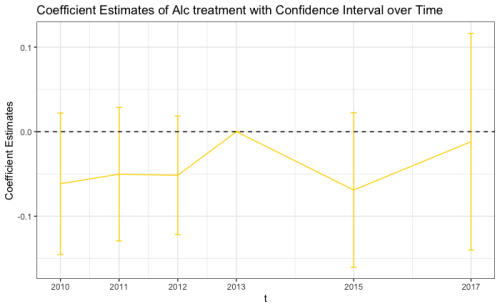
(b) Both Drug and Alcohol SUD Treatment Rate



(c) Drug Only SUD Treatment Rate



(d) Alcohol Only SUD Treatment Rate



Notes: All four figures plot coefficients from an event-study analysis. States included in the analysis implemented the Medicaid expansion in 2014. Because data from 2014 and 2016 are missing due to a change in data collection questionnaire—see Section 3), those two years were excluded from the analysis. See the text for a description of the model.

Figure 3: Medicaid Expansion Income Eligibility for Early-Expansion States

States Getting an Early Start on the Medicaid Expansion: Adult Expansions Between April 2010-March 2012

	Coverage Authority	Effective Date	Income Eligibility Limit	Enrollment
California	Waiver	Nov 1, 2010	200% FPL	251,308
Connecticut	ACA Option	April 1, 2010	56% FPL	74,752
District of Columbia	ACA Option Waiver	July 1, 2010 Dec 1, 2010	133% FPL 200% FPL	40,776 3,411
Minnesota	ACA Option Waiver	March 1, 2010 August 1, 2011	75% FPL 250% FPL	75,982 41,811
New Jersey	Waiver	April 14, 2011	23% FPL	53,490
Washington	Waiver	Jan 3, 2011	133% FPL	50,920

Source: Kaiser Family Foundation (2019)
*Notes:*The table shows states with prior Medicaid expansion and their respective FPL cutoff for Medicaid eligibility. Only the states with higher than 100% FPL cutoff are considered as "Early-expansion states". See Section 3 for an explanation for classification.

Table 1: The 2019 Federal Poverty Levels

Household Size	Income
individuals	$12,490
a family of 2	$16,910
a family of 3	$21,330
a family of 4	$25,750
a family of 5	$30,170
a family of 6	$34,590
a family of 7	$39,010
a family of 8	$43,430

Notes: Federal poverty levels (FPL) is a measure of income issued annually by the Department of Health and Human Services (HHS). It is used to determine individual's eligibility for certain programs and benefits, including Medicaid coverage.

Table 2: State Medicaid Expansion through 2016

State	**Expansion Year**
Early Expansion States	
California	2010
Connecticut*	2010
District of Columbia	2010
Minnesota	2011
New Jersey*	2011
Washington	2011
States Expanding in 2014	
Arizona	2014
Arkansas	2014
Colorado	2014
Delaware	2014
Hawaii	2014
Illinois	2014
Iowa	2014
Kentucky	2014
Maryland	2014
Massachusetts	2014
Michigan	2014
Nevada	2014
New Hampshire	2014
New Mexico	2014
New York	2014
North Dakota	2014
Ohio	2014
Oregon	2014
Rhode Island	2014
Vermont	2014
West Virginia	2014
Late Expanding States	
Alaska	2015
Indiana	2015
Montana	2016
Louisiana	2016
Pennsylvania	2015

Notes: Medicaid expansion dates derived from Kaiser Family Foundation and Sommers et al (2013).
*In the analysis, Connecticut and New Jersey are treated as "States Expanding in 2014" because their prior expansion was relatively small relative to other "Early Expansion States". (See Table 3)

Table 3: Summary Statistics for Expansion and Non-expansion states

Variables	*Expansion States*	*Non-Expansion States*
Outcome variables: SUD Treatment Rate (per 100,000 people)		
Total	457.4	276.3
Drug and Alcohol	197.1	115.9
Drug only	177.8	114.1
Alcohol only	82.5	46.3
State Characteristics		
White	0.637	0.624
Black	0.099	0.156
Hispanic	0.170	0.165
Asian	0.062	0.028
Other race	0.031	0.026
Poverty Rate	13.63	14.88
Democrat Governor	0.607	0.196
Unemployment Rate (%)	7.466	6.794
Beer Excise Tax Rate	0.184	0.420
N	256	152

Notes: Above table presents summary statistics for expansion and non-expansion states.
The main data comes from the National Survey of Substance Abuse Treatment Services (N-SSATS).
Data are aggregated to the state-year level from 2008 to 2017 data (with 2014 and 2016 missing.)
See Section 3 for details on construction and description of the data. The presented means are weighted by population.
Expansion states are the following states: AK, AZ, AR, CA, CO, CT, DE, DC, HI, IL, IN, IA, KY, LA, MD, MA, MI, MN, MT, NV, NH, NJ, NM, NY, ND, OH, OR, PA, RI, VT, WA, and WV.
Non-expnasion states are the following states: AL, FL, GA, ID, KS, ME, MS, MO, NE, NC, OK, SC, SD, TN, TX, UT, VA, WI, and WY.

Table 4: Binning Event Time according to Expansion Year

Event Time	Expansion in 2014	Expansion in 2015	N
t=-5	2009	2010	30
t=-4	2010	2011	30
t=-3	2011	2012	30
t=[-1,-2] (omitted)	2012, 2013	2013, 2014*	30
t=[0,1]	2014*, 2015	2015, 2016*	30
t=[2,3]	2016*, 2017	2017	30

* Missing years from the data

Notes: This table explains the construction of bins with respect to the expansion years. Due to a change in N-SSATS data collection form, 2014 and 2016 data are not available. Therefore, I bin event times together to maximize the use of available data.

Table 5: Estimated Effect of the Medicaid Expansion On State-Level SUD Treatment Rates: DID Result

Dependent Variables: *Natural Log of SUD Treatment per 100,000 residents*	Total	Drug and Alcohol	Drug Only	Alcohol Only
	(1)	(2)	(3)	(4)
Medicaid	0.006	-0.0006	0.025	0.010
	(0.022)	(0.026)	(0.030)	(0.022)
Comprehensive	No	No	No	No
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Clusters	51	51	51	51
Observations	408	408	408	408

Notes: The coefficients are estimated using a difference-in-differences model. The samples come from N-SSATS data from 2008 to 2017 (with 2014 and 2016 missing due to a change in data collection questionnaire (see Section 3). "Total" is the sum of both drug and alcohol, drug only, and alcohol only SUD tratment rates. "Drug and Alcohol" is defined as both drug and alcohol SUD treatment rate. "Drug only" means SUD treatment for drug use disorder, and "Alcohol only" means SUD treatment for alcohol use disorder. Estimates are weighted using population and clustered on state level. The model controls for state-level characteristics: unemployment rate, poverty rate, whether the Governor is a Democrat, beer excise tax rate, and average race and ethnicity. Standard errors are in parentheses. See text for a description of the model.
$* = p < 0.1$, $** = p < 0.05$, $*** = p < 0.01$;

Table 6: Estimated Effect of the Medicaid Expansion On State-Level SUD Treatment Rates: DID Result including the early-expansion states

Dependent Variables: *Natural Log of SUD Treatment per 100,000 residents*	Total	Drug and Alcohol	Drug Only	Alcohol Only
	(1)	(2)	(3)	(4)
Medicaid	0.012	0.0179	0.016	0.0008
	(0.016)	(0.020)	(0.025)	(0.015)
Comprehensive	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Clusters	51	51	51	51
Observations	408	408	408	408

Notes: The coefficients are estimated using a difference-in-differences model. The samples come from N-SSATS data from 2008 to 2017 (with 2014 and 2016 missing due to a change in data collection questionnaire (see Section 3). "Total" is the sum of both drug and alcohol, drug only, and alcohol only SUD tratment rates. "Drug and Alcohol" is defined as both drug and alcohol SUD treatment rate. "Drug only" means SUD treatment for drug use disorder, and "Alcohol only" means SUD treatment for alcohol use disorder. Estimates are weighted using population and clustered on state level. The model controls for state-level characteristics: unemployment rate, poverty rate, whether the Governor is a Democrat, beer excise tax rate, and average race and ethnicity. Standard errors are in parentheses. See text for a description of the model.
$* = p < 0.1$, $** = p < 0.05$, $*** = p < 0.01$;

Table 7: Estimated Effect of the Medicaid Expansion On State-Level SUD Treatment Rates: Event Study Result

Expansion States	2014 and 2015 Expansion States			
Dependent Variable:	Total	Drug and Alcohol	Drug only	Alcohol only
Natural Log of SUD Treatment Rate per 100,000 residents	(1)	(2)	(3)	(4)
Treatment*t=-5	0.005	0.014	-0.004	-0.016
	(0.029)	(0.022)	(0.040)	(0.030)
Treatment*t=-4	-0.012	-0.035	0.006	-0.004
	(0.020)	(0.045)	(0.020)	(0.025)
Treatment*t=-3	0.00005	-0.003	-0.005	0.016
	(0.0150)	(0.021)	(0.017)	(0.017)
Treatment*t=[0,1]	0.015	-0.006	0.098*	-0.066
	(0.033)	(0.057)	(0.053)	(0.045)
Treatment*t=[2,3]	0.070*	0.003	0.189***	-0.008
	(0.040)	(0.066)	(0.064)	(0.056)

Notes: The table displays the results from an event-study model for states with expansion years of either 2014 or 2015. "Total" is the sum of both drug and alcohol, drug only, and alcohol only SUD tratment rates. "Drug and Alcohol" is defined as both drug and alcohol SUD treatment rate. "Drug only" means SUD treatment for drug use disorder, and "Alcohol only" means SUD treatment for alcohol use disorder. 2014 and 2016 data are not available and were excluded from the analysis. Plots for this event-study analysis is displayed in Figure 1. Estimates are weighted using population and clustered on state level. The model controls for state-level characteristics: unemployment rate, poverty rate, whether the Governor is a Democrat, beer excise tax rate, and average race and ethnicity. Standard errors are in parentheses. See text for a description of the model.
$* = p < 0.1$, $** = p < 0.05$, $*** = p < 0.01$;

Table 8: Estimated Effect of the Medicaid Expansion On State-Level SUD Treatment Rates: Event Study Result (2014 Expansion only)

Expansion States	2014 Expansion States Only			
Dependent Variable:	Total	Drug and Alcohol	Drug only	Alcohol only
Natural Log of SUD Treatment Rate per 100,000 residents	(1)	(2)	(3)	(4)
Treatment*2010	-0.037	-0.068	0.014	-0.062
	(0.032)	(0.045)	(0.038)	(0.042)
Treatment*2011	-0.012	-0.023	0.025	-0.051
	(0.027)	(0.039)	(0.032)	(0.040)
Treatment*2012	-0.003	-0.005	0.035	-0.052
	(0.026)	(0.043)	(0.036)	(0.036)
Treatment*2015	0.014	0.004	0.091	-0.069
	(0.035)	(0.058)	(0.060)	(0.046)
Treatment*2017	0.066	0.009	0.183**	-0.012
	(0.044)	(0.069)	(0.073)	(0.065)

Notes: The table displays the results from an event-study model for states with expansion years of 2014. "Total" is the sum of both drug and alcohol, drug only, and alcohol only SUD tratment rates. "Drug and Alcohol" is defined as both drug and alcohol SUD treatment rate. "Drug only" means SUD treatment for drug use disorder, and "Alcohol only" means SUD treatment for alcohol use disorder. 2014 and 2016 data are not available and were excluded from the analysis. Plots for this event-study analysis is displayed in Figure 2. Estimates are weighted using population and clustered on state level. The model controls for state-level characteristics: unemployment rate, poverty rate, whether the Governor is a Democrat, beer excise tax rate, and average race and ethnicity. Standard errors are in parentheses. See text for a description of the model.
$* = p < 0.1$, $** = p < 0.05$, $*** = p < 0.01$;

Table 9: Estimated Effect of the Medicaid Expansion On State-Level SUD Treatment Rates: I(severe)

Dependent Variable:	Total	Drug and Alcohol	Drug only	Alcohol Only
Natural Log of SUD treatment Rate per 100,000 residents	(1)	(2)	(3)	(4)
Medicaid	-0.017	-0.026	-0.013	0.007
	(0.026)	(0.039)	(0.031)	(0.030)
Medicaid * I(severe)	0.039	0.032	0.061*	0.004
	(0.025)	(0.041)	(0.034)	(0.031)

Notes: The coefficients are estimated using a diff-in-diff model. The sample comes from 2008-2017 N-SSATS with 2014 and 2016 missing, and includes 50 states including DC. I(severe) equals 1 when state has an above-the-median SUD problem and 0 otherwise. Estimates are weighted using population and clustered on state level. "Total" is the sum of both drug and alcohol, drug only, and alcohol only SUD tratment rates. "Drug and Alcohol" is defined as both drug and alcohol SUD treatment rate. "Drug only" means SUD treatment for drug use disorder, and "Alcohol only" means SUD treatment for alcohol use disorder. The model controls for state-level characteristics: unemployment rate, poverty rate, whether the Governor is a Democrat, beer excise tax rate, and average race and ethnicity. Standard errors are in parentheses. See text for a description of the model.
$* = p < 0.1$, $** = p < 0.05$, $*** = p < 0.01$;