



Published in final edited form as:

J Public Health Manag Pract. 2025 ; 31(2): 252–262. doi:10.1097/PHH.0000000000002045.

Development of a Definition to Identify Severe Opioid Overdoses Treated in Emergency Departments, 2019–2022

Stephen J. Liu, PhD, MPH,

Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Atlanta, Georgia

Herschel Smith IV, MPH,

Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Atlanta, Georgia

Vikram Krishnasamy, MD,

Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Atlanta, Georgia

R. Matthew Gladden, PhD, MPH

Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Atlanta, Georgia

Abstract

Background: Existing surveillance systems monitor nonfatal and fatal opioid overdoses but do not monitor severe nonfatal overdoses that require intensive medical interventions.

Methods: The Centers for Disease Control and Prevention's Drug Overdose Surveillance and Epidemiology system was used to query emergency department data from local syndromic systems and the National Syndromic Surveillance Program from January 2019 to August 2022. Opioid overdoses were classified as not severe or severe using a definition from the patient's chief complaint terms and discharge diagnosis codes. The percentage of opioid overdoses treated in emergency departments classified as severe was described by patient demographics, US Census region, and month.

Results: Among 503 156 opioid overdoses in 29 states and Washington, DC, from January 2019 to August 2022, 17.4% were classified as severe. Common key terms found among severe opioid overdoses were hypoxia (34.8%), unresponsive (32.9%), and naloxone/Narcan (20.9%).

Correspondence: Stephen J. Liu, PhD, MPH, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, 4770 Buford Hwy NE, Atlanta, GA 30341 (SLiu@cdc.gov).

The CDC determined human subject regulations and IRB approval were not applicable for this study because deidentified secondary data were used.

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

The authors declare that they have no conflicts of interest.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (<http://www.JPHMP.com>).

The largest severity percentage was in the South Census region (19.6%). The trends of severe opioid overdoses remained stable during the study period.

Discussion: Based on the severe opioid overdose definition, there was minimal change in the severity of opioid overdoses during the study period. This definition can help monitor trends of severe opioid overdoses, guiding public health action such as focusing on naloxone and fentanyl test strip distribution to areas of need.

Keywords

nonfatal; opioid; overdose; severe

Introduction

Drug overdoses have steadily increased and have contributed to lower life expectancy in the United States over the past 20 years.¹ The number of drug overdose deaths increased by 16% from 2020 to 2021, and provisional data indicate a record 109 680 overdose deaths in 2022.^{2,3} Nonfatal overdose rates also increased at the beginning of the COVID-19 pandemic in 2020, and rates remained higher than pre-2020 levels.⁴ Due to delays in fatal drug overdose reporting of 4 months (<https://www.cdc.gov/drugoverdose/fatal/sudors.html>, <https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm>), syndromic surveillance of nonfatal drug overdoses from emergency departments (EDs) is widely used to detect emerging trends in overdoses, as well as outbreaks.⁵

Syndromic surveillance identifies opioid overdoses using free text such as patient chief complaints (CC) and discharge diagnosis (DD) codes.⁵ The examination of symptoms and circumstances surrounding an ED overdose presentation is important to capture the purpose of the ED visit and specifically identify overdoses requiring intensive health system interventions (subsequently referred as severe opioid overdoses). Acute opioid intoxication includes those presenting with respiratory or cardiac failure. These individuals would not survive without medical intervention. However, the presenting toxicity can vary from those who respond to supplemental oxygen to those who require multiple doses of naloxone, intubation, and mechanical ventilation.^{6,7} Understanding populations requiring intervention for opioid intoxication can further our understanding of the shifting drivers of the overdose crisis.

Only a few studies have described opioid overdoses based on symptom severity.^{8,9} There is no formal definition for severe opioid overdose nor studies investigating overdose severity using a population-based, nationwide data source. Studies validating heroin and stimulant syndrome definitions^{10,11} found symptoms consistent with opioid and stimulant toxidromes with wide-ranging severity. A better understanding of the number of severe overdoses as identified from the opioid overdose clinical toxidrome would assist interpretation of trends in nonfatal overdoses while potentially focusing public health response on more severe outbreaks and trend changes. Specifically, national fatal drug overdose trends have begun to plateau during 2022, and an analysis of nonfatal overdoses by severity can provide insight into whether recent trends may be related to overall decreases in overdoses involving opioids or disproportionate drops in severe overdoses involving opioids.³ Additionally, this may be

used to help assess whether interventions are proving effective in reversing and preventing severe overdoses involving opioids.

Our study has 3 aims: (1) develop a definition to identify severe nonfatal opioid overdoses treated in EDs based on CC text and DD codes; (2) use data from the Drug Overdose Surveillance and Epidemiology (DOSE) system and the Centers for Disease Control and Prevention's (CDC's) Nonfatal Overdose Surveillance Program⁵ to investigate the distribution of severe opioid overdoses compared to non-severe opioid overdoses by age group, sex, US Census region, race/ethnicity; and (3) describe annual and monthly trends in severe opioid overdoses from January 2019 to August 2022.

Methods

Data source

We used the CDC's DOSE system to query National Syndromic Surveillance Program data using a standardized opioid overdose definition (ie, CDC Opioid Overdose version 3). Thirty-four states and Washington, DC, participating in DOSE shared their line-level, ED syndromic surveillance data with CDC within the National Syndromic Surveillance Program BioSense platform. The opioid overdose visits captured in the DOSE system have a wide range of patient symptoms noted in the combined CC text and DD code fields (nearly all DD were coded International Classification of Diseases, 10th revision, Clinical Modification).¹² We used visits from January 2019 to August 2022¹ and limited analyses to EDs consistently reporting informative data² during the study period to ensure comparable, quality data over time (the final analytic sample was 29 states and Washington, DC).

Definition development

The definition of a severe opioid overdose was created in 2 stages. First, key terms were identified for the definition. Second, the draft definition was refined and validated using record reviews.

Stage 1: Identify key terms that indicate a severe opioid overdose—Candidate severe opioid overdose-related terms were identified from the following 3 resources and approaches, in no order:

A: Capture terms from CDC Opioid Overdose version 3 definition syntax: Among the Opioid overdose *definition* syntax, “unresponsive” and “loss of consciousness” were selected to indicate severe opioid overdoses.

B: Review existing literature for descriptions of severity and leverage clinical expertise: A review of published literature and discussion with clinical experts identified additional terms indicating severe opioid overdose. Two studies^{8,9} identified additional signs and symptoms: cyanosis, collapse, and pulseless. Clinical experts identified hypotension,

¹Downloaded data on September 26, 2022

²Some ED facilities might have started reporting to the National Syndromic Surveillance Program during the study period, while others experienced reporting disruptions. Analyses were performed among EDs submitting data to NSSP that had relatively stable trends based on a coefficient of variation ≤ 45 and average weekly discharge diagnosis informative $\geq 75\%$.

intubation, apnea, hypoxia, and return of spontaneous circulation (ROSC) as indicators of severe opioid overdoses.

C: Capture the descriptions of severity based on text combinations from CC

data: We first used text mining to generate the most common trigrams (consecutive 3-word combinations) to understand the most common descriptions appearing during opioid overdose visits.

The top 200 trigram combinations were evaluated and categorized to determine whether they included terms indicating severity. For example, the following trigrams were considered as potential severe opioid overdoses: “Narcan milligram intravenous,” “cardiopulmonary resuscitation progress,” and “low blood pressure.”

Next, we extracted the words from the trigrams that were indicative of a severe opioid overdose, including Narcan, cardiopulmonary resuscitation, low blood pressure, cardiopulmonary arrest, and respiratory failure.

We also developed a term co-occurrence network graph, which is an undirected graph consisting of single words and their pairwise associations with other single words that co-occurred within records for opioid overdoses. No additional terms relevant to severe opioid overdose were identified in the review of the term network.

Stage 2: Iterative record review and modifications of the severity definition—

Each of the 4 coauthors reviewed 50 randomly selected records that contained each term identified from Stage 1 to determine additional related terms, abbreviations, and DD codes as well as CC word combinations to exclude that would help calibrate the severe opioid overdose definition. For example: we excluded text such as “denies loss of consciousness” and included text for “multiple doses of Narcan.” After the initial round of record reviews, we updated our definition, and each coauthor reviewed another 50 randomly selected records for each term (eg, unresponsive) and updated the severe opioid overdose definition again.

All opioid overdose visits detected from CDC Opioid Overdose v3 were classified as either severe or non-severe. Applying this definition, each coauthor reviewed a randomly selected sample of 100 opioid overdose records classified as non-severe and 100 opioid overdose records classified as severe to validate severity status. The review identified that a substantial number of severe opioid overdoses also involved respiratory conditions such as chronic obstructive pulmonary disease (COPD) or asthma. In these visits, the reason for the severe symptoms (chronic respiratory condition vs overdose) was difficult to determine or appeared primarily attributable to the patient’s chronic respiratory condition. For instance, one visit likely misclassified as a severe opioid overdose had a CC that included “emphysema,” “COPD,” “Shortness of Breath,” and a DD code indicating opioid use, unspecified with intoxication. This scenario is indicated as an opioid overdose, but it is not certain whether the shortness of breath is related to an acute opioid overdose visit. To make the severe overdose definition more specific, we added 2 additional criteria (respiratory disease and either International Classification of Diseases, 10th revision, Clinical Modification T code(s) for opioid poisoning or mention of the word “overdose”) for classifying opioid overdoses as

severe. Therefore, those with COPD and shortness of breath unrelated to opioid overdoses would be excluded.

The CC terms and DD codes included in the final severe opioid overdose definition, with associated frequencies and examples, are listed in Table 1; more details on all CC terms and DD codes included in our definition are available in Appendix Table 1.

Statistical analyses

We described severe opioid overdoses, stratified by demographics (age, sex, and race/ethnicity) and US Census region. To compare the prevalence between subgroups of demographics and Census regions, we calculated prevalence ratios (PRs) and 95% Wald confidence interval (CIs) with the Delta method. In addition, we used Chi-square tests pairwise comparisons of percentage of severe opioid overdoses by US Census region. The data analyzed from states were in the following Census regions: (1) Midwest region (IL, KS, and WI)³; (2) Northeast region (CT, ME, NJ, NY, PA, and RI)⁴; (3) South region (AL, AR, DC, DE, GA, KY, LA, MD, MS, NC, SC, TN, VA, and WV),⁵ and the West region (CO, MT, NM, NV, OR, UT, and WA).⁶

We calculated the annual and monthly average count and percentage of severe opioid overdoses among all opioid overdoses. Trend analyses of the monthly percentage of severe opioid overdoses were performed by testing for the presence of statistically significant average monthly percent change (AMPC) and monthly percent change (MPC) in individual segments with parametric 95% CIs using Joinpoint Regression Program, version 4.9.1.0 (Statistical Research and Applications Branch, National Cancer Institute). The final model was selected via permutation test and AMPC, and MPCs were considered statistically significant at P -values $< .05$.¹³

We used SAS (Statistical Analysis Software 9.4) for data management and record review and used R software (R version 4.2.1; R Foundation) for the text mining, PRs, and 95% CIs.

The CDC determined that human subject regulations and IRB approval were not applicable for this study because deidentified secondary data were used.

Results

From January 2019 to August 2022, there were 503 155 suspected opioid overdoses; 17.4% were identified as severe. One or more of the 3 most commonly occurring key terms identified 77.5% of all severe opioid overdoses: hypoxia (34.8%), unresponsive (32.9%), and naloxone/Narcan (20.9%) (Table 1).

³In 2022, these state populations accounted for an estimated 21 million out of the estimated 69 million population in the entire Midwest region, United States Census.

⁴In 2022, these state populations accounted for an estimated 48 million out of the estimated 57 million population in the entire Northeast region, United States Census.

⁵In 2022, these state populations accounted for an estimated 72 million out of the estimated 129 million population in the entire South region, United States Census.

⁶In 2022, these state populations accounted for an estimated 27 million out of the estimated 79 million population in the entire West region, United States Census.

When comparing severity status by demographics, we found that the percentage of opioid overdoses classified as severe were similar between females and males (17.5% vs 17.4%; PR = 1.01; 95% CI, 1.00–1.02) (Table 2). Also, the severity percentages varied slightly across age groups, ranging from 15.8% to 24.2%. Aside from the unknown category, the ≥65-year-old age group had the highest severity percentage (20.3%; PR = 1.28; 95% CI, 1.27–1.29) compared to the 25 to 34 years old group. The South Census region had the highest severity percentage (19.6%), followed by the West (17.9%), Midwest (15.0%), and Northeast (14.6%). All pairwise comparisons of the differences in percentage of severe opioid overdoses between the US Census regions were statistically significant. Overdose severity varied across race/ethnicity; compared to non-Hispanic (NH) White persons, severity percentage was significantly higher among NH Asian persons (PR = 1.25; 95% CI, 1.20–1.30), NH Black persons (PR = 1.06; 95% CI, 1.05–1.07), and NH multiracial persons (PR = 1.07; 95% CI, 1.06–1.08) and significantly lower among Hispanic/Latino persons (PR = 0.95; 95% CI, 0.94–0.96), NH American Indian or Alaska Native persons (PR = 0.93; 95% CI, 0.91–0.96), and persons with unknown race and/or ethnicity (PR = 0.69; 95% CI 0.68–0.70).

The monthly severe opioid overdose percentage was stable over time from January 2019 to August 2022, ranging from the lowest percentage, 16.0% (August 2021) to the highest percentage, 19.9% (January 2021) (Figure 1). Joinpoint regression identified no overall change in percentages of severe opioid overdoses during study period (AMPC = −0.14; 95% CI, −0.77, 0.50). For MPCs, the best fitting model included 6 line segments (5 joins) with 4 segments being statistically significant: (1) decreased from January 2019 to October 2019 (MPC = −1.04; 95% CI, −1.69 to −0.39); (2) increased from August 2020 to January 2021 (MPC = 2.85; 95% CI, 0.54–5.22); (3) decreased from January 2021 to July 2021 (MPC = −2.91; 95% CI, −4.46 to −1.34); and (4) increased from July 2021 to August 2022 (MPC = 0.41; 95% CI, 0.03–0.79). Overall counts of severe opioid overdoses increased over time (AMPC = 1.24; 95% CI, 0.22–2.27). The best fitting model for the counts of severe opioid overdoses identified 6 line segments (5 joins), yielding 3 segments that had statistically significant MPCs: (1) increased from January 2019 to June 2019 (MPC = 8.10; 95% CI, 4.43–11.90); (2) increased from November 2019 to May 2020 (MPC = 5.23; 95% CI, 1.66–8.93); and (3) increased from January 2022 to August 2022 (MPC = 2.68; 95% CI, 0.59–4.83) (Appendix Table 2).

Severe opioid overdose counts demonstrated slight seasonal patterns, increasing from January until June or July, then decreasing until the end of the year (Figure 1). In addition, in 2019, there were on average 1684.7 severe opioid overdoses per month. There were more severe opioid overdoses in 2020 (2123.9 per month), 2021 (2138.8 per month), and January-August of 2022 (2039.6 per month) than in 2019.

Discussion

To better understand ED overdose severity, we proposed a CC- and DD-based definition to better monitor severe opioid overdoses. Analysis of severe opioid overdoses detected in DOSE found that: (1) about one-sixth of opioid overdoses were classified as severe; (2) the highest percentage of severe overdoses occurred in the South Census region, followed by

the West, Midwest, and Northeast in descending order; there were also small differences in the percentages of opioid overdoses that were severe across age groups and race/ethnicity categories; and (3) the monthly trend in the percentage of opioid overdoses that were severe was relatively stable from January 2019 to August 2022.

Our study found that 17.4% of opioid overdoses were classified as severe among all suspected opioid overdose ED visits from January 2019 to August 2022. Presentations to ED are generally considered serious, and our definition enabled us to capture the most severe opioid overdose cases. Unlike our study results, a previous study in a single facility observed a total of 51.9% participants ever experienced severe overdose based on retrospective survey data regarding an individual's worst symptom of any drug and alcohol use during their lifetime.⁹ Another study led by Britton et al⁸ surveyed one methadone maintenance program and captured a patient's worst symptom of any drug and alcohol use during their lifetime. Among those who had overdosed, patients frequently reported severe symptoms: turning blue (48.6%), unconscious (77.8%), and collapsed (84.7%). These 2 studies focused on reporting the percentage of ever experiencing severe overdose among individuals rather than among all overdose episodes, and therefore, the percentages reported were higher than the current analysis, which may be due to different focus (lifetime experience vs each ED visit in our study) and type of facilities and programs; our analyses focused on reporting the percentage of severe opioid overdose episodes among all suspected opioid overdose ED visits in a nationwide setting.

States in the South Census region had the highest severity percentage, followed by the West region and lower among Midwest and Northeast regions. The causes of current regional differences need to be further investigated and may be attributable to different time trends of fentanyl (a stronger, fast-acting opioid that could have more severe symptoms and increased risk of death) entering the illicit market. States in the Midwest and Northeast regions, like Ohio, Pennsylvania, West Virginia, Maine, New York, and Rhode Island, were mainly impacted by fentanyl around 2013–2017^{14–19} and therefore may have more time to adapt and mitigate the impacts from fentanyl, while states in the South Census region were impacted at a much later time.^{20,21} Effective harm reduction efforts coupled with the availability of community naloxone also vary by geography due to several factors,²² which may also impact the severity of overdoses treated in EDs. This underscores the importance of using standardized definitions for specific potent drugs and those with severe symptoms, including the recently developed fentanyl overdose definition and the proposed severe opioid overdose definition. These could guide future surveillance activities and analyses to determine emerging and evolving trends of overdoses involving more potent drugs. With this evolving overdose epidemic it is important to adapt future definitions to encompass severe symptoms for overdoses of other drug types.

Drug overdose deaths substantially increased from 2019 to 2020 and have remained elevated through 2022, driven primarily by large increases in drug overdoses involving illicitly manufactured fentanyl.^{1,3,23} From 2019 to 2020, trends in severe opioid overdoses treated in EDs roughly mirrored increases in fatal opioid overdoses²⁴; severe opioid overdoses then remained elevated but relatively stable from late 2020 to August 2022. Although opioid overdose deaths increased from 2020 to 2021 they have stabilized during 2022.²⁴ The

stability in severe nonfatal opioid overdose trends from 2021 to 2022 suggests caution in interpreting early and provisional declines in fatal opioid overdoses as evidence of sustained and lasting progress compared to a temporary pause in opioid overdose increases. Our definition can to analyze the number of severe opioid overdoses among opioid overdoses better understand how outbreaks involving other synthetic opioids such as carfentanil and nitazene analogs^{25–27} by identifying large increases those with severe opioid overdose symptoms first, then further exploring the associated CC terms and other datasets that may have more toxicology testing.

Although joinpoint regression analysis of monthly severe opioid overdose percentages showed that there were 4 statistically significant changes, these small fluctuations were deemed to be not practically significant in the overall picture of opioid overdoses from a large dataset. The trends may indicate minor seasonality, but percentages were mainly influenced by shifts in the denominator, total opioid overdoses. Our trend analysis overlapped with time periods when fentanyl was contributing to a substantially higher percent of overdose deaths from 2019 to 2021.² More investigation is warranted to monitor trends in the severe opioid overdoses that also co-involve fentanyl overdose²⁸ to help explain how shifts in the drug supply related to stronger opioids like fentanyl may impact severe opioid overdose trends in syndromic surveillance.

Our study is subject to several limitations. First, some opioid overdose records were identified solely based on DD codes. Since the severe opioid overdose definition primarily captures severe cases using information derived from the CC text, there is potential misclassification for severe cases if CC text is not available for a given ED visit. Second, although we have excluded EDs with inconsistent data submission, data quality may vary across different EDs. We further examined this potential impact by assessing several indicators of data quality (ie, length and completeness of CC and DD data) in each state over time (Appendix Figure 1). We found a low association between the median length of the CC data character and severity percentage (correlation, $r = 0.35$); however, it is possible that states with better data quality may have a better chance of detecting severe opioid overdoses. Thus, future studies may need to account for varying CC length by state when monitoring trends.

Third, since DOSE does not capture ED visits among patients who have fatal opioid overdoses, we may be unable to capture those with the most severe symptoms that could lead to death. To understand the full picture of severe opioid overdoses, a future study using linked data between ED and death records may determine whether those who are categorized as a severe opioid overdose at ED visits are more likely to have a fatal opioid overdose.

Finally, there may be potential misclassification for severe opioid overdoses due to lack of some key terms documented during the ED visit or the ordering of the terms. The description of an overdose presentation may differ by the person entering the information, facility, hospital system, and state. The comprehensive definition development approach coupled with the large dataset used to create the definition should mitigate this issue at the

national and state level. The possibility of misclassification, however, persists and may be larger at granular levels when looking at a specific hospital or county.

Public health agencies can use the severe opioid overdose definition to examine underlying trends within opioid overdoses. Further exploration on the type of opioid (ie, fentanyl, heroin, etc) and overdoses co-involving multiple substances in the context of severe opioid overdoses are warranted. The presence of fentanyl among severe opioid overdoses could inform the need for harm reduction in the community, such as the distribution of fentanyl test strips. Future studies could examine factors contributing to severe opioid overdoses presenting to EDs to aid more specific public health action such as ensuring access to naloxone in areas with disproportionate numbers of severe opioid overdoses.

APPENDIX.

TABLE 1

Full Definition for Severe Opioid Overdoses

Terms used in Severe Opioid Overdose Definition Note: Sorted by Clinical Relevance	Query Terms Including Misspelling and Exclusions^a
Cardiopulmonary arrest, respiratory failure	Cardiopulmonary arrest, cardiac arrest, pulmonary arrest, respiratory arrest, arrest cardiac respiratory, respiratory failu, I46.9, I469, R09.2, R092 and not under arrest, arrest presenting for medical clear, apfmc
CPR, resuscitation	CPR, cardiopulmonary resuscitation, resu[cs] and not Z66, do not resuscitat, dnr
Pulseless	pulseless, no pulse, without pulse, without a pulse
Return of spontaneous circulation (ROSC)	ROSC, return of spontaneous circ
Hypotension	hypotensi, I95.2, I952
Low blood pressure	low bp, low blood pressure
Intubation, Endotracheal tube	intubat[ie], endotracheal tube and not Z66, do not intubate
Apnea	apnea, R0681, R06.81 and not sleep apnea, G47.3, G473
Hypoxia	hypox[ei], R09.02, R0902, J96.01, J9601, J96.91, J9691
Cyanosis	cyanosis, cyanot, cyano, R23.0, R230
Unresponsive	unresponsive, unrespons
Loss of consciousness, Unconscious	loss of consciousn, lose consciousn, loc, unconscious, loss conscious and not deny loss of consciousn, denies loss of conscious
Collapse	collaps, R55
Naloxone/Narcan with response (revival, became responsive, alert, multiple doses Narcan, response to Narcan)	naloxo, narcan and gained conscious, with respons, more respons, became respons, responsive to narcan, narcan ao4, became alert, now alert, alert now, response to, woke up, wake up, now aaox3, aaox3 now, now aaox4, aaox4 now, aando x4, revival or multiple doses narcan, multiple doses of narcan, multiple doses naloxone, nasal narcan, [2–9] of narcan, [2–9] doses narcan, [2–9] doses naloxone, [2–9] narcan, [2–9] naloxone, [4–9] milligram narcan, narcan [4–9] milligram, multiple narcan, multi narcan, narcan multi, naloxone multi, multi naloxone, naloxone [4–9] milligram and not no naloxone give, no narcan give, not responsive to narcan, no response to narcan, not responsive to naloxo, no response to naloxo, not responding to narcan, not responding to naloxo, narcan unrespons, narcan no respons
Special determination: Automatically categorized as non-severe opioid overdoses	
Air Quality Respiratory disease in the absence of an	Non-severe for those with Air Quality related Respiratory Illness, and in absence of opioid overdose DD code or overdose CC CCDD Category: Air Quality-related Respiratory Illness v1 and not “overdose” in chief complaint or T40.0X1A,

Terms used in Severe Opioid Overdose Definition Note: Sorted by Clinical Relevance

opioid T code or explicitly stating overdose

Query Terms Including Misspelling and Exclusions^a

T40.0X4A, T40.1X1A, T40.1X4A, T40.2X1A, T40.2X4A, T40.3X1A, T40.3X4A, T40.4X1A, T40.4X4A, T40.601A, T40.604A, T40.691A, T40.694A, T40.411A, T40.414A, T40.421A, T40.424A, T40.491A, T40.494A, T400X1A, T400X4A, T401X1A, T401X4A, T402X1A, T402X4A, T403X1A, T403X4A, T404X1A, T404X4A, T40601A, T40604A, T40691A, T40694A, T40411A, T40414A, T40421A, T40424A, T40491A, T40494A

Abbreviations: CC, as patient chief complaints; CPR, cardiopulmonary resuscitation; DD, discharge diagnosis.

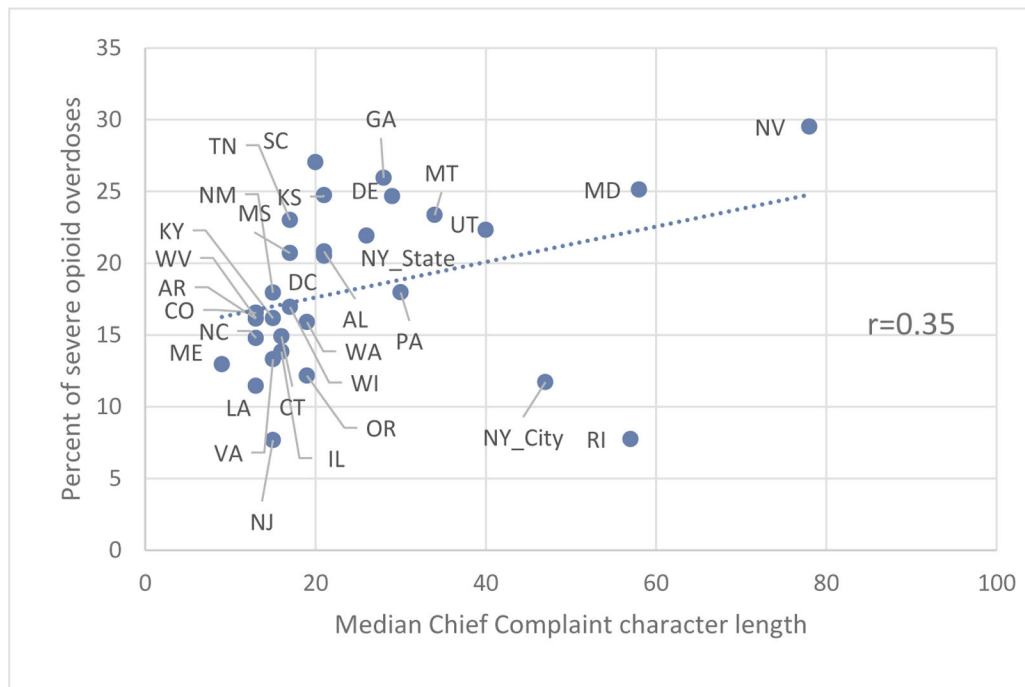
^aBrackets [] are placeholders that specify characters that can be present in a position.

Note: SAS code can be provided upon request.

TABLE 2

Monthly Percentage Changes of Severe Opioid Overdoses, January 2019-August 2022

	Monthly Percentage Changes (%)
Average monthly percent change (95% confidence interval), full time period	-0.14 (-0.77, 0.50)
Segment 1: January 2019-October 2019	-1.04 (-1.69, -0.39)
Segment 2: October 2019-May 2020	1.18 (-0.04, 2.42)
Segment 3: May 2020-August 2020	-2.10 (-8.90, 5.20)
Segment 4: August 2020-January 2021	2.85 (0.54, 5.22)
Segment 5: January 2021-July 2021	-2.91 (-4.46, -1.34)
Segment 6: July 2021-August 2022	0.41 (0.03, 0.79)



- State percent severe opioid overdoses by median chief complaint character length
- Linear trend

FIGURE 1.

Association of Median Chief Complaint Text Character Length with Percent Severe Opioid Overdoses by Jurisdiction, Drug Overdose Surveillance and Epidemiology (DOSE) System, January 2019–August 2022

References

1. Hedegaard H, Miniño AM, Spencer MR, Warner M. Drug Overdose Deaths in the United States, 1999–2020. CDC Website; 2021.
2. Spencer MR, Garnett MF, Miniño AM. Drug overdose deaths in the United States, 2002–2022. NCHS Data Brief, no 491. Hyattsville, MD: National Center for Health Statistics; 2024. doi: 10.15620/cdc:135849.
3. Ahmad FB, Cisewski JA, Rossen LM, S P. Provisional drug overdose death counts National Center for Health Statistics website: CDC; 2024 [Available from: <https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm>. Accessed May 8, 2023.
4. Holland KM, Jones C, Vivolo-Kantor AM, Idaikkadar N, Zwald M, Hoots B, et al. Trends in US emergency department visits for mental health, overdose, and violence outcomes before and during the COVID-19 pandemic. *JAMA Psychiatry*. 2021;78(4):372–379. doi:10.1001/jamapsychiatry.2020.4402. [PubMed: 33533876]
5. Centers for Disease Control and Prevention. About DOSE CDC website2022 [Available from: <https://www.cdc.gov/drugoverdose/nonfatal/case.html>. Accessed May 8, 2023.
6. Stam NC, Cogger S, Schumann JL, Weeks A, Roxburgh A, Dietze PM, et al. The onset and severity of acute opioid toxicity in heroin overdose cases: a retrospective cohort study at a supervised injecting facility in Melbourne, Australia. *Clin Toxicol (Phila)*. 2022;60 (11):1227–1234. doi:10.1080/15563650.2022.2126371. [PubMed: 36200988]
7. Bettano A, Jones K, Fillo KT, Ficks R, Bernson D. Opioid-related incident severity and emergency medical service naloxone administration by sex in Massachusetts, 2013–2019. *Subst Abus* 2022;43(1):479–485. doi:10.1080/08897077.2021.1949661. [PubMed: 34283708]
8. Britton PC, Bohnert AS, Wines JD Jr, Conner KR. A procedure that differentiates unintentional from intentional overdose in opioid abusers. *Addict Behav* 2012;37(1):127–130. doi:10.1016/j.addbeh.2011.08.006. [PubMed: 21955872]
9. Bohnert ASB, Walton MA, Cunningham RM, Ilgen MA, Barry K, Chermack ST, et al. Overdose and adverse drug event experiences among adult patients in the emergency department. *Addict Behav* 2018;86:66–72. doi:10.1016/j.addbeh.2017.11.030. [PubMed: 29198490]
10. Scholl L, Liu S, Vivolo-Kantor A, Board A, Stein Z, Roehler DR, et al. Development and validation of a syndrome definition to identify suspected nonfatal heroin-involved overdoses treated in emergency departments. *J Public Health Manag Pract* 2021;27 (4):369–378. doi:10.1097/PHH.0000000000001271. [PubMed: 33346583]
11. Pickens CM, Scholl L, Liu S, Smith H, Snodgrass S. Development and validation of a syndrome definition for suspected nonfatal unintentional/undetermined intent stimulant-involved overdoses. 433021. 2022;137(6):1079–1090. doi:10.1177/00333549211054489.
12. Injury Surveillance Workgroup 9. The transition from ICD-9-CM to ICD-10-CM: guidance for analysis and reporting of injuries by mechanism and intent. 2016.
13. Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med* 2000;19(3):335–351. doi:10.1002/(SICI)1097-0258(20000215)19:3<335::AID-SIM336>3.0.CO;2-Z. [PubMed: 10649300]
14. O'Donnell JK, Gladden RM, Seth P. Trends in deaths involving heroin and synthetic opioids excluding methadone, and law enforcement drug product reports, by census region—United States, 2006–2015. *MMWR Morb Mortal Wkly Rep* 2017;66(34):897–903. doi:10.15585/mmwr.mm6634a2. [PubMed: 28859052]
15. Ciccarone D The rise of illicit fentanyl, stimulants and the fourth wave of the opioid overdose crisis. *Curr Opin Psychiatry*. 2021;34 (4):344–350. doi: 10.1097/YCO.0000000000000717. [PubMed: 33965972]

16. Gladden RM, Martinez P, Seth P. Fentanyl law enforcement submissions and increases in synthetic opioid-involved overdose deaths—27 states, 2013–2014. *MMWR Morb Mortal Wkly Rep* 2016;65(33):837–843. doi:10.15585/mmwr.mm6533a2. [PubMed: 27560775]
17. Daniulaityte R, Juhascik MP, Strayer KE, Sizemore IE, Zatreh M, Nahhas RW, et al. Trends in fentanyl and fentanyl analogue-related overdose deaths—Montgomery County, Ohio, 2015–2017. *Drug Alcohol Depend* 2019;198:116–120. doi:10.1016/j.drugalcdep.2019.01.045. [PubMed: 30909018]
18. Dai Z, Abate MA, Smith GS, Kraner JC, Mock AR. Fentanyl and fentanyl-analog involvement in drug-related deaths. *Drug Alcohol Depend* 2019;196:1–8. doi:10.1016/j.drugalcdep.2018.12.004. [PubMed: 30658219]
19. Drug Enforcement Agency Philadelphia Division. Pittsburgh UO. The opioid threat in Pennsylvania. Drug Enforcement Agency Website. 2018. <https://www.dea.gov/sites/default/files/2018-10/PA%20Opioid%20Report%20Final%20FINAL.pdf>. Accessed May 8, 2023.
20. Georgia Department of Public Health. Updated suspected drug overdose increases in Georgia amid COVID-19. Drug-Related Health Alerts. 2020. <https://dph.georgia.gov/document/document/updatesuspecteddrugoverdoseincreasesingeorgiaamidcovid-19njdpdf/download>. Accessed May 8, 2023.
21. Georgia Department of Public Health. DPH News Release - Fentanyl Overdose Increases [March 31, 2022, press release]. 2022. <https://dph.georgia.gov/press-releases/2022-03-31/dph-news-release-fentanyl-overdose-increases>. Accessed May 8, 2023.
22. Hill LG, Loera LJ, Torrez SB, Puzantian T, Evoy KE, Ventricelli DJ, et al. Availability of buprenorphine/naloxone films and naloxone nasal spray in community pharmacies in 11 U.S. states. *Drug Alcohol Depend* 2022;237:109518. doi:10.1016/j.drugalcdep.2022.109518. [PubMed: 35691255]
23. Centers for Disease Control and Prevention. Increase in Fatal Drug Overdoses Across the United States Driven by Synthetic Opioids Before and During the COVID-19 Pandemic. CDC Website: Center for Preparedness and Response; 2020.
24. Ahmad F, Cisewski J, Rossen L, S P. Provisional drug overdose death counts 2022 [Available from: <https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm>. Accessed May 8, 2023.
25. Jalal H, Burke DS. Carfentanil and the rise and fall of overdose deaths in the United States. *Addiction*. 2021;116(6):1593–1599. doi: 10.1111/add.15260. [PubMed: 32935381]
26. Delcher C, Wang Y, Vega RS, Halpin J, Gladden RM, O'Donnell JK, et al. Carfentanil outbreak —Florida, 2016–2017. *MMWR Morb Mortal Wkly Rep* 2020;69(5):125–129. doi:10.15585/mmwr.mm6905a2. [PubMed: 32027630]
27. Zibbell JE, Aldridge AP, Cauchon D, DeFiore-Hyrmer J, Conway KP. Association of law enforcement seizures of heroin, fentanyl, and carfentanil with opioid overdose deaths in Ohio, 2014–2017. *JAMA Netw Open*. 2019;2(11):e1914666. doi: 10.1001/jamanetworkopen.2019.14666. [PubMed: 31702795]
28. Casillas S, Vivolo-Kantor A, Ussery E, Stokes E, Liu S. CDC Fentanyl Overdose v1 Factsheet & Technical Brief 2023 [Available from: <https://knowledgerepository.syndromicsurveillance.org/cdc-fentanyl-overdose-v1>. Accessed May 8, 2023.

Implications for Policy & Practice

- Nonfatal opioid overdose surveillance exists, yet cases represent a wide-ranging clinical situation from suspected overdoses to those requiring intensive medical interventions.
- The proposed definition of severe opioid overdoses allows for the translation and description of opioid overdoses in other datasets.
- We described severe opioid overdose trends within a nationwide database of emergency department visits in the United States.
- The creation and implementation of the severe opioid overdose definitions complements surveillance of suspected nonfatal opioid overdoses and fatal opioid overdoses, serving as an early warning to guide public health action need for harm reduction in the community.

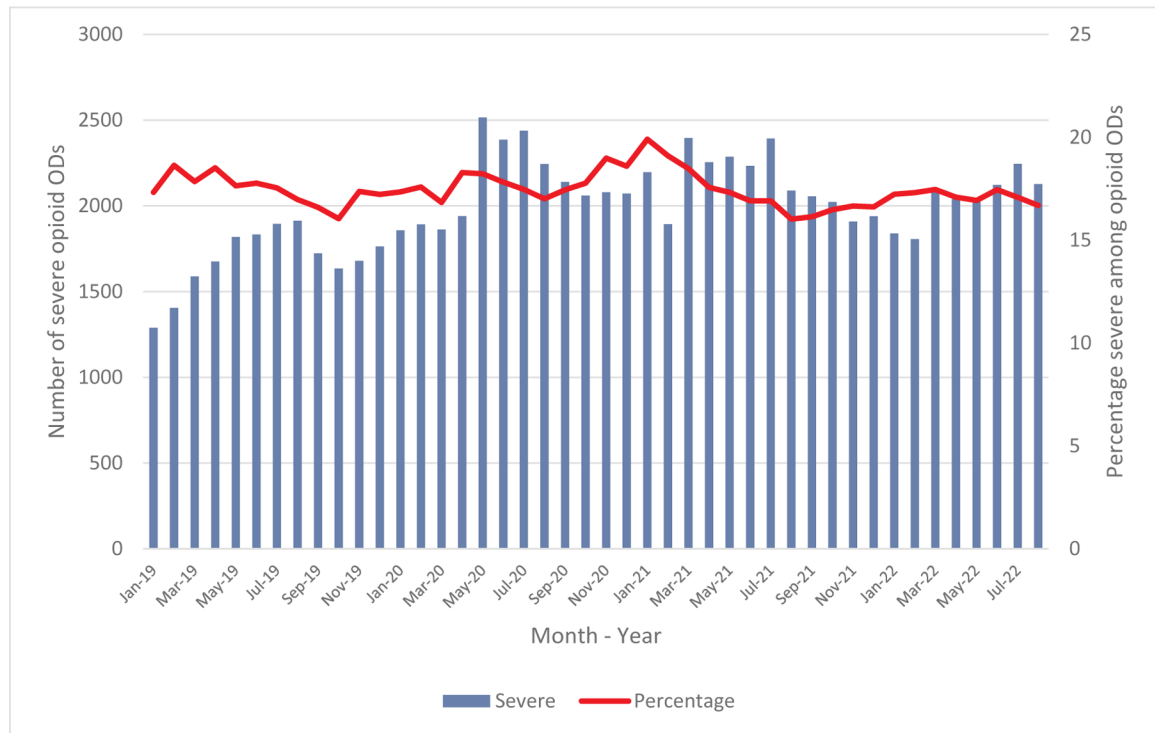


FIGURE 1.

Monthly Number and Percentage of Severe Opioid Overdoses, Drug Overdose Surveillance and Epidemiology (DOSE) System*, January 2019-August 2022 (29 States and District of Columbia). *In facilities with a coefficient of variation ≤ 45 and average weekly discharge diagnosis informative $\geq 75\%$

TABLE 1
Description of the Severe Opioid Overdose Definition CC Terms and DD Codes With Examples

Terms ^d Used in Severe Opioid Overdose definition Note: Sorted by Clinical Relevance	Codes Also Used in Definition	Specific Considerations	Frequencies for Having Either the Listed Terms or Codes (Percentage Among Severe Opioid Overdoses)	Examples From CC and DD Field ^b
Cardiopulmonary arrest and respiratory failure	I46.9, R09.2	Exclude: Under arrest, arrest presenting for medical clearance, and APFMC	11 165 (12.7%)	Cardiac arrest: T40.1X1A; I46.9
CPR and resuscitation		Exclude: Z66 do not resuscitate, DNR	3213 (3.7%)	Overdose cardiopulmonary resuscitation by family now awake
Pulseless			286 (0.3%)	Found down at home room pulseless apneic by mother EMS gave 3 epi 4 milligram Narcan
Return of spontaneous circulation (ROSC)			603 (0.7%)	Post arrest ROSC obtained PTA possible overdose ventricular fibrillation arrest with EMS
Hypotension	I95.2		1855 (2.1%)	Patient arrived by EMS for unresponsiveness hypotension syncope near syncope: T40.1X1A; I95.2
Low blood pressure			288 (0.3%)	Low blood pressure took percoet became less responsive: T40.601A; R55; T40.601A; I10;
Intubation and endotracheal tube		Exclude: Z66 DNI	669 (0.8%)	Respiratory arrest intubated: 1149222004; 445273005; T40.601A; T40.601A; F19.10; R06.03
Apnea	R06.81	Exclude: Sleep apnea, G47.3	1799 (2.1%)	Patient found car apneic cyanotic 2 mg of Narcan given patient ox4 Overdose: R06.02; R53.83; R11.10; R53.83; T50.905A; F11.90; R06.81 ;
Hypoxia	R09.02, J96.01, J96.91		30 506 (34.8%)	Patient arrives by EMS family called because patient was unresponsive patient takes pain medications for knee pain took narcotics before this episode patient responded to 1 5 of Narcan PTA altered level of consciousness: R09.02 ; S09.90XA; T50.901A; R55
Cyanosis	R23.0		983 (1.1%)	Overdose: T50.901A; T40.601A; R23.0 ; R41.89; F19.10; Z79.1; Z79.899
Unresponsive		Exclude: Unresponsive to Narcan and unresponsive to Naloxone	28 885 (32.9%)	Patient found unresponsive apneic by EMS, CPR performed by bystanders at scene; given 4 mg Narcan nasally, and admits snorting fentanyl today
Loss of consciousness and unconscious		Exclude: Deny (denies) loss of consciousness	1768 (2.0%)	EMS reports patient found unconscious by neighbors Narcan given
Collapse	R55		8913 (10.2%)	Throat pain other found by mom unresponsive after 2 doses of Narcan per EMS patient became responsive and very sleepy on arrival not responding appropriately: R91.8; E11.10; R41.82; E11.10; R91.8; R55 ; R09.02; Z20.822
Naloxone/Narcan with response (revival, became responsive, alert, multiple doses Narcan, response to Narcan)		Exclude: Not responsive, no response, not responding, no Narcan given, no effect, and no improvement	18 300 (20.9%)	Patient was brought by EMS for possible overdose ... they gave 4 of Narcan patient woke up patient admits to using fentanyl

Terms ^a Used in Severe Opioid Overdose definition Note: Sorted by Clinical Relevance	Codes Also Used in Definition	Specific Considerations	Frequencies for Having Either the Listed Terms or Codes (Percentage Among Severe Opioid Overdoses)	Examples From CC and DD Field ^b
Special determination: Categorized as non-severe opioid overdoses				
Air quality respiratory disease in the absence of an opioid T code or explicitly stating overdose		Non-severe for air quality ^c and not opioid overdose code or overdose CC		Shortness of breath back pain: I95.951007; I11.0; I50.33; J96.21; N17.9; F11.20; F33.9; E66.2; J43.2; I25.10; K21.9; M10.9; Z68.37; Z95.5; Z20.822; Z79.82;

Abbreviations: APFMC, Arrest presenting for medical clearance; CC, chief complaint; CPR, cardiopulmonary resuscitation; DD, discharge diagnosis; DNR, do not resuscitate; EMS, emergency medical services; PTA, prior to arrival.

^a Our definition also searched for term(s) abbreviations and misspellings.

^b Bolded text below are identified by the terms or code used in the severe opioid overdose definition, shown in this row.

^c Air Quality-Related Respiratory Illness v1, described in: <https://www.cste.org/members/group.aspx?id=87587>.

TABLE 2

Characteristics of Emergency Department Visits for Suspected Nonfatal Opioid Overdoses by Severity, Drug Overdose Surveillance and Epidemiology System, January 2019–August 2022 (29 States and District of Columbia)

	Severe, n (Row %)	Not Severe, n (Row %)	Prevalence Ratio (95% Confidence Interval)	Total, n
Total	87 686 (17.4%)	415 469 (82.6%)		503 155
Sex				
Female	30 170 (17.5%)	142 063 (82.5%)	1.01 (1.00–1.02)	172 233
Male	57 166 (17.4%)	271 944 (82.6%)	Ref	329 110
Missing/Unknown	350 (19.3%)	1462 (80.7%)	1.11 (1.06–1.16)	1812
Age group (in years)				
0–14	508 (15.8%)	2701 (84.2%)	1.00 (0.97–1.03)	3209
15–24	7623 (17.6%)	35 620 (82.4%)	1.11 (1.10–1.12)	43 243
25–34	21 130 (15.8%)	112 276 (84.2%)	Ref	133 406
35–44	17 603 (16.8%)	87 448 (83.2%)	1.06 (1.05–1.07)	105 051
45–54	14 329 (17.9%)	65 515 (82.1%)	1.13 (1.12–1.14)	79 844
55–64	14 802 (18.1%)	66 764 (81.9%)	1.15 (1.14–1.16)	81 566
≥65	10 751 (20.3%)	42 208 (79.7%)	1.28 (1.27–1.29)	52 959
Unknown	940 (24.2%)	2937 (75.8%)	1.53 (1.52–1.54)	3877
Emergency department facility Census region				
Midwest	12 469 (15.0%)	70 725 (85.0%)	Ref	83 194
Northeast	16 510 (14.6%)	96 602 (85.4%)	0.97 (0.96–0.98)	113 112
South	43 268 (19.6%)	177 204 (80.4%)	1.31 (1.30–1.32)	220 472
West	15 439 (17.9%)	70 938 (82.1%)	1.19 (1.18–1.20)	86 377
Race/Ethnicity				
American Indian or Alaska Native, non-Hispanic (NH)	760 (16.6%)	3826 (83.4%)	0.93 (0.91–0.96)	4586
Asian, NH	494 (22.3%)	1718 (77.7%)	1.25 (1.20–1.30)	2212
Black or African American, NH	18 916 (19.0%)	80 866 (81.0%)	1.06 (1.05–1.07)	99 782
Hispanic or Latino	5936 (17.0%)	28 959 (83.0%)	0.95 (0.94–0.96)	34 895
Multiracial/Other, NH	4658 (19.0%)	19 842 (81.0%)	1.07 (1.06–1.08)	24 500
Native Hawaiian or other Pacific Islander, NH	110 (19.1%)	467 (80.9%)	1.07 (0.99–1.15)	577
Unknown race and/or ethnicity	7017 (12.3%)	50 130 (87.7%)	0.69 (0.68–0.70)	57 147

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

	Severe, n (Row %)	Not Severe, n (Row %)	Prevalence Ratio (95% Confidence Interval)	Total, n
White, NH	49 795 (17.8%)	229 661 (82.2%)	Ref	279 456