



## Short communication

## Non-fatal opioid-related overdoses among adolescents in Massachusetts 2012–2014



Avik Chatterjee<sup>a,b,\*</sup>, Marc R. Larochelle<sup>c,d</sup>, Ziming Xuan<sup>e</sup>, Na Wang<sup>f</sup>, Dana Bernson<sup>g</sup>, Michael Silverstein<sup>h</sup>, Scott E. Hadland<sup>d,h</sup>, Thomas Land<sup>g</sup>, Jeffrey H. Samet<sup>c,d,e</sup>, Alexander Y. Walley<sup>c,d,g</sup>, Sarah M. Bagley<sup>c,d,h</sup>

<sup>a</sup> Boston Health Care for the Homeless Program, Boston, MA, United States

<sup>b</sup> Division of Global Health Equity, Department of Internal Medicine, Brigham and Women's Hospital, Boston, MA, United States

<sup>c</sup> 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

<sup>d</sup> Grayken Center for Addiction, Boston Medical Center, Boston, MA, United States

<sup>e</sup> Department of Community Health Sciences, Boston University School of Public Health, Boston, MA, United States

<sup>f</sup> Biostatistics and Epidemiology Data Analytics Center, Boston University School of Public Health, Boston, MA, United States

<sup>g</sup> University of Massachusetts School of Medicine, Worcester, MA, United States

<sup>h</sup> Division of General Pediatrics, Department of Pediatrics, Boston University School of Medicine and Boston Medical Center, Boston, MA, United States

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## ABSTRACT

**Background:** Opioid-related overdoses and deaths among adolescents in the United States continue to increase, but little is known about adolescents who experience opioid-related non-fatal overdose (NFOD). Our objective was to describe (1) the characteristics of adolescents aged 11–17 who experienced NFOD and (2) their receipt of medications for opioid use disorder (MOUD) in the 12 months following NFOD, compared with adults.

**Methods:** We created a retrospective cohort using six Massachusetts state agency datasets linked at the individual level, with information on 98% of state residents. Individuals entered the cohort if they experienced NFOD between January 1, 2012 and December 31, 2014. We compared adolescents to adults experiencing NFOD, examining individual characteristics and receipt of medications for opioid use disorder (MOUD)—methadone, buprenorphine, or naltrexone.

**Results:** Among 22,506 individuals who experienced NFOD during the study period, 195 (0.9%) were aged 11–17. Fifty-two percent (102/195) of adolescents were female, whereas only 38% of adults were female ( $P < 0.001$ ). In the year prior to NFOD, 11% (21/195) of adolescents received a prescription opioid, compared to 43% of adults ( $P < 0.001$ ), and < 5% (< 10/195) received any MOUD compared to 23% of adults ( $P < 0.001$ ). In the 12 months after NFOD, only 8% (15/195) of adolescents received MOUD, compared to 29% of adults.

**Conclusion:** Among individuals experiencing NFOD, adolescents were more likely to be female and less likely to have been prescribed opioids in the year prior. Few adolescents received MOUD before or after NFOD. Non-fatal overdose is a missed opportunity for starting evidence-based treatment in adolescents.

## 1. Introduction

The opioid epidemic in the United States has not spared adolescents. Between 1993 and 2010, emergency department visits for opioid-related overdose increased 1188% for those younger than 20 (Hasegawa et al., 2014), and annual opioid-related overdose deaths among 15–19 year-olds increased 2.3-fold from 1999 to 2015 (Curtin et al., 2017).

A key national response to increased opioid-related deaths has been

increasing access to medications for opioid use disorder (MOUD), yet adolescents face a significant treatment gap. In a national cohort of adolescents receiving an opioid use disorder (OUD) diagnosis between 2000–2014, only 24% of those aged 18–20 subsequently received MOUD, and even fewer—10%—of those aged 16–17 received MOUD (Hadland et al., 2017). Similarly, in a recent study of 4837 adolescents with a recent diagnosis of OUD, only 1 in 21 received medication treatment (Hadland et al., 2018). The American Academy of Pediatrics

\* Corresponding author at: Harvard Medical School, Physician, Boston Health Care for the Homeless Program, 780 Albany St., Boston, MA 02118, United States.  
E-mail address: [avc031@mail.harvard.edu](mailto:avc031@mail.harvard.edu) (A. Chatterjee).

(AAP) has made a strong statement supporting treatment with medications—methadone, buprenorphine, or naltrexone—for adolescents with opioid use disorder (OUD) (Committee on Substance Use and Prevention, 2016) but there is no indication that prescribing medications for opioid use disorder by pediatricians has matched the increasing need among adolescents.

Several possible explanations for this treatment gap exist: federal regulations restrict methadone access for adolescents (Feder et al., 2017); the required 8-hour training and FDA-approval only for those 16 and older create barriers to prescribing buprenorphine; and pediatric providers may feel unprepared to treat adolescents with OUD. Stigma regarding MOUD also plays a role (Bagley et al., 2017).

Non-fatal overdose is a critical event, and may be an opportunity to engage adolescents in evidence-based treatment to prevent future opioid-related harms. Yet, little is known about adolescents who experience NFOD. We sought to describe (1) characteristics of adolescents aged 11–17 who experienced opioid-related NFOD and (2) their receipt of MOUD in the 12 months after overdose.

## 2. Material and methods

### 2.1. Study design

We conducted a retrospective cohort study of Massachusetts residents who experienced NFOD between January 1, 2012 and December 31, 2014.

### 2.2. Data source

Chapter 55 of the Acts of 2015 mandated that the Massachusetts Department of Public Health (MDPH) analyze data from several state agencies and allowed for linkage of these datasets to identify trends among persons who suffered opioid-related overdose. The Chapter 55 database includes Massachusetts residents aged 11 and older, with public or private health insurance. Individual-level data were linked between datasets through a deterministic match protocol (which required exact matches in identifiers) described previously (Government of Massachusetts Department of Public Health, 2017). Data were subsequently de-identified, allowing examination of a broad set of variables during the 2011–2015 study period. To construct the dataset needed for this study, we used data from the All Payer Claims Database (APCD), Registry of Vital Records and Statistics (RVRS) mortality files, MDPH Bureau of Substance Addiction Services (BSAS), the Massachusetts Prescription Monitoring Program (PMP), Massachusetts Ambulance Trip Record Information System, and Massachusetts Acute Hospital Case Mix.

### 2.3. Study cohort

Individuals entered the cohort when they experienced NFOD in Massachusetts between January 1, 2012 and December 31, 2014, providing a full 12 months of observation prior to and after the event. NFOD was identified in two ways. First, we included any emergency department, observation, or inpatient visit with an ICD-9 diagnosis code for opioid poisoning (Green et al., 2017). Second, any individual with an ambulance encounter related to opioid overdose was included—this data was only available for 2013–2014. The algorithm used to identify opioid-related overdoses in EMS data was defined by MDPH and the Centers for Disease Control and Prevention (Supplemental Material). Once identified, records for these events were compared to RVRS data. Overdoses that were fatal within 30 days were removed—1298 such individuals were excluded, fewer than 10 of whom were 11–17 years old.

### 2.4. Independent variables

The independent variable was age, comparing those 11–17 to adults 18 and older.

### 2.5. Covariates

We included the following covariates: gender (APCD); anxiety and depression, both identified through ICD-9 codes in the APCD and defined as ever having had these conditions; prior receipt of opioid prescriptions, obtained from the PMP; zip codes, coded as rural or non-rural according to the classifications provided by the Massachusetts Department of Public Health Office of Local and Regional Health; and MassHealth (the Massachusetts Medicaid program) status, assigned if the individual had at least one month of MassHealth coverage in the year prior to NFOD according to the APCD.

### 2.6. Outcomes

The primary outcome was receipt of MOUD in the 12 months after NFOD, defined as: any buprenorphine prescription documented in the PMP; any prescription claim for oral or injectable naltrexone, identified in APCD; or at least a month of methadone treatment, as identified from BSAS or APCD data.

### 2.7. Statistical analysis

We used summary statistics to describe cohort characteristics and bivariate Chi-Square tests to compare 11–17 year-olds with adults 18 and older. We suppressed cell sizes 1–10 to protect confidentiality. We used SAS Studio version 3.5 (SAS Institute, Cary, NC).

## 3. Results

Between 2012 and 2014, of the 22,506 individuals who experienced NFOD, 0.9% (195) were aged 11–17. Twenty-seven percent (53/195) were aged 11–14 and 73% (142/195) were 15–17 years of age. Fifty-two percent of adolescents (102/195) were female, a higher percentage than the 38% of adults who were female ( $P < 0.001$ ). More adolescents than adults (14% vs. 7%,  $P < 0.001$ ) had an address in a rural zip code, and fewer adolescents than adults were enrolled in MassHealth (57% vs. 73%,  $P < 0.001$ ). Compared to adults, fewer adolescents had a diagnosis of anxiety (13% vs. 19%,  $P < 0.03$ ) or depression (16% vs. 23%,  $P < 0.02$ ).

Eleven percent (21/195) of adolescents had received an opioid prescription in the 12 months preceding NFOD, compared to 43% of adults ( $P < 0.001$ ). No adolescents had received methadone prior to NFOD, and < 5% (< 10) received either naltrexone or buprenorphine, compared to 23% of adults on MOUD prior to NFOD ( $P < 0.001$ ). In the 12 months after NFOD, 8% (15/195) of adolescents received any MOUD, compared to 29% of adults (Table 1).

## 4. Discussion

The 195 adolescents who presented to the health care system after NFOD in Massachusetts between 2012–2014 were more likely to be female and less likely to have received a prescription for opioids in the prior year than adults. Fewer than 5% received medications for opioid use disorder in the year prior to NFOD, which increased minimally, to 8%, in the subsequent 12 months.

The reasons that a larger proportion of adolescents experiencing NFOD were female is unknown—female adolescents may be initiating opioid use earlier, may be more likely to overdose, or may be brought to emergency attention after overdose more frequently. A gender-based difference in opioid use has public health implications. Indeed, prevalence of hepatitis C among women during pregnancy is increasing

**Table 1**

Characteristics of individuals experiencing non-fatal overdose in Massachusetts between 2012 and 2014, comparing adolescents aged 11–17 years with adults  $\geq$  18 years.

| Characteristic                                                                   | % (n) for Those 11-17<br>N = 195 | % (n) for Those 18 and older<br>N = 22,311 | P-Value for Bivariate Chi-Square Test |
|----------------------------------------------------------------------------------|----------------------------------|--------------------------------------------|---------------------------------------|
| Female                                                                           | 52 (102)                         | 38 (8461)                                  | < 0.001                               |
| Rural zip code                                                                   | 14 (27)                          | 7 (1525)                                   | < 0.001                               |
| Enrolled in MassHealth                                                           | 57 (111)                         | 73 (16202)                                 | < 0.001                               |
| Diagnosis of Anxiety                                                             | 13 (25)                          | 19 (4251)                                  | 0.03                                  |
| Diagnosis of Depression                                                          | 16 (32)                          | 23 (5196)                                  | 0.02                                  |
| Prescription for Opioids Prior 12 months                                         | 11 (21)                          | 43 (9544)                                  | < 0.001                               |
| Prescription for Benzodiazepines Prior 12 months                                 | 5 (10)                           | 29 (6454)                                  | < 0.001                               |
| Any Medication for OUD <sup>a</sup> Prior 12 months                              | < 5 (< 10)                       | 23 (5077)                                  | < 0.001                               |
| Prescription for Buprenorphine Prior 12 months                                   | < 5 (< 10)                       | 11 (2548)                                  | < 0.001                               |
| Prescription for Naltrexone Prior 12 months                                      | < 5 (< 10)                       | 4 (1002)                                   | < 0.001                               |
| Methadone Maintenance Prior 12 months                                            | 0 (0)                            | 10 (2195)                                  | < 0.001                               |
| Any Medication for OUD <sup>a</sup> in the 12 months following NFOD <sup>b</sup> | 8 (15)                           | 29 (6472)                                  | < 0.001                               |

<sup>a</sup> OUD: Opioid Use Disorder.

<sup>b</sup> NFOD: Non-Fatal Overdose.

(Patrick et al., 2017) as is the prevalence of OUD diagnosis during delivery hospitalization (Haight et al., 2018) and the incidence of neonatal abstinence syndrome among their children (Tolia et al., 2015). Trauma plays an important role for women who use opioids. In one study, physical abuse was twice as common and sexual abuse more than three times as common among women than men taking opioids for chronic pain (Balousek et al., 2007). Previous research has shown that injection drug practices among younger women are shaped by relationships, frequently violent, with older men, leading to higher seroconversion to hepatitis C among women (Bourgeois et al., 2004). Exploring the overlap of trauma, adolescence, gender, and opioid use is critical to developing effective interventions to engage adolescents in care.

Consistent with 2014 National Survey on Drug Use and Health findings that half of adolescents with prescription opioid misuse received opioids from relatives or friends, adolescents in this study were also unlikely to have received a prior opioid prescription themselves (Center for Behavioral Health Statistics and Quality, 2015). Adolescents could also be initiating use with illicit opioids such as heroin (Cicero et al., 2017).

Adolescents were also slightly more likely than adults to be from rural zip codes and less likely to have MassHealth for health insurance, though the importance of these findings is not known and is worth exploring further in future studies.

Why are so few adolescents receiving MOUD after a critical event like NFOD? Clinicians may be unaware that overdose occurred. Poor communication within the health system has been implicated as a reason that 91% of adults continue to receive opioid prescriptions after NFOD (Larochelle et al., 2016). After NFOD, adolescents may also be more likely to interact with providers, treatment programs, jails or prisons, or schools that do not offer MOUD than with providers or programs that do. Development of ED-based interventions could be a strategy to engage high-risk adolescents, and potentially their families, in timely care. Another reason for limited receipt of MOUD among adolescents may be inadequate access, despite AAP recommendations (Hadland et al., 2017), due to above-mentioned federal limitations on buprenorphine and methadone prescribing, and stigma (Bagley et al., 2017). It is possible that not every adolescent who experienced NFOD met criteria for OUD such that medications were appropriate—prevalence of OUD among individuals in the cohort was not known. Still, frequency of MOUD prescription in our cohort was comparable to that in the cohorts of adolescents described by Hadland and colleagues (10% among those 16–17-year olds in one cohort and 5% in another) (Hadland et al., 2018, 2017).

It may also be that after a serious event such as NFOD, adolescents and adults acting on their behalf are more likely to prefer or be referred

to a more familiar treatment option such as residential treatment where there may be less access to MOUD. Another explanation could be that overdose survivors are not necessarily seeking treatment. Further investigation of the trajectories of adolescents after nonfatal overdose and whether treatment in residential programs is associated with less access to medication treatment is warranted. Importantly, our finding of infrequent initiation of MOUD among adolescents after NFOD mirrors similar findings among adults, indicating a broader need to improve patient engagement (Larochelle et al., 2018).

#### 4.1. Limitations

One limitation of this dataset is that it did not identify those who experienced NFOD without a subsequent healthcare encounter. Lack of ambulance encounter data from 2012 also likely resulted in an undercount of NFOD. Another limitation is that data on race and ethnicity were missing for many patients in the combined Chapter 55 dataset, and data on socioeconomic status of individuals in the cohort were limited. We reported the percentage of individuals in each age group who had MassHealth, the state's Medicaid program, for health insurance, though we recognize this is not a robust measure of socioeconomic status. A final limitation is that we only include individuals who survived an opioid overdose between 2012 through 2014, and the nature of the opioid epidemic—and the characteristics of the opioid supply has changed in that time period with a significant shift towards fentanyl with an associated surge in overdose deaths starting in 2013 (Somerville et al., 2017). Despite this change, there is little evidence that access to treatment among adolescents has improved during this time.

#### 5. Conclusions

Adolescents who experienced NFOD differed from adults in important ways and rarely received medications for OUD. Further work is needed to improve our understanding of these high-risk youth in order to engage them in care and prevent overdose.

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#### Contributors

Dr. Chatterjee led manuscript preparation, data analysis, and interpretation of results; Dr. Larochelle: conceived of and designed the study, contributed to interpretation of results, and provided significant

revision of the manuscript; Ms. Bernson contributed to statistical design and analysis and provided critical revisions to the manuscript; Dr. Xuan contributed to statistical design and critical revision of the manuscript; Dr. Silverstein and Dr. Samet helped with study design, interpretation of results, and critical revision of the manuscript; Dr. Hadland contributed significantly to interpretation of results and critical review of the manuscript; Dr. Walley contributed to study design, interpretation of results, and critical revision of the manuscript; Dr. Land help conceived of the study and with data analysis and interpretation of results; Ms Wang conducted data analysis and helped with interpretation of results; Dr. Bagley contributed significantly to study design, data analysis, and interpretation of results as well as through significant contributions to revision of the manuscript.

### Conflict of interest

No conflict declared.

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### 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.2018.09.020>.

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