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How emergency department visits for substance use disorders have evolved during the early COVID-19 pandemic

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\textbf{ABSTRACT}

\textbf{Objective:} Higher opioid overdoses and drug use have reportedly occurred during the COVID-19 pandemic. We provide evidence on how emergency department (ED) visits for substance use disorders (SUD) changed in the early pandemic period.

\textbf{Methods:} Using retrospective data from January–July 2020 compared to January–July 2019, we calculated weekly 2020/2019 visit ratios for opioid-related, alcohol-related, other drug–related disorders, and all non-COVID-19 visits. We assess how this ratio as well as overall visit numbers changed after the mid-March 2020 onset of general pandemic restrictions.

\textbf{Results:} In 4.5 million ED visits in 2020 and 2019 to 108 EDs in 18 U.S. states, SUD visits were higher in early 2020 compared to 2019. During the peak-pandemic restriction period (March 13–July 31), non-COVID-19, non-SUD visits fell by approximately 45% early on, and then partly recovered with an average decline of 33% relative to 2019 levels. Visits for opioid-related, alcohol-related, and other drug–related disorders also declined, although less sharply, with an average drop of 17%, which was similar across SUD types. The visit ratios for 2020/2019 partially or fully recovered later in our sample period, depending on SUD type, but did not exceed early-2020 levels. However, substantial variation occurred across SUD types and across states. SUD visit declines were most prominent in the 65+ age group, except for alcohol-related visits where trends were similar across ages. SUD visits arriving by ambulance declined less or increased relative to self-transport visits, and ED deaths were rare.

\textbf{Conclusions:} The 2020/2019 ratios of SUD ED visits fell substantially early in the COVID-19 pandemic, yet less than non-SUD, non-COVID ED visits. SUD ED visit ratios partly or fully recovered to 2019 levels by early June 2020, but did not exceed early 2020 ratios.

\section{Introduction}

The U.S. COVID-19 crisis began in early 2020, with the government declaring a national emergency on March 13, 2020. Starting in mid-March, many states closed schools and businesses and promoted social distancing to reduce viral spread. The crisis had a large effect on hospital-based emergency departments (ED), which experienced sharp visit declines approaching 50% of 2019 volumes in mid-April (Lange et al., 2020). Since then, non-COVID visit volumes have partially, but not fully, recovered (Hartnett et al., 2020; Jeffery et al., 2020; Pines et al., 2020). Possible reasons for these include patient fears of contracting COVID-19 while in the ED or hospital, lower incidence of injury and communicable disease due to lockdowns and social distancing, and increased moves to telehealth from in-person care (Pines, 2020).

ED visits for people with substance use disorders (SUDs) may have evolved differently than other visit types during the COVID-19 pandemic. Among individuals with SUDs, social isolation may have reduced distractions from addiction, lowering access to social networks.
In addition, job loss could lead to despair and increased substance use, and the availability of substance use treatment may have become limited (Bojdan et al., 2020; Panno et al., 2020). These effects would potentially increase the propensity for substance use and overdose. By contrast, lockdowns and policies restricting gatherings may have reduced socializing-related substance use, particularly for alcohol. In addition, the pandemic may have disrupted supply chains for illicit drugs and curtailed access to opioid prescriptions, and economic distress could have limited funds to purchase illegal drugs. These factors could decrease substance use. ED visits for substance use are likely to reflect the combined effects of both sets of factors.

Single-center ED studies have reported increased opioid overdoses, and broadly, studies have reported higher rates of urine drug test positivity for cocaine, fentanyl, heroin, and methamphetamine in populations at risk for or with prior diagnoses of substance use during the COVID-19 pandemic (Ochalek et al., 2020; Wainwright et al., 2020). News articles have also described spikes in drug overdoses observed primarily from pre-hospital emergency medical services (EMS) reports and increased calls to substance use hotlines (Wan & Long, 2020). Since drug and alcohol use, in particular when serious (e.g., severe agitation or sedation), commonly results in ED care, ED visit trends for substance use provide evidence on actual trends in community substance use. Studying ED visits can also test the extent to which media and other reports accurately depict those trends.

A recent study used data from the National Syndromic Surveillance Program (NSSP) at the Centers for Disease Control and Prevention (CDC) tabulated ED visits for mental health issues, suicide attempts, and drug and opioid overdoses (Holland et al., 2021). For overdoses (the part of that study that partially overlaps with ours), that study found that nonfatal opioid overdoses increased pre-pandemic over 2019 and early 2020, declined in the early pandemic, and then returned to roughly the baseline trend (thus, higher overdose rates in 2020 than in 2019) within several months after the pandemic’s onset. The study also demonstrates a higher proportion of ED visits for overdose in the pandemic period. This finding reflects a large fall in other ED visits, which fell substantially in the pandemic period, especially low-acuity and pediatric visits (Hartnett et al., 2020; Pines et al., 2020), rather than an increase in overdose visits.

Here we present data on how ED visits for a broad group of substance use-related conditions evolved in the early pandemic period, drawing on data from a national emergency medicine group. We measure ED visit volumes during January–July 2020, relative to visits during the same periods in 2019, and compare trends for substance use visits to trends for other non-COVID-19 visits, before and during the pandemic.

2. Materials and methods

2.1. Study design, setting, and selection of participants

We examined data from general U.S. acute care hospital EDs in 18 states staffed by a national emergency medicine group during January 2019–July 2020. We compared 2020 ED visit volumes to 2019 visits during the same time period within the same EDs for all non-SUD non-COVID-19 ED visits and for ED visits with diagnoses for opioid-related, alcohol-related, other drug-related disorders (cannabis, hallucinogens, sedatives, stimulants, inhalants, and other specific substance-related disorders), and total SUD visits (See Appendix for International Classification of Diseases, version 10 [ICD-10] codes). A previous study described the dataset used for this study (Carlson et al., 2018). The study employed trained billing and coding specialists to abstract ED visit data. Analyses included data from general EDs (n = 108) continuously staffed by the emergency medicine group between January 1, 2019 and July 31, 2020. The Allegheny Health Network Institutional Review Board approved the study.

2.2. Methods of measurement and data analyses

We report changes in visit volumes for each group during the pandemic period (March 13–July 31, 2020) versus the same time period in 2019 stratified by diagnosis and also demographics, disposition, facility characteristics, and U.S. state. We also report the change in this ratio during the pandemic period, relative to a 2020/2019 ratio prior to the pandemic period—a ratio of ratios. The ratio analysis lets us control for a secular trend toward higher substance use visits observed during 2019, which continued into early 2020 (Holland et al., 2021). We thus avoid attributing higher postpandemic visit rates to the pandemic, when we would have expected higher rates based on prepandemic trends.

We graphed the moving 3-week 2020/2019 ratio of ED visits for opioids, alcohol, other drug disorders (stimulants, cannabis, inhalants, hallucinogens, and sedatives) and all non-COVID-19 visits over January 2019–July 2020. The study excluded ED visits with a confirmed COVID-19 diagnosis. We computed this ratio within each ED and smoothed the graphs by calculating ratios for each visit category using a 3-week rolling average (t − 4, t − 3, t − 2, t − 1, t, t + 1). We report average ratios using 2019 total ED volume as hospital weights; the study used these weights to improve precision and make the reported ratios more representative of the full populations seen at these EDs. For each smoothed data point, we calculated 95% confidence intervals using standard errors clustered at the facility-level. In the ratio of ratios approach, we used the 2020/2019 ratio during COVID weeks as the numerator and the 2020/2019 pre-COVID weeks as the denominator. The study used Stata version 16.1 (StataCorp) for analyses.

3. Results

Across 4.5 million ED visits in January–July 2019 and 2020 to 108 EDs in 18 U.S. states, we observed an overall 33% decline in non-substance use-related, non-COVID-19 visits during the period from March 13 through July 31, 2020. Compared to earlier in 2020, measured in both cases relative to visits during 2019, an overall 17% drop occurred in substance use visits (ratio of ratios; Table 1).

Across all types of substance use–related disorders studied, we found similar declines in the early pandemic period, followed by a recovery toward, but not exceeding, the prepandemic trend. Over the full pandemic period that we studied, visits declined across all ages but were somewhat lower for age 18–44 (15%) and higher for children (23%) and the elderly (21%). The overall decline was slightly higher for women (19%; this difference was driven by a larger drop in opioid-related visits for women [26%]). Substance use–related visits arriving by emergency medical services vehicle declined somewhat less (19%) than visits arriving by self-transport (ambulatory or private vehicle; 23%). ED deaths or died on arrival were rare but increased from 10 in 2019 to 16 in 2020, with a 2.51 ratio of ratios. We found some heterogeneity across larger versus smaller facilities, with opioid visits declining more for large fringe and medium metro area facilities (24%) and alcohol visits declining more in small metro and rural EDs (25%).

Substantial heterogeneity existed across states, with some states showing increases while others showed declines. For example, Florida showed a 54% increase in opioid visits from a low base level, while Ohio showed a 39% decline from a much higher base level. Substantial heterogeneity also existed across substance types, both across and within states. In Florida, for example, alcohol visits rose only 7%, in contrast to the much larger rise in opioid visits; while in Ohio other substance visits declined 12%, much less than the Ohio decline in opioid visits.

We plotted weekly 2020/2019 ratios (note that these are simple ratios, not ratios of ratios, unlike the ratios reported in Table 1) for all non-COVID-19 visits; all substance use visits; and for opioid, alcohol, and stimulant and other visits (Fig. 1). Substance use visits were higher in 2020 in the prepandemic period, and declined during the pandemic, but less in percentage terms than other non-COVID visits. Trends for
Table 1
Change in emergency department (ED) visits: 2020 (during pandemic; March 13–July 31) vs. same period in 2019.

| Disposition                  | 2019 Visits | 2020 Visits | Post/pre ratio | 2019 Visits | 2020 Visits | Post/pre ratio | 2019 Visits | 2020 Visits | Post/pre ratio | 2019 Visits | 2020 Visits | Post/pre ratio |
|------------------------------|-------------|-------------|----------------|-------------|-------------|----------------|-------------|-------------|----------------|-------------|-------------|----------------|
| Admitted/transfer            | 350,139     | 271,432     | 0.76           | 1,183,523   | 772,738     | 0.64           | 2242        | 2158        | 1.03           | 58,481     | 39,942     | 0.67           |
| Self-transport               | 937,805     | 619,507     | 0.67           | 334,460     | 228,619     | 0.67           | 1082        | 1188        | 0.90           | 295,040     | 206,915     | 0.69           |
| Emergency vehicle            | 235,876     | 193,173     | 0.73           | 156,111     | 107,810     | 0.58           | 125,339     | 86,559      | 0.67           | 16,650      | 14,587      | 0.88           |
| Other/unidentified Missing  | 128,918     | 77,925      | 0.60           | 334,460     | 228,619     | 0.67           | 1082        | 1188        | 0.90           | 295,040     | 206,915     | 0.69           |
| ED setting                   | 450,128     | 299,464     | 0.66           | 334,460     | 228,619     | 0.67           | 1082        | 1188        | 0.90           | 295,040     | 206,915     | 0.69           |
| Large fringe and medium metro (N = 26) | 849,229 | 580,312     | 0.67           | 334,460     | 228,619     | 0.67           | 1082        | 1188        | 0.90           | 295,040     | 206,915     | 0.69           |
| Small metro and rural (N = 28) | 295,040     | 206,915     | 0.67           | 334,460     | 228,619     | 0.67           | 1082        | 1188        | 0.90           | 295,040     | 206,915     | 0.69           |

| States                       | 2019 Visits | 2020 Visits | Post/pre ratio | 2019 Visits | 2020 Visits | Post/pre ratio | 2019 Visits | 2020 Visits | Post/pre ratio | 2019 Visits | 2020 Visits | Post/pre ratio |
|------------------------------|-------------|-------------|----------------|-------------|-------------|----------------|-------------|-------------|----------------|-------------|-------------|----------------|
| Texas (N = 26)               | 334,460     | 228,619     | 0.67           | 178,589     | 129,088     | 0.72           | 211,032     | 145,176     | 0.68           | 156,111     | 107,810     | 0.68           |
| Colorado (N = 16)            | 211,032     | 145,176     | 0.68           | 156,111     | 107,810     | 0.68           | 125,339     | 86,559      | 0.67           | 164,327     | 108,807     | 0.66           |
| Ohio (N = 12)                | 211,032     | 145,176     | 0.68           | 156,111     | 107,810     | 0.68           | 125,339     | 86,559      | 0.67           | 217,603     | 148,719     | 0.67           |
| Pennsylvania (N = 12)        | 211,032     | 145,176     | 0.68           | 156,111     | 107,810     | 0.68           | 125,339     | 86,559      | 0.67           | 217,603     | 148,719     | 0.67           |
| Maryland (N = 10)            | 206,936     | 131,173     | 0.63           | 156,111     | 107,810     | 0.68           | 125,339     | 86,559      | 0.67           | 217,603     | 148,719     | 0.67           |
| Florida (N = 9)              | 164,327     | 108,807     | 0.66           | 156,111     | 107,810     | 0.68           | 125,339     | 86,559      | 0.67           | 217,603     | 148,719     | 0.67           |
| North Carolina (N = 8)       | 164,327     | 108,807     | 0.66           | 156,111     | 107,810     | 0.68           | 125,339     | 86,559      | 0.67           | 217,603     | 148,719     | 0.67           |
| All other states (N = 18)    | 164,327     | 108,807     | 0.66           | 156,111     | 107,810     | 0.68           | 125,339     | 86,559      | 0.67           | 217,603     | 148,719     | 0.67           |

* Opioid, alcohol, and other drug disorders (cannabis, stimulants, sedatives, hallucinogens, and inhalants) are classified by primary and secondary ICD-10-CM diagnoses using the AHRQ Clinical Classifications Software Refined (v2020.3).

** AMA = left against medical advice. LWT = left without treatment.

** N = number of EDs. ED location determined using the National Center for Health Statistics 2013 Urban-Rural Classification Scheme for Counties. EDs in states not shown include California (1), Connecticut (1), Hawaii (2), Illinois (1), Kansas (1), Kentucky (1), Michigan (1), New Hampshire (2), New York (1), Oklahoma (3), and Virginia (1).

** Ratio is a “ratio of ratios”, i.e., 2020/2019 ratio during the COVID period (Mar-13 to Jul-31)/2020/2019 ratio during the pre-COVID period (Jan-1 to Mar-12).

** Visits to 14 EDs that did not submit mode of arrival data during the study period are excluded.

** Visits had fully recovered to 2019 levels, but remained somewhat below the prepandemic 2020 levels. During the pandemic period, substance use visits peaked in early June and then declined again.

4. Discussion
During the prepandemic period in 2020, substance use ED visits were
higher relative to 2019 for all categories, but especially so for opioids, with 2020 levels around 120% of those in 2019. This finding is consistent with a CDC report of ED visits, which reports progressively higher visits for nonfatal drug overdoses and mental health visits in 2019 and early 2020 (Holland et al., 2021). These trends were potentially related to a deepening drug crisis, with surges in synthetic opioids, methamphetamine, and cocaine (Hoots et al., 2020). The pandemic period saw dramatic declines in general ED visits, with surges in synthetic opioids, methamphetamine, and cocaine (Hoots et al., 2020). The pandemic period saw dramatic declines in general ED visits, likely reflecting a combination of social isolation policies and patients avoiding ED care for fear of becoming infected (Hartnett et al., 2020; Jeffery et al., 2020; Pines, 2020). Visits for substance use disorders followed a similar pattern, but declined less, and have returned to 2019 levels, although in our sample, visit rates remain below the trend we would expect based on 2019 and early 2020. Data from 141 EDs from a physician billing company (Lucero et al., 2020) and in a CDC study (Holland et al., 2021) have shown similar trends. These data suggest that other effects, including the interaction between the mental health effects of isolation and drug use, may have dampened the direct effect of fewer social interactions on ED visits during the pandemic (Krendl & Perry, 2020). The more rapid return for substance use visits to baseline levels compared to other ED visits, which have remained depressed, suggests that some factors that influence demand for non-substance use visits—increased availability of telemedicine or other alternatives, for example—may not directly impact substance use ED visits.

The substantial decline in substance-related ED visits that we observe, relative to prepandemic trends, diverges from the prevailing media stories at the time of large increases in both fatal and nonfatal opioid overdoses during the COVID-19 pandemic (Wan & Long, 2020). These reports largely drew their evidence from fatal overdose data from EMS, substance use hotline call center data, and a single-center ED study; and increases in observed urine drug test positivity in a broad sample across U.S. states (Ochalek et al., 2020; Slavova et al., 2020; Wainwright et al., 2020). Our study did not directly study fatal overdoses. However, a large spike in nonfatal overdoses, if present across our sample, is likely to be observed in ED visits for substance use disorders. Some people may have died from overdoses in social isolation at home without reaching an ED. We did find that deaths related to SUD did increase, and there was less of a fall in ambulance arrivals compared to self-transports. Yet the lack of a large relative increase in observed substance use ED visits suggests a more nuanced story—one of potentially higher drug use and increased fatal overdoses in some communities, as well as calls for help, but with declines in other communities, relative to the prepandemic trend. The pandemic affected some geographic areas more than others, but we found no clear sustained

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**Fig. 1.** Weekly ratio of ED visits 2020/2019 during the COVID-19 pandemic.

Panel A shows the ratio of 2020 to 2019 emergency department (ED) visits for January 2020 through July 2020 for opioid use disorders in a large sample of US EDs. Panel B shows a similar ratio for alcohol disorders and Panel C shows a similar ratio for other drug disorders, including cannabis, stimulants, sedatives, hallucinogens, inhalants, and other, and Panel D is all substance use disorder ED visit ratios, represented similarly. Each panel includes a separate line for the ratio of total 2020 to total/2019 ED visit, excluding COVID-related and substance use visits. A dotted vertical line separates pre-pandemic from pandemic period (National Emergency declared on March 13, 2020). Weekly ratios calculated using a three-week rolling average (t − 2, t − 1, t) in 2020 over a 5-week rolling average in 2019 (t − 3, t − 2, t − 1, t, t + 1). Small vertical bars around each data point indicate 95% confidence intervals. SUD = substance use disorder.
pattern suggesting that the pandemic led to more serious overdoses requiring ED care. Our findings also underscore the importance of using multiple data sources to triangulate evolving, interacting public health issues such as COVID-19 and substance use, for which our near-real-time ED data can be an important source.

On the whole, the COVID-19 pandemic affected ED visits for different substances similarly, with declines of 18% for opioids, 16% for alcohol, and 16% for other drug disorders. While alcohol visits were potentially more affected by bar and restaurant closings, this effect did not translate into a larger drop in ED visits, versus other substances. Another notable finding from our study is the geographic heterogeneity in the effect. While not directly tested in our study, potential explanations may include community-level variation in several parameters, including baseline rates of substance use, rates of COVID-19 and perceived community risk of contagion, access to other health care settings (e.g. telemedicine), or compliance with public health measures. Future studies should assess these different effects.

This study has several limitations. Our study EDs are geographically diverse across 18 states but represent only about 2% of U.S. EDs and may not generalize to other sites. Second, we used only visit diagnosis to identify substance use-related visits. We could not determine whether other diagnoses (e.g. injuries)—which may be caused by substance use but not coded as such—contributed to actual visits being underestimated. However, because our primary goal was to explore trends, this finding would not be systematically different in 2020 compared to 2019. We also did not fully examine how state-level policies, such as the timing of reopening, impacted the speed of patients returning to the ED after the initial fall early in the pandemic, which could conceptually impact the results. We do not hypothesize that reopening timing would explain the observed geographic variation as the other causes we have described were likely more impactful. Third, we focused solely on identifying ED visits with any diagnosis of substance use and did not directly examine other co-diagnoses that may have driven differences in rates (e.g., diagnoses of endocarditis).

We also solely examined ED visit data and did not have data on downstream outcomes after hospitalization or discharge. We could not observe the effects of avoided visits due to fears of ED-based contagion, or substance use that occurred without ED presentation. Future work should assess the extent to which care that patients avoided or deferred impacted outcomes, in particular deaths that occurred outside of the ED or patients who refused ED transport. In general, many substance use ED visits are emergencies that are cared for only in ED settings, particularly those involving agitation or sedation. Therefore, examining ED visits for SUDs provides a valid estimate of community substance use. Finally, we speculate about potential causes for falling ED visits, yet we cannot directly determine why specific visits declined.

5. Conclusion

In conclusion, substance use visits declined during the early part of the pandemic period relative to the pre-pandemic period, although less than other non-COVID visits. Substance use visits recovered in early summer 2020 to prepandemic levels, while other non-COVID visits have not fully recovered. We report evidence against an observable worsening during the pandemic of nonfatal opioid overdoses and health complications of SUDs that would cause ED visits in the communities surrounding our study EDs. The secular trend toward higher rates of ED visits for substance abuse that we observed in 2019 and early 2020 is concerning, but we do not find evidence that the pandemic made this bad situation worse. If it had made it worse, we should have observed higher 2020/2019 ratios in the pandemic period, relative to early 2020. The interaction between the COVID-19 pandemic and SUDs requires further study, particularly as the COVID-19 pandemic evolves in this vulnerable population.

CRediT authorship contribution statement

Jesse M. Pines: Conceptualization, Methodology, Writing original draft, Supervision; Mark S. Zocchi: Conceptualization, Methodology, Software, Formal analysis, Writing original draft, Visualization; Bernard S. Black: Conceptualization, Methodology, Formal analysis, Writing – review & editing, Visualization; Jestin N. Carlson: Conceptualization, Methodology, Writing – review & editing; Pablo Celedon: Conceptualization, Software, Resources, Data Curation, Methodology, Writing – review & editing; Ali Mognatieri: Conceptualization, Methodology, Formal analysis, Writing – review & editing; Arvind Venkat: Conceptualization, Methodology, Project administration, Writing – review & editing. Supervision.

Declaration of competing interest

JMP has been an advisor to CSL Behring, Medtronic, and Abbott Point-of-Care for unrelated work. No other authors have disclosures.

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Appendix A. Supplementary data

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