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Transition from first illicit drug use to first injection drug use among rural Appalachian drug users: A cross-sectional comparison and retrospective survival analysis

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Abstract

Aim—The study's objectives were to characterize initiation of injection drug use, examine the independent association of specific substance use with injection drug use, and determine factors associated with rates of transition from first illicit drug use to first injection among a sample of rural Appalachian drug users.

Design—Interview-administered questionnaires were administered to a sample of drug users recruited via respondent-driven sampling.

Setting—Appalachian Kentucky

Participants—Injection drug users (IDUs) (n=394) and non-IDUs (n=109)

Measurements—Data were collected on substance use and years from age at initiation of illicit substance use to 'event' (initiation of injection or date of baseline interview for non-IDUs). Logistic regression and Cox regression were used to identify factors associated with lifetime injection drug use and transition time to injection, respectively.

Findings—OxyContin® was involved in nearly as many initiations to injection (48%) as were stimulants, other prescription opioids, and heroin combined; for participants who initiated with OxyContin®, the median time from which they began OxyContin® use to their first injection of OxyContin® was 3 years. Adjusting for demographics, five prescription drugs (benzodiazepines, illicit methadone, oxycodone, OxyContin® and other opiates) were associated with an increased hazard for transitioning from first illicit drug use to first injection drug use (each at p<.01).

Conclusions—In Appalachia, in the US, the prescription opioid, OxyContin®, is widely used nonmedically and appears to show a particularly high risk of rapid transition to injection compared with the use of other illicit drugs.

Introduction

National data indicate that 425,000 people 12 and older in the US injected drugs in the past year [1]. Injection drug use is a well-established risk factor for blood-borne infection [2-6], drug dependence [7-9], and overdose [10]. Injection drug users (IDUs) have an exceedingly high incidence of blood-borne infection in the first years of injecting [11-13]; in fact, up to

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90% of IDUs are infected with HCV within 5 years of initiating injection [14]. Individual-level factors associated with transitioning from non-injection to injection drug use include: unemployment [15], insecure income [16], homelessness [15, 17-19], exposure to violence [17, 20, 21], childhood abuse [17, 20, 21], transactional sex [17, 20, 21], deviant adolescent behavior [21-25], school dropout [16], early-onset substance abuse [21], and substance use [15, 17-19].

Drug users' social and environmental contexts, or "site ecology", also contribute to their risk for transitioning to injection drug use [19]. Peer support for or pressure to inject [15, 18, 26], and lower perceived social and geographic distance from other injectors [18, 27] are associated with initiating injection, as is exposure to other IDUs [18, 28], including friends [17], sex partners [15, 29], or family members [16]. Drug markets [30] and drug availability [27, 31, 32] influence drug users' likelihood of injection. Drug users may also be motivated to transition to injection by drug price [19, 26, 27], as non-injection routes are typically more expensive in terms of 'bang per buck' [31].

Despite the evidence that contextual factors strongly affect routes of administration, research on transition to injection has focused almost entirely within urban settings. However, research suggests that communities' profile of drug use may differ in rural settings [33-40], specifically routes of administration [33]. These differences may be due to unique economic, social, and structural characteristics [41], or differences in the types of drugs being used. Nonmedical prescription opioid use (NMPOU) has become particularly problematic in rural areas within the US [34, 38-40], perhaps most notably in Central Appalachia [42-45]. According to qualitative research, NMPOU has been well-established in Appalachia for decades, with roots tracing back to manual laborers' use of prescription opioids for pain management [46]. However, according to community members, nonmedical prescription drug use got "out of control" when OxyContin® was introduced to the market in 1995 [46], an observation that appears to be corroborated by governmental and scientific reports [43, 46, 47]. Recent evidence suggested that an alarming proportion of Appalachian drug users were injecting prescription opioids [33]. In fact, data from drug users in Appalachian Kentucky indicate that prescription opioid injection is four times more common than cocaine injection and thirteen times more common than heroin injection [48]. Herein lies a substantial difference between the rural, drug-using population of Central Appalachia and the predominately urban, heroin- and cocaine-injecting populations involved in previous studies of IDUs.

Despite the growing problem of NMPOU [49], its role in transition to injection has been understudied. Previous studies have specifically cited the need to achieve a better understanding of the factors involved with initiation of injection as well as the speed at which the transition occurs [19, 31, 50]. Therefore, the purpose of this study was three-fold; (1) to determine which substances were most frequently involved in IDUs' initiation to injection, (2) to evaluate the independent association of specific substances with lifetime history of injection and non-injection drug use, and (3) to determine factors associated with faster rates of transition from first illicit drug use to first injection among a sample of rural Appalachian drug users.

Methods

Data are from the ongoing Social Networks among Appalachian People (SNAP) study. The overall goal of the SNAP study is to examine risk factors for HIV, HCV, and HSV-2 in the context of drug users' social networks. A storefront location in a rural Appalachian town of approximately 5000 residents was used for participant recruitment and interviews. Participants were recruited using respondent-driven sampling (RDS), which is often the

most appropriate sampling technique for hidden populations such as drug users [51, 52], and has been used in similar research [53]. Eligibility criteria included being at least 18 years of age, residing in Appalachian Kentucky, and having used at least one of the following to get high in the past 30 days: prescription opioids, heroin, crack/cocaine or methamphetamine. An interviewer-administered questionnaire was utilized to determine self-reported behaviors. Data collection occurred between November 2008 and August 2010. Among individuals screened for eligibility (N=939), 79% (n=742) were eligible and 506 completed the baseline interview. Of those who were eligible but did not participate, the majority were either inaccessible due to incarceration or inpatient treatment, or were not scheduled before the study's baseline recruitment goal of 500 participants was reached. Three additional individuals reported discrepant substance use information on the eligibility screener and baseline interview and were excluded, leaving a final sample size of 503. Participants were compensated \$50 for their time. The Institutional Review Board at the University of Kentucky approved the protocol.

Interviewers queried participants about their lifetime use and age at first use of the following substances to get high: OxyContin® and other oxycodone formulations (e.g. Percocet®, Roxicodone®, Roxicet®), heroin, other opiates (e.g. hydrocodone, Lorcet®, Lortab®, Suboxone®, Tylox®, morphine), methadone, benzodiazepines (e.g. Klonopin®, Xanax®, Valium®), barbiturates, cocaine, crack, methamphetamine, amphetamine, hallucinogens, inhalants, and marijuana. For opiates and benzodiazepines, participants gave drug names and correct classifications were confirmed before analysis. Data were also collected on age at first injection, arrest, and incarceration (in jail, prison, or juvenile lock-up). Using age at time of initiation for each substance and date of birth, the chronological year of initiation for each substance was determined. Similarly, age at first injection, arrest, and incarceration was referenced against date of birth to determine the chronological year of each event. The chronological years for each were compared to the year of first injection to determine which events preceded injection initiation. Data were also collected on the drug used at first injection and on participants' demographic, psychosocial, criminal, and behavioral characteristics.

Analysis

Correlates of lifetime injection drug use were chosen for analysis *a priori* based on the extant literature. Independent samples t-tests, Mann-Whitney U-tests, and chi-square tests were used to examine the correlates of lifetime injection drug use. Multivariable logistic regression was used to examine the independent association of lifetime use of each illicit drug with history of injection drug use. Kaplan-Meier analysis was used to examine the rate of transition for specific drugs from first use of the substance involved with initiation of injection to time of first injection.

The second outcome of interest was time (years), hereafter referred to as 'transition time', from initiation of any illicit drug use to time at first injection. Non-IDUs (n=109) were right-censored at the date of their baseline interview. Seven participants initiating injection in the same year they initiated illicit drug use were excluded from analysis.

To maximize ability to make inferences about temporality, only characteristics which could have realistically and definitively preceded initiation of injection were assessed. Demographic variables included age, gender, race, and education. Time-dependent variables, established *a priori*, included: experiencing first arrest, first incarceration, as well as initiation of each of the aforementioned illicit drugs during the period from initiation of illicit drug use to censorship or initiation of injection. Participants who experienced the time-dependent event of interest in the same year that they initiated illicit drug use and/or

injection or censorship were excluded from the corresponding analysis, as the temporality of events could not be determined (sample sizes for each analysis are denoted in Table 4).

The proportional hazards assumption was evaluated for the demographic variables by examining the Kaplan-Meier log-log survival curves for non-parallelism. Each of the demographic variables violated the assumption, and were entered as time-dependent in subsequent analyses [54]. Variables representing initiation of substance use were time-dependent by definition. Thus, extended Cox regression was used to model transition to injection [54].

Finally, to analyze the factors associated with rate of transition from first illicit drug use to first injection, crude hazard ratios (CHRs) and 95% confidence intervals (CI) for each variable were examined. Adjusted hazard ratios (AHRs) and 95% CIs, controlling for gender, education, race, and age are also reported. Of note, the hazard ratios (HRs) of time-dependent variables in extended Cox regression cannot be interpreted as would time-independent variables; they do not represent a comparison of individuals who experienced the event of interest (e.g. first arrest, first incarceration, etc) to those who did not [55]. Alternatively, the HRs should be interpreted as follows: At any Time_{*i*}, the hazard for a person who has experienced the event is approximately [HR] times the hazard for a person who has not yet experienced the event, adjusting for covariates (where applicable) [55]. Analyses were conducted using SAS version 9.2 using PROC PHREG.

Results

Table 1 displays the descriptive characteristics of the sample. The mean age of participants was 32.5 years (range: 18 – 65 years). The majority (94%) of participants were non-Hispanic white, 57% were male, and 57% had completed high school. The majority had been arrested (65%) and incarcerated (60%) prior to injection initiation. IDUs (n=394) were no different than non-IDUs (NIDUs) (n=109) in terms of age, gender, race, education, employment, homelessness, or history of trauma. IDUs had significantly higher income, and were significantly more likely to report a history of arrest, incarceration, and sex with other IDUs.

Table 2 describes the substances with which injectors most commonly initiated injection. Of the 394 IDUs, 48% initiated injection with OxyContin®, 30% with stimulants (four with methamphetamine and 117 with cocaine), and approximately 14% initiated with other prescription opioids. As shown in Figure 1, most (85%) IDUs began injecting after 1995 (the year OxyContin® entered the market). Figure 2 shows Kaplan-Meier curves representing survival time from the first use of the substance involved with initiation of injection to time of first injection for OxyContin®, other prescription opioids, and stimulants. The fastest initiation rates were observed for participants who initiated injection with OxyContin® (Mdn: 3.0 years, IQR: 1.0 - 6.0), followed by stimulants (Mdn: 4.5 years, IQR: 1.8 - 8.3) and other prescription opioids (Mdn: 7.0 years, IQR: 3.0 - 10.0).

Correlates of lifetime injection drug use

Table 3 displays crude and adjusted associations of injection drug use with lifetime substance use. Adjusting for the use of all other substances, independent associations were observed between injection drug use and lifetime use of stimulants, illicit methadone, OxyContin®, and heroin. There was no association between injection drug use and other prescription opioid use in general. When Lorcet®, Lortab®, morphine, Vicodin®, Tylox®, hydrocodone, and Suboxone® were examined independently, only morphine use was associated with injection drug use. With the exception of morphine and illicit methadone, OxyContin® was the only prescription drug associated with lifetime injection. Adjusting for

use of all other substances, including all other prescription opioids, participants who had ever used OxyContin® and stimulants were over 6.5 times more likely to have a history of injection than those who had never used the substances (OR: 6.7, 95% CI: 2.6 – 17.1 and OR: 6.6, 95% CI: 1.9 – 23.6, respectively). Participants who had ever used heroin and illicit methadone were four times more likely to have engaged in injection drug use (OR: 4.6, 95% CI: 2.45-8.67 and OR: 4.2; 95% CI: 1.6 – 10.9, respectively).

Time from initiation of illicit drug use to first injection

The median time from which IDUs transitioned from first illicit drug use to first injection was 10 years (IQR: 6.0 - 15.0; Range: 0 - 39). Of the eight specific substances associated with transitioning to injection (excluding poly-drug use) in the extended Cox regression models (Table 4), five were prescription drugs. During the time from first illicit drug use to first injection, the hazard for an individual who initiated use of benzodiazepines, illicit methadone, and other opiates was over two times the hazard for a person who had not yet initiated use of those substances, adjusting for race, age, gender, and education. The hazard for an individual who had initiated OxyContin® use was two times the hazard for a person who had not yet initiated OxyContin® use, adjusting for covariates (AHR: 1.97, 95% CI: 1.50-2.60). Initiation of other oxycodone-containing substances (e.g. Percocet®, Roxicodone®, Roxicet®) was also associated with a increased hazard for transitioning to injection (AHR: 1.70, 95% CI: 1.27-2.27), as was cocaine, crack, and poly-substance use.

Discussion

In this sample of rural Appalachian drug users, 78% had a lifetime history of injection drug use. The most notable finding from this study is the frequency with which OxyContin® was involved with the initiation of injection. OxyContin® was involved in nearly as many initiations to injection (48.2%) as were stimulants, other prescription opioids, and heroin combined (49.7%). In fact, after adjusting for lifetime use of all other substances, lifetime use of OxyContin® was associated with 6.7 times higher odds of having a history of injection drug use. While similar to the multivariate association observed between stimulants and history of injection, the strength of the association between OxyContin® use and lifetime injection drug use was substantially higher than that observed for heroin and illicit methadone. When other specific trade-name prescription drugs were examined, none were associated with injection. When hydrocodone and morphine were examined, only morphine was found to be associated with lifetime injection. The median time from which injectors transitioned from first illicit drug use to first injection was 10 years; however, considerable variability was observed across participants, largely according to the type of substance involved in the initiation. For participants initiating injection with OxyContin®, the median time from which they began OxyContin® use to their first injection of OxyContin® was only three years.

Given that the abuse liability for OxyContin® is similar to that of other prescription opioids in human laboratory studies [56, 57], there are clearly a multiplicity of other factors contributing to the association between OxyContin® use and the rapidity of injection initiation. These influences may include OxyContin®'s availability, cost, and ease of preparation for injection. Previous reports have cited OxyContin® use as being especially prevalent in the Appalachian region [43, 46, 47]. Though the cross-sectional design of the present study limits our ability to make inferences regarding time-trends and causality, the findings regarding year of initiation of injection seem to corroborate qualitative reports that suggests that NMPOU reached epidemic levels after the introduction of OxyContin® [46]. Over 80% of injectors in the present study initiated injection drug use after 1995, the year OxyContin® was approved by the FDA [58]. It should be noted, however, that NMPOU has deep historical, social, and economic roots in Appalachia and was problematic decades

before the introduction of OxyContin® [46]. The high cost of OxyContin® may be also be contributing to its association with injection. A combination of economic disadvantage and OxyContin®'s street price, which is up to \$100 per pill in many rural areas [59], may lead users to transition from non-injection to injection to get more 'bang for their buck'. The relative ease of preparing OxyContin® for injection may also contribute to initiation of injection. In qualitative research, some drug users reported that, compared to other oxycodone-containing drugs, OxyContin® is much easier to break down, filter, and inject [60]. The recent development of an abuse-deterrent formulation (ADF) of OxyContin® may resolve this issue. In August, 2010 an ADF OxyContin® was released and the non-ADF version was pulled from the market. The ADF OxyContin® is extremely hard so that if a user attempts to crush the medication for injection, the pills break into large segments that decrease amenability to injection. Nevertheless, given the consistency and strength of OxyContin®'s association with initiation of injection and the rapidity of transition to injection, continued monitoring of OxyContin®'s association with injection is warranted.

The rapidity with which drug users progress to injection drug use merits special attention, given that most research to date has examined whether or not drug users transition to injection rather than the speed at which the transition occurs [16, 61]. Studies examining intra-substance transition times from non-injection to injection have almost exclusively focused on heroin use in urban samples [7, 16, 18, 26, 62]. These studies have shown that transition times can vary substantially between individuals, with some continuing non-injection for ten years while others transition to injection in less than 12 months [61, 63]. Attempts to differentiate drug users who transition quickly from those who do not have concluded that a number of demographic, social, and ecological factors contribute. In this study, many of the previously established correlates to injection drug use (e.g. homelessness, unemployment, adolescent delinquency, and history of trauma) were not associated with history of injection, while others such as criminality and sex with an IDU were. The high rate of criminality in this sample provides some indication that there is a heavy police presence in the community. This has implications for intervention given that extant literature suggests that police presence can have substantial effects on IDUs' ability to engage in harm reduction [64, 65]. Likewise, the association of injection drug use with having sex with other IDUs is troubling given evidence of a strong dyadic influence of injection behavior on HCV infection [66].

In this study, of the eight specific substances associated with an increased hazard for transitioning to injection, five were prescription drugs (benzodiazepines, illicit methadone, oxycodone, OxyContin®, and other prescription opiates). Presently, research on the role that NMPDU plays on initiation of injection is limited, especially in regard to prescription opioids. To date, only one study has examined the speed at which transitions occur from non-injection to injection with prescription opioids [53]. In this study of predominately urban-dwelling opioid users, Grau and colleagues (2007) found that the speed with which drug users progressed to injection drug use and/or heroin use was associated with early polyopioid use rather than with one particular opioid. The authors concluded that polyopioid use may serve as a "gateway" behavior that places individuals at higher risk for a quicker transition to heroin and/or injection drug use [53]. It is unclear as to how collinearity and/or time-dependence of variables were addressed, but in the present study, collinearity among time-dependent variables precluded our ability to examine substances for their independent associations in the extended Cox regression. Nevertheless, the findings are consistent with the general conclusion by Grau and colleagues (2007) that a complex interaction of substance misuse contributes to transition to injection.

The dearth of research on prescription opioid injection may render a gap in understanding that could impede the development of effective interventions [19, 31, 50]. In a review of

'route transition interventions' primarily aimed at heroin and cocaine injectors, Hunt and colleagues (1999) suggest two strategies for preventing injection initiation among NIDUs. First, the influence of IDUs on NIDUs should be reduced by encouraging IDUs to avoid injecting in the presence of NIDUs, and to avoid initiating others to injection [50]. The latter would be an especially important strategy in the current sample, in which 25% of IDUs have introduced someone to injection drug use. The authors of the review also suggest that NIDUs most at risk for initiating injection be identified and prioritized for intervention efforts [50]. This point underscores the importance of the current study, as no other study has attempted to characterize 'at risk' NIDUs who are rural-dwelling and who predominately abuse prescription opioids. Our findings suggest that nonmedical OxyContin® use may be an especially important identifier for at-risk NIDUs in this population.

Though the current study offers important insights for intervention, it is not without limitations. The cross-sectional design precluded inferences to be drawn regarding causality and temporality. However, the rate of transition analyses only utilized variables for which the independent variable definitively preceded onset of injection, thus strengthening the inferences that can be made. Data are self-reported and are subject to issues of recall and social desirability bias, though it should be noted that self-reported drug use has been shown to be a valid measure of actual drug use [69]. Also, the findings from this study may not be generalizable to all Appalachian prescription opioid users. Further, while the use of RDS oftentimes increases the generalizability of findings, the seeds used to recruit the sample were not randomly selected and the data did not employ RDS weights. Finally, the data did not support a thorough examination of a number of social and ecological factors that have been identified by previous research to be associated with injection drug use. While some data were collected from IDUs on their experience of social pressure to inject, corresponding data were not collected from NIDUs, and could not be included in analyses. Similarly, data were not collected on local characteristics of the drug market. Much more research is needed on these and other socio-ecological factors' influence on transition to injection.

Despite limitations, this study provides important insight into the nature of injection drug use in an under-studied population of rural Appalachian drug users. Most striking was the specific involvement of OxyContin® in lifetime injection, initiation of injection and the rapidity of transition to injection. Therefore, targeting non-injection OxyContin® users when developing interventions may be one way in which to prevent transition from non-injection to injection drug use and subsequent public health harms associated with injection.

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Figure 1.
Injection drug users' (n=394) year of initiating injection drug use

Figure 2.
Time from first use to first injection drug use for specific substance

Table 1

Descriptive characteristics of sample (n=503)

Characteristic	Overall n (%)	IDU (n=394) n (%)	Non-IDU (n=109) n (%)	χ^2	p-value
<i>Demographic</i>					
Male	286 (56.9)	231 (58.6)	55 (50.5)	2.32	.127
Mean age in years (SD)	32.5 (8.6)	32.7 (8.4)	32.2 (9.3)	0.51 ¹	.610
Completed high school	284 (56.5)	223 (56.6)	61 (56.0)	0.01	.906
White (non-Hispanic)	474 (94.2)	370 (93.9)	104 (95.4)	0.36	.551
Unemployed (past 30 days)	288 (57.3)	231 (58.6)	57 (52.3)	1.40	.237
Median income in past 30 days (IQR) ²	\$677 (300 – 1200)	\$700 (305 – 1300)	\$600 (200 – 1073)	2.22 ³	.027
Homeless in past 3 years	25 (5.0)	22 (5.6)	3 (2.8)	1.45	.229
<i>Criminality and delinquency</i>					
Arrested before age 18	100 (19.9)	78 (19.8)	22 (20.2)	0.01	.929
Delinquent behavior ⁴ before age 15	269 (53.5)	218 (55.3)	51 (46.8)	2.50	.114
Ever arrested	440 (87.5)	358 (90.9)	82 (75.2)	19.05	<.001
Ever incarcerated	402 (79.9)	332 (84.3)	70 (64.2)	21.38	<.001
<i>Other</i>					
Ever experienced trauma ⁵	254 (50.5)	199 (50.5)	55 (50.5)	0.00	.993
History of sex with IDU(s)	282 (56.1)	259 (65.7)	23 (21.1)	69.06	<.001

SD: standard deviation; IDU: Injection Drug User, IQR: interquartile range

¹ t-statistic² Includes income from all legal and illegal sources³ z-statistic from Mann Whitney U test⁴ Defined as skipping school, running away, repeatedly lying or stealing, fighting, destroying material goods, hurting animals or people, or committing sexual assault⁵ Defined as having experienced or witnessed or had to deal with an extremely traumatic event that included actual or threatened death or serious injury to self or someone else. Examples embedded in the interview include serious accidents, sexual or physical assault, terrorist attack, being held hostage, kidnapping, discovering a body, sudden death of someone close to you, war, or natural disaster.

Table 2

First substance administered by injection among injection drug users (n=394)

	n (%)
OxyContin®	190 (48.2)
Stimulants (e.g. methamphetamine, cocaine)	121 (30.7)
Other prescription opioids ¹	56 (14.2)
Heroin	19 (4.8)
Sedatives	1 (0.3)
Speedball (e.g. heroin and cocaine)	2 (0.5)
Other ²	5 (1.3)

¹ Examples embedded in the interview include hydrocodone, oxycodone, morphine, Dilaudid®, and methadone

² e.g. aspirin (n=1), cat tranquilizer (n=1), combination of OxyContin® and cocaine (n=1), unsure (n=1), and IR-30 (n=1)

Table 3

Illicit drug use and lifetime injection drug use (N=503)

Covariate	IDU (n=394) n(%)	NIDU (n=109) n(%)	χ^2	p-value	COR (95% CI)	AOR ¹ (95% CI)
Sedatives ^{2#}	383 (97.2)	99 (90.8)	8.69	.003	3.5 (1.5 - 8.5)	2.0 (0.7 - 6.2)
Klonopin®	258 (65.5)	68 (62.4)	0.36	.549	1.14 (0.74 - 1.78)	0.97 (0.59 - 1.61)
Xanax®	371 (94.2)	94 (86.2)	7.68	.006	2.57 (1.29 - 5.13)	2.00 (0.88 - 4.54)
Valium®	243 (61.7)	64 (58.7)	0.31	.575	1.13 (0.74 - 1.74)	0.86 (0.53 - 1.42)
Stimulants ^{3#}	390 (99.0)	98 (89.9)	24.31	<.001	10.9 (3.4 - 35.1)	6.6 (1.9 - 23.6)*
Illicit methadone [#]	382 (97.0)	94 (86.2)	19.30	<.001	5.1 (2.3 - 11.2)	4.2 (1.6 - 10.9)*
Other opiates ^{2#}	383 (97.2)	104 (95.4)	0.89	.345	1.7 (0.6 - 4.9)	1.4 (0.4 - 4.9)
Lorcet®	248 (62.9)	74 (67.9)	0.91	.341	0.80 (0.51 - 1.26)	0.93 (0.57 - 1.53)
Lortab®	93 (23.6)	27 (24.8)	0.06	.800	0.94 (0.57 - 1.54)	1.22 (0.70 - 2.12)
Morphine	97 (24.6)	11 (10.1)	10.69	.001	2.91 (1.50 - 5.65)	2.14 (1.08 - 4.27)*
Vicodin®	83 (21.1)	19 (17.4)	0.70	.404	1.26 (0.73 - 2.19)	1.38 (0.76 - 2.51)
Tylox®	67 (17.0)	21 (19.3)	0.30	.582	0.86 (0.50 - 1.48)	1.00 (0.55 - 1.84)
Hydrocodone	60 (15.2)	21 (19.3)	1.03	.310	0.75 (0.43 - 1.30)	0.56 (0.31 - 1.03)
Suboxone®	56 (14.2)	16 (14.7)	0.02	.902	0.96 (0.53 - 1.76)	0.80 (0.42 - 1.54)
Oxycodone ^{5#}	389 (98.7)	106 (97.2)	1.20	.273	2.2 (0.5 - 9.4)	0.6 (0.1 - 3.2)
OxyContin® [#]	385 (97.7)	92 (84.4)	30.87	<.001	7.9 (3.4 - 18.3)	6.7 (2.6 - 17.1)*
Heroin [#]	162 (41.1)	14 (12.8)	30.00	<.001	4.7 (2.6 - 8.6)	4.6 (2.5 - 8.7)*

IDU: injection drug user; NIDU: non-injection drug user; COR: Crude Odds Ratio; AOR: Adjusted Odds Ratio; CI: Confidence Interval

**<.001

* p<.01

[#] Covariates included in multivariate models

¹ Odds ratio adjusted for all other variables marked with [#] in first column

² Xanax®, Klonopin®, and Valium® were the most frequently given examples, though some participants listed Ativan® (n=39), Librium® (n=16), and others

³ Includes crack, cocaine, oral amphetamines, and/or methamphetamine

⁴ Lorcet®, Lortab®, morphine, Vicodin®, Tylox®, hydrocodone, and Suboxone® were the most frequently given examples, though some listed Fentanyl® (n=37), Dilaudid® (n=34), and MS Contin® (n=28), and others

⁵ Examples embedded in the interview include Percocet®, Roxicet®, Roxicodone®

Table 4

Factors associated with transitioning from non-injection illicit drug use to injection drug use

Covariate ¹	Crude HR (95% CI)	Adjusted HR (95% CI) ²
First Arrest (n=449)	1.99 (1.55-2.55)*	1.70 (1.31-2.21)*
First Incarceration (n=452)	1.83 (1.45-2.32)*	1.56 (1.22-2.00)*
Substance initiation		
Amphetamines (n=477)	0.98 (0.75-1.28)	0.88 (0.67-1.15)
Barbiturates (n=497)	0.85 (0.60-1.20)	1.08 (0.75-1.55)
Sedatives ³ (n=419)	3.09 (2.20-4.32)*	2.53 (1.80-3.57)*
Cocaine (n=433)	3.05 (2.25-4.13)*	2.49 (1.82-3.40)*
Crack (n=458)	2.62 (2.08-3.30)*	2.05 (1.61-2.61)*
Hallucinogen (n=465)	0.89 (0.71-1.11)	0.95 (0.75-1.20)
Heroin (n=474)	1.81 (1.34-2.44)*	1.60 (1.17-2.19)
Illicit methadone (n=435)	3.24 (2.56-4.10)*	2.33 (1.78-3.05)*
Inhalant (n=439)	1.10 (0.84-1.45)	1.13 (0.85-1.50)
Marijuana (n=97)	1.87 (0.96-3.66)	1.45 (0.71-2.98)
Methamphetamine (n=482)	1.49 (1.14-1.93)	0.96 (0.73-1.28)
Opiates ⁴ (n=410)	2.78 (2.06-3.76)*	2.10 (1.54-2.88)*
Oxycodone ⁵ (n=411)	2.38 (1.82-3.12)*	1.70 (1.27-2.27)*
OxyContin® (n=433)	2.87 (2.26-3.63)*	1.97 (1.50-2.60)*
Polydrug use (n=432)	2.89 (2.15-3.89)*	2.11 (1.55-2.88)*
Composite substance initiation		
Opioids (n=459)	2.03 (1.61-2.55)*	1.95 (1.54-2.48)*
Stimulants (n=429)	4.01 (2.81-5.72)*	3.34 (2.32-4.81)*
Sedatives (n=418)	3.00 (2.13-4.24)*	2.49 (1.75-3.54)*

HR: Hazard Ratio; CI: Confidence Interval

* p<.01 after Bonferroni adjustment for multiple comparisons

¹ To maximize ability to make inferences about temporality, only characteristics which could definitively occurred during the period from initiation of illicit drug use to initiation of IDU or censorship were assessed as explanatory variables. Therefore, participants' who experienced their first arrest, incarceration, or initiation of the listed substances in the same year that they initiated illicit drug use and/or IDU or censorship were excluded from the corresponding analysis, as the temporality of events of interest could not be determined. The sample size for each regression model is given in parentheses.

² Hazard ratios adjusted for race, age, gender, and education

³ Examples of substances reported by participants include Percocet®, Roxicet®, Roxicodone®

⁴ Examples of substances reported by participants include Klonopin®, Xanax®, Valium®

⁵ Examples embedded in the interview include hydrocodone, Lorcet®, Lortab®, Suboxone®, Tylox®, Dilaudid®