Drug and Alcohol Dependence 156 (2015) 282–288

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Prescription monitoring programs and emergency department visits involving opioids, 2004–2011

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ARTICLE INFO

Article history:
Received 25 May 2015
Received in revised form 4 September 2015
Accepted 22 September 2015
Available online 30 September 2015

Keywords:
Prescription drug monitoring programs
Prescription drug abuse
Opioids
Emergency departments

ABSTRACT

Objective: To determine the association between prescription drug monitoring program (PDMP) implementation and emergency department (ED) visits involving opioid analgesics.
Methods: Rates of ED visits involving opioid analgesics per 100,000 residents were estimated from the Drug Abuse Warning Network dataset for 11 geographically diverse metropolitan areas in the United States on a quarterly basis from 2004 to 2011. Generalized estimating equations assessed whether implementation of a prescriber-accessible PDMP was associated with a difference in ED visits involving opioid analgesics. Models were adjusted for calendar quarter, metropolitan area, metropolitan area-specific linear time trends, and unemployment rate.
Results: Rates of ED visits involving opioid analgesics increased in all metropolitan areas. PDMP implementation was not associated with a difference in ED visits involving opioid analgesics (mean difference of 0.8 visits [95% CI: −3.7 to 5.2] per 100,000 residents per quarter).
Conclusions: During 2004–2011, PDMP implementation was not associated with a change in opioid-related morbidity, as measured by emergency department visits involving opioid analgesics. Urgent investigation is needed to determine the optimal PDMP structure and capabilities to improve opioid analgesic safety.

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1. Introduction

In the last two decades, the United States has experienced an epidemic of prescription opioid analgesic use, abuse, addiction, and overdose. From 1999 to 2011, the number of opioid prescriptions in the United States nearly doubled (Volkow, 2014), and overdose deaths involving opioid analgesics quadrupled from 4030 to 16,917 deaths annually (National Center for Health Statistics, 2014a). By 2011, more than 12 million Americans reported using opioid analgesics non-medically (i.e., without a prescription, at higher-than-prescribed doses, or for purposes other than treating pain) and over 488,000 emergency department (ED) visits involved misuse or abuse (henceforth "misuse") of opioid analgesics (Substance Abuse and Mental Health Services Administration, 2012b, 2013).

Prescription drug monitoring programs (PDMPs) are databases of controlled substance prescriptions that were filled at a pharmacy. In the United States, PDMPs have been developed as a tool to improve safety of prescribed opioid analgesics, identify and decrease diversion of opioid analgesics, and reduce fatal and non-fatal opioid overdose (Centers for Disease Control and Prevention, 2013). From 1989 to 2015, the number of states with an operational PDMP increased from 9 to 49 (Clark et al., 2012; Prescription Drug Monitoring Program Training and Technical Assistance Center, 2015b). In addition to broad expansion, PDMP usage patterns have also changed. Early PDMPs often provided data only to law enforcement officials, but by January 2015 nearly all PDMPs (96%) had adopted regulations to provide data access to prescribers (National Alliance for Model State Drug Laws, 2014b).

The impact of PDMPs on prescribing behavior and opioid safety is unclear. Physician surveys and interviews suggest that PDMP

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http://dx.doi.org/10.1016/j.drugalcdep.2015.09.024
0376-8716/Published by Elsevier Ireland Ltd.

reports may encourage physicians to change their prescribing behaviors, such as reducing the quantity of drug prescribed, forgoing the analgesic prescription or changing it to a non-scheduled (e.g., non-opioid) analgesic, or screening patients for drug abuse before issuing a prescription (Alliance of States with Prescription Monitoring Programs, 2007; Baehren et al., 2010; Feldman et al., 2012; Green et al., 2012; Irvine et al., 2014; Kentucky Cabinet for Health and Family Services and Kentucky Injury Prevention and Research Center, 2010; Perrone et al., 2012; Smith et al., 2015; Weiner et al., 2013). However, on a population level, evidence about the impact of PDMPs is mixed (Haegerich et al., 2014). Studies of PDMPs and state-level opioid consumption have yielded conflicting results; one study found PDMP implementation to be associated with a decrease in opioid consumption (Reisman et al., 2009), while others found no change (Brady et al., 2014) or an increase (Ringwalt et al., 2015). Other studies have associated PDMPs with a decrease in consumption of Schedule II opioid analgesics and a corresponding increase in Schedule III analgesics, suggesting a possible substitution effect (Paulozzi et al., 2011; Simeone and Holland, 2006; Simoni-Wastila and Qian, 2012). PDMPs may be associated with improved opioid safety, as measured by a slower rate of growth of poison center calls involving intentional exposures to opioid analgesics in states with PDMPs (Reifler et al., 2012); however, PDMP implementation was not associated with decreases in state-level opioid overdose mortality (Paulozzi et al., 2011).

While PDMPs have not been associated with lower rates of fatal opioid analgesic overdoses (Paulozzi et al., 2011), nonfatal complications from opioid use are more common (Centers for Disease Control and Prevention, 2015, 2010; Darke et al., 2003; Neale, 2003). These events may necessitate emergency care, and therefore ED visits may be a more sensitive measure of opioid safety than fatal overdoses (Substance Abuse and Mental Health Services Administration, 2012a). To further characterize the association between PDMP implementation and ED visits involving opioids, we conducted a retrospective study using data from 11 metropolitan areas in the United States. We hypothesized that state implementation of a prescriber-accessible PDMP would be associated with lower rates of ED visits involving opioid analgesics.

2. Methods

2.1. Study design and data sources

In this retrospective study, we used the Drug Abuse Warning Network (DAWN) public use files to estimate the rate of ED visits involving opioid analgesics in 11 US metropolitan areas from 2004 to 2011. DAWN is a longitudinal public health surveillance program administered by the Substance Abuse and Mental Health Services Administration to identify all ED visits in which illicit or prescription drugs were a cause or contributing factor (Center for Behavioral Health Statistics and Quality, 2013). DAWN data are collected by trained coders through chart review of medical records from a representative sample of non-federal, short stay hospitals. The survey produces nationally representative estimates of ED visits involving drugs, as well as regional estimates for 11 metropolitan areas (Metropolitan Statistical Areas) in which sufficient data are collected to produce statistically reliable results (Center for Behavioral Health Statistics and Quality, 2013). Because metropolitan areas can cross state boundaries, the 11 metropolitan areas include populations in 14 states. The metropolitan areas and their respective states are: Boston (Massachusetts, New Hampshire), Chicago (Illinois, Wisconsin, Indiana), Denver (Colorado), Detroit (Michigan), Houston (Texas), Miami-Dade County (Florida), Minneapolis-St. Paul (Minnesota, Wisconsin), New York City (New York), Phoenix (Arizona), San Francisco (California), and Seattle (Washington).

To determine whether an ED visit was related to drug use, DAWN coders review the medical record for chief complaint, clinician documentation, and final diagnosis. The drug use must be implicated as a direct or indirect cause of the visit for DAWN coders to record the visit. If a drug is incidentally noted to be "on board" (e.g., such as on a urine drug screen) but the ED visit is for an unrelated reason (e.g., appendicitis), the visit is not included in the DAWN results (Center for Behavioral Health Statistics and Quality, 2013). The DAWN classification system further stratifies these ED visits into two subsets. The first subset includes ED visits with an indication of drug misuse, such as patients who use medications prescribed for another person, use a higher-than-prescribed dose, or use opioids for reasons other than treating pain (Center for Behavioral Health Statistics and Quality, 2013). This category also includes drug-related suicide attempts or requests for detoxification services. The second subset includes ED visits with no indication of misuse, such as accidental ingestions, side effects, or allergic reactions.

2.2. Outcome measures

The primary outcome was the rate of ED visits involving opioid analgesics per quarter, per 100,000 metropolitan area residents. This outcome included ED visits classified as involving misuse and those classified as not involving drug misuse. To calculate this outcome, we used DAWN data to estimate the total number of ED visits involving opioid analgesics (Schedules II through V) for each metropolitan area in each calendar quarter (3-month block) during the study period, then divided this visit total by metropolitan area population estimates from the National Center for Health Statistics (National Center for Health Statistics, 2014b,c). Several secondary outcomes were examined: rates of ED visits involving opioid analgesics in three age strata (18–34 years, 35–54 years, and 55 years or greater); rates of ED visits involving misuse of opioid analgesics; the rate of ED visits involving Schedule II opioid analgesics, and the rate of ED visits involving Schedule II opioid analgesic misuse. We examined these age strata because prior research demonstrated that deaths rates from opioid analgesics were highest among individuals aged 35–54 (Centers for Disease Control and Prevention, 2013). We measured Schedule II opioid analgesics separately because they were monitored by all PDMPs throughout the study period, whereas drugs in Schedules III and IV were not monitored by all PDMPs in all study calendar quarters.

2.3. Exposure of interest

The presence of a prescriber-accessible PDMP was our primary exposure of interest. For this analysis, the first date on which a prescriber-accessible PDMP was present in a state is considered the PDMP implementation date. To determine the PDMP implementation date for each state, we first reviewed online data from the National Alliance for State Model Drug Laws (National Alliance for Model State Drug Laws, 2014a) and the University of Kentucky (Blumenschein et al., 2010), and then contacted PDMP administrators in all 14 states for verification. For each state, we classified a PDMP as present for all calendar quarters that included or followed the PDMP implementation date; if a PDMP was present in any part of a quarter, we counted it as present for the entire quarter.

To account for the fact that metropolitan areas can be composed of counties from several states, the presence of a PDMP in each metropolitan area was coded to reflect the proportion of the population residing in a state with a PDMP present. For example, in the first quarter of 2011, Massachusetts had a provider-accessible PDMP, but New Hampshire did not. Because 91% of the population in the Boston metropolitan area resides in Massachusetts, the value of the PDMP variable in this quarter for this metropolitan area was 0.91.

2.4. Statistical analysis

To investigate the association between PDMP implementation and changes in ED visits involving opioids, we first examined the unadjusted ED visit rates in two ways. First, we grouped each of the 11 metropolitan areas by year of PDMP implementation: prior to 2004, 2008–2009, 2010–2011, or after 2011 (no PDMPs were implemented in this cohort of states during 2004–2007). To do this, we used the implementation year of the PDMP in the state that contributed the majority of the population to a given metropolitan area (e.g., Illinois in the case of the Chicago metropolitan area). These results were graphed for visual comparison. Second, we centered metropolitan areas on the date of PDMP implementation and determined the mean ED visit rate in the calendar quarters before and after program implementation. Only metropolitan areas that implemented PDMPs during 2004–2011 (Boston, New York City, Chicago, Minneapolis, Denver, Phoenix, and San Francisco) were included in this analysis. These results were also graphed for visual inspection. If PDMPs had an impact on ED visits, this analysis would potentially reveal a change in the trend after PDMP implementation.

Next, to determine the association between PDMP implementation and our outcomes of interest while adjusting for other covariates, we developed linear regression models. We used a generalized estimating equations framework with a first-order autoregressive (AR1) working covariance matrix to account for repeated measures within metropolitan areas over time. In each regression model, the main independent variable was the presence of a prescriber-accessible PDMP. The coefficient of this variable represented the mean quarterly difference in ED visit rates associated with presence of the PDMP for the full population of a metropolitan area.

In addition to the main independent variable, we adjusted for calendar quarter (to adjust for time trends common to all metropolitan areas) and metropolitan area (to adjust for time-invariant differences between metropolitan areas), as well as an interaction term between quarter (as a continuous variable) and metropolitan area, to allow for differential effects of time in each metropolitan area. Quarterly metropolitan area unemployment rate (Bureau of Labor Statistics, 2015) was also included as a covariate because prior studies have reported higher rates of prescription drug abuse during periods of unemployment (Henkel, 2011; Merline et al., 2004; Spiller et al., 2009). Log transformations of the outcome variables were explored but were not deemed necessary based on graphical assessments of the distributions.