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Research Paper

Prescription monitoring programs and emergency department visits involving benzodiazepine misuse: Early evidence from 11 United States metropolitan areas

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ABSTRACT

Background: Emergency department (ED) visits involving benzodiazepines have increased in the United States. Most states have created prescription monitoring programs (PMPs) to improve drug prescribing safety. To determine the association between PMP implementation and ED visits involving benzodiazepine misuse, we conducted a retrospective analysis of data from 11 metropolitan areas in the United States from 2004 to 2011.

Methods: We estimated rates of ED visits per 100,000 residents involving benzodiazepine misuse from the Drug Abuse Warning Network dataset. Dates of PMP implementation were obtained from program administrators. We used linear regression models to assess whether PMP implementation was associated with a change in ED visits involving benzodiazepines. Models were adjusted for calendar quarter, metropolitan area, and metropolitan area-specific linear time trends.

Results: Rates of ED visits involving benzodiazepine misuse increased in all metropolitan areas during the study period. PMP implementation was not associated with a change in ED visits (mean difference: 0.9 [95% CI: -0.09 to 1.9] visits per 100,000 population per quarter; $p = 0.08$). When analyzed by number of years after implementation, PMPs were associated with a higher visit rate in year one (0.8 [95% CI: 0.2−1.5]; $p = 0.01$]), but not in year two (0.3 [95% CI: −2.1−2.8]; $p = 0.78$) or year three or later (2.1 [95% CI: −0.4−4.7]; $p = 0.10$).

Conclusion: We did not find evidence that PMP implementation was associated with reductions in ED visits involving benzodiazepine misuse. Future work should identify PMP features and capabilities that improve benzodiazepine safety.

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Introduction

Benzodiazepines are medications with sedative, anxiolytic, and anticonvulsant effects that are commonly used to treat anxiety disorders, insomnia, muscle spasms, and seizure disorders. In 2008, an estimated 5.2% of American adults (over 11 million) filled one or more prescription for a benzodiazepine (Olfson, King, & Schoenbaum, 2015). While the use of benzodiazepines for panic disorder and insomnia is supported by clinical practice guidelines (Baldwin et al., 2005; Bandelow et al., 2008; Morgenthaler et al., 2007; Schutte-Rodin, Broch, Buysse, Dorsey, & Sateia, 2008), it can be associated with several risks, including misuse and dependence (Fenton, Keyes, Martins, & Hasin, 2010), falls and fractures (Xing et al., 2014), and motor vehicle crashes (Smink, Egberts, Lusthof, Uges, & de Gier, 2010). Furthermore, concurrent benzodiazepine use is associated with a much higher risk of opioid overdose and in 2011, benzodiazepines were estimated to be involved in approximately one-third (31%) of opioid overdoses (Jones & McAninch,

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2015; Park, Saitz, Ganoczy, Ilgen, & Bohnert, 2015). Many of these adverse events can lead to emergency department (ED) care and a recent study found that ED visits involving benzodiazepines approximately doubled between 2005 and 2011 (Substance Abuse and Mental Health Services Administration Center for Behavioral Health Statistics and Quality., 2014).

In the United States, prescription monitoring programs (PMPs) are state-level registries of prescriptions for controlled substances. Early PMPs were designed primarily for law enforcement use but more recent PMPs have made prescription data accessible to prescribers (Clark, Eadie, Kreiner, & Strickler, 2012). These programs aim to improve prescription safety by helping providers to identify individuals filling prescriptions from multiple providers or pharmacies (i.e. "doctor shopping" or "pharmacy shopping"), which has previously been documented among some people taking benzodiazepines (Wilsey et al., 2010). As of 2015, all states but one have an operational PMP (Prescription Drug Monitoring Program Training & Technical Assistance Center, 2015). The impact of prescriber-accessible PMPs on benzodiazepine safety, specifically ED visits involving benzodiazepine misuse, is unknown. To examine this association, we conducted a retrospective study of PMP implementation and ED visits involving benzodiazepine misuse in 11 major metropolitan areas in the United States.

Methods

To estimate the rate of ED visits involving benzodiazepine misuse, we used Drug Abuse Warning Network (DAWN) data from 2004 to 2011. DAWN is a survey administered by the Substance Abuse and Mental Health Services Administration to identify ED visits in which illicit or prescription drugs were a cause or contributing factor (Center for Behavioral Health Statistics & Quality, 2013); data are collected by trained chart reviewers. DAWN can be used to study these ED visits on a national level as well as for certain large metropolitan areas in which sufficient data are available to produce reliable estimates. For the period 2004 to 2011, data were available for the following metropolitan areas: Boston, Chicago, Denver, Detroit, Houston, Miami-Dade County, Minneapolis-St. Paul, New York City, Phoenix, San Francisco, and Seattle.

We calculated the ED visit rate per calendar quarter, per 100,000 metropolitan area residents, where benzodiazepine "misuse or abuse" (henceforth "misuse") was coded as causing or contributing to the visit. We only included visits involving benzodiazepines that were coded as specifically related to misuse, such as visits resulting from taking a higher-than-prescribed benzodiazepine dose, taking benzodiazepine medication prescribed for another individual, requesting detoxification services, attempting suicide, or being maliciously poisoned by another individual (Center for Behavioral Health Statistics & Quality, 2013). ED visit rates were calculated using methods to account for DAWN's complex sampling (i.e. weights, strata, and replicates) (Center for Behavioral Health Statistics & Quality, 2013). We contacted PMP administrators to determine dates when prescriber-accessible PMPs began recording data on benzodiazepine (Schedule IV) prescriptions. We classified a PMP as present for all calendar quarters that included or followed the PMP implementation date; if a PMP was present in any part of a quarter, we counted it as present for the entire quarter.

We coded the presence of a PMP in two ways. First, to account for the fact that metropolitan areas can be composed of counties from several states, the presence of a PMP in each metropolitan area was coded to reflect the proportion of the population residing in a state with a PMP present. For example, in the first quarter of 2011, Massachusetts had a provider-accessible PMP, but New Hampshire did not. Because 91% of the population in the Boston metropolitan area resides in Massachusetts, the value of the PMP variable in this quarter for this metropolitan area was 0.91. Second, to determine the association between PMPs and ED visit rates in each year after PMP implementation, we coded the PMP variable as the number of years the PMP has been operational. Given the relatively short follow-up time for several of the metropolitan areas that implemented PMPs, we categorized the years since PMP implementation as: 1, 2, or 3 or later.

First, we examined unadjusted ED visit rates by grouping metropolitan areas by year of PMP implementation. Next, we fit multivariable linear regression models under a generalized estimating equations framework with a first-order autoregressive (AR1) working covariance matrix to account for correlation over time. The ED visit rate for benzodiazepine misuse in a given metropolitan area in a given calendar quarter was the dependent variable. The main independent variable was the presence of a prescriber-accessible PMP. We included several covariates: calendar quarter (to adjust for time trends common to all metropolitan areas), metropolitan area (to adjust for time-invariant differences between metropolitan areas), and an interaction term between quarter and metropolitan area (metropolitan area-specific linear time trends, to adjust for differential effects of time in each metropolitan area). Previous work has found an association between higher rates of drug use during periods of unemployment both on an individual and a state level (Henkel, 2011; Merline, O'Malley, Schulenberg, Bachman, & Johnston, 2004; Spiller, Lorenz, Bailey, & Dart, 2009); however, adjustment for metropolitan area-specific quarterly unemployment rates did not alter the significance, direction, or magnitude of the association between PMPs and ED visit rates and we therefore did not include it. With this model specification, the coefficient on the main independent variable (PMP) represents the mean difference in ED visits associated with PMP implementation, relative to pre-implementation trends and trends in metropolitan areas without PMPs. In these analyses, we weighted by the inverse variance of the estimated ED visit rate to incorporate uncertainty around DAWN estimates (French & Heagerty, 2008). Analyses were conducted with SAS 9.4 (SAS Institute, Cary, NC, USA) and STATA 13.1 (College Station, TX, USA). This study was determined to be exempt by the University of Pennsylvania Institutional Review Board.

Results

Of the 11 metropolitan areas in our sample, Detroit was the first to be in a state implementing a PMP that collected information on benzodiazepine prescriptions (2003). Between 2008 and 2009, such PMPs were implemented in states that contained the majority of residents in the Phoenix, San Francisco, and Denver metropolitan areas. During 2010–2011, PMPs were implemented in states that contained the majority of residents in the Boston, Miami, Minneapolis, and New York City metropolitan areas. Residents of Chicago, Houston, and Seattle were not covered by a PMP until after 2011.

During the study period, unadjusted rates of ED visits involving benzodiazepines increased in all metropolitan areas; increases were similar when grouped by year of PMP implementation (Fig. 1). In adjusted analyses, PMP implementation was not associated with a significant difference in the rate of ED visits involving benzodiazepines (mean difference: 0.9 [95% CI: -0.09–1.9] visits per 100,000 population per quarter; $p = 0.08$; Table 1). When ED visits were analyzed by year after program implementation, PMPs were associated with a significantly higher visit rate in the first year, followed by no significant difference in subsequent years (Table 1).