Understanding methamphetamine and opioid co-use: national trends and local harm reduction strategies for overlapping illicit drug use

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Abstract

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Introduction: In the past 20 years, the United States has seen a remarkable increase the use of both methamphetamine and opioids, used concurrently or simultaneously. A more detailed picture is needed to understand where methamphetamine-opioid co-use is increasing nationally, as well as the characteristics of people who co-use. Methamphetamine-opioid co-use has become particularly prevalent in Seattle, WA, yet the rationale for co-use among people who use drugs in this important region is not yet clear. More harm reduction tools to serve the growing number of people who co-use in Seattle are needed.

Methods: First, we used data from the 2012, 2015, and 2018 cycles of the National HIV Behavioral Surveillance (NHBS) project in people who inject drugs (PWID) to describe trends in methamphetamine-opioid co-use over time and in different Census regions. We also compared the demographic, socio-economic, sexual health, and drug use behavioral characteristics of people who co-used compared to people who primarily used one drug (Chapter 1). Second, we

conducted in-depth semi-structured interviews with people who regularly used both methamphetamine and opioids recruited from a syringe services program (SSP) in downtown Seattle (N=21). We conducted an interpretive descriptive analysis of the data informed by the social-ecological framework to identify themes in the rationale behind methamphetamine-opioid co-use for our participants (Chapter 2). And last, we evaluated access to and interest among Seattle-area PWID in a potential harm reduction strategy to promote safer consumption by facilitating a switch from injection to safer routes such as smoking or oral consumption with free safer smoking equipment. Using data from the Seattle 2018 NHBS survey of people who inject drugs (N=555), we described whether respondents had access to safer smoking equipment, whether they were interested in getting it, and if they thought access did or would reduce their injection frequency (Chapter 3).

Results: In the national data, we found that methamphetamine-opioid co-use increased from 14.0% in 2012 to 26.3% in 2018 in the overall NHBS sample. Co-use was most prevalent in the West and increased the most in the Northeast. Younger age, opioid overdose in the past year, sharing syringes, and sharing other injection equipment were significantly associated with methamphetamine-opioid co-use compared to all other drug use patterns. In our qualitative study, we identified two overarching themes in the rationale of methamphetamine-opioid co-use: availability and function. For many, methamphetamine and opioids were readily available in their social networks, in community sources, and through the fluctuating illicit drug market. Methamphetamine and opioids served a number of functional uses individually and in families and communities. We also identified that houselessness was an environment in which the availability and function of methamphetamine and opioids were uniquely elevated. And last, we

found that among Seattle-area NHBS-PWID participants, just 12% reported access to free safer smoking equipment. Between one third and half of respondents were interested in getting free safer smoking equipment, depending on the drug. A large number of participants reported that access did or would reduce their frequency of injection.

Conclusions: The widespread change in drug use patterns and the higher-risk behavior associated with co-use nationally signal the need for swift, coordinated public health action to expand harm reduction and treatment services and to develop data-informed clinical guidelines to serve this growing population. Locally, methamphetamine-opioid co-use was influenced by complex personal, social, and societal factors. Public health policy to address the needs of people who co-use through treatment, harm reduction, and other social programs must support individuals, their communities, and the broader structural environment. Harm reduction strategies like provision of free safer smoking equipment may be an important tool to reduce risks from opioid and stimulant injection.

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Chapter 1. National trends in co-use of opioids and methamphetamine among people who inject drugs, 2012-2018

National trends in co-use of opioids and methamphetamine among people who inject drugs, 2012-2018

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Abstract

Reports from substance use disorder treatment admissions have described a trend of rapidly increasing overlapping methamphetamine and opioid use throughout the United States in the past twenty years. We used data from the 2012, 2015, and 2018 cycles of the National HIV Behavioral Surveillance (NHBS) project among people who inject drugs (PWID) to describe trends in methamphetamine-opioid co-use over time and in different US Census regions. We also compared the demographic, socio-economic, sexual health, and drug use behavioral characteristics of people who co-used compared to people who primarily used one drug. Methamphetamine-opioid co-use increased from 4.3% in 2012 to 14.3% in 2018 in the overall NHBS sample. Co-use was most prevalent in the West and increased the most in the Northeast. Younger age, frequent drug injection, opioid overdose in the past year, sharing syringes and other injection equipment were significantly associated with methamphetamine-opioid co-use compared to all other drug use patterns. The widespread change in drug use patterns and the higher-risk behavior associated with co-use signal the need for swift and coordinated public health action to expand harm reduction and treatment services and to develop data-informed clinical guidelines to serve this growing population.

Introduction

The landscape of illicit and extra-medical substance use in the United States has shifted substantially in the previous twenty years. Between 2002 and 2020, the proportion of people who reported past-year heroin use more than doubled in the National Survey on Drug Use and Health (NSDUH) (1,2). Use of other opioids, including extra-medical use of prescription painkillers and use of the synthetic opioid fentanyl, has doubled between 2010 and 2020 (1,2). Use of methamphetamine rose dramatically in the 1990's and stabilized somewhat through the early 2000's, though reports have shown a 43% increase in methamphetamine use between 2015 and 2019 (3). Recently, studies that take polysubstance use into account have begun to highlight how the trends of opioid and methamphetamine use in the United States are highly interwoven and overlapping (reviewed in (4)). National studies of substance use disorder treatment admissions have described the proportion of patients who use both methamphetamine and opioids increasing by between 80% and 490% in the past decade (5–7). A report using NSDUH data showed the proportion of people who indicated past-month use of heroin *and* past-month use of methamphetamine increased nearly three-fold between 2015 and 2017 (8). This pattern, referred to here as *co-use*, captures the increasing trend of regular, concurrent, and often simultaneous use of both methamphetamine and opioids.

The sharp rise in co-use of methamphetamine with opioids is a polysubstance use trend that, because of the magnitude of health risks associated with each drug individually, merits significant concern. Used on their own, methamphetamine and opioids are both associated with elevated mortality, cardiovascular disease, stroke, dental pathology, mental health disorders, HIV, hepatitis C virus (HCV), infective endocarditis, skin infections, and other STIs (reviewed in (9,10)), as well as a number of negative experiences in society, including social isolation,

stigmatization, difficulty maintaining employment, interactions with the criminal justice system, and unstable housing (10–15). In terms of health outcomes, co-use of methamphetamine and opioids is associated with greater psychiatric and physical morbidity compared to exclusive use of opioids (16), higher odds of bloodborne infection (17), emergency room visits and overnight hospital stays (18), and higher risk of fatal (19) and nonfatal (20) overdose compared to mono-drug use. Early studies suggest that substance use treatment for people who co-use may be challenging: use of methamphetamine has been associated with opioid use disorder treatment dropout (21–23), and relapse (24). Few studies have examined the demographic and behavioral characteristics of people who co-use methamphetamine and opioids. In nationally representative data on people who use drugs (PWUD), co-use of methamphetamine was associated with unstable housing and criminal legal system involvement (18), and in treatment admissions data, co-use was associated with being white, female, and a younger age (5,7,25). Regional reports from Seattle, WA, Denver, CO, and Tijuana, Mexico have described associations between co-use and history of nonfatal overdose, unsafe injection practices, high risk sex, and comorbid medical and mental health issues compared to those who use only one drug (26–28).

While regional reports and national treatment and NSDUH data outline a broad trend toward increasing co-use, some groups of PWUD have limited representation in these data: treatment admissions data may miss many PWUD who are unable to access or are uninterested in substance use treatment, and NSDUH is a household survey that does not include people who are homeless or unstably housed. To build on these existing reports, we used data from the National HIV Behavior Surveillance (NHBS) project collected across the United States from 2012, 2015, and 2018 among people who inject drugs (PWID). Our first aim was to examine the temporal and regional trends in methamphetamine-opioid co-use to identify how co-use is

changing over time and where it is most prevalent. Our second aim was to describe the demographic, health status, and drug use behavioral characteristics of people who co-use methamphetamines and opioids compared to people who primarily used one drug.

Methods

NHBS-PWID. The NHBS is a surveillance project conducted annually since 2003 by the Centers for Disease Control and Prevention (CDC) to better understand behavioral risk factors for HIV. Each year, the key population surveyed rotates between men who have sex with men (MSM), heterosexually-active people, and PWID (formally referred to as NHBS-IDU). For this evaluation, we used data from rounds 3 (2012), 4 (2015), and 5 (2018) of the PWID cycle. The scheduled 2021 round was deferred to late 2022 due to the COVID-19 pandemic, making round 5 the most recent available dataset.

Study sample. The NHBS-PWID sampling strategy is described in detail elsewhere (29–32). Briefly, staff at local health departments in each project area selected a small number of initial participants ("seeds") who met inclusion criteria to complete the survey and recruit their peers to participate using respondent driven sampling (RDS). Recruitment and interviewing then continued until the target sample size (~500 people per project area) was reached. Inclusion criteria were: (1) respondent had not previously participated in that year's NHBS cycle; (2) lived in the participating metropolitan statistical area or division; (3) was aged 18 years or older; (4) had injected drugs without a prescription in the prior 12 months; and (5) was able to complete the NHBS interview in Spanish or English. Data were collected from project areas across the country (see **Figure 1**). Memphis, TN, Portland, OR, and Virginia Beach, VA were added in 2018. Researchers conducted the interviews in-person, and the survey included demographic, drug use, healthcare utilization, and health status questions. Participants were provided

incentives for completing the survey (typically 25$) and recruiting additional participants (typically 10-20$ per recruit).

Figure 1. NHBS Project Areas and Census Regions

Measures. For both aims, we created a composite variable for our main outcome of interest: co-use of methamphetamines and opioids. Each NHBS survey included measures for how frequently a respondent used heroin, painkillers, methamphetamine, and other drugs, by injection or non-injection routes (when relevant) in the past 12 months. We created binary measures for whether they used each drug more than weekly. Opioid use was defined by use of heroin and/or painkillers (type of painkiller was not specified), by any route, more than weekly. Co-use was defined by use of both methamphetamine *and* opioids, by any route, more than weekly. To analyze temporal and regional trends in co-use, the key variables were study cycle and US Census region (NHBS sites by US Census Region: West (WA, OR, CA, CO), Midwest (IL, MI), South (TX, LA, TN, VA, NC, GA, FL, MD, DC, PR), and Northeast (MA, NY, PA, NJ). The main outcome of interest was the proportion of respondents who co-used methamphetamine and opioids. To describe the characteristics of people who co-used**,** we compared subgroups of the sample by drug use pattern: methamphetamine-opioid co-use, primarily methamphetamine use,

primarily opioids, or primarily other drugs. These categories were mutually exclusive: co-use was defined as described above, primarily methamphetamine was defined as use of methamphetamine more than weekly but use of opioids less often or not at all, primarily opioids was defined as use of opioids weekly or more often but use of methamphetamines less often or not at all, and primarily other drugs was defined as use of any other illicit drugs measured (ecstasy, crack, or cocaine) weekly or more often and use of methamphetamine and opioids less often or not at all. Regular use of any of these other drugs did not preclude a respondent from the three main categories for co-use, methamphetamine use, or opioid use; rather, the "primarily other drugs" category was created to capture the remaining participants who did not frequently use methamphetamine or opioids but did use other drugs regularly.

For examining the characteristics of people who co-used methamphetamine and opioids compared to people who used primarily methamphetamine or opioids, we were interested in demographic covariates: age (in years), gender (male, female, transgender), sexual identity (heterosexual/straight, homosexual/gay, bisexual), race (white, black, another race), and ethnicity (Hispanic/Latino/a). Socioeconomic covariates of interest were (yes/no): homeless in the past year, less than high school education, uninsured, unemployed, incarcerated in past year. Drug use behavioral covariates of interest were (yes/no): injected more than daily, had an opioid overdose in the past year, shared syringes, shared other injection equipment. Last, sexual history or health status covariates of interest were (yes/no): gave or received transactional sex, had positive HIV test result, self-reported HCV diagnosis.

Statistical analysis: We used descriptive statistics (e.g., percentages for categorical variables and medians and interquartile ranges for continuous variable) to examine the sample demographics including age, gender, race and ethnicity, socioeconomic status, drug use and sexual behavior,

and HIV/HCV status. We tested for differences in sample characteristics between the 2012 NHBS cycle and the 2015 and 2018 cycles using t-tests for continuous variables and chi-square tests for categorical variables. We also used chi-square tests to examine if the proportions of respondents in the 2015 and 2018 cycles who used heroin, speedball, crack, marijuana, cocaine, oxycontin or painkillers, methamphetamine, or ecstasy at least weekly differed from the 2012 cycle.

We used descriptive statistics to estimate and report the proportion of NHBS-IDU respondents who co-used methamphetamine and opioids in the US as a whole and broken down by NHBS round and Census-designated geographic region (Northeast, Midwest, Southern, and Western US). To test for temporal and regional trends in co-use of methamphetamine and opioids, we used a log-binomial regression model. To account for sample variation between NHBS-PWID rounds, we adjusted our models for participant age, race and ethnicity, and gender. This analysis excluded the three NHBS sites added in the 2018 round: Memphis, TN, Portland, OR, and Virginia Beach, VA. We also used a separate model including an interaction term for region and time to test for changes in co-use over time by region.

We used multinomial regression to evaluate characteristics of people who co-used methamphetamine and opioids compared to people who used primarily methamphetamine, people who used primarily opioids, and people who used primarily other drugs. We used the most recent NHBS-PWID round (2018) only. Covariates of interest were participant age, gender, sexual identity, race, ethnicity, housing status, insurance status, employment status, recent incarceration history, injection frequency, opioid overdose in past year, syringe sharing, other equipment sharing, history with transactional sex, HIV status (test result), and HCV status (self-report).

RDS adjustment. We adjusted our estimates of methamphetamine and opioids co-use prevalence for respondent-driven sampling probabilities using the Giles Successive Sampling Estimator within the RDS package in R (https://cran.r-project.org/web/packages/RDS/RDS.pdf). We present the adjusted results.

Ethics. Due to the CDC's determination of NHBS as a public health surveillance activity and the lack of personal identifying data from the NHBS survey, the Washington State Institutional Review Board (IRB) approved this evaluation as exempt from review.

Results

Sample characteristics

The sample size was 10,168 respondents in the 2012 cycle, 10,483 in the 2015 cycle, and 11,432 respondents in the 2018 cycle. Information about participant demographics, drug use behavior, and health behavior and health status are presented in **Table 1**. The mean age was in the mid-forties for all three samples, with around 70% of the sample being male. There were small but significant differences in racial and ethnic makeup of the sample between the 2018 and 2015 cycles, compared to the 2012 cycle. A majority of the sample (between 74.7% and 78.5%) reported living below the federal poverty level in all three cycles, with around half of all participants reporting they were unemployed. A smaller proportion of the 2015 and 2018 samples (26% and 26%, respectively) was uninsured compared to the 2012 sample (39%), and a greater proportion (47% and 50%, respectively) of the 2015 and 2018 samples reported being homeless (2012: 37%). There was a small but significant decrease in the proportion of the sample with a positive HIV test after the 2012 cycle (9% in 2012, compared to 7% and 6% in 2015 and 2018, respectively). Just under half of each sample self-reported an HCV diagnosis.

Table 1. Demographic and other sample characteristics, by National HIV Behavioral Surveillance - PWID, years 2012-2018

Characteristic	2012 n = 10,168 N	%	2015 n = 10,483 N	%		2018 n = 11,432 N	%	
Demographics								
Age (mean)	45.9		43.5			44.1		
Gender								
Male	7237	71.2	7521	71.7		7891	69.0	**
Female	2880	28.3	2910	27.8		3449	30.2	*
Transgender	51	0.5	52	0.5		92	0.8	*
MSM	812	8.0	750	7.2	*	736	6.4	***
Race and ethnicity								
Black	4506	44.3	3532	33.7	***	3773	33.0	***
White	2414	23.7	2357	22.5	*	2378	20.8	***
Hispanic/Latinx	2726	26.8	4010	38.3	***	4488	39.3	***
Another Race	507	5.0	562	5.4		786	6.9	***
Socio-economic characteristics								
Below federal poverty level	7985	78.5	8089	77.2	*	8537	74.7	***
Unemployed	4973	48.9	5446	52.0	***	5656	49.5	
Uninsured	3930	38.7	2736	26.1	***	2957	25.9	***
Homeless or unstably housed	3805	37.4	4919	46.9	***	5698	49.8	***
Health status								
HIV-positive (test result)	914	9.0	724	6.9	***	731	6.4	***
Ever had HCV (self-report)	4595	45.2	4664	44.5		5042	44.1	

* Indicated X^2 tests for 2015 or 2018 significantly differed from 2012 (*** < 0.001, ** < 0.01, * < 0.05)

Overall trends in drugs used

Drug use patterns differed significantly between the sample years: each drug showed an increase in the proportion of respondents who reported using it more than weekly between 2012 and 2018 (Table 2). Methamphetamine had the most marked proportional increase in the overall sample, with a 241% increase in the proportion reporting use between 2012 and 2018.

Table 2. Any drug use, by National HIV Behavioral Surveillance – PWID, years 2012-2018

Drugs used more than weekly[#]	2012 n = 10,168 N	%	2015 n = 10,483 N	%		2018 n = 11,432 N	%	
Heroin	7827	77.0	8701	83.0	***	9677	84.6	***
Speedball[+]	2918	28.7	2881	27.5		3954	34.6	***
Crack	2285	22.5	2579	24.6	***	3508	30.7	***
Marijuana	2584	25.4	3060	29.2	***	3872	33.9	***
Cocaine	2212	21.8	2377	22.7		3330	29.1	***
Oxycontin or painkillers	1271	12.5	1408	13.4	*	1613	14.1	***
Methamphetamine	818	8.0	2061	19.7	***	3126	27.3	***
Ecstasy	73	0.7	162	1.5	***	263	2.3	***

[#] Drug use categories were not mutually exclusive, and respondents could indicate use of multiple drugs
* Indicated X^2 tests for 2015 or 2018 significantly differed from 2012 (*** < 0.001, ** < 0.01, * < 0.05)
[+]Speedball is heroin and cocaine, used together

Regional and temporal trends in methamphetamine, opioid, and co-use patterns

Methamphetamine-opioid co-use increased from cycle to cycle, with 4.3%, 11.0%, and 14.3% in the overall sample in 2012, 2015, 2018, respectively. Regionally, methamphetamine-opioid co-use saw proportionally large increases in the Northwest and Midwest, though prevalence was initially very low, and a 426% increase in the South, and 242% in the West between 2012 and 2018 (**Table 3**). Co-use was the most prevalent in the Western region, with just under half of respondents reporting use of both methamphetamine and opioids by 2015.

Use of primarily methamphetamine was increasing somewhat or was steady among NHBS respondents between the 2012, 2015, and 2018 cycles. While there was a proportionally large proportional increase in the use of methamphetamine in the Northeast and the South, it was mostly stable in the Midwest and West. Methamphetamine use was most prevalent in the Western region, and was rare in the Midwest region.

The proportion of respondents who primarily used opioids declined somewhat between the 2012, 2015, and 2018 NHBS cycles, with 70.3% in 2012 and 68.4% of the sample by 2018. This trend was most marked in the Western region, where the proportion of people who primarily

used opioids nearly halved between 2012 and 2018. Primary use of opioids was least prevalent in the West, and most prevalent in the Midwest.

Table 3. Respondents who co-used methamphetamines and opioids, primarily used methamphetamine, or primarily used opioids, by U.S. Census region and National HIV Behavioral Surveillance - PWID, years 2012-2018

	Co-Used Methamphetamine & Opioids						Primarily Used Methamphetamine						Primarily Used Opioids					
	2012		2015		2018		2012		2015		2018		2012		2015		2018	
Region	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Northeast	15	0.1	86	2.8	222	5.3	2	0.0	4	0.0	23	0.6	1954	82.1	1996	84.8	1868	86.3
Midwest	1	0.0	27	2.1	28	3.2	0	0.0	0	0.0	0	0.0	763	94.7	1062	91.0	1014	93.4
South	85	1.9	275	6.5	481	10.0	34	1.3	157	5.6	148	5.6	3122	69.6	3274	71.4	2983	70.2
West	371	11.7	993	29.3	1165	40.1	307	11.0	511	20.8	410	21.6	1702	55.0	1175	40.7	697	29.4
Total	472	4.3	1381	11.0	1896	14.3	343	3.0	672	7.7	581	7.08	7541	70.3	7507	68.8	6562	68.4

RDS-adjusted estimates of the percentage of respondents in each category (proportions will not add up to 100)
Co-use of methamphetamine and opioids: respondent reported use of both methamphetamine and opioids more than weekly
Primarily methamphetamine: respondent reported use of methamphetamine more than weekly and opioids less often
Primarily opioids respondent reported use of opioids more than weekly and methamphetamine less often
US Census Regions: West (WA, OR, CA, CO), Midwest (IL, MI), South (TX, LA, TN, VA, NC, GA, FL, MD, DC, PR), and Northeast (MA, NY, PA, NJ).

Regional and temporal trends in methamphetamine-opioid co-use: model results

In our first logistic regression model, NHBS cycle year was significantly associated with prevalence of methamphetamine-opioid co-use: co-use was 161% more prevalent in 2015 than in 2012, and 277% more prevalent in 2018 than in 2012, after adjusting for age, race and ethnicity, and gender (**Table 4**). Region was also significantly associated with prevalence of methamphetamine-opioid co-use: prevalence of co-use was 85%, 93%, and 72% lower in the Northeast, Midwest, and South than in the West, respectively.

In our second model, which also included an interaction term for region*cycle, differences in prevalence of methamphetamine-opioid co-use by year varied by region (**Table 4**). Based on the interaction terms between region and cycle year, co-use increased the most markedly in the Northeast: the PR comparing co-use between 2012 and 2015 and 2012 and 2018 was significantly higher than the PR of the same comparisons in the West (by 117% and 361%,

p- value < 0.01). The interaction estimates comparing change in co-use over time in the Midwest did not differ significantly from the West. The PR comparing methamphetamine-opioid co-use between NHBS year 2012 and 2018 in the South was 58% greater (p-value 0.01) than the PR comparing co-use between the same years in the West, though the same term was not significant for comparisons between years 2012-2015. Taken together, these estimates show that methamphetamine-opioid co-use increased by the greatest magnitude in the Northeast, while increasing somewhat less in the Midwest and West, and the least in the South.

Table 4. Trends in methamphetamine and opioid co-use: model results from National HIV Behavioral Surveillance- PWID, years 2012-2018

Variable	OR	(95% CI)	p-value	OR	(95% CI)	p-value
Cycle 3, 2012 (ref)	--	--		--	--	
Cycle 4, 2015	2.61	(2.37 - 2.87)	< 0.0001	2.39	(2.15 - 2.66)	< 0.0001
Cycle 5, 2018	3.77	(3.44 - 4.13)	< 0.0001	3.19	(2.88 - 3.53)	< 0.0001
West (ref)	--	--		--	--	
Northeast	0.15	(0.14 - 0.17)	< 0.0001	0.05	(0.03 - 0.08)	< 0.0001
Midwest	0.07	(0.05 - 0.09)	< 0.0001	0.01	(0.00 - 0.10)	< 0.0001
South	0.28	(0.26 - 0.30)	< 0.0001	0.20	(0.16 - 0.26)	< 0.0001
Cycle 3, West (ref)				--	--	
Cycle 4 x Northeast				2.17	(1.24 - 3.78)	0.01
Cycle 5 x Northeast				4.61	(2.72 - 7.83)	< 0.0001
Cycle 4 x Midwest				5.46	(0.75 - 39.76)	
Cycle 5 x Midwest				4.94	(0.68 - 35.97)	
Cycle 4 x South				1.20	(0.92 - 1.56)	
Cycle 5 x South				1.58	(1.24 - 2.03)	< 0.0001

Log-binomial regression model adjusted for age, race and ethnicity, and gender.

Characteristics of people who co-used

Using only the most recent NHBS cycle from 2018, we conducted a multinomial regression analysis comparing demographic, socio-economic, sexual health and history, and drug use behavioral characteristics of people who co-used methamphetamine and opioids compared to those who primarily used methamphetamine, opioids, or other drugs. Estimates for this model,

which represent the odds ratio for those with each characteristic being in the specified drug use category compared to the methamphetamine-opioid co-use category, are presented in **Table 5.** ORs of less than one indicate it was significantly *more* likely for persons with a specified characteristic to be in the co-use category than the comparison group, and ORs of greater than one indicate it was significantly *less* likely for persons with a specified characteristic to be in the co-use category than the comparison group.

Odds of reporting methamphetamine-opioid co-use vs. primarily methamphetamine use: Older age was associated with higher odds of being in the primarily methamphetamine category compared to the co-use category. People who identified as gay, bisexual, who were white, or within the "another race" category, who were Hispanic/Latino, reported having given money or goods in exchange for sex, or had a positive HIV test result were significantly *less* likely to be in the methamphetamine-opioid co-use category than in the primarily methamphetamine category. People who reported an HCV diagnosis, reported injecting multiple times per day, had an opioid overdose in the prior year, or shared equipment were significantly *more* likely to be in the co-use category than in the primarily methamphetamine category.

Odds of being in the methamphetamine-opioid co-use category vs. primarily opioids category: Older age was associated with higher odds of being in the primarily opioids category compared to co-use the category. People who were female were significantly *less* likely to be in the co-use category than in the primarily opioids category. People who identified as gay or bisexual, who were Hispanic/Latino, white, or were in the "another race" category, had received less than a high school education, were currently or recently homeless, recently incarcerated, reported having given money or goods in exchange for sex, injected more than daily, had an

opioid overdose in the prior year, shared syringes, or shared equipment were significantly *more* likely to be in the co-use category than in the primarily opioids category.

Odds of being in the methamphetamine-opioid co-use category vs. primarily other drugs category: Older age was associated with higher odds of being in the primarily other drugs category compared to the co-use category. People who self-reported an HCV diagnosis were significantly *less* likely to be in the methamphetamine-opioid co-use category than in the primarily other drugs category. People who identified as gay, bisexual, who were Hispanic/Latino, white, or in the "another race" category, were currently or recently homeless, recently incarcerated, injected more than daily, had an opioid overdose in the prior year, and shared equipment were significantly *more* likely to be in the co-use category than in the primarily other drugs category.

Table 5. Characteristics of methamphetamine-opioid co-use: multinomial regression results from National HIV Behavioral Surveillance - PWID, year 2018

	Co-use	Primarily Methamphetamine			Primarily Opioids			Primarily Other Drugs		
	(ref.)	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
Demographic characteristics										
Age (per 10 year difference)	--	1.18	(1.07 - 1.30)	0.001	1.24	(1.17 - 1.32)	< 0.001	1.30	(1.14 - 1.47)	< 0.001
Gender										
Male (ref)	--	--	--		--	--		--	--	
Female	--	1.09	(0.86 - 1.38)		1.18	(1.02 - 1.37)	0.025	1.36	(0.97 - 1.90)	
Transgender	--	1.41	(0.63 - 3.18)		0.92	(0.47 - 1.77)		1.48	(0.29 - 7.49)	
Sexual orientation										
Heterosexual/straight (ref)	--	--	--		--	--		--	--	
Homosexual/gay	--	2.43	(1.64 - 3.61)	< 0.001	0.40	(0.28 - 0.55)	< 0.001	0.13	(0.04 - 0.44)	0.001
Bisexual	--	1.45	(1.10 - 1.92)	0.008	0.65	(0.54 - 0.78)	< 0.001	0.64	(0.43 - 0.96)	0.029
Race										
Black (ref)	--	--	--		--	--		--	--	
Hispanic/Latino	--	1.55	(1.04 - 2.31)	0.033	0.56	(0.45 - 0.70)	< 0.001	0.47	(0.30 - 0.74)	0.001
White	--	2.33	(1.66 - 3.28)	< 0.001	0.40	(0.33 - 0.48)	< 0.001	0.30	(0.20 - 0.43)	< 0.001
Another race	--	2.48	(1.64 - 3.76)	< 0.001	0.45	(0.35 - 0.58)	< 0.001	0.52	(0.29 - 0.92)	0.024
Socio-economic characteristics										
Uninsured	--	1.17	(0.89 - 1.54)		1.04	(0.88 - 1.22)		1.24	(0.91 - 1.69)	
Unemployed	--	1.12	(0.92 - 1.38)		0.99	(0.87 - 1.12)		0.98	(0.75 - 1.28)	
Less than high school education	--	0.94	(0.75 - 1.18)		0.87	(0.76 - 0.99)	0.040	0.80	(0.61 - 1.05)	
Homeless, prior year	--	1.14	(0.88 - 1.47)		0.57	(0.49 - 0.67)	< 0.001	0.67	(0.50 - 0.90)	0.007
Incarcerated, prior year	--	0.89	(0.73 - 1.10)		0.59	(0.52 - 0.66)	< 0.001	0.68	(0.51 - 0.90)	0.007
Sexual history/health status										
Exchanged sex, gave	--	1.45	(1.06 - 1.96)	0.018	0.78	(0.65 - 0.94)	0.010	1.32	(0.96 - 1.83)	
Exchanged sex, received	--	0.91	(0.67 - 1.24)		0.87	(0.72 - 1.04)		0.93	(0.62 - 1.38)	
HIV, test result	--	1.58	(1.06 - 2.37)	0.025	0.99	(0.75 - 1.30)		1.08	(0.68 - 1.71)	
HCV, self report	--	0.68	(0.55 - 0.84)	0.000	1.11	(0.97 - 1.26)		1.36	(1.05 - 1.78)	0.021
Drug use behavior										
Injection (more than daily)	--	0.21	(0.17 - 0.26)	< 0.001	0.67	(0.57 - 0.79)	< 0.001	0.21	(0.16 - 0.27)	< 0.001
Opioid overdose, prior year	--	0.30	(0.23 - 0.40)	< 0.001	0.67	(0.59 - 0.76)	< 0.001	0.33	(0.23 - 0.47)	< 0.001
Shared syringes	--	0.82	(0.65 - 1.02)		0.67	(0.58 - 0.77)	< 0.001	0.87	(0.65 - 1.17)	
Shared equipment	--	0.31	(0.25 - 0.39)	< 0.001	0.76	(0.66 - 0.88)	< 0.001	0.60	(0.45 - 0.81)	0.001

Multinomial regression model adjusted for study site.

OR < 1: it was significantly *more* likely for persons with this characteristic to be in the co-use category than the comparison group.

OR > 1: it was significantly *less* likely for persons with this characteristic to be in the co-use category than the comparison group.

Discussion

Our evaluation describes a significant increase in the prevalence of co-use of methamphetamine and opioids among PWID in the United States measured in the 2012, 2015, and 2018 NHBS-PWID surveys. Our study builds on previous reports indicating co-use is increasing with a more detailed temporal and regional picture. We found that co-use was most

prevalent in the Western United States, but that it proportionately increased the most in the Northeast between the three NHBS cycle years. Ours is one of few evaluations to describe the characteristics of people who co-use compared to people who primarily used one drug in a large national sample of PWUD. Younger age, injecting drugs more than daily, having an opioid overdose in the prior year, sharing syringes or other equipment were significantly associated with methamphetamine-opioid co-use compared to either drug alone. Strategies to meet this rapidly emergent drug use pattern are urgently needed, and future work should seek to understand the treatment and harm reduction needs of people with overlapping use of methamphetamine and opioids.

Our findings are similar to existing national studies of drug use patterns that describe methamphetamine-opioid co-use, particularly in observing that co-use is most prevalent in the Western region. This high prevalence in the West has been linked to large increases in methamphetamine supply to the United States from Mexico, which has saturated Western markets first (1). Our study differed somewhat from a major analysis of co-use in drug use treatment admissions data, where co-use was increasing the most rapidly in the West between 2011 and 2017 (7). In our evaluation, co-use was most prevalent in the West, but increased more gradually one a proportional scale there compared to the other regions. This may reflect a temporal delay between prevalent methamphetamine-opioid co-use and drug use treatment admissions. Two national studies of opioid treatment admissions data describe higher prevalence of co-use in the Midwest than in the Northeast (5,6), which is quite different from our findings. This may be the result of the different samples used: NHBS has just two urban sites in the Midwest: Detroit, MI, and Chicago, IL, whereas the treatment data used by Jones et al captured all reported treatment admissions throughout the Midwestern states.

Many of the characteristics of people who co-use described in the existing literature are similar to those we identified. However, studies based on treatment admission data (5,7,25) associated co-use with a greater likelihood of being female, which was not the case in our analysis. Interestingly, gender differences in treatment initiation do not appear to explain why being female was associated with co-use in the treatment admission studies but not in our study nor in the NSDUH data (8): women are overall *less* likely than men to enter substance use treatment (33). Ellis et al associated co-use with a higher likelihood of being unemployed, which was also not found in our study. It is not clear why our findings differed on gender and employment status, but there could reasonably be differences between PWUD seeking treatment and urban PWID who may or may not be in treatment. Our finding that people who primarily used methamphetamine were more likely to identify as gay or bisexual, and were more likely to be living with HIV compared to people who co-used are consistent with published data on people who use methamphetamine in general (34). Our findings are overall similar to regional reports comparing people who co-used methamphetamine and opioids or goofball to people who primarily used one drug (26–28,35).

Taken together with the existing patchwork of national and regional reports from different PWUD populations, our evaluation of the characteristics associated with people who co-use methamphetamine and opioids begins to assemble a picture of the co-using population. This a younger group of people, with higher-risk drug use behaviors, and more vulnerable socio-economic characteristics than people who use either drug exclusively. People who co-use methamphetamine and opioids are different in many ways from people who exclusively used methamphetamine or opioids and were not more similar to one or the other exclusive use group. The most concerning trait associated with co-use is the syringe and equipment sharing and recent

opioid overdose, which were consistently and significantly linked to co-use in comparisons to primarily methamphetamine or primarily opioids use. Sharing syringes and other equipment increases the risk of bloodborne infections like HIV and HCV (36,37). Harm reduction, particularly in the form of syringe services programs, may be the most effective tool to prevent risks from syringe and other equipment sharing (38–40).

Limitations

Our study is subject to several limitations. The NHBS-PWID eligibility criteria focus enrollment on people who *inject* drugs, meaning this analysis may be missing a portion of PWUD relevant to our understanding of co-use. Methamphetamine is commonly consumed by inhalation, so our "primarily methamphetamine" subgroup is not likely to be representative of people who use methamphetamine in general. While heroin is less frequently consumed by non-injection routes, many PWUD do prefer to smoke heroin, and other opioids are often consumed by non-injection routes as well. Similarly, the NHBS focuses on urban areas to capture populations with the greatest burden of HIV, which may limit the generalizability of our analysis to PWUD who live in rural and suburban communities. Future research should undertake to quantify methamphetamine-opioid co-use in a more broadly representative sample of PWUD.

Our data are unlikely to have captured the important and emerging trend of fentanyl use in the co-use estimates or in the primarily opioids category, as questions specific to fentanyl use were not included in the 2018 cycle. Fentanyl use has skyrocketed in recent years (41), and early reports indicate fentanyl is on track to replace heroin as the dominant drug in some areas (42). Future research should explore what patterns of polysubstance use with fentanyl exist, and how the trend of increasing methamphetamine-opioid co-use has been affected by the rapid introduction of fentanyl.

Last, because of computational limitations, we were not able to adjust the log-binomial or multinomial regression for RDS recruitment chains, so the analysis of characteristics associated with co-use may be subject to bias from the effects of large networks.

Conclusions

Methamphetamine-opioid co-use increased across the United States between 2012 and 2018, and showed a greater rate of change in regions with lower initial prevalence of co-use. Co-use was associated with higher risk drug use behaviors, and a number of other characteristics that suggest a higher vulnerability to harms from drug use. The existing infrastructure to address the prevention, harm reduction, and treatment needs of people who use drugs may be inadequately prepared for the emergence of this co-using population. It will be necessary to evaluate treatment and harm reduction strategies for effectiveness in people who co-use methamphetamine and opioids, and to expand access to these resources.

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References

1. Substance Abuse and Mental Health Services Administration. Key substance use and mental health indicators in the United States: Results from the 2010 National Survey on Drug Use and Health. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration: 2013.(https://www.samhsa.gov/data/)

2. SAMHSA. Key substance use and mental health indicators in the United States: Results from the 2020 National Survey on Drug Use and Health. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration: Substance Abuse and Mental Health Services Administration; 2021.(https://www.samhsa.gov/data/)

3. Han B, Compton WM, Jones CM, et al. Methamphetamine Use, Methamphetamine Use Disorder, and Associated Overdose Deaths Among US Adults. *JAMA Psychiatry*. 2021;78(12):1–14.

4. Jones CM, Bekheet F, Park JN, et al. The Evolving Overdose Epidemic: Synthetic Opioids and Rising Stimulant-Related Harms. *Epidemiologic Reviews*. 2020;42(1):154–166.

5. Jones CM, Underwood N, Compton WM. Increases in methamphetamine use among heroin treatment admissions in the United States, 2008-17. *Addiction*. 2020;115(2):347–353.

6. Jones CM, Olsen EO, O'Donnell J, et al. Resurgent methamphetamine use at treatment admission in the United States, 2008-2017. *Am J Public Health*. 2020;110(4):509–516.

7. Ellis MS, Kasper ZA, Cicero TJ. Twin epidemics: The surging rise of methamphetamine use in chronic opioid users. *Drug and Alcohol Dependence*. 2018;193:14–20.

8. Strickland JC, Havens JR, Stoops WW. A nationally representative analysis of "twin epidemics": Rising rates of methamphetamine use among persons who use opioids. *Drug Alcohol Depend*. 2019;204:107592.

9. Gonzales R, Mooney L, Rawson R. The methamphetamine problem in the United States. *Annu Rev Public Health*. 2010;31:385–398.

10. Ciccarone D. Heroin in brown, black and white: structural factors and medical consequences in the US heroin market. *Int. J. Drug Policy*. 2009;20(3):277–282.

11. Gizzi MC, Gerkin P. Methamphetamine use and criminal behavior. *Int J Offender Ther Comp Criminol*. 2010;54(6):915–936.

12. Homer BD, Solomon TM, Moeller RW, et al. Methamphetamine abuse and impairment of social functioning: a review of the underlying neurophysiological causes and behavioral implications. *Psychol Bull*. 2008;134(2):301–310.

13. Link BG, Struening EL, Rahav M, et al. On stigma and its consequences: evidence from a longitudinal study of men with dual diagnoses of mental illness and substance abuse. *J Health Soc Behav*. 1997;38(2):177–190.

14. Marshall BDL, Wood E, Shoveller JA, et al. Individual, social, and environmental factors associated with initiating methamphetamine injection: implications for drug use and HIV prevention strategies. *Prev Sci*. 2011;12(2):173–180.

15. Weber E, Blackstone K, Iudicello JE, et al. Neurocognitive deficits are associated with unemployment in chronic methamphetamine users. *Drug and Alcohol Dependence*. 2012;125(1):146–153.

16. Pilowsky DJ, Wu L-T, Burchett B, et al. Co-occurring amphetamine use and associated medical and psychiatric comorbidity among opioid-dependent adults: results from the Clinical Trials Network. *Subst Abuse Rehabil*. 2011;2:133–144.

17. Cai Y, Dai Z, Wen S, et al. Risk factors associated with infection of blood-borne virus among people who used methamphetamine. *BMC Infectious Diseases*. 2020;20(1):742.

18. Howell BA, Bart G, Wang EA, et al. Service Involvement Across Multiple Sectors Among People Who Use Opioids, Methamphetamine, or Both, United States—2015–2018. *Medical Care*. 2021;59(3):238–244.

19. Herbeck DM, Brecht M-L, Lovinger K. Mortality, causes of death, and health status among methamphetamine users. *Journal of Addictive Diseases*. 2015;34(1):88–100.

20. Korthuis PT, Cook RR, Foot CA, et al. Association of Methamphetamine and Opioid Use With Nonfatal Overdose in Rural Communities. *JAMA Netw Open*. 2022;5(8):e2226544.

21. Liu D, Gu J, Xu H, et al. Club drugs and alcohol abuse predicted dropout and poor adherence among methadone maintenance treatment patients in Guangzhou, China. *AIDS Care*. 2017;29(4):458–463.

22. Tsui JI, Mayfield J, Speaker EC, et al. Association between methamphetamine use and retention among patients with opioid use disorders treated with buprenorphine. *J Subst Abuse Treat*. 2020;109:80–85.

23. Ware OD, Manuel JI, Huhn AS. Adults With Opioid and Methamphetamine Co-use Have Lower Odds of Completing Short-Term Residential Treatment Than Other Opioid Co-use Groups: A Retrospective Health Services Study. *Front Psychiatry*. 2021;12:784229.

24. Liu C-C, Fang C-P, Liu T-H, et al. APBB2 is associated with amphetamine use and plasma beta-amyloids in patients receiving methadone maintenance treatment. *Prog Neuropsychopharmacol Biol Psychiatry*. 2018;83:92–98.

25. El Ibrahimi S, Hallvik S, Johnston K, et al. Characteristics and health care events of patients admitted to treatment for both heroin and methamphetamine compared to patients admitted for heroin only. *J Subst Abuse Treat*. 2022;132:108615.

26. Al-Tayyib A, Koester S, Langegger S, et al. Heroin and methamphetamine injection: an emerging drug use pattern. *Subst Use Misuse*. 2017;52(8):1051–1058.

27. Glick SN, Klein, K, Tinsley J, et al. Increasing heroin-methamphetamine (goofball) use and related morbidity among Seattle area people who inject drugs. *American Journal on Addictions*. 2020;

28. Meacham MC, Roesch SC, Strathdee SA, et al. Perceived treatment need and latent transitions in heroin and methamphetamine polydrug use among people who inject drugs in Tijuana, Mexico. *J Psychoactive Drugs*. 2018;50(1):62–71.

29. Lansky A, Abdul-Quader AS, Cribbin M, et al. Developing an HIV behavioral surveillance system for injecting drug users: the National HIV Behavioral Surveillance System. *Public Health Rep*. 2007;122 Suppl 1:48–55.

30. Burt RD, Thiede H. Evaluating Consistency in Repeat Surveys of Injection Drug Users Recruited by Respondent-Driven Sampling in the Seattle Area: Results from the NHBS-IDU1 and NHBS-IDU2 Surveys. *Annals of Epidemiology*. 2012;22(5):354–363.

31. Burt RD, Thiede H. Evidence for Risk Reduction Among Amphetamine-Injecting Men Who have Sex with Men; Results from National HIV Behavioral Surveillance Surveys in the Seattle Area 2008–2012. *AIDS Behav*. 2014;18(10):1998–2008.

32. Burt RD, Tinsley J, Glick SN. A Decline in HIV Testing Among Persons Who Inject Drugs in the Seattle Area, 2004-2015. *J Acquir Immune Defic Syndr*. 2017;75 Suppl 3:S346–S351.

33. Greenfield SF, Brooks AJ, Gordon SM, et al. Substance abuse treatment entry, retention, and outcome in women: A review of the literature. *Drug and Alcohol Dependence*. 2007;86(1):1–21.

34. Shoptaw S. Methamphetamine use in urban gay and bisexual populations. *Top HIV Med*. 2006;14(2):84–87.

35. Glick SN, Burt R, Kummer K, et al. Increasing methamphetamine injection among non-MSM who inject drugs in King County, Washington. *Drug Alcohol Depend*. 2018;182:86–92.

36. Ball LJ, Puka K, Speechley M, et al. Sharing of Injection Drug Preparation Equipment Is Associated With HIV Infection: A Cross-sectional Study. *J Acquir Immune Defic Syndr*. 2019;81(4):e99–e103.

37. Hagan H, Thiede H, Weiss NS, et al. Sharing of drug preparation equipment as a risk factor for hepatitis C. *Am J Public Health*. 2001;91(1):42–46.

38. Aspinall EJ, Nambiar D, Goldberg DJ, et al. Are needle and syringe programmes associated with a reduction in HIV transmission among people who inject drugs: a systematic review and meta-analysis. *Int J Epidemiol*. 2014;43(1):235–248.

39. Bluthenthal RN, Anderson R, Flynn NM, et al. Higher syringe coverage is associated with lower odds of HIV risk and does not increase unsafe syringe disposal among syringe exchange program clients. *Drug Alcohol Depend*. 2007;89(2–3):214–222.

40. Fernandes RM, Cary M, Duarte G, et al. Effectiveness of needle and syringe Programmes in people who inject drugs – An overview of systematic reviews. *BMC Public Health*. 2017;17(1):309.

41. Han Y, Yan W, Zheng Y, et al. The rising crisis of illicit fentanyl use, overdose, and potential therapeutic strategies. *Transl Psychiatry*. 2019;9(1):1–9.

42. Reuter P, Pardo B, Taylor J. Imagining a fentanyl future: Some consequences of synthetic opioids replacing heroin. *Int J Drug Policy*. 2021;94:103086.

Chapter 2. Motivations for polysubstance use with methamphetamine and opioids among people who use drugs in Seattle, WA: a qualitative study

Motivations for polysubstance use with methamphetamine and opioids among people who use drugs in Seattle, WA: a qualitative study

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Abstract

Background: The United States has seen a remarkable increase the use of both methamphetamine and opioids, used concurrently or simultaneously. This pattern has become prevalent in Seattle, WA, yet the rationale for co-use among people who use drugs in this important region is not yet clear.

Methods: We conducted in-depth semi-structured interviews with people who regularly used both methamphetamine and opioids recruited from a syringe services program (SSP) in downtown Seattle. In addition, SSP staff participated in a focus group discussion (FGD) to share care provision experiences and perceptions on the rise in co-use. We conducted an interpretive descriptive analysis of the data informed by the social-ecological framework to identify multi-level influences on methamphetamine-opioid co-use for our participants.

Results: Among 21 interviewees and 6 FGD participants, we identified two overarching themes describing methamphetamine and opioid co-use decisions and behaviors. First, at the interpersonal, community, and societal levels, the drugs or their precedents were highly prevalent in social networks, community sources (i.e. medical care providers), and through the fluctuating illicit drug market. Second, co-use was useful to participants at the individual level to provide pleasure, emotional and physical pain treatment, and balance between drug effects. Co-use also met the interpersonal social needs of participants responding to family relationships, as well as community-level employment dynamics. In addition, participants also identified that houselessness was an environment in which the prevalence and utility of methamphetamine and opioids were uniquely elevated.

Conclusions: Methamphetamine-opioid co-use was influenced by complex personal, social, and societal factors. Public health policy to address the needs of people who co-use through

treatment, harm reduction, and other social programs must support individuals, their communities, and the broader structural environment.

Introduction

The United States is in the midst of the "fourth wave" of the opioid overdose epidemic, characterized by a sharp increase in the overlapping use of both methamphetamine and opioids (1–3). Reports from Seattle, Washington, were among the earliest to describe the increasing co-use of methamphetamine with opioids among local people who use drugs (PWUD) (4,5). In Seattle and King County, 55% of respondents to a syringe services program (SSP) survey reported using methamphetamine and opioids simultaneously (known as "goofball"), and the proportion who reported using goofball as their primary drug doubled between 2017 and 2019 (4). Between 2012 and 2022, fatal overdoses involving methamphetamine and opioids increased from 16% to just over 50% of the overall overdose fatalities for King County, with the absolute number of deaths involving the combination increasing 10-fold from 45 to 512 in that same period (6).

The reasons for this rise in co-use of methamphetamine and opioids are not clear. A small number of studies have qualitatively examined, among other questions, the rationale behind the combined use of methamphetamine and opioids. These have considered co-use in rural populations in three Western states (7–9), among people presenting for opioid use disorder treatment in the US (1), and in urban Australia (10). These reports suggest a mix of individual, community, and structural reasons using the two drugs together, including reduced availability of opioids, high affordability and availability of methamphetamine, an enhanced high, balance of depressant/stimulant effects, improved functionality, treatment for withdrawal from either drug, or to address mental and physical health symptoms arising during opioid agonist therapy. In addition to these studies, anecdotal expert observations suggest a link to national and local drug

policies that limit the supply of opioids without providing a safe alternative (2) or that criminalize unsheltered living (11).

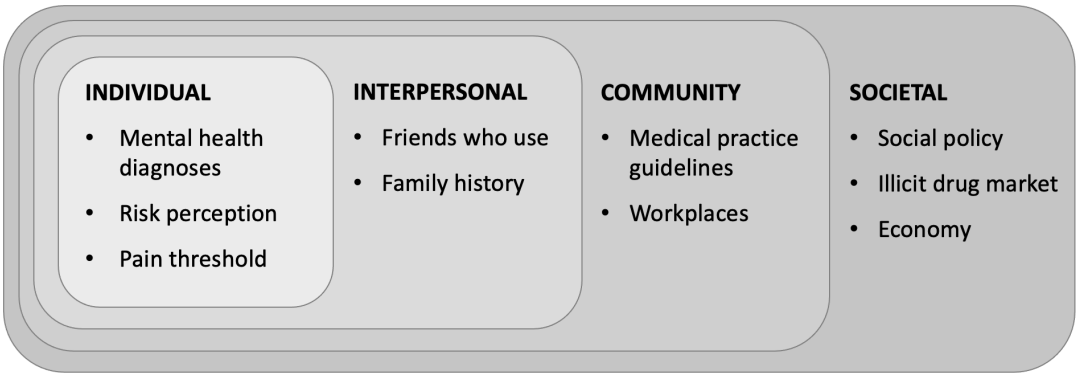
Studies of the rationale for methamphetamine-opioid co-use are lacking among PWUD in a large urban center with prevalent co-use. A better understanding of the origins of methamphetamine-opioid co-use is needed to inform both the local and national awareness of the drivers of co-use and provide insights to inform local public health responses. To address this gap, we conducted a qualitative study of SSP staff and Seattle-area adults who used methamphetamine and opioids to assess co-use experiences and rationale within this key population.

Methods

Social-ecological Model

Our study was informed by the social-ecological model (SEM), used to understand the individual, interpersonal, community, and structural factors associated with co-use in our population (12). The SEM, first developed as an approach to understanding human development by studying both individual and environmental factors, has since been evoked in studies on the factors associated with adolescent substance use (13,14), and proposed as a framework for more holistically addressing the opioid crisis (15). Our study used an adapted version of the SEM (Figure 1) informed by previous literature on influences for use among PWUD, to characterize key influences on methamphetamine and opioid co-use.

Figure 1. The social-ecological model for understanding opioid use



Examples of the known correlates of opioid use at the individual, interpersonal, community, and societal levels. Adapted from Jalali, et al 2018 (15).

Study population.

Participants were recruited on-site from a long-standing SSP in downtown Seattle. All adults over age 18 attending the SSP who reported co-use of methamphetamine and opioids were eligible for the study. Co-use was defined as use of both drugs, via any route, at least once a week in the previous three months. We also held a focus group discussion (FGD) with SSP staff to explore their experiences providing services for people who co-use.

Data collection procedures:

MR worked with SSP staff to develop a protocol for in-person recruitment at the exchange, using purposive sampling to recruit at least five women and five participants of color to learn from people sufficiently representative of the local population of PWUD. Potential participants were informed about the study and screened for eligibility if interested. Word of mouth recruitment from initial participants resulted in enrollment of four participants who were not regular customers of the exchange. Participants were provided a $25 VISA gift card in appreciation of their time. Data were collected over a 4-week period between December, 2022 and January, 2023.

SSP client interviews were guided by a semi-structured interview guide with discussion topics and questions based on a review of the literature and our adapted SEM. Questions included discussion of: 1) personal histories and timelines of drug use, 2) rationale behind their current drug use routine, particularly for methamphetamine and opioids, and 3) changes in experiences with drug use over time. After the first interview, the interview guide was adjusted to improve clarity and add further discussion points. After obtaining oral consent, participants completed a brief survey with demographic and drug use behavior questions. The SSP staff FGD took place on-site during their regularly scheduled staff meeting and included a convenience sample of six staff members who were available that day. Prior to the FGD, staff completed a brief demographic survey. The FGD focused on staff experiences with clients who co-use.

MR conducted the interviews and FGD. At the time of the study, MR was a University of Washington graduate student and was not affiliated with the SSP. Interviews lasted between 30-60 minutes while the FGD lasted 90 minutes. Interviews were conducted in a private exam room at a medical office on site. All interviews and the FGD were recorded and were transcribed verbatim with assistance from Otter.ai transcription services. Structured debrief reports were completed by the interviewer immediately after each interview or FGD to capture initial observations (12).

Data Analysis:

Using an interpretive description methodological approach (13,14), we conducted an applied practice qualitative analysis to characterize experiences with and rationale for methamphetamine and opioid co-use to directly inform service delivery approaches. An initial codebook was developed throughout the data collection period based on interview debrief reports, the SEM,

and existing drug use literature. The codebook was further refined based on reviewing a subset of full transcripts. Multiple coders (MR, MG) used a final version of the codebook to code three transcripts and evaluate consensus in application and segmentation. After achieving consensus, transcripts were divided and independently coded by one member of the analysis team (MR or MG), and a subset of coded transcripts was reviewed for agreement in coding. Any differences were discussed and reconciled as a team. Preliminary themes were identified by running queries on codes within the qualitative software program Dedoose (version 9.0.85), which was used to support data analysis. Preliminary themes were further synthesized by counting codes, clustering codes, noting relationships, and making conceptual coherence to identify overarching themes. Using a social-ecological framework, the resulting themes and patterns identified in the analysis were organized into a narrative discussion of our interpretations.

Ethics. The University of Washington Institutional Review Board (IRB) approved of this research activity.

Positionality statement. The primary author is a self-identified U.S. White American. This positionality may have influenced the study, and protocols for reflexivity and journaling of biases and perceptions were utilized to minimize researcher positionality speaking for the data.

Results

We interviewed a total of 21 participants during the individual interviews. The median age of PWUD participants was 51, and a third were women. The demographic and drug use characteristics of the interview participants are presented in Table 1. The staff FGD included six staff members. Descriptive statistics are not shown for the staff FGD to minimize risk of identification. The mean age of staff participants was 47 years old, most identified as women and

as White, and one identified as Hispanic. The mean duration of employment at the SSP was six years.

Table 1. Demographic characteristics and drug use behavior, individual interviews with Seattle-area PWUD who co-used methamphetamine and opioids, 2018

Characteristic	Total N=21 #	%
Gender		
Man	14	66.7
Woman	7	33.3
Age		
20-30	5	23.8
31-40	1	4.8
41-50	4	19.0
51-60	9	42.9
61-70	2	9.5
Race and ethnicity*		
White	13	61.9
Black	8	38.1
American Indian	5	23.8
Hispanic	2	9.5
Unemployed	18	85.7
Homeless: past year	14	66.7
Homeless: currently	9	42.9
Typical route- opioids		
Injecting	8	38.1
Smoking	4	19.0
Mix of injecting and smoking	7	33.3
Other route	2	9.5
Typical route- methamphetamine		
Injecting	6	28.6
Smoking	10	47.6
Mix of injecting and smoking	5	23.8
Goofball use, weekly or more	9	42.9
Visits SSP, weekly or more	12	57.1

*Participants could select more than one option

Prevalence of methamphetamine and opioids facilitated initial and continued co-use

Nearly all participants discussed how the ubiquity of methamphetamine and opioids influenced their decisions to use both drugs. They experienced drug availability in many ways, with unique influences on access at the interpersonal, community and societal levels. At the interpersonal level, many participants mentioned drugs being introduced to them and accessed through their

friends, close relationships, and families. In some cases, use of both methamphetamine and opioids was frequent within their friend group and peers.

> *"I never would actually go out with intentions to spend money on [meth]. In fact, I generally just ran into a friend or group of friends, you know, and get offered to hang out with them or whatever. And they would either be in the process of trying to pick up or maybe probably had already picked up [meth]"* – male, age 30-40

Closer interpersonal relationships, such as romantic partnerships and relationships with family members, were more likely to have a strong influence on use behaviors.

> *"[M]y mom introduced me to heroin and meth for the first time when I was 17 […] I was renting a room from my mom's friend and just I wanted that mother-daughter relationship so badly that I just gave in and did it anyway."* – female, age 30-40

At the community-level, several participants associated methamphetamine and opioid availability with local medical treatment and challenges accessing appropriate medical care. Multiple participants connected their early opioid use with medical procedures they had undergone and being prescribed excess medication post procedure. This was especially true for participants who described use in the early 2000s, prior to major changes in opioid prescribing guidelines. Participants described experiencing withdrawal post use, and purchasing opioids without a prescription or turning to other cheaper drugs to manage withdrawal symptoms.

> *"I had back surgery, and oh my god, he had me on oxycodone, morphine, Valium, Soma, I mean, I was drooling for months. So it's not hard to get introduced to opioids. Especially when it's coming from a doctor […]. And then when they took the medicine away from me, I started buying it. And when that got too expensive, I started doing heroin because it was way cheaper […] I think it was horrible. And it kind of pisses me off, you know? It's like, you handed them out to me like they were Skittles."* – female, age 50-60

At the societal level, fluctuations in the availability of drugs in the local market were frequently associated with decisions about methamphetamine-opioid co-use in our study population Saturation of the market with methamphetamine was noted by several participants, including many who felt they had to switch from crack cocaine to methamphetamine after the latter became more affordable. In an analogous shift, participants described a recent sharp increase in

fentanyl availability, with heroin becoming increasingly difficult to access. Many participants expressed frustration with the lack of control over the drugs they had access to because of the changing drug market, emphasizing they were reacting to which drugs were available rather than driving the market through consumer demand.

> *"You know, now that there's meth and blues and fentanyl powder form and the blue pill and all the stuff, and then there were shards to contend with, but there's still crack cocaine and heroin available. I mean, it's just ridiculous. And it was happening so quickly, you have to adapt to everything so fast, you can't even explain what you were doing at the time while one was taking over and the other one's coming in. […] It's like the drug dictated the attitude of the streets, and it was ridiculous."* – male, age 50-60

In the FGD, SSP staff also mentioned the importance of availability of methamphetamine and opioids influencing the drug use trends they saw with their clients. They mainly focused on shifts in the local drug market, especially the increases in methamphetamine and fentanyl availability and affordability.

Methamphetamine-opioid co-use was utilitarian.

Methamphetamine-opioid co-use provided numerous functional uses for the people we interviewed: identifying a purpose and functional rationale for co-use was unanimous among our participants. Staff in the FGD also discussed the functional uses for methamphetamine-opioid co-use. Many staff members emphasized that drug use is useful and logical in the environments in which their clients live, with a focus on the emotional pain relief and physical functioning that co-use can provide. At the individual-level, we identified five functional uses for methamphetamine-opioid co-use: pleasure, physical pain relief, emotional pain relief, balance in drug effects, and addiction.

Participants consistently associated methamphetamine-opioid co-use with pleasure, euphoria, or some kind of pleasant "rush".

> *"Just the feeling, you get a rush with the meth, and then the heroin just bring you down to a good nod. It's just a good feeling, and a bigger rush."* –male, age 50-60

In many interviews, people described how they would use methamphetamine and opioids together to ameliorate pain or to otherwise treat a medical concern. Pain relief was the most prevalent function; we observed a chorus of references to the utility of co-use to treat pain.

> *"It took away every ounce of pain from every physical ailment." – 54-year-old male*

The utility of methamphetamine and opioid co-use for emotional pain relief featured heavily during our conversations with participants as well. This function could be as simple as coping with transient day-to-day emotional challenges, or to address major symptoms of mental distress or histories of trauma in our participants.

> *"The trauma part started way earlier, but the addiction stuff started at about [age] eleven."* – female, age 50-60

Achieving balance in drug effects was an important motivator for combining methamphetamine and opioids. Mainly, balance was referenced when a person had been using primarily one drug for some time then came to add the second to address the side-effects or extremities of the original drug. Use of opioids to mellow the intense stimulant effects of methamphetamine was common, as was the inverse; many people described using methamphetamine to help wake them up or improve alertness following opioid use.

> *"Like I say, meth, it keeps you up. You got the heroin, you'd be nodding, but the meth keeps you up, alert to what's going on around you."* – male, age 60-70

Most participants referred to addiction when discussing their rationale for using both methamphetamine and opioids. In some cases, they discussed using methamphetamine to abate opioid withdrawal symptoms when their preferred opioid (usually heroin) was not available. More commonly, participants described using goofball because of a built tolerance to methamphetamine and opioids when used singly.

> *"I couldn't use the heroin without the meth and vice versa. Couldn't even mess with it, had to have a goofball."* – male, age 50-60

On the interpersonal level, methamphetamine-opioid co-use had numerous functional uses for our participants. This primarily took the form of enabling them to perform household, familial, and other caretaking responsibilities. Sometimes people also described using methamphetamine and opioids as an activity to share with an important person in their life.

> *"I want to stop using, but there's a real good reason for me to go visit with my brother, so. 'I want to get high, I want to talk to you, I want to kick it with you'."* – male, age 50-60

At the community level, certain types of employment were associated with methamphetamine-opioid co-use in our participants, particularly among the male participants. Many participants linked their methamphetamine and opioid use to selling drugs, saying that using drugs helped them to function in this role, which also intersected with availability from being linked to a drug supply. Another occupation that participants linked to their methamphetamine-opioid co-use was physically demanding jobs like construction, where methamphetamine helped provide the energy needed for work and opioids helped with some of the physical pain and injuries from the job.

> *"And my buddy was at work one day- I used to work construction, and used to cut wood as a side job. It's a pretty taxing job on a guy. And he gave me some speed [methamphetamine] one day."* – male, age 50-60

Houselessness was a nexus for methamphetamine-opioid availability and functional uses

During the SSP staff FGD, houselessness came to the forefront of the conversation when staff were discussing the trends in methamphetamine-opioid co-use. All staff remarked on the increases in houselessness Seattle has seen in the past several years, and how this trend may be related to changes in substance use.

> *"So many people are using drugs because they're sleeping outside and have to stay up, or worry about being assaulted, or have been traumatized over and over."* – staff member, female

Because of this emphasis on houselessness among staff members, and because houselessness was a pervasive thematic undercurrent throughout the interviews, we identified houselessness as a cross-cutting theme that draws on the availability and functional uses we observed above. Most of the participants we spoke to had experienced houselessness in their lifetimes, with almost half currently living unhoused at the time of the interviews.

At the individual level, living unhoused was linked to several factors that influenced methamphetamine-opioid co-use in our interviews. Many participants felt that methamphetamine and opioids helped them to meet the demanding pace of living unsheltered. They described a constant need to move, be watchful, and to provide for themselves, and explained that co-use supported these demands. Some participants described using methamphetamine and opioids to cope with very basic bodily needs, such as dealing with the exposure and cold when they were living without shelter.

> *"It was cold as shit outside. It was the middle of winter the first time I fucking shot up meth. That shit was crazy. I was like 15, it was freezing."* – male, age 20-30

At the interpersonal level, four participants referenced having been forced out of their home situation as adolescents due to family conflicts. They often recollected significant changes in their personal histories with co-use associated with the time period shortly after being kicked out.

> *"I was super strung out, and, you know, keeping [my mom] in the dark about my life, or that part mostly. Like she always knew I was getting high, fucking just doing what I was doing on the streets, because they kicked me out when I was 16."* – male, age 30-40

Within the larger community, many participants evoked the norm of sharing drugs as a form of support among people living unhoused, intersecting drug availability and social functions. With

the social expectation to support one another through the sharing of drugs, there is little choice in which drugs to use and a greater likelihood for polysubstance use.

> *"We always share and pass, you know, that way, tomorrow you have it, the next day, I have it, you know, like that. So, you know, it goes around, you know, that's how we keep each other high out there on the streets and everything, […] You know, we look out for one another."* – male, age 50-60

The substance use disorder treatment options available to people who use drugs also intersected with co-use and houselessness in our interviews. Several people described having challenges maintaining a treatment program (usually sobriety) after completing an inpatient portion and then returning to the same unhoused or unstable housing situation they had been in prior. They referenced a lack of support for transitioning to post-program living, which was especially challenging when patients were houseless or originally came from an environment with prevalent drug availability.

> *"I mean, you're gonna put me right back into the same position, you're gonna put me back, back into the same street."* – male, age 50-60

At the societal level, larger economic challenges were sometimes referenced by participants when they described their history with methamphetamine-opioid co-use. Many people mentioned losing work and housing at times that corresponded with the difficult years following the recession of 2008. When explaining how they came to use methamphetamine and opioids, some participants pointed to these periods of loss and economic uncertainty as influential in their decisions.

> *"I had the opportunity to use some [heroin], and I used it because I was bored. You could say bored, but I don't really know if that's a good word for it. I didn't have a job and didn't know how to get anywhere. I didn't know how to get a job. I didn't know I was just lost, lost. Came out here homeless."* – female, age 50-60

Discussion

We conducted in-depth qualitative interviews with 21 individuals who regularly used both methamphetamine and opioids in King County, WA to better understand the rationale for co-use. We identified two major themes: the prevalence and usefulness of co-use were key contributors to methamphetamine-opioid co-use for our participants. In social circles, families, partnerships, medical treatment practices, and the illicit drug market in Seattle, methamphetamine and opioids were ubiquitous throughout the lives of our participants. Methamphetamine and opioids served many functions that supported participants physically and emotionally, and helped them participate in their families, careers, and community. We found that both the availability and function of methamphetamine-opioid co-use converged and became densely intertwined with experienced houselessness in our interviews. Seattle is a large urban center that has been an early sentinel of prevalent methamphetamine-opioid co-use, and our findings here build on previous work describing the rationale for methamphetamine-opioid co-use in rural US populations and urban populations abroad.

We used an adapted version of the SEM to guide our analysis and describe key influences for methamphetamine-opioid co-use at the individual, interpersonal, community, and societal levels. From public discourse to national policy, decisions about drug use have historically been attributed primarily to individual behavior (12). We found the SEM to be helpful for identifying the larger social and community factors that had a significant impact on the lives of the people in our study. This model enabled us to see and understand methamphetamine-opioid co-use as a rational behavior within the specific social and structural environments of our participants.

Our findings are consistent with many of the published qualitative studies that have examined the drivers of emerging methamphetamine-opioid co-use in other populations. The

high degree of availability of methamphetamine and opioids has consistently been identified as important in understanding the emergence of methamphetamine-opioid co-use (1,7–10). Interestingly, many previous studies have described how participants used methamphetamine to supplement opioid-agonist treatment (OAT) programs (1,7,8,10). This functional use was not mentioned by any participant in our study, which included discussion of drug use treatment experiences as part of a different research question. This difference may be due to our study location; by recruiting from an SSP, most participants were not actively on OAT at the time of the interview. Two studies have identified a perception among some PWUD that methamphetamine can act as an opioid overdose reversal medication (10,13). This reason for using methamphetamine was not significant in our study. This difference may be because our urban study population has a relatively high level of access to harm reduction services, including naloxone and overdose educational materials.

Ours is the first study to observe how houselessness creates a nexus of methamphetamine and opioid availability and functional uses that can promote co-use. Houselessness is linked to methamphetamine-opioid co-use in the epidemiological data (4,11,14), but the mechanism of how lack of housing contributes to this specific drug use pattern has not been well-defined. In our interviews, it was clear that houselessness creates an elevated need to function in a physically and mentally challenging environment. Participants lived through periods of personal loss and widespread economic instability associated with becoming houseless, and these experiences were critical in the trajectory of their drug use. Our findings are consistent with prior research on the links between houselessness and substance use in general, which include social network factors (15), family conflicts (16), and the rigors and psychosocial trauma of houselessness (17). Our findings linked houselessness to initiation or increase of methamphetamine-opioid co-use, as

consistent with previous work showing many houseless people with substance use disorders did not have issues with substances prior to becoming unhoused (18). These findings emphasize the need to address houselessness and substance use issues as integrally connected public health concerns.

Our study highlights the need for a comprehensive approach to address the ongoing wave of methamphetamine-opioid co-use. Prevention, treatment, and harm reduction efforts must work in tandem to address the individual, social, community, and policy issues that have contributed to rising methamphetamine-opioid co-use. Improved access to appropriate trauma-informed, person-centered mental health support and comprehensive substance use treatment may help to address some of the individual-level factors linked to co-use. Factors like emotional pain, histories with trauma and family conflict, and day-to-day functional needs were prevalent (19,20). Addressing some of the community-level factors that contributed to co-use in our study may require a coordinated effort within medical care providers to prevent, detect, and treat extra-medical prescription use (21). At the societal-level, numerous policy approaches to prevent substance use initiation and support the community of PWUD have been described; there is a general consensus in support of bolstering the social safety net and investing in protective resources for adolescents and young adults through community and school-based programs (22,23).

Policy recommendations that focus on preventing and addressing existing houselessness may be of particular importance for methamphetamine-opioid co-use, given our findings. There is already an urgent need to improve housing security and services for unhoused people across the country (24,25), including Seattle (26). In the annual one-night count of unhoused people in 2020, almost 12,000 unhoused people were living in Seattle, around half of whom were sheltered

(27). Upstream prevention efforts that address the structural causes of houselessness, such as establishing a livable minimum wage, labor protections, and strengthening affordable housing programs, can be more cost-effective than downstream programs designed to provide services for people already experiencing houselessness (28). The Housing First Model, which calls for the provision of "permanent, subsidized, independent housing with no prerequisites" for people experiencing houselessness, may be effective in increasing time housed (29), though the evidence is more mixed for PWUD (30). Future work should study the effectiveness of the Housing First model in populations with high levels of methamphetamine-opioid co-use.

Limitations:

Our findings are based on a small sample of PWUD in Seattle, WA, and may not be generalizable to populations in different geographic areas. Data collection was conducted in the wintertime, including during an uncharacteristically cold week, and this challenging weather may have put surviving houselessness at forefront of the mind for some participants. Our participants skewed somewhat older, and our findings may not reflect the experiences of younger people who use methamphetamine and opioids. Future work should aim to study a wider group of PWUD, including younger people. Our study did include discussions about fentanyl, but fentanyl is fairly new to the illicit drug scene and is sharply rising. Ongoing work should consider how fentanyl differs from heroin for people who co-use and should continue to monitor the changing role of fentanyl within the landscape of polydrug use.

Conclusions

Methamphetamine-opioid co-use was influenced by complex individual, interpersonal, community, and societal-level factors. The widespread availability and numerous functional uses of methamphetamine and opioids were critical features for our participants, and these intersected

significantly with houselessness. To address the needs of people who co-use methamphetamine and opioids, and to prevent future polysubstance use, it will be necessary to consider the nuanced, multifaceted drivers of this drug use pattern. Existing treatment, harm reduction, and public policies, particularly related to housing, are currently insufficient to support this growing and highly marginalized population.

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References

1. Ellis MS, Kasper ZA, Cicero TJ. Twin epidemics: The surging rise of methamphetamine use in chronic opioid users. Drug and Alcohol Dependence. 2018;193:14–20.

2. Strickland JC, Havens JR, Stoops WW. A nationally representative analysis of "twin epidemics": Rising rates of methamphetamine use among persons who use opioids. Drug Alcohol Depend. 2019;204:107592.

3. Jones CM, Underwood N, Compton WM. Increases in methamphetamine use among heroin treatment admissions in the United States, 2008-17. Addiction. 2020;115(2):347–353.

4. Glick SN, Klein, K, Tinsley J, et al. Increasing heroin-methamphetamine (goofball) use and related morbidity among Seattle area people who inject drugs. American Journal on Addictions. 2020.

5. Glick SN, Burt R, Kummer K, et al. Increasing methamphetamine injection among non-MSM who inject drugs in King County, Washington. Drug Alcohol Depend. 2018;182:86–92.

6. Overdose data dashboards - King County. (https://kingcounty.gov/depts/health/overdose-prevention/data.aspx). (Accessed February 7, 2023)

7. Lopez AM, Dhatt Z, Howe M, et al. Co-use of methamphetamine and opioids among people in treatment in Oregon: A qualitative examination of interrelated structural, community, and individual-level factors. International Journal of Drug Policy. 2021;91:103098.

8. Baker R, Leichtling G, Hildebran C, et al. "Like Yin and Yang": perceptions of methamphetamine benefits and consequences among people who use opioids in rural communities. J Addict Med. 2020.

9. Rhed BD, Harding RW, Marks C, et al. Patterns of and Rationale for the Co-use of Methamphetamine and Opioids: Findings From Qualitative Interviews in New Mexico and Nevada. Front Psychiatry. 2022;13:824940.

10. Palmer A, Scott N, Dietze P, et al. Motivations for crystal methamphetamine-opioid co-injection/co-use amongst community-recruited people who inject drugs: a qualitative study. Harm Reduct J. 2020;17(1):14.

11. Al-Tayyib A, Koester S, Langegger S, et al. Heroin and methamphetamine injection: an emerging drug use pattern. Subst Use Misuse. 2017;52(8):1051–1058.

12. Simoni JM, Beima-Sofie K, Amico KR, et al. Debrief reports to expedite the impact of qualitative research: do they accurately capture data from in-depth interviews? AIDS and Behavior. 2019;23:2185–2189.

13. Thompson Burdine J, Thorne S, Sandhu G. Interpretive description: A flexible qualitative methodology for medical education research. Med Educ. 2021;55(3):336–343.

14. Thorne S, Kirkham SR, O'Flynn-Magee K. The Analytic Challenge in Interpretive Description. International Journal of Qualitative Methods. 2004;3(1):1–11.

15. Rhodes T. The 'risk environment': a framework for understanding and reducing drug-related harm. International Journal of Drug Policy. 2002;13(2):85–94.

16. Daniulaityte R, Silverstein SM, Getz K, et al. Lay knowledge and practices of methamphetamine use to manage opioid-related overdose risks. International Journal of Drug Policy. 2022;99:103463.

17. Daniulaityte R, Silverstein SM, Crawford TN, et al. Methamphetamine use and its correlates among individuals with opioid use disorder in a midwestern U.S. city. Subst Use Misuse. 2020;55(11):1781–1789.

18. Rice E, Milburn NG, Rotheram-Borus MJ, et al. The effects of peer group network properties on drug use among homeless youth. American behavioral scientist. 2005;48(8):1102–1123.

19. Mallett S, Rosenthal D, Keys D. Young people, drug use and family conflict: Pathways into homelessness. Journal of Adolescence. 2005;28(2):185–199.

20. Williams S, Stickley T. Stories from the streets: people's experiences of homelessness. Journal of Psychiatric and Mental Health Nursing. 2011;18(5):432–439.

21. Johnson G, Chamberlain C. Homelessness and Substance Abuse: Which Comes First? Australian Social Work. 2008;61(4):342–356.

22. Marchand K, Beaumont S, Westfall J, et al. Conceptualizing patient-centered care for substance use disorder treatment: findings from a systematic scoping review. Substance Abuse Treatment, Prevention, and Policy. 2019;14(1):37.

23. Bassuk EL, Latta RE, Sember R, et al. Universal Design for Underserved Populations: Person-Centered, Recovery-Oriented and Trauma Informed. Journal of Health Care for the Poor and Underserved. 2017;28(3):896–914.

24. McHugh RK, Nielsen S, Weiss RD. Prescription drug abuse: from epidemiology to public policy. Journal of Substance Abuse Treatment. 2015;48(1):1–7.

25. Spooner C. Public policy and the prevention of substance-use disorders. Current Opinion in Psychiatry. 2002;15(3):235–239.

26. Stockwell T, Gruenewald P, Toumbourou J, et al. Preventing harmful substance use: The evidence base for policy and practice. John Wiley & Sons; 2005.

27. Mitchell D. Homelessness, American Style. Urban Geography. 2011;32(7):933–956.

28. Borum Chattoo C, Young L, Conrad D, et al. "The Rent Is Too Damn High": News Portrayals of Housing Security and Homelessness in the United States. Mass Communication and Society. 2021;24(4):553–575.

29. Stringfellow M, Wagle D. The economics of homelessness in Seattle and King County. McKinsey & Company. https://www. mckinsey. com/featured-insights/future-of-cities/the-economics-of-homelessness-in-seattle-and-king-county. 2018;

30. Addressing Homelessness - Human Services | seattle.gov. (https://www.seattle.gov/human-services/reports-and-data/addressing-homelessness). (Accessed February 7, 2023

31. O'Regan KM, Ellen IG, House S. How to Address Homelessness: Reflections from Research. The ANNALS of the American Academy of Political and Social Science. 2021;693(1):322–332.

32. Tsai J. Is the Housing First Model Effective? Different Evidence for Different Outcomes. Am J Public Health. 2020;110(9):1376–1377.

33. Pauly B (Bernie), Reist D, Belle-Isle L, et al. Housing and harm reduction: What is the role of harm reduction in addressing homelessness? International Journal of Drug Policy. 2013;24(4):284–290.

Chapter 3. High levels of interest in access to free safer smoking equipment to reduce injection frequency among people who inject drugs in Seattle, Washington

High levels of interest in access to free safer smoking equipment to reduce injection frequency among people who inject drugs in Seattle, Washington

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Abstract

Background: Drug use route transition interventions promote safer consumption by facilitating a switch from injection to safer routes such as smoking or oral consumption.

Methods: We conducted a descriptive analysis using data from questions about "free, clean equipment for smoking" heroin, methamphetamine and/or crack from the Seattle 2018 National HIV Behavioral Surveillance survey of people who inject drugs (N=555). We estimated the proportion of respondents with access to free safer smoking equipment, and among these participants, the proportion who reported that this access reduced their injection frequency. Among respondents who did not have access to free safer smoking equipment, we described the proportion who were interested in getting access, and whether they thought that this access would reduce their injection frequency.

Results: Among participants who reported heroin (n=495), methamphetamine (n=372), or crack (n=88) injection in the past year, 11%, 11% and 12% reported access to free safer smoking equipment, respectively. Of those with access, the proportion that reported that this access reduced their injection frequency ranged from 12% to 44%. Among participants without access, 28% who used heroin, 45% who used methamphetamine, and 49% who used crack were interested in access. Of interested participants, a majority reported that they thought this access would reduce their frequency of injection.

Conclusions: A large number of participants were interested in access to free safer smoking equipment and reported that this access may reduce their injection frequency. Safer smoking equipment is a harm reduction strategy that should be available to reduce risks from opioid and stimulant injection.

1. Introduction

The United States is experiencing "twin epidemics" in illicit drug use, characterized by the increasing use of both methamphetamine and opioids independently as well as together (1–3). Crack cocaine use has declined moderately in the previous two decades, but remains a public health concern (4). Methamphetamine, opioid, and crack use are associated with numerous health concerns, including increased mortality, HIV, hepatitis C virus (HCV), and other sexually transmitted infections (STIs) (5–7). Methamphetamine and opioid co-use is highly prevalent in Seattle, WA, and is associated with higher overdose risk, unsafe injection practices, and greater frequency of injection than using either substance by itself (8–10).

Risk for adverse health outcomes from drug use are highest among people who inject drugs (PWID); injection drug use produces a more rapid and potent drug effect (11) with greater risk for dependence (12) and overdose (13). Higher risk injection practices such as loaning and borrowing of injection equipment are associated with injection site infections (14), bloodborne infections (15,16), and infective endocarditis (17). The public health response to the crises of rising methamphetamine and opioid use and co-use, particularly among PWID, must rapidly adapt and evolve to minimize substance use related harms to a growing and vulnerable population.

Harm reduction is one of the most powerful tools to minimize the negative consequences of drug use among PWID (18). A specific harm reduction approach to address the higher health risks of injection drug use is "route-transitioning", or encouraging safer routes of consumption such as smoking, snorting, or rectal insertion ("booty bumping") (19). An individual's choice of route of drug administration is complex and may depend on the route they first used, the routes used in their social groups, the severity of the individual's drug dependence, quality of the drugs

available in the local drug supply, safety considerations, stigma, and affordability and availability of equipment for different routes (20,19,11). Safer smoking equipment for drugs may play an important role in delaying injection drug use and reverse route transitioning for people who inject drugs. Moreover, safer smoking equipment delivered through syringe services programs (SSPs) may engage people who smoke drugs who might not otherwise use SSP-delivered harm reduction services. Safer smoking equipment can be specific for each type of drug used, but generally includes a heat resistant pipe or foil, protective mouthpiece, tamp, screen, and lip protectant, all of which reduce heat-related injuries and infection risk (21). In addition to reducing direct harm from improvised smoking devices, safer smoking equipment can reduce the sharing of supplies, which in turn is thought to lower risk of respiratory infections, a potential benefit that is particularly salient amid the COVID-19 pandemic (22,23).

Limited research to date has evaluated the potential role of safer smoking equipment in reducing frequency of injection drug use. Evaluations of safer smoking equipment distribution in Canada and Europe have shown high uptake of safer smoking equipment for crack and heroin (24–27,22,28), and some evidence for decreased injection frequency among people who used the safer smoking equipment (25–28). Locally, an SSP led by people who use drugs (PWUD) in Seattle distributed pipes for smoking heroin, and an evaluation of program participants before and after the pipes were introduced showed a decrease in the proportion of people who exclusively injected heroin (29). Over a third of the people who said they used one of the SSP-distributed heroin pipes reported they reduced their injection frequency because of this access (29). To our knowledge, no studies have examined the effects of safer smoking equipment for methamphetamine on reducing injection frequency.

Despite the evidence from international studies showing high levels of interest in safer smoking equipment among PWUD (24–27,22,28), and promising early evidence in support of reducing injection frequency (25–29), similar strategies have had limited uptake in SSPs in the United States. The present evaluation used responses to questions from a survey conducted among PWID in Seattle about access to free safer smoking equipment for drug consumption, and whether access could or did reduce injection frequency. Our study location presents a unique opportunity to examine reduction in injection frequency among people who already have access to safer smoking equipment, as the Seattle area is home to one of the few SSPs that distributed safer smoking equipment for methamphetamine and crack during the study period (30). Evaluating Seattle PWID interest in free safer smoking equipment can inform local harm reduction policies and may also guide future harm reduction efforts in similar populations across the country.

2. Methods

2.1 National HIV Behavioral Surveillance (NHBS)-PWID. The NHBS is an ongoing surveillance project funded through the Centers for Disease Control and Prevention (CDC). Every third year the key population surveyed focuses on PWID (formally referred to as NHBS-IDU). Each NHBS project area may append questions of local interest to the core NHBS survey. For this analysis, we used data from the Seattle area NHBS-PWID survey conducted between June and November 2018.

The NHBS-PWID sampling strategy is described in detail elsewhere (31,32). Briefly, participants were recruited using respondent-driven sampling whereby initially eligible "seed" participants were invited to recruit up to five additional participants from their personal networks, who were then able to recruit up to 5 additional participants. To be eligible for the

survey, participants had to be 18 years or older, reside in King or Snohomish County, be able to complete the survey in English, and report any injection drug use in the prior 12 months. Researchers conducted the interviews in-person, and the survey included demographic, drug use, healthcare utilization, and health status questions. Participants were provided $25 for completing the survey and $25 if they completed the optional HIV test.

2.2 Analytical sample: We examined access to and interest in free heroin, methamphetamine, and crack cocaine smoking equipment among participants who injected each drug at least once in the previous year.

2.3 Measures. The NHBS questionnaire asked all participants to report their sociodemographic characteristics, health status and behavior, and drug use behaviors.

The analyses focused on responses to three survey questions that were asked separately for heroin, methamphetamine, and crack:

a. Are you interested in getting free, clean equipment for smoking [drug]?
   Possible answers: (no, yes, already get free clean equipment for smoking [drug], don't know, refuse to answer)

b. Do you inject less often because you have access to free, clean equipment for smoking [drug]?
   Possible answers: (no, yes, don't know, refuse to answer)

c. If you had access to free, clean equipment for smoking [drug] would you inject less often?
   Possible answers: (no, yes, don't know, refuse to answer)

Questions were concerned with current access and interest, and did not specify a time frame. Beyond what drug the safer smoking equipment was intended for, the questions did not specify type of equipment (e.g., a pipe or foil), nor the source of the equipment (e.g., SSPs, peers). Free safer smoking equipment data was all self-reported. Responses to the access questions were

mutually exclusive because of a skip pattern in the questions: a person either had access to free safer smoking equipment, was interested in getting access, or did not already get or want to get access to free safer smoking equipment.

2.4 Statistical analysis: Unadjusted. Our analysis was primarily descriptive. We calculated the proportion of NHBS respondents who had access to free safer smoking equipment, and how many of those who had access reported that this access reduced their injection frequency. We examined the proportion of respondents who did not have access to free safer smoking equipment, and among these, the proportion who would have liked access to free safer smoking equipment and who thought it would reduce their injection frequency.

We examined potential differences in characteristics between people who did and did not have access to free smoking equipment for each drug using t-tests for continuous variables and chi-square tests for categorical variables. We compared age, race, gender, and housing status between those with and without access to free safer smoking equipment.

2.5 Statistical analysis: Adjustment for respondent-driven sampling. We adjusted our estimates describing interest in and access to free safer smoking equipment, and experienced or expected reduction in injection frequency for respondent-driven sampling (RDS) probabilities using the RDS package in R (https://cran.r-project.org/web/packages/RDS/RDS.pdf). We present both unadjusted and adjusted results, but use the adjusted results for the discussion of our findings.

2.6 Sensitivity analysis. To understand the relevance of this harm reduction strategy for an emerging drug use pattern in Seattle, WA and nationally, we did a sensitivity analysis of access to and interest in free safer smoking equipment among people who used both methamphetamine and heroin. Methamphetamine-heroin co-use was defined as use of both methamphetamine and heroin weekly or more often.

2.7 Ethics. The NHBS survey procedures were determined by the Washington State Institutional Review Board (IRB) to be a public health surveillance activity and did not require IRB approval. The Public Health – Seattle & King County (PHSKC) HIV/STD Program requested this analysis be completed as a public health surveillance activity. Due to its determination as a surveillance activity and the lack of personal identifying data from the NHBS survey, the University of Washington institutional review board approved its exemption from review.

3. Results

3.1 Sample characteristics

The 2018 Seattle area NHBS-PWID sample included 555 local PWID participants, 550 of whom responded to questions about free safer smoking equipment. Information about participant demographics, drug use behavior, and health behavior and health status are presented in **Table 1**. The majority (52%) of the survey sample was over age 40, and about a third of the respondents were women. Most (61%) of the sample reported they were currently homeless. Most of the sample (83%) had used an SSP in the prior year. Three quarters of the sample reported an injection frequency of more than once per day. Within the sample, 37% of participants co-used methamphetamine and heroin weekly or more often. The main route of drug administration in the past three months was injection at 96%, while smoking/inhalation was also common at 77% of the sample. A small proportion (13%) of the sample reported consuming drugs exclusively by injecting.

Table 1. Characteristics of Seattle area PWID enrolled in the National HIV Behavioral Surveillance survey, 2018

Characteristics	Sample (N=550)	
	n	(%)
Age		
18-29	99	(18.0)
30-39	163	(29.6)
40-49	123	(22.4)
50+	165	(30.0)
Gender		
Female	209	(38.0)
Male	336	(61.1)
Transgender	6	(1.1)
Race/Ethnicity*		
American Indian / Native American	123	(22.4)
Asian	14	(2.5)
Black or African American	110	(20.0)
Latino / Hispanic	67	(12.2)
Native Hawaiian / Pacific Islander	25	(4.5)
White	391	(71.1)
Currently homeless	335	(60.9)
Exchanged sex for money or drugs, past 12 months	132	(21.6)
Exchanged sex for other goods or services, past 12 months	55	(10.3)
HIV+, test result	25	(4.8)
HCV+, test result	391	(71.1)
Overdose, past 12 months	143	(26.0)
Shared syringes, past 12 months	157	(28.5)
Any drug injection frequency, past 12 months		
More than once a day	410	(74.5)
Once a day	58	(10.5)
More than once a week	37	(6.7)
Once a week or less	45	(8.2)
Used an SSP, past 12 months	458	(83.3)
Any drug route of consumption, past 3 months*		
Injecting**	529	(96.2)
Inhalation/smoking	426	(77.5)
Snorting	267	(48.5)
Swallowing/eating	240	(43.6)
Plugging/booty bumping	58	(10.5)
Exclusively used by injecting route, past 3 months	69	(12.5)
Drug/s used, past 12 months*		
Heroin	508	(92.4)
Methamphetamine	384	(69.8)
Speedball (heroin and cocaine, together)	255	(46.4)
Goofball (heroin and methamphetamine in same syringe)	306	(55.6)
Crack	92	(16.7)
Cocaine	153	(27.8)
Painkillers	139	(25.3)
Co-used methamphetamine and heroin, past 12 months***	205	(36.9)

* Respondents could select more than one option

** Injecting included in the vein, in the muscle, or skin popping

*** Co-use defined as use of both methamphetamine and heroin weekly or more often

3.2 Interest and injection frequency reduction results by smoking equipment type

A small proportion of survey respondents reported that they already had access to free safer smoking equipment for heroin (11.2%, 58/495), methamphetamine (10.9%, 31/372), or crack (12%, 8/88) (Table 2). Among people accessing free safer smoking equipment for heroin (32.2%, 16/58), methamphetamine (44.2%, 10/31), or crack (12.2%, 2/8), many reported that they thought this access reduced their injection frequency. There were no significant differences in respondent age, race, gender, or housing status between respondents who had access to free safer smoking equipment and those who did not (results not shown). Among those without access, there was interest in getting access to free safer smoking equipment for heroin (28.2%, 172/437), methamphetamine (44.6%, 210/341), or crack (49.1%, 38/80). Of those interested respondents, many respondents thought access to free safer smoking equipment for heroin (47.9%, 100/172), methamphetamine (71.1%, 152/210), or crack (64.7%, 26/38) would reduce their injection frequency.

Unadjusted proportions were similar to the estimates adjusted for RDS sampling probabilities, with a couple of exceptions (Table 2). In the unadjusted estimates, a slight majority (58%) of people interested in free safer smoking equipment for heroin thought that access would reduce their injection frequency, while the RDS adjusted estimate for this proportion was a slight minority (48%). The proportion of people interested in free safer smoking equipment for methamphetamine in the unadjusted estimates was 45% but was a slight majority (57%) after RDS adjustment. For free safer smoking equipment for crack consumption, the unadjusted estimates showed a smaller proportion of respondents were interested in getting free safer smoking equipment (43%) compared to those who were not interested (48%), whereas the RDS

adjustment flipped this with 49% interested in free safer smoking equipment and just 40% not interested or already getting free safer smoking equipment.

Table 2. Access to and interest in free safer smoking equipment, and reduction in injection frequency among Seattle area PWID enrolled in the National HIV Behavioral Surveillance survey, 2018, by equipment type

	Smoking Equipment for:								
	Heroin N = 495			Methamphetamine N = 372			Crack N = 88		
		Unadjusted	RDS Adjusted		Unadjusted	RDS Adjusted		Unadjusted	RDS Adjusted
	n	%	% 95% CI	n	%	% 95% CI	n	%	% 95% CI
Already getting	58	11.7	11.2 (5.9 - 16.4)	31	8.3	10.9 (3.5 - 18.2)	8	9.1	12 (0.60 - 18.0)
Reduced injection frequency	16	27.6	32.2 (5.7 - 58.8)	10	32.3	44.2 (11.9 - 76.6)	2	25	12.2 (-24.0 - 48.3)
Did not reduce injection frequency	42	72.4	67.8 (41.2 - 94.3)	21	67.7	55.8 (23.5 - 88.1)	6	75	87.9 (51.7 - 124.0)
Interested in getting	172	34.7	28.2 (21.8 - 34.7)	210	56.5	44.6 (35.6 - 53.6)	38	43.2	49.1 (31.0 - 67.2)
Will reduce injection frequency	100	58.1	47.9 (34.6 - 61.1)	152	72.4	71.1 (61.7 - 80.5)	26	68.4	64.7 (37.6 - 91.8)
Will not reduce injection frequency	72	41.9	49.4 (36.0 - 62.8)	58	27.6	28.1 (18.9 - 37.3)	12	31.6	35.1 (8.0 - 62.2)
Not getting or interested in	256	51.7	60.5 (52.9 - 68.0)	130	34.9	44.5 (34.9 - 54.1)	42	47.7	39 (21.7 - 56.2)

Sample size for each safer smoking equipment type is determined by whether respondents injected that drug more than once in the prior 12 months.
*Missing responses among people who inject heroin: 9, methamphetamine: 1, crack: 1

3.3 Sensitivity analysis: interest and injection frequency reduction results among people who co-used methamphetamine and heroin

Among people who co-used methamphetamine and heroin (n=205), access to free safer smoking equipment for smoking heroin (10.1%, 22/205) and for smoking methamphetamine (8.0%, 14/205) was low. Of those with access, the proportion that said that this access reduced their injection frequency was 15.2% (3/22) for heroin and 36.7% (2/14) for methamphetamine. For people who co-used methamphetamine and heroin who did not have access to free safer smoking equipment, interest in equipment for heroin was lower than equipment for methamphetamine (36.4% (92/183) vs. 51.8%, (127/191) respectively). Fewer people who co-used and were interested in free safer smoking equipment for heroin reported that they predicted access would reduce their injection frequency than did people who co-used and were interested in free safer smoking equipment for methamphetamine (45.1% (45/92) vs. 64.4% (90/127)).

4. Discussion

Our evaluation of access to and interest in free safer smoking equipment shows high potential for safer smoking equipment to support harm reduction for PWUD in the Seattle area. While 78% of respondents in our sample reported smoking drugs in the past year and 83% reported using an SSP during that time, less than 12% of the overall sample reported access to free safer smoking equipment. Interest in access to free safer smoking equipment was high, and many participants reported that access to free safer smoking equipment did or would reduce their injection frequency. This evaluation expands on the limited research to date exploring the role of free safer smoking equipment in reducing drug-related harms, and points to areas for further research and policy change.

In our sample, around one tenth of respondents had access to free safer smoking equipment for drug consumption, depending on what drug the equipment was intended for. Equipment for smoking methamphetamine had the lowest level of access in our sample, and access was also low for equipment for smoking crack. This highlights a potential area for growth in local harm reduction efforts: smoking is a preferred consumption route both for people who use methamphetamine and/or crack (33,34). In a sensitivity analysis, we found particularly low levels of access to free safer smoking equipment among people who regularly used both methamphetamine and heroin. This drug use pattern is on the rise in Seattle and nationally, and it may be necessary to study accessibility issues with free safer smoking equipment for people who co-use.

While access to free safer smoking equipment was low in our sample, interest in getting free safer smoking equipment was high, especially for equipment for smoking methamphetamine. The proportion of respondents interested in free safer smoking equipment

was comparable to the interest in a Safer Supervised Smoking Facility for crack use in Vancouver, Canada (24). Interest in free safer smoking equipment for heroin consumption was the lowest in our sample at just a third of respondents, which is somewhat lower than the observed interest/uptake in smoking foils for heroin use in Europe (26–28). This result may reflect how the experience of injecting vs. smoking is often much preferred by people who use heroin (35), and the equipment for smoking it can be readily improvised using store-bought aluminum foil (36). The heroin market in the Western United States, including Seattle, is dominated by black tar heroin from Mexico (5), whereas Western European opioid markets are more likely to have brown heroin from sources in Central Asia (37). The quality and potency of drugs within regional drug markets can influence drug consumption routes (5,38), and may explain some of the differences observed in our region compared to the European studies. Many respondents in our evaluation were neither already getting nor interesting in getting free safer smoking equipment. Future work should consider the reasons for this disinterest, and whether there are changes that can be made to make free safer smoking equipment more interesting to this subset of PWID.

Ours is one of very few studies to show that access to free safer smoking equipment may reduce injection frequency. Among people in our sample who already had access to smoking equipment, between a quarter and a third of respondents reported that this access reduced their injection frequency, depending on which drug the equipment was for. Among people who were interested in getting free safer smoking equipment, a majority said they would reduce their injection frequency. No studies to date describe the impact of free safer smoking equipment on the frequency of methamphetamine injection among people who use methamphetamine. For smoking crack, the self-reported reduction in injection frequency in our evaluation is similar to

observations from a safer smoking equipment pilot study in Canada (25). For heroin, our findings are similar to other studies that describe PWUD using safer smoking equipment when they otherwise would have injected (26–29).

The proportion of respondents with current access to free safer smoking equipment who reported they reduced their injection frequency was overall lower than the proportion interested in free safer smoking equipment who said they would reduce their injection frequency if they had access. This gap between an individual's willingness to change and observed change may reflect unseen barriers that we may need to address to provide more effective support for people trying to modify their drug consumption. Further study is needed to understand the barriers and facilitators for PWUD who are interested in changing their drug consumption route, and how best to support them longitudinally.

These promising findings emphasize the need to address policy barriers to distribution of safer smoking equipment. The federal Controlled Substances Act, Title II of the Comprehensive Drug Abuse Prevention and Control Act of 1970 makes it illegal to possess or distribute equipment to consume drugs with, including safer smoking equipment. Individual states may maintain their own laws distinct from or even in contrast with the federal law, but in most cases safer smoking equipment is not protected in state law (39,40). In Washington State, it has been legal to possess drug paraphernalia for a number of years, and state legislature passed a bill in 2021 making it legal to distribute drug paraphernalia so long as it is not used for drug manufacture (41).

4.1 Limitations: The cross-sectional design of our study is not able to capture temporal data about the effect of access to free safer smoking equipment on subsequent drug consumption routes and frequency. Our data rely on a binary *yes* or *no* reduction in injection frequency; future

research may enhance our understanding by assessing injection frequency outcomes quantitatively. We did not ask about free safer smoking equipment *utilization*, only whether respondents were "getting" equipment, and it is possible that they had access without using it. We did not examine the potential harms of smoking, which would be valuable to study in future work. We used non-specific terms for safer smoking equipment, and so future research should assess more directly and specifically what combinations of safer smoking equipment are of most interest to local PWUD.

Our evaluation does not capture the potential interest in safer smoking equipment for people who only consume drugs by smoking or other non-injection routes. Among non-injecting PWUD, safer smoking equipment has the potential to delay or prevent transition to injection drug use (42), prevent injuries to the lips and mouth caused by the heat and fly-back seen with makeshift smoking devices (43,42,44), and reduce pipe sharing and injury from pipe degradation due to heavy use and reuse (25,45,46). Minimizing the sharing of smoking equipment has become even more important due to the COVID-19 pandemic (23). Expanding to study non-injecting PWUD may also capture more people who use crack, which is more commonly inhaled. We did not have data on fentanyl use in our sample and were unable to assess the importance of safer smoking equipment for this drug, which is rapidly emerging as a drug of public health concern (47) and which is increasingly consumed by smoking (48,49).

4.2 Conclusions

In the wake of increasing opioid, methamphetamine, and opioid-methamphetamine co-use across the country, it is imperative that we expand national and local public health harm reduction efforts. Our evaluation among Seattle area PWID describes low levels of access to free safer smoking equipment, high interest in getting free safer smoking equipment, and sizeable

experienced or anticipated reductions in injection frequency because of access to smoking equipment. Our findings suggest that provision of free safer smoking equipment may be a valuable tool for the local PWUD community and has a strong potential to reduce drug-related harms. Policy barriers to evidence-based harm reduction must be addressed.

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Contributions

Each author contributed in many ways to this manuscript. The original idea for the evaluation was from Thea Oliphant-Wells. Sara slick, Thea Oliphant-Wells, Courtney Moreno, Vanessa McMahan, Jake Ketchum, and Thomas Fitzpatrick shared responsibility for the evaluation design, survey instrumentation, data collection, review, and approval of the manuscript. Sara Glick and Molly Reid developed the analysis plan, and Molly Reid was responsible for conducting and interpreting the statistical analysis, preparation, review, and approval of the manuscript.

References

1. Ellis MS, Kasper ZA, Cicero TJ. Twin epidemics: The surging rise of methamphetamine use in chronic opioid users. *Drug and Alcohol Dependence*. 2018;193:14–20.

2. Strickland JC, Havens JR, Stoops WW. A nationally representative analysis of "twin epidemics": Rising rates of methamphetamine use among persons who use opioids. *Drug Alcohol Depend*. 2019;204:107592.

3. Jones CM, Underwood N, Compton WM. Increases in methamphetamine use among heroin treatment admissions in the United States, 2008-17. *Addiction*. 2020;115(2):347–353.

4. SAMHSA. Key substance use and mental health indicators in the United States: Results from the 2020 National Survey on Drug Use and Health. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration: Substance Abuse and Mental Health Services Administration; 2021.(https://www.samhsa.gov/data/)

5. Ciccarone D. Heroin in brown, black and white: structural factors and medical consequences in the US heroin market. *Int. J. Drug Policy*. 2009;20(3):277–282.

6. Gonzales R, Mooney L, Rawson R. The methamphetamine problem in the United States. *Annu Rev Public Health*. 2010;31:385–398.

7. Butler AJ, Rehm J, Fischer B. Health outcomes associated with crack-cocaine use: Systematic review and meta-analyses. *Drug and Alcohol Dependence*. 2017;180:401–416.

8. Al-Tayyib A, Koester S, Langegger S, et al. Heroin and methamphetamine injection: an emerging drug use pattern. *Subst Use Misuse*. 2017;52(8):1051–1058.

9. Glick SN, Klein, K, Tinsley J, et al. Increasing heroin-methamphetamine (goofball) use and related morbidity among Seattle area people who inject drugs. *American Journal on Addictions*. 2020;

10. Glick SN, Burt R, Kummer K, et al. Increasing methamphetamine injection among non-MSM who inject drugs in King County, Washington. *Drug and Alcohol Dependence*. 2018;182:86–92.

11. Lankenau SE, Teti M, Silva K, et al. Initiation into prescription opioid misuse amongst young injection drug users. *International Journal of Drug Policy*. 2012;23(1):37–44.

12. Novak SP, Kral AH. Comparing Injection and Non-Injection Routes of Administration for Heroin, Methamphetamine, and Cocaine Users in the United States. *Journal of Addictive Diseases*. 2011;30(3):248–257.

13. Darke S, Hall W. Heroin overdose: Research and evidence-based intervention. *J Urban Health*. 2003;80(2):189–200.

14. Jawa R, Stein MD, Anderson B, et al. Association of skin infections with sharing of injection drug preparation equipment among people who inject drugs. *International Journal of Drug Policy*. 2021;94:103198.

15. Pouget ER, Hagan H, Des Jarlais DC. Meta-analysis of hepatitis C seroconversion in relation to shared syringes and drug preparation equipment. *Addiction*. 2012;107(6):1057–1065.

16. Ball LJ, Puka K, Speechley M, et al. Sharing of Injection Drug Preparation Equipment Is Associated With HIV Infection: A Cross-sectional Study. *J Acquir Immune Defic Syndr*. 2019;81(4):e99–e103.

17. Barocas JA, Eftekhari Yazdi G, Savinkina A, et al. Long-term Infective Endocarditis Mortality Associated With Injection Opioid Use in the United States: A Modeling Study. *Clinical Infectious Diseases*. 2021;73(11):e3661–e3669.

18. Des Jarlais DC. Harm reduction in the USA: the research perspective and an archive to David Purchase. *Harm Reduct J*. 2017;14(1):51.

19. Bridge J. Route transition interventions: Potential public health gains from reducing or preventing injecting. *International Journal of Drug Policy*. 2010;21(2):125–128.

20. Strang J, Bearn J, Farrell M, et al. Route of drug use and its implications for drug effect, risk of dependence and health consequences. *Drug and Alcohol Review*. 1998;17(2):197–211.

21. Rigoni R, Breeksema J, Woods S. Speed limits: Harm reduction for people who use stimulants. 2018;

22. Prangnell A, Dong H, Daly P, et al. Declining rates of health problems associated with crack smoking during the expansion of crack pipe distribution in Vancouver, Canada. *BMC Public Health*. 2017;17(1):163.

23. Harris M. An urgent impetus for action: safe inhalation interventions to reduce COVID-19 transmission and fatality risk among people who smoke crack cocaine in the United Kingdom. *Int J Drug Policy*. 2020;83:102829.

24. Shannon K, Ishida T, Morgan R, et al. Potential community and public health impacts of medically supervised safer smoking facilities for crack cocaine users. *Harm Reduct J*. 2006;3(1):1.

25. Leonard L, DeRubeis E, Pelude L, et al. "I inject less as I have easier access to pipes": Injecting, and sharing of crack-smoking materials, decline as safer crack-smoking resources are distributed. *International Journal of Drug Policy*. 2008;19(3):255–264.

26. Pizzey R, Hunt N. Distributing foil from needle and syringe programmes (NSPs) to promote transitions from heroin injecting to chasing: An evaluation. *Harm Reduct J*. 2008;5(1):24.

27. Stöver HJ, Schäffer D. SMOKE IT! Promoting a change of opiate consumption pattern - from injecting to inhaling. *Harm Reduction Journal*. 2014;11(1):18.

28. Dunleavy K, Hutchinson SJ, Palmateer N, et al. The uptake of foil from needle and syringe provision services and its role in smoking or snorting heroin among people who inject drugs in Scotland. *International Journal of Drug Policy*. 2021;98:103369.

29. Fitzpatrick T, McMahan VM, Frank ND, et al. Heroin pipe distribution to reduce high-risk drug consumption behaviors among people who use heroin: a pilot quasi-experimental study. *Harm Reduction Journal*. 2022;19(1):103.

30. Peoples Harm Reduction Alliance. (http://www.peoplesharmreductionalliance.org/). (Accessed December 5, 2019)

31. Lansky A, Abdul-Quader AS, Cribbin M, et al. Developing an HIV behavioral surveillance system for injecting drug users: the National HIV Behavioral Surveillance System. *Public Health Rep*. 2007;122 Suppl 1:48–55.

32. Burt RD, Tinsley J, Glick SN. A Decline in HIV Testing Among Persons Who Inject Drugs in the Seattle Area, 2004-2015. *J Acquir Immune Defic Syndr*. 2017;75 Suppl 3:S346–S351.

33. Rigoni R, Woods S, Breeksema JJ. From opiates to methamphetamine: building new harm reduction responses in Jakarta, Indonesia. *Harm Reduction Journal*. 2019;16(1):67.

34. Cornish JW, O'Brien CP. Crack Cocaine Abuse: An Epidemic with Many Public Health Consequences. *Annual Review of Public Health*. 1996;17(1):259–273.

35. Carruthers S, Loxley W. Attitudes of novice heroin injectors towards non-injecting routes of administration to prevent the transmission of blood borne viruses. *International Journal of Drug Policy*. 2002;13(1):69–74.

36. Cordova JP, Balan S, Romero J, et al. "Chasing the dragon": new knowledge for an old practice. *Am J Ther*. 2014;21(1):52–55.

37. EMCDDA. Opioid trafficking routes from Asia to Europe. 2015 (Accessed February 17, 2023).(www.emcdda.europa.eu). (Accessed February 17, 2023)

38. Horyniak D, Stoové M, Degenhardt L, et al. How do drug market changes affect characteristics of injecting initiation and subsequent patterns of drug use? Findings from a cohort of regular heroin and methamphetamine injectors in Melbourne, Australia. *Int. J. Drug Policy*. 2015;26(1):43–50.

39. Singer JA, Heimowitz S. Drug Paraphernalia Laws Undermine Harm Reduction. Washington, DC: Cato Institute; 2022 (Accessed August 15, 2022).(https://www.cato.org/policy-analysis/drug-paraphernalia-laws-undermine-harm-reduction-reduce-overdoses-disease-states). (Accessed August 15, 2022)

40. Fernández-Viña MH, Prood NE, Herpolsheimer A, et al. State Laws Governing Syringe Services Programs and Participant Syringe Possession, 2014-2019. *Public Health Rep*. 2020;135(1_suppl):128S-137S.

41. SB 5476. 2021.

42. Collins CLC, Kerr T, Tyndall MW, et al. Rationale to Evaluate Medically Supervised Safer Smoking Facilities for Non-injection Illicit Drug Users. *Can J Public Health*. 2005;96(5):344–347.

43. Porter J, Bonilla L. Crack users' cracked lips: an additional HIV risk factor. *Am J Public Health*. 1993;83(10):1490–1491.

44. Imtiaz S, Strike C, Elton-Marshall T, et al. Safer smoking kits for methamphetamine consumption. *Addiction*. 2020;115(6):1189–1190.

45. Ivsins A, Roth E, Nakamura N, et al. Uptake, benefits of and barriers to safer crack use kit (SCUK) distribution programmes in Victoria, Canada—A qualitative exploration. *International Journal of Drug Policy*. 2011;22(4):292–300.

46. Ti L, Buxton J, Wood E, et al. Factors associated with difficulty accessing crack cocaine pipes in a Canadian setting. *Drug Alcohol Rev*. 2012;31(7):890–896.

47. Jannetto PJ, Helander A, Garg U, et al. The Fentanyl Epidemic and Evolution of Fentanyl Analogs in the United States and the European Union. *Clinical Chemistry*. 2019;65(2):242–253.

48. Kral AH, Lambdin BH, Browne EN, et al. Transition from injecting opioids to smoking fentanyl in San Francisco, California. *Drug and Alcohol Dependence*. 2021;227:109003.

49. Kingston S, Glick SN, Newman A, et al. Results from the 2021 WA State Syringe Service Program Health Survey. Seattle, WA: Addictions, Drug & Alcohol Institute, Department of Psychiatry & Behavioral Sciences, University of Washington; 2022.(https://adai.uw.edu/syringe-survey-2021.)

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