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Mandatory Use of Prescription Drug Monitoring Program and Benzodiazepine Prescribing among U.S. Medicaid Enrollees

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Abstract

Background: In the past two decades, the U.S. saw an alarmingly increasing trend of benzodiazepine prescribing. Mandatory use of Prescription Drug Monitoring Programs (PDMPs) was suggested to have potential to reduce opioid prescribing, but little is known about its impacts on benzodiazepines. This study examined whether PDMP data use mandates were associated with changes in benzodiazepine prescribing in the U.S.

Methods: Aggregate state quarterly prescription drug records of benzodiazepines for Medicaid enrollees during 2010–2017 were obtained from the U.S. Medicaid State Drug Utilization Data. Three population-adjusted outcome variables were evaluated, including quantity, dosage, and Medicaid spending of benzodiazepine prescriptions per quarter per 100 Medicaid enrollees. The primary policy variable was the state-wide implementation of PDMP data use mandates for benzodiazepines. To account for between-state variations in mandates, an additional policy variable was considered to indicate strong mandates on PDMP data use, which required all prescribers to query a patient's PDMP records for first prescribing and subsequent prescribing at least every twelve months. Linear regressions with difference-in-difference approach were used to assess the associations between PDMP data use mandates and benzodiazepine prescribing, controlling for state-level time-varying policy and socio-economic covariates.

Results: The state-wide implementation of PDMP data use mandates for benzodiazepines was not associated with quantity, dosage, or Medicaid spending of benzodiazepine prescriptions.

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Strong mandates on PDMP data use were not associated with any benzodiazepine prescribing outcomes, either.

Conclusions: There was no evidence for the associations between PDMP data use mandates for benzodiazepines and changes in benzodiazepine prescribing among Medicaid enrollees. Future research is warranted to replicate the study in other population using individual patient records and continuously monitor the trends in benzodiazepine prescribing in association with PDMPs.

Keywords

1. Introduction

Benzodiazepines are a class of psychoactive drugs widely prescribed for the treatment of anxiety, insomnia, seizures, and sleep disorders. Benzodiazepine long-term use, non-medical use, and co-use with other drugs can be associated with detrimental or even life-threatening consequences. Long-term use was associated with increased risks of benzodiazepine dependence, cognitive decline, falls, fractures, and motor vehicle crashes. [1–3] Non-medical use can result in overdose, hospitalizations, or death. [4] Co-use of benzodiazepines and opioids was associated with a significant risk of mortality: [5] prescription opioid deaths involving benzodiazepines consisted of 27.9% of all 41,491 deaths involving prescription opioids in 2014–15. [6]

The problem of benzodiazepines has been a long-standing public health concern in the U.S. [7] The number of adults filling a benzodiazepine prescription increased from 8.1 million to 13.5 million in 1996–2013, and the quantity of filled benzodiazepines tripled from 1.1 kg to 3.6 kg lorazepam-equivalents per 100,000 adults during the same period. [8] Parallel with the increasing trend of benzodiazepine prescribing, benzodiazepine overdose mortality more than quintupled.[8] In 2016, 10,684 people in the U.S. died of an overdose involving benzodiazepines, which accounted for 16.8% of all drug overdose deaths. [9]

As a major policy intervention for drug control in the U.S., Prescription Drug Monitoring Programs (PDMPs) were designed to monitor the prescribing of controlled drugs, including Schedule IV drugs such as benzodiazepines, by providing a state-wide electronic database on dispensed prescriptions. The access to the database enables prescribers to review patients' history of drug use and identify patients at high risk of drug misuse. The elements of PDMPs varied considerably across states and over time in terms of included drugs, intended users, law enforcement, and requirements on prescriber registration and clinical circumstances and frequency of data queries. As of 2019, 49 states and the District of Columbia have implemented PDMPs in some form. Because of the continuous deterioration of opioid crisis, existing evaluations on the impacts of PDMPs focused on consequences related to prescription opioids. A systematic review revealed mixed impacts of PDMPs on opioid prescribing, diversion and supply, misuses, and morbidity and mortality in early studies when prescribers' participation in PDMPs was low. [10] As more states adopted mandates on queries of opioid prescription records since 2010, most recent studies consistently suggested

that PDMP mandates were associated with reduced opioid prescribing and related mortality. [11–17]

Very little attention has been given to the impacts of PDMPs on other controlled drugs including benzodiazepines. Existing studies found no evidence that the implementation of PDMPs or the access to PDMP data was associated with benzodiazepine-related emergency department visits, drug abuse, drug supply, or mortality. [18–20] Recent studies started to examine the role of PDMP data use mandates. Mixed results were reported from a localized study and two national studies. A study in Ohio found that mandatory use of PDMP data was associated with a statistically significant decrease in benzodiazepine dispensing. [21] Two national studies suggested that PDMP use mandates were not associated with drug abuse treatment admissions related to benzodiazepines, [19] but were associated with reduced overdose mortality involving benzodiazepines. [20] An important distinction failed to be made in most of the previous studies was between PDMP policies specific to benzodiazepines and those specific to opioids. In addition, no studies have considered the differential impacts on benzodiazepines by the strength of PDMP mandates as recommended by opioid literature. [16, 22] New studies based on national data are warranted to address these limitations.

In this study, we examined the associations of PDMP data use mandates with benzodiazepine prescribing among U.S. Medicaid enrollees during 2010–2017. In the U.S., Medicaid is a joint federal and state health insurance program primarily covering people with low income or disabilities (nearly 70 million people). These people are at high risk of benzodiazepine misuse due to excessive burden of mental health and substance use disorder. [23, 24] We focused on PDMP policies specifically relevant to benzodiazepines and considered between-state variations in PDMP mandates.

2. Methods

2.1 Data Source and Study Sample

This was a secondary data analysis on state-level benzodiazepine prescribing in the U.S. The primary data source was 2010–2017 Medicaid State Drug Utilization Data published by the U.S. Centers for Medicare and Medicaid Services. The data included aggregate state-quarter records of outpatient drugs filled (including both new prescriptions and refills) by Medicaid enrollees but excluded drugs dispensed in emergency departments or inpatient settings and those paid with cash. Each quarterly record included state, drug name, National Drug Code, quantity of prescriptions, and dollars reimbursed by Medicaid. In the study period, a total of 704,829 state-quarter records of benzodiazepines were analyzed. The list of benzodiazepine drugs included in the data was reported in Supplemental Information Table S1. Alprazolam, Clonazepam, Diazepam, and Lorazepam accounted for over 92% of all benzodiazepine drugs covered in the data source.

The study population was all Medicaid enrollees, including those enrolled in fee-for-service programs and those enrolled in managed care programs. In the U.S., Medicaid fee-for-service programs pay providers directly for all covered services, while managed care programs pay managed care organizations which provide all covered services at a capitation payment. In the 2010s, more than 70% of Medicaid enrollees were covered in managed care

programs [25]. Our study period started from 2010, because Medicaid State Drug Utilization Data did not consistently report records for managed care programs until 2010. The study timeframe 2010–2017 also coincided with the period when many states started to include benzodiazepines in PDMPs and implement data use mandates relevant to benzodiazepines.

2.2 Measures

The state-quarter aggregate records were population-adjusted to obtain the following three benzodiazepine prescribing outcomes per state per quarter per 100 Medicaid enrollees: 1) quantity of benzodiazepine prescriptions, 2) dosage of benzodiazepine prescriptions (in Milligram of Diazepam Equivalents (MDE), and 3) Medicaid spending on benzodiazepine prescriptions (in 2017 U.S. dollars). To identify benzodiazepine prescriptions, we linked the National Drug Code numbers from the data with drug information in the Approved Drug Products with Therapeutic Equivalence Evaluations published by the U.S. Food and Drug Administration. [26] The dosage of benzodiazepine prescriptions in MDE was calculated as the product of total number of filled units, strength per unit, and MDE conversion factor for each drug with a unique National Drug Code. [27]

The primary policy variable of interest was the presence of statewide PDMP mandates for use of benzodiazepine records (Table 1). Among the states with such mandates, some states applied mandates to all the Schedule IV drugs including benzodiazepines, whereas others applied specifically to benzodiazepines. The information on key PDMP policy effective dates, including the implementation of PDMPs, data made available to users, any mandates on use of benzodiazepine records, and strong mandates on use of benzodiazepine records, was collected and cross-checked from multiple sources (Table 1). The dichotomous policy indicator took the value of 1 if the state mandated prescribers to use the PDMP system before prescribing benzodiazepines under certain clinical circumstances in that quarter and 0 otherwise. Because of variations in state mandates in terms of clinical circumstances and data query frequency, an additional dichotomous policy indictor was created to indicate the presence of strong mandates for use of benzodiazepine records. Mandates were considered strong if: all prescribers, regardless of practice settings, are required to query a patient's PDMP records when first prescribing benzodiazepines and subsequently at least every twelve months if the patient's prescription continues; the mandates apply regardless of prescribers' own judgment of need to query the records. [16] During the study period, 20 states mandated prescribers to query PDMP system before prescribing benzodiazepines under certain clinical circumstances, and 15 states further adopted strong mandates (Table 1). With the only exception of Nevada, all states with PDMP data use mandates for benzodiazepines implemented the mandates in or after 2010. Of the 20 states with any PDMP mandates, 7 states made PDMP data available to users after 2010 and 13 states did it before 2010. Thus, we also included a dichotomous variable indicating user access to benzodiazepine records.

We considered the following state-level policy and socioeconomic covariates that may confound the relationships between PDMP mandates and benzodiazepine prescribing: a dichotomous indicator for the implementation of state-wide Medicaid expansion to cover all adults with income up to 138% of the federal poverty level, median household income in 2017 constant thousand U.S. dollars, the number of active physicians per 1000 population,

poverty rate defined as the percentage of residents with household income below the federal poverty level, and unemployment rate. Details about these covariates were described in Supplemental Information Technical Note S1.

2.3 Statistical Analyses

The analysis unit was state-quarter pair observations. A total of 1,629 state-quarter pairs entered statistical analyses. Linear multivariable regressions with difference-in-differences design were used to assess the associations of PDMP data use mandates with the three benzodiazepine prescribing outcomes, which were log transformed to obtain normal distributions. The coefficient of the dichotomous indicator of PDMP data use mandates can be interpreted as the average percentage change in benzodiazepine prescribing outcome associated with the implementation of PDMP data use mandates. Two regressions were conducted, with the primary policy predictor being the presence of any PDMP mandates in Model 1 and the presence of strong PDMP mandates in Model 2. These two primary policy predictors entered regressions respectively to avoid collinearity. Both models controlled for state-level policy and socioeconomic covariates described above. Both models also included the following regressors: state indicators to control for unobserved time-invariant state-level fixed effects; year and quarter indicators to control for national-level shocks applying to all the states at the same time; and state-specific linear time trends to control for state-level natural trends in benzodiazepine prescribing outcomes. Notably, Medicare, a U.S. federal health insurance program primarily covering adults aged 65 years or older, started to cover benzodiazepines in its prescription drug benefit on January 1st, 2013. In the U.S., about 9 million people out of 70 million Medicaid enrollees were also covered by Medicare. Medicaid saw a sharp decline in benzodiazepine prescriptions filled by Medicare and Medicaid dually eligible enrollees after January 1st, 2013. Thus, we allowed separate state-specific time trends before and after 2013. The standard errors in all regression models were clustered at the state level. Detailed model specifications were described in Supplemental Information Technical Note S1.

To test the assumption of parallel time trends between treatment and control states in difference-in-difference design, we further conducted a series of event studies for any PDMP mandates and strong PDMP mandates respectively. The event study disaggregated the single dichotomous policy indicator for any PDMP mandates (or strong PDMP mandates) into a series of dichotomous indicators to indicate the number of quarters relative to the quarter of mandates implementation (e.g., 4 quarters before implementation, 1 quarter after implementation). The dichotomous indicator equaled to 1 if the outcome observation represented the outcome in that specific quarter and equaled to 0 otherwise. The remaining model specification was the same as described in the paragraph above. Event studies allowed us to identify any violation of the parallel time trends assumption if significant coefficients were detected in any of the quarter indicators prior to the implementation of mandates.

To test the robustness of the results, we also conducted two sensitivity analyses. First, we removed state-specific time trends in regressions and expected that the associations would be more discernable. It is suggested that adding state-specific time trends may attenuate estimates of policy impacts if the policy affects the trend itself [28, 29]. Second, we limited our

study sample to 2013–2017, as Medicare started to cover benzodiazepines in its prescription drug benefit since the beginning of 2013.

3. Results

Table 2 compares descriptive statistics on outcome variables, policy variables, and socioeconomic variables between states with and without any PDMP data use mandates for benzodiazepines. Among the three benzodiazepine prescribing outcomes, only the average Medicaid spending on benzodiazepines significantly differed between states with and without any PDMP mandates (p<0.001). States with any PDMP mandates had a greater number of quarters with Medicaid expansion implemented (p=0.003), lower median household income (p<0.001), and higher poverty rate (p<0.001).

The regression results are presented in Table 3. Model 1 examined any mandates on PDMP data use whereas Model 2 examined strong mandates on PDMP use. No significant associations were found between any mandates and the three benzodiazepine prescribing outcomes (quantity, dosage, and Medicaid spending). Similarly, no significant associations were found between strong mandates and the three benzodiazepine prescribing outcomes. In both models, access to PDMP data was associated with 16–17% less Medicaid spending on benzodiazepine prescriptions (Model 1: 95% CI: –0.30, –0.036, p=0.014; Model 2: 95% CI: –0.30, –0.030, p=0.017), but it was not associated with quantity or dosage of benzodiazepine prescriptions. All the other covariates were nonsignificant.

Results on event studies are illustrated in Figure 1. We did not detect any significant coefficients in the quarters prior to the implementation of any mandates (Figure 1 Panels A-C) or strong mandates (Figure 1 Panels D-F). This indicated that the benzodiazepine outcomes in states with and without PDMP data use mandates did not differ significantly prior to policy implementation. The pre-policy parallel time trends assumption was therefore not rejected.

Sensitivity analysis results are reported in Supplemental Information Tables S2 and S3. The null associations between any PDMP mandates and the three benzodiazepine prescribing outcomes and between strong PDMP mandates and the three benzodiazepine prescribing outcomes were replicated in regressions removing state-specific time trends (Table S2) and regressions removing observations before 2013 (Table S3). The significant association between access to PDMP data and Medicaid spending on benzodiazepines in the main analysis, however, no longer held in these two sensitivity analyses.

4. Discussion

Using the U.S. Medicaid State Drug Utilization Data in 2010–2017, this study suggested that the mandatory use of PDMP data was not associated with quantity, dosage, or spending of benzodiazepine prescriptions among Medicaid enrollees. Strong mandates of PDMP data use were not associated with any of the benzodiazepine prescribing outcomes, either. Access to PDMP data might be associated with reduced Medicaid spending on benzodiazepines, but the result was sensitive to model specifications. This study contributed to the still limited

literature on PDMP data use mandates and the associations of PDMP use mandates with the prescribing of drugs other than opioids.

Our findings supported the previous national study that found null associations between PDMP data use mandates and drug abuse treatment utilization related to benzodiazepines. [19] They were not supported by another national study, however, which reported a 13% reduction in overdose deaths involving benzodiazepines in association with mandatory PDMP data use in 2000–2013. [20] The discrepancies might be explained by differences in study population, study period, and study outcomes. In addition, our study differentiated PDMP data use mandates specific to opioids from those specific to benzodiazepines and focused on those particularly relevant to benzodiazepines. Because states typically included Schedule IV drugs (drug schedule for most benzodiazepines in the U.S.) in PDMPs later than Schedule II and Schedule III drugs (drug schedules for most opioids in the U.S.), the dates of data access and mandates for benzodiazepines and opioids could be different. The misclassification of PDMP policies may lead to biased estimations.

The mandatory use of PDMP data might not have reduced benzodiazepine prescribing among Medicaid enrollees during the study period for several possible reasons. First, the expansion of PDMP data use mandates primarily focused on opioid prescribing and dispensing. The mandates specific to benzodiazepines were less commonly adopted and typically implemented later than those specific to opioids. In the study period, prescribers of benzodiazepines might have used PDMPs infrequently. Second, some challenges for PDMPs to control opioid prescribing might be also common to benzodiazepine prescribing. For instance, it remains challenging to integrate PDMPs into prescribers' work flow. [30, 31] Also, delays in reporting or the lack of information on prescriptions filled in neighboring states could limit its effectiveness. [32] Third, strong mandates were mostly implemented after 2015. Our study might be limited in power to detect the effects.

The findings should be interpreted with caution. First, the findings suggested associations instead of causality. Important between-state differences that were varying over time may not be successfully captured by covariates, state and time fixed effects, or state-specific time trends in regressions. Second, this study relied on state-level variations in PDMP policies and state-level aggregate observations on benzodiazepine outcomes as in most previous studies. This ecological study design cannot provide information on individual patient or physician behaviors in response to PDMP policy changes. Third, most of the states adopted PDMP data use mandates late in the study period. The associations may be underestimated if the impacts of PDMP data use mandates had not been fully realized or reflected in our data. Fourth, the outcomes examined in this study provided an overall picture of benzodiazepine prescribing at state aggregate level. We were not able to differentiate inappropriate prescribing (e.g., long-term prescribing, high-dose prescribing) from appropriate prescribing due to the aggregate nature of the data source. Fifth, co-prescribing of opioids and benzodiazepines, a significant risk factor for overdose mortality, [5] could not be identified, because the aggregate data provided no information on individual patient records. We were not able to add PDMP data use mandates specific to opioid prescribing in the models, either, because many states adopted mandates on benzodiazepine and opioid prescribing concurrently and including both policies caused collinearity problems. Lastly, the findings

may not be generalizable to benzodiazepines dispensed in emergency department setting, in-patient setting, or to healthier population in the U.S.

Conclusion

In summary, the associations between PDMP data use mandates and benzodiazepine prescribing were not found among Medicaid enrollees in the 2010–2017 study period. The lack of evidence calls for continuous monitoring in the next few years when mandates may be more successfully realized. Replication studies in other population and with observations at individual level are also strongly encouraged.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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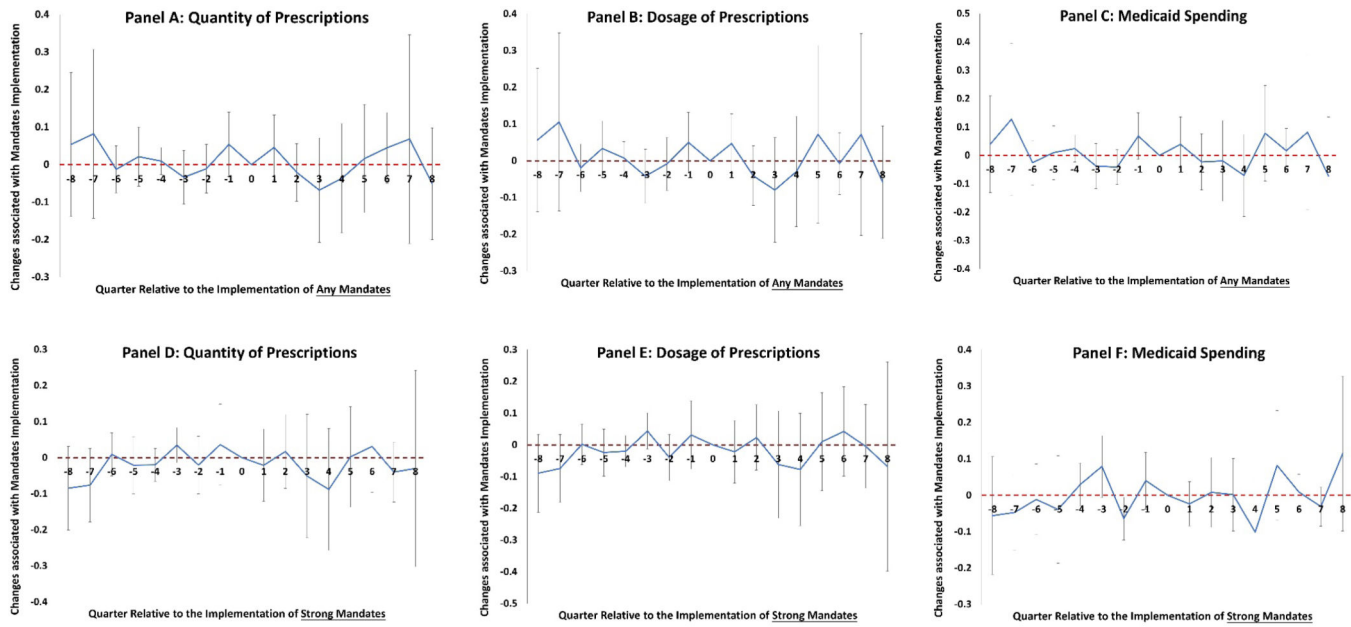
Figure 1. Event Study for Benzodiazepine Prescribing, 2010–2017.
"0" on the x-axis indicated the quarter when PDMP use mandates were adopted; it was omitted from the regression to provide a reference category. Other numbers on the x-axis indicated the number of quarters before or after mandates implementation. For example, "−4" indicated the 4 quarters before mandates implementation. The Panel A, B, and C illustrated event study results on any mandates on PDMP use, and Panel D, E, and F illustrated event study results on strong mandates on PDMP use.

Table 1.

Effective Dates of Prescription Drug Monitoring Program Policies

State	Pass Date of Prescription Drug Monitoring Program	Date of User Access to Benzodiazepine Records	Effective Date of Any Mandates on Use of Benzodiazepine Records	Effective Date of Strong Mandates on Use of Benzodiazepine Records
Alabama	Before 2010	Before 2010	NA	NA
Alaska	Before 2010	Q1 2012	NA	NA
Arizona	Before 2010	Before 2010	Q3 2011	Q4 2017
Arkansas	Q1 2011	Q1 2013	Q3 2015	Q3 2017
California	Before 2010	Q1 2010	NA	NA
Colorado	Before 2010	Before 2010	NA	NA
Connecticut	Before 2010	Before 2010	Q4 2015	Q4 2015
Delaware	Q3 2010	Q3 2012	Q3 2012	NA
District of Columbia	Q1 2014	Q4 2016	NA	NA
Florida	Before 2010	Q4 2011	NA	NA
Georgia	Q2 2011	Q2 2013	Q3 2014	NA
Hawaii	Before 2010	Q1 2012	NA	NA
Idaho	Before 2010	Before 2010	NA	NA
Illinois	Before 2010	Before 2010	NA	NA
Indiana	Before 2010	Before 2010	NA	NA
Iowa	Before 2010	Before 2010	NA	NA
Kansas	Before 2010	Q2 2011	NA	NA
Kentucky	Before 2010	Before 2010	Q3 2012	Q3 2012
Louisiana	Before 2010	Before 2010	NA	NA
Maine	Before 2010	Before 2010	Q1 2017	Q1 2017
Maryland	Q2 2011	Q1 2014	NA	NA
Massachusetts	Q3 2010	Q1 2011	Q1 2013	Q4 2016
Michigan	Before 2010	Before 2010	NA	NA
Minnesota	Before 2010	Q2 2010	NA	NA
Mississippi	Before 2010	Before 2010	Q4 2013	NA
Missouri	NA	NA	NA	NA
Montana	Q2 2011	Q4 2012	NA	NA
Nebraska	After 2011	Q1 2016	NA	NA
Nevada	Before 2010	Before 2010	Before 2010	Q4 2015
New Hampshire	Q2 2012	Q4 2014	NA	NA
New Jersey	Before 2010	Q1 2012	NA	NA
New Mexico	Before 2010	Before 2010	Q4 2012	Q1 2017
New York	Before 2010	Q2 2013	Q3 2013	Q3 2013
North Carolina	Before 2010	Before 2010	NA	NA

State	Pass Date of Prescription Drug Monitoring Program	Date of User Access to Benzodiazepine Records	Effective Date of Any Mandates on Use of Benzodiazepine Records	Effective Date of Strong Mandates on Use of Benzodiazepine Records
North Dakota	Before 2010	Before 2010	Q2 2014	NA
Ohio	Before 2010	Before 2010	Q4 2011	Q2 2015
Oklahoma	Before 2010	Before 2010	Q4 2010	Q4 2015
Oregon	Before 2010	Q3 2011	NA	NA
Pennsylvania	Before 2010	Q3 2016	Q3 2015	Q3 2015
Rhode Island	Before 2010	Q3 2012	NA	NA
South Carolina	Before 2010	Before 2010	NA	NA
South Dakota	Q1 2010	Q1 2012	NA	NA
Tennessee	Before 2010	Before 2010	Q1 2013	Q1 2013
Texas	Before 2010	Q2 2012	Q3 2015	Q3 2017
Utah	Before 2010	Before 2010	NA	NA
Vermont	Before 2010	Before 2010	Q4 2013	NA
Virginia	Before 2010	Before 2010	NA	NA
Washington	Before 2010	Q1 2012	NA	NA
West Virginia	Before 2010	Before 2010	NA	NA
Wisconsin	Q2 2010	Q2 2013	Q2 2017	Q2 2017
Wyoming	Before 2010	Q3 2013	NA	NA

Notes: The 20 states with any PDMP mandates during the study period included Arizona, Arkansas, Connecticut, Delaware, Georgia, Kentucky, Maine, Massachusetts, Mississippi, Nevada, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Vermont, Wisconsin. The 15 states with strong PDMP mandates during the study period included Arizona, Arkansas, Connecticut, Kentucky, Maine, Massachusetts, Nevada, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Wisconsin.

Source:

LawAtlas: http://legacy.lawatlas.org/query?dataset=prescription-monitoring-program-laws-1408223416

NAMSDL: https://namsdl.org/

PEW: https://www.pewtrusts.org/en/research-and-analysis/data-visualizations/2018/when-are-prescribers-required-to-use-prescription-drug-monitoring-programs

PDAPS: http://pdaps.org/datasets/pdmp-implementation-dates

PDMP training and technical assistance center: http://www.pdmpassist.org/

Table 2.

Descriptive Statistics for Pooled Quarterly Data in 2010–2017

	States with Any PDMP Use Mandates	States with No PDMP Use Mandates	Between-group Difference Test
	Mean (95% CI)	Mean (95% CI)	P-values
Benzodiazepine Prescribing Outcomes			
Quantity of Benzodiazepine Prescriptions per quarter per 100 Medicaid Enrollees	9.04 (8.63, 9.46)	9.10 (8.76, 9.43)	0.85
Diazepam Milligram Equivalents of Benzodiazepine Prescriptions per quarter per 100 Medicaid Enrollees	7689 (7352, 8026)	7535 (7235, 7836)	0.51
Medicaid Spending on Benzodiazepine Prescriptions per quarter per 100 Medicaid Enrollees, 2017 U.S. dollars	140.80 (136.52, 145.08)	158.12 (153.05, 163.20)	<0.001
Policy Variables			
Any Mandates on PDMP Use	0.50 (0.46, 0.54)	0	<0.001
Strong Mandates on PDMP Use	0.17 (0.14, 0.20)	0	<0.001
Access to PDMP Data	0.83 (0.80, 0.86)	0.77 (0.74, 0.79)	0.002
Socioeconomic Variables			
Medicaid Expansion as Part of Affordable Care Act	0.34 (0.31, 0.38)	0.28 (0.25, 0.30)	0.003
Median Household Income, 2017 thousand U.S. dollars	54.98 (54.34, 55.63)	59,62 (59.03, 60,22)	<0.001
Number of Physicians per 1,000 people	2.76 (2.70, 2.81)	2.82 (2.75, 2.89)	0.17
Poverty Rate	14.72 (14.44, 15.00)	12.93 (12.73, 13.14)	<0.001
Unemployment Rate	6.45 (6.29, 6.61)	6.28 (6.14, 6.41)	0.11

Table 3.

Linear Regression Results for Benzodiazepine Prescribing, 2010–2017.

	Logged Quantity of Benzodiazepine Prescriptions per quarter per 100 Medicaid Enrollees		Logged Oral Diazepam Milligram Equivalents of Benzodiazepine Prescriptions per quarter per 100 Medicaid Enrollees		Logged Medicaid Spending on Benzodiazepine Prescriptions per quarter per 100 Medicaid Enrollees	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	Coefficients (95% CI)					
Any Mandates on PDMP Use	0.10 (−0.15, 0.35)		0.097 (−0.16, 0.35)		0.10 (−0.14, 0.35)	
Strong Mandates on PDMP Use		−0.074 (−0.31, 0.16)		−0.10 (−0.33, 0.12)		−0.040 (−0.20, 0.12)
Access to PDMP Data	−0.093 (−0.19, 0.0072)	−0.087 (−0.18, 0.0085)	−0.088 (−0.19, 0.012)	−0.081 (−0.17, 0.012)	−0.17 * (−0.30, −0.036)	−0.16 * (−0.30, −0.030)
Medicaid Expansion as Part of Affordable Care Act	0.10 (−0.019, 0.23)	0.11 (−0.015, 0.23)	0.078 (−0.050, 0.21)	0.080 (−0.047, 0.21)	0.015 (−0.16, 0.20)	0.019 (−0.16, 0.20)
Median Household Income, 2017 thousand U.S. dollars	0.0088 (−0.013, 0.031)	0.0074 (−0.012, 0.027)	0.0075 (−0.016, 0.031)	0.0062 (−0.015, 0.027)	0.0016 (−0.028, 0.031)	0.00013 (−0.027, 0.028)
Number of Physicians per 1,000 people	0.057 (−0.088, 0.20)	0.062 (−0.086, 0.21)	0.054 (−0.081, 0.19)	0.060 (−0.081, 0.20)	0.30 (−0.19, 0.78)	0.30 (−0.18, 0.79)
Poverty Rate	0.028 (−0.033, 0.089)	0.030 (−0.036, 0.097)	0.030 (−0.034, 0.095)	0.033 (−0.038, 0.10)	0.028 (−0.043, 0.098)	0.030 (−0.046, 0.11)
Unemployment Rate	0.037 (−0.040,0.11)	0.037 (−0.041, 0.12)	0.035 (−0.043, 0.11)	0.036 (−0.044, 0.12)	0.057 (−0.021, 0.14)	0.057 (−0.022, 0.14)
Constant	1.15 (−1.64, 3.94)	1.14 (−1.71, 3.99)	7.96 *** (5.05, 10.86)	7.94 *** (4.98, 10.90)	3.67 * (0.75, 6.59)	3.68 * (0.73, 6.63)
Number of State–Quarter Observations	1,629	1,629	1,629	1,629	1,629	1,629
R^2	0.91	0.91	0.92	0.92	0.76	0.76

*
p<.05,

***
p<.001

Notes: Data were analyzed at state-quarter level. All regressions also controlled for state indicators, year indicators, quarter indicators, and state-specific time trends before and after 2013. Standard errors were clustered at state level.