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Research Paper

The COVID-19 pandemic and the health of people who use illicit opioids in New York City, the first 12 months

Alex S. Bennett^{a,b,*}, Tarlise Townsend^{b,c,d}, Luther Elliott^{a,b}^a Department of Social and Behavioral Sciences, School of Global Public Health, New York University, United States^b Center for Drug Use and HIV Research (CDUHR), School of Global Public Health, New York University, 708 Broadway, 6th Floor, New York, NY 10012, United States^c Center for Opioid Epidemiology and Policy, Department of Population Health, New York University Grossman School of Medicine, United States^d Behavioral Science Training Program, NYU Rory College of Nursing, United States

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ABSTRACT

Background: Concurrent opioid-related overdose and COVID-19 crises in the U.S. have imposed unprecedented challenges on people who use illicit opioids.

Methods: Using the experiences of 324 people who use illicit opioids between April 2020 and March 2021, we examined four domains of health and well-being potentially impacted by COVID-19: drug risks and responses, healthcare and related services, material hardship, and mental health. Data were drawn from participants' completed monthly survey assessments which were grouped into four periods of interest for the unfolding pandemic: April-June 2020, July-October 2020, November-January 2021, and February-March 2021.

Results: A majority of measures in our four domains showed early COVID-19 related impacts, which quickly diminished as people and agencies responded to the pandemic. Difficulty obtaining food was the most frequently reported material hardship and appeared worst in April-June 2020. Over half of the population reported depression in April-June 2020, but this declined over the study period. Some participants reported changes to the heroin supply, including higher prices, lower quality, difficulty finding the drug, and fentanyl contamination. There was no discernable temporal shift in the frequency of use of each substance or the frequency of withdrawal symptoms. Over the study period, the mean number of overdoses per month decreased while the percent of opioid use events at which both a witness and naloxone were present (i.e., protected events) increased. Most participants receiving MOUD experienced an increase in take-home doses.

Conclusions: Findings speak to the resilience of people who use drugs as a population with disproportionate experience of trauma and crisis and also to the rapid response of NYC health agencies and service providers working with this population. Despite evident signs of adaptability and resilience, the COVID-19 pandemic has highlighted some of the unique vulnerabilities of people who use illicit opioids and the need for greater rates of "protected" opioid use and greater availability of wrap-around services to efficiently address the safety, food security, mental health, and treatment needs of the population.

Introduction

In the United States (U.S.) there were over 100,000 reported overdose fatalities in the 12-month period ending April 2021, and there are no signs that the overdose crisis is letting up (CDC, 2021). Coinciding with the worst year yet for overdose mortality in the history of the U.S. opioid overdose crisis (CDC, 2021), the COVID-19 pandemic has been an ongoing global public health emergency that has imposed unprecedented health challenges, physically, psychologically, and socially, for many vulnerable populations. Emerging reports and commentaries sug-

gest widespread and, in some cases, lengthy disruptions to the illicit drug supply, drug treatment, and harm reduction services, all of which has made drug use riskier (Grebely, Cerdá & Rhodes, 2020; Nguyen & Buxton, 2021; Volkow, 2020). New York City (NYC), the setting for this study, was the COVID-19 epicenter in the U.S. in March – May 2020 with over 203,000 laboratory confirmed cases of COVID-19 during this period (Thompson et al., 2020). On March 7, 2020 former Governor Andrew Cuomo issued a "State of Emergency," subsequently closing schools (March 15), issuing "stay at home" orders and closing all non-essential businesses (March 20).

* Corresponding author.

E-mail address: asb19@nyu.edu (A.S. Bennett).<https://doi.org/10.1016/j.drugpo.2021.103554>

As in many locations around the world, COVID-19 exacerbated social and structural inequalities in NYC, exerting the heaviest toll on essential workers and already vulnerable populations: COVID-19 infections, hospitalizations and deaths were disproportionately concentrated in communities of color and high-poverty areas (Dorn, Cooney & Sabin, 2020). While NYC syringe service programs were deemed “essential,” allowing for ongoing (though limited) service provision to people who use and inject drugs during the early months of the pandemic, a range of commentaries in major drug research journals warned about the likelihood for wide-ranging impacts of COVID-19 on the health and well-being of people who use drugs across the country. Authors posited that people who use drugs would have to navigate social distancing and physical isolation, which could limit access to healthcare, harm reduction, treatment, and medications for opioid use disorder (MOUD; Alexander, Stoller, Haf-fajee, & Saloner, 2020; Becker & Fiellin, 2020; Glick et al., 2020; Khatri & Perrone, 2020; Vasylyeva, Smyrnov, Strathdee & Friedman, 2020; Volkow, 2020; Wang, Kaelber, Xu & Volkow, 2021).

People who use drugs are also considered a population at elevated risk for COVID-19 infection (Allen et al., 2020; Bonn et al., 2020) and have experienced worse COVID-19 outcomes due to factors such as stigma-related avoidance of medical care, poor health literacy and discrimination (Dunlop et al., 2020). Highlighting the compounding of existing vulnerabilities among people who use drugs by the pandemic, Nguyen & Buxton, 2021 have suggested that broadly adopted public health responses to COVID-19 have had the unintentional effect of undermining already established prevention interventions designed to reduce overdose morbidity and mortality. For example, social distancing mandates encourage solitary drug use, which reduces the opportunity for bystanders to administer naloxone and/or call emergency medical services in an overdose situation. This is especially concerning during a time when the illicit opioid market is potentially becoming more lethal due to disrupted supply chains and a reportedly greater reliance on illicitly manufactured fentanyl (Nguyen & Buxton, 2021). Confirming the predictions of researchers that COVID-19 will lead to rising rates of overdose (Wakeman, Green, & Rich, 2020), recent epidemiological data have now confirmed fears of a nexus of risk and vulnerability resulting in a national surge of overdose fatalities in 2020 and 2021 (CDC, 2021).

The COVID-19 crisis is still unfolding, and, in the absence of longitudinal findings about its impacts on people who use drugs (Giommoni, 2020), it bears considering the precedent of research into previous natural and man-made disasters when conceptualizing the potential impacts of the current pandemic. Researchers investigating the impacts of Hurricanes Katrina and Sandy, as well as 9/11 (Pouget, Sandoval, Nikolopoulos & Friedman, 2015; Reid, Bennett, Elliot & Golub, 2012; Zolopa et al., 2021) have documented the evolving impacts of disasters on the health and well-being of people who use drugs, finding evidence that the greatest impacts and health risks often occur during and immediately after the event and that these risks are mitigated as people adjust and adapt to new drug markets and reestablish social relationships (Bennett, Golub & Dunlap, 2011; Dunlap, Graves & Benoit, 2012). Research on disasters and complex emergencies, for example, the Big Events framework, considers how natural, economic, and/or political disasters can result in better or worse health outcomes for vulnerable populations in the short- and long-term (Friedman, Rossi & Braine, 2009; Zolopa et al., 2021). These impacts can be felt in multiple overlapping and intertwined psychosocial, economic, policy and political domains, rapidly evolving “risk environments” that affect the health of people who use drugs (Rhodes, 2002). Drawing on this multidimensional social-ecological framework, as well as individual-level responses to the pandemic, we focus on the following domains:

Drug-related risks

Disasters can greatly disrupt local drug markets, forcing people to look for ways to deal with supply shortages and changes while also dealing with the impacts of the disaster-related dislocation and trauma,

psychologically and socially (Goldmann & Galea, 2014). As was the case following 9/11 and Hurricane Sandy, some people medicate to deal with the newly felt traumatic experience (Vlahov, Galea, Ahern, Resnick & Kilpatrick, 2004). For people who use drugs and those with opioid use disorder (OUD), risks associated with procuring and using drugs may increase, especially in the context of policy mandates encouraging social distancing and social isolation (Tyndall, 2020). The effects of disrupted supply chains, market instability, lack of a stable supply of drugs and changes in terms of potency, chemical composition, and price, coupled with the introduction of other drugs into the supply, can significantly increase overdose risk and other drug-related harms (Cepeda, Valdez, Kaplan & Hill, 2010; Dietze & Peacock, 2020; Nguyen & Buxton, 2021; Vlahov et al., 2004). With drug markets in flux, drug use potentially becomes riskier, and supply shortages can precipitate drug use transitions and substitutions, some of which may present greater risks for negative health outcomes (Neaigus et al., 2001). The global nature of the COVID-19 pandemic, impacting countries that produce raw opium for morphine and heroin as well as the synthetic opioid, fentanyl, suggests that there may be considerable shifts in the illicit supply of opioids for years to come (Ciccarone, 2009, 2019).

Healthcare and related services

For those receiving drug treatment or supportive services, including those provided by syringe service programs, disaster-related closures or drastic reductions in services may also create serious public health risks, as occurred following Hurricane Sandy (Elliott, Benoit, Matusow & Rosenblum, 2017; Matusow, Benoit, Elliott, Dunlap, & Rosenblum, 2017). In one study of NYC opioid users, for example, almost half of participants enrolled in opioid treatment programs reported use of heroin or diverted prescription opioids alone or in combination with maintenance medications to avoid withdrawal after being displaced from their home programs in the wake of the storm (Pouget et al., 2015). Likewise, across the U.S., more than 40 percent of syringe service programs responding to a survey in 2020 reported decreasing the services they offer due to the COVID-19 pandemic, and 25 percent reported that one or more of their sites had closed entirely (Glick et al., 2020). Limited availability of safer use supplies and services (sterile syringes and other injection equipment, naloxone, condoms, and HIV/HCV testing), especially in the first few weeks of the pandemic as many harm reduction agencies went on “pause” or reduced operations (Substance Abuse and Mental Health Services Administration (SAMHSA), 2020), created additional risks that people who use drugs had to navigate. COVID-related service reductions may have created additional problems because people who use and/or inject drugs may have not only lost access to supplies and services, but to healthcare more generally at a time when the risks were greatest (Collins, Ndoye, Arene-Morley & Marshall, 2020; Nguyen & Buxton, 2021).

Material hardship

By prompting widespread business closures and mass layoffs, the COVID-19 pandemic contributed to increased material hardship for many people who use drugs, including unemployment or reduced working hours and difficulty obtaining supportive services. In many locations there was concern over food scarcity, which is especially salient in the context of drug use as poor access to food often co-occurs with drug use and contributes to associated sequelae, such as risks for HIV and diabetes (Rouhani et al., 2021). With limited resources there was a greater risk for increased sharing of syringes and drugs and experiencing painful (and sometimes health-threatening) periods of drug withdrawal due to financial hardship.

Mental health

Concerns about employment and maintaining adequate food and drug supplies can have negative consequences for psychological well-being (Chiappini, Guirguis, John, Corkery & Schifano, 2020). Work on disaster has demonstrated the myriad forms of mental health-related challenge that can be generated by a destructive “big event” (Zolopa et al., 2021). COVID-19 may have contributed to depression, anxiety, and loneliness through a range of pathways including the grief associated with loss of loved ones to COVID-19, isolation associated with social distancing, and stress due to unemployment or other hardship (Chiappini et al., 2020; Galea, Nandi & Vlahov, 2005; Goldmann & Galea, 2014; Nguyen & Buxton, 2021). These effects may be particularly prominent among people who use drugs and may contribute to worsening substance use and related outcomes (Stuber, Resnick & Galea, 2006). Experiencing a disaster may increase vulnerability to other mental health concerns including depression, loneliness and anxiety, on top of higher-risk substance use behaviors (Goldmann & Galea, 2014).

The impacts of COVID-19 on the mental health of people who use drugs, and how these varied throughout the course of the pandemic, are not yet well understood. In the analysis that follows, we attempt to fill gaps in our scientific understanding of how COVID-19 has impacted people who use illicit opioids in a city that, within the U.S. context, has a relatively well-resourced public health and harm reduction infrastructure as well as a relatively large population of people who use drugs, potentially providing for more rapid and effective adaptation to COVID-related challenges than has been suggested in much of the early commentary on the pandemic and the responses of people who use drugs.

Method

Study design and sample

To better understand the impacts of COVID-19 on people who use illicit opioids in NYC and how these evolved throughout the first year of the pandemic, we surveyed people who use illicit opioids between April 2020 and March 2021, focusing on impacts in several domains including drug risks and responses, healthcare and related services, material hardship, and mental health. Participants were enrolled in a longitudinal cohort study and were persons ($N = 576$) aged 18 or older who were currently using non-prescribed opioids (including heroin, fentanyl, and prescription opioids used without prescription) and residing in one of the 5 boroughs of NYC. At initial enrollment into the study, self-report of recent (defined as past 3-day) opioid use was verified using a rapid urinalysis tool from BTNX that included 9 fentanyl-class drugs in addition to heroin/morphine, benzodiazepines, alcohol, amphetamines, oxycodone, marijuana, and methadone metabolites. Recruitment followed a traditional respondent-driven sampling (RDS) approach (Heckathorn, 1997; Heckathorn & Cameron, 2017) that used “coupons” to allow participants to refer as many as three of their opioid-using network members to the study. Ten initial participants representing ethnic, gender, and geographical diversity were directly recruited as “seeds,” ultimately resulting in a sample of 575 participants with complete baseline data. Participants completed a face-to-face baseline assessment with a trained and experienced interviewer entering data on a computer. At the same visit, participants completed their first of 24 monthly assessments tracking substance use, overdose, and psychosocial factors. For all subsequent monthly follow-ups, we used SMS/text-messaging and email reminders to contact participants every 30 days about their eligibility for a new follow-up survey. In April of 2020, due to the COVID-19 pandemic, staff added several new COVID-related measures to the monthly survey instrument (see Appendix).

In the present study, we limit the sample to 324 individuals who participated in the survey at the beginning and end of our analytic period, April 2020 through March 2021. That is, participants were included if they completed at least one monthly survey in the first period of

COVID-19, defined as April-June 2020, and at least one in the last period of interest, i.e., January-March 2021. The sociodemographic characteristics of this cohort differed little from the broader sample (Appendix Table 1).

Data collection

Data used in the current analyses are drawn from both baseline assessment, a roughly 2-hour survey instrument, administered at time of enrollment, as well as monthly online follow-up surveys during the study’s 24-month data collection. We used SMS/text-messaging and email reminders to contact participants every 30 days about their eligibility for a new follow-up survey. The project developed protocols to maximize retention. When enrolled, each participant completed a detailed locator form that included contact information for the participant and a number of family and peer relations whom the study could contact should the participant cease to respond to phone, SMS, and email notifications about monthly surveys.

Completion of the baseline assessment compensated eligible participants \$60 for the approximate 2.5-hour visit, which included urinalysis and overdose prevention and naloxone training and provision. Monthly follow-up surveys compensated participants \$20, transferred immediately upon completion of the surveys to their Clinical Trial Payer (CT-Payer) Visa cards.

All human research protocols were approved by the NYU Grossman School of Medicine’s Institutional Review Board.

Measures

We examined four domains of health and well-being among people who use illicit opioids in the context of COVID-19: drug risks and responses (Appendix Table 2), healthcare and related services (Appendix Table 3), material hardship (Appendix Table 4), and mental health (Appendix Table 5). Questions regarding drug risks and responses included frequency of use of a given substance (heroin, benzodiazepines, cocaine, methamphetamine, and alcohol); frequency of overdose events; the proportion of opioid use events at which both a witness and naloxone were present; frequency of withdrawal symptoms; concerns about accessing unprescribed drugs; experience of COVID-related difficulties regarding their drug supply; the impact of COVID-19 on overdose rescue response; and encounters with police. Questions regarding healthcare and related services included concerns about accessing medical care due to COVID; difficulty accessing prescribed medications, including MOUD; difficulty obtaining a COVID-19 test; and changes to MOUD and syringe service program access. Questions regarding material hardship investigated difficulties with employment and keeping food on the table, overall and due to COVID-19, as well as experiences losing housing and going unsheltered in the past month. Questions regarding mental health investigated participants’ isolation behavior in response to COVID-19, mental health difficulties due to COVID-19, and severity of and disruption due to pain. The wording of each question is provided in the supplemental materials (Appendix Tables 2–5).

Analyses

All analyses were conducted in Stata 15.1 (StataCorp, 2017). In univariate analyses, we calculated means and proportions endorsing the measures of interest in four separate time periods during the first year of the COVID-19 pandemic: April-June 2020, July-October 2020, November-January 2021, and February-March 2021. Each participant completed the first set of COVID-specific questions at some point between April and June 2020. We selected the remaining periods to roughly align with waves of COVID-19 burden in NYC, through the most recent data available. We thereby examined levels and trends in health and well-being among people who use illicit opioids in NYC throughout the first year of the pandemic.

Table 1
Sample characteristics

| | Mean (95% CI) | |
|---|---------------|------------------|
| Individuals | 324 | |
| Gender (%) | | |
| Male | 59.0 | (53.57 to 64.34) |
| Female | 39.8 | (34.46 to 45.17) |
| Other | 1.2 | (0.03 to 2.44) |
| Age (%) | | |
| 20-50 years | 49.7 | (44.22 to 55.16) |
| 51-56 years | 24.4 | (19.68 to 29.08) |
| 57-72 years | 25.9 | (21.13 to 30.72) |
| Race (%) | | |
| NH white | 21.3 | (16.81 to 25.78) |
| NH Black | 34.6 | (29.36 to 39.77) |
| Hispanic/Lat. | 38.6 | (33.25 to 43.91) |
| Other | 4.6 | (2.33 to 6.93) |
| Missing | 0.9 | (-0.12 to 1.97) |
| Education (%) | | |
| Less than high school | 23.1 | (18.53 to 27.77) |
| High school degree or GED | 40.4 | (35.06 to 45.80) |
| Some college/associate's | 31.2 | (26.10 to 36.24) |
| College degree | 5.2 | (2.81 to 7.69) |
| Employed (%) | 25.2 | (20.39 to 29.92) |
| Borough (%) | | |
| Manhattan | 31.5 | (26.40 to 36.57) |
| Staten Island | 2.2 | (0.57 to 3.75) |
| Brooklyn | 18.8 | (14.55 to 23.11) |
| Bronx | 34.9 | (29.66 to 40.09) |
| Queens | 12.7 | (9.02 to 16.29) |
| Married or living as married (%) | 23.8 | (19.11 to 28.42) |
| Currently living alone (%) | 25.9 | (21.13 to 30.72) |
| Currently homeless (%) | 32.8 | (27.02 to 38.60) |
| Opium Severity (%) | | |
| Mild | 5.6 | (3.05 to 8.06) |
| Moderate | 10.5 | (7.14 to 13.85) |
| Severe | 84.0 | (79.93 to 87.97) |
| Any heroin injection (%) | 37.3 | (31.88 to 42.64) |
| In treatment at study entry (%) ^a | 63.1 | (57.45 to 68.79) |
| Opioid use events protected by naloxone & witness, December 2019-February 2020 (%) ^b | 36.8 | (32.93 to 40.72) |

Notes: Unless otherwise indicated, estimates refer to each individual's first month participating during the analytic period of interest, April 2020-March 2021.

^a Participants were recruited to and initiated the study between April 2019 and March 2020.

^b For comparison to pre-pandemic levels. N=276 members of the sample cohort participated in at least one survey between 12/2019 and 2/2020.

Results

A total of 324 individuals met cohort inclusion criteria. [Table 1](#) details sample characteristics. The sample was predominantly male (59.0% male, 39.8% female, 1.2% other) and between ages 20–50 years (49.7%). Participants were most likely to be Hispanic/Latino (38.6%), followed by non-Hispanic Black (34.6%) and non-Hispanic white (21.3%). More than 75% had obtained at least a high school degree or equivalent, 84.0% met criteria for severe opioid use disorder, and 63.1% were receiving treatment for substance use disorder at study entry.

Drug risks and responses

Considerable proportions of participants reported impacts of COVID-19 on overdose response and on the drug supply ([Table 2](#)) but few reported changes in drug use and related outcomes throughout the first year of the pandemic. Some participants reported COVID-related changes to the heroin supply, including higher prices, lower quality, difficulty finding the drug, and fentanyl contamination. In April-June 2020, for example, 15.2% (95% CI: 10.9%–19.4%) reported decreasing heroin quality and 14.4% (95% CI: 10.3%–18.6%) reported it was harder to find. These perceived changes appeared to decrease during the first year of the pandemic. For example, between April-June 2020

and February-March 2021, the proportion of participants reporting suspected fentanyl in their drug supply decreased from 13% (95% CI: 9.0%–17.0%) to 7.3% (95% CI: 5.2%–9.5%).

In addition, 10–15% of participants reported both stocking up on non-prescribed drugs and concern about being able to access drugs due to the pandemic ([Table 2](#)). A substantial proportion of participants said that COVID-19 discouraged them from administering rescue breathing (62–68% throughout the year) and naloxone (39–43% throughout the year), although it is not clear whether this translated into behavior change.

Despite these reported impacts of COVID-19, there was no discernible temporal shift in the following outcomes during the first year of the pandemic: the frequency of use of each substance, the frequency of withdrawal symptoms, or the percent of opioid use events at which both a person to administer it and naloxone were present (i.e., protected events). Across periods, for example, 42–45% of opioid use events were “protected” – the respondent had both naloxone and a trusted person to administer it in the event of an overdose. The mean number of overdoses per month declined slightly in the last months ([Table 2](#)).

Healthcare and related services

Participants reported considerable impacts of COVID-19 on access to healthcare and related services ([Table 3](#)). For many measures, these ap-

Table 2
Drug risks and response

| | Apr.-Jun. 2020 | Jul.-Oct. 2020 | Nov. 2020-Jan. 2021 | Feb.-Mar.2021 |
|---|--------------------------|---------------------------|--------------------------|--------------------------|
| Individuals | 324 | 315 | 319 | 310 |
| Observations | 324 | 1155 | 827 | 567 |
| Number of days out of last 30 on which you used... (mean) | | | | |
| Heroin | 22.7 (21.66 to 23.74) | 22.5 (21.98 to 23.07) | 22.6 (21.99 to 23.28) | 22.6 (21.77 to 23.34) |
| Benzodiazepines | 4.0 (3.10 to 4.97) | 4.0 (3.49 to 4.46) | 4.0 (3.44 to 4.60) | 4.1 (3.39 to 4.80) |
| Cocaine | 6.2 (5.15 to 7.32) | 6.2 (5.64 to 6.78) | 6.2 (5.58 to 6.91) | 6.5 (5.69 to 7.33) |
| Methamphetamine | 0.2 (-0.04 to 0.36) | 0.2 (0.06 to 0.28) | 0.2 (0.04 to 0.31) | 0.1 (-0.01 to 0.22) |
| Alcohol | 5.2 (4.14 to 6.18) | 5.1 (4.56 to 5.62) | 4.9 (4.30 to 5.53) | 5.1 (4.37 to 5.89) |
| Percent of opioid use events protected by naloxone & witness | 44.7 (38.65 to 50.80) | 43.4 (40.24 to 46.51) | 44.8 (40.92 to 48.59) | 42.6 (37.95 to 47.17) |
| Overdose events in last 30 days | | | | |
| Any overdose (%) | 13.27 (9.56 to 16.99) | 13.33 (11.37 to 15.30) | 11.25 (9.09 to 13.40) | 10.58 (8.04 to 13.12) |
| Number (mean) | 0.8 (0.38 to 1.13) | 0.7 (0.55 to 0.93) | 0.6 (0.43 to 0.77) | 0.5 (0.32 to 0.72) |
| Number of days out of last 30 with any withdrawal symptoms (mean) | 2.0 (1.37 to 2.64) | 2.2 (1.92 to 2.56) | 2.2 (1.75 to 2.57) | 2.2 (1.64 to 2.66) |
| Recently stocked up on unprescribed drugs (%) | 13.6 (9.50 to 17.70) | 13.7 (11.48 to 15.98) | 11.6 (9.19 to 14.01) | 11.5 (8.51 to 14.39) |
| Top concern: not being able to get unprescribed drugs I use (%) | 14.9 (10.71 to 19.07) | 15.9 (13.69 to 18.06) | 14.4 (11.94 to 16.77) | 15.6 (12.57 to 18.61) |
| COVID-related difficulties: drug supply change (%) | | | | |
| Heroin prices going up | 7.6 (4.44 to 10.72) | 4.9 (3.63 to 6.21) | 4.0 (2.69 to 5.41) | 3.4 (1.90 to 4.91) |
| Heroin quality going down | 15.2 (10.91 to 19.41) | 13.5 (11.42 to 15.51) | 10.2 (8.10 to 12.26) | 9.3 (6.90 to 11.74) |
| Heroin harder to find | 14.4 (10.28 to 18.61) | 9.3 (7.55 to 11.02) | 7.7 (5.89 to 9.57) | 6.3 (4.25 to 8.29) |
| Suspect there is more fentanyl in my heroin | 13.0 (9.01 to 16.98) | 9.5 (7.72 to 11.22) | 9.6 (7.55 to 11.59) | 7.3 (5.18 to 9.52) |
| COVID makes it harder to want to... (%) | | | | |
| Administer rescue breathing | 68.0 (61.88 to 74.08) | 61.2 (57.77 to 64.67) | 63.1 (59.01 to 67.13) | 62.1 (57.01 to 67.21) |
| Administer naloxone | 39.8 (33.39 to 46.25) | 40.4 (37.06 to 43.70) | 42.6 (38.76 to 46.46) | 39.7 (34.84 to 44.55) |
| Stopped by police in last 30 days (%) | Not asked | 1.4 (0.69 to 2.09) | 1.1 (0.39 to 1.82) | 1.1 (0.22 to 1.93) |

Notes: 95% Confidence interval in parentheses.

peared to lessen throughout the first year of the pandemic. For example, 31.3% (95% CI: 27.7%–36.8%) of participants reported avoiding going to the doctor due to COVID-19 in April-June 2020; this percentage fell to 11.9% (95% CI: 8.9%–14.9%) by February-March 2021. However, COVID-19 was not the only barrier to healthcare access; in April-June 2020, 29.8% (95% CI: 24.4%–35.2%) of participants reported that not being able to get medical care was among their top three concerns, but only 11.2% (95% CI: 7.5%–14.9%) reported problems accessing healthcare due specifically to COVID-19.

The pandemic may have led participants to stock up on MOUD, particularly in early months: 25.7% (95% CI: 20.5%–31.0%) reported having stocked up in April-June 2020 (Table 3). This proportion fell to 13.0% (95% CI: 9.9%–16.1%) by February-March 2021. Most participants receiving MOUD (76–83%) reported receiving an increase in take-home doses, while far fewer experienced other changes to MOUD, including longer lines and wait times. While just 2.2% (95% CI: 0.1%–4.3%) reported MOUD clinic closure in April-June 2020, 30.8% (95% CI: 17.8%–43.7%) reported during that period that their syringe service program had closed. The proportion reporting syringe service program closures fell dramatically during the year, to 7.6% (95% CI: 2.1%–13.1%) by February-March 2021. Conversely, the proportion of participants reporting no changes to their syringe services program rose from 15.4% (95% CI: 5.2%–25.5%) in April-June 2020 to 47.8% (95% CI: 37.4%–58.2%) in February-March 2021.

Material hardship

Overall, a substantial proportion of participants experienced material hardship throughout the first year of the pandemic, although there appeared to be improvement in some measures over time (Table 4). Difficulty obtaining food was the most frequently reported material hardship and appeared most prevalent in April-June 2020. For example, 26.0% (95% CI: 20.8%–31.2%) of participants reported problems getting food due to COVID-19 in that period; this rate had fallen to 6.8% (95% CI: 4.7%–8.9%) by February-March 2021. Participants also reported employment challenges, such as lost employment (13.0% in April-June 2020, 95% CI: 9.0%–17.0%) and reduced wages or work hours due to COVID-19 (10.1% in April-June 2020, 95% CI: 6.5%–13.7%). While these rates appeared to decline somewhat during the year, 10.0% (95% CI: 7.5%–12.5%) of participants still reported job loss due to COVID-19 in February-March 2021.

Mental health

Overall, the majority of participants reported isolating some or all of the time due to COVID-19, and many reported mental health difficulties related to COVID-19 (Table 5). Isolating due to COVID-19 fell considerably across periods, from 85.4% (95% CI: 81.2%–89.5%) of participants reporting isolating most or all the time in April-June 2020 to

Table 3
Healthcare and related services

| | Apr.-Jun. 2020 | Jul.-Oct. 2020 | Nov. 2020-Jan. 2021 | Feb.-Mar.2021 |
|---|--------------------------|--------------------------|--------------------------|--------------------------|
| Individuals | 324 | 315 | 319 | 310 |
| Observations | 324 | 1155 | 827 | 567 |
| Avoiding going to the doctor due to COVID (%) | 31.3 (25.71 to 36.79) | 20.5 (17.85 to 23.12) | 15.6 (12.84 to 18.29) | 11.9 (8.91 to 14.88) |
| Top concerns today (%) | | | | |
| Not being able to get medical care | 29.8 (24.42 to 35.16) | 24.8 (22.21 to 27.37) | 26.4 (23.35 to 29.41) | 24.9 (21.31 to 28.51) |
| Not being able to get prescribed drugs I use, incl. buprenorphine & methadone | 24.5 (19.42 to 29.52) | 17.3 (15.01 to 19.53) | 18.0 (15.39 to 20.68) | 15.6 (12.57 to 18.61) |
| Difficulties due to COVID (%) | | | | |
| Problems accessing healthcare | 11.2 (7.46 to 14.93) | 5.5 (4.12 to 6.84) | 3.9 (2.59 to 5.26) | 2.7 (1.34 to 4.03) |
| Problems getting prescribed medications | 10.8 (7.15 to 14.51) | 5.2 (3.87 to 6.53) | 3.8 (2.49 to 5.12) | 3.6 (2.04 to 5.13) |
| Running out of methadone or buprenorphine | 6.5 (3.58 to 9.42) | 4.4 (3.14 to 5.59) | 3.4 (2.18 to 4.69) | 3.2 (1.76 to 4.70) |
| Ever sought COVID test but unsuccessful (%) | Not asked | 10.7 (8.82 to 12.62) | 9.3 (7.21 to 11.33) | 10.6 (7.99 to 13.27) |
| Medication for opioid use disorder (MOUD) (%) | | | | |
| Used any MOUD in last 30 days | 59.2 (53.83 to 64.67) | 58.6 (55.77 to 61.46) | 55.5 (52.11 to 58.90) | 57.5 (53.41 to 61.58) |
| Currently enrolled in MOUD program | 68.2 (62.53 to 73.84) | 57.0 (54.05 to 77.52) | 54.7 (51.30 to 73.32) | 56.6 (52.51 to 74.68) |
| Have stocked up on MOUD | 25.7 (20.51 to 30.96) | 16.9 (14.49 to 19.39) | 16.6 (13.79 to 19.39) | 13.0 (9.89 to 16.10) |
| Changes to MOUD in last 30 days ^a | | | | |
| Individuals | 187 | 146 | 174 | 176 |
| Observations | 187 | 620 | 451 | 318 |
| More take-homes (%) | 83.4 (77.96 to 88.89) | 77.6 (74.36 to 80.88) | 73.2 (69.06 to 77.33) | 75.8 (69.02 to 82.57) |
| Clinic is open shorter hours (%) | 12.0 (7.22 to 16.69) | 11.2 (8.73 to 13.74) | 11.7 (8.67 to 14.65) | 9.2 (5.98 to 12.38) |
| Harder to get to the clinic (%) | 6.5 (2.92 to 10.12) | 5.2 (3.45 to 6.97) | 4.7 (2.74 to 6.68) | 5.7 (3.13 to 8.27) |
| Clinic is closed (%) | 2.2 (0.05 to 4.30) | 1.5 (0.51 to 2.42) | 2.5 (1.02 to 3.91) | 1.3 (0.03 to 2.51) |
| Had to change clinics (%) | 1.1 (-0.43 to 2.60) | 1.5 (0.51 to 2.42) | 2.2 (0.86 to 3.62) | 1.6 (0.20 to 2.97) |
| Longer lines than usual (%) | 20.7 (14.75 to 26.56) | 16.6 (13.66 to 19.56) | 16.6 (13.13 to 20.06) | 14.9 (10.93 to 18.82) |
| Takes longer to get my medications | 17.4 (11.86 to 22.92) | 12.4 (9.77 to 14.99) | 10.3 (7.48 to 13.15) | 12.3 (8.70 to 15.99) |
| Other | 8.7 (4.59 to 12.81) | 5.0 (3.31 to 6.79) | 4.5 (2.56 to 6.41) | 4.4 (2.15 to 6.71) |
| Changes to syringe services programs experience in last 30 days ^b | | | | |
| Individuals | 52 | 55 | 56 | 51 |
| Observations | 52 | 228 | 147 | 94 |
| Agency has closed (%) | 30.8 (17.79 to 43.74) | 9.4 (5.53 to 13.22) | 7.0 (2.76 to 11.22) | 7.6 (2.09 to 13.13) |
| Limited to certain days/times (%) | 46.2 (32.14 to 60.17) | 48.2 (41.62 to 54.81) | 29.4 (21.82 to 36.93) | 38.0 (27.93 to 48.15) |
| Have to use a new location (%) | 7.7 (0.20 to 15.18) | 8.9 (5.17 to 12.69) | 6.3 (2.27 to 10.32) | 12.0 (5.20 to 18.71) |
| No change; I'm still getting syringes and/or other services (%) | 15.4 (5.24 to 25.53) | 37.9 (31.54 to 44.35) | 59.4 (51.30 to 67.59) | 47.8 (37.42 to 58.23) |

^a Asked only of individuals receiving treatment in a given period.

^b Asked only of individuals participating in a syringe service program in a given period.

Notes: 95% confidence intervals in parentheses.

60.8% (95% CI: 56.7%–64.8%) in February–March 2021. In April–June 2020, 51.7% (95% CI: 51.7%–57.3%) reported feelings of depression due to COVID-19 and 54.0% (95% CI: 48.4%–59.5%) reporting feelings of anxiety, fear, or nervousness due to COVID-19. These also grew less prevalent over time, dropping to 38.5% (95% CI: 34.5%–42.5%) and 39.8% (95% CI: 35.7%–43.8%), respectively, by February–March 2021. Similarly, feelings of emptiness, loneliness or rejection due to COVID-19 fell from 57.1% (95% CI: 46.2%–57.3%) in April–June 2020 to 40.9% (95% CI: 38.1%–43.8%) in the following period (July–October 2020) and remained stable thereafter. Finally, participants' mean pain severity score and pain interference score were consistent over time.

Discussion

The findings presented here represent some of the first to characterize COVID-19 impacts on the experiences of people who use illicit opioids as the pandemic was unfolding between April 2020 and March 2021. Perhaps one of the biggest contributions of this analysis is the survey data presented—from 324 people who use illicit opioids—that offer an empirical supplement to the early commentaries which warned of the multiple, dire impacts of the pandemic on people who use opioids. During the past two 12-month periods ending in May 2020 and April 2021, respectively, the U.S. experienced the highest number of

Table 4
Material hardship

| | Apr.-Jun. 2020 | Jul.-Oct. 2020 | Nov. 2020-Jan. 2021 | Feb.-Mar.2021 |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
| Individuals | 324 | 315 | 319 | 310 |
| Observations | 324 | 1155 | 827 | 567 |
| Top concerns today (%) | | | | |
| Not being able to keep food on the table | 44.0 (38.14 to 49.80) | 36.4 (33.52 to 39.28) | 34.6 (31.33 to 37.87) | 36.7 (32.73 to 40.75) |
| Not being able to work | 21.6 (16.80 to 26.47) | 20.4 (18.02 to 22.84) | 18.5 (15.85 to 21.20) | 19.5 (16.23 to 22.83) |
| Difficulties due to COVID (%) | | | | |
| Reduced wages/work hours | 10.1 (6.54 to 13.68) | 7.7 (6.11 to 9.30) | 6.3 (4.59 to 7.92) | 5.4 (3.50 to 7.25) |
| Lost job | 13.0 (9.01 to 16.98) | 10.6 (8.74 to 12.43) | 9.0 (6.99 to 10.92) | 10.0 (7.54 to 12.54) |
| Problems getting food | 26.0 (20.80 to 31.19) | 11.7 (9.78 to 13.62) | 9.3 (7.32 to 11.33) | 6.8 (4.71 to 8.91) |
| Lost housing in last 30 days (%) | 1.0 (-0.13 to 2.03) | 2.0 (1.20 to 2.83) | 1.8 (0.91 to 2.75) | 0.7 (0.01 to 1.41) |
| Went unsheltered in last 30 days (%) | 2.2 (0.59 to 3.86) | 2.1 (1.27 to 2.93) | 2.4 (1.38 to 3.50) | 1.6 (0.56 to 2.65) |

Note: 95% confidence intervals in parentheses.

Table 5
Mental health

| | Apr.-Jun. 2020 | Jul.-Oct. 2020 | Nov. 2020-Jan. 2021 | Feb.-Mar.2021 |
|---|--------------------------|--------------------------|--------------------------|--------------------------|
| Individuals | 324 | 315 | 319 | 310 |
| Observations | 324 | 1155 | 827 | 567 |
| Isolating due to COVID (%) | | | | |
| None of the time | 1.1 (-0.14 to 2.28) | 12.9 (10.90 to 14.91) | 15.5 (12.97 to 17.95) | 15.8 (12.74 to 18.80) |
| Some of the time | 13.6 (9.54 to 17.61) | 26.1 (23.46 to 28.72) | 23.2 (20.29 to 26.09) | 23.5 (19.95 to 27.00) |
| Most or all of the time | 85.4 (81.19 to 89.52) | 61.0 (58.09 to 63.92) | 61.3 (58.00 to 64.70) | 60.8 (56.69 to 64.82) |
| Any mental health difficulties due to COVID (%) | | | | |
| Feelings of depression | 51.7 (46.20 to 57.29) | 35.0 (32.23 to 37.76) | 37.9 (34.52 to 41.18) | 38.5 (34.46 to 42.54) |
| Feelings of anxiety, fear, or nervousness | 54.0 (48.43 to 59.50) | 35.3 (32.57 to 38.12) | 37.4 (34.04 to 40.68) | 39.8 (35.69 to 43.81) |
| Feelings of not having good enough relationships | 29.8 (24.76 to 34.92) | 32.2 (29.48 to 34.91) | 36.9 (33.56 to 40.19) | 36.2 (32.20 to 40.17) |
| Feelings of emptiness, loneliness, or rejection | 57.1 (51.59 to 62.51) | 40.9 (38.09 to 43.80) | 42.6 (39.22 to 46.01) | 41.5 (37.44 to 45.62) |
| Pain severity score (0-10) | 3.6 (3.20 to 3.95) | 3.6 (3.42 to 3.80) | 3.5 (3.24 to 3.69) | 3.5 (3.18 to 3.72) |
| Pain interference score (0-10) | 3.0 (2.63 to 3.35) | 3.1 (2.88 to 3.25) | 2.9 (2.69 to 3.13) | 2.9 (2.67 to 3.19) |

Notes: 95% confidence intervals in parentheses.

OD deaths ever recorded in a 12-month period (Ahmad, Rossen & Sutton, 2021; CDC, 2021), with COVID-19 widely acknowledged to be a significant factor underlying the increase (which was already occurring in 2019). Similarly, in New York City, based on provisional mortality data for the 12-month period ending in April 2021, there were an estimated 2316 deaths—compared to 1683 in the previous 12-month period, a roughly 40% increase (Ahmad et al., 2021).

As pandemic closures set in between late March and May 2020, participants reported more suspected fentanyl in the drug supply and higher priced heroin that was harder to find and lower quality, all potentially increasing the risk for an overdose. However, that we saw a downward trend in nonfatal overdose experiences may suggest that the overdose prevention repertoire of the people who use illicit opioids in our sample was considerable, and they were particularly well informed and prepared for overdose prevention and response. Especially in light of the provisional overdose reports from NYC from 2020 to 2021 that

show significant increases in overdose fatalities (Ahmad et al., 2021), the downward trend of nonfatal overdose observed in our study may be an indication that NYC's well-resourced harm reduction infrastructure and history of overdose prevention outreach and naloxone saturation efforts aided some participants who were able to adapt to the new structural constraints and changing risk environment relatively quickly, producing the downward trends seen across many of the measures of disruption described above. At the same time, our findings show that many participants struggled economically – they reported lost work, endured reduced wages, and struggled to keep food on the table just as prices for heroin were reportedly going up for some participants. This hardship may have also have contributed to at least some protective effect against overdose, as people who use illicit opioids were forced to limit their dosages or seek medications for opioid use disorder. From another angle, despite shifts in the supply/demand, it is possible that many of the common overdose prevention strategies offered through

opioid overdose education and naloxone distribution (OEND) trainings continued to be practiced by participants, such as doing test shots, using smaller amounts, and limiting polysubstance use, though more research is needed to confirm this.

Our data on naloxone protectedness (the proportion of use events protected by both naloxone and someone to administer it) may also suggest that fatalities were minimized because many drug use events occurred in the presence of naloxone and a trusted person to administer it. Even with a riskier drug supply, “stay-at-home” orders coupled with the closing of the city may have had the unanticipated effect of increasing the number of use events that were protected with naloxone and a person to administer it. Before the pandemic, roughly 37% of opioid use events were protected with naloxone, while across the COVID-19 study period, roughly 42% of opioid use events were protected, potentially a lifesaving increase in protected opioid use events due to the practice of sheltering in place, with others. At the same time, the fact that the majority of opioid use events remained “unprotected” is a reminder of the critical need to increase efforts to saturate communities with naloxone (Bennett & Elliott, 2021; Collins et al., 2020).

In contrast to some commentaries warning of COVID-related barriers to MOUD, including temporary closures of methadone clinics (Alexander, Stoller, Haffajee, & Saloner, 2020; Dunlop et al., 2020; Volkow, 2020), at least in NYC, there seemed to be robust collaboration across individuals and agencies, assuring the continued access to methadone and buprenorphine. Participants’ reports of their healthcare experiences, especially regarding MOUD and harm reduction services, were generally positive, with only a handful of participants experiencing closures. Furthermore, as pandemic-related policies were implemented and services were closed, participants reported that they stockpiled not only drugs, but MOUD and sterile injection supplies, a potential harm reduction practice observed in other communities (Vasylyeva et al., 2020) and in the wake of Hurricanes Katrina and Sandy (Bennett et al., 2011).

Many participants had undoubtedly experienced other large-scale public health emergencies, including HIV and the ongoing overdose epidemic; they likely also had experience navigating myriad structural constraints, stigma, and limited resources in their day-to-day lives. In NYC, recent experiences with Hurricane Sandy may have heightened awareness about the limitations of methadone distribution and the very real potential to be without MOUD. At the same time, providers in NYC seemed better prepared to immediately implement emergency measures to ensure there was minimal disruption in the provision of MOUD in light of new and evolving structural constraints. For example, early telemedicine programs for buprenorphine were implemented alongside expanded take-home methadone (Tofighi et al., 2021). Based on our results, we would cautiously suggest that policies and procedures surrounding MOUD in NYC have been a critical part of the response and have helped avoid even larger increases in OD mortality seen elsewhere in the country where access to methadone may have been more limited (Joudrey et al., 2021). The telehealth model, coupled with increased low-threshold access and delivery of prescription methadone and buprenorphine could be widely implemented beyond the COVID-19 pandemic, saving time and resources, and reducing stigma associated with the clinic system (Bennett & Elliott, 2021; Brothers, Viera & Heimer, 2021). Lowering barriers to MOUD entry and maintenance could help improve treatment initiation and retention, while conferring the additional benefit of reducing overdose risk, as the literature suggests that MOUD can be protective against overdose and confer other benefits (Bonn et al., 2020; Carlson, Daniulaityte, Silverstein, Nahhas & Martins, 2020; Paone et al., 2015).

That participants reported some challenges accessing sterile syringes, however, especially in the early months of the pandemic suggests much more needs to be done, especially for individuals who are not connected to treatment. There was a severe initial shock at the beginning of the pandemic, in which many syringe service programs closed, followed by drastic improvements, also reflected in our findings on barriers to syringe service program utilization. Significant disruption in access

to sterile syringes underscores the need for disaster preparedness and alternative mechanisms to deliver sterile syringes to people who need them under emergency conditions. Addressing disruptions in the ability of participants to access sterile syringes is critical (Bartholomew, Nakamura, Metsch, & Tookes, 2020) - a gap that may be best filled by mail delivery models of harm reduction (Hayes et al., 2021).

Given its clear suitability for substance use disorder treatment, telehealth models (Clark et al., 2021) tailored to persons with co-occurring substance use disorder and mental health concerns should be expanded to non-disaster contexts. Problematic substance use has been associated with a range of mental health disorders, and our findings indicate that over half of participants struggled with depression, anxiety, and loneliness that they attributed to the pandemic, especially in its first three months. Adding to these mental health challenges, a considerable number of participants reported that even basic necessities like food were hard to find, which can be a factor contributing to anxiety, distress, and overdose if people are undernourished. On top of this, many people who use drugs have underlying health conditions which place them at even greater risk for negative health outcomes that increased during the pandemic (Abadie, Gelpi-Acosta, Aquino-Ruiz, & Aponte-Melendez, 2020; Iversen et al., 2020; Marsden et al., 2020; Richardson et al., 2020). Low-threshold programs that provide supplies for safer drug use and/or MOUD with co-located mental health counseling should be explored to meet the needs of these groups who face barriers in accessing services.

While we documented “successes” in our study findings, the fact that so many opioid use events were absent naloxone and that overdose events still occurred on a regular basis suggests that additional overdose prevention strategies for people who use illicit opioids are warranted. Easily accessible, low-barrier services such as supervised consumption sites (also called overdose prevention centers and safe injection facilities) could help reduce mortality, especially during disaster situations (Roxburgh et al., 2021). Since unstable drug markets and variable drug supplies increase the risk for overdose, in order to minimize morbidity and mortality, consideration should also be given to the establishment of programs that provide pharmaceutical hydromorphone and/or diacetylmorphine to persons who are dependent on opioids, helping to provide a safe alternative to “street” drugs that might contain illicitly manufactured fentanyl (Oviedo-Joekes et al., 2021; Tyndall, 2020).

This study is not without limitations. Data are self-report, and there is a possibility of under- and over-reporting. Measuring non-fatal overdose is difficult and may be biased by the social contexts of use, in that those who use with others are more likely to learn of their own non-fatal overdose events—characterized by collapse, unexpected loss of consciousness, fingers or lips turning blue—compared to those who use in isolated, solitary-use settings. It is possible that there is an under-reporting of overdose experiences as a person may not recognize that he/she had experienced an overdose. While we hypothesize that participants may have used harm reduction measures to prevent drug overdose, utilization of the entire range of harm reduction practices (e.g., use of test shots, use of fentanyl test strips) was not captured in our survey and is a topic in need of additional research. Similarly, participants’ perspectives on telemedicine were not captured in the current study’s structured assessments and should be included in future assessments of this nature and in qualitative interviews. Finally, our study sample includes only people who use illicit opioids in NYC and findings are not generalizable to other populations of people who use drugs or other cities and regions—particularly those with considerably fewer treatment and harm-reduction resources available.

Despite these caveats, it is clear from our findings that, across domains, the first few months of the pandemic were the most challenging as people had to adapt to new constraints – getting to an MOUD clinic, accessing sterile syringes, and obtaining and testing drugs, in a context of widespread COVID-19 transmission and associated structural constraint (Grebely, Cerdá, & Rhodes, 2020; Wenger et al., 2021). Perhaps past experiences navigating the HIV/AIDS pandemic, the federal ban on syringes, as well as persistent structural racism, stigma and

poverty helped prepare the participants in this study to safely navigate the COVID-19 pandemic. Findings from subsequent study periods speak much more to the resilience of people who use drugs as a population with disproportionate experience of trauma and crisis, and also to the rapid response of NYC health agencies and service providers who work with this population. Taken together, these temporally-sensitive early findings on the experiences of pandemic-related impacts among people who use opioids in NYC speak to both the complex vulnerabilities of a population in need of greater supports for “protected” opioid use and wrap-around services to efficiently address their safety, food security, mental health and treatment needs, and the adaptability and resilience of people who use drugs and the agencies that serve them in NYC, even during a major public health crisis.

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Declaration of ethics

The study received ethics approval from New York University Grossman School of Medicine IRB.

Declarations of Interest

None of the authors has any conflict of interest to declare. The opinions of the authors do not necessarily reflect those of National Institutes of Health, National Institute on Drug Abuse, or New York University.

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Supplementary materials

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