Earlier research on the effect of PDMPs on opioid overdose deaths provides conflicting evidence that states that have recently implemented PDMPs experience reduced opioid overdose deaths. The theoretical purpose of PDMPs is to regulate the distribution of prescription opioids and to reduce drug diversion, which would lead to a lower supply of prescription drugs overall, and specifically to those most at risk of abusing them. Several studies on the association between PDMP implementation and levels of prescription opioid prescribing have been conducted.

Brady et al. (2014) investigate the effect of prescription drug monitoring programs (PDMPs) on dispensing prescription opioids in the United States. The authors use a multivariate analysis design to compare changes in the dispensing of prescription opioids before and after the implementation of PDMPs in each state and the District of Columbia from 1999 to 2008. The results of the study suggest that the implementation of PDMPs was associated with a 3% decrease in the annual morphine milligram equivalents (MMEs) per capita, which may lead to a reduction in the number of opioid overdoses. The researchers found that the effect of PDMPs on opioid prescriptions varied greatly across states, in some states the effect was negative and in others it was positive. The study provides valuable insights into the potential effectiveness of PDMPs in reducing the dispensing of prescription opioids, which is an important way in which PDMPs can reduce the number of opioid overdoses. One shortcoming of the study is that it does not assess the potential unintended consequences of PDMPs, such as patients seeking opioids from other sources, including illegal options, or engaging in more dangerous forms of drug use. This is an important consideration, as the impact of PDMPs on the opioid epidemic is likely to depend not only on the reduction in the dispensing of prescription opioids but also on the potential emergence of alternative sources of opioids. Also, the study does not investigate the effect that PDMPs have on causing people to switch from using prescription opioids to using opioids purchased illegally, which are usually more dangerous. In terms of answering the research question, this study provides evidence that PDMPs may be an effective tool for reducing the dispensing of prescription opioids in the United States. The results suggest that PDMPs may play an important role in addressing the opioid epidemic by reducing the number of prescription opioids available for use. This is important because prescription opioids are often the reason why many people begin using opioids and develop addictions. Also, prescription opioids are sold to other people who do not have the prescription.

Earlier research on the effect of PDMPs on opioid overdose deaths provides conflicting evidence that states that have recently implemented PDMPs experience reduced negative opioid related outcomes. Reifler et al. (2012) conducted a similar study to investigate whether PDMPs impact state trends in opioid abuse. The researchers used quarterly data from 2003 to 2009 from the RADARS System Poison Center and Opioid Treatment surveillance databases to measure the level of opioid abuse in each state and year. They find that opioid treatment admission increases by 4.9% per quarter on average in states without a PDMP, compared to only 2.6% in states with a PDMP. These results suggest that PDMPs are successful programs at reducing overall opioid misuse and abuse because of the smaller increases in opioid treatment admissions for states with a PDMP. One limitation of this study is that the treatment admission data is subject to self-reporting and selection bias, which may lead to inaccurate numbers. Poison Center specialists record information that is self-reported by callers into a standardized database.

# Patrick et al. (2017) used an interrupted time-series design to estimate the association of implementation and characteristics of PDMPS with opioid overdose rates. State and year fixed effects account for unmeasured variation at the state level and for time-varying state-level factors, with the state-year pair as the unit of analysis. The data comes from publicly available sources from 1999 to 2013 to determine whether implementation or different characteristics of a program were associated with decreases in opioid overdose deaths. The researchers conclude that a state newly implementing a program was predicted to have 1.55 fewer opioid-related overdose deaths per 100,000 people per year compared to a state without a program. The study uses robust econometric methods and appropriate data to estimate the causal effect of PDMPs on opioid overdose rates. They also examined the interaction of the implementation with time to discover that effect. One shortcoming of the study was that each source of data likely had errors, as opioid overdose-related deaths may be underreported if medical examiners do not have enough evidence of opioid use. Also, the authors acknowledge that it is possible that they did not include all important time-varying state-level factors that are confounding variables. The study results suggest that implementing PDMPs is associated with significant reductions in opioid-related death rates.

# More recently, Cerda et al. (2021) explore the relationship between proactive reporting of state-level prescription drug monitoring programs (PDMPs) and county-level fatal prescription opioid overdoses. The authors use county-level data across 3,109 counties in 49 states from 2002 to 2016 to estimate the effect of PDMPs on opioid overdoses. The study employs Bayesian space-time models which control for differences in the population and opioid prescribing practices between states and over time. Linear distributed lag specifications were used to allow a linear progression of policy associations from instantaneous through 3-year-lagged effects. The results of the study suggest that electronic PDMPs are associated with a significant reduction in prescription opioid overdose deaths after three years. They found that electronic PDMP access was associated with a 2% increase in opioid overdose deaths after the first year but found there to be fewer opioid overdoses in the following three years. They found that proactive PDMPs were associated with fewer deaths attributed to natural or semi-synthetic opioids compared to states with weak PDMPs. They also concluded that state adoption of PDMPs was associated with fewer opioid deaths overall. Cerda et al. (2017) built on a previous study that used latent transition analysis by examining combinations of PDMP characteristics that were associated with the greatest change in prescription opioid overdose fatalities. However, the shortcoming of the study is that they used certain coding in death certificates to identify the cause of death to construct the county-level overdose rates, which may not reliably identify the drugs involved in overdoses. The research provides evidence that state adoption of PDMPs was associated with fewer prescription opioid deaths overall. The authors provide evidence that proactive reporting PDMPs has a significant impact, compared to weak PDMPS, on reducing fatal prescription opioid overdoses at the county level.

Nam et al. (2017) analyze the effect of PDMPS on the number of fatal drug overdose mortality rates in the United States. The authors used multivariate regression models with state and year fixed effects and state-specific linear time trends. The results break down the association of PDMPs with various types of drugs, and they found that PDMPs were not associated with a decrease in the overdose mortality rate of prescription opioids. The researchers found that they may be associated with increased overdose mortality rates in categories other than prescription opioids. Longer-standing PDMPs were associated with significantly increased mortality rates for legal narcotics and unspecified drugs and illicit drugs. The authors used state-fixed effects to allow each state to serve as a control group. Many state-level time-varying covariates that could be associated with drug overdoses and PDMP implementation were controlled for. This approach is a strong point in the research, as it allows for causal inference about the effect of PDMPs on overdose rates in each of the states. However, one shortcoming is that the authors do not account for other factors that may be affecting the number of overdoses, such as the availability of non-opioid pain medications or changes in law enforcement practices. Also, the authors do not break down the results to discuss the association between PDMPs and illegal opioids. This study does help to answer my specific research question by providing evidence that PDMPs may not be effective at reducing prescription opioid drug overdose deaths.

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