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**eTable 1.** Policies for States Removing Buprenorphine Prior Authorization Requirements in Medicaid (Intervention States)

**eTable 2.** Prior Authorization Policies Related to Buprenorphine for OUD in Control States

**eTable 3.** Legal Mapping for State Medicaid Prior Authorization Policies Related to Buprenorphine for OUD

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**eReferences**

This supplemental material has been provided by the authors to give readers additional information about their work.

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**eTable 1. Policies for States Removing Buprenorphine Prior Authorization Requirements in Medicaid (Intervention States)**

| State     | Effective date for policies | Description                                                                                     | Exemptions                                                                                     |
|-----------|----------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| California| June 1, 2015                | PA request is not required by Medi-Cal for buprenorphine-containing products when prescribed by qualified physicians for the treatment of individuals with opioid addiction.\(^1,2\) | See document \(^3\) for specific medications that does not require PA since 2019.                |
| Illinois  | July 1, 2015                | FDA approved medication assisted treatment for opioid dependence is covered under both fee for service and managed care medical assistance programs and do not require PA mandate, or lifetime restriction limit mandate.\(^3,4\) | N/A                                                                                             |

PA- prior authorizations, PDL-preferred drug list, OUD- opioid use disorder
### eTable 2. Prior Authorization Policies Related to Buprenorphine for OUD in Control States

| State       | Description                                                                 | Last updated  |
|-------------|-----------------------------------------------------------------------------|--------------|
| Alabama     | PA is required for medication treatment for OUD, which includes buprenorphine.5,3 | November 2019 |
| Florida     | PA is required for all buprenorphine formulations. 7 days’ supply of buprenorphine formulations is allowed for patients who have not undergone MAT in the last 12 months without PA for induction with preferred medications, with a maximum of two 7 days induction refills within 60 days. After induction PA is required.3 | October 2019 |
| Idaho       | PA is required for preferred drugs that include Suboxone, and generic buprenorphine/naloxone.3,6 | October 2019 |
| Kansas      | PA requiring documentation of clinical criteria and participation in behavioral treatment. No approved medication OUD is listed under the PDL.3 | October 2019 |
| Mississippi | Prior authorization is required for preferred and non-preferred drugs. Suboxone and generic buprenorphine/naloxone are preferred that require patients to meet clinical pre-authorization criteria.3 | November 2019 |
| Nevada      | Preferred buprenorphine formulations require PA.3,7                           | October 2019 |
| South Dakota| PA is required for preferred and non-preferred buprenorphine formulations. It requires patients to meet clinical criteria, approval request for starting dose, regular drug test among other requirements.3 | October 2019 |
| Wyoming     | Preferred and non-preferred buprenorphine formulations require PA.3           | October 2019 |

PA- prior authorizations, PDL-preferred drug list, OUD- opioid use disorder, MAT- Medication Assisted Treatments
### eTable 3. Legal Mapping for State Medicaid Prior Authorization Policies Related to Buprenorphine for OUD

| State            | Complete Removal of PA | Partial Removal of PA | Effective Date of Removal | Description                                                                                                                                                                                                 | Last Updated |
|------------------|------------------------|-----------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Alaska           | No                     | Yes                   | April 20, 2017            | PA is not required for buprenorphine-based products used for MAT for the first 28-day fill. Products containing buprenorphine as single ingredient for MAT is not authorized for males. | October 2019 |
| Arizona          | No                     | Yes                   | Unknown                   | PA is not required for preferred buprenorphine products, but it is required for non-preferred buprenorphine formulations. | October 2019 |
| Arkansas         | No                     | Yes                   | April 12, 2019            | PA is not required for preferred buprenorphine products. The state law was effective in April 12, 2019 but Medicaid program had until Jan1, 2020 to comply. | June 2020    |
| Colorado         | No                     | Yes                   | January 1, 2020           | Medicaid managed care plans do not require PA for any FDA approved medications for SUD covered by the plan. | August 2019  |
| Connecticut      | Unknown                | Unknown               | Unknown                   | Preferred and no-preferred drug do not require PA | August 2019  |
| Delaware         | No                     | Yes                   | January 1, 2017           | Delaware Medicaid removed PA requirements for preferred drugs for treatment of OUD. Non-preferred agents require a PA. See PDL for list of preferred and non-preferred agents. | April 2017   |
| District of Columbia | Yes                  | Yes                   | April-01-2019             | All FDA approved medication for OUD prescribed and dispensed with PA in does up to 24mg/day | April 2019   |
| Georgia          | No                     | Yes                   | November 2017             | Fee-for-service Medicaid removed the PA requirement for preferred buprenorphine products in 2017. The PDL contains buprenorphine sublingual tablets and quantity limits may apply for a branded product. Non-preferred medications that require PA include generic buprenorphine/naloxone SL tablets and others (quantity limits may apply). See document for list of preferred and non-preferred agents. | October 2019 |
| Hawaii           | No                     | Yes                   | 2012                      | PA is not required for most drugs used for the treatment of addiction | November 2019 |
| Indiana          | No                     | Yes                   | -                         | PA is required for initial 6 months with renewal every 6 months | September 2019 |
| Iowa             | Unknown                | Unknown               | June 1, 2019              | At least one form of methadone, buprenorphine, naloxone, buprenorphine/ naloxone, and naltrexone can be prescribed without PA | May 2019     |
| State            | Required PA | Required MAT | Date or Details                                                                 | Date       |
|------------------|-------------|--------------|-------------------------------------------------------------------------------|------------|
| Kentucky         | No          | Yes          | Unknown                                                                       | October 2019 |
| Louisiana        | No          | Yes          | 2019                                                                           | January 2020 |
| Maine            | No          | Yes          | June 16, 2020                                                                 | May 2020   |
| Maryland         | No          | Yes          | -                                                                             | July 2019  |
| Massachusetts    | No          | Yes          | -                                                                             | October 2019 |
| Michigan         | No          | Yes          | -                                                                             | December 2019 |
| Minnesota        | No          | Yes          | -                                                                             | July 2019  |
| Missouri         | Unknown     | Unknown      | July 11, 2019                                                                  | October 2019 |
| Montana          | Unknown     | Unknown      | -                                                                             | September 2019 |
| Nebraska         | No          | Yes          | -                                                                             | October 2019 |
| New Hampshire    | No          | Yes          | -                                                                             | March 2022 |
| New Jersey       | Yes         | Yes          | October 15, 2019                                                              | July 2019  |
| New Mexico       | No          | Yes          | -                                                                             | October 2019 |
| New York*        | No          | Yes          | August 2016                                                                   | October 2019 |
| North Dakota     | No          | No           | -                                                                             | October 2019 |
| Ohio             | No          | Yes          | -                                                                             | October 2019 |

PA is not required for preferred buprenorphine products, but it is required for non-preferred buprenorphine formulations.3

PA is not required for Buprenorphine/naloxone sublingual films.15

PA is prohibited for at least one drug in each therapeutic class of medication used for MAT for OUD and for any MAT for OUD for pregnant women.16

PA is required for preferred buprenorphine products.3

SB 514 was passed on July 11 2014 to include all current and new FDA approved formulation and medications for OUD.16

FDA approved medications for OUD are covered without PA18

Preferred buprenorphine formulations may not require PA, but non-preferred formulations require PA. The PDL is different for each Managed care plans.3

Pre-authorization is required for preferred and non-preferred buprenorphine formulations.3

Preferred buprenorphine products do not require PA but all non-preferred formulations require PA3
| State             | No | Yes | - | Preferred buprenorphine products do not require PA but all non-preferred formulations require PA. \(^3\)\(^{19}\) | 2018 |
|-------------------|----|-----|---|---------------------------------------------------------------------------------|------|
| Oklahoma          | No | Yes | - | Preferred buprenorphine products do not require PA but all non-preferred formulations require PA. \(^3\)\(^{19}\) | 2018 |
| Oregon            | No | Yes | August 23, 2019 | PA is not required for the first 30 days of MAT for OUD.\(^{20}\) | 2019 |
| Pennsylvania      | No | Yes | - | Preferred buprenorphine products do not require PA but all non-preferred formulations require PA\(^3\) | October 2019 |
| Rhode Island      | Unknown | Unknown | - | Preferred buprenorphine products do not require PA.\(^3\) | June 2018 |
| South Carolina    | No | Yes | - | Certain buprenorphine formulations do not require PA. \(^3\) | July 2019 |
| Tennessee         | No | No | - | Preferred and non-preferred medications for OUD require PA. \(^3\) Buprenorphine Enhanced Medication Assisted Recovery and Treatment (BESMART) Program was developed in 2019 to provide office based buprenorphine treatment.\(^{21}\) | 2019 |
| Texas             | Yes | Yes | September 1, 2019 | PA is not required for MAT for OUD\(^{16}\) | May 2020 |
| Utah              | No | Yes | - | PA is not required for certain buprenorphine formulations for the first 180 days but if treatment is required beyond 180-day period further formalities and documentation must be submitted\(^3\) | August 2019 |
| Vermont           | No | Yes | - | Preferred buprenorphine products do not require PA but all non-preferred formulations require PA and quantity limit may apply\(^3\) | October 2019 |
| Virginia          | No | Yes | - | Preferred buprenorphine products do not require PA but all non-preferred formulations require PA. \(^3\) | October 2019 |
| Washington        | No | Yes | July 28, 2019 | Medicaid managed care plan does not require PA on at least one FDA approved opioid agonists, antagonists, and partial agonists\(^{22}\) | |
| West Virginia     | No | Yes | - | PA may not be required for preferred buprenorphine formulation, but it is required for non-preferred formulations | October 2019 |
| Wisconsin         | No | Yes | November, 2018 | PA is required for certain buprenorphine containing formulations\(^{76}\) | May 2020 |

PA- prior authorizations, PDL-preferred drug list, OUD- opioid use disorder, MAT- Medication Assisted Treatments

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**eTable 4. Analytical Dataset. Source: State Drug Utilization Data**

| Year, quarter | California | Illinois | Control States |
|---------------|------------|----------|----------------|
|               | Numerator  | Denominator | Numerator  | Denominator | Numerator  | Denominator |
| 2013,4        | 2976       | 9661152   | 3099       | 2934163    | 8411       | 6429386    |
| 2014,1        | 3824       | 10334000  | 2420       | 2791737    | 8750       | 6022549    |
| 2014,2        | 6547       | 10900000  | 3666       | 3003141    | 10117      | 6222496    |
| 2014,3        | 7969       | 11300000  | 2279       | 3098603    | 11859      | 6375878    |
| 2014,4        | 8885       | 11919314  | 2605       | 3126814    | 13422      | 6374089    |
| 2015,1        | 9796       | 12248555  | 2183       | 3198477    | 13520      | 6488865    |
| 2015,2        | 12366      | 12627234  | 1799       | 3163839    | 14123      | 6546112    |
| 2015,3        | 15628      | 11463750  | 3802       | 3147955    | 14535      | 6637983    |
| 2015,4        | 17752      | 12166109  | 8904       | 3134109    | 15629      | 6626559    |
| 2016,1        | 19268      | 11869623  | 9272       | 3150343    | 15945      | 6680437    |
| 2016,2        | 18432      | 12333253  | 11003      | 3123639    | 17576      | 6703785    |
| 2016,3        | 26822      | 12281044  | 11266      | 3116270    | 17980      | 7433234    |
| 2016,4        | 24948      | 12405352  | 18799      | 3065331    | 19712      | 7428542    |
| 2017,1        | 26536      | 12376741  | 24388      | 3097621    | 19735      | 7431779    |
| 2017,2        | 24632      | 12293428  | 20954      | 3075710    | 23119      | 6911107    |
| 2017,3        | 36104      | 12268887  | 22309      | 3070815    | 22384      | 6843013    |
| 2017,4        | 33593      | 12220546  | 22803      | 3062268    | 23019      | 6854673    |
| 2018,1        | 35814      | 12193802  | 24343      | 2978713    | 23775      | 6811950    |
| 2018,2        | 32470      | 12064332  | 23857      | 2989709    | 25897      | 6721252    |
| 2018,3        | 46957      | 12011621  | 24451      | 2955094    | 26845      | 6732842    |
| 2018,4        | 46424      | 11927676  | 25638      | 2860188    | 28567      | 6705386    |
| 2019,1        | 40934      | 11874143  | 26543      | 2800206    | 29148      | 6643936    |
| 2019,2        | 40106      | 11744007  | 28374      | 2826169    | 31354      | 6625351    |
| 2019,3        | 59716      | 11728031  | 29145      | 2842807    | 31493      | 6620451    |
| 2019,4        | 51210      | 11588323  | 30475      | 2812371    | 32286      | 6584936    |
| 2020,1        | 52934      | 11576877  | 30738      | 2855246    | 36130      | 6640203    |
eMethods. Sensitivity Analyses: Synthetic Control Method

We conducted additional sensitivity analysis using the synthetic control method (SCM) to create the counterfactual rate outcome for California and Illinois. This synthetic control is a weighted average of the control states that best emulates the pre-policy trend in the intervention state.\textsuperscript{23} The synthetic version of California and Illinois was constructed using a convex combination of states that had strict PA policies related to buprenorphine (Alabama, Florida, Idaho, Kansas, Mississippi, Nevada, South Dakota, and Wyoming) referred as donor pool.

| Variable                  | Definition                                                                 | Source                                                |
|---------------------------|---------------------------------------------------------------------------|-------------------------------------------------------|
| Pre-treatment outcomes    | State buprenorphine prescribing rates for 2013.Q4, 2014.Q3 and 2015, Q2 | State Drug Utilization Data                           |
| Opioid Prescribing        | State opioid dispensing rate per 100 population (Averaged for 2014 and 2015) | CDC Injury Center\textsuperscript{24,25}              |
| Overdose deaths           | State annual overdose deaths per 100 population (Averaged for 2014 and 2015) | CDC Injury Center\textsuperscript{26,27}              |
| Opioid Treatment Programs | State number of substance use disorder treatment facilities accepting Medicaid patients per 100 Medicaid enrollees (Averaged for 2014 and 2015) | SAMHSA. Data on Substance Abuse Treatment Facilities\textsuperscript{28,29} |

eFigure 1 and eFigure 2 shows the contributing weights of the donor states, pre-treatment outcomes and covariates for California and Illinois. We used tidysynth package in R for this analysis.\textsuperscript{30}

Results

We estimated that by the end of our study period (i.e., 2020. Q1) the buprenorphine prescription rate in the Actual California Medicaid program was 0.45 per 100 Medicaid enrollees and for the Synthetic California was 0.433 per 100 Medicaid enrollees (eFigure 3). This represents a small increase in prescription rate by 0.02\% than what would have been in the absence of removal of PA. (eFigure 4. In Illinois state Medicaid program, the buprenorphine prescription rate in the Actual Illinois was 1.07 per 100 Medicaid enrollees and for the Synthetic Illinois was 0.39 per 100 Medicaid enrollees (eFigure 5). This represents an increase in prescription rate by 0.68\% than what would have been in the absence of removal of PA (eFigure 6).
In this analysis using weighted control we observed a small increase in the buprenorphine prescription rate for California compared to its synthetic counterfactual. These results are not contradictory to our primary analysis though as we see in eFigure3 how the rate of prescribing in California closely overlaps that of the synthetic California trend. It is to be noted that the synthetic control method is an extension of difference-in-difference which does not report level and trend changes described in our primary analysis.\textsuperscript{23}

**Placebo analysis**

We calculated the ratio of the mean squared prediction error (MSPE) between the post-treatment and pre-treatment periods using the synthetic counterfactuals for each state. We then ranked the MSPE ratios in descending order and constructed the p-value as rank/total number of states. For a meaningful change due to the intervention (i.e., removal of PA related to buprenorphine) the synthetic control must have low MSPE in the pre-intervention period and high MSPE in the post-intervention period. A ratio close to one indicates that the intervention had no change. The MSPE ratio for California was 14.4 and for Illinois was 59.6 (eFigure 7, eFigure 8). This indicates that the post-treatment error is larger than the pre-treatment error.
eFigure 1. States Weights and Variable Weights in the Synthetic California

| Control Unit Weights (W) | Variable Weights (V) |
|--------------------------|----------------------|
| SD                       | pre_treatment_2015_2  |
| NV                       | overdose_death_rate  |
| FL                       | pre_treatment_2013_4  |
| WY                       | pre_treatment_2014_3  |
| AL                       | opioid_disp_rate     |
| MS                       | SUD_facility         |
| ID                       |                      |
| KS                       |                      |

weight

eFigure 2. States Weights and Variable Weights in the Synthetic Illinois

| Control Unit Weights (W) | Variable Weights (V) |
|--------------------------|----------------------|
| SD                       | pre_treatment_2015_2  |
| KS                       | pre_treatment_2014_3  |
| NV                       | pre_treatment_2013_4  |
| MS                       | overdose_death_rate  |
| FL                       | opioid_disp_rate     |
| ID                       | SUD_facility         |
| WY                       |                      |
| AL                       |                      |

weight

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eFigure 3. Trends in Buprenorphine Prescribing Rate in California vs. Synthetic California

![Graph showing trends in buprenorphine prescribing rate]

Dashed line denotes the time of the intervention.

eFigure 4. Buprenorphine Prescribing Rate Gap in California vs. Synthetic California

![Graph showing buprenorphine prescribing rate gap]

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eFigure 5. Trends in Buprenorphine Prescribing Rate in Illinois vs. Synthetic Illinois

![Graph showing trends in buprenorphine prescribing rate in Illinois vs. synthetic Illinois.](image)

Dashed line denotes the time of the intervention.

eFigure 6. Buprenorphine Prescribing Rate Gap in Illinois vs. Synthetic Illinois

![Graph showing the difference in percent buprenorphine prescription.](image)

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eFigure 7. Ratio of Post-Intervention RMSPE to Pre-Intervention RMSPE: California and Control States

RMSPE: Root Mean Square Prediction Error

eFigure 8. Ratio of Post-Intervention RMSPE to Pre-Intervention RMSPE: Illinois and Control States

RMSPE: Root Mean Square Prediction Error
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