JAMA Psychiatry | Original Investigation

Racial/Ethnic, Social, and Geographic Trends in Overdose-Associated Cardiac Arrests Observed by US Emergency Medical Services During the COVID-19 Pandemic

Joseph Friedman, MPH; N. Clay Mann, PhD, MS; Helena Hansen, MD, PHD; Philippe Bourgois, PhD; Joel Braslow, MD, PhD; Alex A. T. Bui, PhD; Leo Beletsky, JD, MPH; David L. Schriger, MD, MPH

IMPORTANCE Provisional records from the US Centers for Disease Control and Prevention (CDC) through July 2020 indicate that overdose deaths spiked during the early months of the COVID-19 pandemic, yet more recent trends are not available, and the data are not disaggregated by month of occurrence, race/ethnicity, or other social categories. In contrast, data from emergency medical services (EMS) provide a source of information nearly in real time that may be useful for rapid and more granular surveillance of overdose mortality.

OBJECTIVE To describe racial/ethnic, social, and geographic trends in EMS-observed overdose-associated cardiac arrests during the COVID-19 pandemic through December 2020 and assess the concordance with CDC-reported provisional total overdose mortality through May 2020.

DESIGN, SETTING, AND PARTICIPANTS This cohort study included more than 11 000 EMS agencies in 49 US states that participate in the National EMS Information System and 83.7 million EMS activations in which patient contact was made.

EXPOSURES Year and month of occurrence of overdose-associated cardiac arrest; patient race/ethnicity; census region and division; county-level urbanicity; and zip code–level racial/ethnic composition, poverty, and educational attainment.

MAIN OUTCOMES AND MEASURES Overdose-associated cardiac arrests per 100 000 EMS activations with patient contact in 2020 were compared with a baseline of values from 2018 and 2019. Aggregate numbers of overdose-associated cardiac arrests and percentage increases were compared with provisional total mortality in CDC records from rolling 12-month windows with end months spanning January 2018 through July 2020.

RESULTS Among 33.4 million EMS activations in 2020, 16.8 million (50.2%) involved female patients and 16.3 million (48.8%) involved non-Hispanic White individuals. Overdose-associated cardiac arrests were elevated by 42.1% nationally in 2020 (42.3 per 100 000 EMS activations at baseline vs 60.1 per 100 000 EMS activations in 2020). The highest percentage increases were seen among Latinx individuals (49.7%; 38.8 per 100 000 activations at baseline vs 58.1 per 100 000 activations in 2020) and Black or African American individuals (50.3%; 21.5 per 100 000 activations at baseline vs 32.3 per 100 000 activations in 2020), people living in more impoverished neighborhoods (46.4%; 42.0 per 100 000 activations at baseline vs 61.5 per 100 000 activations in 2020), and the Pacific states (63.8%; 33.1 per 100 000 activations at baseline vs 54.2 per 100 000 activations in 2020), despite lower rates at baseline for these groups. The EMS records were available 6 to 12 months ahead of CDC mortality figures and showed a high concordance (r = 0.98) for months in which both data sets were available. If the historical association between EMS-observed and total overdose mortality holds true, an expected total of approximately 90 632 (95% CI, 85 737-95 525) overdose deaths may eventually be reported by the CDC for 2020.

CONCLUSIONS AND RELEVANCE In this cohort study, records from EMS agencies provided an effective manner to rapidly surveil shifts in US overdose mortality. Unprecedented overdose deaths during the pandemic necessitate investments in overdose prevention as an essential aspect of the COVID-19 response and postpandemic recovery. This is particularly urgent for more socioeconomically disadvantaged and racial/ethnic minority communities subjected to the compounded burden of disproportionate COVID-19 mortality and rising overdose deaths.

JAMA Psychiatry. 2021;78(8):886-895. doi:10.1001/jamapsychiatry.2021.0967
Published online May 26, 2021.

Supplemental content

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Joseph Friedman, MPH, Center for Social Medicine and Humanities, B7-435, PO Box 951759, Los Angeles, CA 90095 (josephfriedman@mednet.ucla.edu).

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

As the COVID-19 pandemic arrived in the US, the country was in the midst of a several decades-long and accelerating overdose crisis, with more than 70 000 deaths in 2019.[1,2] At the outset of the pandemic, many experts expected that overdose mortality would increase sharply because of increased social isolation and instability and shifts in the drug supply, if adequate measures were not taken to flatten the overdose curve as part of the COVID-19 response.[3] In December 2020, provisional records were released by the US Centers for Disease Control and Prevention (CDC), confirming this prediction; in the first months of the pandemic, overdose fatalities spiked sharply, reaching a total of 81 684 deaths in the 12-month period ending in May 2020.[4]

These preliminary data strongly suggest that the social and economic fallout from the pandemic may have exacerbated already increasing overdose rates in the US. However, existing surveillance systems that could be used to confirm this have considerable limitations.[5] For example, the released figures covered only the first 2 months of significant pandemic-associated disruptions (April and May 2020), and trends were not disaggregated by month. Instead, the large increases in mortality seen during those months were averaged together with and therefore masked by the 10 months of relatively lower mortality preceding them.

Importantly, the provisional records are not broken down by race/ethnicity or other social dimensions. This is especially concerning, because the demographic attributes of the overdose crisis have shifted in the years leading up to 2020, driven by several factors, including increasing penetrance of the heroin market with illicitly manufactured fentanyls.[6] These changes have led to an increasing burden of overdose mortality in communities with historically lower rates, such as among Black communities, Latinx communities, and people living in Western states.[7,8] However, it is unclear how the fallout from the COVID-19 pandemic may be affecting this changing social and geographic profile of the overdose crisis.

Given the limitations of traditional mortality databases, data from emergency medical services (EMS) have been increasingly used during the pandemic as a source of epidemiological surveillance nearly in real time.[9-13] In this analysis, we expand on a previously defined method[10] to track changes in overdose mortality during the pandemic using a large, national EMS database. We provide updated overdose mortality trends through December 2020, which are stratified by characteristics such as race/ethnicity, geography, urbanicity, and neighborhood poverty level. We also assess the concordance of EMS-based results with provisional total overdose mortality data from the CDC through July 2020 and offer a more thorough characterization of the methods and findings.

Key Points

Question Can a national emergency medical services (EMS) database be used to rapidly surveil geographic, social, and overall trends in US overdose mortality?

Findings In this cohort study of 83.7 million EMS patient encounters, overdose-associated cardiac arrests rose about 40% nationally in 2020, with the largest increases among racial/ethnic minorities, in areas of socioeconomic disadvantage, and in Western states. High concordance was observed with provisional total overdose death figures through July 2020.

Meaning In this analysis, overdose deaths reached unprecedented levels during the pandemic, highlighting the need for investments in overdose prevention as an essential element of the COVID-19 response and postpandemic recovery, particularly for communities with greater vulnerability.

Methods

We conducted a cohort study using data from the National EMS Information System (NEMSIS), a large of cohort of more than 11 000 EMS agencies in 49 US states, which represented more than 87% of all EMS activations nationally in 2020.[9] Patient care reporting is standardized across the US, and data are electronically submitted nearly in real time, allowing for rapid surveillance of trends, although some agencies submit records up to a few weeks after incidents occur.[14]

This study was deemed exempt from review and informed consent by the UCLA institutional review board because the study uses publicly available, deidentified records. This study follows the STROBE reporting guideline for cohort studies.[15]

We calculated weekly rates of reported overdose-associated cardiac arrests as determined by EMS professionals on scene. In line with prior studies drawing on NEMSIS data, we measured each outcome as a rate per 100 000 EMS activations with patient contact, to adjust for increases in call volume over time as new agencies joined the NEMSIS.[9,10] Both the numerator and denominator were drawn only from calls for which patient contact occurred; therefore, calls canceled prior to EMS arrival on scene or in which no patient was found were excluded (eMethods in the Supplement).

Rates were calculated by month and year nationally, as well as stratified by 4 US census regions and 9 US census divisions; county urban or rural status (based on 2013 Urban Influence Codes[16]); patient race/ethnicity as identified by the EMS provider; and zip code-level education, poverty, and neighborhood racial/ethnic composition (based on 2013 American Communities Survey files[17]). Missing values in both the numerators and denominators were assessed (**Table**), and missingness was assumed to be proportionally equal across the levels of each stratifier (eMethods in the Supplement).

Because a drop in call volume (the study denominator) was noted during the initial months of the COVID-19 pandemic,[9] we conducted a sensitivity analysis to examine whether a smaller denominator (decreased EMS runs) would explain findings of an increased overdose fraction. This analysis entailed holding call volume constant for April through June 2020 at March 2020 values, before call volume decreased (**Figure 1**).

Provisional rolling aggregates published by the CDC provide the earliest direct evidence about total overdose mortality at the national level and are generally reported 6 to 12 months later than NEMSIS data.[1,5] We conducted a validation exercise

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

Table. Characteristics of Overdose Cardiac Arrests and EMS Activations, 2020 and Baseline[a]

	No. (%)			
	Overdose-associated cardiac arrests		Emergency medical service activations, millions	
Characteristic	2020	2018-2019	2020	2018-2019
Total	19 957	21 357	33.4	50.3
Census region				
South	8362 (41.9)	8749 (41.0)	15.6 (46.6)	24.3 (48.2)
Northeast	4088 (20.5)	4376 (20.5)	5.8 (17.2)	6.5 (12.9)
West	3764 (18.9)	4009 (18.8)	6.5 (19.5)	10.6 (21.1)
Midwest	3399 (17.0)	3761 (17.6)	5.0 (14.9)	8.0 (15.9)
Missing	343 (1.7)	459 (2.1)	0.5 (1.6)	0.9 (1.9)
Census division				
South Atlantic	5805 (29.1)	6300 (29.5)	8.8 (26.4)	14.6 (29.1)
Middle Atlantic	3248 (16.3)	3083 (14.4)	4.6 (13.7)	4.7 (9.3)
East North Central	2497 (12.5)	3018 (14.1)	3.3 (9.9)	5.8 (11.6)
Pacific	2198 (11.0)	2094 (9.8)	4.1 (12.1)	6.3 (12.6)
East South Central	1073 (5.4)	913 (4.3)	2.3 (6.9)	3.0 (6.0)
Mountain	1566 (7.8)	1915 (9.0)	2.5 (7.4)	4.2 (8.4)
West South Central	1484 (7.4)	1536 (7.2)	4.5 (13.3)	6.6 (13.2)
West North Central	902 (4.5)	743 (3.5)	1.7 (5.0)	2.2 (4.3)
New England	840 (4.2)	1293 (6.1)	1.2 (3.6)	1.8 (3.5)
Missing	343 (1.7)	459 (2.1)	0.5 (1.6)	0.9 (1.9)
Urbanicity of county				
Urban	16 385 (82.1)	17 639 (82.6)	25.9 (77.4)	38.5 (76.6)
Rural	2772 (13.9)	2831 (13.3)	5.3 (15.8)	8.4 (16.6)
Missing	800 (4.0)	887 (4.2)	2.3 (6.8)	3.4 (6.8)
Population with completed high school education in zip code, %				
91-100	6090 (30.5)	7215 (33.8)	10.0 (30.0)	15.5 (30.7)
81-90	8649 (43.3)	8863 (41.5)	7.8 (23.3)	11.3 (22.5)
<81	4358 (21.8)	4309 (20.2)	13.1 (39.1)	19.7 (39.1)
Missing	860 (4.3)	970 (4.5)	2.5 (7.5)	3.8 (7.6)

(continued)

to assess concordance between these 2 measures. The CDC provisional death records are made available in rolling windows, each representing a 12-month period.[1] The most recent window, at the time of this analysis, covered August 2019 to July 2020. The NEMSIS data used for this analysis were processed in the same fashion (rolling 12-month sums) and compared for concordance in percentage change and level. In the CDC data, a percentage change for a given period reflects the difference between total deaths in a 12-month period and the 12-month period ending 1 year prior. For example, the most recent results showed an 24.2% increase between August 2018 through July 2019 and August 2019 through July 2020. Calculating percentage changes thus requires data covering a 24-month window. Assessing the level (the rate for a given period) requires data for a 12-month window. Monthly NEMSIS data were available for 2017 through 2020, and therefore concordance in level could be assessed for rolling 12-month windows with end months from January 2018 through July 2020. Concordance in percentage change could be assessed for rolling 24-month windows with end months spanning January 2019 to July 2020. More details regarding steps taken to conduct the analysis can be found in the eMethods in the Supplement.

Statistical Analysis

Pearson correlation coefficients were calculated to assess the concordance between EMS-observed and total overdose deaths in each rolling 12-month period, for both level and percentage increase. Additionally, concordance was assessed graphically using Bland-Altman plots.[18,19] The mean association between each measure was calculated using linear regression and applied to the most current EMS data through December 2020 to estimate total overdose deaths for the same period, assuming prior associations hold true. A 95% CI was calculated based on the uncertainty in the modeled association and reflected a threshold for statistical significance of $P < .05$, 2 tailed. Statistical analysis was completed with R version 4.0.3 (R Foundation for Statistical Computing).

Results

The 2020 NEMSIS database represented 33.4 million EMS patient encounters, including 19 957 overdose-associated cardiac arrests, as defined by EMS professionals on scene (Table). The proportion of baseline characteristics among all

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

Table. Characteristics of Overdose Cardiac Arrests and EMS Activations, 2020 and Baseline[a] (continued)

	No. (%)			
	Overdose-associated cardiac arrests		Emergency medical service activations, millions	
Characteristic	2020	2018-2019	2020	2018-2019
Population in poverty in zip code, %				
>20	5480 (27.5)	5674 (26.6)	9.7 (29.2)	14.6 (28.9)
11-15	7853 (39.3)	8110 (38.0)	12.3 (36.9)	18.6 (37.0)
<11	5742 (28.8)	6580 (30.8)	8.8 (26.3)	13.2 (26.1)
Missing	882 (4.4)	993 (4.6)	2.6 (7.7)	4.0 (7.9)
White population in zip code, %				
<50	3236 (16.2)	3057 (14.3)	5.9 (17.8)	8.1 (16.2)
50-74	5044 (25.3)	5311 (24.9)	8.6 (25.7)	13.3 (26.5)
75-89	6035 (30.2)	6760 (31.7)	9.4 (28.1)	14.4 (28.7)
>89	4717 (23.6)	5198 (24.3)	6.9 (20.7)	10.4 (20.7)
Missing	925 (4.6)	1031 (4.8)	2.6 (7.8)	4.0 (8.0)
Race/ethnicity of patient				
White	11 727 (58.8)	13 305 (62.3)	16.3 (48.8)	26.0 (51.7)
Black or African American	2082 (10.4)	2144 (10.0)	6.4 (19.1)	10.0 (20.0)
Hispanic or Latino	1,296 (6.5)	1308 (6.1)	2.2 (6.6)	3.4 (6.8)
Other[b]	290 (1.5)	284 (1.3)	0.7 (2.0)	1.0 (2.1)
Missing	4459 (22.3)	4229 (19.8)	7.6 (22.9)	9.5 (18.9)
Sex of patient				
Female	6189 (31.0)	7042 (33.0)	16.8 (50.2)	26.0 (51.6)
Male	13 686 (68.6)	14 174 (66.4)	16.4 (49.1)	23.9 (47.6)
Missing	82 (0.4)	141 (0.7)	0.2 (0.7)	0.4 (0.8)

[a] Characteristics of the study numerator and denominator occurring in the period of 2018 to 2020 are shown; *baseline* refers to the summation of values from 2018 and 2019 (and not the mean calculated across 2018 and 2019, as reported elsewhere in the article).

[b] Other includes individuals recorded with a race/ethnicity of American Indian or Alaska Native, Native Hawaiian or other Pacific Islander, or Asian. The number of observations for these groups was too small to assess trends in the main analysis.

calls, such as patient race/ethnicity and census region, remained relatively constant between the baseline years (2018 and 2019) and 2020. Encounters in 2020 included 16.8 million (50.2%) involving administering to female patients, and 16.3 million encounters (48.8%) involved non-Hispanic White individuals.

Emergency medical services–observed overdose-associated cardiac arrests rose during April 2020, reaching the highest value ever recorded for a single month of 2112 cardiac arrests in May 2020 (Figure 1A). Total patient encounters decreased from 2.86 million in March 2020 to a low of 2.35 million in April 2020 (a decrease of 17.7%; Figure 1B). Overdose-associated cardiac arrests per 100 000 EMS activations with patient contact increased to a high of 78.9 cardiac arrests in May 2020 (Figure 1C), representing an increase of 98.3% above baseline (39.8 per 100 000 EMS activations; Figure 1D). The rate slowly declined over the remainder of 2020, reaching 56.7 cardiac arrests per 100 000 activations by December 2020, 21.4% above the baseline rate of 46.7 per 100 000 EMS activations. Overall, the mean rate for 2020 was 60.1 per 100 000 EMS activations, representing 42.1% above the baseline rate of 42.3 per 100 000 EMS activations. In the sensitivity analysis, assuming a constant call volume (denominator) during April through June 2020, overdose cardiac arrests remained elevated in 2020, with a rate of 58.6 per 100 000 EMS activations, a 38.4% elevation over baseline.

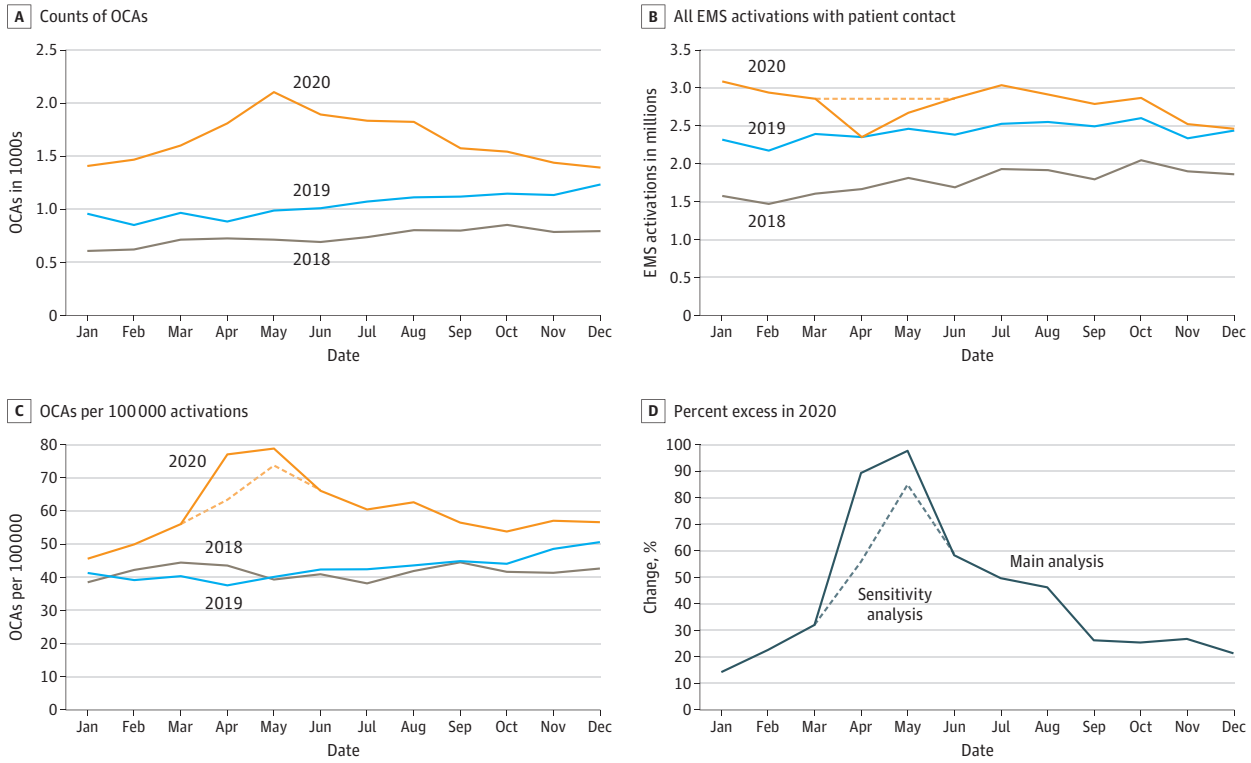
Stratified Trends

Among multiple strata of demographic variables, groups with historically lower overdose mortality rates (such as African American individuals and people in Western states) saw the highest percentage increases in 2020. For example, although White patients began with the highest rate of overdose-associated cardiac arrests, larger relative increases were seen among Latinx and Black patients, with 49.7% (38.8 per 100 000 activations at baseline vs 58.1 per 100 000 activations in 2020) and 50.3% (21.5 per 100 000 activations at baseline vs 32.3 per 100 000 activations in 2020), respectively, compared with 38.3% (51.6 per 100 000 activations at baseline vs 71.4 per 100 000 activations in 2020) among White patients (**Figure 2**; eTable in the Supplement). Similarly, the largest relative increases were seen among medium-poverty zip codes (increasing by 46.4%, from 42.0 per 100 000 activations at baseline to 61.5 per 100 000 activations in 2020) and high-poverty zip codes (increasing by 44.3%, from 37.7 per 100 000 activations at baseline to 54.3 per 100 000 activations in 2020), although low-poverty areas began with the highest levels (48.3 per 100 000 activations, which increased by 30.8% to 63.2 per 100 000 encounters in 2020). Rates in 2020 increased 54.6% in rural counties (32.9 per 100 000 activations at baseline vs 50.9 per 100 000 activations in 2020), compared with 38.2% in urban counties (44.5 per 100 000 activations at baseline vs 61.5 per 100 000

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

Figure 1. Overdose-Associated Cardiac Arrest (OCA) Counts in Aggregate and per 100 000 Emergency Medical Services (EMS) Activations, 2018-2020



Dotted lines represent results based on the sensitivity analysis.

activations in 2020), although urban areas had the highest starting rates.

This effect was especially pronounced across geographic areas (**Figure 3**). The Northeast census region started with the highest level of overdose-associated cardiac arrests, at 67.8 per 100 000 activations, although it had the smallest percentage increase in 2020 (4.8%; corresponding to a rate of 71.0 per 100 000 activations in 2020). The largest relative increases were seen in the West (a 52.2% increase from 38.0 per 100 000 activations at baseline to 57.8 per 100 000 activations in 2020) and the South (a 48.5% increase, from 36.2 per 100 000 activations at baseline to 53.7 per 100 000 activations in 2020). At the census division level, New England had the highest rate at baseline of 73.0 cardiac arrests per 100 000 activations, yet this fell by 3.8% to 70.2 per 100 000 activations in 2019. The Pacific Census Division had lower rates at baseline (33.1 per 100 000 activations), with the largest percentage increase in 2020, 63.8%, to 54.2 per 100 000 activations.

Validation Exercise

At the national level, high concordance was detected between EMS-observed, overdose-associated cardiac arrests and provisional total overdose death figures, both in percentage increase (r = 0.97) and level (r = 0.98). Concordance was also assessed visually using a Bland-Altman plot (**Figure 4**B), which also showed good agreement. Across 19 distinct periods for which 12-month rolling window comparisons were possible, EMS-observed trends could be seen to both underestimate and overestimate total overdoses, suggesting no systematic bias up or down (Figure 4A and Figure 4B). However, in the most recent data, through July 2020, EMS data showed an increase of 34.6%, compared with only 24.4% in the CDC total overdose trends. This period also represents the largest magnitude increase in both time series. If the historical mean association between EMS-observed overdose-associated cardiac arrests and total overdose mortality holds true for the most recent EMS data, we expect 90 632 (95% CI, 85 737-95 525) overdose deaths to eventually be reported by the CDC for 2020.

There was general concordance between the 2 estimates when stratified by census regions and divisions, although with increasing geographic granularity, the association became noisier (eFigure in the Supplement). In the Midwest, reported EMS-observed overdose-associated cardiac arrests overestimated the percentage change seen in total overdose mortality, with 45.6% and 22.9% increases, respectively, whereas they were largely concordant in the Northeast, West, and South (eResults of the Supplement).

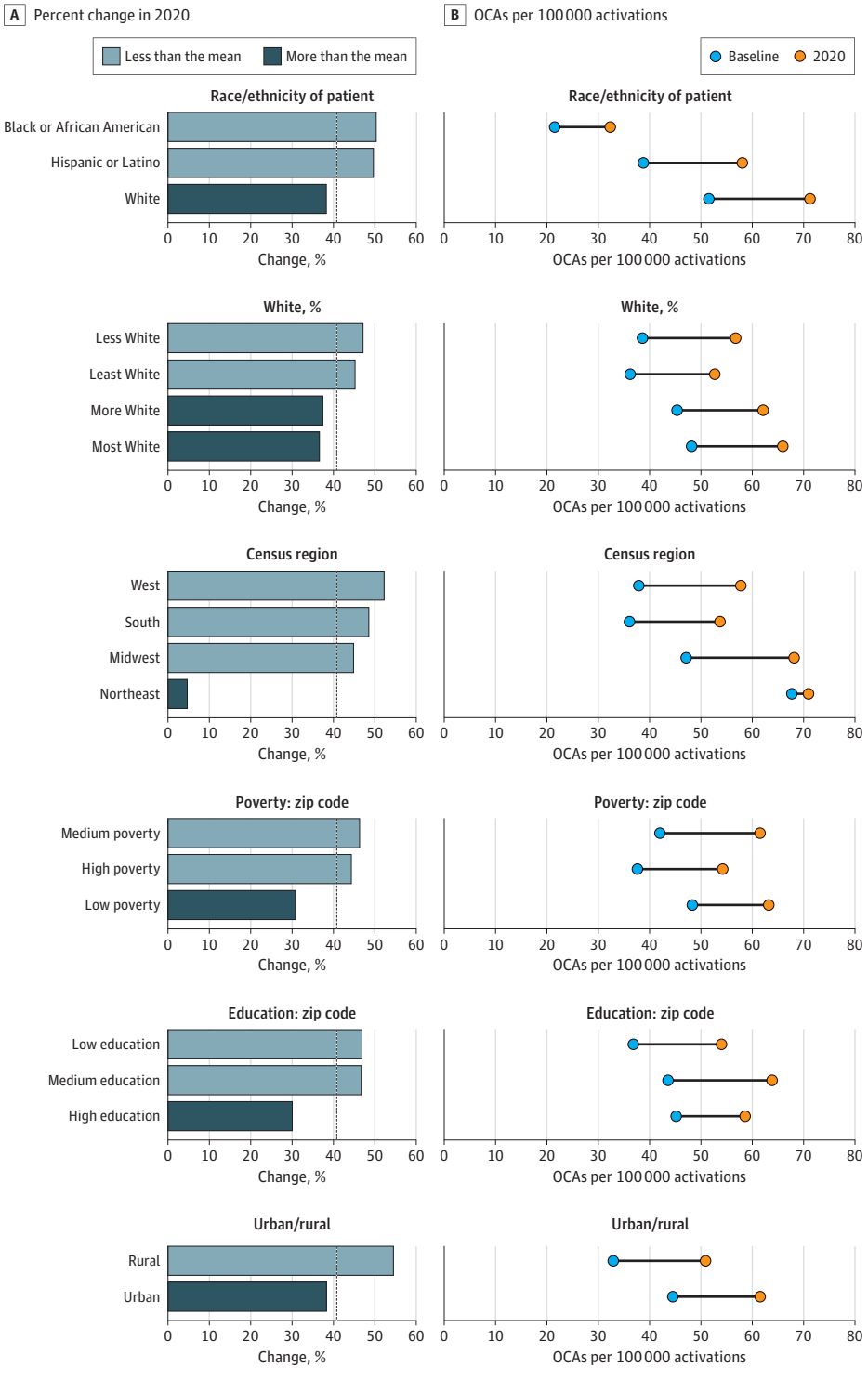
Discussion

The COVID-19 pandemic has highlighted the need for faster data collection mechanisms to track overdose mortality in an up-to-date manner and facilitate a more precise public health

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

Figure 2. Overdose-Associated Cardiac Arrests (OCAs) Percentage Changes and Aggregate Numbers, Stratified by Race/Ethnicity, Census Region, and Neighborhood Characteristics



All categories are sorted from greatest to least change. The vertical line on each graph indicates the mean percentage change.

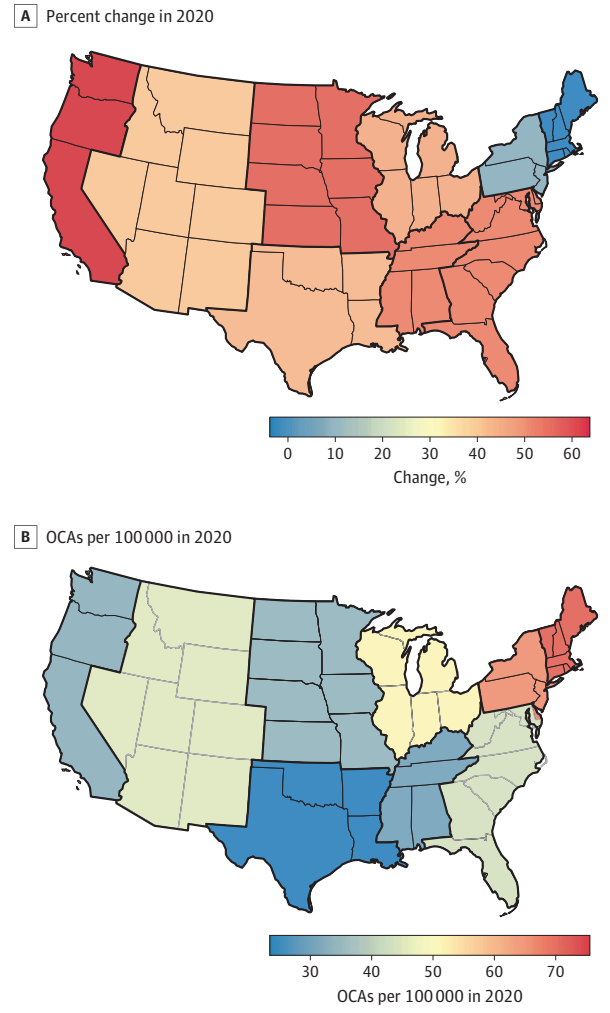
response.[20,21] Provisional mortality records often lag by many months because of delays in the data-generating processes, such as toxicology and autopsy services.[5] Furthermore, these records are often not disaggregated by race/ethnicity or other social categories, although important changes are known to be occurring along these dimensions.

In light of these limitations, these findings suggest that EMS databases may provide a unique opportunity to rapidly sur-

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

Figure 3. Overdose-Associated Cardiac Arrests (OCAs) per 100 000 Activations and Percentage Increases by Census Division, 2020



Percentage changes are relative to baseline (a mean of values from 2018 and 2019).

veil shifts in overdose mortality in the US. Although EMS databases have limitations that should be considered, the high degree of concordance with recent trends in total overdose mortality suggests they may serve as a reliable proxy. Furthermore, EMS data can be uploaded to the NEMSIS nearly in real time. A recent estimate indicates that records pertaining to 75% of the incidents occurring on a given day are uploaded and available in the NEMSIS within 7.75 days.[22] Additionally, EMS trends can be broken down by the exact date of occurrence, as well as race/ethnicity and other social and geographic characteristics, to monitor the shifting profile of the overdose crisis. Further study is warranted to assess exactly how the NEMSIS and other associated EMS databases may be able to serve effectively as an early warning system to give public health officials highly current information regarding changes in overdose. A similar approach would likely also be useful for monitoring other outcomes, such as suicide attempts and mortality, and myriad other conditions for which rapid shifts could occur. Additional study should also consider differences between fatal and nonfatal overdose trends occurring during the COVID-19 pandemic and dig into the causal mechanisms underlying increases in overdose in 2020.

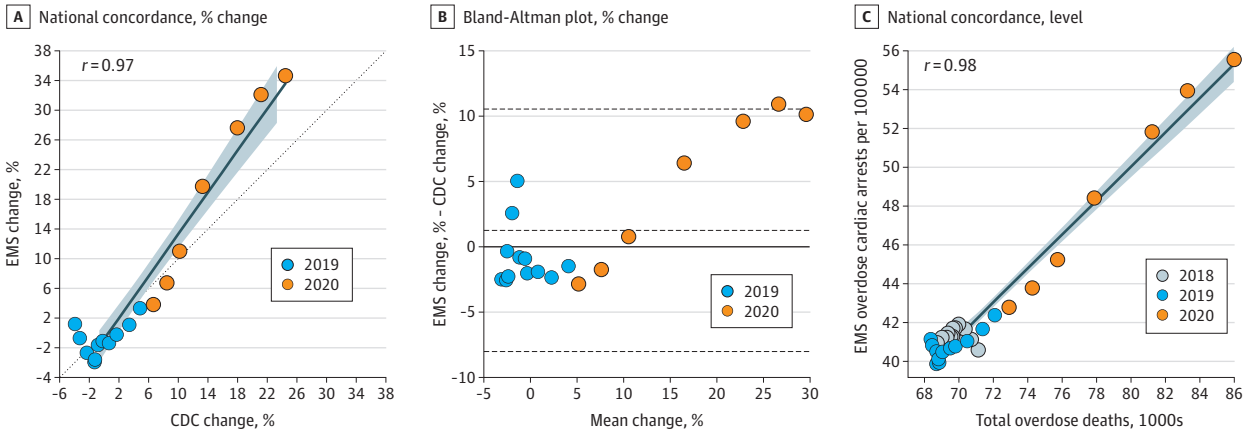
We note sharply increasing overdose rates in all regions of the continental US, except for the Northeast, which had relatively stable (albeit previously the most highly elevated) trends. This observation is consistent with recent evidence suggesting rising overdose deaths in the Western US in recent years, largely being driven by the entrance of illicitly manufactured fentanyls into the drug supply.[4,7] The COVID-19 pandemic appears to have accelerated this trend, with greater than 40% increases in EMS-observed overdose-associated cardiac arrest rates occurring in the West, South, and Midwest census regions.

Stratifying by race/ethnicity, we saw that the largest relative increases in overdose-associated cardiac arrests during the pandemic occurred among Black and Latinx individuals, despite White individuals having had the highest rates at baseline. This finding is consistent with recent data showing the fastest growth in overdose mortality among communities of color.[23] This likely reflects the overall evolution of the overdose crisis, often described to have 3 waves[24,25]: (1) initially driven by opioid pain relievers that were disproportionately marketed and prescribed to White patients,[26-29] (2) subsequently transitioning to being driven by heroin, once regulations of opioid prescribing were strengthened, and (3) most recently reflecting the spread of illicitly manufactured fentanyls, a family of ultrapotent synthetic opioids, which are less bulky and easier to smuggle than heroin and have been added to a growing percentage of the heroin supply.[6,7] Disproportionate numbers of Black people who use drugs are exposed to fentanyl,[30,31] which may reflect a relative lack of social power, given that the inability to avoid unintentional fentanyl exposure has been characterized as an inequality between different groups of people who use drugs.[32] Furthermore, the high prevalence of fentanyl has strengthened recent incarceration as a risk factor for overdose, in that many individuals are released with lowered tolerance and unaddressed substance use disorders into a context of great difficulty securing social and medical services.[33] Combined with deep-seated racial inequalities in incarceration rates,[34,35] this may reflect an important driver of growing fentanyl-associated overdose among Black communities. Given preexisting racial/ethnic inequalities in access to treatment and prevention efforts[36] and the disproportionate direct and indirect effects of the pandemic borne by communities of color,[37] this suggests structural interventions are required to stem the rising tide of overdose mortality in communities with increased vulnerability.

Commonalities between rising overdose rates and a greater burden of COVID-19 mortality in more socioeconomically disadvantaged areas and communities of color likely reflect similar structural drivers. The US has a long history of deep-seated disparities in economic opportunities, employment, housing, access to health care, education, and incarceration rates, many of which have been exacerbated by the fallout from the COVID-19 pandemic.[37-40] The overdose crisis has played

© 2021 American Medical Association. All rights reserved.
Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

Figure 4. Validation Exercise: Concordance Between Emergency Medical Services (EMS)–Observed Overdose-Associated Cardiac Arrests and Total Provisional Overdose Deaths



A, Dashed line of equality is plotted to show where the percentage change in both metrics is equal. B, Bland-Altman diagram for percentage change in both measures. The solid line marks 0, and the central dashed line shows the mean difference between the percentage errors in both data sets, which should be close to 0 for concordant measures. The outer dashed lines mark 2 SDs from the mean. Ideally, 95% of points should fall within these bounds for concordant measures. A and C, A line of best fit and 95% CIs are also shown for both percentage increase and aggregate numbers. CDC indicates the US Centers for Disease Control and Prevention.

out in a racialized manner for many reasons, and structural racism in the health care system and US drug policy has harmed both White communities and communities of color in different ways and at distinct historical moments.[26-28] Moving forward, ameliorating these fundamental drivers of inequalities in overdose mortality and myriad other public health outcomes must be prioritized.[25]

Unprecedented increases in overdose deaths during the pandemic necessitate investments in overdose prevention as an essential aspect of the COVID-19 response and postpandemic recovery. This should entail increased resources for substance use treatment; harm reduction; reducing the toxicity of the opioid supply; and systems-level approaches to addressing the structural, social, and economic drivers of overdose risk.[25,41] Given the current crisis, many evidence-based interventions should be considered, including lowering barriers to accessing methadone, including allowing it to be dispensed from pharmacies, eliminating the X-waiver and byzantine bureaucracy to prescribe buprenorphine, providing a safe supply of legal opioids free of harmful contaminants, and supporting overdose prevention sites.[3,42,43] Furthermore, as survival becomes more difficult for millions of people in the US, economic investments in ensuring adequate employment, housing, healthy food, and health care for all will be needed to avoid exacerbating these root drivers of overdose,[25,44] as well other so-called deaths of despair, such as suicide.[45]

Limitations

This study has several limitations that should be considered. Overdose-associated cardiac arrests observed by EMS are only a proxy for total overdose mortality. If the proportion of national overdose deaths that is observed by EMS shifts because of the pandemic, that could bias our results up or down. High concordance through the most recent total mortality database is encouraging, but further validation will need to be sought once final statistics for 2020 are available.

Stratified trends should be assessed in the context of missingness, which varied by the dimension used to stratify. Not surprisingly, missing patient race/ethnicity data were common, approximately 20%, because race/ethnicity can be difficult to assess in an emergency situation (Table). Variables derived from incident location had much lower missingness, such as census region and division, with less than 2%. Stratifying variables defined at the zip code level had intermediate missingness of about 5% to 10%, depending on the period and measure.

High missingness in the race/ethnicity variable of about 20% limits confidence in race/ethnicity–stratified trends. However, trends using this variable did have generally good concordance with the dichotomous White vs non-White zip code–level variables, which had lower rates of missingness.

Conclusions

In this cohort study, records from EMS agencies, which were available 6 to 12 months ahead of total mortality records from the CDC, were found to serve as a reasonable proxy for forthcoming overdose mortality. Both of these data sets demonstrated a large-magnitude national increase in overdose mortality during the COVID-19 epidemic in the US, with EMS data through December 2020 showing annual values elevated by 40% above baseline. If the historical association between EMS-observed overdose-associated cardiac arrests and total overdose mortality holds true, we expect that approximately 85 000 to 95 000 overdose deaths will eventually be reported by the CDC for 2020, making it the deadliest year on record.

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

Emergency medical service trends disaggregated by race and geography indicated that the largest percentage increases were observed among groups with historically lower mortality rates, such as African American individuals, people living in Western states, those in rural counties, and those in more impoverished areas. Such unprecedented increases in overdose deaths during the pandemic necessitate investments in overdose prevention as an essential aspect of the COVID-19 response, especially for low-income communities and communities of color that are now experiencing the double burden of disproportionate COVID-19 mortality and more rapidly rising overdose deaths.

ARTICLE INFORMATION

Accepted for Publication: March 30, 2021.

Published Online: May 26, 2021. doi:10.1001/jamapsychiatry.2021.0967

Author Affiliations: Center for Social Medicine and Humanities, University of California, Los Angeles, Los Angeles (Friedman, Hansen, Bourgois, Braslow); Medical Informatics Home Area, University of California, Los Angeles, Los Angeles (Friedman, Bui); Department of Pediatrics, School of Medicine, University of Utah, Salt Lake City (Mann); Department of Radiological Sciences, University of California, Los Angeles, Los Angeles (Bui); School of Law, Northeastern University, Boston, Massachusetts (Beletsky); Department of Health Sciences, Northeastern University, Boston, Massachusetts (Beletsky); Health in Justice Action Lab, Northeastern University, Boston, Massachusetts (Beletsky); Department of Emergency Medicine, University of California, Los Angeles, Los Angeles (Schriger).

Author Contributions: Mr Friedman had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Friedman, Beletsky, Schriger.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Friedman, Braslow, Beletsky.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Friedman, Mann, Schriger.
Obtained funding: Braslow.
Administrative, technical, or material support: Friedman, Hansen, Bourgois, Schriger.
Supervision: Friedman, Bourgois, Braslow, Bui, Beletsky, Schriger.

Conflict of Interest Disclosures: None reported.

Funding/Support: Mr Friedman received support from the UCLA Medical Scientist Training Program (National Institute of General Medical Sciences training grant GM008042). Dr. Schriger's time on this project was supported by an unrestricted grant from the Korein Foundation.

Role of the Funder/Sponsor: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

REFERENCES

1. US Centers for Disease Control and Prevention. Products: vital statistics rapid release, provisional drug overdose data. Published December 8, 2020. Accessed December 25, 2020. https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm

2. Jalal H, Buchanich JM, Roberts MS, Balmert LC, Zhang K, Burke DS. Changing dynamics of the drug overdose epidemic in the United States from 1979 through 2016. *Science*. 2018;361(6408):eaau1184. doi:10.1126/science.aau1184

3. Wakeman SE, Green TC, Rich J. An overdose surge will compound the COVID-19 pandemic if urgent action is not taken. *Nat Med*. 2020;26(6):819-820. doi:10.1038/s41591-020-0898-0

4. US 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. Published December 17, 2020. Accessed December 25, 2020. https://emergency.cdc.gov/han/2020/han00438.asp

5. Spencer MR, Ahmad F. Timeliness of death certificate data for mortality surveillance and provisional estimates: CDC vital stat rapid release. Published December 2016. Accessed April 21, 2021. https://www.cdc.gov/nchs/data/vsrr/report001.pdf

6. Ciccarone D. Fentanyl in the US heroin supply: a rapidly changing risk environment. *Int J Drug Policy*. 2017;46:107-111. doi:10.1016/j.drugpo.2017.06.010

7. Shover CL, Falasinnu TO, Dwyer CL, et al. Steep increases in fentanyl-related mortality west of the Mississippi River: recent evidence from county and state surveillance. *Drug Alcohol Depend*. 2020;216:108314. doi:10.1016/j.drugalcdep.2020.108314

8. James K, Jordan A. The opioid crisis in black communities. *J Law Med Ethics*. 2018;46(2):404-421. doi:10.1177/1073110518782949

9. Lerner EB, Newgard CD, Mann NC. Effect of the coronavirus disease 2019 (COVID-19) pandemic on the U.S. emergency medical services system: a preliminary report. *Acad Emerg Med*. 2020;27(8):693-699. doi:10.1111/acem.14051

10. Friedman J, Beletsky L, Schriger DL. Overdose-related cardiac arrests observed by emergency medical services during the US COVID-19 epidemic. *JAMA Psychiatry*. Published online December 3, 2020. doi:10.1001/jamapsychiatry.2020.4218

11. Lai PH, Lancet EA, Weiden MD, et al. Characteristics associated with out-of-hospital cardiac arrests and resuscitations during the novel coronavirus disease 2019 pandemic in New York City. *JAMA Cardiol*. 2020;5(10):1154-1163. doi:10.1001/jamacardio.2020.2488

12. Baldi E, Sechi GM, Mare C, et al; Lombardia CARe Researchers. Out-of-hospital cardiac arrest during the COVID-19 outbreak in Italy. *N Engl J Med*. 2020;383(5):496-498. doi:10.1056/NEJMc2010418

13. Friedman J, Calderón-Villarreal A, Bojorquez I, Vera Hernández C, Schriger DL, Tovar Hirashima E. Excess out-of-hospital mortality and declining oxygen saturation: the sentinel role of emergency medical services data in the COVID-19 Crisis in Tijuana, Mexico. *Ann Emerg Med*. 2020;76(4):413-426. doi:10.1016/j.annemergmed.2020.07.035

14. National Emergency Medical Services Information System. Homepage: NEMSIS. Accessed January 4, 2021. https://nemsis.org/

15. Vandenbroucke JP, von Elm E, Altman DG, et al; STROBE Initiative. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. *PLoS Med*. 2007;4(10):e297. doi:10.1371/journal.pmed.0040297

16. United States Department of Agriculture. Urban Influence Codes. Updated October 24, 2019. Accessed December 26, 2020. https://www.ers.usda.gov/data-products/urban-influence-codes.aspx

17. US Census. Explore census data. Published 2020. Accessed February 10, 2018. https://data.census.gov/cedsci/

18. Kwiecien R, Kopp-Schneider A, Blettner M. Concordance analysis: part 16 of a series on evaluation of scientific publications. *Dtsch Arztebl Int*. 2011;108(30):515-521. doi:10.3238/arztebl.2011.0515

19. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*. 1986;1(8476):307-310. doi:10.1016/S0140-6736(86)90837-8

20. Blanco C, Compton WM, Volkow ND. Opportunities for research on the treatment of substance use disorders in the context of COVID-19. *JAMA Psychiatry*. 2021;78(4):357-358. doi:10.1001/jamapsychiatry.2020.3177

21. MacKinnon L, Socías ME, Bardwell G. COVID-19 and overdose prevention: challenges and opportunities for clinical practice in housing settings. *J Subst Abuse Treat*. 2020;119(0):108153. doi:10.1016/j.jsat.2020.108153

22. NEMSIS TAC. EMS by the numbers: impact of COVID-19. Published July 8, 2020. Accessed December 26, 2020. https://www.youtube.com/watch?v=sDlMxxWdDK0

23. Lippold KM, Jones CM, Olsen EO, Giroir BP. Racial/ethnic and age group differences in opioid and synthetic opioid-involved overdose deaths among adults aged ≥18 years in metropolitan areas—United States, 2015-2017. *MMWR Morb Mortal Wkly Rep*. 2019;68(43):967-973. doi:10.15585/mmwr.mm6843a3

24. US Centers for Disease Control and Prevention. Understanding the epidemic. Published March 19, 2020. Accessed January 7, 2021. https://www.cdc.gov/drugoverdose/epidemic/index.html

25. Dasgupta N, Beletsky L, Ciccarone D. Opioid crisis: no easy fix to its social and economic determinants. *Am J Public Health*. 2018;108(2):182-186. doi:10.2105/AJPH.2017.304187

26. Netherland J, Hansen H. White opioids: pharmaceutical race and the war on drugs that wasn't. *Biosocieties*. 2017;12(2):217-238. doi:10.1057/biosoc.2015.46

27. Friedman J, Kim D, Schneberk T, et al. Assessment of racial/ethnic and income disparities in the prescription of opioids and other controlled medications in California. *JAMA Intern Med*. 2019;179(4):469-476. doi:10.1001/jamainternmed.2018.6721

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026

28. Hansen H, Netherland J. Is the prescription opioid epidemic a white problem? *Am J Public Health*. 2016;106(12):2127-2129. doi:10.2105/AJPH.2016.303483

29. DeWeerdt S. Tracing the US opioid crisis to its roots. *Nature*. 2019;573(7773):S10-S12. doi:10.1038/d41586-019-02686-2

30. Phalen P, Ray B, Watson DP, Huynh P, Greene MS. Fentanyl related overdose in Indianapolis: estimating trends using multilevel bayesian models. *Addict Behav*. 2018;86:4-10. doi:10.1016/j.addbeh.2018.03.010

31. Spencer M, Warner M, Bastian BA, Trinidad JP, Hedegaard H. Drug overdose deaths involving fentanyl, 2011–2016. Published online March 21, 2019. Accessed April 21, 2021. https://stacks.cdc.gov/view/cdc/77832

32. Mitra S, Boyd J, Wood E, et al. Elevated prevalence of self-reported unintentional exposure to fentanyl among women who use drugs in a Canadian setting: a cross-sectional analysis. *Int J Drug Policy*. 2020;83:102864. doi:10.1016/j.drugpo.2020.102864

33. Brinkley-Rubinstein L, Macmadu A, Marshall BDL, et al. Risk of fentanyl-involved overdose among those with past year incarceration: findings from a recent outbreak in 2014 and 2015. *Drug Alcohol Depend*. 2018;185:189-191. doi:10.1016/j.drugalcdep.2017.12.014

34. Alexander M. *The New Jim Crow: Mass Incarceration in the Age of Colorblindness*. The New Press; 2010.

35. Bowleg L. Reframing mass incarceration as a social-structural driver of health inequity. *Am J Public Health*. 2020;110(S1):S11-S12. doi:10.2105/AJPH.2019.305464

36. Goedel WC, Shapiro A, Cerdá M, Tsai JW, Hadland SE, Marshall BDL. Association of racial/ethnic segregation with treatment capacity for opioid use disorder in counties in the United States. *JAMA Netw Open*. 2020;3(4):e203711-e203711. doi:10.1001/jamanetworkopen.2020.3711

37. Arena PJ, Malta M, Rimoin AW, Strathdee SA. Race, COVID-19 and deaths of despair. *EClinicalMedicine*. 2020;25:100485. doi:10.1016/j.eclinm.2020.100485

38. Friedman J, York H, Mokdad A, Gakidou E. US Children 'learning online' during COVID-19 without the internet or a computer: visualizing the gradient by race/ethnicity and parental educational attainment. *SocArXiv*; 2020. doi:10.31235/osf.io/42trc

39. Reinhart E, Chen DL. Incarceration and its disseminations: COVID-19 pandemic lessons from Chicago's Cook County Jail. *Health Aff (Millwood)*. 2020;39(8):1412-1418. Published online June 4, 2020. doi:10.1377/hlthaff.2020.00652

40. Friedman J, Karandinos G, Hart LK, Castrillo FM, Graetz N, Bourgois P. Structural vulnerability to narcotics-driven firearm violence: an ethnographic and epidemiological study of Philadelphia's Puerto Rican inner-city. *PLoS One*. 2019;14(11):e0225376. doi:10.1371/journal.pone.0225376

41. Selfridge M, Greer A, Card KG, Macdonald S, Pauly B. "It's like super structural"—overdose experiences of youth who use drugs and police in three non-metropolitan cities across British Columbia. *Int J Drug Policy*. 2020;76:102623. doi:10.1016/j.drugpo.2019.102623

42. Beletsky L, Baker P, Arredondo J, et al. The global health and equity imperative for safe consumption facilities. *Lancet*. 2018;392(10147):553-554. doi:10.1016/S0140-6736(18)31469-7

43. Priest KS. The COVID-19 pandemic: practice and policy considerations for patients with opioid use disorder. Published April 3, 2020. Accessed December 27, 2020. https://www.healthaffairs.org/do/10.1377/hblog20200331.557887/full/

44. Venkataramani AS, Bair EF, O'Brien RL, Tsai AC. Association between automotive assembly plant closures and opioid overdose mortality in the United States: a difference-in-differences analysis. *JAMA Intern Med*. 2020;180(2):254-262. doi:10.1001/jamainternmed.2019.5686

45. Reger MA, Stanley IH, Joiner TE. Suicide mortality and coronavirus disease 2019—a perfect storm? *JAMA Psychiatry*. 2020;77(11):1093. doi:10.1001/jamapsychiatry.2020.1060

© 2021 American Medical Association. All rights reserved.

Downloaded from jamanetwork.com by University of California - San Diego, Joseph Friedman on 11/08/2026