Supplemental Online Content


eFigure. Timeline of state implementation of PDMP mandates among the 29 states included in the study: 2011-2017

eMethods.

This supplemental material has been provided by the authors to give readers additional information about their work.
eFigure. Timeline of state implementation of PDMP mandates among the 29 states included in the study: 2011-2017

Notes: Comprehensive mandates require use of PDMP at the point of care for all prescribers and in all circumstances. Noncomprehensive mandates are registration mandates or use mandates that fall short of being comprehensive.
eMethods. Difference-in-Differences model specification and definition of variables

The equation below depicts the Difference-in-Differences models we estimated for the two study outcomes. A linear probability model was estimated for the dichotomous outcome of an opioid dispensed following an ED encounter to a patient with SCD or CBM. (A sensitivity analysis with a logistic model generated similar results.) A Generalized Linear Model (GLM) was estimated for the outcome of morphine milligram equivalents (MMEs) of the opioid prescription dispensed, with a log link function and a Gamma distribution for the error term.[1] The equation below is presented in a linear form, without loss of generality.

\[ y_{1js} = \beta_0 + \beta_1 \text{AnyMandate}_{1js} + \beta_2 \text{CompMandate}_{1js} + \gamma \text{OtherPolicies}_{js} + \delta X_{ij} + S_{ij} + T_{ij} + \epsilon_{ij} \]

\( y_{1js} \): 0/1 indicator of any opioid prescription dispensed following the jth ED encounter of Patient i residing in State s, or, MMEs of the opioid prescription dispensed, calculated using conversion factors provided by the CDC.[2] Opioid prescriptions dispensed following ED encounters were identified as the first opioid prescription dispensed within 3 days of an ED encounter. Refills were excluded.\n
\( \text{AnyMandate}_{1js} \): 0/1 indicator of whether the state of residence of Patient i (State s) had implemented a PDMP registration or use mandate prior to Patient i’s jth ED encounter. Implementation is defined based on effective dates of PDMP mandates, which were initially provided by the National Alliance for Model State Drug Laws[3] and subsequently updated based on original legal research by the research team.\n
\( \text{CompMandate}_{1js} \): 0/1 indicator of whether the state of residence of Patient i (State s) had implemented a PDMP comprehensive use mandate prior to Patient i’s jth ED encounter. Comprehensive use mandate was defined as use mandates that apply to all prescribers and all clinical circumstances and not allowing for prescriber discretion.\n
\( \text{OtherPolicies}_{js} \): Four dichotomous indicators including 1) state legislations allowing prescribers to delegate PDMP use to an office staff, 2) state participation in interstate data sharing via PMP InterConnect®, provided by the National Association of Boards of Pharmacy, 3) state legislative limits on duration or dosage of the first opioid prescriptions received by a patient or for acute pain, and, 4) medical marijuana legalization. All four indicators were determined to be 1 (0 otherwise) if the policy took effect prior to the jth ED encounter of Patient i in the state of residence (State s).\n
\( X_{ij} \): Demographics (age and gender) and comorbid conditions (chronic non-cancer or SCD related pain and behavioral health conditions) for Patient i around the time of the jth ED encounter. All chronic pain and behavioral health conditions were determined based on diagnostic codes in claims during the calendar quarter of the jth ED encounter.\n
\( S_{ij} \): 0/1 indicators of the state of residence of Patient i at the start of the jth ED encounter (“state fixed effects”), to control for between-state differences that did not change over time.\n
\( T_{ij} \): 0/1 indicators of calendar quarters in which the jth ED encounter of Patient i took place (“time fixed effects”), to control for national secular trend in the outcome.\n
\( \epsilon_{ij} \): Random error that is clustered at the individual patient level

Parallel Trends Assumption

For a staggered design, the state-of-the-art approach to testing the parallel trend assumption is to conduct an event study analysis. Because we have two policy categories – non-comprehensive mandates and comprehensive mandates, we operationalized our tests with two event studies: one examining trends between states that implemented vs. those that did not (yet) implement a mandate (non-comprehensive or comprehensive) leading up to implementation, and, a second examining trends between states that
implemented a comprehensive mandate vs those that did not (including those that did not implement any mandate and those that implemented a non-comprehensive mandate) leading up to implementation of a comprehensive mandate. Below are figures reporting on results of the event study analysis.

Event study results: Any mandate vs. no mandate

The data points in the figures are adjusted differences (and 95% CIs) between the two groups of states at 6-month intervals prior to implementation of any mandate, holding the difference at 6 months prior to implementation at zero. All estimated differences were not statistically different from 0, supporting parallel trends in the two outcomes leading up to implementation of any mandate.

Event study results: Comprehensive mandates vs. (no mandate or non-comprehensive mandates)
Here, results of the event study analysis suggest parallel trends in all outcome-sample combinations except one. The figure for MMEs dispensed to patients with SCD suggests possible deviation from the parallel trend assumption, as shown by the faster increases (or slower decreases) in MMEs in states that implemented comprehensive mandates (vs. those that did not) over 13-18 months and 7-12 months prior to implementation. However, this trend did not continue over 1-6 months prior to implementation. Moreover, our finding that comprehensive mandates were associated with a reduction in MMEs dispensed to patients with SCD represented a reversal of the temporal trend seen over 7-18 months before implementation, rather than a continuation of a pre-existing trend. We thus do not consider this temporal deviation from the parallel trend assumption a threat to the validity of our findings.

References