Route of opioid consumption and association with overdose among people who inject drugs in Seattle, WA: an analysis of the National HIV Behavioral Surveillance survey 2005 – 2022

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A thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Public Health

University of Washington

2024

Committee:

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Program Authorized to Offer Degree:

Epidemiology

University of Washington

Abstract

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To better characterize trends in route of opioid consumption and associations with overdose, we analyzed data from six cycles of the National HIV Behavioral Surveillance survey from 2005 to 2022. Respondents reported injection and non-injection use of heroin, prescription opioids, fentanyl, and goofballs as well as overdose in the past 12 months. Proportional odds logistic regression found less heroin injection after the 2012 cycle. Robust Poisson regression found prevalence of overdose was greater among respondents who consumed heroin through both injection and non-injection compared to only non-injection routes, with the largest prevalence ratios favoring non-injection use identified during the 2018 and 2022 cycles. Future research is needed to clarify how routes of fentanyl use are changing and their associations with overdose.

Background

Opioid overdose is a leading cause of morbidity and mortality among people who use drugs (PWUD).[1,2] Historically, most opioid overdoses in the United States have been caused by heroin or prescription opioid use, but in the last decade fentanyl and coadministration of opioids and stimulants have been increasingly implicated in lethal and non-lethal overdose.[3,4] The total number of overdose deaths nationwide has increased fivefold over the past 20 years, with an especially large increase seen on the west coast of the United States since 2015.[3,5] In King County, Washington, the annual number of deaths attributed to opioid poisoning increased from 215 in 2015 to 1,141 in 2023.[5]

Opioids can be consumed through multiple routes, including injection, smoking, snorting, and ingestion.[6] Preliminary research suggests PWUD on the west coast of the United States may be switching from injecting to smoking opioids; however, these studies have been limited to California and data collected after 2019.[7–9] When this change in route of opioid consumption began and whether similar trends are occurring outside of California remains unknown.

Route of opioid consumption may have important implications for overdose risk, and the association between route and overdose may differ depending on type of opioid consumed. Pharmacokinetic studies in controlled laboratory settings have found that peak plasma concentrations of heroin are 2-4 times lower when heroin is smoked compared to injected, which may reduce risk of overdose.[10,11] In contrast, intranasal and inhalation administration of fentanyl has a similar pharmacokinetic profile to intravenous use.[12]

Real-world data on the relationship between route of opioid consumption and overdose is limited and unclear. People who use fentanyl believe injection increases overdose risk, and switching to smoking has been used by some PWUD as an overdose prevention strategy.[8] In retrospective analyses of toxicology reports in Australia, only 1% of fatal heroin overdose cases involved a non-injection route of administration.[13] However, analysis of data collected from overdose reporting systems in the United States found the number of lethal overdoses with evidence of smoking equipment more than doubled between 2020 and 2022, and smoking was the most commonly reported route of consumption associated with overdose deaths during this period.[14]

To better characterize trends in route of opioid consumption and associations with overdose, we analyzed data from six cycles of the Seattle area National HIV Behavioral Surveillance (NHBS) survey from 2005 to 2022.

Methods

Study Design

NHBS is a routine, serial cross-sectional survey conducted by the Centers for Disease Control and Prevention (CDC) to monitor behavioral trends among groups at higher risk for HIV infection. Respondents are recruited across multiple metropolitan areas; the greater Seattle

metropolitan area is one recruitment site. Six cycles of NHBS have exclusively recruited people who inject drugs (PWID): 2005 (Cycle 1), 2009 (Cycle 2), 2012 (Cycle 3), 2015 (Cycle 4), 2018 (Cycle 5), and 2022 (Cycle 6). Details of the NHBS study design have been published elsewhere.[15]

Study Subjects and Eligibility Criteria
To participate in any of the six NHBS-PWID cycles, respondents had to meet the following eligibility criteria: (1) ≥18 years old, (2) injected any drug on at least one occasion in the past 12 months, (3) lived in King or Snohomish County, and (4) were able to complete the survey in English or Spanish.

Study Setting and Recruitment
Participants for each cycle were recruited using respondent driven sampling (RDS). Project staff first identified a small number of eligible seed participants who completed a survey and then were offered compensation to recruit peers through their social networks. Surveys were administered by trained NHBS staff at community sites across the greater Seattle area. Participants received incentives for completing the survey, and incentive amounts differed across cycles.

Sample Size and Study Power
For each cycle a target sample size for each recruitment site was set based on presumed HIV prevalence and the desired standard error for key indicators. Participants were actively recruited using RDS until the cycle target sample size was achieved.

Data Collection
The survey for each NHBS-PWID cycle consisted of a core instrument of standard questions used at all sites nationwide as well as a local instrument of additional questions only asked of participants recruited in the greater Seattle area. Together the core and local components of the NHBS survey collected information on the following domains across all six cycles: (1) sociodemographic characteristics, (2) injection drug use behaviors, (3) non-injection drug use behaviors, and (4) experiences with drug overdose. All survey items were assessed by self-report.

Variables
In each cycle, respondents reported whether they had overdosed on opioids on at least one occasion in the past 12 months. Overdose was coded as a dichotomous variable (≥1 overdose vs no overdose in the past 12 months).

All six cycles asked respondents to report past 12 month frequency of heroin injection and non-injection (smoking or snorting). Cycles 4, 5, and 6 asked respondents to report past 12 month frequency of illicit prescription opioid (e.g. oxycodone, hydrocodone, morphine) injection and non-injection (no specific non-injection routes specified). Cycle 6 local questions asked respondents to report past 12 month frequency of fentanyl and goofball (i.e., co-administered heroin and methamphetamine) injection and non-injection (no specific non-injection routes

specified). For cycles in which data on route of consumption for a particular opioid were available, respondents were categorized as consuming each opioid through injection only, non-injection only, or both injection and non-injection in the past 12 months.

Several sociodemographic characteristics were measured across all six cycles: age, gender (man, woman, transgender), race (American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, White, Multiple Races), Hispanic or Latino/a identity (yes or no), and current housing status (housed or unhoused). All respondents were also asked to report their age when they first injected drugs, and duration of injection drug use was calculated as the difference between current age and age of first injection.

Data Analyses

Descriptive statistics were used to summarize sociodemographic characteristics, any use of each opioid, route of consumption of each opioid, and overdose in the past 12 months for each cycle as well as for all six cycles combined.

To examine trends in route of heroin consumption (Cycles 1-6) and route of illicit prescription opioid consumption (Cycles 4-6), we used proportional odds logistic regression models. For each model the analytical sample was limited to respondents who used heroin and prescription opioids, respectively. Route of consumption for each opioid was treated as an ordinal response variable with three levels: non-injection only, both injection and non-injection, and injection only. The primary predictor variable was NHBS cycle, with Cycle 1 and Cycle 4 set as the reference category for heroin and prescription opioids, respectively. Both an unadjusted model and a model that adjusted for four potential confounders selected *a priori* (age, gender, race, and housing status) were fit to the data. Results were reported as odds ratios (OR) and adjusted odds ratios (aOR) with associated 95% confidence intervals (95% CI). For all models we assessed the proportional odds assumption using the Brant test, and the assumption was met if the p-value of the Omnibus test was > 0.05.

To visually inspect trends in route of heroin consumption across the six cycles, we created a stacked area chart. Data were aggregated by cycle, and proportions of each route of consumption category were plotted along the y-axis and cycle year along the x-axis.

To examine associations between route of opioid consumption and overdose, we used Poisson regression models with robust standard errors. For each model the analytical sample was limited to respondents who used heroin in Cycles 1-6, prescription opioids in Cycles 4-6, fentanyl in Cycle 6, and goofballs in Cycle 6, respectively. Any overdose in the past 12 months was the response variable in each model. The primary predictor variable was route of consumption of each opioid as a categorical variable with three levels (only non-injection, both injection and non-injection, only injection), with only non-injection set as the reference category. Both unadjusted and adjusted models were fit to the data. Adjusted models included six potential confounders selected *a priori*: age, gender, race, housing status, duration of injection drug use, and use of any opioid in the past 12 months besides the predictor variable

opioid. Results were reported as prevalence ratios (PR) and adjusted prevalence ratios (aPR) with associated 95% CI.

Contamination of heroin with fentanyl has rapidly increased in Washington State since 2018.[16] To further investigate whether associations between route of heroin consumption and overdose differed before and during the periods of fentanyl contamination, separate Poisson regression models were created for Cycles 1-4 (2005 through 2015) and Cycles 5-6 (2018-2022).

All analysis were performed using R Statistical Software (v4.1.2; R Core Team 2021), and p-values ≤0.05 were considered statistically significant.

Ethics

Informed consent was obtained from all NHBS participants. The data collection procedures for Cycles 1-4 were approved by the Washington State Institutional Review Board (WS IRB). Beginning with Cycle 5, the WS IRB determined that the Seattle area NHBS survey was a surveillance activity (i.e., not research) and did not require ongoing review and approval. This analysis was determined to not involve human subjects by the University of Washington Internal Review Board (#STUDY00017223).

Results

Across all six NHBS-PWID cycles in the greater Seattle area, there were 2,943 respondents, with the fewest in Cycle 2 (296) and most in Cycle 5 (555). Sociodemographic characteristics and past 12 month opioid use behaviors are summarized in Table 1. For each individual cycle and all six cycles combined, most respondents were men, white, and not Hispanic. The mean age for all six cycles was 43 years. Roughly half (52%) of the combined sample were unhoused. Heroin was the most commonly used opioid across all six cycles, with 91% of the combined sample having used heroin in the 12 months prior to being surveyed. In Cycle 6, 84%, 72%, 64%, and 57% of respondents had used heroin, fentanyl, goofballs, and prescription opioids in the past 12 months, respectively.

Route of Opioid Consumption

Route of consumption in the past 12 months differed across the four analyzed opioid categories (Table 2). Across all six cycles, 55% and 2% of respondents who used heroin exclusively consumed heroin through injection and non-injection routes, respectively. Non-injection use of other prescription opioids, fentanyl, and goofballs was more common. Nearly half (47%) of respondents who used prescription opioids and 35% of respondents who used fentanyl consumed those opioids exclusively through non-injection methods, compared to only 13% and 5% who exclusively injected those opioids, respectively. In Cycle 6, the most common route of consumption was mixed injection and non-injection use for heroin (59%), fentanyl (60%), and goofballs (57%).

Trends in Route of Opioid Consumption Across NHBS-PWID Cycles

Routes of heroin consumption remained similar across Cycles 1, 2, and 3, after which the proportion of respondents who only injected heroin successively decreased while the proportions of respondents who only non-injected heroin and both injected and non-injected heroin successively increased (Figure 1). In Cycles 1, 2, and 3 roughly two-thirds of respondents who used heroin exclusively injected; by Cycle 6 that proportion dropped to one-third. In proportional odds logistic regression modeling, respondents in Cycles 4, 5, and 6 who used heroin had significantly lower odds of being in a higher injection consumption category compared to Cycle 1 (Table 2). These ORs remained significant in the model that adjusted for potential confounding. Respondents in Cycle 6 who used prescription opioids had significantly lower odds of being in a higher injection consumption category compared to Cycle 4, however this finding did not remain significant after adjusting for potential confounding. For all models the Brant test p-value was >0.05, indicating the proportional odds assumption was valid.

Association between Route of Opioid Consumption and Overdose
Across all six cycles, 19% of all NHBS respondents reported experiencing ≥1 overdose in the past 12 months (Table 1). Among respondents who used heroin, 21% had an overdose in the past 12 months. The proportion who had an overdose was greater among respondents who used prescription opioids (27%), fentanyl (33%), and goofballs (30%). In robust Poisson regression models, the prevalence of overdose in the past 12 months was greater among respondents who only injected and both injected and non-injected compared to respondents who only non-injected across all four opioids categories; however, this greater prevalence was only statistically significant when comparing both injection and non-injection of heroin to only non-injection of heroin in the adjusted model (aPR 2.97, 95% CI 1.13-7.78) (Table 3).

When considering years before frequent fentanyl contamination in the local heroin supply (Cycles 1-4), there was no significant difference in overdose by route of heroin consumption. However, during the period when fentanyl contamination in the local heroin supply was more common (Cycles 5-6), prevalence of overdose was significantly greater among respondents who only injected heroin (aPR 5.40, 95% 1.32 – 21.98) and consumed heroin through injection and non-injection (aPR 5.51, 95% CI 1.36 – 22.34) compared to respondents who exclusively consumed heroin through non-injection (Table 4).

Discussion

In this analysis of six serial cross-sectional surveys of PWID in the greater Seattle area conducted between 2005 and 2022, we found evidence of a transition away from exclusively injecting heroin starting after 2012. Despite this transition, exclusive non-injection use of other opioids – fentanyl, goofballs, and prescription opioids such as oxycodone and hydrocodone – was more common than exclusive non-injection use of heroin, which remained relatively uncommon throughout all six cycles. The prevalence of overdose in the past 12 months was nearly threefold greater among people who consumed heroin through injection and non-injection routes compared to people who only smoked or snorted heroin. The lower prevalence of overdose among people who only consumed heroin through non-injection routes was more pronounced during NHBS Cycles 5 and 6 compared to earlier cycles, which coincided with a

period of increasing fentanyl contamination in the local heroin supply.[16] Further research is needed to characterize trends in route of fentanyl and goofball consumption. Future surveys of PWUD which enroll people who have not injected drugs in the past 12 months would help further clarify associations between route of opioid consumption and overdose.

Because injection and non-injection use of heroin among PWID were consistently assessed in NHBS surveys across all six cycles, we were able to report trends in route of heroin consumption over a 17-year period. Between Cycle 3 in 2012 and Cycle 6 in 2022, the proportion of respondents who only injected heroin continually fell, while the proportions of respondents who consumed heroin through only non-injection and both injection and non-injection routes continually grew. This trend away from heroin injection was found to be significant in proportional odds logistic regression modelling, and the progressively smaller aORs from Cycles 4 to 6 suggest this trend became more pronounced over time (Table 2). Our findings are consistent with a cohort study of PWUD in San Deigo, California and Tijuana, Mexico in which injecting heroin declined by 14% between 2020 and 2023.[7] However, our analysis suggests the transition away from heroin injection in Washington State started well before 2020, potentially beginning a decade ago. Qualitative research in San Francisco, California has identified several motivations for the observed switch to opioid smoking, including ease of use, feelings of improved health, lower perceived risk of overdose, and less perceived stigma.[8,9] Syringe service programs in Seattle began distributing pipes designed to smoke heroin in 2019 to encourage participants to transition from injection to inhalational use.[17] Local heroin pipe distribution may have also contributed to the observed shift away from heroin injection.

Prevalence of overdose was lower among NHBS respondents who only smoked or snorted heroin compared to those who injected it. While little previous research has examined associations between route of heroin consumption and overdose risk, both laboratory pharmacokinetic data and analyses of toxicology reports from overdose deaths suggest heroin overdose may be more likely with injection than non-injection use.[10,11,13] Importantly, the prevalence of overdose was similar between NHBS respondents who only injected heroin and those who consumed heroin through both injection and non-injection routes (Table 3). This suggests any protection from overdose afforded by non-injection consumption may require complete cessation of heroin injection. The proportion of respondents in our sample who exclusively smoked or snorted heroin was small. Consequently, the confidence intervals on estimated aPRs were large, and the true magnitude of the association between route of heroin consumption and overdose prevalence remains unclear. If the proportion of NHBS respondents who exclusively consume heroin through non-injection routes continues to increase, more precise estimates might be derived from analysis of future NHBS cycles.

Compared to respondents who only smoked fentanyl, prevalence of overdose was 40% greater among those who used fentanyl through injection and non-injection routes, and 80% greater among those who only injected fentanyl; however, these aPRs were not statistically significant (Table 3). Data on fentanyl use were only collected in Cycle 6, limiting the analytical sample of people who used fentanyl to only 340 respondents, impacting the power of our models and precluding trend analyses. Interestingly, the magnitude of this association is similar to a 2023

cross-sectional survey of PWUD attending syringe service programs across California which found people who injected fentanyl were 40% more likely to experience a non-fatal overdose compared to people who only smoked fentanyl.[18] It is more common for PWUD to exclusively consume fentanyl through non-injection routes than other opioids, such as heroin. The NHBS requirement that respondents must have injected drugs at least once in the past 12 months likely excluded a substantial proportion of people who use fentanyl from this sample. Future studies that include PWUD regardless of injection drug use history may recruit samples that are more generalizable to the actual fentanyl using population, and thereby allow for more accurate estimates of associations between route of fentanyl consumption and overdose.

Our study has several limitations. The cross-sectional design only allows for the detection of associations between route of opioid consumption and overdose. While our regression models adjusted for potential confounders, we still cannot make conclusions about whether particular routes of consumption increase or decrease risk of overdose. Because NHBS surveys did not record the number of overdoses in the past 12 months, overdose was analyzed as a dichotomous outcome, which cannot account for potentially important associations with overdose frequency. Survey instruments also did not ask respondents to report which opioid they had consumed immediately prior to overdosing, information that could strengthen conclusions about associations between particular opioids and overdose risk. Moreover, drug use behaviors that bring about non-lethal overdose and lethal overdose may differ in substantial ways, and this analysis cannot make conclusions about associations with lethal overdose, a more important health outcome. NHBS questions about non-injection heroin use only asked respondents to report snorting and smoking. Therefore, behaviors of respondents who consume heroin intrarectally (i.e., bootybumping) or by ingestion would not have been accurately represented. Finally, given increasing fentanyl contamination in Seattle's heroin supply, respondents might not be able to accurately report whether and how they consumed these two opioids. Our finding that prevalence ratios differed substantially between Cycles 1-4 and Cycles 5-6 suggests the presence of fentanyl in heroin may have important implications for associations between overdose and route of opioid consumption.

Non-lethal overdose was common among NHBS respondents, with one-fifth of those who used heroin and one-third of those who used fentanyl having experienced an overdose in the past 12 months. Interventions to prevent overdose among PWUD are urgently needed. Our analysis found evidence that the switch from injecting to smoking heroin seen in other west coast locations is also occurring in the greater Seattle area, and this transition may have important implications for overdose risk. The lower prevalence of overdose among those who exclusively smoke heroin suggests route transition interventions that successfully encourage PWUD to replace injection with non-injection heroin use may prevent overdose. Further research is needed to better characterize the relationship between route of fentanyl consumption and overdose, which is vitally important as fentanyl continues to replace heroin and other opioids in the illicit drug supply.

	Overall, N = 2,943	**NHBS Cycle 1 (2005)**, N = 371	**NHBS Cycle 2 (2009)**, N = 296	**NHBS Cycle 3 (2012)**, N = 687	**NHBS Cycle 4 (2015)**, N = 534	**NHBS Cycle 5 (2018)**, N = 555	**NHBS Cycle 6 (2022)**, N = 500
Sociodemographic Characteristics							
Age[1]	43 (12)	43 (10)	42 (10)	43 (11)	41 (13)	42 (12)	47 (11)
Gender							
Men	1,904 (65%)	281 (76%)	198 (67%)	433 (63%)	342 (64%)	337 (61%)	313 (63%)
Women	1,021 (35%)	89 (24%)	97 (33%)	249 (36%)	191 (36%)	211 (38%)	184 (37%)
Transgender	18 (0.6%)	1 (0.3%)	1 (0.3%)	5 (0.7%)	1 (0.2%)	7 (1.3%)	3 (0.6%)
Race							
White	1,818 (63%)	224 (62%)	199 (68%)	428 (63%)	377 (71%)	307 (56%)	283 (57%)
Black	456 (16%)	70 (19%)	41 (14%)	119 (17%)	56 (11%)	77 (14%)	93 (19%)
Asian/Pacific Islander	44 (1.5%)	2 (0.6%)	1 (0.3%)	7 (1.0%)	7 (1.3%)	10 (1.8%)	17 (3.4%)
American Indian/Alaska Native	165 (5.7%)	13 (3.6%)	18 (6.2%)	38 (5.6%)	20 (3.8%)	44 (8.1%)	32 (6.5%)
Multiple Races	423 (15%)	53 (15%)	32 (11%)	90 (13%)	70 (13%)	107 (20%)	71 (14%)
Missing	*37*	*9*	*5*	*5*	*4*	*10*	*4*
Hispanic							
Not Hispanic	2,652 (90%)	334 (90%)	276 (94%)	623 (91%)	487 (91%)	486 (88%)	446 (89%)
Hispanic	288 (9.8%)	37 (10.0%)	18 (6.1%)	64 (9.3%)	47 (8.8%)	69 (12%)	53 (11%)
Missing	*3*	*0*	*2*	*0*	*0*	*0*	*1*
Current Housing Status							
Housed	1,397 (48%)	141 (38%)	160 (54%)	380 (55%)	223 (42%)	217 (39%)	276 (55%)
Unhoused	1,544 (52%)	230 (62%)	136 (46%)	307 (45%)	309 (58%)	338 (61%)	224 (45%)
Missing	*2*	*0*	*0*	*0*	*2*	*0*	*0*
Opioid Use in Past 12 Months							
Heroin							
No Heroin Use	268 (9.1%)	30 (8.1%)	28 (9.5%)	44 (6.4%)	52 (9.8%)	33 (5.9%)	81 (16%)
Any Heroin Use	2,670 (91%)	341 (92%)	267 (91%)	641 (94%)	480 (90%)	522 (94%)	419 (84%)

Missing	*5*	*0*	*1*	*2*	*2*	*0*	*0*
Prescription Opioids							
No Prescription Opioid Use	729 (46%)	N/A	N/A	N/A	229 (43%)	286 (52%)	214 (43%)
Any Prescription Opioid Use	857 (54%)	N/A	N/A	N/A	302 (57%)	269 (48%)	286 (57%)
Missing	*3*	N/A	N/A	N/A	*3*	*0*	*0*
Fentanyl							
No Fentanyl Use	N/A	N/A	N/A	N/A	N/A	N/A	135 (28%)
Any Fentanyl Use	N/A	N/A	N/A	N/A	N/A	N/A	341 (72%)
Missing	N/A	N/A	N/A	N/A	N/A	N/A	*24*
Goofball							
No Goofball Use	N/A	N/A	N/A	N/A	N/A	N/A	177 (36%)
Any Goofball Use	N/A	N/A	N/A	N/A	N/A	N/A	320 (64%)
Missing	N/A	N/A	N/A	N/A	N/A	N/A	*3*
Opioid Overdose in Past 12 Months							
No Overdose	2,316 (81%)	278 (84%)	253 (88%)	580 (85%)	419 (80%)	409 (74%)	377 (76%)
≥1 Overdose	560 (19%)	53 (16%)	33 (12%)	100 (15%)	108 (20%)	144 (26%)	122 (24%)
Missing	*67*	*40*	*10*	*7*	*7*	*2*	*1*

[1]Mean (SD); n (%)

National HIV Behavioral Surveillance (NHBS), People Who Inject Drugs (PWID)

Table 1: Sociodemographic Characteristics, Opioid Use in Past 12 Months, and Overdose in Past 12 Months among NHBS-PWID Survey Respondents in Seattle, WA across Six Cycles 2005 – 2022

	Overall[1]	NHBS Cycle 1 (2005)	NHBS Cycle 2 (2009)	NHBS Cycle 3 (2012)	NHBS Cycle 4 (2015)	NHBS Cycle 5 (2018)	NHBS Cycle 6 (2022)
Route of Consumption in Past 12 Months							
Heroin	N = 2,670	N = 341	N = 267	N = 641	N = 480	N = 522	N = 419
Non-injection Only	54 (2.0%)	3 (0.9%)	0 (0%)	4 (0.6%)	8 (1.7%)	10 (1.9%)	29 (6.9%)
Both Injection and Non-injection	1,161 (43%)	115 (34%)	79 (30%)	203 (32%)	230 (48%)	287 (55%)	247 (59%)
Injection Only	1,455 (55%)	223 (65%)	188 (70%)	434 (68%)	242 (50%)	225 (43%)	143 (34%)
OR, 95% CI[2]		Reference	1.27, 0.90 – 1.79	1.11, 0.84 – 1.46	**0.54, 0.41 – 0.72**	**0.41, 0.31 – 0.54**	**0.25, 0.19 – 0.34**
aOR, 95% CI[3]		Reference	1.21, 0.85 – 1.71	1.04, 0.79 – 1.38	**0.52, 0.39 – 0.69**	**0.40, 0.30 – 0.53**	**0.22, 0.16 – 0.30**
Prescription Opioids	N = 857				N = 302	N = 269	N = 286
Non-injection Only	398 (47%)	N/A	N/A	N/A	130 (43%)	123 (46%)	145 (51%)
Both Injection and Non-injection	345 (40%)	N/A	N/A	N/A	133 (44%)	97 (36%)	115 (40%)
Injection Only	114 (13%)	N/A	N/A	N/A	39 (13%)	49 (18%)	26 (9.1%)
OR, 95% CI[2]					Reference	1.03, 0.75 – 1.40	**0.73, 0.54 – 1.00**
aOR, 95% CI[3]					Reference	1.06, 0.77 – 1.46	0.79, 0.58 – 1.09
Fentanyl Route Past 12 Months							N = 341
Non-injection Only	N/A	N/A	N/A	N/A	N/A	N/A	121 (35%)
Both Injection and Non-injection	N/A	N/A	N/A	N/A	N/A	N/A	203 (60%)
Injection Only	N/A	N/A	N/A	N/A	N/A	N/A	17 (5.0%)
Goofball Route Past 12 Months							N = 320
Non-injection Only	N/A	N/A	N/A	N/A	N/A	N/A	63 (20%)

Both Injection and Non-injection	N/A	N/A	N/A	N/A	N/A	N/A	182 (57%)
Injection Only	N/A	N/A	N/A	N/A	N/A	N/A	75 (23%)

[1]For heroin calculated as the sums across all six NHBS cycles. For prescription opioids calculated as the sums across NHBS cycles 4-6.
[2]Odds ratios (OR) and associated 95% confidence intervals (CI) estimated using a proportional odds logistic regression model
[3]Adjusted odds ratios (aOR) and associated 95% confidence intervals (CI) estimated using a proportional odds logistic regression model adjusting for age, gender, race, and housing status
National HIV Behavioral Surveillance (NHBS) People Who Inject Drugs (PWID)

Table 2: Route of Consumption in Past 12 Months by Opioid among NHBS-PWID Survey Respondents in Seattle, WA across Six Cycles 2005 – 2022

	No Overdose in Past 12 Months	≥1 Overdose in Past 12 Months	PR, 95% CI[1]	aPR, 95% CI[2]
Route of Consumption in Past 12 Months				
Heroin[3]	N = 2,063	N = 546		
Non-injection Only	48 (92%)	4 (7.7%)	Reference	Reference
Both Injection and Non-injection	863 (76%)	276 (24%)	**3.15, 1.20 – 8.27**	**2.97, 1.13 – 7.78**
Injection Only	1,152 (81%)	266 (19%)	2.44, 0.93 – 6.41	2.46, 0.94 – 6.45
Prescription Opioids[4]	N = 619	N = 232		
Non-injection Only	301 (76%)	94 (24%)	Reference	Reference
Both Injection and Non-injection	243 (71%)	100 (29%)	1.23, 0.96 – 1.56	1.13, 0.88 – 1.45
Injection Only	75 (66%)	38 (34%)	**1.41, 1.03 – 1.94**	1.26, 0.91 – 1.74
Fentanyl[5]	N = 228	N = 112		
Non-injection Only	88 (73%)	32 (27%)	Reference	Reference
Both Injection and Non-injection	129 (64%)	74 (36%)	1.37, 0.96 – 1.94	1.41, 0.97 – 2.05
Injection Only	11 (65%)	6 (35%)	1.32, 0.63 – 2.79	1.80, 0.88 – 3.69
Goofball[5]	N = 224	N = 95		
Non-injection Only	49 (78%)	14 (22%)	Reference	Reference
Both Injection and Non-injection	121 (67%)	60 (33%)	1.49, 0.89 – 2.49	1.40, 0.83 – 2.34
Injection Only	54 (72%)	21 (28%)	1.26, 0.69 – 2.29	1.23, 0.67 – 2.25

[1]Prevalence ratios (PR) and associated 95% confidence intervals (CI) estimated using Poisson regression with robust standard errors

[2]Adjusted prevalence ratios (aPR) and associated 95% confidence intervals (CI) estimated using Poisson regression with robust standard errors adjusting for age, gender, race, housing status, years since first injection drug use, and use of other opioids beside the opioid under investigation in the past 12 months

[3]Data collected across all six cycles of the National HIV Behavioral Surveillance People Who Inject Drugs (NHBS-PWID) Survey 2005 – 2022

[4]Data collected from cycles 4-6 of the National HIV Behavioral Surveillance People Who Inject Drugs (NHBS-PWID) Survey 2015 - 2022

[5]Data collected from cycle 6 of the National HIV Behavioral Surveillance People Who Inject Drugs (NHBS-PWID) Survey 2022

Table 3: Associations between Overdose in the Past 12 Months and Route of Opioid Consumption in the Past 12 Months among NHBS-PWID Survey Respondents in Seattle, WA

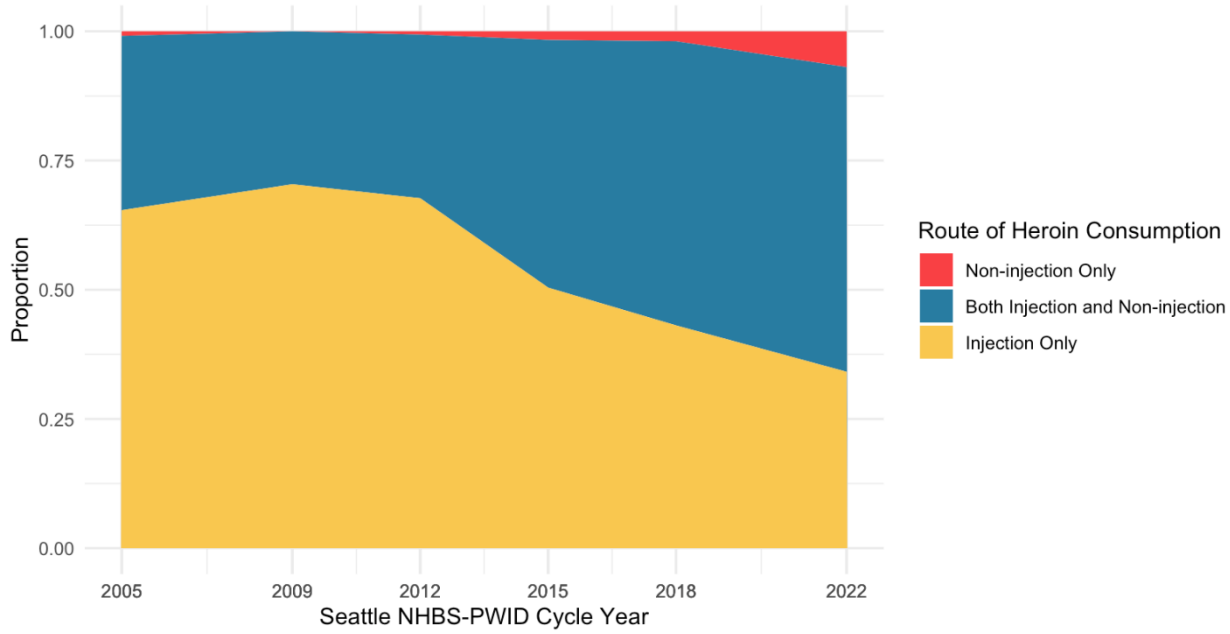
	NHBS Cycles 1-4 (2005 - 2015)				NHBS Cycles 5-6 (2018 - 2022)			
	No Overdose in Past 12 Months, N = 1,386	**≥1 Overdose in Past 12 Months**, N = 285	**PR, 95% CI**[1]	**aPR, 95% CI**[2]	**No Overdose in Past 12 Months**, N = 677	**≥1 Overdose in Past 12 Months**, N = 266	**PR, 95% CI**[1]	**aPR, 95% CI**[2]
Route of Heroin Consumption in Past 12 Months								
Non-injection Only	12 (86%)	2 (14%)	Reference	Reference	36 (95%)	2 (5.3%)	Reference	Reference
Both Injection and Non-injection	492 (81%)	115 (19%)	1.33, 0.33 – 5.33	1.24, 0.30 – 5.06	371 (70%)	161 (30%)	**5.75, 1.43 – 23.12**	**5.51, 1.36 – 22.34**
Injection Only	882 (84%)	168 (16%)	1.12, 0.28 – 4.49	1.08, 0.27 – 4.40	270 (73%)	98 (27%)	**5.06, 1.25 – 20.43**	**5.40, 1.32 – 21.98**

[1]Prevalence ratios (PR) and associated 95% confidence intervals (CI) estimated using Poisson regression with robust standard errors

[2]Adjusted prevalence ratios (aPR) and associated 95% confidence intervals (CI) estimated using Poisson regression with robust standard errors adjusting for age, gender, race, housing status, years since first injection drug use, and use of other opioids besides heroin in the past 12 months

National HIV Behavioral Surveillance (NHBS) People Who Inject Drugs (PWID)

Table 4: Association between Overdose in the Past 12 Months and Route of Heroin Consumption in the Past 12 Months among NHBS-PWID Survey Respondents in Seattle, WA Comparing NHBS Cycles 1-4 and Cycles 5-6



National HIV Behavioral Surveillance (NHBS), People Who Inject Drugs (PWID)

Figure 1: Proportional Stacked Area Chart of Route of Heroin Consumption in Past 12 Months among PWID-NHBS Survey Respondents in Seattle, WA across Six Cycles 2005 – 2022

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