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Predictors of Overdose Death Among High-Risk Emergency Department Patients With Substance-Related Encounters: A Data Linkage Cohort Study

Noa Krawczyk, PhD[*], **Matthew Eisenberg, PhD**, **Kristin E. Schneider, BA**, **Tom M. Richards, MS**, **B. Casey Lyons, MPH**, **Kate Jackson, MPH**, **Lindsey Ferris, DrPH**, **Jonathan P. Weiner, DrPH**, **Brendan Saloner, PhD**

Department of Mental Health, Johns Hopkins Bloomberg School of Public Health (Krawczyk, Schneider, Saloner) and Department of Health Policy and Management (Eisenberg, Ferris, Weiner, Saloner), Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; the Johns Hopkins Center for Population and Health and Information Technology (Richards, Weiner), Baltimore, MD; the Behavioral Health Administration, Maryland Department of Health, Columbia, MD (Lyons, Jackson); and the Chesapeake Regional Information System for Our Patients, Columbia, MD (Ferris).

Abstract

Study objective: Persons with substance use disorders frequently utilize emergency department (ED) services, creating an opportunity for intervention and referral to addiction treatment and harm-reduction services. However, EDs may not have the appropriate tools to distinguish which patients are at greatest risk for negative outcomes. We link hospital ED and medical examiner mortality databases in one state to identify individual-level risk factors associated with overdose death among ED patients with substance-related encounters.

Methods: This retrospective cohort study linked Maryland statewide ED hospital claims records for adults with nonfatal overdose or substance use disorder encounters in 2014 to 2015 with medical examiner mortality records in 2015 to 2016. Logistic regression was used to identify factors in hospital records associated with risk of opioid overdose death. Predicted probabilities for overdose death were calculated for hypothetical patients with different combinations of overdose and substance use diagnostic histories.

Results: A total of 139,252 patients had substance-related ED encounters in 2014 to 2015. Of these patients, 963 later experienced an opioid overdose death, indicating a case fatality rate of

[*]Corresponding Author. noakra@gmail.com, Twitter: @NoaKrawczyk.

Author contributions:

NK, JPW, and BS conceptualized the study question. NK conducted the analyses and drafted the article. ME, KES, TMR, BCL, KJ, LF, JPW, and BS revised the article. ME, KES, and TMR generated the analytic database. NK, ME, KES, TMR, BCL, KJ, and LF developed study variables. BCL, KJ, and LF contributed to the conception of the study and secured databases for analysis and linkage. JPW and BS led and oversaw the research project and conceptualized the study variables. NK takes responsibility for the paper as a whole.

All authors attest to meeting the four ICMJE.org authorship criteria: (1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (2) Drafting the work or revising it critically for important intellectual content; AND (3) Final approval of the version to be published; AND (4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

69.2 per 10,000 patients, 6 times higher than that of patients who used the ED for any cause. Factors most strongly associated with death included having both an opioid and another substance use disorder (adjusted odds ratio 2.88; 95% confidence interval 2.04 to 4.07), having greater than or equal to 3 previous nonfatal overdoses (adjusted odds ratio 2.89; 95% confidence interval 1.54 to 5.43), and having a previous nonfatal overdose involving heroin (adjusted odds ratio 2.24; 95% confidence interval 1.64 to 3.05).

Conclusion: These results highlight important differences in overdose risk among patients receiving care in EDs for substance-related conditions. The findings demonstrate the potential utility of incorporating routine data from patient records to assess risk of future negative outcomes and identify primary targets for initiation and linkage to lifesaving care.

INTRODUCTION

Background

Emergency departments (EDs) are critical providers of acute care for persons affected by the current overdose crisis in the United States.[1] Persons with substance use disorders and other comorbid conditions, such as mental illness or homelessness, commonly seek care in ED settings, often as a result of lack of access to regular sources of primary and specialty care.[2–4] Frequent hospital and ED use has been linked to greater risk of experiencing both nonfatal and fatal overdoses,[5,6] and both US and international research has found ED utilization to be highest in the months preceding and after overdose.[7–9]

Given that persons at risk of overdose interact frequently with the ED, intervening at this point of contact could be an effective overdose prevention strategy. EDs are especially important intervention points because patients who come into contact with the ED because of overdose or other conditions may not otherwise access the health care system.[10] As a result, multiple ED interventions after overdose have begun to be proposed as part of comprehensive public health responses to the opioid crisis.[11] However, because EDs are facing an overwhelming volume of patients with one or more risk factors, given the current opioid crisis, it may be challenging to discern which persons are at highest risk of fatal overdose. Although having a substance use disorder[12,13] or a previous nonfatal overdose[14–16] likely signals risk of future overdose, substantial variability remains among this high-risk population in regard to who eventually experiences a fatal overdose.[6,14] EDs and other hospital service settings are pressed for time and resources and may not have the capacity to intervene with every patient who presents to the hospital with substance-related risk factors, highlighting the need for streamlined analytic tools that could help identify high-risk individuals.[17–19] The need for decision support tools to help assess the multiple factors among high volumes of hospital patient risk has never been greater; opioid-related ED visits in the United States doubled[20] from 2005 to 2014 and are increasingly attributed to drug poisonings rather than dependence or abuse.[21]

Importance

Given these challenges, characterizing specific risk factors associated with overdose death among patients with substance-related ED encounters is crucial.[22] One approach that has been suggested is using past and current electronic hospital records that capture treated

diagnoses as a mechanism of identifying and notifying clinicians about high-risk patients in need of intervention.[19,23,24] However, to our knowledge studies have not focused on risk factors specifically among high-risk patients who are visiting the ED for substance-related encounters.

Goals of This Investigation

In this study, we linked a statewide, all-payer hospitalization database with information on overdose deaths obtained from Maryland's statewide medical examiner's office to identify demographic and diagnosis-related risk factors available from hospital records that are associated with overdose death. We first characterized risk factors among the entire ED patient population who received ED care in nonfederal acute care hospitals in Maryland during 2014 or 2015. Then, we focused specifically on persons with substance-related conditions to better distinguish predictors of death among this high-risk group. With this universal, linked database, we were able to identify specific patient- and encounter-related information that could be readily available to hospital-based providers to indicate mortality risk. Our intent was to develop a basis for predictive risk models that could be used by EDs to better identify the highest-risk patients in the context of increasing visits because of substance-related conditions and thus improve the efficiency and effectiveness of their interventions.

MATERIALS AND METHODS

Study Design and Setting

This was a retrospective cohort study linking an all-payer administrative hospital database of ED services delivered by Maryland acute care nonfederal hospitals during 2014 to 2015, with records of all overdose deaths in the state during 2015 to 2016. With an overall overdose death rate of 3.63 per 10,000 in 2017, Maryland currently has the eighth-highest overdose death rate in the United States.[25] ED visits for overdoses and other substance-use-related encounters have also increased across the state in recent years.[26]

Hospital data were derived from an administrative claims database of all Maryland acute care and licensed specialty hospital records that are reported to the Maryland Health Services Cost Review Commission. Mortality data included cause-of-death information for all deaths that were investigated by the Maryland Office of the Chief Medical Examiner. All records were linked by the Maryland state-designated health information exchange, the Chesapeake Regional Information System for Our Patients, which applied a probabilistic algorithm to demographic data to link persons across databases by appending a unique, encrypted identifier to each person. The probabilistic algorithm leverages bucketing and standardization functions to apply a weighted score to each demographic data element (inputs include name, date of birth, sex, address, telephone number, and social security number, if available). If the final score reaches the predefined threshold for the health information exchange, the 2 records are considered a match; otherwise, they are considered to belong to separate patients. The upper limit of the false-positive rate has been estimated to be 0.9%, which was validated by a comparative analysis with a subset of data provided by a major payer in Maryland.

Both the Maryland Department of Health and Johns Hopkins Bloomberg School of Public Health institutional review boards approved this study. Methods and reporting adhered to the Strengthening the Reporting of Observational Studies in Epidemiology criteria for cohort studies.[27]

Selection of Participants

Figure 1 outlines the sample selection. Hospital records were first limited to adults (≥18 years) with ED encounters in 2014 to 2015 who had not died during hospitalization after an overdose-related visit (most overdose deaths were not processed in hospital records because they occurred in other locations).

A subset was then identified among ED patients that included persons who met at least one of the following diagnostic criteria: a diagnosis of an opioid use disorder, a diagnosis of any other type of substance use disorder (excluding tobacco use disorder), or a diagnosis for a nonfatal overdose from any drug. Table E1 (available online at http://www.annemergmed.com) contains detailed lists of *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* and *ICD-10-CM* diagnosis codes used to designate these categories.

Methods of Measurement and Outcome Measures

Independent variables were derived from hospital data during the 2014 to 2015 period and were selected according to the literature of known risk factors for overdose[12–14,28] and consideration of what information may be readily available within hospital records for potential clinical decision support interventions. We used protocols defined by the Maryland Department of Health to classify substance-related hospitalizations in the state and selected diagnosis codes in accordance with previous literature.[29,30]

Independent variable specifications of the risk factors we included in our model were as follows: substance use disorder diagnoses (no diagnoses, opioid use disorder diagnosis only, other substance use disorder diagnosis only, or both diagnoses); having had 1 or more chronic pain diagnoses, based on *ICD* codes determined to highly likely represent chronic pain[31]; having 1 or more nonpoisoning injury diagnoses, based on the National Center for Health Statistics proposed definitions for injury hospitalization and ED visits (regardless of intent),[30] excluding diagnoses specified for substance-related poisonings; having had 1 or more mental health diagnoses for a mood, anxiety, psychotic, or personality disorder, adapted from a previous risk factor analysis of conditions associated with overdose risk[32]; the number of previous nonfatal overdoses from any drug during the period (0, 1, 2, or ≥3); the types of drugs involved in previous nonfatal overdoses (heroin, methadone, other opioids, benzodiazepines, alcohol, cocaine, and other drugs); and whether a patient had been admitted to an inpatient unit for any health condition during the studied time frame (versus just ED). Table E1 (available online at http://www.annemergmed.com) contains a detailed list of diagnosis and hospital codes used to define each of the aforementioned independent risk factors. We included sex, age, and race as additional demographic variables in our model.

The dependent variable was an opioid overdose death that occurred in 2015 or 2016. Opioid overdoses were defined as all deaths, regardless of method, that the Office of the Chief Medical Examiner, using toxicology data and other forensic information, determined were caused alone or in combination with other drugs, by heroin, fentanyl or analogues, or any other opioids.

A time frame including 1 overlapping year between hospital records (2014 to 2015) and death records (2015 to 2016) was selected to account for some delay that may have occurred between previous hospitalization and overdose death. Sensitivity analyses were performed that included 2014 death records, which did not qualitatively change results or conclusions.

Primary Data Analysis

First, a risk-factor analysis using multivariable logistic regression was conducted among the entire ED population to identify characteristics that were associated with opioid overdose death and assess the risk incurred by substance-related and other diagnostic categories of interest. Then, the sample was limited to patients who had experienced a substance-related encounter, which included a nonfatal overdose, an opioid use disorder diagnosis, or another substance use disorder diagnosis. Once limited to this subset population, prevalence of each diagnostic predictor of interest was calculated and compared across persons who eventually experienced an opioid overdose death in 2015 or 2016 and those who did not. Univariable odds ratios (ORs) of overdose death for each predictor were then calculated with logistic regression and used to identify which factors were associated with increased odds of overdose death among patients with substance-related conditions. Predictors of interest were entered into a multivariable logistic regression model along with demographic characteristics to assess what predictors remained independently associated with overdose death after controlling for all other factors.

Last, to provide an illustration of how this model might be applied within an ED setting to identify risk among individual patients, we calculated predicted probabilities for overdose death among hypothetical patients with different combinations of nonfatal overdose and substance use disorder diagnostic histories. This was done with predictive margins from the multivariable logistic regression model, which estimates a probability of having the outcome of interest (opioid overdose death), given certain individual patient factors, holding all other variables at their means. Estimating predicted probabilities for hypothetical patients using their records of previous hospital visits exemplifies how data present in a patient record could be used during an ED visit to gauge the severity of an individual patient's risk of overdose death in the near future.

For all analyses, confidence intervals (CIs) were assessed at the 95% level. Thus, it is possible that 5% of tests were significant merely by chance. Variance inflation factors were calculated for all multivariable regressions to test for collinearity among variables. Data were missing for only 0.5% of the total sample, and therefore a complete case analysis was used for all multivariate analyses. All analyses were conducted with Stata (version 15.1; StataCorp, College Station, TX).[33]

RESULTS

Characteristics of Study Subjects

A total of 1,251,535 persons had an ED encounter in 2014 or 2015, of whom 139,252 met criteria for a substance-related encounter. Full demographic characteristics of both the full ED population and the subset with substance-related encounters are presented in Table 1. Of patients with substance-related encounters, 36,199 (26.00%) had an opioid use disorder diagnosis, 118,586 (85.16%) had a substance use disorder diagnosis other than opioid use disorder, and 18,549 (13.32%) had a nonfatal drug overdose (categories were not mutually exclusive). The types of drugs involved in nonfatal overdoses included opioids (44.89%), alcohol (3.65%), benzodiazepines (17.35%), cocaine (6.22%), and all other drugs (43.16%). Having experienced an overdose did not necessarily indicate a patient would have a substance use disorder diagnosis; 36.44% of persons who had some type of nonfatal overdose did not have any opioid use disorder or other substance use disorder diagnosis in their records during the study period.

Among patients who sought care for any condition in the ED, 1,452 eventually went on to experience an opioid overdose death during 2015 to 2016, indicating an opioid overdose case fatality rate of 11.6 per 10,000 persons within the full ED patient population. This rate was 6 times lower than that of patients who had substance-related encounters, in which 963 persons went on to experience an opioid overdose death, with a case fatality rate of 69.2 per 10,000 persons among this subset of the ED patient population.

Within various high-risk subgroups that met inclusion criteria, there was substantial variability in risk of overdose death. Patients with a previous nonfatal overdose exhibited the largest overdose case fatality rate (183.3/10,000 persons), followed by persons with an opioid use disorder diagnosis (164.1/10,000 persons) and persons with another substance use disorder diagnosis (65.0/10,000 persons). Among patients with substance-related encounters, 49.53% (n=477) of opioid overdose deaths involved fentanyl, 36.76% (n=354) involved heroin, and 29.60% (n=285) involved other prescription opioids. Many of the identified opioid overdose deaths also involved additional nonopioid substances, including alcohol (n=246; 25.55%), cocaine (n=176; 18.28%), and benzodiazepines (n=76; 7.89%). A breakdown of the frequencies of substances involved in overdose deaths by quarter of 2015 and 2016 is presented in Figure 2.

Table 2 presents risk factors for opioid overdose death among the entire ED population. Women were less likely to experience an overdose death than men (OR 0.47; 95% CI 0.42 to 0.52), and being aged 30 to 59 years increased odds of overdose death compared with being aged 18 to 29 years, whereas being aged 60 years or older decreased odds of overdose death (Table 3). Moreover, black patients (adjusted odds ratio [aOR] 0.63; 95% CI 0.55 to 0.72) or those of multiracial/other race (aOR 0.43; 95% CI 0.33 to 0.57) were less likely to have an overdose death than white patients. The 3 highest diagnostic risk factors for overdose death included having had a nonfatal overdose (aOR 3.13; 95% CI 2.71 to 3.61), having had an opioid use disorder diagnosis (OR 4.60; 95% CI 3.98 to 5.31), and having had another substance use disorder diagnosis (OR 2.78; 95% CI 2.42 to 3.19). Chronic pain (OR 1.51;

95% CI 1.32 to 1.73) and mental health diagnoses (OR 1.59; 95% CI 1.39 to 1.82) were also associated with higher odds of overdose death.

Hereafter, the sample was limited to persons with substance-related encounters. The distribution of risk factors among patients with substance-related encounters who did and did not subsequently experience an overdose death in 2015 or 2016 is presented in Table 3. Persons who did experience an overdose death were more likely to have either an opioid use disorder only or both an opioid use disorder and other substance use disorder diagnosis, to have had a nonfatal overdose of any kind, and to have had a greater number of previous nonfatal overdoses. Persons with an overdose death were also more likely to have had a diagnosis of nonoverdose injury, chronic pain, or mental illness and to have been admitted to an inpatient unit than persons who did not experience an overdose death during these years (Table 3). All chosen predictors increased odds of death, with the exception of having received a diagnosis solely of a substance use disorder other than opioid use disorder, which decreased odds of death (OR 0.49; 95% CI 0.36 to 0.67). Factors most strongly associated with overdose death included having had 3 or more previous overdoses (OR 11.7; 95% CI 8.27 to 16.5), having had a previous heroin overdose (OR 7.09; 95% CI 5.99 to 8.41), having had a previous methadone overdose (OR 5.14; 95% CI 3.34 to 7.90), and having had a previous cocaine overdose (OR 3.79; 95% CI 2.60 to 5.50). Persons who had both an opioid use disorder and other substance use disorder diagnosis had the highest odds of experiencing an overdose death compared with those who had not received a diagnosis of an opioid use disorder or other substance use disorder (OR 2.99; 95% CI 2.21 to 4.06).

Results of the multivariable regression model for opioid overdose death among persons with substance-related conditions are presented in Table 4. Demographic risk factors for overdose death largely followed trends observed in the general ED population, with men, white patients, and persons aged 30 to 59 years having relatively higher odds of opioid overdose death. The hospital predictors that remained most strongly associated with odds of death even when controlling for other factors included having both an opioid use disorder and other substance use disorder diagnosis (aOR 2.88; 95% CI 2.04 to 4.07) and having had more previous overdoses, especially 3 or more (aOR 2.89; 95% CI 1.54 to 5.43). Having had only an opioid use disorder diagnosis (aOR 2.13; 95% CI 1.47 to 3.07), a chronic pain diagnosis (aOR 1.18; 95% CI 1.01 to 1.37), or a mental health diagnosis (aOR 1.22; 95% CI 1.05 to 1.42) was also associated with overdose death. However, among the specific drugs involved in previous overdoses, only having had a heroin overdose remained significantly associated with overdose death (aOR 2.24; 95% CI 1.64 to 3.05) in multivariable analyses.

Figure 3 presents predicted probabilities for overdose death among hypothetical patients with different combinations of substance use disorder diagnoses and 0, 1, or 2 previous nonfatal overdoses (while keeping all other patient factors at their mean). Probability of overdose death was generally greater among patients with more previous nonfatal overdoses and those receiving a diagnosis of both an opioid use disorder and another substance use disorder, but the contributions of each of these risk factors to probability of death vary. For example, a patient who had not received a diagnosis of an opioid use disorder or other substance use disorder but experienced 2 nonfatal overdoses in the past had less than half the probability of death (0.83%) of a person who had received a diagnosis of both an opioid use

disorder and another substance use disorder but had only 1 nonfatal overdose during the studied time frame (1.84%).

LIMITATIONS

Although this study made use of comprehensive statewide databases, it does have several limitations. First, analyses relied on diagnostic codes captured within hospital claims records and therefore may have missed patients who had conditions or risk factors of interest that were not documented. This was likely to result in underascertainment or misclassification of substance use disorder and overdose diagnoses, and it has been documented that persons presenting with overdose to EDs often do not receive an overdose diagnosis in their record.[34] In addition, our analyses were limited to assessing a few risk factors identified with diagnostic codes that have been previously associated with overdose death, but many other hospital- and patient-level factors that may have increased risk of overdose death were not considered. In particular, we did not have information on substance use disorder treatment enrollment (including medication treatment use) or criminal justice involvement, 2 factors that may influence risk of overdose death. We also could not distinguish illicit fentanyl from other synthetic opioids that were involved in nonfatal overdoses, so it was not possible to isolate the association of previous illicit fentanyl overdose with risk of overdose death. This study did not take into account the specific hospital, or geographic cluster of hospitals, in which patients received care, which could vary significantly in resources and approaches for diagnosis and provision of care for persons with substance-related conditions. Last, given the unique characteristics of Maryland, and particularly the high rates of overdose in this state and the high rates of cocaine involvement in overdoses, the current findings may not be generalizable to other regions.

DISCUSSION

Our study aimed to identify risk factors for overdose death among a high-risk cohort of persons who received ED care in Maryland. Findings confirmed that patients with substance-related encounters were in fact at extremely high risk of overdose death, with an overdose case fatality rate of 69.2 per 10,000 persons. This group had greater than 6 times the fatality rate of the general adult ED population during that period. Trends in the number of overdose deaths among the study population and the types of drugs involved in overdoses followed larger trends observed across Maryland during the same period,[35] with number of deaths increasing significantly in 2016 and fentanyl playing a greater role in overdose deaths over time.

Our findings highlight that, despite an overall elevated death risk among this population, certain conditions and diagnostic patterns were more strongly associated with risk of death. Among this high-risk cohort, patients having a previous nonfatal overdose had the greatest overdose case fatality rate, consistent with studies that have identified previous overdose as one of the strongest predictors of future overdose death.[14,15] There was also substantial variation in the risk of death, depending on specific substance use disorder diagnoses; persons with an opioid use disorder diagnosis were at considerably greater risk of overdose death than those with other types of substance use disorders or who had no diagnosis at all.

Those with polysubstance use disorders, who had both an opioid use disorder diagnosis in addition to a diagnosis of another substance use disorder, were at greatest risk of experiencing an overdose death. This is in line with results of other studies that have identified polysubstance use as a risk factor for overdose.[36,37] Indeed, other drugs such as alcohol and cocaine were often implicated in opioid overdose deaths, reflecting larger trends across Maryland and the United States in which opioid deaths often involve multiple substances.[35,38] These findings emphasize the importance of addressing polysubstance use beyond sole use of opioids in initiatives that aim to prevent overdoses. The association of diagnoses with higher odds of overdose death may also indicate greater severity or longer-term disorders that were more likely to have been recognized and recorded as relevant to care in hospital settings.

Our findings also demonstrate the utility of incorporating specific information about the nature and history of a patient's nonfatal overdose when assessing future risk of negative outcomes among persons who present to EDs because of these events. For example, we found that the more overdoses a patient had within the studied period, the higher the patient's risk for eventual overdose death. Although these results are not unexpected, given previous literature on frequency of hospital encounters predicting negative outcomes,[6] they point to the need to consider a patient's full medical history, rather than relying on single-event information, when assessing his or her risk.

Risk of overdose death also varied significantly according to what drug was involved in previous nonfatal overdose encounters, pointing to the importance of identifying specific substances involved in these encounters. Although having had any nonfatal overdose increased odds of eventual overdose death, patients with previous heroin overdose, specifically, had the highest increased odds of overdose death, and this association remained significant in multivariate models that controlled for other patient and hospital encounter characteristics. Moreover, patients who had concurrent chronic pain or mental health conditions had higher odds of overdose death, and greater than two thirds of persons who died of overdose had received inpatient care during the study period. This underscores the critical need to consider co-occurring disorders and health conditions in addition to substance use when assessing fatality risk and designing appropriate preventive interventions.[13,39]

Even among patients who had an identified substance use disorder or nonfatal overdose, less than 1% went on to experience a fatal overdose in the subsequent year of follow-up. This indicates that fatal overdose is not inevitable in this high-risk group and there is clear opportunity to intervene with patients who present to the hospital with these conditions. Clinical decision support tools that use objective patient-level risk data are important, given that research has suggested providers themselves are not always objective or accurate in assessment of opioid-related risks when not provided with the necessary tools.[40,41] Adding additional measures from patient records to generate data-informed predictive risk models for death and other negative outcomes could provide more nuanced risk calculations to help guide clinician decisionmaking. Such clinical decision support tools have long aided screening and response to risk for other conditions, such as the Framingham risk score for coronary heart disease,[42] and more recently have begun to be developed for patient

populations at risk of overdose.[24,43,44] For example, a recent study showed that electronic health record prompts containing messages to remind physicians to prescribe naloxone for ED patients whose nurse assessments contained key words related to opioid use increased uptake naloxone distribution to overdose survivors.[45] The risk variables identified in this study could be incorporated into algorithms that generate empirically derived risk scores that alert physicians about a patient's underlying risk for a fatal overdose and guide the appropriate action, such as naloxone distribution, in response.

Indeed, there has been significant growth in the development and implementation of hospital and ED-based interventions for substance use disorder patients, ranging from screening to education to harm-reduction services to peer support and referral to treatment.[11,22] One of the most direct interventions that has been applied across multiple emergency and hospital care settings for high-risk patients is naloxone education and distribution.[17,46] Recognizing that patients with opioid-related conditions remain at risk even after naloxone distribution,[47] and that few are linked to care after an opioid-related hospitalization,[48,49] efforts are being promoted to directly initiate medication for addiction treatment in hospitals, with linkage to ongoing treatment in the community. Clinical trials have shown the efficacy of ED-initiated buprenorphine in increasing engagement in addiction treatment,[50] and such initiatives have already begun to be successfully adopted in both emergency and inpatient settings.[51,52]

Given the scope of the current opioid epidemic and the increasing potency of illicit opioids,[53] it is likely that EDs will continue to act as a critical interface with patients who have substance use disorders. Efforts are therefore needed now, more than ever, to ensure that hospital systems can properly respond to and intervene with patients who present with these conditions. As efforts continue to be developed to better understand and attend to patients with substance use disorders,[54] the development and refinement of valid and practical risk measures is needed to better identify patients at risk of overdose and other negative consequences of substance use. Integrating data currently available from hospital records, such as those presented in this article, may be one simple but effective step in this direction.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Editor's Capsule Summary

What is already known on this topic

Emergency departments (EDs) are an important point of contact for patients at risk for fatal opioid overdoses, a key public health problem.

What question this study addressed

This study linked ED and medical examiner data to identify risk factors for fatal opioid overdoses among patients with substance-related ED encounters.

What this study adds to our knowledge

In Maryland, the 140,000 patients with ED visits for substance-related problems had the highest fatal overdose risk, 6 times that of the general ED population. Risk factors included an opioid use disorder; additional substance use disorders; previous nonfatal overdoses, particularly involving heroin; and underlying chronic pain and mental health diagnoses.

How this is relevant to clinical practice

Results identify high-risk patients at whom to direct interventions (eg, naloxone, medication-assisted treatment) to reduce fatal opioid overdoses.

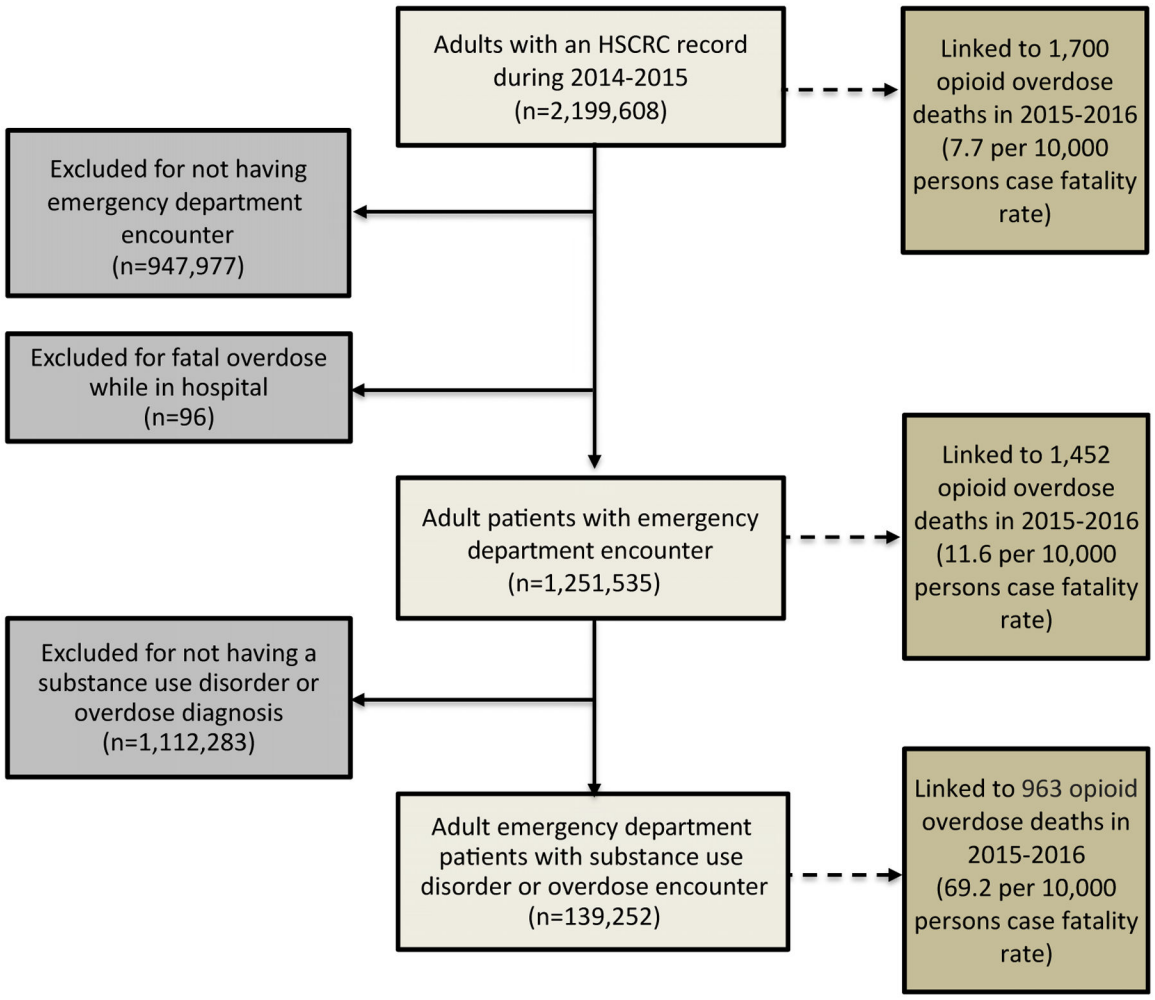

Figure 1.
Health Services Cost Review Commission (HSCRC) study sample inclusion flowchart.

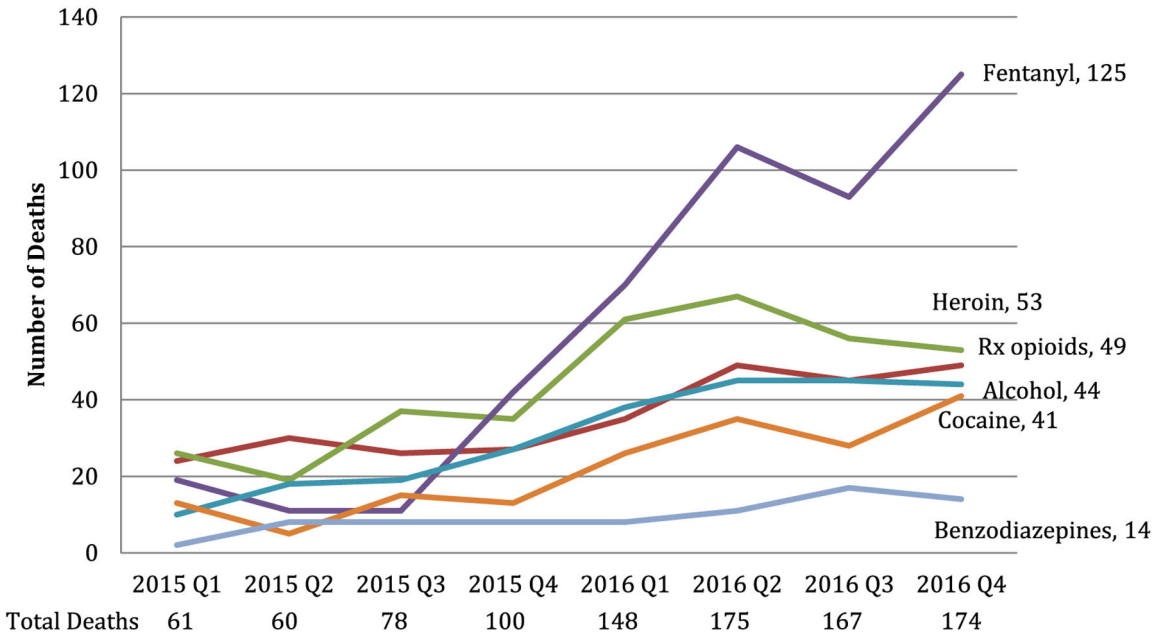

Figure 2.

Drug types involved in opioid overdose deaths among ED patients with subsance-related encounters by quarter, 2015–2016.

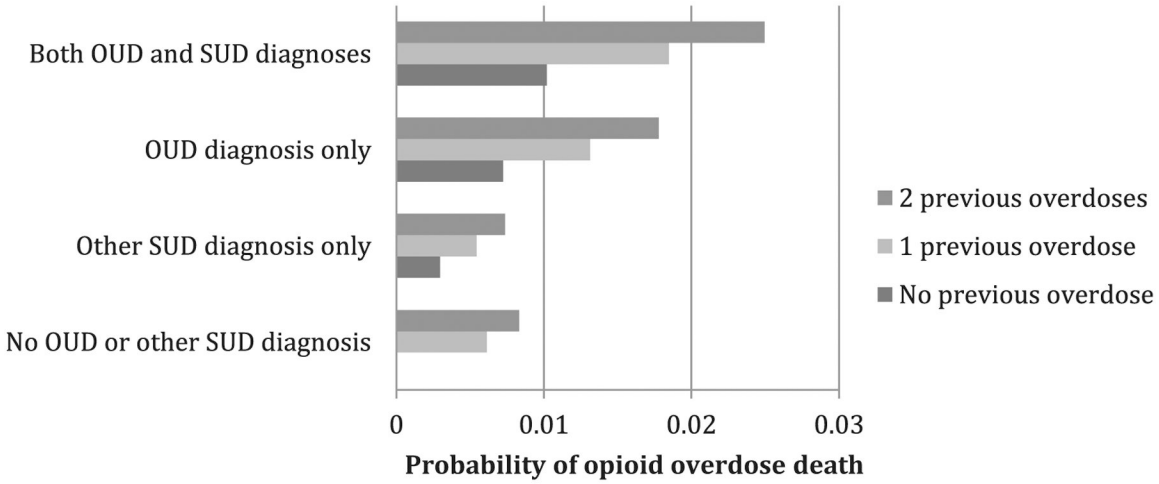

Figure 3.

Predicted probabilities for opioid overdose death among hypothetical patients with different combinations of substance use disorder diagnoses and nonfatal overdose histories.

Table 1.

Characteristics of the general ED population and ED patients with substance-related encounters in 2014 or 2015.

Characteristic	All ED Patients, No. (%)	ED Patients With Substance-Related Encounters, No. (%)
Total No. of Patients	1,251,535	139,252
Patients who had a nonfatal overdose	18,549 (1.48)	18,549 (13.32)
Patients who had any OUD diagnosis	36,199 (2.89)	36,199 (26.00)
Patients who had any other SUD diagnosis [*]	118,586 (9.48)	118,586 (85.16)
Sex		
Men	557,638 (44.56)	83,181 (59.73)
Women	693,897 (55.44)	56,071 (40.27)
Age group, y		
18–29	304,300 (24.44)	43,533 (31.29)
30–39	219,171 (17.60)	27,692 (19.90)
40–49	202,881 (16.29)	24,233 (17.42)
50–59	211,582 (16.99)	27,041 (19.43)
≥60	307,173 (24.67)	16,647 (11.96)
Race [†]		
White	605,500 (48.38)	57,774 (41.49)
Black	412,750 (32.98)	47,081 (33.81)
Multiracial/other	115,879 (9.26)	9,909 (7.12)
Unknown	117,406 (9.38)	24,488 (17.59)
Maryland region [‡]		
Northwest area	99,558 (8.84)	10,350 (8.20)
Baltimore metro area	570,461 (50.63)	75,918 (60.18)
National Capital area	268,034 (23.79)	20,584 (16.32)
Southern area	85,975 (7.63)	7,019 (5.56)
Eastern Shore area	102,760 (9.12)	12,279 (9.73)

OUD, Opioid use disorder; *SUD*, substance use disorder.

[*] Other SUD diagnosis includes all substance use disorders other than opioid and tobacco use disorder.

[†]White and black race was determined as such if all patients' hospital encounters during this period were identified as such. Multiracial/other race was determined if the patient was identified as Native American, Asian, native Hawaiian, other, or multiple races during this time. Race was determined as unknown if the patient was never identified as any race category during this period.

[‡]Distribution of counties into regions was conducted in accordance with Maryland medical examiner overdose reporting.

Table 2.

Adjusted odds ratios and confidence intervals for overdose death, using demographic and hospital encounter type among all ED patients, 2014 to 2015 (N=1,245,107).

HSCRC Predictor During 2014–2015	aOR	95% CI
Sex		
Men	1	1 [Reference]
Women	0.47	0.42–0.52
Age group, y		
18–29	1	1 [Reference]
30–39	1.38	1.18–1.62
40–49	1.59	1.36–1.85
50–59	1.36	1.16–1.59
≥60	0.35	0.28–0.45
Race		
White	1	1 [Reference]
Black	0.63	0.55–0.72
Multiracial/other	0.43	0.33–0.57
Unknown	1.04	0.90–1.19
Had nonfatal overdose	3.13	2.71–3.61
Had OUD diagnosis	4.60	3.98–5.31
Has other SUD diagnosis	2.78	2.42–3.19
Had injury diagnosis (excludes overdoses)	1.12	1.00–1.25
Had chronic pain diagnosis	1.51	1.32–1.73
Had mental health diagnosis	1.59	1.39–1.82
Admitted to inpatient unit	1.09	0.95–1.25

Table 3.

Prevalence of hospital predictor by outcome and odds ratio for opioid overdose death among ED patients with substance-related encounters (N=139,252).

HSCRC Predictor During 2014–2015	No Opioid Overdose Death 2015–2016 (N = 138,289), No. (%)	Had Opioid Overdose Death 2015–2016 (N = 963), No. (%)	OR for Opioid Overdose Death 2015–2016	95% CI
SUD diagnostic information				
No OUD or SUD	6,713 (4.85)	46 (4.78)	1	1 [Reference]
OUD only	13,761 (9.95)	146 (15.16)	1.55	1.11–2.16
Other SUD only	95,971 (69.40)	323 (33.54)	0.49	0.36–0.67
Both OUD and other SUD	21,844 (15.80)	448 (46.52)	2.99	2.21–4.06
No. of nonfatal overdoses (any type)				
0	120,080 (86.83)	623 (64.69)	1	1 [Reference]
1	15,882 (11.48)	242 (25.13)	2.94	2.53–3.41
2	1,733 (1.25)	62 (6.44)	6.90	5.29–8.99
≥3	594 (0.43)	36 (3.74)	11.7	8.27–16.5
Opioid overdose type (binary)				
Nonfatal heroin	3,972 (2.87)	167 (17.34)	7.09	5.99–8.41
Nonfatal methadone	626 (0.45)	22 (2.28)	5.14	3.34–7.90
Nonfatal other opioid	4,051 (2.93)	90 (9.35)	3.42	2.74–4.25
Nonopioid drug overdose types (binary)				
Nonfatal benzodiazepine	3,152 (2.28)	66 (6.85)	3.15	2.45–4.06
Nonfatal alcohol	655 (0.48)	12 (1.25)	2.61	1.47–4.64
Nonfatal cocaine	1,125 (0.81)	29 (3.01)	3.79	2.60–5.50
Nonfatal other drug	7,915 (5.72)	90 (9.35)	1.70	1.37–2.11
Other hospital characteristics (binary)				
Injury diagnosis (excludes overdoses)	72,878 (52.70)	598 (62.10)	1.47	1.29–1.68
Chronic pain diagnosis	25,007 (18.08)	311 (32.29)	2.16	1.89–2.47
Mental health diagnosis	63,962 (46.25)	617 (64.07)	2.07	1.82–2.36
Admitted to inpatient unit	63,301 (45.77)	619 (64.28)	2.13	1.87–2.43

Table 4.

Adjusted odds ratios and confidence intervals for overdose death, using demographic and hospital predictors among ED patients with substance-related encounters (N=139,146).

HSCRC Predictor During 2014–2015	aOR	95% CI
Sex		
Men	1	1 [Reference]
Women	0.63	0.54–0.72
Age group, y		
18–29	1	1 [Reference]
30–39	1.58	1.30–1.93
40–49	2.09	1.72–2.54
50–59	1.83	1.50–2.24
≥60	0.79	0.58–1.07
Race		
White	1	1 [Reference]
Black	0.63	0.53–0.74
Multiracial/other	0.67	0.49–0.92
Unknown	1.00	0.85–1.17
Type of SUD diagnosis		
No OUD or SUD	1	1 [Reference]
OUD only	2.13	1.47–3.07
Other SUD only	0.87	0.61–1.24
Both OUD and other SUD	2.88	2.04–4.07
Had injury diagnosis (excludes overdoses)	1.14	1.00–1.31
Had chronic pain diagnosis	1.18	1.01–1.37
Had mental health diagnosis	1.22	1.05–1.42
Admitted to inpatient unit	1.23	1.06–1.45
No. of nonfatal overdoses (any type)		
0	1	1 [Reference]
1	1.81	1.33–2.45
2	2.43	1.53–3.88
≥3	2.89	1.54–5.43
Had nonfatal heroin overdose	2.24	1.64–3.05
Had nonfatal methadone overdose	1.06	0.66–1.70
Had nonfatal other opioid overdose	1.19	0.89–1.60
Had nonfatal alcohol overdose	0.93	0.51–1.69
Had nonfatal benzodiazepine overdose	1.00	0.73–1.36
Had nonfatal cocaine overdose	0.79	0.52–1.18
Had nonfatal other drug overdose	0.92	0.67–1.27