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Original article

Emergency department utilization and subsequent prescription drug overdose death

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ABSTRACT

Purpose: Prescription drug overdose (PDO) deaths are a critical public health problem in the United States. This study aims to assess the association between emergency department (ED) utilization patterns in a cohort of ED patients and the risk of subsequent unintentional PDO mortality.
Methods: Using data from the New York Statewide Planning and Research Cooperative System for 2006–2010, a nested case-control design was used to examine the relationship between ED utilization patterns in New York State residents of age 18–64 years and subsequent PDO death.
Results: The study sample consisted of 2732 case patients who died of PDO and 2732 control ED patients who were selected through incidence density sampling. With adjustment for demographic characteristics, and diagnoses of pain, substance abuse, and psychiatric disorders, the estimated odds ratios of PDO death relative to one ED visit or less in the previous year were 4.90 (95% confidence interval [CI]: 4.50–5.34) for those with two ED visits, 16.61 (95% CI: 14.72–18.75) for those with three ED visits, and 48.24 (95% CI: 43.23–53.83) for those with four ED visits or more.
Conclusions: Frequency of ED visits is strongly associated with the risk of subsequent PDO death. Intervention programs targeting frequent ED users are warranted to reduce PDO mortality.

Introduction

Increases in drug overdose death in the United States are a critical public health problem. Nearly 60% of drug overdose deaths involved prescription drugs, and in 2011, 1.4 million emergency department (ED) visits involved nonmedical use of prescription drugs [1,2]. Frequent ED utilization has been shown to be a marker for substance use—narcotic use, especially [3,4], and is associated with nonmedical opioid use, drug diversion, and poorly controlled pain [3–5]. Therefore, frequent ED utilization may be a marker for increased risk for prescription drug overdose (PDO), and this point of clinician contact may serve as a setting to launch preventive intervention efforts [6–15]. Preventive interventions targeted at ED patients at high risk for PDO death, may include advice such as not mixing opioids with sedatives or alcohol [16], or targeted patient education initiatives [17]. Furthermore, identifying high risk populations can help medical practitioners decide whom to target with screening, intervention (e.g., take-home naloxone), and treatment program referrals [18–24].

Despite the importance of the ED as a key clinical entry point for patients at high risk of PDO, the relationship between ED utilization patterns and subsequent drug overdose death is understudied. In the present study, we used a nested case-control design to examine the relationship between ED utilization in a cohort of ED patients and the risk of subsequent unintentional PDO death. Characterizing risk markers for fatal PDO available in administrative databases can be useful for identifying individuals at increased likelihood of PDO death. The goal of the analysis was to determine whether increased ED utilization in a cohort of ED patients was associated with subsequent unintentional PDO death.

Materials and methods

Data sources

Data for this study came from the New York Statewide Planning and Research Cooperative System (SPARCS) for the years

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2006–2010. SPARCS is a data reporting system that collects ED visit data from nonfederal hospitals in New York State (NYS) [25]. SPARCS contains patient-level data including patient characteristics, discharge diagnoses, procedures received, and charges for ED visits [25]. To ensure data quality, SPARCS visit data are examined for proper formatting upon submission format [26]. Data completeness and accuracy are assessed for each facility. Data are reviewed monthly and compared with other benchmarks from Department of Health data [26,27]. To ascertain dates of death, and underlying and contributing causes of death for patients who visited the ED during the study period, SPARCS ED data were linked to NYS and New York City vital statistics records by a SPARCS analyst. Data were linked based on the patient's date of birth, residential address, first two characters of the patient's first name, the first and last two characters of the patient's last name, and the last four digits of the patient's social security number. PDO mortality within one year of the most recent ED visit within the study period 2006–2010 was evaluated. The study protocol was reviewed and approved by the Institutional Review Board of Columbia University Medical Center (IRB-AAAK6304 New York, NY).

ED utilization

ED utilization (1, 2, 3, and $\geq$4 visits) in last year of follow-up was calculated with respect to date of death for cases. The choice of these time frames was based on research by the Agency for Healthcare Research and Quality, which proposed two ED visits or more in 3 days, three ED visits or more in 90 days, and four ED visits or more in a year as metrics to track suboptimal quality of care [28].

Model evaluation for which ED utilization time frame best fit the data was based on Akaike information criterion statistics [29]. Time-varying 365-day ED utilization was operationalized using three separate indicator variables: two, three, or four or more ED visits in a 365-day time window. When calculating these ED utilization measures, admissions for patients who were transferred on the day of discharge to other acute care hospitals, including patients admitted to hospital specialty units, inpatient rehabilitation facilities, skilled nursing facilities, and long-term care hospitals, were collapsed and treated as one continuous admission. If a patient died at the ED, this visit was not counted. Same-day ED revisits were included in the analyses.

Other risk markers

Other risk markers that were evaluated included age, sex, and race (white, black, Asian/Pacific Islander/Native American, and other). To help improve model fit, a discharge against medical advice (AMA) at the initial ED visit and several other diagnoses were examined as potential risk markers for drug overdose death given that discharges AMA are associated with drug abuse [30]. Previous studies have noted a rise in nontraumatic dental condition-related ED visits that may result in an opioid analgesic prescription (Online Appendix A) [31–33]. Studies of drug overdose have noted that substance use disorders, mental health disorders, and chronic pain conditions are associated with drug overdose [34–42]. Accordingly, these conditions were evaluated as potential risk markers of PDO death. In accordance with the State Personal Privacy Protection Law, individual characteristics involving less than six patients may not be reported.

Outcome measurements

Classification codes from the *International Classification of Diseases and Related Health Problems, 10th Revision* were used to classify PDO deaths. Unintentional and undetermined intent overdose deaths (X40–X44, Y10–Y14), where there was also an indication that a prescription drug was a contributing cause of death (T40.2, T40.3, T40.4 [opioid analgesics], T40.6 [Other and unspecified narcotics], T42.2 [Succinimides and oxazolidinediones], T42.3 [Barbiturates], T42.4 [Benzodiazepines], T43.0 [Tricyclic and tetracyclic antidepressants], T43.1 [Monoamine-oxidase-inhibitor antidepressants], T43.2 [other and unspecified antidepressants], T50.9 [other and unspecified drugs]), were evaluated as the primary outcome of interest [43,44].

Study design

A nested case-control study design was used. ED patients who subsequently died of PDO during the follow-up were considered cases. Using incidence density sampling, one control was randomly selected from the same base population from which the cases arose and was matched to the corresponding case on follow-up time [45]. The first visit date in the study period was considered the entry visit. The end of follow-up for cases was the date when PDO death occurred. For controls, the end of follow-up time corresponded to elapsed time from study entry to the time when death occurred for the matched case. To be eligible to be a control the individual must be alive when the case occurred. All case patients were able to be matched with control patients. Incidence density sampling was used because ED utilization is time-varying. Time-dependent covariates may be accurately assessed in nested case-control study by using incidence density-based sampling to create risk sets [45].

The cohort from which the cases arose included patients who were NYS residents, were 18–64 years of age, and who visited the ED in NYS from 2006–2010 (Fig. 1). Patients with any discharge diagnoses indicating palliative care, cancer, metastatic carcinoma, or sickle cell anemia at any ED visit were excluded from the cohort because they may have different ED utilization patterns and may receive higher doses of opioids than other patients. Patients without a previous ED visit who died during the index ED visit were excluded from the cohort because there was no pattern of prior ED visits to predict the study outcome. Of the remaining patients who visited the ED, all individuals who subsequently died of a PDO death were used as cases.

Statistical analysis

To better understand the attributes of the individuals included in this study, the frequency distribution of patient characteristics at the initial ED visit from 2006–2010 who subsequently died of a PDO was compared with those of patients who did not. Differences between groups were compared using χ^2 tests. A *P*-value of .05 or less was considered statistically significant. Baseline characteristics were examined in unadjusted models to estimate the odds ratio (OR) and 95% confidence interval (CI) for PDO death. Conditional logistic regression was used to estimate ORs [46,47]. Because this study is based on the nested case-control design, the measure of association is the OR. With incidence density sampling, the OR approximates the incidence rate ratio [48]. To prevent overadjustment in multivariable models, demographic characteristics (age, sex, and composite independent variables of diagnoses at study entry) were created and included in the final multivariable model. Four binary composite independent variables of diagnoses at entry were created, including presence or absence of the following: (1) Diagnosis of alcohol abuse, alcohol drug seeking, drug dependence, opioid abuse, other drug abuse, nonfatal opioid overdose, or sedative anxiolytic abuse at the initial ED visit; (2) Diagnosis of anxiety disorder, depression, episodic mood disorder, major depressive disorder, personality disorder, post-traumatic