Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.
eAppendix A. Introduction to Optum Database

Our analysis draws on medical and pharmacy claims data from the Optum Clininformatics Data Mart Database (2007-2018) as well as a publicly available mortality dataset from the National Center for Health Statistics. The Optum database is a large deidentified database from a national private insurance provider\(^1\)-\(^3\) that includes medical and prescription claims for the full population of patients ever prescribed any controlled substance between 2007 and 2018 (approximately 23 million). This database covers about 20% of the entire commercially insured population in all 50 US States and Washington DC and 24% of the Medicare Advantage population. Patients in this dataset are of similar age and sex to the US commercially insured population more broadly (see eTable 1 for the state-level coverage). Using this database, previous studies reported that annual opioid use prevalence was 14% for commercial beneficiaries, 26% for aged Medicare beneficiaries, and 52% for disabled Medicare beneficiaries\(^4\). eTable 2 describes characteristics of our analytic sample drawn from the Optum database, and eTable 3 shows summary statistics for six outcome indicators used in this study across Medicare beneficiary status.
eAppendix B. State Policies

As a representative policy to control the opioid supply, governments have enacted *prescription drug monitoring programs* (PDMPs). We follow Horwitz and colleagues' collection of *PDMP operational dates* (i.e., when the full PDMP program becomes available to any end user). With regard to the *mandatory PDMP* (i.e., that which requires prescribers under certain circumstances to access the PDMP prior to prescribing opioids), we combine and compare six sources, resolving discrepancies between them (see eTable 6). In addition to the PDMPs, states have implemented two other notable policies during the observation period. These are *prescription limit laws*, which impose limitations on the number of days that medical professionals prescribe or dispense opioids for acute pain, and *pill mill laws*, which regulate the operation of pain clinics. We obtained information on prescription limit laws from Davis et al., and pill mill laws from the Prescription Drug Abuse Policy System (PDAPS). To reduce harms related to overdose events and treatment, states have enacted *good Samaritan laws* that provide immunities or other legal protections for those who call for help during overdose events. These laws aim to reduce the fear of overdose bystanders being arrested for drug-related crimes. In addition, *naloxone access laws* provide civil or criminal immunity to licensed healthcare providers or lay responders for administration of opioid antagonists such as naloxone hydrochloride to reverse overdose. We obtained data from PDAPS to identify the enactment dates of good Samaritan laws and naloxone access laws in each state. We state-level Medicaid expansion data from Kaiser Family Foundation (https://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act to control for its potential influence on our statistical inference: last accessed as of May 10, 2020). eTable 7 presents detailed schedules of all seven policies.
eAppendix C. Application of Panel Matching Under the Parallel Trends Assumption

A difference-in-difference (DID) design has been widely used as a quasi-experimental design to identify the effects of state policy changes on opioid abuse and misuse indicators. Panel A in eFigure 1 shows a graphical representation of the core logic behind the DID approach explained above. The parallel trends assumption is a critical foundation of the DID approach. However, the assumption is often violated if the treated states face stronger pressure to enact the state policy due to the rapid increase of opioid mortality and other opioid misuse indicators, compared to control states without it. In this case, the policy timing is no longer considered exogenous to potential outcomes. To mitigate these likely violations, we use panel matching to construct a weighted data set that makes trends of pretreatment outcomes parallel across control and treatment units. In contrast to synthetic control methods, the proposed method allows us to flexibly estimate the causal effects of multiple treated units simultaneously. For each treated state, we first construct a matched set by pruning control states that do not share the identical treatment history in two previous years (eight quarters) and retain control states that do not receive any treatment for periods when we estimate the treatment effect on the leading outcomes at quarter after three years (0 to 12 quarters). This matching procedure reduces extrapolation biases due to model misspecification.

We further adjust for observed confounders through covariate-balancing propensity scores (CBPS) including three years of lagged outcomes as well as state-level variables (% Female, % Age 40-60, % Age 60+, % White, % Blacks, % Asian, % Hispanic, % unemployed, % living below the poverty line, and the number of state population). In addition, we account for state implementation of Medicaid expansion in balancing scores. We illustrate the importance of the parallel-trends assumption in eFigure 1 using a case for examining the impact of the mandatory PDMP policy on all overdose deaths as an example. Panel B in eFigure 1 shows that states did mandate PDMP access in
the wake of experiencing linearly increasing trends of all overdose deaths, where states without mandatory PDMP policy experienced a much weaker slope of changes at the same time. It also confirms that our application of panel matching makes the pre-trend of the matched set approximate that of the treated states, which is also consistent across other outcomes and other policies (see eFigure 2 and 3 for all other results). Panel C shows that the violation of the parallel-trends assumption poses a challenge for the event study framework since the increase of all overdose deaths after the implementation of mandatory PDMP may be part of continuing trends in a linear increase of all overdose deaths. Panel D shows that the effect becomes much weaker from estimating panel matching models that fix the likely violation of the parallel-trends assumption.

Finally, the recent methodological literature suggests that the standard method for conducting difference-in-difference (DID) analysis may produce biased estimates. The most widely used method, two-way linear fixed effects regressions, is mathematically equivalent to the DID estimator in a simple case of two time periods and two groups. However, this equivalence does not hold when there are multiple periods and multiple groups\textsuperscript{11,12} due to the inconsistent standard errors arising from serial correlation\textsuperscript{13}, biases in coefficients associated with temporal treatment heterogeneity \textsuperscript{14}, and negative weights\textsuperscript{15}. To address the challenges arising from employing two-way fixed effects models for DID analysis, we compute a weighted difference-in-difference estimator to address methodological concerns that a standard method, two-way fixed effects models\textsuperscript{12}, for conducting DID analysis may produce biased estimates using PanelMatch package in R\textsuperscript{7}. The basic intuition behind the weighted DID estimator is to use three distinctive sets — a within-time matched set, within-unit matched set, and adjustment set — for multi-period multi-group DID estimators, while discarding some group-time units that confound causal inference. For example, in 2012, Kentucky began to require that physicians check the PDMP database prior to providing a prescription. We first define the within-unit matched set that
contains the observations for Kentucky in previous time periods. We also define the within-time matched set as states that do not have a must-access PDMP in the same time period. Finally, we define the adjustment set, which contains the observations of the within-time matched set in the previous time periods. Then, the multi-period DID estimator is defined as the difference of outcomes between Kentucky at \( t \) and the within-unit matched set against the difference of outcomes between the within-time matched set and the adjustment set. Imai and Kim\(^{12} \) show that the multi-period DID estimator is numerically equivalent to a weighted two-way fixed effects regression estimator and use the method of moment estimator to calculate the cluster-robust standard error.

To account for potential policy-response lags, we estimate the effects of policies on the leading outcomes at each quarter for three years (i.e., up to 12 quarters) based on the matched set described above. To facilitate the interpretation of a large number of over-time effects across six policies across 12 outcomes, we perform meta-analysis using random effects models on these quarterly effects for each policy and outcome combination. Specifically, we assume that each observed effect \( y_q \) at quarter \( q \) is the combination of the unknown true effect \( \theta_q \) and the sampling error \( \epsilon_q \), where \( \theta_q = \mu + u_q \), \( e_q \sim N(0, \nu_q^2) \) and \( u_q \sim N(0, \tau^2) \). In this random effects model, we assume that differences in our matched sample sets across different quarters may introduce some random variability among the true effects in addition to the random sampling error. We use restricted maximum-likelihood estimation to estimate \( \tau^2 \) given that the REML estimator is approximately unbiased and quite efficient using *metaphor* package in \( \mathbf{R} \)^{16}. Employing fixed effect models provides similar results.
eTable 1. Population Coverage of the Optum Database by State

| State | Total Patients | Medicare | Medicare with LIS | Total Prescription | Total overdosed |
|-------|----------------|----------|-------------------|--------------------|-----------------|
| TX    | 2,974,836      | 498,968  | 190,642           | 204,752,690        | 63,516          |
| FL    | 2,244,856      | 565,100  | 177,166           | 169,658,088        | 48,082          |
| CA    | 2,052,791      | 549,714  | 78,141            | 167,477,841        | 42,528          |
| GA    | 1,365,300      | 306,706  | 99,518            | 129,817,404        | 24,499          |
| OH    | 1,035,082      | 154,670  | 53,554            | 83,126,081         | 17,082          |
| NC    | 967,921        | 286,752  | 100,767           | 95,806,530         | 20,699          |
| AZ    | 821,364        | 217,098  | 41,635            | 65,188,193         | 21,064          |
| CA    | 795,702        | 157,655  | 22,390            | 52,492,928         | 10,261          |
| CO    | 759,119        | 144,476  | 22,390            | 59,522,148         | 13,127          |
| WI    | 684,096        | 169,845  | 78,899            | 58,872,354         | 14,626          |
| MN    | 670,737        | 113,088  | 2,521             | 48,738,611         | 10,403          |
| NY    | 639,038        | 212,635  | 90,416            | 54,692,299         | 12,263          |
| VA    | 513,849        | 50,045   | 9,399             | 32,705,063         | 9,198           |
| MD    | 474,291        | 105,269  | 53,684            | 33,266,520         | 12,746          |
| IN    | 463,086        | 77,850   | 20,743            | 29,449,604         | 11,033          |
| TN    | 412,607        | 154,214  | 60,711            | 34,539,868         | 12,272          |
| WA    | 397,750        | 5,681    | 510               | 26,526,136         | 7,252           |
| LA    | 373,596        | 85,279   | 26,097            | 25,108,023         | 6,647           |
| NJ    | 331,840        | 32,244   | 15,651            | 18,464,291         | 6,479           |
| OR    | 306,616        | 109,517  | 52,798            | 21,786,253         | 7,276           |
| SC    | 303,590        | 133,946  | 44,169            | 15,349,604         | 11,033          |
| UT    | 277,968        | 71,213   | 20,871            | 18,767,421         | 8,288           |
| AR    | 236,341        | 49,392   | 26,008            | 16,046,455         | 5,124           |
| MA    | 228,440        | 49,392   | 26,008            | 16,046,455         | 5,124           |
| OR    | 224,648        | 67,308   | 35,973            | 17,802,553         | 5,552           |
| IA    | 224,253        | 47,037   | 8,336             | 19,360,514         | 3,120           |
| MI    | 215,134        | 6,300    | 606               | 9,318,761          | 3,135           |
| CT    | 208,257        | 87,341   | 56,703            | 17,685,543         | 4,291           |
| NE    | 193,339        | 25,338   | 5,743             | 15,344,763         | 2,287           |
| MS    | 187,644        | 2,098    | 114               | 10,399,838         | 3,812           |
| KY    | 184,430        | 39,633   | 1,834             | 11,139,635         | 3,880           |
| KS    | 182,390        | 12,274   | 3,273             | 10,420,283         | 1,968           |
| RI    | 180,052        | 43,155   | 14,399            | 19,905,905         | 4,158           |
| NV    | 149,366        | 40,597   | 6,103             | 7,661,397          | 4,993           |
| NM    | 125,390        | 25,798   | 18,433            | 8,518,540          | 3,358           |
| ID    | 72,831         | 26,002   | 5,460             | 5,718,673          | 2,206           |
| DC    | 50,377         | 6,317    | 5,858             | 3,170,202          | 939             |
| WV    | 48,709         | 1,708    | 94                | 2,650,876          | 1,044           |
| NH    | 47,636         | 11,131   | 1,767             | 2,965,460          | 1,166           |
| ND    | 36,044         | 6,328    | 100               | 1,927,162          | 569             |
| ME    | 31,912         | 12,969   | 2,963             | 2,356,420          | 987             |
| HI    | 29,658         | 25,066   | 15,592            | 4,674,164          | 1,184           |

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| State | DE  | SD  | WY  | MT  | VT  | AK  |
|-------|-----|-----|-----|-----|-----|-----|
|       | 26,980 | 25,053 | 22,617 | 20,365 | 12,069 | 8,169 |
|       | 2,695  | 6,726  | 2,267  | 2,888  | 7,378  | 185  |
|       | 1,784  | 76     | 388    | 320    | 1,503  | 9    |
|       | 1,637,072 | 1,614,492 | 1,246,725 | 1,198,649 | 1,119,626 | 322,679 |
|       | 514     | 318    | 342    | 282    | 346    | 151  |
eTable 2. International Classification of Diseases (ICD), Ninth and Tenth Revision Codes to Identify Opioid Use Disorder (OUD) and Overdose Diagnosis (OD)

|                          | ICD9                          | ICD10                          |
|---------------------------|-------------------------------|--------------------------------|
| Opioid use disorder (OUD) | 304.00, 304.01, 304.02, 304.70, 304.71, 304.72, 305.50, 305.51, 305.52 | F11 series except F11.21       |
| Overdose diagnosis (OD)   | 965.00, 965.01, 965.02; 965.09, 970.1, E850.0, E850.1, E850.2, E935.0, E935.1, E935.2, E940.1 | T40 series                     |
eTable 3. Characteristics of the Study Samples From the Optum Database

|                                | Full Sample (N=22,857,346) | Analytic Sample (N=13,493,867) | Cancer Patient (N=9,363,479) |
|--------------------------------|----------------------------|-------------------------------|------------------------------|
|                                | Mean / % | SD       | Mean / % | SD       | Mean / % | SD       |
| Age                            | 45.931   | 19.924   | 40.401   | 19.32    | 53.899   | 17.988   |
| Female (%)                     | 0.551    | 0.508    | 0.611    | 0.551    | 0.611    | 0.611    |
| Low Income Subsidy in Medicare program (%) | 0.049    | 0.043    | 0.058    | 0.049    | 0.058    | 0.058    |
| Enrolled in Medicare Part D program (%) | 0.204    | 0.138    | 0.3      | 0.204    | 0.138    | 0.3      |
| Overdose + OUD patients (%)    | 0.021    | 0.018    | 0.025    | 0.021    | 0.018    | 0.025    |
| Number of prescriptions        | 78.315   | 126.723  | 47.679   | 85.713   | 122.465  | 159.097  |
| Number of opioid prescriptions | 5.115    | 15.169   | 3.671    | 11.414   | 7.195    | 19.147   |
| Cancer Patients (%)            | 0.407    | 0        | 0.994    | 0.078    | 0.994    | 0.078    |
| Palliative Care Patients (%)   | 0.01     | 0        | 0.025    | 0.156    | 0.025    | 0.156    |

Note. The full sample includes the complete sample of patients ever prescribed any controlled substance between 2007 and 2018 (approximately 23 million patients). The analytic sample excludes cancer patients and palliative care patients.
eTable 4. Summary Statistics for Six Indicators Across Medicare Beneficiary Status

|                                | Non-medicare | Medicare | Medicare with LIS | All       |
|--------------------------------|--------------|----------|-------------------|-----------|
| Number of patient-quarters     | 265,760,865  | 55,865,425 | 13,661,567        | 335,287,857 |
| Mean Age                       | 39.46        | 72.79    | 68.55             | 46.20     |
| % Female                       | 52           | 59       | 66                | 54        |
| Number of prescriptions        | 879,753,467  | 451,065,934 | 192,956,349     | 1,523,775,750 |
| Number of opioid prescriptions | 57,809,195   | 27,097,688 | 14,480,658       | 99,387,541 |
| % MAT drug prescription        | 0.20         | 0.12     | 0.42              | 0.20      |
| % OUD + overdosed patients     | 0.22         | 0.48     | 1.37              | 0.31      |
| % taking opioids               | 11.09        | 20.69    | 36.16             | 13.71     |
| % high MME                     | 1.69         | 3.65     | 7.94              | 2.27      |
| % overlapping claim            | 0.23         | 0.68     | 1.51              | 0.36      |
| % 4+4+90                       | 0.0065       | 0.0063   | 0.028             | 0.0074    |

Note. This table is based on the analytic sample excluding cancer patients and palliative care patients (N=13,493,867) across all 47 quarters from 2007 to 2018 Q3.
**eTable 5. Overdose Death Counts Across Different Causes of Death**

We could identify the unsuppressed monthly death count across 50 states using the public CDC wonder database by identifying the total death count except for each month, which is subtracted from the total death count. For example, to get the number of deaths for 2018 December, we first make a query to retrieve the total number of deaths due to T40.1 from 1999 January to 2018 December (A), and then make another query to retrieve the total number of deaths due to T40.1 from 1999 January to 2018 November (B), and subtract B from A (i.e., A-B). The suppressed column shows the number of deaths after we suppress the death below 10 following the CDC’s privacy protection rule.

| ICD 10 code | Total Number of Deaths | Total Number of Deaths (suppressed) | Difference | Suppression rate (%) |
|-------------|------------------------|-------------------------------------|------------|----------------------|
| T40.1       | 115,568                | 110,596                             | 4,972      | 4.3                  |
| T40.2       | 175,004                | 169,900                             | 5,104      | 2.9                  |
| T40.3       | 70,214                 | 63,078                              | 7,136      | 10.2                 |
| T40.4       | 124,486                | 116,587                             | 7,899      | 6.3                  |
| T40.5       | 125,481                | 119,983                             | 5,498      | 4.4                  |
| T40.6       | 54,688                 | 46,532                              | 8,156      | 14.9                 |
| All causes  | 695,607                | 694,637                             | 970        | 0.1                  |
eTable 6. Mandatory PDMP Implementation Dates

This table presents a list of different dates for mandatory PDMP enactment reported by previous studies, and the final date we selected based on our own research on conflicted cases.

| State | PDAPS | Pauly et al\textsuperscript{17} | PEW\textsuperscript{18} | Buchmueler and Carey\textsuperscript{19} | Sacks et al\textsuperscript{20} | Mallatti\textsuperscript{21} | Meinhofer\textsuperscript{22} | Final |
|-------|-------|-------------------------------|---------------------|--------------------------------|-----------------|-----------------|----------------|------|
| AL    |       |                               |                     |                                 |                 |                 |               | 2017-3 |
| AK    |       |                               |                     |                                 |                 | 2017-7          |                 | 2017-07 |
| AZ    |       |                               |                     |                                 |                 |                 |               | 2018-3 |
| AR    |       |                               |                     |                                 |                 | 2017-8          |                 | 2018-03 |
| CA    | 2017-01 |                               |                     |                                 |                 | 2018-10         |                 | 2018-08 |
| CO    |       |                               |                     |                                 |                 |                 |               | 2018-5 |
| CT    | 2015-10 | 2015-10                       |                     |                                 |                 | 2015-10         |                 | 2015-10 |
| DE    |       | 2012-h1                       |                     |                                 |                 | 2012-3          |                 | 2012-03 |
| DC    |       |                               |                     |                                 |                 |                 |               | 2018-7 |
| FL    |       |                               |                     |                                 |                 |                 |               | 2018-7 |
| GA    |       |                               |                     |                                 |                 |                 |               | 2018-6 |
| HI    |       |                               |                     |                                 |                 |                 |               | 2018-6 |
| ID    |       |                               |                     |                                 |                 |                 |               | 2018-5 |
| IL    |       |                               |                     |                                 |                 | 2018-1          |                 | 2018-01 |
| IN    | 2014-07 | 2014-07                       |                     |                                 |                 | 2014-7          |                 | 2019-1 |
| IA    |       |                               |                     |                                 |                 |                 |               | 2018-1 |
| KS    |       |                               |                     |                                 |                 |                 |               | 2018-1 |
| KY    | 2012-07 | 2012-07                       | 2012-07            | 2012-h2                        | 2012-7          | 2012-7          | 2012-07       | 2012-07 |
| LA    | 2014-08 | 2008-h1                       | 2008-1             |                                 | 2014-8          | 2014-08         |               | 2014-08 |
| ME    | 2017-01 |                               |                     |                                 |                 | 2017-1          |                 | 2017-01 |
| MD    |       |                               |                     |                                 |                 | 2018-7          |                 | 2018-07 |
| MA    | 2014-07 | 2014-07                       | 2016-01            |                                 |                 | 2014-7          |                 | 2016-10 |
| MI    |       |                               |                     |                                 |                 | 2018-1          |                 | 2018-01 |
| MN    |       |                               |                     |                                 |                 |                 |               | 2018-3 |
| MS    |       |                               |                     |                                 |                 |                 |               | 2018-03 |
| MO    |       |                               |                     |                                 |                 |                 |               | 2018-03 |
| MT    |       |                               |                     |                                 |                 |                 |               | 2018-03 |
| NE    |       |                               |                     |                                 |                 |                 |               | 2018-03 |
| NV    | 2015-10 | 2015-10                       | 2007-h2            |                                 | 2007-10         | 2007-10         | 2007-10        | 2015-10 |
| NH    | 2016-01 |                               |                     |                                 | 2016-1          | 2017-1          |                 | 2016-01 |
| NJ    | 2015-11 | 2015-11                       |                     |                                 | 2015-11         | 2015-7          |                 | 2015-11 |
| NM    | 2012-09 | 2012-09                       | 2012-11            | 2012-h2                        | 2012-9          | 2012-10         | 2017-01        | 2017-01 |
| NY    | 2013-08 | 2013-08                       | 2013-08            | 2013-h2                        | 2013-8          | 2013-9          | 2013-08        | 2013-08 |
| NC    |       |                               |                     |                                 |                 |                 |               | 2013-08 |
| ND    |       |                               |                     |                                 |                 |                 |               | 2013-08 |
| OH    | 2015-12 | 2015-04                       | 2012-h1            |                                 | 2012-3          | 2011-11         | 2011-10        | 2015-04 |
| OK    | 2015-11 | 2015-11                       | 2011-h1            |                                 | 2011-3          | 2010-11         | 2010-11        | 2015-11 |
| OR    |       |                               |                     |                                 |                 |                 |               | 2017-01 |
| PA    | 2015-06 | 2015-06                       |                     |                                 | 2017-1          | 2017-1          |                 | 2017-01 |
| RI    | 2016-06 | 2015-03                       |                     |                                 | 2016-7          | 2014-7          |                 | 2015-03 |
| SC    |       |                               |                     |                                 | 2017-5          | 2016-4          |                 | 2017-05 |
| SD    |       |                               |                     |                                 |                 | 2017-7          |                 | 2017-05 |
| TN    | 2013-04 | 2013-07                       | 2013-04            | 2013-h2                        | 2013-7          | 2013-1          | 2013-04        | 2013-04 |
| TX    |       |                               |                     |                                 | 2019-9          | 2019-9          |                 | 2019-09 |
| UT    |       | 2017-5                        |                     |                                 |                 |                 |               | 2017-05 |
| VT    | 2015-05 | 2013-11                       |                     |                                 | 2015-5          | 2013-11         |                 | 2013-11 |
| VA    | 2015-07 | 2015-07                       |                     |                                 | 2015-7          |                 |                 | 2015-07 |
WA  2012-06  2012-06  2013-05  2012-h2  2012-6  2012-6  2012-06  2013-05
WV  2013-05  2012-6  2013-05
WI  2017-04  2017-4  2017-04
WY

Note. PDAPS: [http://pdaps.org/](http://pdaps.org/) Last accessed on 29, October, 2018. See the following source for each conflict:
AL: no mandatory PDMP, see [http://www.alabamapublichealth.gov/PDMP/faq.html](http://www.alabamapublichealth.gov/PDMP/faq.html) (as of 06/18/19)
AZ: Since 2017-10 is the date for mandatory reporting, we chose 2018-04 for mandatory access. See [https://pharmacympm.az.gov/](https://pharmacympm.az.gov/) (as of 06/18/19)
AR: See [https://www.healthy.arkansas.gov/images/uploads/pdf/Official_PMP_Quarterly_Report_1st_Quarter.pdf](https://www.healthy.arkansas.gov/images/uploads/pdf/Official_PMP_Quarterly_Report_1st_Quarter.pdf)
GA: See [https://dph.georgia.gov/pdmp](https://dph.georgia.gov/pdmp)
IN: See [http://www.ciproms.com/2018/12/new-requirements-for-indianas-prescription-drug-monitoring-program-inspect-begin-january-1/](http://www.ciproms.com/2018/12/new-requirements-for-indianas-prescription-drug-monitoring-program-inspect-begin-january-1/)
LA: [https://www.lsblme.la.gov/sites/default/files/documents/In%20The%20News%20Items/Lammico%20Schedule%20II%20Drugs%2010%202014.pdf](https://www.lsblme.la.gov/sites/default/files/documents/In%20The%20News%20Items/Lammico%20Schedule%20II%20Drugs%2010%202014.pdf)
MA: [http://www.eprescribing.org/tag/massachusetts-state-mandate/Effective](http://www.eprescribing.org/tag/massachusetts-state-mandate/Effective)
NV: [https://nabp.pharmacy/wp-content/uploads/2016/06/NV102016.pdf](https://nabp.pharmacy/wp-content/uploads/2016/06/NV102016.pdf)
NH: [http://www.pdmpassist.org/content/new-or-amended-pdmp-legislationregulations](http://www.pdmpassist.org/content/new-or-amended-pdmp-legislationregulations)
NJ: [https://www.njconsumeraffairs.gov/Adoptions/dirado_11072016.pdf](https://www.njconsumeraffairs.gov/Adoptions/dirado_11072016.pdf)
NM: [http://www.pdmpassist.org/content/new-or-amended-pdmp-legislationregulations](http://www.pdmpassist.org/content/new-or-amended-pdmp-legislationregulations)
OH: [https://www.ohiopmp.gov/Documents/General/PHARMACIES_PRESCRIBERS/Requirements%20Prior%20to%20Prescribing%20%-%20Opioids%20and%20Benzodiazepines.pdf](https://www.ohiopmp.gov/Documents/General/PHARMACIES_PRESCRIBERS/Requirements%20Prior%20to%20Prescribing%20%-%20Opioids%20and%20Benzodiazepines.pdf)
OK: [https://www.insurancejournal.com/news/southcentral/2015/04/06/363125.htm](https://www.insurancejournal.com/news/southcentral/2015/04/06/363125.htm)
PA: [https://www.mcneeslaw.com/changes-pennsylvania-drug-monitoring-program-january-1-2017-compliance-prescribing-physicians/](https://www.mcneeslaw.com/changes-pennsylvania-drug-monitoring-program-january-1-2017-compliance-prescribing-physicians/)
RI: [http://health.ri.gov/publications/plans/2015PrescriptionDrugMonitoringProgramEnforcementPlan.pdf](http://health.ri.gov/publications/plans/2015PrescriptionDrugMonitoringProgramEnforcementPlan.pdf)
SC: [https://qioprogram.org/sites/default/files/editors/141/SouthCarolina_PDMP_withDisclaimer_CF_FINAL_508.pdf](https://qioprogram.org/sites/default/files/editors/141/SouthCarolina_PDMP_withDisclaimer_CF_FINAL_508.pdf)
TN: [http://www.pdmpassist.org/pdf/Mandatory_conditions.pdf](http://www.pdmpassist.org/pdf/Mandatory_conditions.pdf)
VT: [https://legislature.vermont.gov/statutes/fullchapter/18/084A](https://legislature.vermont.gov/statutes/fullchapter/18/084A)
WV: [https://wvbom.wv.gov/download_resource.asp?id=269](https://wvbom.wv.gov/download_resource.asp?id=269)
eTable 7. State Policy Implementation Dates

This table presents implementation dates for six different policies that control the supply-side of opioid consumption or enhance access to treatment, as well as the implementation date for Medicaid expansion. We have collected dates of policy adoption from the following sources: Horwitz and colleagues’ Table 1, Davis and colleagues’ Table 2, PDAPS for Naloxone Law, PDAPS for Good Samaritan Law, PDAPS for Pain Clinic Law as of 2018/10/29. PDAPS, Kaiser Family Foundation for Medicaid Expansion. Also see eTable 6 for mandatory PDMP dates.

| state | Law authorizing access to PDMP | Law requiring PDMP | Prescription Limit Law | Pill Mill Law | Good Samaritan Law | Naloxone Access Law | Medicaid Expansion |
|-------|-------------------------------|---------------------|------------------------|---------------|-------------------|---------------------|--------------------|
| AK    | 2012m1                         | 2017m7              | 2017m7                 | 2014m10       | 2016m3            | 2015m9              |
| AL    | 2006m4                         |                     |                        | 2013m5        | 2015m6            | 2015m6              |
| AR    | 2013m5                         | 2017m8              |                        | 2015m7        | 2015m7            | 2014m1              |
| AZ    | 2008m12                        | 2018m3              | 2018m4                 | 2018m4        | 2016m8            | 2014m1              |
| CA    | 2009m9                         | 2018m10             |                        | 2013m1        | 2008m1            | 2014m1              |
| CO    | 2008m2                         |                     |                        | 2012m5        | 2013m5            | 2014m1              |
| CT    | 2008m7                         | 2015m10             | 2016m7                 | 2011m10       | 2003m10           | 2014m1              |
| DC    | 2016m10                        |                     |                        | 2013m3        | 2013m3            | 2014m1              |
| DE    | 2012m8                         | 2012m3              | 2017m4                 | 2013m8        | 2014m8            | 2014m1              |
| FL    | 2011m10                        | 2018m7              | 2010m10                | 2012m10       | 2015m6            | 2014m1              |
| GA    | 2013m5                         | 2018m7              | 2013m7                 | 2014m4        | 2014m4            |                     |
| HI    | 2012m2                         | 2018m6              | 2016m7                 | 2015m7        | 2016m6            | 2014m1              |
| IA    | 2009m3                         |                     |                        | 2018m7        | 2016m5            | 2014m1              |
| ID    | 2008m4                         |                     |                        | 2018m7        | 2015m7            | 2020m1              |
| IL    | 2009m12                        | 2018m1              | 2012m1                 | 2012m6        | 2010m1            | 2014m1              |
| IN    | 2007m7                         | 2019m1              | 2017m7                 | 2016m7        | 2015m4            | 2015m2              |
| KS    | 2011m4                         |                     |                        | 2017m7        |                  |                     |
| KY    | 2001m7                         | 2012m7              | 2017m6                 | 2012m7        | 2015m3            | 2013m6              |
| LA    | 2009m1                         | 2014m8              | 2017m8                 | 2006m1        | 2014m8            | 2015m8              |
| MA    | 2011m1                         | 2016m10             | 2016m3                 | 2012m8        | 2012m8            | 2014m1              |
| MD    | 2013m12                        | 2018m7              | 2017m5                 | 2014m10       | 2013m10           | 2014m1              |
| ME    | 2005m1                         | 2017m1              | 2017m1                 | 2014m4        | 2019m1            |                     |
| MI    | 2003m1                         | 2018m1              |                        | 2017m1        | 2014m10           | 2014m4              |
| MN    | 2010m4                         |                     | 2017m7                 | 2014m7        | 2014m5            | 2014m1              |
| MO    |                               |                     |                        | 2017m8        | 2016m8            |                     |
| MS    | 2008m7                         | 2018m3              | 2011m4                 | 2015m7        | 2015m7            |                     |
| MT    | 2012m10                        |                     |                        | 2017m5        | 2017m5            | 2016m1              |
| NC    | 2007m7                         | 2018m1              |                        | 2013m4        | 2013m4            |                     |
| ND    | 2008m10                        |                     |                        | 2015m8        | 2015m8            | 2014m1              |

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| State | Dates |
|-------|-------|
| NE    | 2017m1, 2017m8, 2015m5 |
| NH    | 2014m10, 2016m1, 2017m1, 2015m9, 2015m6, 2014m8 |
| NJ    | 2012m1, 2015m11, 2017m5, 2013m5, 2013m7, 2014m1 |
| NM    | 2005m8, 2017m1, 2007m6, 2001m4, 2014m1 |
| NV    | 2011m2, 2015m10, 2017m6, 2015m10, 2015m10, 2014m1 |
| NY    | 2013m6, 2013m8, 2016m7, 2011m9, 2006m4, 2014m1 |
| OH    | 2006m10, 2015m4, 2017m8, 2011m5, 2016m9, 2014m3, 2014m1 |
| OK    | 2006m7, 2015m11, 2013m11 |
| OR    | 2011m9, 2016m1, 2013m6, 2014m1 |
| PA    | 2016m8, 2017m1, 2017m1, 2014m12, 2014m12, 2015m1 |
| RI    | 2012m9, 2015m3, 2017m3, 2012m6, 2012m6, 2014m1 |
| SC    | 2008m2, 2017m5, 2007m6, 2017m6, 2015m6 |
| SD    | 2012m3, 2017m7, 2016m7 |
| TN    | 2010m1, 2013m4, 2013m10, 2011m5, 2015m7, 2014m7 |
| TX    | 2012m8, 2019m9, 2009m9, 2015m9 |
| UT    | 2006m1, 2017m5, 2017m3, 2014m3, 2014m5, 2020m1 |
| VA    | 2006m6, 2015m7, 2017m3, 2015m7, 2013m7, 2019m1 |
| VT    | 2009m1, 2013m11, 2017m7, 2013m6, 2013m7, 2014m1 |
| WA    | 2012m1, 2010m6, 2010m6, 2014m1 |
| WI    | 2013m6, 2017m4, 2016m3, 2014m4, 2014m4 |
| WV    | 2013m5, 2013m5, 2012m6, 2015m6, 2015m5, 2014m1 |
| WY    | 2013m7, 2017m7 |
eTable 8. The Meta-Analysis of Quarterly Effects of State Policy Implementation on Indicators of Prescription Opioid Misuse and Opioid Overdose From a Commercially Insured Population

|                          | PDMP access         | mandatory PDMP       | Pill Mill Law        |
|--------------------------|---------------------|----------------------|----------------------|
| P(taking opioid)         | 0.167 [0.074,0.26]  | -0.729 [-1.011,-0.447] | -0.444 [-0.618,-0.27] |
| P(overlapping claims)    | -0.004 [-0.014,0.006] | -0.027 [-0.038,-0.017] | -0.009 [-0.024,0.005] |
| P(daily MME > 90)        | 0.041 [0.007,0.075]  | -0.095 [-0.15,-0.041]  | -0.082 [-0.15,-0.014]  |
| P(4+4 within 90 days)    | 0 [-0.001,0]       | -0.002 [-0.003,-0.001] | -0.001 [-0.001,0]   |
| P(OUD and Overdose)      | 0.001 [-0.007,0.01] | 0.017 [-0.008,0.043]  | -0.008 [-0.025,0.009] |
| P(taking MAT drug)       | -0.006 [-0.015,0.003] | 0.015 [0.002,0.028]  | 0.013 [0.005,0.021] |

|                          | Prescription Limit | Good Samaritan | Naloxone Law |
|--------------------------|-------------------|----------------|--------------|
| P(taking opioid)         | 0.062 [-0.257,0.381] | 0.042 [-0.061,0.145] | 0.163 [0.053,0.273] |
| P(overlapping claims)    | -0.017 [-0.03,-0.004] | 0.008 [-0.003,0.018] | -0.001 [-0.01,0.007] |
| P(daily MME > 90)        | -0.127 [-0.229,-0.025] | -0.027 [-0.049,-0.005] | 0.022 [-0.001,0.046] |
| P(4+4 within 90 days)    | -0.002 [-0.003,-0.001] | 0 [-0.001,0] | 0 [-0.001,0] |
| P(OUD and Overdose)      | 0.021 [-0.004,0.047] | 0.014 [0.002,0.027] | 0.051 [0.03,0.073] |
| P(taking MAT drug)       | 0.034 [0.02,0.049] | 0.007 [-0.003,0.016] | -0.001 [-0.007,0.005] |

Note. We perform random-effects meta-analysis to summarize all temporal associations from t to t+12. The average effects with 95% confidence intervals are presented.
**eTable 9. The Meta-Analysis of Quarterly Effects of State Policy Implementation on Overdose Deaths**

|                          | PDMP access     | mandatory PDMP | Pill Mill Law  |
|--------------------------|-----------------|----------------|---------------|
| **All overdose**         | -193.1 [-589.6,203.4] | -231.4 [-656.5,193.7] | -146.8 [-479,185.3] |
| Natural opioid           | -183.9 [-345,-22.7]  | -518.5 [-728.5,-308.5] | -182.9 [-434,68.3]  |
| Methadone                | -87.9 [-142.3,-33.5]  | -122.7 [-207.5,-37.8]  | -45.8 [-167.6,75.9]  |
| Heroin                   | -40.7 [-228.7,147.3]  | -115.9 [-298.6,66.8]  | 336.3 [79.5,593]    |
| Synthetic opioid         | 380.3 [149.9,610.8]  | 12.2 [-350.8,375.3]   | 132.8 [-27,292.5]   |
| Cocaine                  | 103.7 [28,179.5]    | -43.8 [-229,141.5]   | 97.3 [23.9,170.8]   |

|                          | Prescription Limit | Good Samaritan Law | Naloxone Law     |
|--------------------------|--------------------|--------------------|-----------------|
| **All overdose**         | 3.4 [-625.8,632.7]  | 403.7 [172.7,634.8] | 1344.3 [627.1,2061.6] |
| Natural opioid           | 13.6 [-232.2,259.5] | -64.6 [-178.4,49.2] | 13.6 [-115.9,143.1] |
| Methadone                | 66.4 [-14.1,146.8]  | -21.5 [-65.7,22.8]  | -27.8 [-74.1,18.5] |
| Heroin                   | -146.5 [-441,147.9] | -9.6 [-118.8,99.6]  | 280.3 [50.7,509.9]  |
| Synthetic opioid         | -723.9 [-1419.7,-28.1] | 58.3 [-90.4,207] | 1338.2 [662.5,2014] |
| Cocaine                  | 85.2 [-218.6,389]   | -1.1 [-106.4,104.3] | 557.6 [328.3,787]  |

Note. We perform random-effects meta-analysis to summarize all temporal associations from t to t+12. The average effects with 95% confidence intervals are presented.
eFigure 1. Illustration of Parallel Trends Assumption Under the Difference-in-Difference Framework: The Impact Of Mandatory PDMPs on All Overdose Deaths

Panel A shows how the parallel trends assumption allows difference-in-difference estimators to identify the causal effect of state policy treatment. Panel B shows quarterly trends of all overdose deaths before and after the implementation of mandatory PDMP across treated states (red), all unmatched controls (black), and matched controls based on panel matching (blue). Panel C shows marginal effects with 95% confidence intervals based on state-clustered standard errors from even study design, where we estimate the following models:

$$y_{st} = \sum_{t=-15}^{5} \alpha_t 1(T_{st} = t) + \sum_{f=0}^{15} \beta_f 1(T_{st} = f) + \theta_s + \gamma_t + \epsilon_{st},$$

where $T_{st}$ the number of quarters between quarter $t$ and the policy implementation date in state $s$, and $\theta_s$ is a set of state fixed effects, and $\gamma_t$ is a set of year-quarter fixed effects. Panel D shows marginal effects with 95% confidence intervals based on block-bootstrapped standard errors from panel matching.
eFigure 2. Pre-Post Trends for Six Outcomes From a Commercially Insured Population Across Six Policies

Each panel shows quarterly trends for outcomes (on the column) before and after the implementation of each policy (on the row) across treated states (red), all unmatched controls (black), and matched controls based on panel matching (blue).
eFigure 3. Pre-Post Trends for Different Types of Drug-Related Deaths Across Six Policies

Each panel shows quarterly trends of outcomes (on the column) before and after the implementation of each policy (on the row) across treated states (red), all unmatched controls (black), and matched controls based on panel matching (blue).
eFigure 4. Trends for Major Outcomes

The following eFigure4 depicts state-level opioid outcomes as a function of policy adoption. First, the rate of overdose deaths, as well as the diagnosis of overdose and opioid use disorder, have increased as states have implemented more state policies. Correspondingly, the use of opioid treatment has continuously increased as states have implemented more policies; the rate of Medication-Assisted Treatment (MAT) takers per 100,000 has more than quadrupled from 0.1% in a state without any policy to about 0.5% in a state with six policies. In contrast, indicators of opioid misuse and drug seeking have declined as policy implementation has increased. Namely, the proportion of patients taking a high-risk dosage and meeting the 4+4+90 threshold began to drop after the first and second adoption of state policies respectively, though the proportion of prescription opioid recipients exhibits some fluctuation.

Note. Average mortality is calculated based on state-level data from the CDC Multiple Cause of Death database and all other measures are obtained from medical claims data from 29 million commercially-insured patients in the US from 2007 to 2018. All Opioid Mortality includes all overdose-related deaths. P(OUD + OD) indicates the proportion of patients with opioid use disorder and/or overdose. P
(taking opioid) indicates the proportion of prescription opioid takers. P(4+4+90) measures the proportion of opioid takers who visit 4+ unique doctors and 4+ unique pharmacies within 90 days. P(daily MME > 90) is calculated by the proportion of patients prescribed daily morphine mg equivalents (MME) greater than 90 mg. P(taking MAT) measures the proportion of patients prescribed any medication-assisted treatment (MAT) drug.
Figure 5. The Association of State Policy Implementation With Indicators of Prescription Opioid Misuse and Opioid Overdose From a Commercially Insured Population

Note. Each dot represents the marginal effect of policy implementation on the future outcomes from 0 to 12 quarters after policy implementation from estimating panel matching models. The statistically significant effects (p < 0.05) are filled, otherwise empty. The horizontal lines show the average quarterly effects (noted in the upper-left corner) with 95% confidence intervals from meta-analysis using random-effects models across all over-time effects. When the overall effects across all quarters are significant, the background are colored by transparent red (positive effects) and blue (negative effects). See eTable 8 for meta-analysis results, and Appendix E for policy effects on all leading outcomes from t=0 to 12 quarters.
**eFigure 6. The Association of State Policy Implementation With Different Types of Drug Overdose Deaths**

| Policy Type          | PDP Access | Mandatory PDP | Pill Mill | Prescription Limit | Good Samaritan | Naloxone Law |
|----------------------|------------|---------------|-----------|--------------------|----------------|--------------|
| Avg.                 | Avg.       | Avg.          | Avg.      | Avg.               | Avg.           | Avg.         |
| Research (per 300 million) |            |               |           |                    |                |              |
| All overdose         | -193.1     | -231.4        | -148.8   | 3.4                | 403.7          | 1344.3       |
| Natural opioid      | -185.9     | -518.6        | -182.9   | 13.6               | -64.6          | 13.6         |
| Methadone           | -87.9      | -122.7        | -45.8    | 65.4               | -21.5          | -27.8        |
| Heroin              | -46.7      | -115.9        | 316.3    | -146.5             | -5.6           | 280.3        |
| Synthetic opioid    | 380.3      | 12.2          | 132.8    | -223.9             | 58.3           | 1338.2       |
| Cocaine             | 103.7      | -43.8         | 97.3     | 85.2               | -1.1           | 557.6        |

Note. Each dot represents the marginal effect of policy implementation on the future outcomes from 0 to 12 quarters after policy implementation from estimating panel matching models. The statistically significant effects (p < 0.05) are filled, otherwise empty. The horizontal lines show the average quarterly effects (noted in the upper-left corner) with 95% confidence intervals from meta-analysis using random-effects models across all over-time effects. When the overall effects across all quarters are significant, the background are colored by transparent red (positive effects) and blue (negative effects). See eTable 9 for meta-analysis results, and Appendix E for policy effects on all leading outcomes from t=0 to 12 quarters.

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**eTable 10. Regression Tables for Effects of State Policies on All Outcomes With 95% Confidence Intervals**

| time after policy change | Coef. | 95% LCI  | 95% UCI  | N treated | N total matched |
|--------------------------|-------|----------|----------|-----------|-----------------|
| **Outcome P(taking opioid), Policy PDMP access** |       |          |          |           |                 |
| t+0                      | 5.6   | -0.24    | 11       | 31        | 469             |
| t+1                      | 6.3   | -0.31    | 13       | 30        | 448             |
| t+2                      | 3.1   | -5       | 11       | 30        | 410             |
| t+3                      | -1.9  | -11      | 6.3      | 30        | 373             |
| t+4                      | 7     | -3       | 16       | 30        | 355             |
| t+5                      | 5.2   | -5.4     | 17       | 30        | 316             |
| t+6                      | 5.7   | -4.6     | 16       | 30        | 289             |
| t+7                      | 5.1   | -8       | 19       | 31        | 259             |
| t+8                      | 5.7   | -7.3     | 20       | 30        | 236             |
| t+9                      | 4.7   | -12      | 22       | 29        | 209             |
| t+10                     | 5.5   | -11      | 23       | 29        | 194             |
| t+11                     | 17    | -9.3     | 41       | 29        | 179             |
| t+12                     | 16    | -10      | 40       | 29        | 152             |
| **Outcome P(taking opioid), Policy mandatory PDMP** |       |          |          |           |                 |
| t+0                      | -11   | -19      | -3       | 32        | 569             |
| t+1                      | -23   | -40      | -1.6     | 29        | 522             |
| t+2                      | -26   | -44      | -2.9     | 28        | 480             |
| t+3                      | -28   | -51      | 3.8      | 24        | 442             |
| t+4                      | -25   | -54      | 7.9      | 24        | 410             |
| t+5                      | -26   | -64      | 11       | 22        | 362             |
| t+6                      | -40   | -95      | 9.6      | 19        | 321             |
| t+7                      | -29   | -74      | 6.5      | 16        | 289             |
| t+8                      | -28   | -77      | 7.7      | 15        | 266             |
| t+9                      | -24   | -67      | 13       | 15        | 236             |
| t+10                     | -35   | -81      | 2.6      | 15        | 209             |
| t+11                     | -56   | -110     | -11      | 14        | 183             |
| t+12                     | -93   | -220     | 8.2      | 10        | 158             |
| **Outcome P(taking opioid), Policy Pain Clinic** |       |          |          |           |                 |
| t+0                      | -7.1  | -14      | -0.36    | 10        | 52              |
| t+1                      | -9.4  | -20      | 0.73     | 10        | 50              |
| t+2                      | -18   | -31      | -6.2     | 10        | 47              |
| t+3                      | -16   | -34      | 0.15     | 10        | 46              |
| t+4                      | -18   | -41      | 2.5      | 10        | 41              |
| t+5                      | -22   | -41      | -6.7     | 10        | 36              |
| time after policy change | Coef. | 95% LCI    | 95% UCI    | N treated | N total matched |
|--------------------------|-------|------------|------------|-----------|----------------|
| t+0                      |      | -7.1       | -18        | 5.9       | 23             | 233           |
| t+1                      | 2.1  | -15        | -18        | 18        | 23             | 173           |
| t+2                      | -6.7 | -27        | 16         | 18        | 18             | 156           |
| t+3                      | -7   | -29        | -79        | 18        | 17             | 171           |
| t+4                      | 6.6  | -20        | 34         | 20        | 20             | 190           |
| t+5                      | 3.4  | -27        | 37         | 14        | 14             | 167           |
| t+6                      |      |            |            |           |                |               |
| t+7                      | -32  | -85        | 25         | 6         | 6              | 99            |
| t+8                      | -34  | -96        | 26         | 6         | 6              | 119           |
| t+9                      | -20  | -110       | 28         | 3         | 3              | 64            |
| t+10                     | -13  | -89        | 31         | 3         | 3              | 64            |
| t+11                     | 23   | 8.8        | 36         | 2         | 2              | 40            |
| t+12                     | 17   | 0.19       | 36         | 2         | 2              | 40            |
| time after policy change | Coef. | 95% LCI    | 95% UCI    | N treated | N total matched |
| t+0                      |      | -1.1       | -4.8       | 2.3       | 43             | 950           |
| t+1                      | 1.6  | -2.7       | 6.5        | 43        | 43             | 889           |
| t+2                      | 5.4  | -9.9       | 21         | 42        | 42             | 832           |
| t+3                      | 5.2  | -11        | 23         | 42        | 42             | 771           |
| t+4                      | 4.7  | -16        | 24         | 42        | 42             | 706           |
| t+5                      | 11   | -12        | 36         | 39        | 39             | 655           |
| t+6                      | 8.2  | -16        | 33         | 37        | 37             | 601           |
| t+7                      | 18   | -4.7       | 40         | 36        | 36             | 541           |
| t+8                      | 19   | -8.9       | 45         | 36        | 36             | 494           |
| t+9                      | 4.1  | -31        | 41         | 34        | 34             | 422           |
| t+10                     | 4    | -32        | 46         | 34        | 34             | 383           |
| t+11                     | -12  | -65        | 50         | 33        | 33             | 337           |
| t+12                     | -6.6 | -57        | 48         | 32        | 32             | 363           |
| time after policy change | Coef. | 95% LCI    | 95% UCI    | N treated | N total matched |
| t+0                      | 2.4  | -3.3       | 7.3        | 45        | 45             | 1018          |
| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|-----------------|
| Outcome P(overlapping claims), Policy PDMP access |
| t+0                      | -0.06 | -0.72   | 0.58    | 31        | 469             |
| t+1                      | 0.61  | -0.26   | 1.4     | 30        | 448             |
| t+2                      | 0.035 | -0.83   | 0.48    | 30        | 410             |
| t+3                      | -0.42 | -1.3    | 0.12    | 30        | 355             |
| t+4                      | -0.6  | -1.4    | 1.1     | 30        | 316             |
| t+5                      | -0.055| -1.5    | 1.5     | 30        | 289             |
| t+6                      | -0.44 | -1.6    | 0.87    | 31        | 259             |
| t+7                      | -0.6  | -2.1    | 0.98    | 30        | 236             |
| t+8                      | -0.22 | -1.9    | 1.3     | 29        | 209             |
| t+9                      | 0.25  | -1.8    | 2       | 29        | 194             |
| t+10                     | -0.081| -2      | 1.9     | 29        | 179             |
| t+11                     | 0.096 | -2.4    | 2.3     | 29        | 152             |
| Outcome P(overlapping claims), Policy mandatory PDMP |
| t+0                      | -0.56 | -1.1    | 0.053   | 32        | 569             |
| t+1                      | -0.97 | -1.6    | -0.26   | 29        | 522             |
| t+2                      | -0.68 | -1.7    | 0.48    | 28        | 480             |
| t+3                      | -0.65 | -1.6    | 0.54    | 24        | 442             |
| t+4                      | -1.2  | -2.6    | 0.34    | 24        | 410             |
| t+5                      | -1.1  | -2.7    | 0.55    | 22        | 362             |
| t+6                      | -1.2  | -3      | 0.68    | 19        | 321             |
| t+7                      | -1.7  | -3.3    | 0.17    | 16        | 289             |
| t+8                      | -1.3  | -2.6    | 0.19    | 15        | 266             |
| t+9                      | -0.95 | -2.7    | 1.3     | 15        | 236             |
| t+10                     | -0.64 | -2.3    | 1.8     | 15        | 209             |

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| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|-------------------------|-------|---------|---------|-----------|----------------|
| **t+11**                | -1.1  | -2.9    | 1.4     | 14        | 183            |
| **t+12**                | 0.4   | -2.7    | 4.9     | 10        | 158            |

**Outcome P(overlapping claims), Policy Pain Clinic**

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|-------------------------|-------|---------|---------|-----------|----------------|
| **t+0**                 | 0.065 | -0.78   | 1       | 10        | 52             |
| **t+1**                 | -0.25 | -1.1    | 0.75    | 10        | 50             |
| **t+2**                 | 0.029 | -0.91   | 1.2     | 10        | 47             |
| **t+3**                 | -0.62 | -1.7    | 0.69    | 10        | 46             |
| **t+4**                 | -0.46 | -1.9    | 1.2     | 10        | 41             |
| **t+5**                 | -0.66 | -2.1    | 1.2     | 10        | 36             |
| **t+6**                 | -0.97 | -2.8    | 1.6     | 10        | 35             |
| **t+7**                 | -0.64 | -2.9    | 2.1     | 10        | 31             |
| **t+8**                 | -1.4  | -4.3    | 2.4     | 10        | 28             |
| **t+9**                 | -0.71 | -4.5    | 4       | 9         | 28             |
| **t+10**                | -1    | -5      | 4.5     | 10        | 23             |
| **t+11**                |       |         |         |           |                |
| **t+12**                |       |         |         |           |                |

**Outcome P(overlapping claims), Policy Prescription Limit**

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|-------------------------|-------|---------|---------|-----------|----------------|
| **t+0**                 | -0.79 | -1.5    | -0.0038 | 23        | 233            |
| **t+1**                 | -0.26 | -0.95   | 0.5     | 23        | 173            |
| **t+2**                 | 0.18  | -1.1    | 1.5     | 18        | 156            |
| **t+3**                 | -0.88 | -2      | 0.45    | 17        | 171            |
| **t+4**                 | -0.85 | -2      | 0.28    | 20        | 190            |
| **t+5**                 | -0.82 | -2      | 0.77    | 14        | 167            |
| **t+6**                 |       |         |         |           |                |
| **t+7**                 | -1.1  | -3.2    | 4.2     | 6         | 99             |
| **t+8**                 | -0.11 | -3.2    | 6.3     | 6         | 119            |
| **t+9**                 | 0.38  | -2.1    | 6.9     | 3         | 64             |
| **t+10**                | 0.037 | -2.2    | 6.5     | 3         | 64             |
| **t+11**                | 0.62  | -1.9    | 4.4     | 2         | 40             |
| **t+12**                | 0.65  | -1.8    | 3.9     | 2         | 40             |

**Outcome P(overlapping claims), Policy Good Samaritan**

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|-------------------------|-------|---------|---------|-----------|----------------|
| **t+0**                 | -0.27 | -0.66   | 0.13    | 43        | 950            |
| **t+1**                 | -0.17 | -0.57   | 0.24    | 43        | 889            |
| **t+2**                 | 0.29  | -0.41   | 0.98    | 42        | 832            |
| **t+3**                 | 0.22  | -0.65   | 1       | 42        | 771            |
| **t+4**                 | 0.44  | -0.66   | 1.6     | 42        | 706            |
| **t+5**                 | 0.97  | -0.075  | 2.1     | 39        | 655            |
| t+6 | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|-----|-------|----------|---------|-----------|----------------|
|     | 0.66  | -0.58    | 1.9     | 37        | 601            |
|     | 0.98  | -0.57    | 2.5     | 36        | 541            |
|     | 1     | -0.71    | 2.6     | 36        | 494            |
|     | 1.1   | -0.42    | 2.9     | 34        | 422            |
|     | 0.84  | -1.1     | 3.1     | 34        | 383            |
|     | 1.1   | -1.5     | 4       | 33        | 337            |
|     | 0.54  | -2       | 3.2     | 32        | 363            |

| t+7 | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|-----|-------|----------|---------|-----------|----------------|
|     |       |          |         |           |                |
| t+8 |       |          |         |           |                |
|     |       |          |         |           |                |
| t+9 |       |          |         |           |                |
|     |       |          |         |           |                |
| t+10|       |          |         |           |                |
|     |       |          |         |           |                |
| t+11|       |          |         |           |                |
|     |       |          |         |           |                |
| t+12|       |          |         |           |                |

| t+12 | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|------|-------|----------|---------|-----------|----------------|
|      |      |          |         |           |                |

| t+0 | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|-----|-------|----------|---------|-----------|----------------|
|     | -0.076| -0.54    | 0.36    | 45        | 1018           |
|     | -0.48 | -1.1     | 0.17    | 44        | 914            |
|     | 0.03  | -0.88    | 0.9     | 44        | 845            |
|     | 0.12  | -0.87    | 1.1     | 45        | 764            |
|     | 0.16  | -0.68    | 0.98    | 45        | 646            |
|     | 0.48  | -0.52    | 1.4     | 45        | 567            |
|     | 0.069 | -1.2     | 1.2     | 44        | 539            |
|     | 0.12  | -1.1     | 1.3     | 44        | 483            |
|     | -0.034| -1.6     | 1.3     | 44        | 438            |
|     | 0.65  | -1.1     | 2.5     | 41        | 468            |
|     | 0.098 | -1.9     | 2.2     | 39        | 431            |
|     | -0.67 | -2.6     | 1.2     | 38        | 438            |
|     | -0.41 | -2.1     | 1.5     | 37        | 434            |

| t+4 | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|-----|-------|----------|---------|-----------|----------------|
|     | 0.079 | -2.6     | 2.7     | 30        | 373            |
|     | 1.5   | -1.5     | 4.8     | 30        | 355            |
|     | 0.63  | -3.8     | 4.6     | 30        | 316            |
|     | 2     | -2.5     | 7       | 30        | 289            |
|     | 1.6   | -3.5     | 6.6     | 31        | 259            |
|     | -0.015| -5.4     | 5.3     | 30        | 236            |
|     | 0.71  | -5       | 6.4     | 29        | 209            |
|     | 1.9   | -4.1     | 8.1     | 29        | 194            |
|     | 3.7   | -2.3     | 10      | 29        | 179            |
|     | 4.2   | -3.3     | 11      | 29        | 152            |

| t+10| Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|-----|-------|----------|---------|-----------|----------------|
|     |       |          |         |           |                |
| t+11|       |          |         |           |                |
|     |       |          |         |           |                |
| t+12|       |          |         |           |                |

| t+12 | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|------|-------|----------|---------|-----------|----------------|
|      |      |          |         |           |                |

| t+0 | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|-----|-------|----------|---------|-----------|----------------|
|     | -1.3  | -3.4     | 1.1     | 32        | 569            |

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| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | -1.3  | -4.8    | 1.9     | 10        | 52             |
| t+1                      | -1.8  | -9.5    | 6.9     | 10        | 50             |
| t+2                      | -2.1  | -9.8    | 5.6     | 10        | 47             |
| t+3                      | -0.89 | -7.1    | 5.3     | 10        | 46             |
| t+4                      | -3.8  | -11     | 2.9     | 10        | 41             |
| t+5                      | -4.3  | -11     | 2.5     | 10        | 36             |
| t+6                      | -4.8  | -16     | 5.7     | 10        | 35             |
| t+7                      | -4    | -13     | 5.5     | 10        | 31             |
| t+8                      | -4.8  | -14     | 6.2     | 10        | 28             |
| t+9                      | -4.4  | -14     | 5.3     | 9         | 28             |
| t+10                     | -4.4  | -19     | 12      | 10        | 23             |
| t+11                     |       |         |         |           |                |
| t+12                     |       |         |         |           |                |

Outcome P(daily MME > 90), Policy Prescription Limit

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | 0.18  | -2.6    | 3       | 23        | 233            |
| t+1                      | 1.8   | -3.6    | 7.4     | 23        | 173            |
| t+2                      | -3    | -9.8    | 3.8     | 18        | 156            |
| t+3                      | -2.7  | -9.6    | 4.8     | 17        | 171            |
| t+4                      | 1.8   | -5.6    | 10      | 20        | 190            |
| t+5                      | 1.9   | -5.4    | 11      | 14        | 167            |
| t+6                      |       |         |         |           |                |
| t+7                      | -11   | -19     | 0.23    | 6         | 99             |
| t+8                      | -13   | -24     | 1.9     | 6         | 119            |
| t+9                      | -14   | -34     | -2.1    | 3         | 64             |
| t+10                     | -13   | -31     | -0.88   | 3         | 64             |

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| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | -0.77 | -1.6    | 0.12    | 43        | 950            |
| t+1                      | -0.99 | -2.1    | 0.27    | 43        | 889            |
| t+2                      | -1.2  | -4.1    | 3.3     | 42        | 832            |
| t+3                      | -0.87 | -4.9    | 3.3     | 42        | 771            |
| t+4                      | -1.8  | -6.8    | 4.6     | 42        | 706            |
| t+5                      | -0.22 | -5.1    | 5.6     | 39        | 655            |
| t+6                      | -2.9  | -8.6    | 4.9     | 37        | 601            |
| t+7                      | -0.11 | -5.4    | 5.5     | 36        | 541            |
| t+8                      | 1.6   | -3.5    | 6.6     | 36        | 494            |
| t+9                      | 1.1   | -6.6    | 8.2     | 34        | 422            |
| t+10                     | 0.015 | -7.1    | 8.1     | 34        | 383            |
| t+11                     | -0.12 | -9.1    | 9.0     | 33        | 337            |
| t+12                     | 0.38  | -7.8    | 11.0    | 32        | 363            |

Outcome P(daily MME > 90), Policy Naloxone Law

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | 0.32  | -0.75   | 1.2     | 45        | 1018           |
| t+1                      | 0.25  | -1.1    | 1.7     | 44        | 914            |
| t+2                      | 0.95  | -1.5    | 3.3     | 44        | 845            |
| t+3                      | 2.3   | -1.4    | 6.8     | 45        | 764            |
| t+4                      | 1.2   | -3.9    | 6.1     | 45        | 646            |
| t+5                      | 3.2   | -1.3    | 7.5     | 45        | 567            |
| t+6                      | 2.5   | -3.3    | 7.3     | 44        | 539            |
| t+7                      | 2.8   | -3.3    | 8.4     | 44        | 483            |
| t+8                      | 1.6   | -3.5    | 6.2     | 41        | 468            |
| t+9                      | 2.6   | -2.6    | 7.9     | 39        | 431            |
| t+10                     | 1.4   | -4.2    | 6.7     | 38        | 438            |
| t+11                     | -0.67 | -5.3    | 4.0     | 37        | 434            |

Outcome P(4+4 within 90 days), Policy PDMP access

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | -0.031| -0.067  | 0.0048  | 31        | 469            |
| t+1                      | -0.026| -0.077  | 0.027   | 30        | 448            |
| t+2                      | -0.062| -0.12   | 0.031   | 30        | 410            |
| t+3                      | -0.0031| -0.062| 0.049   | 30        | 373            |
| t+4                      | 0.03  | -0.058  | 0.11    | 30        | 355            |
| t+5                      | -0.0009| -0.074| 0.067   | 30        | 316            |

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| time after policy change | Coef. | 95% LCI    | 95% UCI    | N treated | N total matched |
|--------------------------|-------|------------|------------|-----------|----------------|
| t+0                      | -0.015| -0.044     | 0.013      | 32        | 569            |
| t+1                      | -0.064| -0.11      | -0.015     | 29        | 522            |
| t+2                      | -0.069| -0.12      | -0.016     | 28        | 480            |
| t+3                      | -0.065| -0.12      | 0.0067     | 24        | 442            |
| t+4                      | -0.069| -0.14      | 0.02       | 24        | 410            |
| t+5                      | -0.072| -0.14      | 0.026      | 22        | 362            |
| t+6                      | -0.085| -0.17      | 0.015      | 19        | 321            |
| t+7                      | -0.072| -0.15      | 0.02       | 16        | 289            |
| t+8                      | -0.085| -0.17      | 0.016      | 15        | 266            |
| t+9                      | -0.064| -0.17      | 0.07       | 15        | 236            |
| t+10                     | -0.063| -0.18      | 0.072      | 15        | 209            |
| t+11                     | -0.059| -0.18      | 0.1        | 14        | 183            |
| t+12                     | -0.083| -0.18      | 0.084      | 10        | 158            |

Outcome P(4+4 within 90 days), Policy Pain Clinic

| time after policy change | Coef. | 95% LCI    | 95% UCI    | N treated | N total matched |
|--------------------------|-------|------------|------------|-----------|----------------|
| t+0                      | 0.0031| -0.019     | 0.03       | 10        | 52             |
| t+1                      | -0.025| -0.069     | 0.026      | 10        | 50             |
| t+2                      | -0.06  | -0.12      | 0.0017     | 10        | 47             |
| t+3                      | -0.00095| -0.055    | 0.063      | 10        | 46             |
| t+4                      | 0.00025| -0.057    | 0.065      | 10        | 41             |
| t+5                      | -0.056| -0.14      | 0.042      | 10        | 36             |
| t+6                      | -0.073| -0.18      | 0.061      | 10        | 35             |
| t+7                      | -0.061| -0.18      | 0.084      | 10        | 31             |
| t+8                      | -0.021| -0.12      | 0.088      | 10        | 28             |
| t+9                      | -0.062| -0.18      | 0.075      | 9         | 28             |
| t+10                     | -0.012| -0.14      | 0.14       | 10        | 23             |
| t+11                     |       |            |            |           |                |
| t+12                     |       |            |            |           |                |

Outcome P(4+4 within 90 days), Policy Prescription Limit

| t+0                      | -0.052| -0.099    | 0.0048    | 23        | 233            |
| time after policy change | Coef. | 95% LCI      | 95% UCI      | N treated | N total matched |
|--------------------------|-------|--------------|--------------|-----------|----------------|
| t+0                      | -0.0078 | -0.026 | 0.01 | 43 | 950 |
| t+1                      | -0.025 | -0.023 | 0.016 | 43 | 889 |
| t+2                      | 0.011 | -0.025 | 0.045 | 42 | 832 |
| t+3                      | -0.031 | -0.077 | 0.018 | 42 | 771 |
| t+4                      | -0.037 | -0.089 | 0.02 | 42 | 706 |
| t+5                      | -0.03 | -0.084 | 0.03 | 39 | 655 |
| t+6                      | -0.058 | -0.12 | 0.013 | 37 | 601 |
| t+7                      | -0.052 | -0.12 | 0.017 | 36 | 541 |
| t+8                      | -0.016 | -0.097 | 0.068 | 36 | 494 |
| t+9                      | -0.033 | -0.12 | 0.058 | 34 | 422 |
| t+10                     | -0.04 | -0.14 | 0.053 | 34 | 383 |
| t+11                     | -0.037 | -0.14 | 0.073 | 33 | 337 |
| t+12                     | -0.064 | -0.14 | 0.031 | 32 | 363 |

Outcome P(4+4 within 90 days), Policy Good Samaritan
| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|-------------------------|-------|---------|---------|-----------|----------------|
| Outcome P(Opioid Use Disorder and Overdose), Policy PDMP access |
| t+0                     | 0.096 | -0.27   | 0.43    | 31        | 469            |
| t+1                     | -0.13 | -0.62   | 0.39    | 30        | 448            |
| t+2                     | 0.17  | -0.55   | 0.92    | 30        | 410            |
| t+3                     | -0.3  | -1.2    | 0.67    | 30        | 373            |
| t+4                     | -0.3  | -1.4    | 1       | 30        | 355            |
| t+5                     | 0.75  | -0.72   | 2.2     | 30        | 316            |
| t+6                     | 0.82  | -1.1    | 2.7     | 30        | 289            |
| t+7                     | 0.53  | -1.8    | 2.9     | 31        | 259            |
| t+8                     | -0.088| -3.1    | 3       | 30        | 236            |
| t+9                     | 0.23  | -3.2    | 3.8     | 29        | 209            |
| t+10                    | 0.0026| -4.3    | 4.3     | 29        | 194            |
| t+11                    | 0.39  | -3.9    | 5.3     | 29        | 179            |
| t+12                    | 1.4   | -2.7    | 5.8     | 29        | 152            |
| Outcome P(Opioid Use Disorder and Overdose), Policy mandatory PDMP |
| t+0                     | 0.13  | -1      | 1.3     | 32        | 569            |
| t+1                     | 0.43  | -1.5    | 2.1     | 29        | 522            |
| t+2                     | -0.59 | -3.2    | 2       | 28        | 480            |
| t+3                     | -1.1  | -4.4    | 2.1     | 24        | 442            |
| t+4                     | -0.6  | -4.4    | 2.6     | 24        | 410            |
| t+5                     | 0.83  | -3      | 4.1     | 22        | 362            |
| t+6                     | 1.6   | -3.1    | 5.7     | 19        | 321            |
| t+7                     | 4.2   | -0.29   | 7.2     | 16        | 289            |
| t+8                     | 4.1   | -1      | 7.3     | 15        | 266            |
| t+9                     | 3.6   | -3.1    | 7.9     | 15        | 236            |
| t+10                    | 2.4   | -5.4    | 7.2     | 15        | 209            |
| t+11                    | 1.4   | -9.6    | 8.9     | 14        | 183            |
| t+12                    | -0.6  | -14     | 5.7     | 10        | 158            |
| Outcome P(Opioid Use Disorder and Overdose), Policy Pain Clinic |
| t+0                     | -0.31 | -1.2    | 0.46    | 10        | 52             |
| t+1                     | -0.5  | -1.9    | 0.84    | 10        | 50             |
| t+2                     | -0.14 | -1.6    | 1.1     | 10        | 47             |
| t+3                     | 0.089 | -0.93   | 1.1     | 10        | 46             |
| t+4                     | -1.2  | -4.2    | 1.5     | 10        | 41             |
| t+5                     | -1.2  | -5.1    | 1.9     | 10        | 36             |
| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| **Outcome P(Opioid Use Disorder and Overdose), Policy Prescription Limit** |
| t+0                      | 0.49  | -0.71   | 1.7     | 23        | 233            |
| t+1                      | 1.4   | 0.019   | 2.8     | 23        | 173            |
| t+2                      | -0.35 | -2.4    | 1.6     | 18        | 156            |
| t+3                      | -0.42 | -4.1    | 2.5     | 17        | 171            |
| t+4                      | 0.12  | -3.7    | 3.7     | 20        | 190            |
| t+5                      | 2     | -2.6    | 5.5     | 14        | 167            |
| t+6                      | 0.23  | -10     | 4.2     | 6         | 99             |
| t+7                      | 0.0028| -11     | 5.1     | 6         | 119            |
| t+8                      | 3.8   | -16     | 12      | 3         | 64             |
| t+10                     | 3.6   | -17     | 13      | 3         | 64             |
| t+11                     | 5.5   | -12     | 20      | 2         | 40             |
| t+12                     | 6.6   | -9.3    | 19      | 2         | 40             |
| **Outcome P(Opioid Use Disorder and Overdose), Policy Good Samaritan** |
| t+0                      | 0.29  | -0.23   | 0.78    | 43        | 950            |
| t+1                      | 0.46  | -0.38   | 1.3     | 43        | 889            |
| t+2                      | 0.54  | -0.66   | 1.6     | 42        | 832            |
| t+3                      | 0.54  | -1.1    | 1.8     | 42        | 771            |
| t+4                      | 1.1   | -0.8    | 2.9     | 42        | 706            |
| t+5                      | 2.1   | -0.39   | 4.4     | 39        | 655            |
| t+6                      | 1.1   | -1.7    | 3.8     | 37        | 601            |
| t+7                      | -0.39 | -3.8    | 3.5     | 36        | 541            |
| t+8                      | 0.43  | -3.5    | 4.4     | 36        | 494            |
| t+9                      | -0.59 | -5.5    | 4.4     | 34        | 422            |
| t+10                     | -1.3  | -7.6    | 5       | 34        | 383            |
| t+11                     | -0.18 | -6.2    | 5.8     | 33        | 337            |
| t+12                     | -0.61 | -7.5    | 5.6     | 32        | 363            |
| **Outcome P(Opioid Use Disorder and Overdose), Policy Naloxone Law** |
| t+0                      | 0.56  | -0.065  | 1.1     | 45        | 1018           |
| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|-------------------------|-------|---------|---------|-----------|----------------|
| t+0                     | 0.054 | -0.41   | 0.45    | 31        | 469            |
| t+1                     | -0.23 | -0.95   | 0.49    | 30        | 448            |
| t+2                     | -0.23 | -0.87   | 0.41    | 30        | 410            |
| t+3                     | -0.58 | -1.7    | 0.47    | 30        | 373            |
| t+4                     | -0.53 | -1.7    | 0.74    | 30        | 355            |
| t+5                     | -0.14 | -1.2    | 0.93    | 30        | 316            |
| t+6                     | 0.041 | -1.3    | 1.4     | 30        | 289            |
| t+7                     | -0.22 | -1.5    | 1.2     | 31        | 259            |
| t+8                     | -0.34 | -2.1    | 1.3     | 30        | 236            |
| t+9                     | -0.26 | -2.3    | 1.7     | 29        | 209            |
| t+10                    | -0.8  | -2.8    | 1.2     | 29        | 194            |
| t+11                    | -0.89 | -3.1    | 1.4     | 29        | 179            |
| t+12                    | -0.92 | -3      | 1.2     | 29        | 152            |

Outcome P(taking MAT drug), Policy mandatory PDMP

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|-------------------------|-------|---------|---------|-----------|----------------|
| t+0                     | -0.062| -0.46   | 0.35    | 32        | 569            |
| t+1                     | 0.084 | -0.62   | 0.77    | 29        | 522            |
| t+2                     | 0.22  | -0.72   | 1.3     | 28        | 480            |
| t+3                     | 0.46  | -0.41   | 1.2     | 24        | 442            |
| t+4                     | 0.63  | -0.69   | 1.9     | 24        | 410            |
| t+5                     | 0.94  | -0.96   | 2.6     | 22        | 362            |
| t+6                     | 1.6   | -0.71   | 3.5     | 19        | 321            |
| t+7                     | 1.5   | -0.16   | 2.7     | 16        | 289            |
| t+8                     | 1.2   | -0.72   | 2.5     | 15        | 266            |
| t+9                     | 1.3   | -0.74   | 3.1     | 15        | 236            |
| t+10                    | 0.68  | -2.3    | 3.1     | 15        | 209            |
| time after policy change | Outcome | P(taking MAT drug), Policy Pain Clinic | time after policy change | Outcome | P(taking MAT drug), Policy Prescription Limit | time after policy change | Outcome | P(taking MAT drug), Policy Good Samaritan |
|--------------------------|---------|---------------------------------------|--------------------------|---------|---------------------------------------------|--------------------------|---------|------------------------------------------|
|                          | Coef.   | 95% LCI                              | 95% UCI                  | N       | treated                                    | N total matched          | Coef.   | 95% LCI                              | 95% UCI                  | N       | treated                                    | N total matched          | Coef.   | 95% LCI                              | 95% UCI                  | N       | treated                                    | N total matched          |
|                          |         |                                      |                          |         | treated                                    |                          |         |                                      |                          |         | treated                                    |                          |         |                                      |                          |         | treated                                    |                          |
| t+0                      | 0.12    | -0.22                                | 0.52                     | 10      | 52                                         |                          | 0.63    | 0.31                                   | 0.94                     | 23      | 233                                        |                          | -0.16   | -0.29                                   | -0.013                    | 43      | 950                                        |                          |
| t+1                      | 0.44    | -0.017                               | 0.85                     | 10      | 50                                         |                          | 0.53    | -0.26                                  | 1.3                      | 23      | 173                                        |                          | -0.21   | -0.5                                   | 0.11                      | 43      | 889                                        |                          |
| t+2                      | 0.45    | -0.4                                 | 1.3                      | 10      | 47                                         |                          | 1.1     | 0.042                                  | 2.1                      | 18      | 156                                        |                          | 1.9     | -3.3                                   | 4.7                      | 3       | 64                                         |                          |
| t+3                      | 0.23    | -0.76                                | 1.2                      | 10      | 46                                         |                          | 1.4     | 0.12                                   | 2.5                      | 17      | 171                                        |                          | 2.1     | -4.4                                   | 4.9                      | 3       | 64                                         |                          |
| t+4                      | 0.53    | -0.49                                | 1.4                      | 10      | 41                                         |                          | 2.2     | 0.56                                   | 3.6                      | 20      | 190                                        |                          | 2.2     | -0.26                                  | 4.6                      | 2       | 40                                         |                          |
| t+5                      | 0.83    | -0.41                                | 2                       | 10      | 36                                         |                          | 2.6     | -0.33                                  | 4.8                      | 14      | 167                                        |                          | 2.3     | -0.59                                  | 5                       | 2       | 40                                         |                          |
| t+6                      | 1       | -0.36                                | 2.4                      | 10      | 35                                         |                          | 0.94    | -2.7                                   | 2.8                      | 6       | 99                                         |                          | 0.39    | -4.3                                   | 3                       | 6       | 119                                        |                          |
| t+7                      | 0.85    | -1.1                                 | 2.4                      | 10      | 31                                         |                          | 1.9     | -3.3                                   | 4.7                      | 3       | 64                                         |                          | 2.1     | -4.4                                   | 4.9                      | 3       | 64                                         |                          |
| t+8                      | 0.89    | -0.91                                | 2.3                      | 10      | 28                                         |                          | 0.99    | -0.99                                  | 2.7                      | 9       | 28                                         |                          | 2.2     | -0.26                                  | 4.6                      | 2       | 40                                         |                          |
| t+9                      | 0.99    | -0.99                                | 2.7                      | 9       | 28                                         |                          | 1       | -0.89                                  | 2.8                      | 10      | 23                                         |                          | 2.3     | -0.59                                  | 5                       | 2       | 40                                         |                          |
| t+10                     | 0.85    | -2.7                                 | 2.8                      | 6       | 99                                         |                          | 0.39    | -4.3                                   | 3                       | 6       | 119                                        |                          | 2.1     | -4.4                                   | 4.9                      | 3       | 64                                         |                          |
| t+11                     | 1       | -0.36                                | 2.4                      | 10      | 35                                         |                          | 2.3     | -0.59                                  | 5                       | 2       | 40                                         |                          | 2.2     | -0.26                                  | 4.6                      | 2       | 40                                         |                          |
| t+12                     | 0.17    | -0.41                                | 0.72                     | 39      | 655                                        |                          | 0.17    | -0.41                                  | 0.72                     | 39      | 655                                        |                          | 0.39    | -4.3                                   | 3                       | 6       | 119                                        |                          |

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| time after policy change | Coef. | 95% LCI   | 95% UCI   | N treated | N total matched |
|--------------------------|-------|-----------|-----------|-----------|----------------|
| **Outcome P(taking MAT drug), Policy Naloxone Law** |       |           |           |           |                |
| t+6                      | 0.45  | -0.35     | 1.3       | 37        | 601           |
| t+7                      | 0.57  | -0.22     | 1.3       | 36        | 541           |
| t+9                      | 0.53  | -0.53     | 1.5       | 36        | 494           |
| t+10                     | 1     | 0.049     | 2         | 34        | 422           |
| t+11                     | 1.7   | 0.39      | 3         | 33        | 337           |
| t+12                     | 1.4   | 0.28      | 3         | 32        | 363           |

| time after policy change | Coef. | 95% LCI   | 95% UCI   | N treated | N total matched |
|--------------------------|-------|-----------|-----------|-----------|----------------|
| **Outcome All Opioid Mortality, Policy Naloxone Law** |       |           |           |           |                |
| t+0                      | -0.0036 | -0.24    | 0.21      | 45        | 1018          |
| t+1                      | -0.0033 | -0.32    | 0.32      | 44        | 914           |
| t+2                      | -0.16  | -0.59     | 0.27      | 44        | 845           |
| t+3                      | -0.26  | -0.78     | 0.28      | 45        | 764           |
| t+4                      | -0.46  | -1.2      | 0.42      | 45        | 646           |
| t+5                      | -0.22  | -1.2      | 0.86      | 45        | 567           |
| t+6                      | -0.25  | -1.1      | 0.68      | 44        | 539           |
| t+7                      | -0.18  | -1.1      | 0.92      | 44        | 483           |
| t+8                      | 0.009  | -0.99     | 1         | 44        | 438           |
| t+9                      | 0.26   | -0.84     | 1.3       | 41        | 468           |
| t+10                     | 0.17   | 1         | 1.3       | 39        | 431           |
| t+11                     | 1.1    | -0.037    | 2.1       | 38        | 438           |
| t+12                     | 1.4    | -0.069    | 2.6       | 37        | 434           |

| time after policy change | Coef. | 95% LCI   | 95% UCI   | N treated | N total matched |
|--------------------------|-------|-----------|-----------|-----------|----------------|
| **Outcome All Opioid Mortality, Policy PDMP access** |       |           |           |           |                |
| t+0                      | 36    | 1.8       | 68        | 31        | 469           |
| t+1                      | 9.8   | -15       | 30        | 30        | 448           |
| t+2                      | 9.9   | -19       | 38        | 30        | 410           |
| t+3                      | -11   | -34       | 12        | 30        | 373           |
| t+4                      | -23   | -47       | 6.5       | 30        | 355           |
| t+5                      | -18   | -50       | 17        | 30        | 316           |
| t+6                      | -17   | -58       | 24        | 30        | 289           |
| t+7                      | -25   | -75       | 30        | 31        | 259           |
| t+8                      | -37   | -89       | 24        | 31        | 237           |
| t+9                      | -59   | -130      | 29        | 30        | 211           |
| t+10                     | -30   | -120      | 67        | 29        | 194           |
| t+11                     | -40   | -140      | 74        | 29        | 179           |
| t+12                     | -45   | -160      | 74        | 29        | 152           |

| time after policy change | Coef. | 95% LCI   | 95% UCI   | N treated | N total matched |
|--------------------------|-------|-----------|-----------|-----------|----------------|
| **Outcome All Opioid Mortality, Policy mandatory PDMP** |       |           |           |           |                |
| t+0                      | 0.92  | -23       | 27        | 33        | 571           |
| t+1  | -7.8 | -34  | 24  | 32  | 528 |
|------|------|------|-----|-----|-----|
| t+2  | -15  | -42  | 16  | 29  | 482 |
| t+3  | -8.8 | -50  | 35  | 28  | 450 |
| t+4  | -29  | -100 | 50  | 24  | 410 |
| t+5  | 8.3  | -74  | 93  | 24  | 366 |
| t+6  | 7.7  | -71  | 83  | 22  | 327 |
| t+7  | -33  | -150 | 70  | 19  | 295 |
| t+8  | -61  | -200 | 59  | 16  | 268 |
| t+9  | -51  | -200 | 57  | 15  | 236 |
| t+10 | 20   | -110 | 110 | 15  | 209 |
| t+11 | -9.5 | -170 | 100 | 15  | 185 |
| t+12 | -26  | -200 | 120 | 14  | 166 |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|-----------------|

Outcome All Opioid Mortality, Policy Pain Clinic

| t+0  | -25  | -80  | 29  | 10  | 52  |
|------|------|------|-----|-----|-----|
| t+1  | -14  | -46  | 14  | 10  | 50  |
| t+2  | -18  | -68  | 27  | 10  | 47  |
| t+3  | -7.4 | -33  | 23  | 10  | 46  |
| t+4  | 0.067| -38  | 36  | 10  | 41  |
| t+5  | 13   | -18  | 40  | 10  | 36  |
| t+6  | -4   | -42  | 40  | 10  | 35  |
| t+7  | -21  | -75  | 31  | 10  | 31  |
| t+8  | -9.7 | -46  | 22  | 10  | 28  |
| t+9  | 17   | -24  | 57  | 9   | 28  |
| t+10 | -23  | -73  | 25  | 10  | 23  |
| t+11 |      |      |     |     |     |
| t+12 |      |      |     |     |     |

Outcome All Opioid Mortality, Policy Prescription Limit

| t+0  | 2.5  | -40  | 45  | 23  | 233 |
|------|------|------|-----|-----|-----|
| t+1  | 9.4  | -42  | 64  | 23  | 173 |
| t+2  | 8.9  | -46  | 64  | 18  | 156 |
| t+3  | 40   | -38  | 130 | 17  | 171 |
| t+4  | -7.2 | -70  | 54  | 20  | 190 |
| t+5  | 3.8  | -47  | 58  | 20  | 190 |
| t+6  |      |      |     |     |     |
| t+7  | -50  | -140 | 28  | 12  | 171 |
| t+8  | -50  | -310 | 93  | 6   | 119 |
| t+9  | -62  | -370 | 91  | 6   | 118 |
| t+10 | -68  | -440 | 100 | 3   | 64  |
| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| **Outcome All Opioid Mortality, Policy Good Samaritan** |       |         |         |           |                |
| t+0                      | 7.9   | -11     | 27      | 43        | 950            |
| t+1                      | -3.7  | -25     | 17      | 43        | 889            |
| t+2                      | 11    | -6.6    | 30      | 43        | 842            |
| t+3                      | 18    | 0.18    | 37      | 42        | 771            |
| t+4                      | 11    | -7.9    | 32      | 42        | 706            |
| t+5                      | -7.5  | -45     | 37      | 42        | 664            |
| t+6                      | 10    | -31     | 56      | 39        | 613            |
| t+7                      | 23    | -26     | 71      | 37        | 549            |
| t+8                      | 40    | -10     | 91      | 36        | 494            |
| t+9                      | 25    | -19     | 66      | 36        | 440            |
| t+10                     | 40    | -16     | 87      | 34        | 383            |
| t+11                     | 63    | 9       | 120     | 34        | 348            |
| t+12                     | 61    | 6       | 110     | 33        | 375            |
| **Outcome All Opioid Mortality, Policy Naloxone Law** |       |         |         |           |                |
| t+0                      | -13   | -28     | 5       | 45        | 1018           |
| t+1                      | -12   | -32     | 8.1     | 44        | 914            |
| t+2                      | 6.8   | -16     | 31      | 44        | 845            |
| t+3                      | 13    | -12     | 36      | 45        | 764            |
| t+4                      | 9.4   | -11     | 31      | 45        | 646            |
| t+5                      | 43    | 18      | 72      | 45        | 567            |
| t+6                      | 56    | 27      | 85      | 45        | 541            |
| t+7                      | 80    | 37      | 120     | 44        | 483            |
| t+8                      | 90    | 44      | 140     | 44        | 438            |
| t+9                      | 76    | 33      | 120     | 44        | 477            |
| t+10                     | 100   | 53      | 150     | 41        | 443            |
| t+11                     | 95    | 42      | 150     | 39        | 446            |
| t+12                     | 110   | 50      | 170     | 38        | 443            |
| **Outcome Natural Opioid Mortality, Policy PDMP access** |       |         |         |           |                |
| t+0                      | 7.1   | -3.1    | 18      | 31        | 469            |
| t+1                      | -0.56 | -11     | 9       | 30        | 448            |
| t+2                      | 0.67  | -12     | 13      | 30        | 410            |
| t+3                      | -11   | -27     | 5.9     | 30        | 373            |
| t+4                      | -16   | -31     | 2.7     | 30        | 355            |
| t+5                      | -7.2  | -23     | 11      | 30        | 316            |
| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | -1.2  | -12     | 9.9     | 33        | 571            |
| t+1                      | -12   | -23     | -0.95   | 32        | 528            |
| t+2                      | -17   | -32     | -1.2    | 29        | 482            |
| t+3                      | -22   | -36     | -9.3    | 28        | 450            |
| t+4                      | -26   | -49     | 0.43    | 24        | 410            |
| t+5                      | -5.5  | -24     | 12      | 24        | 366            |
| t+6                      | -16   | -39     | 6.2     | 22        | 327            |
| t+7                      | -37   | -71     | -4.9    | 19        | 295            |
| t+8                      | -24   | -57     | -0.24   | 16        | 268            |
| t+9                      | -34   | -65     | -2.9    | 15        | 236            |
| t+10                     | -34   | -75     | 4.6     | 15        | 209            |
| t+11                     | -30   | -72     | 4.3     | 15        | 185            |
| t+12                     | -61   | -110    | -21     | 14        | 166            |

Outcome Natural Opioid Mortality, Policy Pain Clinic

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | -12   | -36     | 10      | 10        | 52             |
| t+1                      | -2.8  | -26     | 23      | 10        | 50             |
| t+2                      | -21   | -58     | 15      | 10        | 47             |
| t+3                      | -11   | -34     | 15      | 10        | 46             |
| t+4                      | -6.2  | -33     | 25      | 10        | 41             |
| t+5                      | 3.1   | -21     | 31      | 10        | 36             |
| t+6                      | -3.6  | -33     | 27      | 10        | 35             |
| t+7                      | -13   | -48     | 25      | 10        | 31             |
| t+8                      | -18   | -57     | 22      | 10        | 28             |
| t+9                      | -5.6  | -24     | 12      | 9         | 28             |
| t+10                     | 9.6   | -20     | 45      | 10        | 23             |
| t+11                     |       |         |         |           |                |
| t+12                     |       |         |         |           |                |

Outcome Natural Opioid Mortality, Policy Prescription Limit

| t+0                      | 4.9   | -15     | 28      | 23        | 233            |
| time after policy change | Coef.  | 95% LCI  | 95% UCI  | N treated | N total matched |
|-------------------------|--------|----------|----------|-----------|----------------|
| Outcome Natural Opioid Mortality, Policy Good Samaritan |
| t+0                     | -1.7   | -12      | 9.2      | 43        | 950            |
| t+1                     | 4.8    | -5.2     | 14       | 43        | 889            |
| t+2                     | 4.9    | -4.3     | 14       | 43        | 842            |
| t+3                     | 1.7    | -9.2     | 12       | 42        | 771            |
| t+4                     | -3.5   | -16      | 11       | 42        | 706            |
| t+5                     | -7.6   | -24      | 11       | 42        | 664            |
| t+6                     | -3     | -17      | 13       | 39        | 613            |
| t+7                     | -0.68  | -13      | 13       | 37        | 549            |
| t+8                     | -5.9   | -20      | 0.57     | 36        | 494            |
| t+9                     | -14    | -29      | 0.57     | 36        | 440            |
| t+10                    | -15    | -32      | 0.76     | 34        | 383            |
| t+11                    | -3.9   | -23      | 14       | 34        | 348            |
| t+12                    | -14    | -34      | 6.8      | 33        | 375            |
| Outcome Natural Opioid Mortality, Policy Naloxone Law |
| t+0                     | -9.2   | -19      | 1.1      | 45        | 1018           |
| t+1                     | -2.3   | -13      | 8        | 44        | 914            |
| t+2                     | -1.5   | -13      | 9.9      | 44        | 845            |
| t+3                     | 0.28   | -11      | 11       | 45        | 764            |
| t+4                     | -9.8   | -26      | 7        | 45        | 646            |
| t+5                     | 4.3    | -14      | 20       | 45        | 567            |
| t+6                     | 4.2    | -6       | 16       | 45        | 541            |
| t+7                     | -7.2   | -19      | 5.7      | 44        | 483            |
| t+8                     | 12     | -3.7     | 29       | 44        | 438            |
| t+9                     | -4.2   | -18      | 12       | 44        | 477            |
| t+10                    | 6      | -12      | 25       | 41        | 443            |
| t+11  | 20  | 2.3  | 40  | 39  | 446  |
|-------|-----|------|-----|-----|------|
| t+12  | 14  | -1.1 | 32  | 38  | 443  |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|--------|---------|-----------|----------------|

**Outcome Methadone Mortality, Policy PDMP access**

| t+0  | -2.3 | -11   | 6.2    | 31        | 469             |
| t+1  | -3.2 | -8.5  | 2.2    | 30        | 448             |
| t+2  | -5.4 | -11   | 0.82   | 30        | 410             |
| t+3  | -3.7 | -8.9  | 1.7    | 30        | 373             |
| t+4  | -5   | -9.9  | 0.096  | 30        | 355             |
| t+5  | 2.2  | -7.2  | 11     | 30        | 316             |
| t+6  | 1.3  | -5.2  | 7.6    | 30        | 289             |
| t+7  | -1.5 | -7.3  | 3.8    | 31        | 259             |
| t+8  | -5.2 | -10   | 0.93   | 31        | 237             |
| t+9  | -0.84| -6.6  | 4.8    | 30        | 211             |
| t+10 | -1.4 | -11   | 7.2    | 29        | 194             |
| t+11 | -4.2 | -12   | 3.8    | 29        | 179             |
| t+12 | -6.9 | -18   | 3.2    | 29        | 152             |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|--------|---------|-----------|----------------|

**Outcome Methadone Mortality, Policy mandatory PDMP**

| t+0  | 3.8  | -2.3  | 9.6    | 33        | 571             |
| t+1  | -2.6 | -7.7  | 2      | 32        | 528             |
| t+2  | -7.9 | -13   | -1.9   | 29        | 482             |
| t+3  | -5.6 | -11   | 0.089  | 28        | 450             |
| t+4  | -10  | -18   | -1.8   | 24        | 410             |
| t+5  | -0.72 | -6.7  | 5.4    | 24        | 366             |
| t+6  | 1.2  | -7    | 9.9    | 22        | 327             |
| t+7  | -9.4 | -21   | 4.7    | 19        | 295             |
| t+8  | -6   | -16   | 4.3    | 16        | 268             |
| t+9  | -5.4 | -16   | 4.1    | 15        | 236             |
| t+10 | -11  | -25   | 0.0075 | 15        | 209             |
| t+11 | -16  | -31   | -3.1   | 15        | 185             |
| t+12 | 2.6  | -8.6  | 13     | 14        | 166             |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|--------|---------|-----------|----------------|

**Outcome Methadone Mortality, Policy Pain Clinic**

| t+0  | 4.3  | -2.5  | 12     | 10        | 52             |
| t+1  | 4.4  | -2.5  | 11     | 10        | 50             |
| t+2  | 1.2  | -5.9  | 8.3    | 10        | 47             |
| t+3  | -5.4 | -15   | 4.6    | 10        | 46             |
| t+4  | 9.8  | 1.3   | 18     | 10        | 41             |
| t+5  | -4.8 | -15   | 2.6    | 10        | 36             |

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| t+6  | -2.7 | -13  | 9.4  | 10  | 35  |
| t+7  | -6.7 | -18  | 5    | 10  | 31  |
| t+8  | -14  | -29  | -1.9 | 10  | 28  |
| t+9  | -4.8 | -16  | 4.5  | 9   | 28  |
| t+10 | -11  | -22  | 0.25 | 10  | 23  |
| t+11 |      |      |      |     |     |
| t+12 |      |      |      |     |     |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| Outcome Methadone Mortality, Policy Prescription Limit |
| t+0                      | -0.23 | -5.6   | 4.6     | 23        | 233            |
| t+1                      | 0.84  | -7     | 9       | 23        | 173            |
| t+2                      | 1.1   | -8.2   | 11      | 18        | 156            |
| t+3                      | 8.4   | -0.15  | 18      | 17        | 171            |
| t+4                      | -1.4  | -13    | 9.8     | 20        | 190            |
| t+5                      | 5.4   | -5     | 16      | 20        | 190            |
| t+6                      |       |        |         |           |                |
| t+7                      | -8.9  | -26    | 8       | 12        | 171            |
| t+8                      | 9.5   | -1.3   | 29      | 6         | 119            |
| t+9                      | 2.2   | -6.6   | 13      | 6         | 118            |
| t+10                     | 5.2   | -5     | 13      | 3         | 64             |
| t+11                     | 4.3   | -6.7   | 19      | 3         | 61             |
| t+12                     | 3.8   | -4.4   | 14      | 2         | 40             |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| Outcome Methadone Mortality, Policy Good Samaritan |
| t+0                      | -1.5  | -5.1   | 2.4     | 43        | 950            |
| t+1                      | -3.4  | -7.1   | 0.15    | 43        | 889            |
| t+2                      | 0.86  | -3.2   | 4.9     | 43        | 842            |
| t+3                      | -0.061| -4.2   | 4.3     | 42        | 771            |
| t+4                      | 0.82  | -4.3   | 5.7     | 42        | 706            |
| t+5                      | 0.82  | -3.6   | 6.1     | 42        | 664            |
| t+6                      | 3.9   | -0.15  | 8.2     | 39        | 613            |
| t+7                      | -3.6  | -9.1   | 2.3     | 37        | 549            |
| t+8                      | -1.7  | -7.3   | 4.1     | 36        | 494            |
| t+9                      | -4.4  | -11    | 2.4     | 36        | 440            |
| t+10                     | -4.8  | -11    | 1.8     | 34        | 383            |
| t+11                     | -1.4  | -7     | 4.6     | 34        | 348            |
| t+12                     | 2.2   | -4.1   | 8.9     | 33        | 375            |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| Outcome Methadone Mortality, Policy Naloxone Law |
| t+0                      | -2    | -5.7   | 1.7     | 45        | 1018           |
| Time after policy change | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|-------------------------|-------|----------|---------|-----------|----------------|
| **Outcome Heroin Mortality, Policy PDMP access** |       |          |         |           |                |
| t+0                     | 12    | -9.8     | 30      | 31        | 469            |
| t+1                     | 0.55  | -12      | 13      | 30        | 448            |
| t+2                     | 5.2   | -12      | 22      | 30        | 410            |
| t+3                     | -11   | -29      | 6.7     | 30        | 373            |
| t+4                     | -1    | -16      | 15      | 30        | 355            |
| t+5                     | -18   | -50      | 19      | 30        | 316            |
| t+6                     | -3.6  | -29      | 26      | 30        | 289            |
| t+7                     | -9.8  | -33      | 19      | 31        | 259            |
| t+8                     | -11   | -42      | 25      | 31        | 237            |
| t+9                     | -5.8  | -38      | 30      | 30        | 211            |
| t+10                    | -14   | -60      | 36      | 29        | 194            |
| t+11                    | -2.2  | -44      | 41      | 29        | 179            |
| t+12                    | 12    | -15      | 41      | 29        | 152            |
| **Outcome Heroin Mortality, Policy mandatory PDMP** |       |          |         |           |                |
| t+0                     | -3.3  | -15      | 8.5     | 33        | 571            |
| t+1                     | 2.7   | -12      | 18      | 32        | 528            |
| t+2                     | -2.4  | -16      | 13      | 29        | 482            |
| t+3                     | -9.2  | -26      | 8.4     | 28        | 450            |
| t+4                     | -6.6  | -33      | 19      | 24        | 410            |
| t+5                     | 2.3   | -25      | 30      | 24        | 366            |
| t+6                     | 2.7   | -29      | 31      | 22        | 327            |
| t+7                     | -24   | -59      | 6.9     | 19        | 295            |
| t+8                     | -28   | -74      | 12      | 16        | 268            |
| t+9                     | -12   | -65      | 32      | 15        | 236            |
| t+10                    | -9.4  | -72      | 37      | 15        | 209            |
| Time after policy change | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|--------------------------|-------|----------|---------|-----------|----------------|
| t+11                     | -4.9  | -63      | 43      | 15        | 185            |
| t+12                     | 5.1   | -47      | 54      | 14        | 166            |

Outcome Heroin Mortality, Policy Pain Clinic

| Time after policy change | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|--------------------------|-------|----------|---------|-----------|----------------|
| t+0                      | -15   | -32      | -0.3    | 10        | 52             |
| t+1                      | 3.7   | -5.6     | 11      | 10        | 50             |
| t+2                      | 12    | -2.4     | 23      | 10        | 47             |
| t+3                      | 17    | -3.1     | 34      | 10        | 46             |
| t+4                      | 19    | -4.5     | 37      | 10        | 41             |
| t+5                      | 25    | -7.2     | 52      | 10        | 36             |
| t+6                      | 26    | -0.58    | 50      | 10        | 35             |
| t+7                      | 22    | -13      | 48      | 10        | 31             |
| t+8                      | 20    | -21      | 54      | 10        | 28             |
| t+9                      | 20    | -36      | 61      | 9         | 28             |
| t+10                     | 10    | -74      | 71      | 10        | 23             |
| t+11                     |       |          |         |           |                |
| t+12                     |       |          |         |           |                |

Outcome Heroin Mortality, Policy Prescription Limit

| Time after policy change | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|--------------------------|-------|----------|---------|-----------|----------------|
| t+0                      | -8.4  | -30      | 13      | 23        | 233            |
| t+1                      | 16    | -11      | 40      | 23        | 173            |
| t+2                      | -7.6  | -25      | 13      | 18        | 156            |
| t+3                      | 6.4   | -22      | 31      | 17        | 171            |
| t+4                      | -15   | -55      | 21      | 20        | 190            |
| t+5                      | -2.9  | -45      | 33      | 20        | 190            |
| t+6                      |       |          |         |           |                |
| t+7                      | -31   | -80      | 16      | 12        | 171            |
| t+8                      | -51   | -150     | 14      | 6         | 119            |
| t+9                      | -74   | -210     | 7.7     | 6         | 118            |
| t+10                     | -48   | -280     | 60      | 3         | 64             |
| t+11                     | -49   | -300     | 49      | 3         | 61             |
| t+12                     | 3.9   | -96      | 70      | 2         | 40             |

Outcome Heroin Mortality, Policy Good Samaritan

| Time after policy change | Coef. | 95% LCI  | 95% UCI | N treated | N total matched |
|--------------------------|-------|----------|---------|-----------|----------------|
| t+0                      | -0.82 | -8.3     | 6.3     | 43        | 950            |
| t+1                      | -3    | -9.7     | 3.1     | 43        | 889            |
| t+2                      | 1.1   | -7.7     | 9.4     | 43        | 842            |
| t+3                      | 3.6   | -9       | 3.1     | 42        | 771            |
| t+4                      | -5.4  | -20      | 9.7     | 42        | 706            |
| t+5                      | -4.8  | -21      | 14.4    | 42        | 664            |
| Time (t) | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|---------|-------|--------|--------|-----------|----------------|
| t+0     | -5.1  | -12    | 2.7    | 45        | 1018           |
| t+1     | -1.3  | -8.1   | 4.8    | 44        | 914            |
| t+2     | -1.6  | -9.3   | 6.5    | 44        | 845            |
| t+3     | 2.8   | -8.2   | 14     | 45        | 764            |
| t+4     | -6.6  | -17    | 3.9    | 45        | 646            |
| t+5     | 2.8   | -9.4   | 15     | 45        | 567            |
| t+6     | 4     | -7.4   | 16     | 45        | 541            |
| t+7     | 9.6   | -2     | 20     | 44        | 483            |
| t+8     | 15    | 2.7    | 26     | 44        | 438            |
| t+9     | 20    | 7.5    | 34     | 44        | 477            |
| t+10    | 33    | 14     | 51     | 41        | 443            |
| t+11    | 33    | 16     | 48     | 39        | 446            |
| t+12    | 39    | 17     | 59     | 38        | 443            |
| Time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |

Outcome Synthetic Mortality, Policy PDMP access

| Time (t) | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|---------|-------|--------|--------|-----------|----------------|
| t+0     | 0.69  | -19    | 20     | 33        | 571            |

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| Time | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|------|-------|---------|---------|-----------|----------------|
| t+1  | -1.9  | -26     | 26      | 32        | 528            |
| t+2  | 0.84  | -26     | 30      | 29        | 482            |
| t+3  | 4.3   | -27     | 37      | 28        | 450            |
| t+4  | -40   | -110    | 25      | 24        | 410            |
| t+5  | -7.7  | -81     | 60      | 24        | 366            |
| t+6  | 19    | -57     | 87      | 22        | 327            |
| t+7  | -4    | -120    | 100     | 19        | 295            |
| t+8  | -19   | -190    | 120     | 16        | 268            |
| t+9  | 23    | -130    | 130     | 15        | 236            |
| t+10 | 64    | -96     | 180     | 15        | 209            |
| t+11 | 21    | -140    | 140     | 15        | 185            |
| t+12 | 5.8   | -200    | 170     | 14        | 166            |

| Time after Policy Change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | 0.7   | -12     | 12      | 10        | 52             |
| t+1                      | -3.6  | -12     | 2.6     | 10        | 50             |
| t+2                      | 4.7   | -6.6    | 14      | 10        | 47             |
| t+3                      | 0.52  | -10     | 9.8     | 10        | 46             |
| t+4                      | 5.7   | -8.8    | 17      | 10        | 41             |
| t+5                      | 23    | -6.6    | 44      | 10        | 36             |
| t+6                      | 24    | -13     | 55      | 10        | 35             |
| t+7                      | 19    | -9.5    | 40      | 10        | 31             |
| t+8                      | 14    | -21     | 42      | 10        | 28             |
| t+9                      | 21    | -6.2    | 45      | 9         | 28             |
| t+10                     | 20    | -28     | 55      | 10        | 23             |
| t+11                     |       |         |         |           |                |
| t+12                     |       |         |         |           |                |

| Time after Policy Change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+0                      | -41   | -80     | 2.6     | 23        | 233            |
| t+1                      | -37   | -99     | 27      | 23        | 173            |
| t+2                      | -27   | -96     | 36      | 18        | 156            |
| t+3                      | 9.2   | -75     | 92      | 17        | 171            |
| t+4                      | 4.5   | -61     | 58      | 20        | 190            |
| t+5                      | -6.8  | -62     | 41      | 20        | 190            |
| t+6                      | -81   | -240    | 33      | 12        | 171            |
| t+7                      | -58   | -390    | 99      | 6         | 119            |
| t+8                      | -54   | -400    | 110     | 6         | 118            |
| t+10                     | -49   | -420    | 92      | 3         | 64             |
| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| t+11                     | -41   | -350    | 82      | 3         | 61             |
| t+12                     | -130  | -390    | 59      | 2         | 40             |

Outcomes: Synthetic Mortality, Policy Good Samaritan

| t+0          | 3.4   | -2.5  | 10      | 43        | 950            |
| t+1          | -15   | -30   | 4.2     | 43        | 889            |
| t+2          | -4.8  | -19   | 10      | 43        | 842            |
| t+3          | -3.6  | -22   | 17      | 42        | 771            |
| t+4          | 0.41  | -18   | 20      | 42        | 706            |
| t+5          | -6.7  | -42   | 31      | 42        | 664            |
| t+6          | 1.2   | -44   | 43      | 39        | 613            |
| t+7          | 20    | -34   | 75      | 37        | 549            |
| t+8          | 25    | -33   | 78      | 36        | 494            |
| t+9          | 31    | -18   | 77      | 36        | 440            |
| t+10         | 51    | -7.5  | 99      | 34        | 383            |
| t+11         | 51    | -7.4  | 96      | 34        | 348            |
| t+12         | 34    | -41   | 100     | 33        | 375            |

Outcomes: Synthetic Mortality, Policy Naloxone Law

| t+0          | 3.6   | -5    | 12      | 45        | 1018           |
| t+1          | -6.2  | -19   | 8.5     | 44        | 914            |
| t+2          | -7.9  | -31   | 22      | 44        | 845            |
| t+3          | -0.16 | -21   | 24      | 45        | 764            |
| t+4          | 26    | 14    | 37      | 45        | 646            |
| t+5          | 35    | 16    | 51      | 45        | 567            |
| t+6          | 49    | 26    | 70      | 45        | 541            |
| t+7          | 74    | 42    | 100     | 44        | 483            |
| t+8          | 79    | 43    | 110     | 44        | 438            |
| t+9          | 76    | 42    | 110     | 44        | 477            |
| t+10         | 89    | 36    | 140     | 41        | 443            |
| t+11         | 100   | 56    | 150     | 39        | 446            |
| t+12         | 120   | 63    | 170     | 38        | 443            |

Outcomes: Cocaine Mortality, Policy PDMP access

| t+0          | 10    | 0.36  | 19      | 31        | 469            |
| t+1          | -1.4  | -10   | 7.7     | 30        | 448            |
| t+2          | 14    | 0.021 | 26      | 30        | 410            |
| t+3          | 4.4   | -1.3  | 9.6     | 30        | 373            |
| t+4          | 1.8   | -4.4  | 7.4     | 30        | 355            |
| t+5          | 1.3   | -7.8  | 11      | 30        | 316            |
| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|-------------------------|-------|---------|---------|-----------|----------------|
| **Outcome Cocaine Mortality, Policy mandatory PDMP** |
| t+6 | 6.4 | -1.2 | 14 | 30 | 289 |
| t+7 | 1 | -11 | 14 | 31 | 259 |
| t+8 | -6.5 | -19 | 7.1 | 31 | 237 |
| t+9 | 4.1 | -4.3 | 13 | 30 | 211 |
| t+10 | -4.4 | -23 | 17 | 29 | 194 |
| t+11 | -0.32 | -14 | 13 | 29 | 179 |
| t+12 | 5.4 | -8 | 19 | 29 | 152 |
| **Outcome Cocaine Mortality, Policy Pain Clinic** |
| t+0 | -0.2 | -3.8 | 3.9 | 10 | 52 |
| t+1 | 3.2 | -2.8 | 8.9 | 10 | 50 |
| t+2 | 8 | -5.5 | 20 | 10 | 47 |
| t+3 | 2.4 | -3.6 | 8.6 | 10 | 46 |
| t+4 | 4.8 | -6 | 14 | 10 | 41 |
| t+5 | 5.6 | -6.8 | 16 | 10 | 36 |
| t+6 | 6.8 | -5.7 | 18 | 10 | 35 |
| t+7 | 5 | -6.7 | 16 | 10 | 31 |
| t+8 | 9.3 | -4.5 | 20 | 10 | 28 |
| t+9 | 7.6 | -5.8 | 20 | 9 | 28 |
| t+10 | 5.3 | -3.5 | 13 | 10 | 23 |
| t+11 | | | | | |
| t+12 | | | | | |
| **Outcome Cocaine Mortality, Policy Prescription Limit** |
| t+0 | -4.2 | -24 | 18 | 23 | 233 |
| t+1 | -7.8 | -33 | 19 | 23 | 173 |
| t+2 | 4.2  | -23 | 26 | 18 | 156 |
| t+3 | 11   | -21 | 37 | 17 | 171 |
| t+4 | 8.6  | -17 | 33 | 20 | 190 |
| t+5 | 19   | -12 | 50 | 20 | 190 |
| t+6 | 3.3  | -52 | 50 | 12 | 171 |
| t+7 | -140 | -52 | 49 | 6  | 119 |
| t+8 | -87  | -33 | 35 | 6  | 118 |
| t+9 | 3.3  | -120| 63 | 3  | 64  |
| t+10| -33  | -170| 23 | 3  | 61  |
| t+11| -20  | -98 | 28 | 2  | 40  |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| Outcome Cocaine Mortality, Policy Good Samaritan |
| t+0 | 3.6 | -1.1 | 8.1 | 43 | 950 |
| t+1 | -6.9 | -12 | -2.1 | 43 | 889 |
| t+2 | -1.1 | -6 | 4.5 | 43 | 842 |
| t+3 | -4.8 | -12 | 3.3 | 42 | 771 |
| t+4 | -0.29 | -9.4 | 9.4 | 42 | 706 |
| t+5 | -6 | -20 | 11 | 42 | 664 |
| t+6 | 4 | -9.7 | 20 | 39 | 613 |
| t+7 | 3.4 | -11 | 20 | 37 | 549 |
| t+8 | 7.4 | -11 | 25 | 36 | 494 |
| t+9 | 4.6 | -13 | 24 | 36 | 440 |
| t+10 | 6.3 | -15 | 24 | 34 | 383 |
| t+11 | 10 | -12 | 28 | 34 | 348 |
| t+12 | 19 | -5.4 | 41 | 33 | 375 |

| time after policy change | Coef. | 95% LCI | 95% UCI | N treated | N total matched |
|--------------------------|-------|---------|---------|-----------|----------------|
| Outcome Cocaine Mortality, Policy Naloxone Law |
| t+0 | 1.5 | -3.8 | 6.6 | 45 | 1018 |
| t+1 | -0.68 | -6.1 | 4.6 | 44 | 914 |
| t+2 | 5.9 | 0.07 | 12 | 44 | 845 |
| t+3 | 8.4 | 3.5 | 13 | 45 | 764 |
| t+4 | 11 | 4.9 | 17 | 45 | 646 |
| t+5 | 16 | 11 | 21 | 45 | 567 |
| t+6 | 17 | 10 | 24 | 45 | 541 |
| t+7 | 23 | 14 | 30 | 44 | 483 |
| t+8 | 27 | 18 | 37 | 44 | 438 |
| t+9 | 30 | 18 | 43 | 44 | 477 |
| t+10 | 31 | 19 | 42 | 41 | 443 |
|       | 42 | 26 | 57 | 39 | 446 |
|-------|----|----|----|----|-----|
| t+11  |    |    |    |    |     |
| t+12  | 46 | 30 | 62 | 38 | 443 |
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