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# Recent fentanyl use among people who inject drugs: Results from a rapid assessment in Baltimore, Maryland

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## Abstract

**Background—**Fentanyl-related mortality continues to increase in the US, but knowledge of the drivers of fentanyl use (both intentional and unintentional) remains limited. We conducted a rapid assessment to characterize knowledge, attitudes and practices related to fentanyl use in a community-based cohort of current and former people who inject drugs (PWID) in Baltimore, Maryland.

**Methods—**Between November 2017 and June 2018, participants of the AIDS Linked to the IntraVenous Experience (ALIVE) cohort completed a survey related to fentanyl use. Correlates of recent (past 6 months) fentanyl use and preference for fentanyl-contaminated and –substituted heroin (FASH) were examined using logistic regression among persons who reported using drugs in the prior six months.

**Results—**Of 994 participants, 28% reported ever having used fentanyl, with 58% of those reporting recent use. Independent correlates of recent fentanyl use among the subset of participants reporting recent (past 6 month) drug use were younger age, male sex, homelessness, opioid use, cocaine use, and daily injection ($p<0.05$ for all). 18% of those who recently used fentanyl reported preference for FASH, which was associated with younger age, homelessness and daily injection ($p<0.05$ for all).

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**Megan Buresh:** Conceptualization, Writing – original draft. **Becky L. Genberg:** Conceptualization, Methodology, Writing – original draft. **Jacquie Astemborski:** Data curation, Formal analysis, Software. **Gregory D. Kirk:** Writing – review and editing. **Shruti H. Mehta:** Conceptualization, Supervision, Writing – review and editing

**Conclusions—**Recent fentanyl use was commonly reported. Interventions to reduce the harms associated with fentanyl use should target young, homeless PWID who may be more likely to seek out fentanyl.

**Keywords**

fentanyl; heroin; opioid overdose; harm reduction; PWID

## 1. Introduction

Drug overdose is the leading cause of death among Americans under 50 years of age. Indeed, drug-related mortality rates have surpassed peak annual mortality due to HIV, motor vehicle fatalities and firearm-related deaths (Katz, 2017). The majority of overdose deaths involve opioids; overdose mortality rates involving opioids have quadrupled between 1999 and 2015, (O'Donnell, Gladden, & Seth, 2017) becoming the leading cause of injury-related death in the US (Rudd, Seth, David, & Scholl, 2016). In recent years, a "third wave" of opioid overdoses has been driven by the synthetic opioid, fentanyl (O'Donnell, Halpin, Mattson, Goldberger, & Gladden, 2017). Fentanyl is an opioid 50-100 times more potent than heroin by weight (CDC, 2017). Since 2013, there have been multiple reports of surges of fentanyl in drug markets, particularly in the Northeast (Creppage et al., 2018; Dwyer, Janssen, Luckasevic, & Williams, 2018; Gladden, Martinez, & Seth, 2016; Phalen, Ray, Watson, Huynh, & Greene, 2018; Slavova et al., 2017; Somerville et al., 2017). Patterns of overdose deaths in Maryland reflect these national trends. Since 2013, there has been a 55-fold increase in fentanyl-related deaths (Hogan, Rutherford, Governor, & Schrader Secretary, 2017), with a 42% rise from 2016-2017. In 2017 alone, there were 1594 fentanyl-related overdose deaths, accounting for over 50% of opioid-related deaths. (Hogan et al., 2017) The majority of fentanyl-related deaths in Maryland occurred in the Baltimore Metropolitan area. (Hogan et al., 2017)

Despite this dramatic rise in fentanyl-related deaths, the patterns of fentanyl use, both intentional and unintentional, and knowledge regarding risks of fentanyl among people who use drugs (PWUD) remain poorly characterized. In studies to date, perceived and actual fentanyl exposure is highest among those using heroin compared to other substances, (Carroll, Marshall, Rich, & Green, 2017; Hayashi et al., 2018; Kenney, Anderson, Conti, Bailey, & Stein, 2018) which aligns with the known distribution of illicit fentanyl being mixed into heroin. In a recent study from Vancouver, 14.5% of PWUD tested positive for fentanyl, with fentanyl exposure associated with injection drug use, younger age, heroin use and polysubstance use, notably stimulants (Hayashi et al., 2018).

Ethnographic research among persons using heroin to date has found mixed attitudes towards the use of fentanyl. A mixed methods study from Rhode Island found low demand and limited ability of individuals to detect fentanyl (Carroll et al., 2017). By contrast, studies in Baltimore, northeast Massachusetts and Nashua, New Hampshire showed more mixed attitudes, including some reports of fentanyl-seeking for its better "rush" and potency (Ciccarone, Ondocsin, & Mars, 2017). Persons using heroin reported mixed ability to detect fentanyl by physiologic effects, taste and color (Ciccarone et al., 2017; Park, Weir, Allen,

Chaulk, & Sherman, 2018). Taken together, it seems likely that many PWUD underestimate their risk of fentanyl exposure. In a recent study, 90% of persons seeking treatment for opioid dependence who reported using heroin tested positive for fentanyl, including two-thirds of those who reported never using fentanyl (Kenney et al., 2018). Moreover, while prior studies have focused on exposure to fentanyl-adulterated and -substituted heroin (FASH), there are growing reports of reports of fentanyl contamination of non-opioid drugs like cocaine and methamphetamine (Marinetti & Ehlers, 2014; Seth, Scholl, Rudd, & Bacon, 2018).

Most of the prior research on fentanyl use has been conducted in populations of PWUD seeking treatment and among persons using opioids including heroin. There is a need for information from broader community-based samples including those using opioids and other drugs and to more comprehensively characterize the populations using fentanyl and at risk for associated morbidity and mortality. In response, we conducted a rapid assessment from November 2017 to June 2018 to assess knowledge, attitudes and self-reported practices related to fentanyl use in a community-based cohort of former and current PWID in Baltimore, Maryland.

## 2. Methods

### 2.1 Study population

The AIDS Linked to the IntraVenous Experience (ALIVE) study is an ongoing community-based cohort of people who currently inject or formerly injected drugs. The study has been described elsewhere (Vlahov, Anthony, Munoz, & Margolick, 1991). Initial recruitment was conducted in 1988, with open enrollment periods occurring in 1994-95, 1998, 2000, 2005-8, and recently in 2015-18. Participants were recruited through outreach at several locations throughout Baltimore including local syringe services providers, HIV treatment providers, word-of-mouth, and via community events attended by study staff. To be eligible to participate, individuals had to be 18 years of age or older, report a history of injection drug use, and if HIV-positive, have not received an AIDS diagnosis prior to enrollment (AIDS criterion applies only to recruitments prior to 1998). We conducted a cross-sectional rapid assessment focused on knowledge, attitudes and practices related to fentanyl use among all participants in active follow-up in the ALIVE study between November 2017 and June 2018.

### 2.2 Measures

Participants complete bi-annual follow-up visits with standardized survey assessments, either interviewer-administered or collected via audio computer-assisted self-interview (ACASI). Assessments administered during follow-up visits collect information from participants regarding socio-demographic characteristics (age, sex, race, residential location, marital status, educational attainment, income, employment, etc.) and recent (prior 6 months): drug use (opioids, cocaine, marijuana), modes of administration (injection, snorting, smoking), alcohol and tobacco use, alcohol use disorders (using the Alcohol Use Disorders Identification Test: Saunders, Aasland, Babor de La Fuente, & Grant, 1993; Volk, Steinbauer, Cantor, & Holzer, 1997), depressive symptoms (using the Center for

Epidemiologic Studies Depression Scale: Radloff, 1977), homelessness, incarceration of seven days or longer, and recent overdose.

For this rapid assessment, a quantitative survey with questions regarding fentanyl was interviewer-administered. Fentanyl use in this survey refers to self-reported intentional use of fentanyl or fentanyl-contaminated drugs. The specific questions included the following: self-reported history of fentanyl use (ever, recent [prior six months], route of administration [injection, snorted, orally, patch], used fentanyl alone or in combination with heroin, source of fentanyl [street, family, friend, other]), and knowledge of fentanyl overdose among contacts (know someone who overdosed following use of fentanyl, number of times someone you know overdosed following fentanyl, route of use [fentanyl by itself, mixed with other drugs, don't know] preceding other person's overdose). All participants were asked about recent overdose in the prior six months and drugs used prior to overdose.

In this same quantitative survey, questions to assess attitudes regarding fentanyl were asked of those reporting ever having used heroin and referred to a participants' entire drug use history. To assess preference for fentanyl-adulterated or –substituted heroin (FASH), participants were asked: "If you heard a dealer was selling heroin laced with fentanyl, would you be more likely to buy it than standard heroin?" with responses: yes, neutral/don't know, no. Those who responded yes were considered as having preference for FASH. For assessment of fentanyl detection, participants were asked whether heroin looked different when mixed with fentanyl, with responses: yes, don't know, no. Attitudes regarding the perception of risk of fentanyl-related overdose were assessed with the following question: "Using fentanyl (either by itself or in combination with other drugs) increases risk of overdose" with responses agree, neutral or don't know, disagree.

### 2.3 Statistical Analysis

Standard descriptive statistics were used to characterize the sample and examine the frequency of self-reported fentanyl use, knowledge of and perceptions of overdose risk using the questions described above. Associations between socio-demographic variables, substance use behaviors and other risk factors were examined using univariable logistic regression analysis with respect to two outcomes: recent (prior six months) fentanyl use and preference for FASH among all participants who reported recent (past 6 month) drug use. No objective measures of fentanyl use were available as part of the rapid assessment so all outcomes were based on self-report. Covariates considered in multivariable analysis included all those deemed important factors *a priori* (i.e., age, sex, race) and those associated with the outcomes in univariable analysis (defined as $p \leq 0.05$). An additional analysis explored the association between fentanyl use in the prior six months and self-reported drug overdose. Covariates considered in this multivariable model included all factors associated with both recent fentanyl use and overdose.

# 1. Results

## 3.1 Study Sample

Table 1 presents the socio-demographic characteristics and recent substance use among 994 participants in the ALIVE study who were in follow-up during the administration of the fentanyl survey. The mean age of the overall sample was 55 years (standard deviation (SD) = 9.1). About one-third were female (n=343, 35%), 84% were African American (n=838), with nearly half having completed high school (n=457, 46%). One-third of the participants were HIV-positive (n=310, 31%). In the prior six months, 10% reported homelessness (n=97) and nearly one-third reported depressive symptoms (scoring 23 or more on the CES-D). Nearly half of the sample (n=481, 48%) reported any alcohol use, with 16% (n=163) scoring 8 or higher on the AUDIT. One-third reported injecting any drug in the prior six months (n=315) and 4% reported a recent non-fatal overdose (n=35). Approximately equal proportions of participants reported any cocaine use by snorting, smoking or injection (n=420, 42%) or use of any opioid (heroin or prescription opioid) by snorting, smoking or injection (n=412, 41%).

## 3.2 Lifetime history of fentanyl use

Of the 994 participants, 93% (n=923) reported that they had heard of fentanyl. Twenty eight percent (n=277) of participants reported ever having used fentanyl in their lifetime (Table 2). The prevalence of lifetime fentanyl use among the 523 (53%) of participants who reported actively using any drugs in the past 6 months was 43% (226/523). Female ($p<0.03$), African American ($p<0.0001$) and HIV-positive ($p<0.003$) respondents were less likely to report having ever used fentanyl. Younger participants (<50 years) ($p<0.001$) were also more likely to report lifetime fentanyl use. The majority who reported ever using fentanyl reported injecting (59%, n=163) or snorting (n=79, 29%) fentanyl with heroin. Eighteen percent reported injecting fentanyl by itself (n=50) and 12% (n=34) reported snorting fentanyl on its own. Ninety-five percent (n=264) reported acquiring fentanyl on the street. Over half of the participants (52%, n=510) reported knowing someone who had previously overdosed as a result of fentanyl use, with the majority of those (52%, n=265) reporting that the person had used fentanyl combined with other drugs.

## 3.3 Knowledge and attitudes about fentanyl

Among the 954 respondents who reported having ever used heroin, 76% (n=726) reported that they did not prefer buying FASH over standard heroin and 35% (n=331) reported that FASH looks different from heroin (Table 3). Seventy-seven percent of the sample (n=734) agreed that using fentanyl increases the risk of overdose.

## 3.4 Recent fentanyl use

Among those who reported lifetime fentanyl use, 58% (n=162) reported using fentanyl in the past six months (Table 2). Among persons who reported any drug use in the prior 6 months, 29.6% (155/523) reported using fentanyl in the prior six months. Table 4 presents the unadjusted and adjusted odds ratios and 95% confidence intervals (CI) for factors associated with recent fentanyl use among n=523 participants who reported recent drug use (either by

injection or non-injection). Recent fentanyl use was negatively associated with age (OR=0.74, 95% CI: 0.71-0.95), female sex (OR=0.53, 95% CI: 0.35-0.81), African American race (OR=0.36, 95% CI: 0.23-0.55) and HIV-positive status (OR=0.62, 95% CI: 0.40-0.96). Recent fentanyl use was positively associated with recent homelessness (OR =4.03, 95% CI: 2.44-6.66), active injection drug use (OR=5.63, 95% CI: 3.50-9.05), any cocaine use (OR=2.27, 95% CI: 1.34-3.84), any opioid use (OR=31.2, 95% CI: 7.59-128), and marijuana use (OR =1.72, 95% CI: 1.14-2.60). Residential location, marital status, and educational attainment were not significantly associated with recent fentanyl use. In adjusted analysis, younger age, female sex, homelessness, greater frequency of injection (daily or more often in the prior six months), any recent (prior six months) opioid use and cocaine use remained independently associated with recent fentanyl use ($p<0.05$ for all). Race, HIV-status and marijuana use were not significantly associated with recent use in adjusted analysis.

### 3.5 Overdose

Of the 162 who reported recent fentanyl use, 30% (n=49) reported ever experiencing an overdose after using fentanyl. Although the majority (55%, n=27) reported experiencing only one overdose following fentanyl use, 39% (n=19) reported two or three prior overdoses, and 6% (n=3) reported overdosing four or more times following fentanyl use. With respect to the last overdose related to fentanyl, 26% (n=12) reported having used fentanyl by itself, while 74% (n=35) reported using fentanyl with other drugs.

Of those who reported recent fentanyl use, 17% (n=26) reported an overdose in the prior six months. Compared to persons who did not use fentanyl in the prior six months, those that reported fentanyl use were 9 times more likely to report a recent overdose following the use of any drug (OR = 9.02, 95% CI:3.96-20.5) than those who did not recently use fentanyl, an association that persisted in analysis adjusted for age, sex, race, and other factors associated with recent fentanyl use including homelessness, frequency of injection, opioid use and cocaine use (aOR = 8.31, 95% CI:3.11-22.2).

### 3.6 Preference for fentanyl-adulterated and –substituted heroin (FASH)

Among 277 participants who reported a history of fentanyl use, 31% (n=85) reported preference for FASH. Among persons reporting active drug use in the prior 6 months, 17% (81/476) reported a preference for FASH. Table 4 presents the unadjusted and adjusted odds ratios and 95% CIs examining the association between reporting preference for FASH and sociodemographic and other characteristics among respondents who reported active drug use in the prior six months. Preference for FASH was negatively associated with age (OR per 5 years = 0.72, 95% CI: 0.64-0.81), African American race (OR=0.29, 95% CI: 0.18-0.46) and any alcohol use (OR=0.63, 95% CI: 0.40-0.99). Those with preference for FASH were also more likely to be homeless (OR=3.13, 95% CI: 1.83-5.37), actively inject drugs (OR = 2.81, 95% CI: 1.68-4.70), and use opioids (OR=2.57, 95% CI: 1.29-5.15). In adjusted analysis, younger age, homelessness, and greater frequency of injection (daily or more often in the prior six months) remained independently associated with preference for FASH ($p<0.05$ for all). Race, alcohol use and opioid use were not significantly associated with preference for FASH in adjusted analysis.

## 2. Discussion

Among this community-based cohort of current and former PWID in Baltimore, comprised of people who predominantly use heroin and/or cocaine, self-reported fentanyl use was common, attributed nearly universally to drugs bought on the street, and mostly due to injection in combination with other opioids (heroin in this cohort). Moreover, recent fentanyl use was significantly more common among those with the highest intensity of injection. While the majority of participants reported using fentanyl mixed with other drugs (which may reflect unintentional use), some participants reported injecting or snorting fentanyl by itself, which may reflect intentional use of fentanyl. While our results were limited by not having an objective measure of fentanyl and not being able to completely discern the reasons for use, they suggest a high prevalence of fentanyl use in this urban setting putting individuals at increased risk for overdose.

Indeed, in our study, recent fentanyl use was significantly associated with increased likelihood of recent non-fatal overdose, similar to findings in a recent study of Baltimore SSP participants (Park et al., 2018). One-third of those who reported recent fentanyl use had ever overdosed after use of fentanyl, and 50% of all participants knew someone with a recent fentanyl-related overdose. While the majority of participants (77%) were aware of increased risk of overdose associated with fentanyl use, only 35% of persons using heroin reported being able to detect fentanyl prior to use, limiting their ability to decrease their exposure risk. In heroin markets of Northeast US cities like Baltimore, where adulteration of heroin with fentanyl is common, it is likely that many more persons using heroin are exposed to fentanyl than they realize, as found in studies using urine toxicology (Kenney et al., 2018).

While the current study is based on self-reported fentanyl use, and likely underestimates actual exposure rates to fentanyl, it does reflect beliefs of fentanyl consumption by PWUD, which is more likely to influence their risk perception and patterns of drug use in the absence of point of care drug testing. At the time of this study, fentanyl test strips were not commonly used in Baltimore outside of limited research studies (Krieger et al., 2018). We intentionally asked participants about any fentanyl use (and not just FASH) due to local reports of fentanyl contamination of non-opioid drugs, most commonly cocaine. We observed a statistically significant association between recent cocaine use and fentanyl use in this population; however all of those who reported cocaine use also reported heroin use (data not shown) so it is not possible to discern whether this association is simply reflective of heroin contaminated fentanyl used in conjunction from cocaine vs. fentanyl contaminated cocaine. This warrants further study as urine toxicology findings from Vancouver (Hayashi et al., 2018) and recent reports of increases in cocaine-related overdose deaths (Jones, Baldwin, & Compton, 2017) support potential fentanyl contamination of cocaine.

This study is among the first to quantify prevalence of preference for FASH among community-based PWID and builds on previous qualitative work on attitudes toward fentanyl in Baltimore and other settings (Carroll et al., 2017; Ciccarone et al., 2017; Mars, Ondocsin, & Ciccarone, 2018). The vast majority of persons in our sample reported that they did not prefer FASH to standard heroin. This was consistent across persons who were and were not actively using drugs. We further identified population subgroups that were more

likely to report a preference for FASH. Specifically, persons who were younger, homeless and reported higher intensity of injection drug use were more likely to report a preference for FASH. It will be important to continue to monitor changes in the patterns of use and in particular if they translate into higher risk of overdose and other morbidity.

There were several limitations to this rapid assessment. First, the study sample consisted of primarily heroin users in a single urban setting and may not be generalizable to other populations of people who use drugs or people who inject drugs in the US or outside of the US. Second, data on fentanyl use was obtained by self-report without verification using urine toxicology. Thus, it is likely that we have underestimated the true prevalence of fentanyl use in the community both because of social desirability and recall bias and the fact that it can be difficult for users to identify fentanyl in drugs they are using. We were also unable to distinguish between intentional and unintentional fentanyl use. It will be important for these data to be supplemented with ethnographic work that can investigate unintentional and intentional use and the drivers of FASH preference, which was not possible through this brief rapid assessment.

Despite these limitations, these data have important implications for targeting harm reduction and overdose prevention strategies in settings such as this one where fentanyl accounts for the majority of opioid-overdose deaths and continues to rise, despite declines in mortality due to other opioid use (Hogan et al., 2017). Specifically interventions will need to be tailored to reach young homeless PWID. Interventions include expanding access to medication assisted treatment and other harm-reduction services, including naloxone distribution and supervised injection facilities (SIFs). Given that many heroin users underestimate their risk of fentanyl consumption and are at high risk of overdose, SIFs can function as a critical space where drugs can be tested and overdoses quickly reversed. SIFs have been associated with significant reductions in overdose mortality where they have been implemented (Potier, Laprévote, Dubois-Arber, Cottencin, & Rolland, 2014). Other interventions which might be critical include a reliable means of fentanyl detection, such as fentanyl test strips, which have shown acceptability among young PWUD (Krieger et al., 2018) and have been shown to alter drug use behavior (Peiper et al., 2018).

## 3. Conclusion

Fentanyl use was commonly reported among young PWID who inject heroin in Baltimore and recent use was associated with increased risk of overdose. Attitudes and perceived ability to detect fentanyl were mixed. Future interventions should be used to target harm reduction services to changing populations of people who use heroin and other opioids in order to decrease fentanyl-related overdose.

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Declaration of Interest:

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## References

Carroll JJ, Marshall BDL, Rich JD, & Green TC (2017). Exposure to fentanyl-contaminated heroin and overdose risk among illicit opioid users in Rhode Island: A mixed methods study. International Journal of Drug Policy, 46, 136–145. [PubMed: 28578864]

CDC. (2017). Prescription Behavior Surveillance System: Issue Brief.

Ciccarone D, Ondocsin J, & Mars SG (2017). Heroin uncertainties: Exploring users' perceptions of fentanyl-adulterated and -substituted 'heroin.' International Journal of Drug Policy, 46, 146–155. [PubMed: 28735775]

Creppage KE, Yohannan J, Williams K, Buchanich JM, Songer TJ, Wisniewski SR, & Fabio A (2018). The Rapid Escalation of Fentanyl in Illicit Drug Evidence in Allegheny County, Pennsylvania, 2010-2016. Public Health Reports, 133(2), 142–146. [PubMed: 29389251]

Dwyer JB, Janssen J, Luckasevic TM, & Williams KE (2018). Report of Increasing Overdose Deaths that include Acetyl Fentanyl in Multiple Counties of the Southwestern Region of the Commonwealth of Pennsylvania in 2015–2016. Journal of Forensic Sciences, 63(1), 195–200. 10.1111/1556-4029.13517 [PubMed: 28605020]

Gladden RM, Martinez P, & Seth P (2016). Fentanyl Law Enforcement Submissions and Increases in Synthetic Opioid-Involved Overdose Deaths — 27 States, 2013–2014. MMWR. Morbidity and Mortality Weekly Report, 65(33), 837–843. 10.15585/mmwr.mm6533a2 [PubMed: 27560775]

Hayashi K, Milloy MJ, Lysyshyn M, DeBeck K, Nosova E, Wood E, & Kerr T (2018). Substance use patterns associated with recent exposure to fentanyl among people who inject drugs in Vancouver, Canada: A cross-sectional urine toxicology screening study. Drug and Alcohol-Dependence, 183, 1–6. [PubMed: 29220642]

Hogan L, Rutherford B, Governor L, & Schrader Secretary DR (2017). Drug-and Alcohol-Related Intoxication Deaths in Maryland, 2016. Maryland Department of Health and Mental Hygiene. Retrieved from https://bha.health.maryland.gov/OVERDOSE_PREVENTION/Documents/Maryland2016OverdoseAnnualreport.pdf

Jones CMC, Baldwin GT, & Compton WM (2017). Recent increases in cocaine-related overdose deaths and the role of opioids. American Journal of Public Health, 107(3), 430–432. [PubMed: 28177817]

Katz J (2017, 9 2). The First Count of Fentanyl Deaths in 2016: Up 540% in Three Years. The New York Times. Retrieved from https://www.nytimes.com/interactive/2017/09/02/upshot/fentanyl-drug-overdose-deaths.html

Kenney SR, Anderson BJ, Conti MT, Bailey GL, & Stein MD (2018). Expected and actual fentanyl exposure among persons seeking opioid withdrawal management. Journal of Substance Abuse Treatment, (86), 65–69.

Krieger MS, Yedinak JL, Buxton JA, Lysyshyn M, Bernstein E, Rich JD, … Marshall BDL (2018). High willingness to use rapid fentanyl test strips among young adults who use drugs. Harm Reduction Journal, 15(1), 7. [PubMed: 29422052]

Marinetti LJ, & Ehlers BJ (2014). A series of forensic toxicology and drug seizure cases involving illicit fentanyl alone and in combination with heroin, cocaine or heroin and cocaine. Journal of Analytical Toxicology. 10.1093/jat/bku086

Mars SG, Ondocsin J, & Ciccarone D (2018). Sold as Heroin: Perceptions and Use of an Evolving Drug in Baltimore, MD. Journal of Psychoactive Drugs, 50(2), 167–176. [PubMed: 29211971]

O'Donnell JK, Gladden RM, & Seth P (2017). Trends in Deaths Involving Heroin and Synthetic Opioids Excluding Methadone, and Law Enforcement Drug Product Reports, by Census Region — United States, 2006–2015. MMWR. Morbidity and Mortality Weekly Report. 10.15585/mmwr.mm6634a2

O'Donnell JK, Halpin J, Mattson CL, Goldberger BA, & Gladden RM (2017). Deaths Involving Fentanyl, Fentanyl Analogs, and U-47700 — 10 States, July-December 2016. MMWR. Morbidity and Mortality Weekly Report. 10.15585/mmwr.mm6643e1

Park JN, Weir BW, Allen ST, Chaulk P, & Sherman SG (2018). Fentanyl-contaminated drugs and non-fatal overdose among people who inject drugs in Baltimore, MD. Harm Reduction Journal, 15(1), 34 10.1186/sl2954-018-0240-z [PubMed: 29976195]

Peiper NC, Clarke SD, Vincent LB, Ciccarone D, Kral AH, & Zibbell JE (2018). Fentanyl test strips as an opioid overdose prevention strategy: Findings from a syringe services program in the Southeastern United States. International Journal of Drug Policy. 10.1016/j.drugpo.2018.08.007

Phalen P, Ray B, Watson DP, Huynh P, & Greene MS (2018). Fentanyl related overdose in Indianapolis: Estimating trends using multilevel Bayesian models. Addictive Behaviors, 86, 4–10. 10.1016/j.addbeh.2018.03.010 [PubMed: 29631798]

Potier C, Laprévote V, Dubois-Arber F, Cottencin O, & Rolland B (2014). Supervised injection services: What has been demonstrated? A systematic literature review. Drug and Alcohol Dependence, 145, 48–68. [PubMed: 25456324]

Radloff L The CES-D scale: A self-report depression scale for research in the general population. Applied Psychol Measurement 1977;3:385–401.

Rudd RA, Seth P, David F, & Scholl L (2016). Increases in Drug and Opioid-Involved Overdose Deaths — United States, 2010–2015. MMWR. Morbidity and Mortality Weekly Report. 10.15585/mmwr.mm655051e1

Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption-II. Addiction 1993;88:791–804 [PubMed: 8329970]

Seth P, Scholl L, Rudd RA, & Bacon S (2018). Overdose Deaths Involving Opioids, Cocaine, and Psychostimulants — United States, 2015–2016. MMWR. Morbidity and Mortality Weekly Report. 10.1111/ajt.14905

Slavova S, Costich JF, Bunn TL, Luu H, Singleton M, Hargrove SL, … Ingram V (2017). Heroin and fentanyl overdoses in Kentucky: Epidemiology and surveillance. International Journal of Drug Policy. 10.1016/j.drugpo.2017.05.051

Somerville NJ, O'Donnell J, Gladden RM, Zibbell JE, Green TC, Younkin M, … Walley AY (2017). Characteristics of Fentanyl Overdose — Massachusetts, 2014–2016. MMWR. Morbidity and Mortality Weekly Report. 10.15585/mmwr.mm6614a2

Vlahov D, Anthony JC, Munoz A, & Margolick J (1991). The ALIVE study: A longitudinal study of HIV-1 infection in intravenous drug users: Description of methods. JOURNAL OF DRUG ISSUES, 21(4), 759–776.

Volk RJ, Steinbauer JR, Cantor SB, Holzer CE III. The Alcohol Use Disorders Identification Test (AUDIT) as a screen for at-risk drinking in primary care patients of different racial/ethnic backgrounds. Addiction 1997;92:197–206. [PubMed: 9158231]

**Table 1.**

Sociodemographic, drug use and risk behaviors of N=994 participants

| | N (%) |
|---|---|
| Socio-demographic characteristics | |
| Mean age (SD) | 55 years (9.1) |
| Female | 343 (35) |
| Baltimore City residence | 856 (88) |
| African American | 838 (84) |
| Ever married | 449 (48) |
| High school education | 457 (46) |
| HIV-positive | 310 (31) |
| Socio-demographic characteristics (prior 6 months) | |
| Employed | 139(14) |
| Income<$5K | 685 (70) |
| Homeless | 97 (10) |
| Incarcerated | 20 (2) |
| Depressive symptoms (CESD≥23) | 276 (28) |
| Substance Use (prior 6 months) | |
| Any cigarette use | 772 (78) |
| Any alcohol use | 481 (48) |
| AUDIT ≥ 8 (vs. AUDIT<8) | 163 (16) |
| Any injection drug use | 315 (32) |
| Frequency of injection | |
| None | 675 (68) |
| Less than daily injection | 167 (17) |
| Daily or more injection | 148 (15) |
| Overdose (any drug) | 35 (4) |
| Any cocaine use (snorted, smoked, injected) | 420 (42) |
| Any opioid use (snorted, smoked, injected heroin or prescription opioids) | 412 (41) |
| Marijuana use | 181 (18) |

**Table 2.**

History of fentanyl use and knowledge and attitudes related to fentanyl among 994 people who currently inject or formerly injected drugs in Baltimore

| N=994 | N (%) |
|---|---|
| Lifetime fentanyl use | 277 (28) |
| Route of use* | |
| Injected fentanyl by itself | 50 (18) |
| Injected with heroin | 163 (59) |
| Snorted fentanyl by itself | 34 (12) |
| Snorted fentanyl with heroin | 79 (29) |
| Took orally | 3 (1) |
| Fentanyl patch | 8 (3) |
| Source of fentanyl* | |
| Street | 264 (95) |
| Family | 2 (<1) |
| Friend | 20 (7) |
| Other | 2 (<1) |
| Fentanyl use in the last 6 months* | 162 (58) |
| Ever overdosed after fentanyl use** | 49 (31) |
| Mean number of times overdosed** (SD) | 2 (2) |
| Route of use*** | |
| Fentanyl by itself | 12 (26) |
| Mixed with other drugs | 35 (74) |
| Overdose in past 6 months (any drug)** | 26 (17) |
| Know someone who overdosed after fentanyl use | 510 (52) |
| Mean number of times someone else overdosed**** (SD) | 5 (6) |
| Route of use**** | |
| Fentanyl by itself | 56 (11) |
| Mixed with other drugs | 265 (52) |
| Don't know | 189 (37) |

* among n=277 who reported lifetime fentanyl use

** among n=162 who reported fentanyl use in past 6 months

*** among n=49 who reported ever overdosing after using fentanyl

**** among n=510 who knew someone who overdosed; SD = standard deviation

**Table 3.**

Attitudes regarding fentanyl among N=954 PWID reporting ever having used heroin

| | Yes | Neutral or Don't Know | No |
|---|---|---|---|
| If you heard that a dealer was selling heroin laced with fentanyl, would you be more likely to buy it than standard heroin? | 169 (18) | 60 (6) | 726 (76) |
| Does heroin look different when it is mixed with fentanyl? | 331 (35) | 488 (51) | 137 (14) |
| | **Agree** | **Neutral or Don't Know** | **Disagree** |
| Using fentanyl (either by itself or in combination with other drugs) increases risk of overdose | 734 (77) | 197(21) | 26 (3) |

**Table 4:**

Factors associated with recent fentanyl use (prior six months) and reported preference for fentanyl-adulterated and –substituted heroin (FASH) among 523 PWUD

| | Recent Fentanyl Use | | Prefer FASH | |
|---|---|---|---|---|
| | **OR (95% CI)** | **aOR (95% CI)** | **OR (95% CI)** | **aOR (95% CI)** |
| Socio-demographic characteristics (time-fixed) | | | | |
| Age (5 yrs) | **0.74 (0.67, 0.82)** | **0.82 (0.71, 0.95)** | **0.72 (0.64, 0.81)** | **0.86 (0.74, 0.99)** |
| Female (vs. Male) | **0.53 (0.35, 0.81)** | **0.52 (0.32, 0.85)** | 0.75 (0.45, 1.22) | 0.79 (0.47, 1.34) |
| Residence outside Baltimore City (vs. City) | 0.91 (0.49, 1.67) | | 1.82 (0.98, 3.40) | 1.38 (0.68, 2.81) |
| African American (vs. other race) | **0.36 (0.23, 0.55)** | 0.81 (0.44, 1.48) | **0.29 (0.18, 0.46)** | 0.56 (0.30, 1.07) |
| Ever married (vs. never) | 0.72 (0.48, 1.08) | | 0.97 (0.60, 1.57) | |
| High school education (vs. less than high school) | 1.33 (0.91, 1.94) | | 1.15 (0.73, 1.80) | |
| HIV-positive (vs. HIV-negative) | **0.62 (0.40, 0.96)** | 0.76 (0.45, 1.27) | 0.62 (0.36, 1.06) | |
| Socio-demographic characteristics (prior 6 months) | | | | |
| Employed (vs. unemployed) | 0.89 (0.46, 1.74) | | 0.39 (0.14, 1.11) | |
| Income<$5K (vs. ≥$5K) | 1.43 (0.91, 2.26) | | 1.19 (0.70, 2.03) | |
| Homeless (vs. not) | **4.03 (2.44, 6.66)** | **1.87 (1.05, 3.41)** | **3.13 (1.83, 5.37)** | **1.96 (1.05, 3.68)** |
| Incarcerated (vs. not) | 1.65 (0.58, 4.72) | | 2.31 (0.77, 6.92) | |
| CESD≥23 (vs. CESD<23) | 1.08 (0.73, 1.59) | | 1.38 (0.88, 2.17) | |
| Substance Use (prior 6 months) | | | | |
| Any cigarette use (vs. none) | 1.71 (0.95, 3.07) | | 0.62 (0.35, 1.10) | |
| Any alcohol use (vs. none) | 0.99 (0.68, 1.48) | | **0.63 (0.40, 0.99)** | 0.68 (0.42, 1.13) |
| AUDIT ≥ 8 (vs. AUDIT<8) | 1.39 (0.91, 2.14) | | 0.84 (0.49, 1.44) | |
| Any injection | **5.63 (3.50, 9.05)** | | **2.81 (1.68, 4.70)** | |
| Frequency of injection | | | | |
| None | 1.00 | 1.00 | 1.00 | 1.00 |
| Less than daily injection | **3.83 (2.25, 6.52)** | 1.68 (0.92, 3.07) | **2.31 (1.28, 4.15)** | 1.52 (0.78, 2.97) |
| Daily or more injection | **8.36 (4.93, 14.2)** | **3.04 (1.68, 5.52)** | **3.41 (1.92, 6.04)** | **2.10 (1.07, 4.11)** |
| Any cocaine use (vs. none) | **2.27 (1.34, 3.84)** | **2.12 (1.18, 3.83)** | 1.59 (0.88, 2.89) | |
| Any opioid use (vs. none) | **31.2 (7.59, 128)** | **17.0 (3.95, 73.4)** | **2.57 (1.29, 5.15)** | 1.44 (0.63, 3.12) |
| Marijuana use (vs. none) | **1.72 (1.14, 2.60)** | 1.17 (0.72, 1.90) | 1.31 (0.81, 2.14) | |

OR = odds ratio; aOR = adjusted odds ratio; 95% CI = 95% confidence interval