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# Emergency Department Visits for Nonfatal Opioid Overdose During the COVID-19 Pandemic Across Six US Health Care Systems

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**Study objective:** People with opioid use disorder are vulnerable to disruptions in access to addiction treatment and social support during the COVID-19 pandemic. Our study objective was to understand changes in emergency department (ED) utilization following a nonfatal opioid overdose during COVID-19 compared to historical controls in 6 healthcare systems across the United States.

**Methods:** Opioid overdoses were retrospectively identified among adult visits to 25 EDs in Alabama, Colorado, Connecticut, North Carolina, Massachusetts, and Rhode Island from January 2018 to December 2020. Overdose visit counts and rates per 100 all-cause ED visits during the COVID-19 pandemic were compared with the levels predicted based on 2018 and 2019 visits using graphical analysis and an epidemiologic outbreak detection cumulative sum algorithm.

**Results:** Overdose visit counts increased by 10.5% (n=3486; 95% confidence interval [CI] 4.18% to 17.0%) in 2020 compared with the counts in 2018 and 2019 (n=3020 and n=3285, respectively), despite a 14% decline in all-cause ED visits. Opioid overdose rates increased by 28.5% (95% CI 23.3% to 34.0%) from 0.25 per 100 ED visits in 2018 to 2019 to 0.32 per 100 ED visits in 2020. Although all 6 studied health care systems experienced overdose ED visit rates more than the 95th percentile prediction in 6 or more weeks of 2020 (compared with 2.6 weeks as expected by chance), 2 health care systems experienced sustained outbreaks during the COVID-19 pandemic.

**Conclusion:** Despite decreases in ED visits for other medical emergencies, the numbers and rates of opioid overdose-related ED visits in 6 health care systems increased during 2020, suggesting a widespread increase in opioid-related complications during the COVID-19 pandemic. Expanded community- and hospital-based interventions are needed to support people with opioid use disorder and save lives during the COVID-19 pandemic. [Ann Emerg Med. 2022;79:158-167.]

Please see page 159 for the Editor's Capsule Summary of this article.

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## INTRODUCTION

Patients with opioid use disorder are vulnerable to disruptions in access to addiction treatment and social support due to the COVID-19 pandemic.[1] Restrictions on the addiction treatment facilities interrupt medications for opioid use disorder and harm reduction services and behavioral health resources.[2] Moreover, the loss of employment and social isolation increase stress and hinder social support used to maintain recovery.[3,4] Finally, the alterations in the composition and distribution of illicit drugs and decreased access to sterile injection supplies increase the risk of infection, overdose, and death.[5]

The emergency department (ED) serves as a critical access point for the treatment of patients with opioid use disorder, especially those who have had a disruption in care or have experienced a nonfatal opioid overdose.[6] However, the spread of COVID-19 throughout the United States forced the health care systems to rapidly transform to accommodate patients with potentially contagious respiratory tract infections. As a result, total ED visits across the country initially fell up to 40% because of patient apprehension of contracting COVID-19, stay-at-home orders, and recommendations to minimize nonurgent visits.[7-10] The reduction in ED census included a decrease in visits for medical emergencies, such as stroke and

**Editor's Capsule Summary**

*What is already known on this topic*

Changes in use habits and supply chains resulting from the COVID-19 pandemic have increased the likelihood of unintentional overdose in persons using opioids.

*What question this study addressed*

How did the frequency of visits for opioid overdose in 25 emergency departments in 6 US states change as a result of the COVID-19 pandemic?

*What this study adds to our knowledge*

Despite a decrease in overall patient volume, visits for opioid overdose increased 10.5% relative to prior levels.

*How this is relevant to clinical practice*

Increased opioid overdoses are an important consequence of the pandemic and steps should be take to mitigate the pandemic-induced changes that have resulted in excess overdoses and deaths.

myocardial infarction, contributing to the substantial increase in non–COVID-19 related mortality.[11-16]

A patient who presents to the ED with a nonfatal opioid overdose has a 1-year mortality rate of 5%, similar to other medical emergencies like myocardial infarction.[17,18] Although preliminary data have exposed increased community opioid overdose rates, evidence also suggests that people with opioid use disorder may be reluctant to utilize health care resources during the COVID-19 pandemic, potentially reducing the proportion of patients with a nonfatal opioid overdose available to engage in treatment from the ED.[19-22] Identifying the changes in ED utilization for patients after nonfatal opioid overdoses is critical because an index nonfatal opioid overdose is the strongest predictor of a subsequent fatal overdose, and taking medications for opioid use disorder treatment after a nonfatal opioid overdose is the most effective means to reduce future mortality.[20,23,24] To understand the changes in ED utilization following nonfatal opioid overdoses during the COVID-19 pandemic, we evaluated the ED visits during the pandemic and compared them with the historical controls in 6 health care systems across the United States.

## MATERIALS AND METHODS

We conducted a multicenter, retrospective, cross-sectional study using data from 25 EDs in 6 health care systems representing diverse geographic locations, socioeconomic populations, and previously documented drug overdose rates.[25] Five of the systems, Yale New Haven Health (YNHH) in Connecticut, University of North Carolina (UNC), University of Colorado Health (UCHealth), Baystate Health in Massachusetts, and the University of Alabama at Birmingham (UAB Health), are collaborating on an ongoing trial evaluating an electronic clinical decision support system to facilitate buprenorphine treatment for ED patients with opioid use disorder (map of the hospitals is provided in Figure E1 [available at http://www.annemergmed.com]). The study protocol was approved by a central institutional review board as an amendment to the ongoing trial (WIRB protocol 1189765, ClinicalTrials.gov NCT03658642). In addition, this study included data from Lifespan Health System, affiliated with Brown University in Rhode Island (institutional review board protocol 1237301-21). Data were abstracted locally within each health care system's electronic health record and shared in a deidentified format. The Strengthening the Reporting of Observational Studies in Epidemiology guidelines were used to ensure the reporting of this cross-sectional study.

### Participants

Visits by adults 18 years or older who presented to a study ED between January 1, 2018 and December 31, 2020 were included. An ED visit was counted as an opioid overdose if the associated diagnoses included one or more International Classification of Disease, Tenth Revision, Clinical Modification (ICD-10-CM) codes for opioid poisoning/overdose (T40.0*, T40.1*, T40.2*, T40.3*, T40.4*, or T40.6*).

### Variables

Hospitals were classified using rural-urban commuting area codes for the zip codes associated with the hospital service areas into urban, suburban, or rural (details provided in Appendix E1, available at http://www.annemergmed.com). Hospital opioid burden was estimated using 2018 National Center for Health Statistics Mortality Files for county-level drug poisoning death rates per 100,000 population, with counties exceeding 26 drug poisoning deaths per 100,000 population considered to have a high opioid burden. Hospitals were further classified by self-reported teaching status (academic and community). Finally, Connecticut and Massachusetts were

identified as having emergency medical services (EMS) "no refusal" laws requiring ambulance transport after suspected opioid overdose, whereas Colorado, Alabama, North Carolina, and Rhode Island had no similar laws. It was hypothesized that "no refusal" laws could increase the number of patients treated in the ED compared with states without such laws, as the patients would lack the choice to seek medical services following EMS activation for suspected opioid overdoses.

### Outcome Measures

The primary outcome was weekly counts of ED visits with 1 or more ICD-10 diagnosis codes associated with an opioid overdose (T40.0* to T40.4* and T40.6*). Because the COVID-19 pandemic was associated with reductions in total ED visits across each health care system, consistent with prior literature, we assessed overdose visits both as counts and as rates per 100 all-cause ED visits.[9] Under this hypothesis, rates per 100 all-cause ED visits would provide an estimate more directly comparable to prior years, whereas the counts of ED visits for opioid overdose would help estimate if, like strokes, myocardial infarctions, and other medical emergencies, patients suffering from an opioid overdose were potentially avoiding medical care in the ED.

### Analysis

To assess the COVID-19-associated change in ED visits for opioid overdoses, data from 2020 were compared at the health care system level with overdose-related ED visits in 2018 and 2019. Two complementary methods were used to analyze the data: a graphical approach and an epidemiologic outbreak detection approach. Both approaches used 2018 and 2019 data to model predicted 2020 visit counts.

***Prediction model.*** A Poisson model with fixed effects for month was run for each health care system, summing 2018 and 2019 visits by week across all included EDs in that health care system. Huber-White standard errors were used. Because all ED visits declined substantially in March 2020 and April 2020, the natural log of the count of all-cause ED visits was included as a covariate in the model, with its coefficient constrained to 1 to control for variation in weekly ED visit volume. The weekly counts of opioid overdose ED visits for 2020 were predicted for each health care system using the estimated model and the observed 2020 weekly total adult ED visit counts (ie, all-cause, not just opioid-related).

***Graphical analysis.*** Locally Weighted Scatterplot Smoothing plots of 2020 opioid overdose ED visits were compared with Locally Weighted Scatterplot Smoothing-smoothed plots of predicted counts for 2020 (bandwidth of 0.2). Shading highlighted the time periods during which actual 2020 counts exceeded predicted counts and vice versa.

***Epidemiologic outbreak detection approach.*** A 2-sided "cumulative sum" approach was used to detect the sustained outbreaks of increased or decreased overdose ED visits.[26] Because no outbreaks of decreased opioid overdose visits were observed in this study, only the increased visit case is described here. The algorithm consists of a running sum of residuals: $C_{i,t} = \max\{0, C_{i,t-1} + (y_{i,t} - \widehat{y}_{i,t} - k_i)\}$, where $i$ indexes health care system, $t$ indexes time, $y$ is the outcome (opioid overdose ED visits), and $k$ is the algorithm reference value. For these analyses, the reference value was set at 2 times the 95th percentile of the residuals (ie, observed value minus the estimated value from the model) for the 2018 and 2019 data. When $C_{i,t}$ exceeded the reference value, the outbreak alert was turned on. When $C_{i,t}$ dropped below that value, the outbreak alert was turned off.

***Stratified analysis by hospital characteristics.*** The counts and rates of overdose ED visits were calculated for 2018, 2019, and 2020 for groups of EDs including by health care system, academic versus nonacademic hospitals, county drug poisoning death rates (<26 drug poisoning deaths per 100,000 versus ≥26 drug poisoning per 100,000), rural versus urban or suburban, and states with versus without an EMS "no refusal" law. In these analyses, counts of all-cause and overdose ED visits were summed across all EDs in each group, and the rate of overdose visits per 100 ED visits was calculated. Counts and rates were calculated, along with percent changes and 95% confidence intervals (CIs) comparing 2018 and 2019 with 2020.

## RESULTS

Study EDs accounted for more than 1.3 million combined annual visits by people aged 18 years and more in 2019 (range 10,867 to 114,733) (Table 1). Of the 25 EDs included in the analysis, 22 were urban or suburban, 3 were rural, 8 were academic, and 17 were community sites. From 2016 to 2018, estimated county rates of death due to drug overdose ranged from 12.26 per 100,000 in Wake County, NC to 45.01 per 100,000 in Hampden County, MA. All states included in the analysis enacted COVID-19 stay-at-home orders between March 23, 2020 and April 4, 2020 (Table E1, available at http://www.annemergmed.com).

### Opioid Overdose Visit Counts

Opioid overdose ED visit counts increased substantially in 4 of the 6 health care systems in 2020 compared with 2018 and 2019. Across all sites, the count of overdose visits

**Table 1.** Characteristics of the 6 health care systems participating in the study (YNHH, UNC, UCHealth, Baystate Health, UAB Health, and Lifespan Health System).

| Site | State/County | 2019 Annual Adult ED Volume | Geographic Classification of Hospital Service Area‡ | Academic Site | 2018 County Drug Poisoning Rate Per 100,000 Population |
|---|---|---|---|---|---|
| **Yale New Haven Health** | Connecticut | | | | |
| York Street campus | New Haven | 95,679 | Urban | Yes | 29.95 |
| Saint Raphael campus | New Haven | 62,495 | Urban | No | 29.95 |
| Bridgeport | Fairfield | 74,613 | Urban | No | 18.99 |
| Lawrence & Memorial | New London | 41,469 | Urban | No | 33.24 |
| Greenwich | Fairfield | 30,569 | Urban | No | 18.99 |
| **UNC Health** | **North Carolina** | | | | |
| Memorial | Orange | 53,690 | Urban | Yes | 15.93 |
| Chatham | Chatham | 14,119 | Rural | No | 15.38 |
| Rex | Wake | 64,551 | Urban | No | 12.27 |
| Johnston-Smithfield | Johnston | 35,705 | Rural | No | 14.44 |
| Nash | Nash | 56,748 | Urban | No | 21.42 |
| **UCHealth** | **Colorado** | | | | |
| Anschutz Medical campus | Arapahoe | 97,569 | Urban | Yes | 17.65 |
| Memorial Central | El Paso | 78,574 | Urban | No | 25.78 |
| Poudre Valley | Larimer | 47,083 | Urban | No | 16.32 |
| Medical Center of the Rockies | Larimer | 28,874 | Urban | No | 16.32 |
| **Baystate Health** | **Massachusetts** | | | | |
| Springfield | Hampden | 114,733 | Urban | Yes | 45.01 |
| Franklin | Franklin | 24,316 | Rural | No | 23.8 |
| Wing | Hampden | 20,988 | Urban | No | 45.01 |
| Mary Lane* | Hampden | 10,867 | Suburban | No | 45.01 |
| Noble | Hampden | 27,183 | Urban | No | 45.01 |
| **University of Alabama** | **Alabama** | | | | |
| Main | Jefferson | 45,882 | Urban | Yes | 27.22 |
| Highlands | Jefferson | 25,784 | Urban | Yes | 27.22 |
| Gardendale† | Jefferson | 22,238 | Urban | No | 27.22 |
| **Lifespan Health System** | **Rhode Island** | | | | |
| Newport Hospital | Newport | 32,397 | Urban | No | 23.72 |
| Rhode Island Hospital-Anderson | Providence | 102,725 | Urban | Yes | 31.27 |
| The Miriam Hospital | Providence | 80,562 | Urban | Yes | 31.27 |

*Mary Lane is reported together with Wing for 2020.
†UAB Gardendale opened 2019 and contributes only 2019 and 2020 data.
‡The method of classifying hospital service area urbanicity is given in Appendix E1.

increased by 10.6% (95% CI 4.2% to 17.0%) in 2020 compared with the average for 2018 and 2019, despite a 14% decline in all-cause ED visits. The largest increase in visit counts was seen at UNC, where the overdose visits increased by 51.1% (95% CI 22.1% to 80.0%). Visits increased by 47.3% at UAB Health (95% CI 18.4% to 76.3%), 34.6% at UCHealth (95% CI 16.3% to 52.8%), and 25.3% at YNHH (95% CI 12.8% to 37.9%). Baystate Health and Lifespan Health System had statistically insignificant declines in the counts of ED visits for overdose (95% CI −6.8% [−15.3% to 1.7%] and −11.6% [−23.9% to 0.6%], respectively).

## Opioid Overdose Visit Rates

Overdose visit rates per 100 all-cause ED visits increased by 28.5% (95% CI 23.3% to 34.0%), from 0.25 overdose visits per 100 all-cause adult ED visits in 2018 and 2019 to

**Table 2.** Stratified analysis of changes in opioid overdose ED visits before and during the COVID-19 pandemic at the 6 health care systems (YNHH, UNC, UCHealth, Baystate Health, UAB Health, and Lifespan Health System).

| | 2018 | | | 2019 | | | 2020 | | | 2020 vs Combined 2018-2019 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | All ED Visits (Age 18+) | ED Visits for Opioid Overdose | Overdose Visit Rate (Per 100 ED Visits) | All ED Visits (Age 18+ y) | ED Visits for Opioid Overdose | Overdose Visit Rate (Per 100 ED Visits) | All ED Visits (Age 18+ y) | ED Visits for Opioid Overdose | Overdose Visit Rate (Per 100 ED Visits) | % Change in Count (95% CI) | % Change in Rate 100 ED Visits (95% CI) |
| **All Sites (N=25)** | 1,215,250 | 3,020 | 0.25 | 1,283,303 | 3,285 | 0.26 | 1,074,936 | 3,486 | 0.32 | 10.6 (4.2–17.0) | 28.5 (23.3–34.0) |
| **System** | | | | | | | | | | | |
| YNHH (n=5) | 307,511 | 813 | 0.26 | 304,825 | 864 | 0.28 | 252,979 | 1,051 | 0.42 | 25.3 (12.8–37.9) | 51.7 (40.3–64.0) |
| UNC (n=5) | 178,823 | 131 | 0.07 | 224,813 | 192 | 0.09 | 192,149 | 244 | 0.13 | 51.1 (22.1–80.0) | 58.7 (33.8–88.0) |
| UAB Health* (n=3) | 75,682 | 147 | 0.19 | 93,904 | 172 | 0.18 | 82,348 | 235 | 0.29 | 47.3 (18.4–76.3) | 51.7 (27.6–80.1) |
| UCHealth (n=4) | 251,147 | 301 | 0.12 | 252,101 | 295 | 0.12 | 221,515 | 401 | 0.18 | 34.6 (16.3–52.8) | 52.9 (34.3–73.8) |
| Baystate (n=5) | 193,070 | 1,166 | 0.60 | 198,087 | 1,201 | 0.61 | 157,285 | 1,103 | 0.70 | −6.8 (−15.3 to 1.7) | 15.9 (7.8–24.5) |
| Lifespan (n=3) | 209,017 | 462 | 0.22 | 209,573 | 561 | 0.27 | 168,660 | 452 | 0.27 | −11.6 (−23.9 to 0.6) | 9.7 (−2.1 to 22.6) |
| **Academic** | | | | | | | | | | | |
| No (n=18) | 710,964 | 2,097 | 0.29 | 783,359 | 2,226 | 0.28 | 657,009 | 2,392 | 0.36 | 10.7 (3.1–18.2) | 25.8 (19.7–32.3) |
| Yes (n=7) | 504,286 | 923 | 0.18 | 499,944 | 1,059 | 0.21 | 417,927 | 1,094 | 0.26 | 10.4 (0.9–19.8) | 32.6 (23.1–42.9) |
| **County overdose rate†** | | | | | | | | | | | |
| Low (n=12) | 508,209 | 703 | 0.14 | 556,071 | 747 | 0.13 | 476,261 | 863 | 0.18 | 19.0 (8.1–30.0) | 33.0 (22.1–44.8) |
| High (n=13) | 707,041 | 2,317 | 0.33 | 727,232 | 2,538 | 0.35 | 598,675 | 2,623 | 0.44 | 8.1 (1.0–15.1) | 29.4 (23.4–35.8) |
| **Urbanicity** | | | | | | | | | | | |
| Rural (n=3) | 75,062 | 169 | 0.23 | 74,140 | 211 | 0.28 | 62,668 | 193 | 0.31 | 1.6 (−14.1 to 17.3) | 20.9 (1.2–44.2) |
| Urban/Suburban (n=22) | 1,140,188 | 2,851 | 0.25 | 1,209,163 | 3,074 | 0.25 | 1,012,268 | 3,293 | 0.33 | 11.2 (4.5–17.8) | 29.0 (23.6–34.6) |
| **State EMS no refusal law** | | | | | | | | | | | |
| No (n=15) | 714,669 | 1,041 | 0.15 | 780,391 | 1,220 | 0.16 | 664,672 | 1,332 | 0.20 | 17.8 (8.7–26.9) | 32.5 (23.7–41.9) |
| Yes (n=10) | 500,581 | 1,979 | 0.40 | 502,912 | 2,065 | 0.41 | 410,264 | 2,154 | 0.53 | 6.5 (−1.3 to 14.4) | 30.3 (23.6–37.3) |

*UAB opened a new ED in 2019 (Gardendale), which is urban and nonacademic.

†High County overdose rate defined as >26 drug poisoning deaths per 100,000 population in 2018 per CDC datahttps://data.cdc.gov/NCHS/NCHS-Drug-Poisoning-Mortality-by-County-United-Sta/pbkm-d27e

0.32 in 2020. Of the 6 health care systems, 4 had large increases in the rate of overdose ED visits per 100 all-cause ED visits, with increases of more than 50% at UNC (58.7% [95% CI 33.8% to 88.0%]), YNHH (51.7% [95% CI 40.3% to 64.0%]), UAB Health (51.7% [95% CI 27.6% to 80.1%]), and UCHealth (52.9% [95% CI 34.3% to 73.8%]). Lifespan Health was the only site without a double-digit increase in overdose rate (9.7% [95% CI −2.1% to 22.6%]). Overdose rates increased by a significant amount in both urban or suburban areas (29.0% [95% CI 23.6% to 34.6%]) and rural areas (20.9% [95% CI 1.2% to 44.2%]). Areas with high and low historical drug poisoning deaths had similar increases in the rates of ED visits for overdose (high burden, 29.6% [95% CI 23.8% to 35.8%]; and low burden, 33.0% [95% CI 20.8% to 46.4%]). States with EMS "no refusal" laws requiring transit after overdose had higher rates of opioid overdose visits than states without these laws in all 3 years of the analysis. States with and without "no refusal" laws had similar rates of growth in opioid overdose visits in 2020 versus 2018 to 2019 (32.5% [95% CI 23.7% to 41.9%] and 30.3% [95% CI 23.6% to 37.3%], respectively) (Table 2).

## Graphical Analysis

Locally Weighted Scatterplot Smoothing-smoothed plots compared 2020 overdose visit counts per week with predicted counts based on 2018 to 2019 data and actual 2020 ED visit counts. Three health care systems (YNHH, UCHealth, and Baystate) saw sustained excess overdose visits from late January to the end of the study period (Figure 1). UAB Health and UNC Health each had 2 periods of sustained excess overdose visits, with a period in late summer or early fall in which the visit rates were average. Lifespan Health had excess overdose visits from February through the end of July, followed by a period of below-average overdose visits through mid-November (Figure 1). The outbreak detection analysis identified 1 or more weeks with opioid overdose visit outbreaks in YNHH (May 20 to the end of the study period except 1 week in

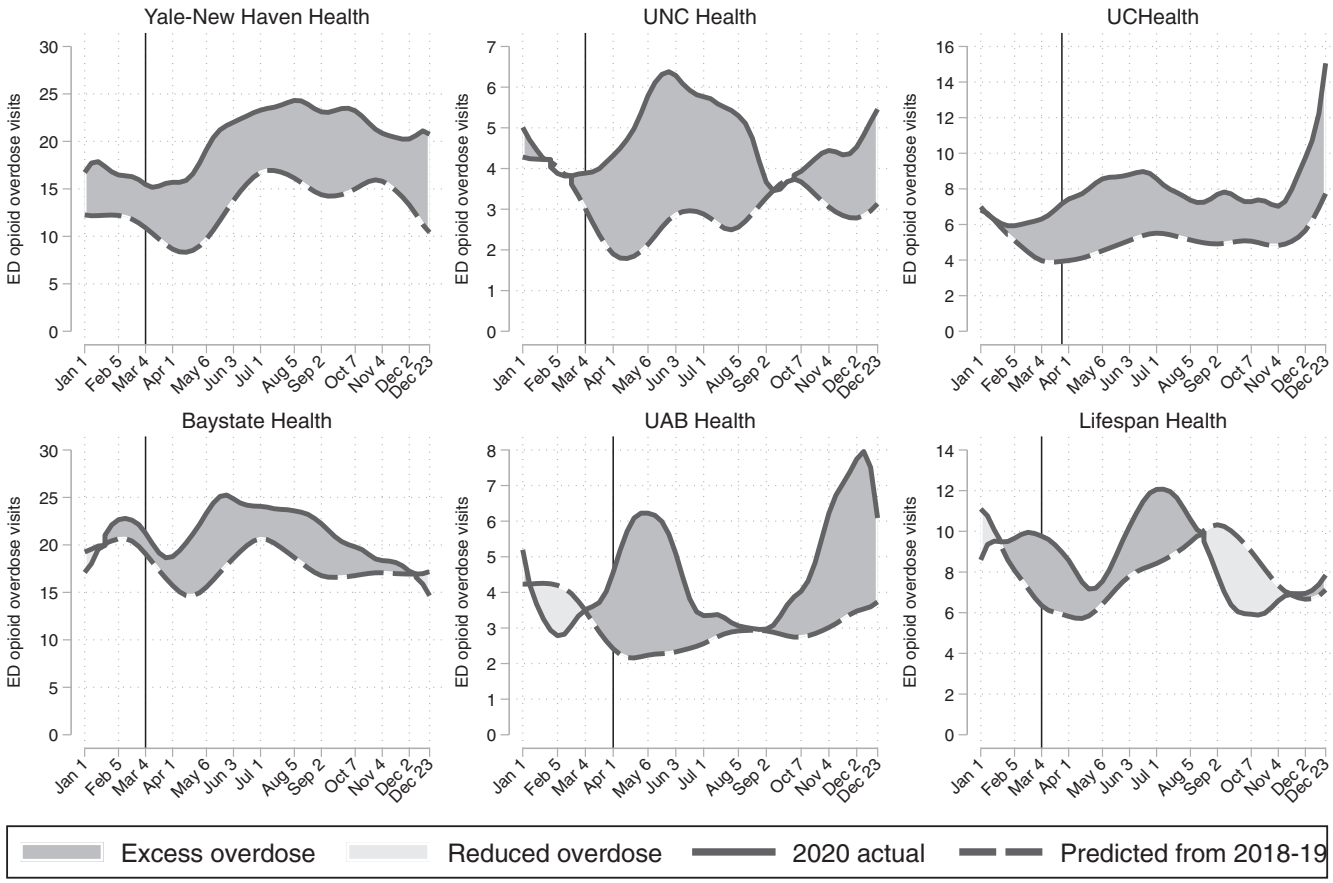


**Figure 1.** Excess ED visits for opioid overdose in 6 health care systems, from January 1, 2020 to December 31, 2020. Data from 2018 and 2019 and 2020 all-cause ED visit counts were used to predict opioid overdose visit counts for 2020. The vertical line represents the stay-at-home order start date for each state. Table E1 (available at http://www.annemergmed.com) provides additional information on state-specific stay-at-home orders.

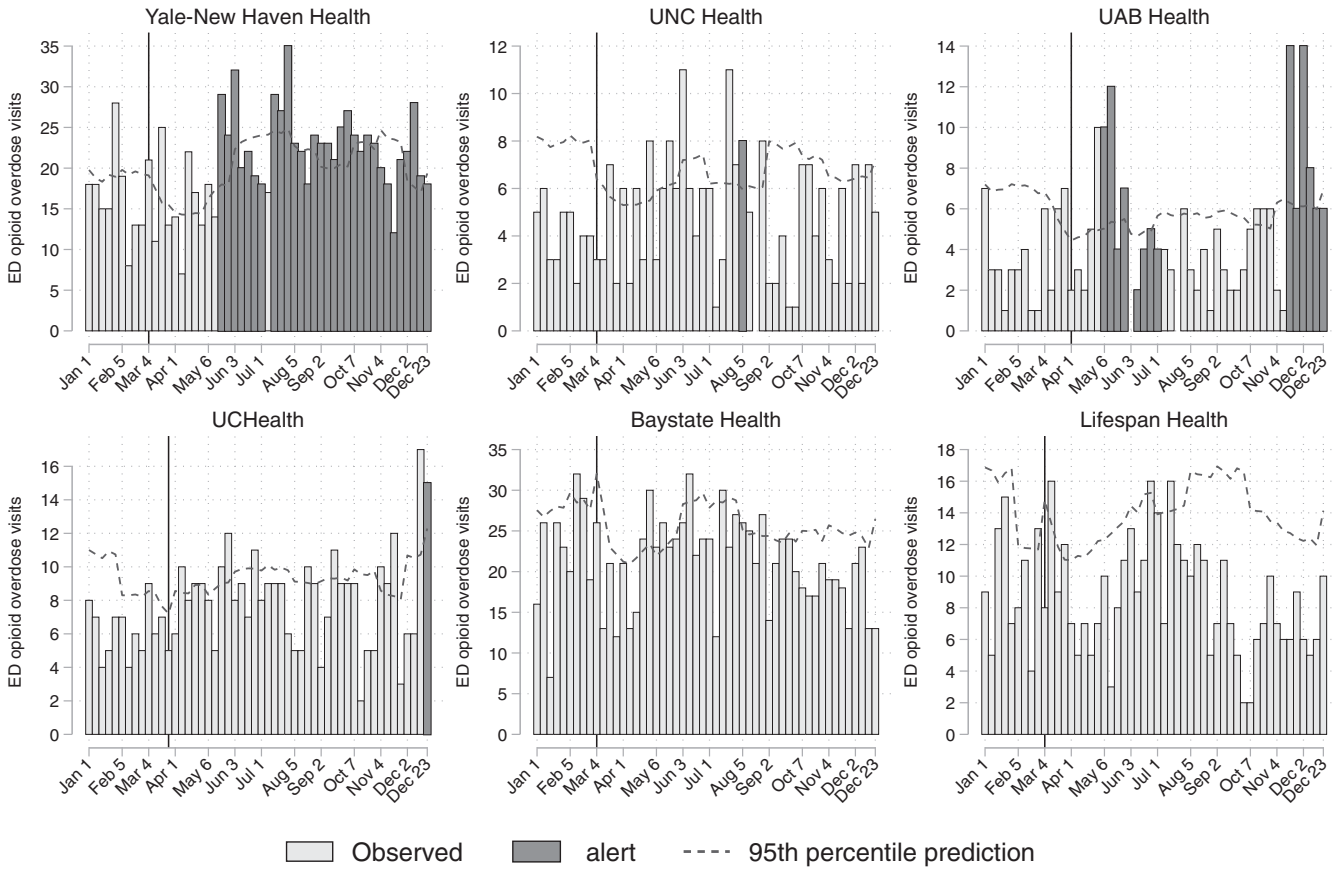


**Figure 2.** Outbreak detection analysis of opioid overdose ED visits. Data from 2018 and 2019 and 2020 all-cause ED visit counts were used to predict overdose visit counts for 2020. A cumulative sum algorithm was used to identify weeks with a potential outbreak of opioid overdose visits. Outbreak weeks are dark gray. The 95th percentile prediction line adds the 95th percentile model residual observed in 2018 to 2019 data to the prediction for 2020. The vertical line represents the stay-at-home order start date for each state.

July), UNC (week of August 5), and UAB (May through the beginning of July and November 18 to the end of the study period); other sites had 6 or more weeks that exceeded the 95th percentile prediction but did not meet criteria for an outbreak (the expected number of weeks exceeding the 95th percentile prediction was 2.6) (Figure 2).

## LIMITATIONS

Our study has several limitations. First, although geographically diverse, our study population was not a nationally representative sample; findings may not apply equally to other locations.[27] Second, although each health care system experienced an increased rate of ED visits for opioid overdose during the COVID-19 pandemic, the magnitude of change was highly variable between institutions, resulting in wide CIs. Because of institutional and geographic differences in how variables known to influence opioid overdose rates are captured (such as community prevalence of fentanyl, concurrent drug use, or mental health diagnoses), we were unable to reliably correlate the known predictors of overdose across all health care systems. Further research is needed to determine the patient- and community-level factors associated with regional differences in the rates of ED visits for opioid overdose.

Third, with increased clinician education and training regarding the recognition and management of opioid use disorder, it is possible that temporal changes in the clinician's documentation of opioid overdose influenced the results. To address potential confounding due to increased recognition and documentation, we included 2 years of historical comparison data. We found that from 2018 to 2019, there was no consistent temporal increase in the rates of documented opioid overdose across health care systems.

Despite the above limitations, our study was able to leverage a previously established research collaboration to analyze opioid overdose-related ED visits across multiple US-based health care systems in accordance with epidemiologic outbreak detection methods.[28] The real-time

capture of opioid overdose visits across multiple institutions is a unique strength of our study as comprehensive surveillance and claims data are not yet available and previously published opioid overdose rates during the COVID-19 pandemic have been limited to a single health care system or proxy outcomes, including the administration of naloxone by EMS and estimated fatal drug overdose rates.

## DISCUSSION

In the first 12 months of the COVID-19 pandemic, 25 EDs representing 6 health care systems across the United States experienced an average increase in opioid overdose visit rates of almost 30% compared with 2018 and 2019. The rise in opioid overdose rates occurred across all measured health care system characteristics, including location, teaching status, estimated 2018 drug poisoning death rates, and the presence of EMS "no refusal" laws. The increase in both the number and rate of overdose-related ED visits is in direct contrast to the reduction in ED visits seen for many other life-threatening conditions, including myocardial infarction, stroke, appendicitis, subarachnoid hemorrhage, and hyperglycemic crisis.[8-10,12,29,30]

### Comparison With Other Studies

Our results expand on previous single-institution studies that warned about the increasing rates of opioid-related complications during the COVID-19 pandemic. In Kentucky, EMS experienced a 17% (1323 versus 1133) increase in opioid overdose calls and a 50% (18 versus 12) increase in overdose deaths at the scene during the 2 months following the COVID-19 emergency declaration compared with the 2 months prior.[22] Additionally, in San Francisco, ED visits for nonfatal opioid overdose nearly doubled, from 1.4 patients per day in January 2020 to 2.5 patients per day in April 2020.[31] In the absence of comprehensive, real-time national surveillance data, our results offer evidence that the increases in nonfatal opioid overdose rates are not isolated to specific communities. Rather, the opioid epidemic during the COVID-19 pandemic appears to be worsening throughout multiple diverse geographic and socioeconomic populations in the United States.

Evidence is also emerging that similar to other life-threatening conditions like myocardial infarction and stroke, people who experience nonfatal opioid overdoses are less likely to access medical care during the COVID-19 pandemic. The US Centers for Disease Control and Prevention estimates a 21.3% mean national increase in deaths due to drug overdose from June 2019 to June 2020.[32] Further, a review of the National EMS Information System registry found that although nonfatal opioid overdose cases were consistently 17% higher during the COVID-19 pandemic than historical controls, overdose-related cardiac arrests increased 123.4% during April 2020 compared with 2018 or 2019, highlighting a worsening case fatality rate per overdose during the first wave of COVID-19 pandemic.[33] Finally, Kentucky EMS also recorded a 70% (382 versus 223) increase in patient refusal to transport to the hospital after a nonfatal opioid overdose for further medical treatment.[22] Similar to other emergent conditions, patients experiencing a nonfatal opioid overdose appear less likely to access medical care during the COVID-19 pandemic, suggesting that the 30% increase in overdose visit rates found in this study substantially understates the true community growth of the opioid epidemic.

### Variability in Nonfatal Opioid Overdose Rates

Although all health care systems in our study experienced an increase in ED visit rates for nonfatal opioid overdoses during 2020, individual health care system rates varied from a statistically insignificant 9.7% to a nearly 60% increase. The variability in opioid overdose rates during the COVID-19 pandemic was not explained by measured institutional variables; similar rates were seen in academic versus community hospitals, the presence or absence of no refusal to transport EMS laws, and high versus low county drug poisoning rates. Although it appeared that opioid overdose visits were higher in the urban EDs compared with the rural EDs, the small sample size of rural hospitals may have limited its validity.

Instead, the variability in the rates of opioid overdose visits between the health care systems is likely due to a combination of community-level factors that are more difficult to capture, including differences in drug supply and historical opioid overdose rates; changing drug use patterns, including additional stimulants and fentanyl analogs; the availability of community addiction resources during the COVID-19 pandemic; and the timing and severity of local COVID-19 cases.

One important community-level factor that has recently emerged is the influence of race and ethnicity on opioid overdose rates. An academic ED in Virginia experienced a 2.2-fold increase in opioid overdose visits in the first 4 months of the COVID-19 pandemic, with Black patients accounting for 94% (117 of 125) of the increased visits.[21] Additionally, EMS data from Philadelphia found that non-Hispanic Black individuals experienced a 60% increase in fatal overdoses during the first 3 months of the COVID-19

pandemic compared with the same 3-month period the year prior, whereas patients identified as non-Hispanic White had a 23% decrease in fatal overdoses during the same time period.[34] Future studies are critical to help further identify and address the racial, ethnic, and socioeconomic disparities in opioid-related complications worsened during the COVID-19 pandemic.

## Implications for Clinicians and Policymakers

Against the backdrop of decreased ED visits for other life-threatening conditions during the COVID-19 pandemic, the increases in the rate and absolute count of ED visits for opioid overdose present an opportunity for ED clinicians and policymakers to expand evidence-based treatments and resources for patients with opioid use disorder. It is well established that opioid agonist medications, such as buprenorphine and methadone, substantially reduce future morbidity and mortality.[35,36] Yet, among the nonfatal opioid overdoses seen in the ED in Virginia, only 10% (23 of 227) attended an affiliated outpatient opioid treatment program.[21] For ED clinicians, given the evidence that the opioid crisis is escalating throughout the United States during the COVID-19 pandemic, all patients who present to an ED with a nonfatal opioid overdose should have access to treatment options, including medications for opioid use disorder, take-home naloxone, overdose prevention education, and linkage to outpatient resources.[37] For policymakers, regulatory changes designed to improve the access to treatment should be prioritized and permanently addressed, including the emergency expansion of Medicaid, easing the restrictions on methadone dispensing and buprenorphine prescribing, and the expansion of telemedicine.[38,39] The effort we devote now to combating opioid use disorder during the COVID-19 pandemic will determine the trajectory of the opioid epidemic for years to come.

In conclusion, despite decreases in ED visits for other life-threatening conditions during the COVID-19 pandemic in the United States, we found large increases in both the rate and number of ED visits for opioid overdose in a diverse group of 6 health care systems across the country, suggesting widespread increases in opioid-related complications during the COVID-19 pandemic. Expanded community- and hospital-based interventions are needed to support people with opioid use disorder through the COVID-19 pandemic.

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