Drug and Alcohol Dependence 228 (2021) 108977

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

The impact of the national stay-at-home order on emergency department visits for suspected opioid overdose during the first wave of the COVID-19 pandemic

Elisabeth D. Root[a,*], Svetla Slavova[b], Marc LaRochelle[c], Daniel J. Feaster[d], Jennifer Villani[e], Jolene Defiore-Hyrmer[f], Nabila El-Bassel[g], Rosa Ergas[h], Kitty Gelberg[i], Rebecca Jackson[j], Kara Manchester[k], Megha Parikh[h], Peter Rock[l], Sharon L. Walsh[m]

[a] *Department of Geography and Division of Epidemiology, The Ohio State University, Columbus, OH, United States*
[b] *Department of Biostatistics, University of Kentucky, Lexington, KY, United States*
[c] *Clinical Addiction Research and Education Unit, Section of General Internal Medicine, Department of Medicine, Boston University School of Medicine and Boston Medical Center, Boston, MA, United States*
[d] *Department of Public Health Sciences, University of Miami Miller School of Medicine, Miami, FL, United States*
[e] *National Institutes of Health, National Institute on Drug Abuse, Bethesda, MD, United States*
[f] *Bureau of Health Improvement and Wellness, Ohio Department of Health, Columbus, OH, United States*
[g] *School of Social Work, Columbia University, New York, NY, United States*
[h] *Massachusetts Department of Public Health, Bureau of Infectious Disease and Laboratory Sciences, Jamaica Plain, MA, United States*
[i] *New York State Department of Health, Office of Drug User Health, Albany, NY, United States*
[j] *Departments of Physical Medicine and Rehabilitation, Internal Medicine/ Endocrinology, and Diabetes and Metabolism, Ohio State University, Columbus, OH, United States*
[k] *Ohio Violence and Injury Prevention Program, Ohio Department of Health, Columbus, OH, United States*
[l] *Center for Clinical and Translational Science, University of Kentucky, Lexington, KY, United States*
[m] *Department of Behavioral Science and Center on Drug and Alcohol Research, University of Kentucky College of Medicine, Lexington, KY, United States*

ARTICLE INFO

Keywords:
Opioid use disorder
COVID-19
Syndromic surveillance
Emergency department encounter
Segmented regression
HEALing Communities Study

ABSTRACT

Background: Although national syndromic surveillance data reported declines in emergency department (ED) visits after the declaration of the national stay-at-home order for COVID-19, little is known whether these declines were observed for suspected opioid overdose.

Methods: This interrupted time series study used syndromic surveillance data from four states participating in the HEALing Communities Study: Kentucky, Massachusetts, New York, and Ohio. All ED encounters for suspected opioid overdose (n = 48,301) occurring during the first 31 weeks of 2020 were included. We examined the impact of the national public health emergency for COVID-19 (declared on March 14, 2020) on trends in ED encounters for suspected opioid overdose.

Results: Three of four states (Massachusetts, New York and Ohio) experienced a statistically significant immediate decline in the rate of ED encounters for suspected opioid overdose (per 100,000) after the nationwide public health emergency declaration (MA: -0.99; 95 % CI: -1.75, -0.24; NY: -0.10; 95 % CI, -0.20, 0.0; OH: -0.33, 95 % CI: -0.58, -0.07). After this date, Ohio and Kentucky experienced a sustained rate of increase for a 13-week period. New York experienced a decrease in the rate of ED encounters for a 10-week period, after which the rate began to increase. In Massachusetts after a significant immediate decline in the rate of ED encounters, there was no significant difference in the rate of change for a 6-week period, followed by an immediate increase in the ED rate to higher than pre-COVID levels.

Conclusions: The heterogeneity in the trends in ED encounters between the four sites show that the national stay-at-home order had a differential impact on opioid overdose ED presentation in each state.

* Corresponding author at: Institute for Disease Modeling, Bill & Melinda Gates Foundation, 440 5th Ave N, Seattle, WA 98109, United States.
E-mail address: eroot@idmod.org (E.D. Root).

https://doi.org/10.1016/j.drugalcdep.2021.108977
Received 31 March 2021; Received in revised form 27 July 2021; Accepted 29 July 2021
Available online 28 August 2021
0376-8716/

1. Background

The initial months of the COVID-19 pandemic saw a significant change in health care-seeking behavior and health care delivery. Stay-at-home orders were enacted by most states by the end of March 2020, and many health systems began prioritizing urgent visits and delaying/ceasing elective care to prepare for a potential surge in COVID-19 patients. By May 2020, the national syndromic surveillance program (NSSP) reported that emergency department (ED) visits declined 42 % during the early months of the pandemic (Hartnett et al., 2020). Even visits for events necessitating emergent care (e.g., myocardial infarction and stroke) declined during this time (Lange et al., 2020). Fear of COVID-19 exposure, unintended consequences of public health recommendations to minimize non-urgent health care, and stay-at-home orders have been postulated as contributors to this decline in care-seeking behavior (Lange et al., 2020; Wong et al., 2020).

The impact of the COVID-19 pandemic and national and state stay-at-home orders will likely have a disproportionate adverse effect on individuals with opioid use disorder (OUD) due to disruptions in the availability and accessibility of treatment, changes in social support and networks, isolation, and stress-associated increases in substance use or relapse (Enns et al., 2020). Service organizations changed naloxone distribution practices, which may have decreased distribution (Ostrach et al., 2021). Disruptions to drug supply chains (Shelley, 2020) may lead individuals to obtain substances with which they are less familiar. For those in treatment for OUD, interruptions to care due to reduced access to treatment programs providing medications for opioid use disorder (MOUD), behavioral health services, and recovery support services may place people with OUD at higher risk for relapse and potential overdose (Alexander et al., 2020; Becker and Fiellin, 2020). Additionally, isolation physical distancing, closure of recreation and community facilities, and limits on cultural and religious gatherings may affect social support systems that help people cope with stress and addiction. These changes in social support may lead to higher levels of anxiety, depression, and despair (Holingue et al., 2020; Liu et al., 2020; Munk et al., 2020; Papandreou et al., 2020), known risk factors for substance use disorders and relapse.

EDs are critical touch points where individuals with OUD are identified and linked to recovery and treatment resources (Larochelle et al., 2019; Samuels, 2014). Accordingly, surveillance of opioid overdoses (OOD) treated in the emergency department is a critical component of the public health response to OUD. Because it is timelier than death data, ED data can identify emergent trends in nonfatal drug overdoses, highlighting opportunities for rapid public health response to prevent overdoses (Vivolo-Kantor et al., 2020). Health departments can use ED syndromic data to identify changes in overdose burden quickly and disperse naloxone and alerts to communities at risk (Houry et al., 2018). This type of surveillance is particularly important during a public health crisis, such as the COVID-19 pandemic, because widespread disruption to the public health system may lead to unexpected changes in ED utilization for OOD. Such changes may complicate the use of indicators of nonfatal overdose for public health surveillance actives, perhaps rendering them less reliable or less representative of overdose rates. Examining the dynamics of ED syndromic data before and after the declaration of the national stay-at-home order and throughout the initial wave of the pandemic may lead to important insights into how ED utilization for OOD was affected by the crisis.

Here we examine patterns of ED encounters for suspected OOD from before and after the national stay-at-home order for COVID-19 in the four states participating in the Helping to End Addiction Long-term (HEALing) Communities Study (HCS) (Walsh et al., 2020). We extend prior research by examining the impact of stay-at-home orders at the state level, but also on specific communities with the highest burden of OOD death in each state. We address two hypotheses. First, we expect significant changes in ED encounters for suspected OOD after national stay-at-home orders were enacted. Second, we expect these changes may be short-term as individuals and the health system adjust to COVID-19. Our primary analysis examines these hypotheses by evaluating the impact of the national stay-at-home order within each HCS state over time and assessing whether the impact was similar across the four HCS states. As a secondary analysis, we evaluate whether the stay-at-home order had a differential impact in HCS vs. non-HCS communities within each state.

2. Methods

2.1. Data and study population

The HCS is a multi-site study in 67 communities across four states (Kentucky, Massachusetts, New York, and Ohio) ("HEALing Communities Study," 2019). The goal of the HCS is to test the impact of the Communities That Heal (CTH) intervention, a community-based approach to adopting and implementing evidence-based programs to reduce OOD fatalities. The intervention began in January 2020 with a protracted community engagement phase. Implementation of the EBPs was not fully underway until late summer and did not directly affect the ED trends examined here. The HCS communities were selected because they were some of the most highly affected by the opioid crisis. This unique aspect of the study design allowed us to examine whether the national stay-at-home order for COVID-19 impacted ED encounters for suspected OOD differentially in highly affected (HCS) vs. less affected (non-HCS) communities.

We utilized data from state syndromic surveillance systems (Henning, 2004) (which report ~95 % of all statewide ED encounters) to quantify the frequency of ED encounters for suspected OOD. Encounter definitions were based on presence of opioid poisoning codes using the International Classification of Diseases, 10th revision, Clinical Modification (ICD-10-CM) with relevant keywords and state-specific definitions (Supplementary Appendix A). Encounters that occurred during the first 31 weeks of 2020 (weeks ending 1/4/2020-8/1/2020) were included.

For each state, counts of ED encounters for suspected OOD were aggregated by the Morbidity and Mortality Weekly Report (MMWR) week (Centers for Disease Control and Prevention (CDC), 2016) for: 1) the state, 2) HCS communities, and 3) non-HCS communities. Data for New York excluded New York City. Encounters from facilities reporting partial data for the study period were excluded. HCS communities are defined geographically by zip codes corresponding to cities and towns (Massachusetts), county (Kentucky and Ohio), or both (New York). Population denominators used the 2019 NCHS bridged-race population estimates for communities mapping to counties (Ohio, Kentucky, and some New York communities) and the 2014–2018 American Community Survey population estimates for communities mapping to zip codes (Massachusetts and some New York communities).

Daily number of COVID-19 cases for each state was obtained from the CDC COVID tracker website (https://covid.cdc.gov/covid-data-tracker/#datatracker-home). State-level data were aggregated by MMWR week and divided by the total population to create rates.

This study was approved by Advarra, the single institutional review board, on October 16, 2019 (Protocol Title: The HEALing Communities Study: Intervention Protocol, # Pro0003808).

2.2. Statistical methods

We used an interrupted time series design with segmented regression with autoregressive error (Slavova et al., 2018; Wagner et al., 2002; Walley et al., 2013) to model trends in the rate of weekly ED encounters for suspected OOD (per 100,000 population) for three segments of the study period defined by two change points. The first change point was pre-specified as MMWR week 12, the week following the national emergency declaration (March 15–21, 2020). To identify the second change point and model the potential for a leveling off or reversal of trend, we tested each week between MMWR weeks 13–27 and selected the model with the best fit based on the maximum likelihood estimates for the Akaike's Information Criteria (AIC). The end of the time series was MMWR week 31 (July 26–31, 2020), which allowed for a 4-week run-out period after the last potential change point to measure slope accurately. A model with no second change point was also assessed (Supplemental Appendix A).

Each model examined autoregressive parameters up to order 14 and dropped autocorrelation terms using backward selection when significance >0.05 to account for possible temporal autocorrelation. Each state's data were analyzed separately, additionally comparing HCS to non-HCS communities within the state. Parameter estimates and 95 % confidence intervals are reported. Average weekly rates and standard deviations (SD) were reported by state and time-period. We compare differences across states and between HCS and non-HCS communities by comparing overlap in the confidence intervals of estimates. All analyses were performed using SAS software, Version 9.4 (SAS Institute Inc, 2013).

3. Results

Fig. 1 shows trends in the rate of ED encounters for suspected OOD by state. The solid line represents the week ending 3/14/2020. Kentucky and Ohio experienced increased ED rates after the nationwide state of emergency, Massachusetts experienced an initial decline in ED rates followed by a rebound to slightly higher rates, and New York exhibited little change over the study period. Summary statistics for ED encounters for suspected OOD by state and study period are shown in Table 1.

3.1. Primary analysis: statewide models

Segmented regression analysis of statewide data (Fig. 2, Table 2) found that on MMWR week 1 (the pre-COVID intercept), the rate of ED encounters for suspected OOD per 100,000 residents was highest in Massachusetts with a rate of 3.99/100,000 population (95 % CI: 3.60, 4.38), followed by Kentucky (1.78; 95 % CI: 1.45, 2.11), Ohio (1.63; 95 % CI: 1.45, 1.81) and New York (1.06; 95 % CI: 1.00, 1.12). New York and Kentucky had small but significant positive slopes before March 14 (0.03 and 0.07, respectively), while Massachusetts and Ohio did not. We identified a statistically significant immediate decline in ED rates after March 14 in Massachusetts, New York, and Ohio, but not in Kentucky (e.g., COVID-19 Period 1 intercept change). Three states had a significant difference in the slope of the weekly ED rate regression lines before and after 3/14/2020; Kentucky and Ohio both saw an increase in rates (estimated slope change of 0.17 and 0.09, respectively), whereas New York saw a decrease (-0.08), and Massachusetts had no significant change.

The timing of the second change point differed across states. Massachusetts' was earliest (week ending 5/2/2020), followed by New York (week ending 5/30/2020), Kentucky (week ending 6/20/2020), and Ohio (week ending 6/27/2020). Kentucky experienced an estimated immediate drop in ED encounters of 1/100,000 (95 % CI: -1.67, -0.32) in the week ending 6/20/2020 compared with the previous week's estimated rate. Furthermore, there was a significant change (-0.35; 95 % CI: -0.49, -0.21) in the slope of Kentucky's trend during COVID-19 Period 2 compared to Period 1. Ohio did not see a significant estimated immediate drop in the ED rate in COVID-19 Period 2, but there was a significant change in the slope of Ohio's trend during Period 2 compared with the previous period (-0.18; 95 % CI: -0.25, -0.10). New York (0.34, 95 % CI: 0.23, 0.44) and Massachusetts (1.33; 95 % CI: 0.07, 1.97) both had a significant immediate increase in the estimated ED rate in the COVID-19 Period 2, though only New York saw a small but significant change in the slope of the trend in Period 2 (0.03; 95 % CI: 0.02, 0.05).

Taken together, these results indicate that national stay-at-home order impacted ED rates within each HCS state, but the dynamics differed across HCS states. We observed an initial decrease in visits in Massachusetts, New York and Ohio, but not Kentucky. After 3/14/2020 Kentucky and Ohio experienced a sustained rate of increase for an ~13-week period, after which rates declined again. New York saw a decline in rates after 3/14/2020, before rising to rates similar to January 2020 at the end of May. After a significant decline in rates after 3/14/2020, Massachusetts experienced relatively little change, but then had a large increase at the second change point (5/2/2020) to a rate slightly higher than January 2020.

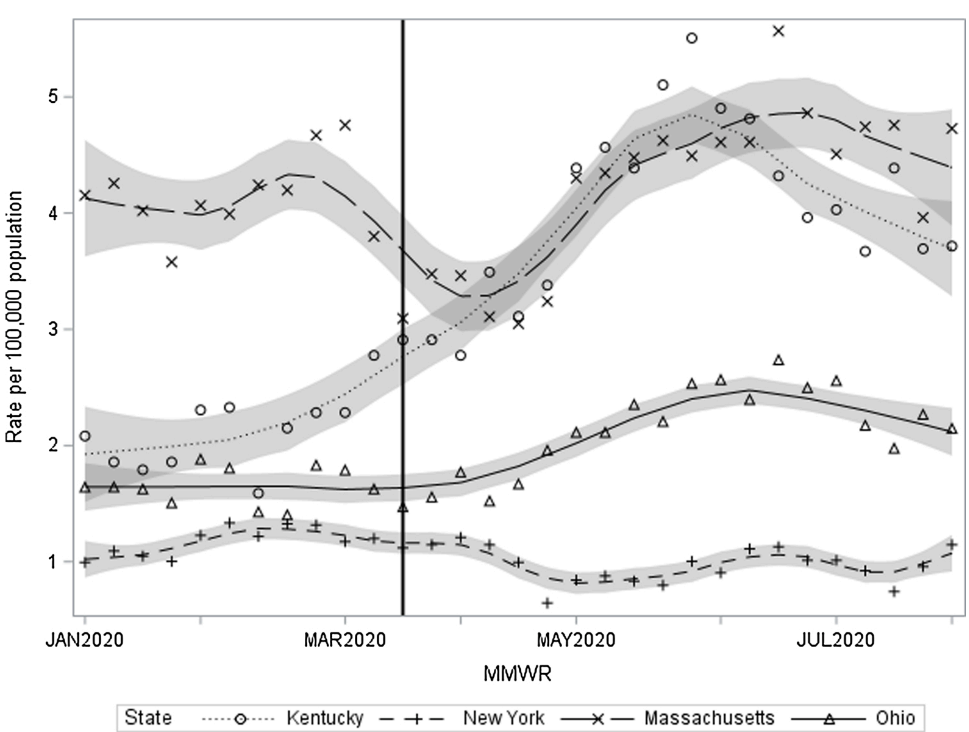

Fig. 1. Weekly rate of ED encounters for suspected opioid overdose per 100,000 population, January-August 2020 in Kentucky (o), Massachusetts (x), New York (+), and Ohio (△). Weekly rates are visualized by points; the trends are visualized by the lines and confidence bands and derived from a loess regression using a 7-day window. The vertical line represents the week ending March 14, 2020.
Note: Data from New York exclude New York City.

Table 1
Summary statistics for ED encounters for suspected opioid overdose during pre-COVID-19 study period (January 1, 2020–March 14, 2020) vs. COVID-19 study period 1 (March 15, 2020–second change point) and COVID-19 study period 2 (second change point–July 31, 2020). The second change point varies by state.

	Week of second change point		January 1, 2020–March 14, 2020			March 15, 2020–second change point			Second change point–July 31, 2020		
	MMWR Week	Week Ending	Number of Weeks	N	Weekly Mean Rate (SD)	Number of Weeks	N	Weekly Mean Rate (SD)	Number of Weeks	N	Weekly Mean Rate (SD)
State Model											
KY	24	20-Jun	11	1041	2.12 (0.33)	13	2334	4.02 (0.95)	7	1241	3.97 (0.30)
MA	17	2-May	11	3105	4.16 (0.34)	6	1319	3.24 (0.19)	14	4385	4.61 (0.36)
NY	21	30-May	11	1444	1.18 (0.13)	10	1073	0.96 (0.19)	10	1110	0.99 (0.12)
OH	25	27-Jun	11	2125	1.65 (0.16)	14	3678	2.10 (0.42)	6	1300	2.22 (0.21)
HCS Community Model											
KY	22	6-Jun	11	663	3.30 (0.62)	11	1577	6.64 (1.33)	9	765	5.98 (0.68)
MA	26	4-Jul	11	653	6.85 (1.23)	15	952	7.32 (1.00)	5	331	7.63 (1.01)
NY	17	2-May	11	868	1.74 (0.27)	6	411	1.51 (0.36)	14	878	1.38 (024)
OH	19	16-May	11	978	1.77 (0.28)	8	1551	2.06 (0.46)	12	497	1.98 (0.28)
State without HCS Communities Model											
KY	24	20-Jun	11	378	1.30 (0.36)	13	757	2.21 (0.84)	7	476	2.58 (0.25)
MA	27	11-Jul	11	2452	3.76 (0.37)	16	3459	3.65 (0.77)	4	962	4.06 (0.33)
NY	14	11-Apr	11	576	0.79 (0.08)	3	156	0.79 (0.09)	17	738	0.66 (0.12)
OH	24	20-Jun	11	1147	1.57 (0.16)	13	2127	2.13 (0.44)	7	803	2.41 (0.22)

Note: Data from New York exclude New York City.

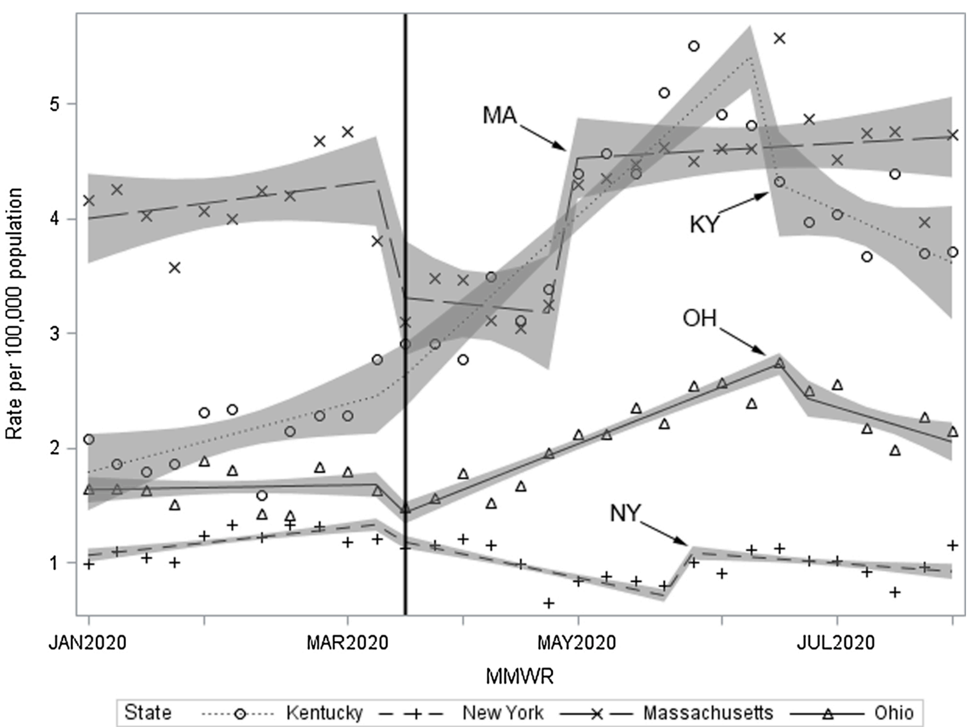

Fig. 2. Estimated trends in rate of ED encounters for suspected opioid overdose (per 100,000 population) from ITS models, January 1, 2020 to July 31, 2020 for Kentucky (o), Massachusetts (x), New York (+), and Ohio (△). The solid black line indicates the first change point (MMWR week 12). Arrows indicate the state-specific second change points. The vertical line represents the week ending March 14, 2020.
Note: Data from New York exclude New York City.

3.2. *Secondary analysis: HCS vs. non-HCS community models*

The initial rate of ED encounters for suspected OOD was higher in HCS vs. non-HCS communities in Kentucky, New York, and Massachusetts (no overlap in 95 % CIs), but not Ohio. Trends in ED encounters for HCS communities differed from trends in non-HCS communities (Fig. 3, Table 2). In HCS communities, there was a statistically significant immediate drop in the estimated rate of ED encounters after 3/14/2020 in Massachusetts (-2.53; 95 % CI: -3.69, -1.37) and Ohio (-0.38; 95 % CI: -0.72, -0.03), but not in Kentucky or New York. For non-HCS communities, there was a significant immediate drop in the estimated rate of ED encounters after 3/14/2020 in Kentucky (-0.72; 95 % CI: -1.22, -0.22), Massachusetts (-1.56; 95 % CI: -1.96, -1.16), and New York (-0.22; 95 % CI: -0.44, 0.00), but not in Ohio (-0.24; 95 % CI: -0.51, 0.04).

In HCS communities, two states saw significant slope changes for weekly ED encounter regression lines before and after 3/14/2020; Kentucky saw a significant increase (estimated slope change of 0.34), whereas New York saw a decrease (-0.21). In the non-HCS communities, Kentucky, Massachusetts, and Ohio saw a significant increase in the slope of the weekly ED encounters compared to the pre-COVID-19 period, to levels higher than before the national emergency was declared (slope change of 0.14, 0.13, 0.08, respectively).

The second change point in Kentucky and Ohio was earlier in HCS communities compared to non-HCS communities (Table 1), and the slope of the regression line after the second change point was negative, indicating a decreasing trend. In Massachusetts, rather than a drop after 3/14/2020 with a rebound at the second change point to nearly identical levels, HCS communities experienced a drop in March followed by a

Table 2
Parameter estimates for interrupted time series regression analysis of weekly rates of ED encounters for suspected opioid overdose, January 1, 2020 to July 31, 2020.

	Parameter Estimates*					
	Pre-COVID Intercept	Pre-COVID Slope	COVID-19 Period 1 Intercept Change[a]	COVID-19 Period 1 Slope Change[b]	COVID-19 Period 2 Intercept Change[c]	COVID-19 Period 2 Slope Change[d]
State Model						
KY	1.78 (1.45, 2.11)	**0.07 (0.01, 0.12)**	−0.05 (-0.39, 0.29)	**0.17 (0.10, 0.23)**	**−1.00 (-1.67, -0.32)**	**−0.35 (-0.49, -0.21)**
MA	3.99 (3.60, 4.38)	0.03 (-0.03, 0.10)	**−0.99 (-1.75, -0.24)**	−0.06 (-0.24, 0.12)	**1.33 (0.70, 1.97)**	0.04 (-0.13, 0.21)
NY	1.06 (1.00, 1.12)	**0.03 (0.02, 0.04)**	**−0.10 (-0.20, 0.00)**	**−0.08 (-0.09, -0.07)**	**0.34 (0.23, 0.44)**	**0.03 (0.02, 0.05)**
OH	1.63 (1.45, 1.81)	0.00 (-0.03, 0.03)	**−0.33 (-0.58, -0.07)**	**0.09 (0.06, 0.13)**	−0.14 (-0.48, 0.19)	**−0.18 (-0.25, -0.10)**
HCS Community Model						
KY	2.86 (2.27, 3.45)	0.09 (-0.01, 0.19)	0.32 (-0.58, 1.22)	**0.34 (0.19, 0.48)**	**−1.66 (-2.63, -0.7)**	**−0.60 (-0.76, -0.43)**
MA	5.34 (4.40, 6.28)	**0.32 (0.17, 0.47)**	**−2.53 (-3.69, -1.37)**	−0.16 (-0.41, 0.09)	**−2.28 (-3.84, -0.71)**	0.43 (-0.04, 0.89)
NY	1.47 (1.26, 1.69)	**0.05 (0.02, 0.09)**	0.00 (-0.51, 0.51)	**−0.21 (-0.32, -0.10)**	0.23 (-0.10, 0.57)	**0.16 (0.05, 0.27)**
OH	1.74 (1.56, 1.93)	0.00 (-0.03, 0.03)	**−0.38 (-0.72, -0.03)**	0.07 (0.01, 0.12)	**0.85 (0.54, 1.16)**	**−0.14 (-0.20, -0.08)**
State without HCS Communities Model						
KY	1.04 (0.70, 1.37)	0.05 (-0.01, 0.11)	**−0.72 (-1.22, -0.22)**	**0.14 (0.08, 0.21)**	**−0.89 (-1.57, -0.20)**	**−0.16 (-0.31, -0.01)**
MA	3.64 (3.35, 3.93)	0.02 (-0.03, 0.07)	**−1.56 (-1.96, -1.16)**	**0.13 (0.08, 0.19)**	**−1.00 (-1.95, -0.05)**	−0.09 (-0.43, 0.25)
NY	0.75 (0.64, 0.86)	0.01 (-0.01, 0.03)	**−0.22 (-0.44, 0.00)**	0.08 (-0.02, 0.17)	**−0.29 (-0.44, -0.08)**	−0.08 (-0.17, 0.02)
OH	1.51 (1.32, 1.71)	0.01 (-0.02, 0.05)	−0.24 (-0.51, 0.04)	**0.08 (0.04, 0.12)**	0.30 (-0.04, 0.64)	**−0.19 (-0.26, -0.12)**

Notes: Data from New York exclude New York City.
Bolded values had $p < 0.05$.
[a] Immediate intercept change (difference between the estimated end of the regression line for Pre-COVID Period and beginning of regression line for COVID-19 Period 1).
[b] Change in slope between pre-COVID period and Period 1.
[c] Immediate intercept change (difference between the estimated end of the regression line for COVID-19 Period 1 and beginning of regression line for Period 2).
[d] Change in slope between Period 1 and Period 2.
* The intercept and slope change parameter estimates for Period 1 and Period 2 represent changes from the prior period: -The COVID-19 Period 1 (2) Intercept change is the immediate change in ED encounter rates at the first (second) time point. - The COVID-19 Period 1 (2) Slope change is the change in slope with respect to the prior period.

small but significant increase, and a second drop after 7/4/2020 with a second increase in slope. In New York, HCS communities saw a non-significant increase in ED encounters after the second change point while non-HCS communities saw a decrease.

4. Discussion

Study results support our hypothesis of a significant impact of the national stay-at-home order on ED encounters for suspected OOD in the 4 HCS states, but indicate that the dynamics of this impact differed across the four states. ED encounters in New York and Massachusetts appear to mirror a general decrease in overall ED visits observed across the US. Kentucky and Ohio provide a counterpoint to this finding as both experienced increases in ED encounters for suspected OOD after the national emergency was declared. Results also indicate different dynamics between HCS and non-HCS communities suggesting communities with higher rates of OOD likely experienced differential effects of the stay-at-home order than communities with lower rates. Notably, this distinction was not apparent in Ohio where both HCS and non-HCS communities have high OOD rates. We also hypothesized that changes in ED encounters for overdose might be short-term in nature. Our analyses support this hypothesis as the regression models for all 4 states identified a second change point after which the slope or the intercept for ED encounters changed.

Research on the impact of the COVID-19 pandemic on OOD events is limited and results are mixed. Studies have used both ED and emergency medical services (EMS) encounter data to examine changes in OOD events. A national study using NSSP data, comparing ED visit counts for OOD for March 15-October 10, 2020 to the same period in 2019, found a significantly higher number in 2020 (Holland et al., 2021). Similarly, a study of 25 emergency departments across 6 states compared rates of OOD visits in 2018–2019 to visits during the COVID-19 pandemic and found a 10.5 % increase in 2020 despite a 14 % decline in all-case ED visits (Soares et al., 2021). Conversely, a study of 108 EDs in 18 U.S. states compared ED visits from March-July 2020 to the same period in 2019 found a decline in rates for OOD which began in mid-March (Pines et al., 2021). The authors also found substantial heterogeneity across states, though only a few states were directly compared and only Florida showed an increase in OOD during this time.

EMS clinicians surveyed between April–May 2020 reported substantial variation with 20 % of surveyed communities experiencing an increase in OOD and events during which naloxone was administered, while 40 % experienced a decrease (Cone et al., 2020). An interrupted time series study in Kentucky found a 17 % increase in the number of EMS OOD runs with transportation to an ED, and a 71 % increase in runs with refused transportation (Slavova et al., 2020). Similarly, an analysis of the National EMS Information System identified large increases in overdose-related cardiac arrest in the initial months of the pandemic (Friedman et al., 2021). There is inconsistency between the initial NSSP studies showing a decline in overall emergency department use and both the conceptual understanding of how the COVID-19 pandemic may affect individuals with OUD and the few studies reporting an increase in EMS utilization for suspected OOD. This difference could be related to the difference in study endpoints (ED vs. EMS), but prior studies have shown that OOD-related ED visits and EMS calls for suspected OOD follow similar trends over time (Lasher et al., 2019; Lindstrom et al., 2015).

Several reasons could account for that the differential impact of the national stay-at-home order across states and between HCS and non-HCS communities. The COVID-19 epidemic curves for the HCS states (Fig. S1) show very different dynamics. State and local governments chose to implement (and relax) a diverse set of mitigation measures, which affected health systems, care-seeking behaviors, social isolation, and economic stress differentially. Both New York and Massachusetts saw a rapid and significant spike in COVID-19 cases between April and May with a marked decline through July and August, while Ohio and Kentucky experienced much slower and gradual growth in COVID-19 cases throughout the summer, surpassing New York and Massachusetts by early June (Centers for Disease Control and Prevention (CDC), 2020). Health systems in New York and Massachusetts were immediately overwhelmed, which could account for the initial drop in ED visits for suspected OOD in these states. The relatively quick rebound in opioid-involved ED rates experienced by Massachusetts is somewhat puzzling; in the statewide model, the decrease in ED rates for OOD lasted

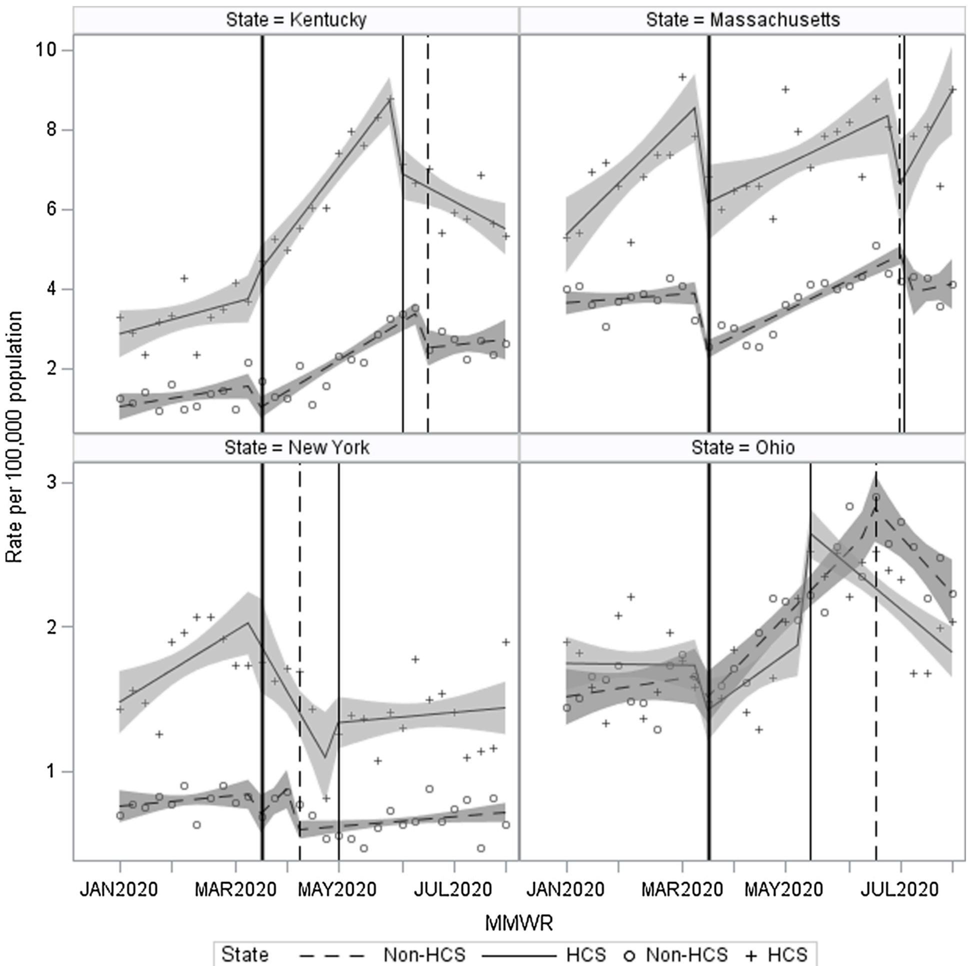

Fig. 3. Estimated trends in rate of ED encounters per 100,000 population for suspected opioid overdose in HCS communities from ITS models, January 1, 2020 to July 31, 2020 for Kentucky, Massachusetts, New York, and Ohio. Solid lines indicate trends within HCS communities and dashed lines indicate trends for the rest of the state, excluding HCS community data. The thick solid black line indicates the first change point (MMWR week 12). The second set of lines indicate the timing of the second change point for HCS (solid) and non-HCS (dashed) communities.
Note: Data from New York exclude New York City.

for ~6 weeks before returning to early-2020 levels. Massachusetts hospitals were at the peak of the epidemic curve during this time and continued to have substantial burden of COVID-19, indicating hospital capacity issues may not be a main factor associated with observed declines. While a detailed analysis of the drivers behind the heterogeneity in ED rates is outside of the scope of this study, we examined whether there was a simple linear relationship between ED rates for OOD and community-level COVID-19 rates (results not shown) and found no consistent relationship across states, suggesting that the heterogeneity in ED rates for OOD was not mediated by local COVID infection rates. Future work is needed to examine the complex community dynamics that drove ED encounters for OOD throughout the COVID-19 pandemic.

Differences in the progression of the epidemic and state/local responses may also have affected EMS transports. An increase in patients refusing transport could impact the number of ED encounters for suspected OOD. One study of EMS OOD runs in Kentucky reported a large and significant increase in runs with transportation to ED in late March–April 2020 (Friedman et al., 2021), concordant with the Kentucky trends observed here. Another study in Massachusetts found a small increase in transport refusals after the statewide emergency was declared (from 5.0 % to 7.5 %) (Weiner et al., 2020), and we find a small but measurable drop in ED encounters for suspected OOD as well. These findings suggest that the relationship between EMS opioid runs and ED encounters for suspected OOD is complex and warrants further research.

While there is little empirical evidence on the impact of the pandemic on illicit drug markets, researchers have suggested that travel restrictions may disrupt established drug supply chains leading to substitutions of potentially more deadly analogues (Dietze and Peacock, 2020; Giommoni, 2020). Drug market changes could be responsible for the differences we observed in ED encounters for suspected OOD across HCS states. A recent study (Niles et al., 2021) examined clinical drug testing results from a national clinical laboratory before and during the COVID-19 pandemic and found a significant increase in illicit fentanyl/fentanyl drug combinations. Preliminary mortality data from Kentucky and Ohio indicate an increase in fentanyl-involved deaths in the first half of 2020 (Ohio Department of Health (ODH), 2021; Slavova et al., 2020); reports from Massachusetts and New York do not indicate similar trends (Massachusetts Department of Public Health, 2020; New York, 2021). Preliminary data from the Centers for Disease Control and Prevention confirms a 29.4 % increase in drug overdose deaths through December 2020 over the prior year. This includes an increase of 53.7 % in Kentucky, 1.9 % in Massachusetts, 32.3 % in New York, and 21.9 % in Ohio (Centers for Disease Control and Prevention (CDC), 2021). Assuming that overdose deaths and ED encounters for suspected OOD are correlated, the preliminary death data show that overdoses have increased, especially in Kentucky, New York, and Ohio, and suggest that an increase in fentanyl may be driving the increase in ED encounters in Kentucky (Slavova et al., 2020) and possibly Ohio. Similar trends were seen in 2015 when the increase in OOD deaths across the U.S. were driven by the introduction of illicitly manufactured fentanyl (Gladden et al., 2016; Park et al., 2021; Peterson et al., 2016).

Finally, we are careful to note that ED encounters for suspected OOD are only one component of community-level overdose rates. Historically, there has been an association in the overall trends in overdose morbidity and mortality data, and it is reasonable to expect that significant shifts in ED encounters for OOD would be indicative of significant shifts in mortality. However, the unprecedented nature of the COVID-19 pandemic may have disrupted this historical relationship between data sources of morbidity and mortality, given the recent CDC data documenting 2020 as having the highest historical rates of overdose death (Centers for Disease Control and Prevention (CDC), 2021). Rather, we suggest that the national stay-at-home order and the COVID-19 pandemic led to widespread and complicated changes in historical patterns of opioid misuse, overdose, and care seeking behaviors. These changes are reflected in the inconsistency and heterogeneity in the dynamics of ED encounters and EMS transports for OOD and OOD mortality noted in the current literature. If health departments are using ED syndromic data for surveillance purposes, officials should be aware that a decline in ED encounters for drug overdose may not be indicative of a larger community-wide decline. When states release their weekly and monthly counts of OOD deaths for 2020, researchers will be able to assess if the general association between mortality and morbidity overdose trends remained during the unprecedented circumstances of the COVID-19 pandemic.

We note a few limitations of this study. States' syndromic systems vary in terms of data elements captured and completeness, leading to slightly differing OOD definitions. These differences may impact resultant magnitudes of cases and limit direct comparison between states. However, comparison of changes in patterns of overdose over time are relevant. Second, at baseline, the scalar differences between states' syndromic OOD encounters are similar to historic differences seen in publicly available opioid-related hospital use provided by the Agency for Healthcare Research and Quality (Agency for HealthCare Research and Quality (AHRQ), 2021). The ability to detect opioid visits may differ by state and facility based on the percentage of ED visits with diagnosis codes. Third, while we examine ED encounters for suspected OOD as one indicator of rates of overdose in our communities, not all OOD are captured in ED data, so this is likely an underestimation of the problem. Finally, our analysis only extends through the first (summer) wave of the pandemic. It is possible that the dynamics of ED encounters were different for the second (winter) wave.

5. Conclusions

In this study, three of four states experienced a statistically significant decline in ED encounters for suspected OOD immediately after the national public health emergency was announced for the COVID-19 pandemic. The heterogeneity in the trends in ED encounters across the four states suggest that the national stay-at-home order had a significantly different impact on OOD in each state.

Role of funding source

This research was supported by the National Institutes of Health through the NIH HEAL Initiative under award numbers UM1DA049394 (RTI), UM1DA049406 (KY), UM1DA049412 (MA), UM1DA049415 (NY), and UM1DA049417 (OH). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or its NIH HEAL Initiative.

Contributors

E.D. Root contributed to the conception and design of the study, conducted statistical analysis for Ohio and drafted the manuscript. S. Slavova contributed to the conception and design of the study. P. Rock and S. Slavova conducted statistical analysis for Kentucky and provided critical primary revisions to the manuscript. M. LaRochelle contributed to the conception and design of the study, conducted statistical analysis for Massachusetts, and provided critical primary revisions to the manuscript. D. Feaster contributed to the conception and design of the study, conducted statistical analysis for New York, and provided critical primary revisions to the manuscript. J. Villani contributed to the conception and design of the study and provided critical primary revisions to the manuscript. J. Defiore-Hyrmer and K. Manchester developed analytic datasets from Ohio syndromic surveillance data (EpiCenter) and provided revisions to the manuscript. R. Ergas assisted with the Massachusetts syndromic surveillance data and provided revisions to the manuscript. M. Parikh and K. Gelberg assisted with the New York syndromic surveillance data and provided revisions to the manuscript. J. Villani, N. El-Bassel, R. Jackson and S. Walsh contributed to drafts of the manuscript, critical revisions, and approved the final manuscript.

Declaration of Competing Interest

M. LaRochelle reports receiving consulting funds for research paid to his institution by OptumLabs outside the submitted work. All other authors declare no conflicts of interest.

Acknowledgements

We would like to acknowledge support for this study from the following agencies: Kentucky Cabinet for Health and Family Services (Department for Public Health, Kentucky Health Information Exchange, Office of Health Data and Analytics); New York State (NYS) Department of Health, Bureau of Surveillance and Data Systems, Division of Epidemiology; RecoveryOhio, the Ohio Department of Health, the Ohio Department of Administrative Services (InnovateOhio Platform); the Massachusetts Department of Public Health, Bureau of Infectious Disease and Laboratory Sciences, and the Biostatistics Epidemiology Data Analytics Center (BEDAC) at Boston University. We also would like to thank the following colleagues and collaborators for their support for the study and contribution to the HCS measures: Sharon Coleman, Megan Lindstrom, Austin Booth.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2021.108977.

References

Agency for HealthCare Research and Quality (AHRQ), 2021. Opioid Hospital Stays/ Emergency Department Visits - HCUP Fast Stats [WWW Document]. URL https://www.hcup-us.ahrq.gov/faststats/OpioidUseServlet (Accessed 21 July 2021).

Alexander, G.C., Stoller, K.B., Haffajee, R.L., Saloner, B., 2020. An epidemic in the midst of a pandemic: opioid use disorder and COVID-19. Ann. Intern. Med. 173, 57–58. https://doi.org/10.7326/M20-1141.

Becker, W.C., Fiellin, D.A., 2020. When epidemics collide: coronavirus disease 2019 (COVID-19) and the opioid crisis. Ann. Intern. Med. 173, 59–60. https://doi.org/10.7326/M20-1210.

Centers for Disease Control and Prevention (CDC), 2016. MMRW Weeks [WWW Document]. URL http://wwwn.cdc.gov/nndss/document/MMWR_Week_overview.pdf (Accessed 7 March 2016).

Centers for Disease Control and Prevention (CDC), 2020. COVID Data Tracker [WWW Document]. Cent. Dis. Control Prev.. URL https://covid.cdc.gov/covid-data-tracker (Accessed 21 July 2021).

Centers for Disease Control and Prevention (CDC), 2021. Provisional Drug Overdose Data [WWW Document]. URL https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm (Accessed 21 July 2021).

Cone, D.C., Bogucki, S., Burns, K., D'Onofrio, G., Hawk, K., Joseph, D., Fiellin, D.A., 2020. Naloxone use by emergency medical services during the COVID-19 pandemic: a national survey. J. Addict. Med. 14, e369–e371. https://doi.org/10.1097/ADM.0000000000000746.

Dietze, P.M., Peacock, A., 2020. Illicit drug use and harms in Australia in the context of COVID -19 and associated restrictions: Anticipated consequences and initial responses. Drug Alcohol Rev. 39, 297–300. https://doi.org/10.1111/dar.13079.

Enns, A., Pinto, A., Venugopal, J., Grywacheski, V., Gheorghe, M., Kakkar, T., Farmanara, N., Deb, B., Noon, A., Orpana, H., 2020. Substance use and related harms in the context of COVID-19: a conceptual model. Health Promot. Chronic Dis. Prev. Can. 40, 342–349. https://doi.org/10.24095/hpcdp.40.11/12.03.

Friedman, J., Beletsky, L., Schriger, D.L., 2021. Overdose-related cardiac arrests observed by emergency medical services during the US COVID-19 epidemic. JAMA Psychiatry 78, 562. https://doi.org/10.1001/jamapsychiatry.2020.4218.

Giommoni, L., 2020. Why we should all be more careful in drawing conclusions about how COVID-19 is changing drug markets. Int. J. Drug Policy 83, 102834. https://doi.org/10.1016/j.drugpo.2020.102834.

Gladden, R.M., Martinez, P., Seth, P., 2016. Fentanyl Law enforcement submissions and increases in synthetic opioid–involved overdose deaths — 27 states, 2013–2014. MMWR Morb. Mortal. Wkly. Rep. 65, 837–843. https://doi.org/10.15585/mmwr.mm6533a2.

Hartnett, K.P., Kite-Powell, A., DeVies, J., Coletta, M.A., Boehmer, T.K., Adjemian, J., Gundlapalli, A.V., National Syndromic Surveillance Program Community of Practice, 2020. Impact of the COVID-19 pandemic on emergency department visits — United States, January 1, 2019–May 30, 2020. MMWR Morb. Mortal. Wkly. Rep. 69, 699–704. https://doi.org/10.15585/mmwr.mm6923e1.

HEALing Communities Study, 2019. NIH HEAL Initiat [WWW Document]URL https://heal.nih.gov/research/research-to-practice/healing-communities (Accessed 21 July 2021).

Henning, K.J., 2004. What is syndromic surveillance? MMWR Suppl. 53, 5–11.

Holingue, C., Badillo-Goicoechea, E., Riehm, K.E., Veldhuis, C.B., Thrul, J., Johnson, R. M., Fallin, M.D., Kreuter, F., Stuart, E.A., Kalb, L.G., 2020. Mental distress during the COVID-19 pandemic among US adults without a pre-existing mental health condition: findings from American trend panel survey. Prev. Med. 139, 106231. https://doi.org/10.1016/j.ypmed.2020.106231.

Holland, K.M., Jones, C., Vivolo-Kantor, A.M., Idaikkadar, N., Zwald, M., Hoots, B., Yard, E., D'Inverno, A., Swedo, E., Chen, M.S., Petrosky, E., Board, A., Martinez, P., Stone, D.M., Law, R., Coletta, M.A., Adjemian, J., Thomas, C., Puddy, R.W., Peacock, G., Dowling, N.F., Houry, D., 2021. Trends in US Emergency Department visits for mental health, overdose, and violence outcomes before and during the COVID-19 pandemic. JAMA Psychiatry 78, 372. https://doi.org/10.1001/jamapsychiatry.2020.4402.

Houry, D.E., Haegerich, T.M., Vivolo-Kantor, A., 2018. Opportunities for prevention and intervention of opioid overdose in the emergency department. Ann. Emerg. Med. 71, 688–690. https://doi.org/10.1016/j.annemergmed.2018.01.052.

Lange, S.J., Ritchey, M.D., Goodman, A.B., Dias, T., Twentyman, E., Fuld, J., Schieve, L. A., Imperatore, G., Benoit, S.R., Kite-Powell, A., Stein, Z., Peacock, G., Dowling, N.F., Briss, P.A., Hacker, K., Gundlapalli, A.V., Yang, Q., 2020. Potential indirect effects of the COVID-19 pandemic on use of emergency departments for acute life-threatening conditions — United States, January–May 2020. MMWR Morb. Mortal. Wkly. Rep. 69, 795–800. https://doi.org/10.15585/mmwr.mm6925e2.

Larochelle, M.R., Bernstein, R., Bernson, D., Land, T., Stopka, T.J., Rose, A.J., Bharel, M., Liebschutz, J.M., Walley, A.Y., 2019. Touchpoints – opportunities to predict and prevent opioid overdose: a cohort study. Drug Alcohol Depend. 204, 107537. https://doi.org/10.1016/j.drugalcdep.2019.06.039.

Lasher, L., Rhodes, J., Viner-Brown, S., 2019. Identification and description of non-fatal opioid overdoses using Rhode Island EMS data, 2016–2018. R. I. Med. J. 2013 (102), 41–45.

Lindstrom, H.A., Clemency, B.M., Snyder, R., Consiglio, J.D., May, P.R., Moscati, R.M., 2015. Prehospital naloxone administration as a public health surveillance tool: a retrospective validation study. Prehospital Disaster Med. 30, 385–389. https://doi.org/10.1017/S1049023X15004793.

Liu, C.H., Stevens, C., Conrad, R.C., Hahm, H.C., 2020. Evidence for elevated psychiatric distress, poor sleep, and quality of life concerns during the COVID-19 pandemic among U.S. young adults with suspected and reported psychiatric diagnoses. Psychiatry Res. 292, 113345. https://doi.org/10.1016/j.psychres.2020.113345.

Massachusetts Department of Public Health, 2020. Data Brief: Opioid-Related Overdose Deaths Among Massachusetts Residents [WWW Document]. URL https://www.mass.gov/doc/opioid-related-overdose-deaths-among-ma-residents-november-2020 (Accessed 21 July 2021).

Munk, A.J.L., Schmidt, N.M., Alexander, N., Henkel, K., Hennig, J., 2020. Covid-19—beyond virology: potentials for maintaining mental health during lockdown. PLoS One 15, e0236688. https://doi.org/10.1371/journal.pone.0236688.

New York, 2021. Personal Communication.

Niles, J.K., Gudin, J., Radcliff, J., Kaufman, H.W., 2021. The Opioid Epidemic Within the COVID-19 Pandemic: Drug Testing in 2020. Popul. Health Manag. 24, S-43–S-51. https://doi.org/10.1089/pop.2020.0230.

Ohio Department of Health (ODH), 2021. Ohio Public Health Information Warehouse [WWW Document]. URL http://publicapps.odh.ohio.gov/EDW/DataCatalog (Accessed 21 July 2021).

Ostrach, B., Buer, L., Armbruster, S., Brown, H., Yochym, G., Zaller, N., 2021. COVID-19 and rural harm reduction challenges in the US Southern Mountains. J. Rural Health 37, 252–255. https://doi.org/10.1111/jrh.12499.

Papandreou, C., Arija, V., Aretouli, E., Tsilidis, K.K., Bulló, M., 2020. Comparing eating behaviours, and symptoms of depression and anxiety between Spain and Greece during the COVID -19 outbreak: cross-sectional analysis of two different confinement strategies. Eur. Eat. Disord. Rev. 28, 836–846. https://doi.org/10.1002/erv.2772.

Park, J.N., Rashidi, E., Foti, K., Zoorob, M., Sherman, S., Alexander, G.C., 2021. Fentanyl and fentanyl analogs in the illicit stimulant supply: results from U.S. drug seizure data, 2011–2016. Drug Alcohol Depend. 218, 108416. https://doi.org/10.1016/j.drugalcdep.2020.108416.

Peterson, A.B., Gladden, R.M., Delcher, C., Spies, E., Garcia-Williams, A., Wang, Y., Halpin, J., Zibbell, J., McCarty, C.L., DeFiore-Hyrmer, J., DiOrio, M., Goldberger, B. A., 2016. Increases in fentanyl-related overdose deaths — Florida and Ohio, 2013–2015. MMWR Morb. Mortal. Wkly. Rep. 65, 844–849. https://doi.org/10.15585/mmwr.mm6533a3.

Pines, J.M., Zocchi, M.S., Black, B.S., Carlson, J.N., Celedon, P., Moghtaderi, A., Venkat, A., 2021. How emergency department visits for substance use disorders have evolved during the early COVID-19 pandemic. J. Subst. Abuse Treat. 129, 108391 https://doi.org/10.1016/j.jsat.2021.108391.

Samuels, E., 2014. Emergency department naloxone distribution: a Rhode Island department of health, recovery community, and emergency department partnership to reduce opioid overdose deaths. R. I. Med. J. 2013 (97), 38–39.

SAS Institute Inc, 2013. SAS 9.4. SAS Institute Inc, Cary, NC.

Shelley, L., 2020. Fentanyl, COVID-19, and public health. World Med. Health Policy 12, 390–397. https://doi.org/10.1002/wmh3.355.

Slavova, S., Costich, J.F., Luu, H., Fields, J., Gabella, B.A., Tarima, S., Bunn, T.L., 2018. Interrupted time series design to evaluate the effect of the ICD-9-CM to ICD-10-CM coding transition on injury hospitalization trends. Inj. Epidemiol. 5, 36. https://doi.org/10.1186/s40621-018-0165-8.

Slavova, S., Rock, P., Bush, H.M., Quesinberry, D., Walsh, S.L., 2020. Signal of increased opioid overdose during COVID-19 from emergency medical services data. Drug Alcohol Depend. 214, 108176. https://doi.org/10.1016/j.drugalcdep.2020.108176.

Soares, W.E., Melnick, E.R., Nath, B., D'Onofrio, G., Paek, H., Skains, R.M., Walter, L.A., Casey, M.F., Napoli, A., Hoppe, J.A., Jeffery, M.M., 2021. Emergency department visits for nonfatal opioid overdose during the COVID-19 pandemic across six US health care systems. Ann. Emerg. Med. https://doi.org/10.1016/j.annemergmed.2021.03.013. S0196064421002262.

Vivolo-Kantor, A.M., Hoots, B.E., Scholl, L., Pickens, C., Roehler, D.R., Board, A., Mustaquim, D., Smith, H., Snodgrass, S., Liu, S., 2020. Nonfatal drug overdoses treated in emergency departments — United States, 2016–2017. MMWR Morb. Mortal. Wkly. Rep. 69, 371–376. https://doi.org/10.15585/mmwr.mm6913a3.

Wagner, A.K., Soumerai, S.B., Zhang, F., Ross-Degnan, D., 2002. Segmented regression analysis of interrupted time series studies in medication use research. J. Clin. Pharm. Ther. 27, 299–309. https://doi.org/10.1046/j.1365-2710.2002.00430.x.

Walley, A.Y., Xuan, Z., Hackman, H.H., Quinn, E., Doe-Simkins, M., Sorensen-Alawad, A., Ruiz, S., Ozonoff, A., 2013. Opioid overdose rates and implementation of overdose education and nasal naloxone distribution in Massachusetts: interrupted time series analysis. BMJ 346, f174. https://doi.org/10.1136/bmj.f174.

Walsh, S.L., El-Bassel, N., Jackson, R.D., Samet, J.H., Aggarwal, M., Aldridge, A.P., Baker, T., Barbosa, C., Barocas, J.A., Battaglia, T.A., Beers, D., Bernson, D., Bowers-Sword, R., Bridden, C., Brown, J.L., Bush, H.M., Bush, J.L., Button, A., Campbell, A. N.C., Cerda, M., Cheng, D.M., Chhatwal, J., Clarke, T., Conway, K.P., Crable, E.L., Czajkowski, A., David, J.L., Drainoni, M.-L., Fanucchi, L.C., Feaster, D.J., Fernandez, S., Freedman, D., Freisthler, B., Gilbert, L., Glasgow, L.M., Goddard-Eckrich, D., Gutnick, D., Harlow, K., Helme, D.W., Huang, T., Huerta, T.R., Hunt, T., Hyder, A., Kerner, R., Keyes, K., Knott, C.E., Knudsen, H.K., Konstan, M., Larochelle, M.R., Craig Lefebvre, R., Levin, F., Lewis, N., Linas, B.P., Lofwall, M.R., Lounsbury, D., Lyons, M.S., Mann, S., Marks, K.R., McAlearney, A., McCollister, K.E., McCrimmon, T., Miles, J., Miller, C.C., Nash, D., Nunes, E., Oga, E.A., Oser, C.B., Plouck, T., Rapkin, B., Freeman, P.R., Rodriguez, S., Root, E., Rosen-Metsch, L., Sabounchi, N., Saitz, R., Salsberry, P., Savitsky, C., Schackman, B.R., Seiber, E.E., Slater, M.D., Slavova, S., Speer, D., Martinez, L.S., Stambaugh, L.F., Staton, M., Stein, M.D., Stevens-Watkins, D.J., Surratt, H.L., Talbert, J.C., Thompson, K.L., Toussant, K., Vandergrift, N.A., Villani, J., Walker, D.M., Walley, A.Y., Walters, S.T., Westgate, P.M., Winhusen, T., Wu, E., Young, A.M., Young, G., Zarkin, G.A., Chandler, R.K., 2020. The HEALing (Helping to End Addiction Long-term SM) Communities Study: Protocol for a cluster randomized trial at the community level to reduce opioid overdose deaths through implementation of an integrated set of evidence-based practices. Drug Alcohol Depend. 217, 108335. https://doi.org/10.1016/j.drugalcdep.2020.108335.

Weiner, S.G., Cash, R.E., Hendricks, M., El Ibrahimi, S., Baker, O., Seethala, R.R., Peters, G., Goldberg, S.A., 2020. Ambulance Calls for Substance-Related Issues Before and After COVID-19. Prehosp. Emerg. Care 1–17. https://doi.org/10.1080/10903127.2020.1845420.

Wong, L.E., Hawkins, J.E., Langness, S., Murrell, K.L., Iris, P., Sammann, A., 2020. Where Are All the Patients? Addressing Covid-19 Fear to Encourage Sick Patients to Seek Emergency Care. NEJM Catal. Innov. Care Deliv.