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Publication Date

2024-05-01

DOI

10.1016/j.resuscitation.2024.110159

Peer reviewed

HHS Public Access

Author manuscript

Resuscitation. Author manuscript; available in PMC 2024 June 24.

Published in final edited form as:

Resuscitation. 2024 May ; 198: 110159. doi:10.1016/j.resuscitation.2024.110159.

Trends in presumed drug overdose out-of-hospital cardiac arrests in San Francisco, 2015–2023

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Abstract

Introduction: Estimates of the prevalence of drug-related out of hospital cardiac arrest (OHCA) vary, ranging from 1.8% to 10.0% of medical OHCA. However, studies conducted prior to the recent wave of fentanyl deaths likely underestimate the current prevalence of drug-related OHCA. We evaluated recent trends in drug-related OHCA, hypothesizing that the proportion of presumed drug-related OHCA treated by emergency medical services (EMS) has increased since 2015.

Methods: We conducted a retrospective analysis of OHCA patients treated by EMS providers in San Francisco, California between 2015 and 2023. Participants included OHCA cases in which resuscitation was attempted by EMS. The study exposure was the year of arrest. Our primary outcome was the occurrence of drug-related OHCA, defined as the EMS impression of OHCA caused by a presumed or known overdose of medication(s) or drug(s).

Results: From 2015 to 2023, 5044 OHCA resuscitations attended by EMS (average 561 per year) met inclusion criteria. The median age was 65 (IQR 50–79); 3508 (69.6%) were male. The EMS impression of arrest etiology was drug-related in 446/5044 (8.8%) of OHCA. The prevalence of presumed drug-related OHCA increased significantly each year from 1% in 2015 to 17.6% in

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CRediT authorship contribution statement

Ralph C. Wang: Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Juan Carlos C. Montoy:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Robert M. Rodriguez:** Writing – review & editing, Writing – original draft, Validation, Supervision, Investigation, Formal analysis, Data curation, Conceptualization. **James J. Menegazzi:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jeremy Lacocque:** Writing – review & editing, Writing – original draft, Validation, Data curation, Conceptualization. **David G. Dillon:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resuscitation.2024.110159.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

2023 (p-value for trend = 0.0001). After adjustment, presumed drug-related OHCA increased by 30% each year from 2015–2023.

Conclusion: Drug-related OHCA is an increasingly common etiology of OHCA. In 2023, one in six OHCA was presumed to be drug related. Among participants less than 60 years old, one in three OHCA was presumed to be drug related.

Keywords

Drug related cardiac arrest; Opioid overdose

Introduction

In the United States, drug overdose deaths increased five-fold over the last 2 decades and exceeded 100,000 deaths in 2021.[1] Of the 107,622 drug overdose deaths in 2021, 71,238 were associated with synthetic opioids, primarily fentanyl.[2,3] EMS providers frequently treat drug-related OHCA,[1,5] which is most often caused by opioid associated OHCA, defined as cardiac arrest precipitated by the use of opioids.[4] Estimates of the prevalence of presumed drug-related OHCA vary, ranging from 1.8% to 10.0% of all medical OHCA.[4–9] These studies likely underestimate the current prevalence of drug-related OHCA, as they were conducted prior to the recent wave of fentanyl deaths, which accounted for more drug overdose deaths in 2016 than other substances.[4,6–11] We previously found that 15% of OHCA presumed to be cardiac etiology in San Francisco County between 2011 and 2014 were caused by occult drug overdoses based on autopsy results, suggesting a substantial proportion of drug-related OHCA are not identified or misattributed as sudden cardiac death.[12] More recent studies of drug-related OHCA report increased incidence during the COVID-19 pandemic.[13,14]

It is important to determine trends in drug-related OHCA, as interventions should be tailored to the particular etiology of arrest.[11] Focusing on differences before and after the rise in fentanyl overdose deaths in 2016, we sought to evaluate recent trends in drug-related OHCA, hypothesizing that the prevalence of presumed drug-related OHCA treated by EMS has increased over time since 2015. Additionally, we sought to identify demographic and cardiac arrest case characteristics associated with drug-related OHCA encountered by EMS.[15]

Methods

We conducted this retrospective analysis of OHCA patients treated by EMS providers between 2015 and 2023. We obtained OHCA data from the San Francisco EMS Agency using Utstein definitions collected for the Cardiac Arrest Registry to Enhances Survival, a prospective registry of OHCA established by the Centers for Disease Control.[16] We obtained a Letter of Determination from the IRB.

Participants included EMS attended medical OHCA cases in which resuscitation was attempted. Our primary outcome was presumed drug-related OHCA, defined as the EMS impression of cardiac arrest caused by known or presumed overdose of medication (s) or drug(s). Overdoses included intentional and accidental exposures, and both legal and illegal

substances. Cardiac arrest etiology was determined by case review of EMS electronic health record by trained staff and reviewed by the EMS medical director. The study exposure was the year of arrest, as drug overdose deaths have increased dramatically over time.[4] We included covariates based on our review of the literature, including: age, sex, initial cardiac rhythm, whether the OHCA was witnessed, and OHCA location.[4,7]

Statistical analysis

We reported continuous variables as medians with interquartile ranges and categorical variables as percentages. Data were analyzed using the Cochrane Armitage test to assess temporal trends.[17] We stratified drug-related OHCA prevalence to age greater than or equal to 60 years old vs. less than 60 based on prior work.[18] To determine the association between year of study and drug-related OHCA, we fit regression models to adjust for known predictors available at the time of EMS encounter. Stata 17 was used.

Results

From January 2015 to August 2023, 5044 OHCA resuscitations treated by EMS (561 per year) met inclusion criteria. The median age was 65 (IQR 50–79); 3508 (69.6%) were male; 3264 (64.7%) were found at home, 2254 (44.7%) were unwitnessed, and 3919 (81%) had non-shockable rhythms (Table 1). The EMS impression of arrest etiology was drug-related in 446/5044 (8.8%) of OHCA. The prevalence of presumed drug-related OHCA increased significantly each year from 1% in 2015 to 17.6% in 2023 (p-value for trend = 0.0001). Among participants less than 60 years old, 34% of medical OHCA were presumed drug-related in 2023 (Table 1, Fig. 1).

Drug-related OHCA cases differed significantly according to age, sex, arrest location, witnessed arrest, and initial cardiac rhythm (Table 1). In drug-related OHCA the median age was 42 (IQR 19–72) vs. 67 (IQR 54–81) in non-drug-related OHCA. 85.3% of drug-related OHCA were below 60 years old vs. 34.4% of presumed non-drug related OHCA. (Fig. 2). The location of drug-related OHCA was most often on the street (46.4%), and also unwitnessed (59.8%). Bystanders may be reluctant to determine whether a person is asleep or experiencing a drug overdose.

The association between year and presumed drug-related OHCA was estimated in a regression model, controlling for age, gender, witnessed, initial rhythm, and arrest location (Table 1). For every increase in year of the study, the odds of drug-related OHCA was times the previous year (95% CI: 1.2–1.4). Age was strongly associated with drug-related OHCA, with those less than 60 years having 9 times the odds as compared to those over 60. (Table 2).

Discussion

In this retrospective cohort study using San Francisco EMS data from 2015 to 2023, we found that EMS treated drug-related OHCA cases increased consistently over time from less than 1% in 2015 to 17.6% in 2023 (approximately one in six OHCAs). Among patients less than 60 years of age, 34.0% or 1 in three EMS attended OHCA were drug-related in 2023.

This trend of increasing prevalence over time should be contrasted to prior studies reporting estimates ranging from 2% to 10.0% among all medical OHCA.[4–9,19] This may be explained by the increasing incidence of drug-related OHCA due to the recent fentanyl wave, which worsened during the COVID-19 pandemic and forms a larger portion of our dataset compared to prior estimates. This confirms more recent literature that found increased prevalence of overdose related OHCA during the COVID-19 pandermic - rates in May 2020 were more than double the baseline from 2018 and 2019, and overall 2020 values increased by approximately 50%.[13] We add to this literature by reporting the trend of drug-related OHCA over a longer and more contemporaneous time period.

As drug-related OHCA (an in particular, opioid associated OHCA) have distinct pathophysiologies compared to sudden cardiac death, identifying patient and arrest characteristics associated with drug-related OHCA may aid in its improved identification and management.[4,20] Drug overdose patients in our study were younger than those with general medical OHCA (42 vs. 67 years of age) which confirms prior studies which reported that patients with drug-related OHCA tended to be younger than those with general medical OHCA.[7,21] In addition, certain characteristics of the arrest were associated with drug-related OHCA, including unwitnessed arrest, location outside of the patient's home, and more often in a non-shockable rhythm. These findings corroborate the results from a prior study which identified young age and unwitnessed arrest as predictors of opioid associated OHCA among medical OHCA using autopsy data.[18].

Our study illustrates that EMS providers are increasingly called upon to resuscitate patients with drug-related OHCA. These results should increase prehospital care providers' suspicion of drug-related OHCA, especially among those who are young, unwitnessed, and not found at home. These findings may have therapeutic implications. While the benefit of naloxone in suspected opioid associated out of hospital cardiac arrest has not been assessed in a clinical trial,[4] a recent propensity score matched analysis of 29,821 OHCA in PEA, found an association between naloxone and survival - OR: 1.7 (1.3–2.4).[22] The American Heart Association has indicated that whether "naloxone is beneficial when given to patients in cardiac arrest" is a key knowledge gap requiring further study.[20]

Limitations

An important limitation of this research is that presumed drug-related OHCA was defined according to EMS provider impression in the field, which may be an inaccurate estimate of its true prevalence. While prior literature suggests that EMS provider impression of drug involvement may be accurate, this is an understudied area without known estimates of sensitivity or specificity for opioid-associated OHCA.[23] In prior work of patients in OHCA with presumed cardiac etiology in San Francisco from 2011–2017, 133/767 (17%) participants died of a drug overdose as adjudicated by the medical examiner.[12] This suggests that EMS providers underestimated the true prevalence of drug-related OHCA early in our study period. The increased prevalence of a drug-related cause by EMS providers could be due to improved sensitivity among EMS providers, rising drug-related OHCA incidence, or both. The trend we observed is unlikely to be completely explained by increased EMS reporting.

We only included EMS-treated OHCA, and excluded patients with prolonged, unwitnessed downtimes or evidence of obvious death, thus our study does not estimate the proportion of drug overdose among all OHCA. Another limitation is that "drug-related OHCA" is a non-specific term that obscures the etiology of which drug(s) led to each cardiac arrest. However, this reflects the reality of caring for undifferentiated patients with limited information, as highlighted by the AHA statement: "treatment and stabilization of critically poisoned patients often must be performed before the poison involved is known."[20] Finally, this analysis is limited to a single urban county, thus limiting the study's generalizability.

Conclusion

Presumed drug-related OHCA is an increasingly common etiology of OHCA. In 2023, one in six OHCA was presumed to be drug related. Among participants less than 60 years old, one in three OHCA was presumed to be drug related.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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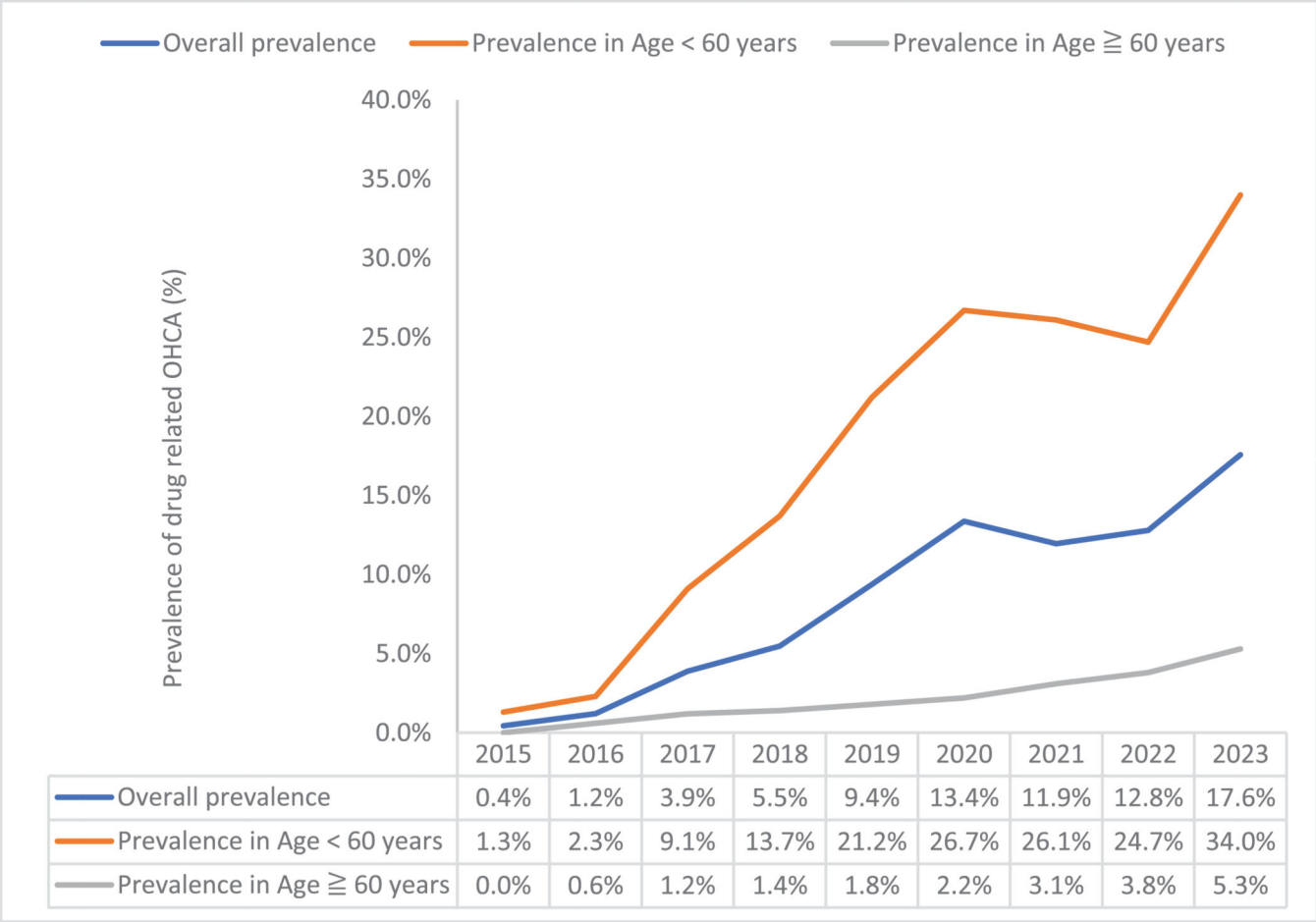
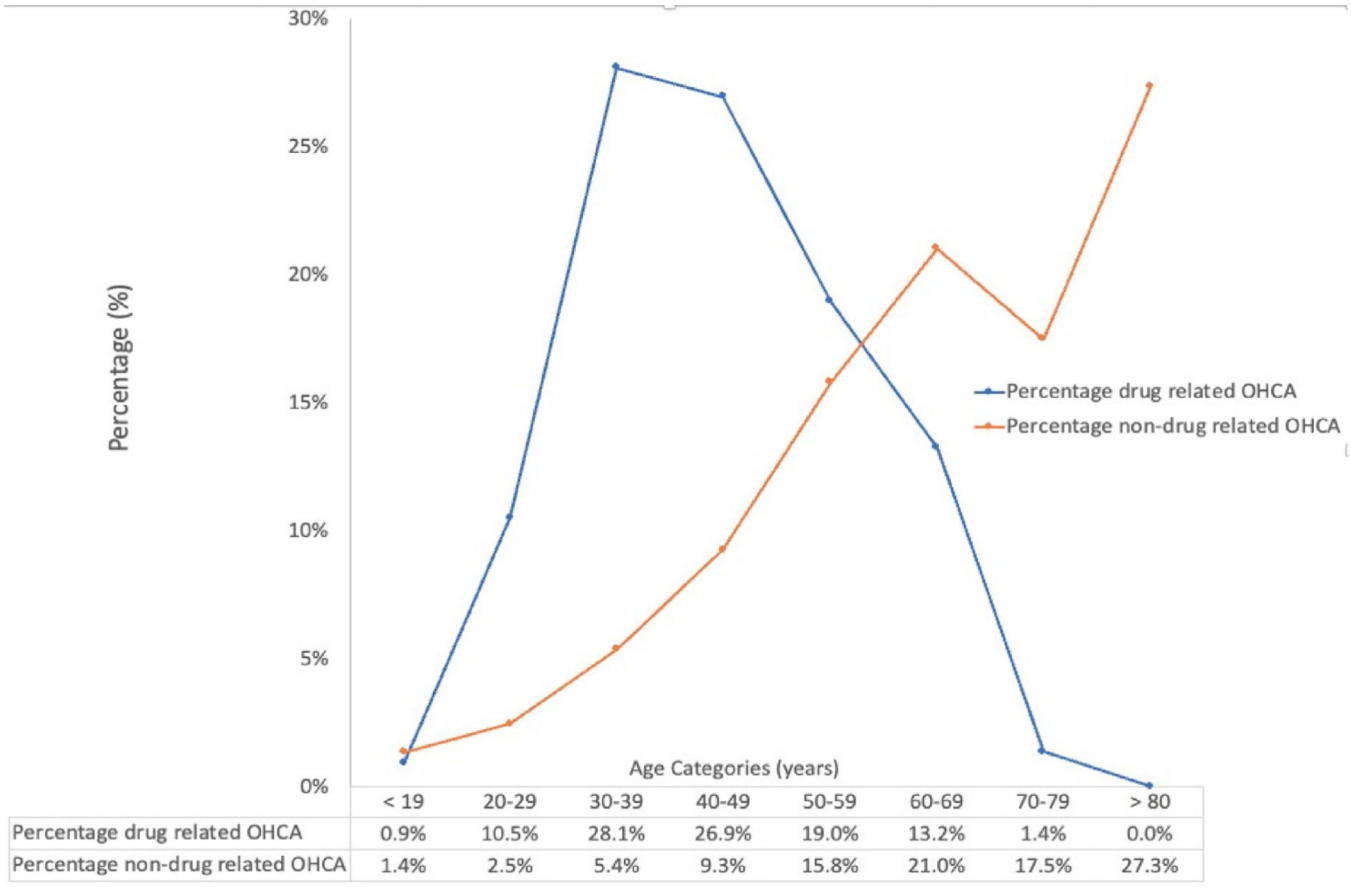


	2015	2016	2017	2018	2019	2020	2021	2022	2023
Overall prevalence	0.4%	1.2%	3.9%	5.5%	9.4%	13.4%	11.9%	12.8%	17.6%
Prevalence in Age < 60 years	1.3%	2.3%	9.1%	13.7%	21.2%	26.7%	26.1%	24.7%	34.0%
Prevalence in Age ≧ 60 years	0.0%	0.6%	1.2%	1.4%	1.8%	2.2%	3.1%	3.8%	5.3%

Fig. 1 –. Prevalence of presumed drug-related OHCA over time (2015–2023).



	< 19	20-29	30-39	40-49	50-59	60-69	70-79	> 80
Percentage drug related OHCA	0.9%	10.5%	28.1%	26.9%	19.0%	13.2%	1.4%	0.0%
Percentage non-drug related OHCA	1.4%	2.5%	5.4%	9.3%	15.8%	21.0%	17.5%	27.3%

Fig. 2 –. Percentage of drug-related OHCA vs. presumed cardiac OHCA by age.

Table 1 –

Characteristics of OHCA patients stratified by presumed drug overdose as the etiology of arrest.

	Overall N = 5044	Drug Overdose N = 446	Non-Drug Overdose N = 4598	p-value
Age (med, IQR)	65 (50–79)	42 (19–72)	67 (54–81)	<0.0001
Male Gender	3508 (69.6%)	349 (78.3%)	3159 (68.7%)	<0.001
Race				
American Indian/Alaska Native	27 (0.5%)	3 (0.7%)	24 (0.5%)	<0.001
Asian/Native Hawaiian/Pacific Islander	1088 (21.6%)	14 (3.1%)	1074 (23.4%)	
Black	792 (15.7%)	112 (25.1%)	680 (14.8%)	
White	1672 (33.1%)	200 (44.8%)	1472 (32.0%)	
Hispanic/Latino	401 (8.0%)	59 (13.2%)	342 (7.4%)	
More than one	16 (0.3%)	4 (0.9%)	12 (0.2%)	
Unknown	1048 (20.8%)	54 (12.1%)	994 (21.6%)	
EMS Agency				
San Francisco Fire Dept.	3851 (76.4%)	321 (72.0%)	3530 (76.8%)	0.023
King	635 (12.6%)	74 (16.6%)	561 (12.2%)	
AMR	558 (11.1%)	51 (11.4%)	507 (11.0%)	
Location				
Home	3264 (64.7%)	189 (42.4%)	3075 (66.9%)	<0.001
Public, non-street	825 (16.4%)	50 (11.2%)	775 (16.9%)	
Public, street	955 (18.9%)	207 (46.4%)	748 (16.3%)	
Unwitnessed Arrest	2254 (44.7%)	266 (59.8%)	1988 (43.2%)	<0.001
CPR * Prior to EMS arrival	1243 (24.6%)	102 (22.9%)	1141 (24.8%)	0.36
Initial Rhythm				
Asystole	2648 (52.5%)	293 (65.7%)	2355 (51.2%)	<0.001
PEA	1335 (26.5%)	112 (25.1%)	1223 (26.6%)	
Other non-shockable rhythm	136 (2.7%)	20 (4.5%)	116 (2.5%)	
Ventricular tachycardia	101 (2.0%)	3 (0.7%)	98 (2.1%)	
Ventricular fibrillation	757 (15.0%)	16 (3.6%)	741 (16.1%)	
Other shockable rhythm	66 (1.3%)	2 (0.5%)	64 (1.4%)	

* CPR prior to EMS arrival defined as bystander, family member, healthcare provider (non EMS).

Table 2 –

Unadjusted and Adjusted Odds Ratios for Variables Associated with Drug Overdose OHCA.

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p-value
Age less than 60 years old	11.1 (8.5–14.5)	9.3 (7.1–12.3)	<0.001
Year	1.3 (1.3–1.4)	1.3 (1.2–1.4)	<0.001
Unwitnessed Arrest	2.0 (1.6–2.4)	1.3 (1.1–1.4)	0.017
Gender	1.6 (1.3–2.1)	1.2 (1.0–1.6)	0.11
Non-shockable rhythm	4.9 (3.2–7.7)	5.5 (3.5–8.8)	<0.001
Arrest outside of home	2.7 (2.3–3.3)	2.1 (1.7–2.7)	<0.001