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### Journal

The Permanente Journal, 28(3)

### Authors

Shin, Jordan

Saadat, Soheil

Lotfipour, Shahram

et al.

### Publication Date

2024-09-16

### DOI


10.7812/TPP/23.181

Peer reviewed

# Trends in Substance Use Disorder-Related Emergency Department Visits in California: An Analysis of 46 Million Visits From 2006 to 2011

Jordan Shin, BA<sup>1</sup>; Soheil Saadat, MD, MPH, PhD<sup>2</sup>; Shahram Lotfipour, MD, MPH<sup>2</sup>; Joseph Zakaria, MD, MBA<sup>3</sup>; Tim Bruckner, MPH, PhD<sup>4</sup>; Bharath Chakravarthy, MD, MPH<sup>2</sup>

Perm J 2024;28:23.181 • <https://doi.org/10.7812/TPP/23.181>

 SS, 0000-0002-2744-7983

## Corresponding Author

Soheil Saadat, MD, MPH, PhD  
saadat@hs.uci.edu

## Author Affiliations

<sup>1</sup> School of Medicine, University of California, Irvine, Irvine, CA, USA

<sup>2</sup> Department of Emergency Medicine, University of California, Irvine, Irvine, CA, USA

<sup>3</sup> Department of Emergency Medicine, Jackson Memorial Hospital, Miami, FL, USA

<sup>4</sup> Department of Public Health, University of California, Irvine, Irvine, CA, USA

## Author Contributions

Jordan Shin, BA, participated in project administration, investigation, and original draft preparation. Soheil Saadat, MD, MPH, PhD, participated in conceptualization, methodology, analysis, review, and editing. Shahram Lotfipour, MD, MPH, participated in conceptualization, review, and editing. Joseph Zakaria, MD, MBA, participated in conceptualization and investigation. Tim Bruckner, MPH, PhD, participated in data curation, resources, review, and editing. Bharath Chakravarthy, MD, MPH, participated in resources, supervision, validation, review, and editing.

## Disclosures

**Conflict of Interest:** None declared  
**Funding:** None declared

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Published Online First: July 19, 2024  
Final issue publication: September 16, 2024

Volume 28 Issue 3

## Abstract

**INTRODUCTION:** To better understand the development of the growing opioid crisis in the early 21st century, the authors studied trends in substance use disorder among 46,132,211 emergency department (ED) visit discharges in California between 2006 and 2011.

**METHODS:** Utilizing the California State Emergency Department Database, the authors identified substance use based on International Classification of Diseases, Ninth Revision codes. Tabular and multivariable analysis methods were applied. ED visits were considered clustered at the level of patient.

**RESULTS:** The authors observed a notable increase in substance use prevalence from  $7.32 \pm 6.07$  to  $12.21 \pm 9.35$  per 1000 ED visits. Nonopioid substance use was more prevalent among individuals aged  $\leq 50$  years old. Opioid use disorder (OUD) was associated with a higher mortality rate in the ED. In 2011, OUD was significantly higher among American Indians visiting the ED. A multivariable analysis revealed that OUD was an independent predictor for increased ED visits after controlling for demographic factors.

**DISCUSSION:** Despite an overall decrease in mortality rate, opioid-related ED visits showed a higher mortality rate, underscoring the grave consequences of OUD. Nonopioid substance use was prevalent among younger age groups, suggesting a need for age-specific interventions. A major finding was the elevated OUD among American Indians, indicating persistent health disparities impacting this demographic. OUD was an independent risk factor for excess ED visits, which could strain health care systems. The authors suggest strategies like nonopioid pain management, community-level programs, and bridging ED with outpatient treatment facilities to mitigate the opioid crisis and ED overutilization.

**CONCLUSION:** These findings advocate for tailored public health strategies, addressing the underlying disparities to combat the opioid epidemic effectively.

## Introduction

The emergency department (ED) plays a vital role in the health care system, offering critical care for a broad range of health conditions.<sup>1</sup> In the early 21st century, a substantial shift in health care dynamics emerged. In 2008, for the first time in more than 3 decades, the number of poisoning deaths surpassed the number of deaths due to motor vehicle crashes.<sup>2</sup> Opioids, heroin, and prescription pain medications were identified as major contributors to this alarming trend, highlighting the burgeoning challenge of substance use disorder (SUD) in the United States.<sup>3</sup> In particular, from 1999 to 2011, the number of deaths due to opioid poisoning almost quadrupled from 1.4 per 100,000 deaths to 5.4 per 100,000 deaths.<sup>4</sup>

In 2011, EDs across the United States provided care to over 136 million patients.<sup>5</sup> In the 6-year period from 2006 to 2011, the total number of ED visits increased by nearly 5%.<sup>6</sup> Notably, SUD accounted for a 52% increase over this time frame of 2006–2011.<sup>7</sup> This surge marked the second-largest increase among all medical conditions during this period, contributing immensely to rising health care costs.<sup>6</sup> Furthermore, with the implementation of the Medicaid expansion under the Affordable Care Act, ED visits increased even more. This underscores the need to understand the association between rising levels of ED visits and the health care costs associated with SUD.<sup>8</sup>

To better understand the development of the opioid crisis in the early 21st century, the authors studied trends in SUD among 46 million ED visit discharges in California between 2006 and 2011 and examined the distribution of substance use across various age and ethnicity groups. The authors also examined the association between opioid use and excess ED resource utilization in terms of total number of visits per individual per year within that time frame.

## Methods

The authors analyzed the California State Emergency Department Database, Healthcare Cost and Utilization Project, and Agency for Healthcare Research and Quality, all of which contain discharge information on all outpatient ED visits.<sup>9</sup> The authors included 2006–2009 and 2011 data, which contained 46,132,211 ED visit records, to determine the trend. Then, they analyzed 2011 data to find out the association between substance use

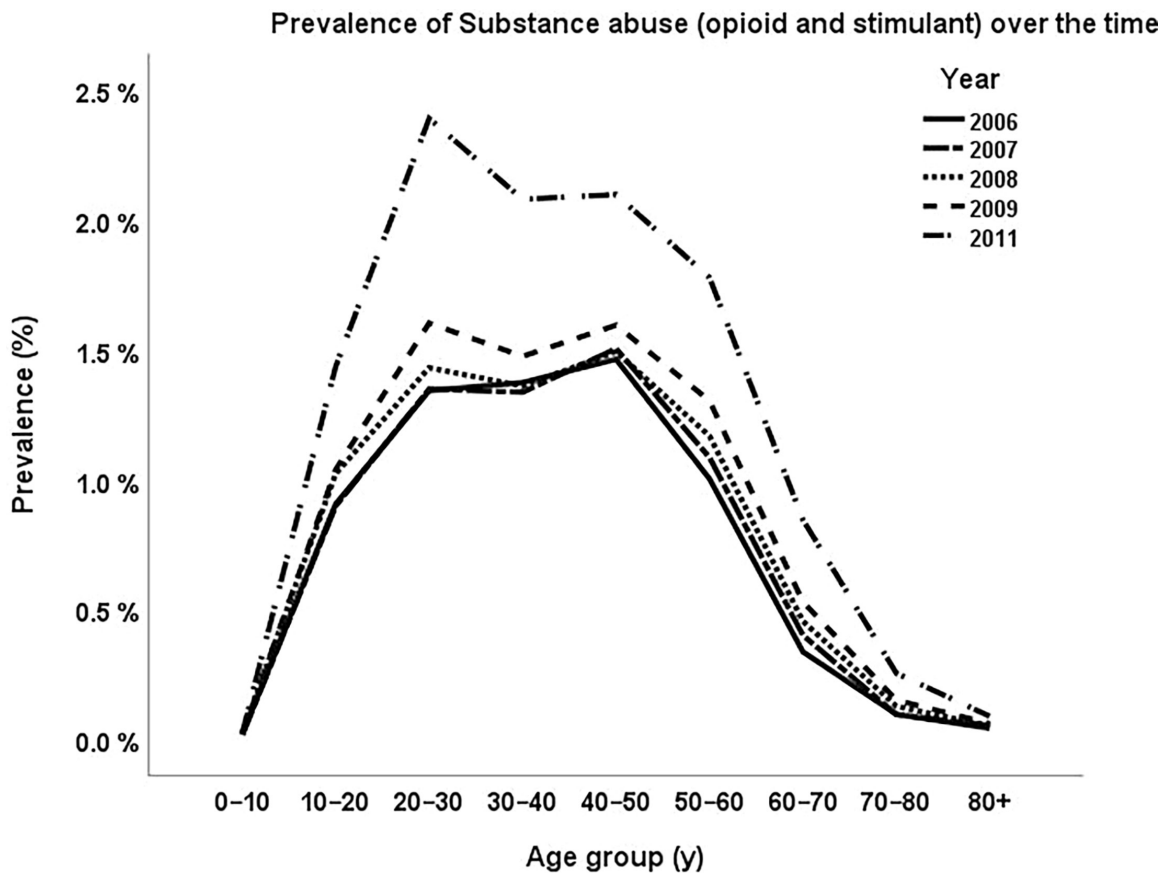
and ED visits. Substance use and its subcategories were detected based on relevant International Classification of Diseases, Ninth Revision (ICD-9) codes. Opioid use–related ED visits were identified by using the following ICD-9 codes: 304.0, 304.00, 304.01, 304.02, 304.03, 304.7, 304.70, 304.71, 304.72, 304.73, 305.5, 305.50, 305.51, 305.52, 305.53, 965.0, 965.00, 965.01, 965.02, 965.09, 970.1, E850.0, E850.1, E850.2, and E935.2. Other substance use–related ED visits were identified by the following ICD-9 codes: 304.20, 304.21, 304.22, 304.23, 304.30, 304.31, 304.32, 304.33, 304.40, 304.41, 304.42, 304.43, 305.20, 305.21, 305.22, 305.23, 305.60, 305.61, 305.62, 305.63, 305.70, 305.71, 305.72, 305.73, 969.70, 969.71, 969.72, 969.73, 969.79, 970.0, 970.1, 970.8, 970.81, 970.89, 970.9, E854.2, E854.3, E939.7, E940.0, E940.8, and E940.9. The authors utilized tabular and then multi-variable analysis methods to find out the association between substance use and excess ED visits, controlling for demographic risk factors. In multi-variable analysis, data were considered clustered at the level of patients, and the standard error estimation was adjusted accordingly. Prevalence ratios are presented as point estimates  $\pm$  standard deviation, and mortality ratios as point estimates (95% confidence intervals). A  $p$  value  $< 0.05$  was considered statistically significant. Data were analyzed using STATA 14.2 SE software (StataCorp LLC, College Station, TX). The University of California, Irvine institutional review board reviewed the details of this study and deemed it quality improvement and thus exempt from institutional review board review.

## Results

From 2006 to 2011, excluding 2010, the overall substance use prevalence rose from  $7.32 \pm 6.07$  to  $12.21 \pm 9.35$  per 1000 ED visits ( $p < 0.001$ ; Figure 1).

Over these 5 years, among patients aged 50 years or less, nonopioid substance use was more prevalent ( $8.97 \pm 5.08$  per 1000 ED visits) than opioid use ( $3.12 \pm 2.29$  per 1000 ED visits;  $p < 0.001$ ; Figure 2).

Mortality in the study group dropped from 2.05 (2.02–2.08) per 1000 ED visits in 2006 to 1.62 (1.60–1.64) per 1000 ED visits in 2011 ( $p < 0.001$ ; Figure 3). However, opioid use was associated with a slightly elevated mortality rate (2.02 per 1000 ED visits) compared to ED visits nonrelated to opioid use (1.79 per 1000;  $p = 0.047$ ; Figure 3).



**Figure 1:** Prevalence of substance use in patients visiting California emergency departments from 2006 to 2011.

In 2011, opioid use was most prevalent among American Indians (0.75%) and White people (0.65%) who visited the ED (both  $p < 0.001$ ). In 2011, the average ED visit rate was 3.26 (3.26–3.27) per 1000 ED visits for those with no substance use. The average ED visit rate was 6.25 (6.17–6.33) per 1000 ED visits for patients with a history of opioid use and 4.79 (4.75–4.83) per 1000 ED visits for patients with a history of nonopioid substance use (Table 1).

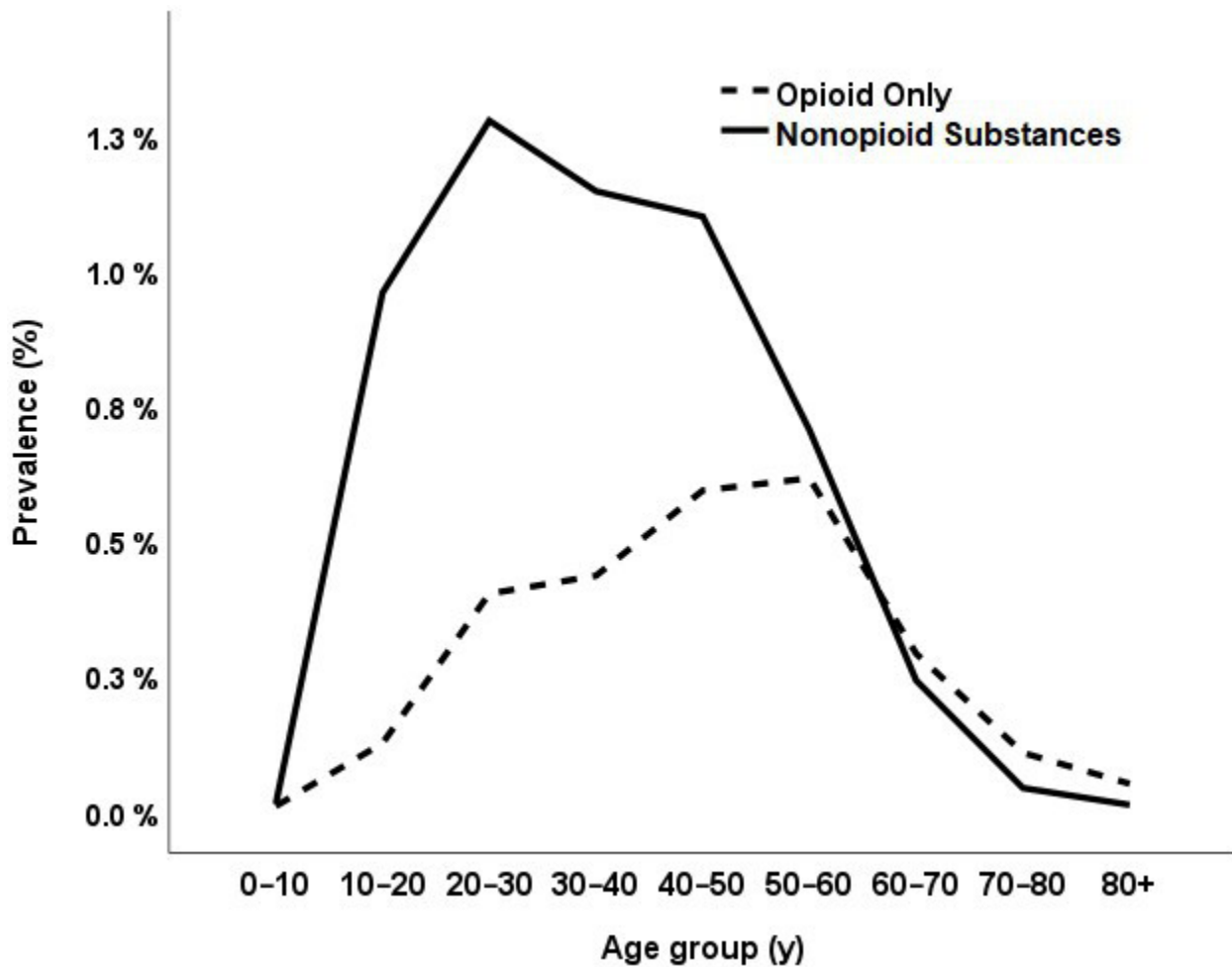
In multivariable analysis, opioid use was associated with increased ED visits (standardized beta: 0.026,  $p < 0.001$ ) after controlling for sex, age, race, type of insurance, and number of chronic diseases.

## Discussion

This study investigates the trends in SUD-related ED visits in California between 2006 and 2011 and examines the distribution of substance use across various age and ethnicity groups. The findings from this study corroborate the growing concerns about

the opioid epidemic and its impact on ED resource utilization in the United States. Although the time frame under investigation may seem dated, it holds considerable relevance, providing insights into the onset and progression of the opioid crisis in the early 21st century.

Consistent with existing literature, the authors observed a steady rise in substance use from 2006 to 2011. Between 2002 and 2011, approximately 25 million individuals utilized opioids for purposes outside of medical treatment in the United States.<sup>10</sup> It was not until 2010 when California became one of the top 10 states for drug use,<sup>11</sup> and the nationwide opioid crisis became front page news when President Obama released his first National Drug Control Strategy that addressed the epidemic.<sup>12</sup> Interventions aimed at reducing patients' exposure to opioid pain medications, such as alternatives to opioids-first approach in pain management in the ED, could help curtail the opioid epidemic. Such interventions have shown promising outcomes in reducing



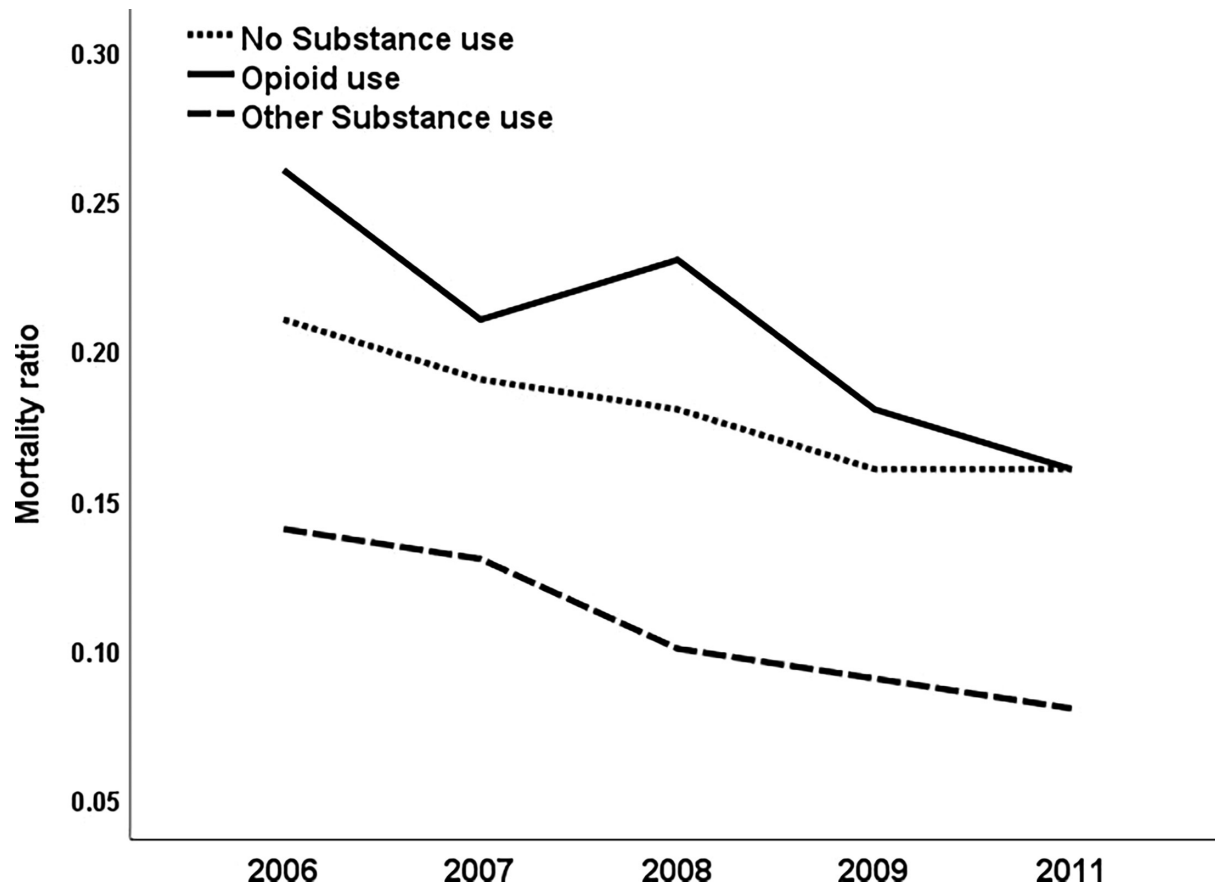
**Figure 2:** Prevalence of opioid and nonopioid use in patients visiting California emergency departments from 2006 to 2011 by age groups.

patients’ exposure to opioids in medical facilities and need to be consistently promoted.<sup>13</sup>

Another essential finding of the present study was that nonopioid substance use was much more common in younger age groups. This finding supports the results of the 2011 National Survey of Drug and Health that found that in both youths aged 12–17 and 18–25 years old, marijuana was the most common drug used.<sup>10</sup> This differential trend could be indicative of differences in motivations, drug-seeking behaviors, varying accessibility to drugs, or potential underreporting of opioid cases in the ED. The pronounced nonopioid substance use in younger demographics underscores the need to explore strategies different than those designed for opioid use, given the difference in demographics and drivers of substance use. Notably, brief interventions like Project REDUCE have appeared

effective in mitigating alcohol and marijuana misuse patterns within the ED setting.<sup>14</sup> Further investigations are warranted to comprehensively understand the underlying causes of this disparity.

Despite the rising prevalence of both opioid and nonopioid substance use from 2006 to 2011, the authors observed a consistent decline in mortality over this period in their study sample. This decrease in overall mortality across all 3 subgroups aligns with the broader trend of declining US mortality rates from 2006 to 2011 and probably reflects an improvement in the quality of ED care.<sup>15</sup> Nevertheless, the increased mortality rate among ED visits associated with opioid use underscores the fatalities and direct repercussions of opioid consumption. These findings are consistent with national data that underscore the risks associated with opioid overdose, emphasizing the imperative for enhanced



**Figure 3:** Mortality of patients over the study period according to their substance use status.

drug monitoring systems, targeted public health initiatives, and proactive preventive measures. Meanwhile, the mortality rate for ED visits related to nonopioid substance use was lower compared to that of patients with a history of opioid use and even those without any substance use history. This trend can potentially be attributed to younger age, given the association between nonopioid substance use and younger demographics.

This research showed an alarmingly elevated prevalence of opioid use among American Indians in 2011. This highlights the multifaceted health disparities and inequities that continue to impact the American

Indian communities and subsequently contribute to the disproportionate impact of substance use on Indigenous populations.<sup>16</sup> In 2020, the overdose death rates for American Indian and Alaska Native populations markedly exceeded those of their White counterparts.<sup>17</sup> Despite these alarming statistics, there is a scarcity of adequate SUD treatments for this demographic, indicating deep-rooted health disparities.<sup>17</sup> Racial disparities in substance use reflect the broader societal and socioeconomic factors that contribute to SUDs. Addressing these disparities is pivotal for a comprehensive approach to tackle the opioid crisis.

The authors identified opioid use as an independent risk factor for excess ED visits in 2011. Nonopioid substance use was also associated with more frequent ED visits; however, the effect size was smaller than opioid use. The difference in excess ED visits could be partly because of chronic and painful conditions that are associated with opioid use. More than 50% of patients who use opioids have been identified to have coexisting chronic pain conditions, often preexisting before their

Substance use	ED visits/y	SE	95% confidence interval
None	3.26	0.002	3.26-3.27
Opioids	6.25	0.040	6.17-6.33
Nonopioids	4.79	0.020	4.75-4.83

**Table 1:** Mean emergency department visit per year according to substance use history

ED = emergency department; SE = Standard error.

first opioid use disorder (OUD) diagnosis.<sup>18</sup> Moreover, nonopioid substance use was more common among younger patients, and this could be another reason for the difference observed in excess ED visits between those groups of patients. Excess ED visits could be considered as a surrogate of direct health care costs. White et al evaluated the direct costs of opioid use in an insured population during a 5-year period starting in 1998 and found that opioid use was associated with 8 times more average yearly direct health care costs.<sup>19</sup> Additionally, half of uninsured opioid use–related ED visit charges were paid by taxpayer dollars.<sup>20</sup> A study by Maeng et al found long-term financial burdens in opioid overdose patients from as early as 2 years prior to the first overdose event.<sup>21</sup> The increased prevalence of substance use, consequently, is associated with excess ED visits that may strain health systems. A better understanding of the multifaceted factors contributing to the opioid epidemic will better equip ED practitioners with resources and the knowledge to ultimately address the epidemic and improve patient outcomes. As the ED is one of the main resources for the medical needs of patients with SUD, it is important to find alternative avenues to provide accessible quality health care for the nonacute medical needs of these patients.

Many studies have examined how to address overutilization of the ED in the United States. A randomized, controlled trial in 2016 implemented a citywide ED care coordination program with educated ED case managers and found a 34% decrease in ED visits and an 80% decrease in ED opioid prescriptions.<sup>22</sup> With structured programs targeted to streamline patients toward appropriate resources, this study emphasizes the benefits of community-level programs to reduce overutilization of ED resources. Health authorities should implement harm reduction principles and provide a bridge between ED and outpatient medication for OUD treatment facilities to ensure the patient's health, and ultimately, form durable solutions to address the opioid epidemic.

## Conclusions

Substance use is an independent predictor of excess ED visits regardless of a patient's age, sex, race, and insurance coverage. Using evidence-based strategies, such as alternative pain management, in the ED could limit exposure to prescribed opioid medications and may lower the chance of OUD. Furthermore, by enhancing patient education and

increasing access to medical resources, the health care system can better address the overutilization of ED visits resulting from substance use.

Certain demographic subgroups face a heightened likelihood of developing SUDs. Tailored public health strategies may be necessary to assist these specific subgroups. Opioid use has been linked to increased mortality rates in ED settings. It is imperative that patients presenting in the ED with a history of opioid use receive appropriate substance use treatment and are connected to the relevant service providers.

The opioid epidemic in the United States underscores the existence of racial, socioeconomic, and cultural disparities in health care, emphasizing the urgent need for policy- and community-level interventions to address opioid use and overdose, especially among marginalized and vulnerable populations.

## LIMITATIONS

This study is constrained by its retrospective design, potentially leading to the omission or inaccurate recording of handwritten prescriptions in electronic medical records. Furthermore, the availability of the California State Emergency Department Database 2010 data for inclusion in this analysis was limited.

## Data-Sharing Statement

Readers may access the underlying study data via a third-party, not publicly available, repository. The repository is the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality. Access to the data requires application and adherence to the HCUP Data Use Agreement. For more details on how to apply for access and the terms of use, please visit the HCUP User Support website at <https://www.hcup-us.ahrq.gov/>.

## REFERENCES

1. Morganti KG, Bauhoff S, Blanchard JC, et al. The evolving role of emergency departments in the United States. *Rand Health Q.* 2013;3(2):3.
2. Warner M, Chen LH, Makuc DM, Anderson RN, Miniño AM. Drug poisoning deaths in the United States, 1980–2008. *NCHS Data Brief.* 2011;81(81):1–8.
3. Jones C, Logan J, Gladden M, et al. Vital signs: Demographic and substance use trends among heroin users - United States, 2002–2013. *Morbidity and Mortality Weekly Report.* 2015;64(26):719–725.
4. Chen LH, Hedegaard H, Warner M. Drug-poisoning deaths involving opioid analgesics: United States, 1999–2011. *Centers for Disease Control and Prevention; 2014. NCHS Data Brief 166.* Accessed February 6, 2023. <https://www.cdc.gov/nchs/products/databriefs/db166.htm>

5. Centers for Disease Control and Prevention. National Hospital Ambulatory Medical Care Survey: 2011 Emergency Department Summary Tables. Accessed February 6, 2023. [https://www.cdc.gov/nchs/data/ahcd/nhamcs\\_emergency/2011\\_ed\\_web\\_tables.pdf](https://www.cdc.gov/nchs/data/ahcd/nhamcs_emergency/2011_ed_web_tables.pdf)
6. Skinner H, Blanchard J, Elixhauser A. Trends in Emergency Department Visits, 2006-2011. Agency for Healthcare Research and Quality; 2014. HCUP Statistical Brief #179. Accessed February 6, 2023. <https://hcup-us.ahrq.gov/reports/statbriefs/sb179-Emergency-Department-Trends.jsp>
7. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality. The DAWN Report: Highlights of the 2011 Drug Abuse Warning Network (DAWN) Findings on Drug-Related Emergency Department Visits. Accessed February 6, 2023. <https://www.samhsa.gov/data/sites/default/files/DAWN127/DAWN127/sr127-DAWN-highlights.htm>
8. Nikpay S, Freedman S, Levy H, Buchmueller T. Effect of the Affordable Care Act Medicaid expansion on emergency department visits: Evidence from state-level emergency department databases. *Ann Emerg Med.* 2017;70(2):215-225. DOI: <https://doi.org/10.1016/j.annemergmed.2017.03.023>
9. Overview of the State Emergency Department Databases (SEDD). Agency for Healthcare Research and Quality. Accessed August 1, 2022. <https://hcup-us.ahrq.gov/seddoverview.jsp>
10. Results from the 2011 National Survey on Drug Use and Health: Summary of national findings. Substance Abuse and Mental Health Services Administration. Accessed February 6, 2023. <https://www.samhsa.gov/data/sites/default/files/Revised2k11NSDUHSummNatFindings/Revised2k11NSDUHSummNatFindings/NSDUHresults2011.htm>
11. Results from the 2010 National Survey on Drug Use and Health: Summary of national findings. Substance Abuse and Mental Health Services Administration. Accessed February 6, 2023. <https://www.samhsa.gov/data/sites/default/files/NSDUHNationalFindingsResults2010-web/2k10ResultsRev/NSDUHresultsRev2010.pdf>
12. Fact Sheet: Obama Administration announces public and private sector efforts to address prescription drug abuse and heroin use. The White House, Office of the Press Secretary; 2015. Accessed February 6, 2023. <https://obamawhitehouse.archives.gov/the-press-office/2015/10/21/fact-sheet-obama-administration-announces-public-and-private-sector#:~:text=Improving%20Access%20to%20Treatment%3A%20Second,to%20conduct%20a%20review%20to>
13. Duncan RW, Smith KL, Maguire M, Stader DE. Alternatives to opioids for pain management in the emergency department decreases opioid usage and maintains patient satisfaction. *Am J Emerg Med.* 2019;37(1):38-44. DOI: <https://doi.org/10.1016/j.ajem.2018.04.043>
14. Woolard R, Baird J, Longabaugh R, et al. Project Reduce: Reducing alcohol and marijuana misuse: Effects of a brief intervention in the emergency department. *Addict Behav.* 2013;38(3):1732-1739. DOI: <https://doi.org/10.1016/j.addbeh.2012.09.006>
15. Ramirez M, Kamal R, Cox C. How has the quality of the US healthcare system changed over time? Peterson-KFF Health System Tracker. Accessed August 14, 2022. <https://www.healthsystemtracker.org/chart-collection/how-has-the-quality-of-the-u-s-healthcare-system-changed-over-time/#Amenable%20mortality%20per%20100,000%20population,%202003-2015>
16. Whelshula M, Hill M, Galaitsi SE, et al. Native populations and the opioid crisis: Forging a path to recovery. *Environ Syst Decis.* 2021;41(3):334-340. DOI: <https://doi.org/10.1007/s10669-021-09813-3>
17. Overdose death rates increased significantly for Black, American Indian/Alaska Native people in 2020. Centers for Disease Control and Prevention; 2020. Accessed October 5, 2022. <https://www.cdc.gov/media/releases/2022/s0719-overdose-rates-vs.html>
18. Hser Y-I, Mooney LJ, Saxon AJ, Miotto K, Bell DS, Huang D. Chronic pain among patients with opioid use disorder: Results from electronic health records data. *J Subst Abuse Treat.* 2017;77:26-30. DOI: <https://doi.org/10.1016/j.jsat.2017.03.006>
19. White AG, Birnbaum HG, Mareva MN, et al. Direct costs of opioid abuse in an insured population in the United States. *J Manag Care Pharm.* 2005;11(6):469-479. DOI: <https://doi.org/10.18553/jmcp.2005.11.6.469>
20. Ryan JL, Rosa VR. Healthcare cost associations of patients who use illicit drugs in Florida: A retrospective analysis. *Subst Abuse Treat Prev Policy.* 2020;15(1). DOI: <https://doi.org/10.1186/s13011-020-00313-2>
21. Maeng DD, Han JJ, Fitzpatrick MH, Boscarino JA. Patterns of health care utilization and cost before and after opioid overdose: Findings from 10-year longitudinal health plan claims data. *Subst Abuse Rehabil.* 2017;8:57-67. DOI: <https://doi.org/10.2147/SAR.S135884>
22. Neven D, Paulozzi L, Howell D, et al. A randomized controlled trial of a citywide emergency department care coordination program to reduce prescription opioid related emergency department visits. *The Journal of Emergency Medicine.* 2016;51(5):498-507. DOI: <https://doi.org/10.1016/j.jemermed.2016.06.057>