Appendix

Methods

Our model included an indicator that captured whether an individual lived in a state that had expanded Medicaid, an indicator of whether the state had expanded Medicaid at the time of the admission, and the interaction term of these two variables (i.e., the difference-in-difference estimator). In our analysis, we categorized a state as "expanded" in a given year if they had expanded for at least 6 months of that year. We considered most expansion states to have expanded in 2014, with the exception of New Hampshire (2015), Indiana (2015), Pennsylvania (2015), Alaska (2016), Montana (2016), and Louisiana (2016). We, a priori, excluded the first year of policy implementation (2014 for most states, 2015 for New Hampshire, Indiana, and Pennsylvania, and 2016 for Alaska, Montana, and Louisiana) from our adjusted differences-in-differences model to allow for a washout period that accounted for a period between when Medicaid expansion was legislatively enacted in a given state and when it was fully operational.[1] We clustered our standard errors at the state level to account for state-level correlation.

Difference-in-difference estimates are only valid under the assumption of parallel trends. Although treatment and control groups can have different levels of the outcome prior to the start of treatment, trends in pretreatment outcomes should be the same, implying that, absent treatment, outcomes for the two groups are expected to change at the same rate.[2] To determine whether our data satisfied the parallel trends assumption, we assessed trends in medications for OUD by expansion status in the pre-Medicaid expansion time period (2008-2013) by interacting a pre-ACA linear time trend with expansion status in our multivariable logistic regression model.

We stratified analyses by race because of well-documented racial disparities that exist in the treatment of OUD, including with medications for OUD, in the general population.[3-5] We also stratified our analyses by treatment setting because residential treatment facilities may serve patients with more severe levels of OUD and have historically been more resistant to medications for OUD than outpatient settings and thus have relatively low uptake of medications for OUD.[6]

We conducted several sensitivity analyses to assess the robustness of our results. First, we estimated models using state and year fixed effects. We removed indicators of whether a state expanded Medicaid or the admission was before or after expansion and added state and year fixed effects, which absorbed the removed main effects; the interaction term remained the key variable of interest as the difference-in-differences estimator. Second, we estimated models using our primary specification, but accounted for state random effects using a multilevel mixed-effects linear regression model. Third, we estimated a model with both state fixed and random effects. Fourth, we estimated the DID model with robust standard errors, rather than standard errors clustered at the state level. Fifth, we estimated models removing census region. Sixth, we excluded pregnant patients, since health insurance coverage and treatment plans may vary during pregnancy. Seventh, we excluded patients with veteran status, as their insurance coverage may not be affected by Medicaid expansion if they qualify for healthcare through the Veteran's Administration. Eighth, and lastly, we ran the primary model as a linear regression model rather than a logistic regression model to assess the robustness of our estimates to alternative modeling approaches that have been employed in other analyses of the ACA's Medicaid expansion.[7] Each model included the same washout period as our primary specification.

We conducted analyses between March 2020 and September 2020. We used Stata 15.1 for all analyses and considered $P < .05$ to be statistically significant. Because we used de-identified, publicly available data, the study was not considered to be human subjects research and was exempt from review by the University of Pennsylvania Institutional Review Board, Yale University Institutional Review Board and the Hennepin Healthcare Research Institute Institutional Review Board.

Findings

In adjusted stratified analyses, receipt of medications for OUD increased to a greater degree among criminal justice-referred individuals in states that expanded Medicaid compared to those in states that did not for white (Adjusted DID 9.8 pp, 95% CI 2.7-16.9), Black (Adjusted DID 6.9 pp, 95% CI 0.8-13.0) and Native American/Alaskan Native populations (Adjusted DID 5.9 pp, 95% CI 1.8-10.0). While similar point estimates were observed among individuals identified

as Hispanic (Adjusted DID 5.5 pp, 95% CI -1.0-12.0) and "other race" (Adjusted DID 9.0 pp, 95% CI -0.9-18.9), these differences were not statistically significant. In an adjusted stratified analysis by service setting, criminal justice-referred individuals in states that expanded Medicaid had higher receipt of medications for OUD compared to those in states that did not in ambulatory settings (Adjusted DID 9.5 pp, 95% CI 2.8-16.2). The difference was not statistically significant in residential settings (Adjusted DID 5.9 pp, 95% CI -0.1-11.9; Exhibit 4).

Estimates from sensitivity analyses that used a fixed and/or random effects model, removed region as a covariate, excluded pregnant women, excluded veterans, used robust standard errors, or used a linear, rather than logistic, regression model did not differ significantly from the main model examining the receipt of medications for OUD among criminal justice referrals (Appendix Exhibit 1).

Appendix Exhibit 1:Sensitivity Analyses

Estimates from sensitivity analyses of primary difference-in-differences model

Model	Difference-in-differences estimate	95% CI	*P* value
Primary logistic regression model	8.6 percentage points	2.2-15.0	.008
Linear regression with state and year fixed effects	8.7 percentage points	0.3-17.2	.043
Linear regression with state random effects	8.7 percentage points	8.4-9.1	<.001
Linear regression with state fixed and random effects and year fixed effects	8.7 percentage points	8.4-9.1	<.001
Primary model with robust standard errors (no clustering at state level)	8.6 percentage points	8.3-9.0	<.001
Primary model without census region as a covariate	9.5 percentage points	1.5-17.6	.02
Pregnant women excluded from primary model	8.6 percentage points	2.2-15.0	.008
Veterans excluded from primary model	8.7 percentage points	2.3-15.1	.008
Linear regression with otherwise similar specification to primary model	9.1 percentage points	1.0-17.1	.03

Appendix References:

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