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Individual and Network Factors Associated with Non-fatal Overdose among Rural Appalachian Drug Users

Jennifer R. Havens^{1,2,*}, Carrie B. Oser^{1,3}, Hannah K. Knudsen^{1,2}, Michelle Lofwall^{1,2,4}, William W. Stoops^{1,2}, Sharon L. Walsh^{1,2}, Carl G. Leukefeld^{1,2}, and Alex H. Kral⁵

¹Center on Drug and Alcohol Research, University of Kentucky College of Medicine, Lexington, Kentucky, 40504, United States

²Department of Behavioral Science, University of Kentucky College of Medicine, Lexington, Kentucky, 40506, United States

³Department of Sociology, University of Kentucky College of Arts and Sciences, Lexington, Kentucky, 40506, United States

⁴Department of Psychiatry, University of Kentucky College of Medicine, Lexington, Kentucky, 40509, United States

⁵Urban Health Program, RTI International, San Francisco, California, 94104, United States

Abstract

Background—Fatal overdoses involving prescription opioids have increased significantly in recent years in the United States – especially in rural areas. However, there are scant data about non-fatal overdose among rural drug users. The purpose of this study is to examine the prevalence and correlates of non-fatal overdose and witnessed overdose among rural Appalachian drug users.

Methods—Rural drug users were participants in a longitudinal study of social networks and HIV transmission. An interviewer-administered questionnaire elicited information in the following domains: sociodemographic characteristics, drug use (including lifetime overdose and witnessed overdose), psychiatric disorders, HIV risk behaviors and social networks (support, drug and sex networks). Negative binomial regression was used to model the number of lifetime overdoses and witnessed overdoses.

Results—Of the 400 participants, 28% had ever experienced a non-fatal overdose, while 58.2% had ever witnessed an overdose (fatal or non-fatal). Factors independently associated with a greater number of overdoses included having ever been in drug treatment, past 30-day injection of prescription opioids, meeting the criteria for post-traumatic stress disorder and/or antisocial personality disorder and having more members in one's support network.

Conclusions—Rural drug users with history of overdose were more likely to have injected with prescription opioids – which is different from urban heroin users. However, the remaining correlates of non-fatal overdose among this cohort of rural drug users were similar to those of

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*To whom correspondence should be addressed: Jennifer R. Havens, PhD, MPH Assistant Professor Center on Drug and Alcohol Research University of Kentucky College of Medicine 333 Waller Avenue, Suite 480 Lexington, KY 40504 (p) 859-323-6553 (f) 859-257-9070 Jennifer.havens@uky.edu.

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urban heroin users, which suggests current overdose prevention strategies employed in urban settings may be effective in preventing fatal overdose in this population.

Keywords

non-fatal overdose; witnessed overdose; rural; prescription drug use; social networks

1. Introduction

Overdose is amongst the leading cause of death among drug users worldwide (Degenhardt et al., 2006) and the second leading cause of accidental death in the United States (U.S.) (Kung et al., 2008). While the number of heroin overdoses in recent years has remained similar or even decreased over time, there are growing public health concerns about overdoses involving prescription opioids. Fatal overdoses involving prescription opioids now outnumber those from heroin and cocaine combined in the U.S. and are associated with the marked rise in prescriptions for opioid pain relievers (Paulozzi & Xi 2008). This is especially pronounced in rural areas of the United States, where the fatal overdose rate for prescription opioids increased an astonishing 371% compared to a 50% increase in urban areas (Paulozzi & Xi 2008). Non-fatal opioid-related overdoses are also prevalent. Heroin users have reported lifetime non-fatal overdose rates ranging from 29% to 68% (Darke & Zador 1996; Pollini et al., 2006a; Seal et al., 2001; Sherman et al., 2007) and among a nationwide sample of treated prescription opioid users, the prevalence of non-fatal overdose was 37.5% for men and 38.8% for women (Green et al., 2009). While not all illicit opioid users have experienced a non-fatal overdose, the majority indicate that they have witnessed an overdose in their lifetime. For example, among injection drug users (IDUs) in Baltimore, more than two-thirds reported witnessing an overdose (Pollini et al., 2006b).

To date, there has been limited study of individual and network factors associated with lifetime overdose in rural populations, which have been disproportionately affected by overdoses involving prescription opioids (Paulozzi & Xi 2008). Understanding factors associated with non-fatal overdose are important as they could be used to help inform development of interventions aimed at decreasing risk of repeated overdoses and preventing overdose fatalities in rural areas. Thus, the purpose of the current study is to determine the individual and network-related factors associated with lifetime non-fatal overdose and witnessed overdose among community-based rural prescription opioid users in Kentucky. Kentucky is consistently ranked among the top five states in the prevalence of community prescription drug misuse by the National Survey on Drug Use and Health (Hughes et al., 2008) and high prevalence rates have also been observed within community-based studies conducted in rural Appalachian Kentucky (Havens et al., 2007a; Havens et al., 2007b; Havens et al., 2007c).

2. Methods

2.1 Study Population

We analyzed baseline data from participants enrolled in a longitudinal study of social networks and HIV risk among rural Appalachian drug users (Social Networks among Appalachian People – SNAP). Eligibility criteria included being at least 18 years of age, residing in an Appalachian county in Kentucky, and had used at least one of the following drugs to get high in the previous 30 days: prescription opioids, cocaine, heroin or methamphetamine. The majority of those screened (96.6%) indicated they had used prescription opioids to get high in their lifetime followed by cocaine (87%), methamphetamine (40%), and heroin (29.3%). Those consenting to participate in the SNAP

study were compensated \$50 for their time. The study was approved by the Institutional Review Board (IRB) at the University of Kentucky.

2.2 Sampling

Respondent driven sampling (RDS) was utilized to recruit the SNAP cohort. Developed with a network framework in mind, RDS is a relatively new technique that is useful when recruiting drug users that often remain hidden/unsampled within standard sampling frame techniques (Frost et al., 2006; Heckathorn 1997; Heckathorn 2002; Wang et al., 2007). While used extensively to recruit IDUs and other potentially hidden populations in urban areas (Abdul-Quader et al., 2006; Des et al., 2007; Wang et al., 2005), until recently, use of RDS had not been described in rural populations. In a 2007 study by Wang and colleagues, however, they report that RDS was successfully employed to recruit a sample of rural stimulant users in rural Ohio (Wang et al., 2007).

Because the study focuses on determining risk factors for HIV and other infectious complications of drug use, flyers specifically seeking IDUs were posted publically to recruit the seeds (i.e., the first participants recruited to the study who will then be used to recruit additional participants). Seeds were asked to participate if they had injected in the prior six months and met all other eligibility criteria. Once the seeds were interviewed, they were free to sample their drug-using peers regardless of injection status. Each participant was given three coupons and instructed to give them to their peers. If those who came into the study from a coupon were deemed eligible and subsequently interviewed, they were given three coupons and so on. For each coupon that was redeemed, the original participant was compensated \$10. A total of 30 seeds were necessary to recruit the sample of 400 analyzed here.

2.2 Measures

Data from the current study were gathered from the baseline questionnaire which was administered via a trained interviewer using Computer Assisted Personal Interviewing (CAPI) software (Questionnaire Development System [QDS], Nova Research Company, Bethesda, MD). Measures included sociodemographics, recent (past 30-day) nonmedical use of the following substances: alcohol, heroin, illicit methadone, OxyContin®, other oxycodone products, hydrocodone products, benzodiazepines, methamphetamine, cocaine, and marijuana. To measure lifetime overdose and witnessed overdose, participants were asked “Have you ever overdosed?” and “Have you ever witnessed an overdose?” If either of the questions were answered “yes”, the participant was asked how many times they personally experienced a non-fatal overdose or witnessed either a fatal or non-fatal overdose.

The MINI International Neuropsychiatric Interview, version 5.0 (Sheehan et al., 1998) was used to measure the following psychiatric disorders: major depressive disorder (MDD), generalized anxiety disorder (GAD), panic disorder (PD), post-traumatic stress disorder (PTSD) and antisocial personality disorder (ASPD).

Finally, to ascertain the characteristics of the participants' support, drug and sex networks, subjects were asked to provide the first name and last initial of individuals with whom they: 1) were dependent on for social support (e.g., someone they could talk to, someone they ate meals with on a regular basis, someone who could provide advice on health issues, etc.); 2) consumed drugs with; and 3) had sex with in the past 6 months. The sociodemographic characteristics for each named network member were also ascertained in order to help validate the linkages. Individuals could span multiple networks. For the current analysis, two levels of variables were considered: egocentric and sociometric. The individual-level

network variables, or egocentric variables, included: number of network members named in either the support, drug or sex network, overall network density, and the number of ties that network members had to and from other network members. Sociometric variables were calculated for the drug network only and included measures of indegree and outdegree centrality, which is essentially the number of verified linkages that the participant reports and that others report, respectively. The greater the degree of centrality, the more central one is to any given network. Before calculating sociometric variables, all network linkages were verified using data gathered as part of the baseline interview, screening process or via study staff. Only verified linkages were included in the drug matrix.

2.3 Statistical Analyses

The two primary outcomes of interest for this study were number of non-fatal overdoses and number of witnessed overdoses. Both of these variables had a count distribution and a large number of zero values, therefore zero-inflated negative binomial regression (ZINB) models were utilized. However, in conducting the goodness-of-fit tests (vuong) for each of these models, it was discovered that the ZINB models were no different from standard negative binomial models. Therefore, for ease of interpretation, negative binomial regression was used for all analyses. First, unadjusted negative binomial regression models were constructed for each independent variable to test for their association with the number of lifetime overdoses and the number of lifetime witnessed overdoses. Those variables significant at the $p < 0.05$ level in the unadjusted models were considered for inclusion in the two multivariable models. We also had two levels of variables – individual and network-level. Therefore, hierarchical negative binomial regression modeling was used (*nestreg: nbreg* in STATA) such that the individual-level characteristics were entered into the first block of the model and the network-related factors were entered into the second block of the model.

It may also have been appropriate to model overdose using multilevel random effects regression to examine the association of network factors (in which individuals are nested within networks) and overdose. However, results from the variance component model using overdose as the level one variable and membership in network components as the second level revealed that neither the number of overdoses nor witnessed overdoses differed across network components. Finally, to determine whether necessary to adjust for clustering, the Breusch-Pagan test for heteroskedasticity was conducted to determine homogeneity of variance of the residuals. Because no evidence of heteroskedasticity was found, no adjustments were made for clustering. STATA, version 11.0 was used for all analyses (College Station, TX).

3. Results

Of the 400 study participants, the majority were male (58.7%), white (93.7%) and the median age was 31 (interquartile range [IQR]: 26, 38)(Table 1). The lifetime prevalence of non-fatal overdose and witnessed overdose was 28% and 58.2%, respectively. The median number of overdoses among those who reported a history of non-fatal overdose was 1.5 (IQR: 1, 3) and the median number of witnessed overdoses was 2 (IQR: 1, 3).

Several individual-level factors were found to be significantly associated with an increasing number of non-fatal overdoses in unadjusted negative binomial regression models (Table 2). Male gender, ever having been in drug treatment and past 30 day use of heroin and/or cocaine were statistically associated with lifetime non-fatal overdose ($p < 0.05$). Recent use of hydrocodone, however, was associated with lesser odds of lifetime non-fatal overdose. Injection-related factors, including recent injection, greater number of years injecting and injection of prescription opioids as well as non-prescription drugs (heroin, cocaine and/or

methamphetamine) were also significantly greater among those reporting overdose. Two psychiatric diagnoses, post-traumatic stress disorder (PTSD) and antisocial personality disorder (ASPD), were more commonly observed among those with a lifetime history of 1 or more overdoses. For network factors, having more persons in one's support network was significantly associated with a greater number of non-fatal overdoses.

In unadjusted negative binomial models, the number of witnessed overdoses was correlated with meeting the DSM-IV criteria for PTSD, and recent use of heroin, illicit methadone, other oxycodone, hydrocodone, methamphetamine and marijuana. Injection related factors included current injection and additional years of injecting. Network factors were strongly associated with witnessed overdose, as those with a greater number of members in their support, drug and sex networks were significantly more likely to have witnessed 1 or more overdoses. Additionally, greater outdegree centrality (i.e., the number of drug network members mentioning the participant) was correlated with a higher number of witnessed overdoses.

Results from the hierarchical multivariable negative binomial regression model indicated that ever having been in drug treatment (incidence rate ratio [IRR]: 1.58, 95% confidence interval [CI]: 1.00, 2.51), past 30-day injection with prescription opioids (IRR: 1.58, 95% CI: 1.0, 2.49), and meeting criteria for post-traumatic stress disorder (PTSD) (IRR: 2.71, 95% CI: 1.52, 4.86) were all independently associated with a greater number of non-fatal overdoses, adjusting for social network characteristics and the other individual-level factors. Having more members in one's support network was also independently associated with an increasing number of non-fatal overdoses, adjusting for the other variables in the model.

In the first block of the negative binomial model, an increased number of witnessed overdoses was independently associated with recent methamphetamine use (IRR: 6.09, 95% CI: 2.29, 16.2), PTSD and increasing age. In block 2, a greater number of members in one's support network as well as outdegree centrality were strongly associated with witnessed overdose (IRR 1.34, 95% CI: 1.16, 1.56), indicating those participants witnessing overdoses were more likely to be more central to the drug network than those witnessing fewer or no overdoses. Fit statistics for the hierarchical model examining the number of witnessed overdoses indicate that network factors were highly associated with the outcome, even after adjusting for the individual-level factors.

4. Discussion

To our knowledge this is the first study that describes non-fatal and witnessed overdose among a community sample of rural drug users – a population that decedent data suggests may be at high risk for fatal overdose (Hall et al., 2008; Paulozzi & Xi 2008). Results from this study indicate that the lifetime prevalence of non-fatal overdose in this population of predominantly prescription opioid users is similar to that of urban populations of illicit heroin and cocaine users (Fairbairn et al., 2008; Latkin et al., 2004; Pollini et al., 2006b). However, differing correlates of non-fatal overdose emerged that are more closely aligned with this rural population in which drug users are primarily injected prescription opioids not designed for parenteral use. Thus, the finding that recent injection with prescription opioids was independently associated with a greater number of non-fatal overdoses merely reiterates the problematic nature of prescription opioid abuse in rural Appalachia.

Results from this study also indicate that ever having been in substance abuse treatment was a correlate of non-fatal overdose(s). Data from previous reports showed that having been in such treatment is indeed a risk factor for overdose because tolerance levels may have changed while abstaining from drug use during treatment (Darke & Hall 2003; Wines, Jr. et

al., 2007). This may have been a contributing factor with the present population because residential treatment, where it is more likely that the participant was abstinent for a more substantial length of time, was the most prevalent treatment modality. It may also be, however, that those who overdosed were then referred to treatment. Given the cross-sectional study design, this association cannot be explored further. And while methadone maintenance treatment (MMT) has been shown to be protective against overdose as opposed to a risk factor (Clausen et al., 2008; Milloy et al., 2008), that was not found in this study. However, use of MMT is not nearly as prevalent in this cohort of rural drug users as only 12% of the drug users in the SNAP study had ever been enrolled in a methadone program. With only four private programs serving 54 rural Appalachian counties, methadone is not a widely employed therapeutic option for the majority of opioid users in this region, even though the majority of these rural drug users are using prescription opioids to get high and may benefit from MMT.

Meeting the DSM-IV criteria for post-traumatic stress disorder (PTSD) was also independently associated with a greater number of lifetime overdoses. This is expected in that the presence of axis I symptomatology such as depression and anxiety is often a correlate of overdose (Latkin et al., 2004; Maloney et al., 2009) and that benzodiazepines are often prescribed for anxiety. Concomitant use of benzodiazepines and opioids are implicated more often than opioids alone in fatal overdose (Fairbairn et al., 2008; Galea et al., 2006), and benzodiazepine use in combination with other drugs has been shown in longitudinal studies to be among the primary risk factors for both fatal and non-fatal overdose (Dietze et al., 2005; Gossop et al., 2002). However, the prevalence of lifetime benzodiazepine use in this study is exceedingly high at 95%, and does not, in and of itself, increase the odds of overdose in this particular population given there is not much variability in the prevalence of use between those who did and did not have a history of overdose.

Few studies have reported on the association between ASPD and overdose. However, in this study, those with a history of ASPD were significantly more likely to have a greater number of overdoses than those without ASPD, even after adjusting for other drug, psychiatric and network-related factors. These findings are in accord with those found among treatment-seeking heroin users in Australia. Darke and colleagues (2004) reported that among those with a diagnosis of ASPD, the odds of having a recent and lifetime history of opioid overdose was significantly greater than those who did not meet the criteria for ASPD. Findings from several studies indicate that drug users with ASPD are more likely to engage in risky behaviors (Brooner et al., 1990; Brooner et al., 1993; Compton et al., 1995), but not overdose specifically.

The finding that the odds of overdose increased by 19% for each additional support network member reported appears to be counterintuitive. Support networks have often been found to be associated with a reduction in drug-related behaviors that would put one at risk for overdose such as use of heroin and/or cocaine (Williams & Latkin 2007) or injection drug use (Costenbader et al., 2006). However, in a study by Latkin and colleagues (2004) they found a greater mean number of support network members among those who had a history of overdose versus those who did not. In our study, this may be at least be partially explained by the high proportion of drug users within the participants' support network, as participants were also using drugs with more than 65% of the support network members they named.

When examining the number of lifetime witnessed overdoses, two interesting variables emerged as significant factors. First, recent methamphetamine use was associated with a greater number of witnessed overdoses. Use of methamphetamine is positively correlated with observing overdose behaviors (Fairbairn et al., 2008; Ochoa et al., 2005); however,

fewer than half of the participants had used methamphetamine in their lifetime. Second, outdegree centrality, or the number of people within the drug network component with whom the participant reported using drugs, was significantly associated with observing a greater number of lifetime overdoses. This finding is intuitive as the greater number of people with whom one uses drugs would be related to increasing opportunity to witness an overdose. Perhaps the most interesting finding with regard to the witnessed overdose model was that, based on the fit statistics of the model, the measured network characteristics appeared to have more influence on the number of witnessed overdoses than individual behaviors.

4.1 Limitations

There are several limitations that warrant attention when considering the results of this study. First, for the primary outcome measure, lifetime overdose, it is difficult to discern whether the factors found to be associated with overdose actually preceded the event. Specifically, data on the timing and types of drugs present during the non-fatal overdose event(s) was not available for the current analysis. Therefore, we cannot infer causality from the results. However, the findings do suggest pathways to overdose that should be explored in further detail in this population of rural drug users. Second, the majority of the data is based on self-report of drug users, which may affect the validity of the findings. That being said, several studies have found that self-reported drug use is a valid measure of actual drug use in drug using populations (Darke 1998; Kokkevi et al., 1997). Furthermore, there were no adverse repercussions for participants reporting illicit drug use in this study in contrast to those being treated for substance use or those in the criminal justice setting. Thus, we would expect that the majority of self-reported behaviors would be representative of actual behaviors. We also did not measure intentions with regard to overdose at baseline. Recent data has come to light suggesting differential risk factors for intentional versus unintentional overdose (Bohnert et al., 2010). Fortunately, we will be able to explore this in future analyses as the follow-up questionnaires for this study include questions on intent. Finally, the data may also be subject to recall bias, especially for the primary outcome variable, non-fatal overdose, which is a lifetime measure. However, it is highly unlikely that a participant would be unable to recall a potentially traumatic event such as a non-fatal overdose.

4.2 Conclusions

In conclusion, results from this study add key data to the literature on rural prescription drug users as it was the first to examine the correlates of non-fatal overdose and witnessed overdose among rural drug users who may be at increased risk for non-fatal or even fatal overdose. In addition, this study is also among the first, if not the first, to examine social network factors as they relate to overdose in a rural drug-using population. While some of the findings point to the fact that some of the correlates of non-fatal overdose may be unique to this population (i.e., injection of prescription opioids), others are similar to urban populations (i.e., treatment history and anxiety disorders). This is encouraging, given that it may mean that interventions such as naloxone training and distribution programs that have been shown to be effective in preventing overdose death in urban populations (Green et al., 2008) may also be effective for rural populations of prescription drug users. In addition to potential community interventions, longitudinal evaluation and prevention strategies of overdose risk factors should be aggressively pursued in this underserved rural area to prevent continuation of the current public health epidemic of overdose fatalities.

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Table 1

Drug Use and Psychosocial Characteristics of Rural Drug Users by Overdose Status (N=400)

	1 or More ODs n=112		No OD n=288		Witness 1 or More OD n=233		Not Witness 1 or more OD n=167	
	n	%	n	%	n	%	n	%
Male Gender	68	60.7	167	58.0	148	63.5	87	52.1
Age, median (interquartile range [IQR])	33 (31, 35)		30.5 (30, 31)		31 (30, 32)		31 (30, 33)	
White	100	89.3	275	95.5	215	92.3	160	95.8
Education, median (IQR)	12 (11, 12)		12 (12, 12)		12 (12, 12)		12 (11, 12)	
Ever in Drug Treatment	72	64.3	148	51.4	140	60.1	80	47.9
Injection Drug Use (IDU)								
Current (past 30 days)	61	54.5	134	46.5	115	49.4	80	47.9
Lifetime	89	79.5	219	76.0	183	78.5	125	74.8
Years injecting, median (IQR)	7 (6, 10)		5 (4, 6)		5 (4, 7)		5 (4, 7)	
Lifetime Injection non-Rx Drugs	73	65.2	151	52.4	133	57.1	91	54.5
Lifetime Injection Rx Opioids	81	72.3	194	67.4	165	70.8	110	65.9
DSM-IV Disorders								
Major Depressive Disorder (MDD)	34	30.4	65	22.6	58	24.9	41	24.5
Generalized Anxiety Disorder (GAD)	43	38.4	70	24.3	65	27.9	48	28.7
Post-traumatic Stress Disorder (PTSD)	23	20.5	33	11.5	39	16.7	17	10.2
Antisocial Personality Disorder (ASPD)	45	40.2	81	28.1	87	37.3	39	23.3
Recent (Past 30 Day) Substance Use								
Alcohol	75	67.0	141	49.0	138	29.2	78	46.7
Heroin	7	6.2	13	4.5	17	7.3	3	1.8
Illicit Methadone	71	63.4	172	59.7	147	63.1	96	57.5
OxyContin	74	66.1	199	69.1	163	70.0	110	65.9
Other oxycodone	80	71.4	199	69.1	171	73.4	108	64.7
Hydrocodone	98	87.5	227	79.1	201	86.3	124	74.7
Benzodiazepines	95	84.8	241	83.7	195	93.7	141	84.4
Cocaine	37	33.0	59	20.5	57	24.5	39	23.3
Methamphetamine	5	4.5	6	2.1	8	3.4	3	1.8
Marijuana	81	72.3	167	58.0	160	68.7	88	52.7
Egocentric Social Network Factors								

	1 or More ODs n=112		No OD n=288		Witness 1 or More OD n=233		Not Witness 1 or more OD n=167	
	n	%	n	%	n	%	n	%
# Support Members, median (IQR)	2	(1.25, 3)	2	(1, 3)	2	(1.5, 3)	2	(1, 3)
# Drug Members, median (IQR)	4	(3, 9)	4	(2, 9)	5	(3, 9)	3	(2, 7.5)
# Sex Members, median (IQR)	2	(1, 5.75)	2	(1, 4)	2	(1, 5.5)	2	(1, 4)
Drug Network Ties, mean (SE)	1.53	(0.29)	1.75	(0.23)	1.73	(0.26)	1.64	(0.27)
Drug Network Density, mean (SE)	0.10	(0.01)	0.10	(0.01)	0.08	(0.10)		
Sociometric Social Network Factors								
In-degree Centrality, mean (SE)	1.41	(0.14)	1.52	(0.10)	1.55	(0.12)	1.41	(0.11)
Out-degree Centrality, mean (SE)	1.57	(0.12)	1.46	(0.08)	1.63	(0.09)	0.129	(0.09)

Table 2

Unadjusted Associations with Number of Non-fatal ODs/Witnessed ODs among Rural Drug Users

	Non-fatal Overdose		Witnessed Overdose	
	Incidence Rate Ratio	95% CI	Incidence Rate Ratio	95% CI
Male Gender	1.72	1.06 – 2.81	1.33	0.92 – 1.91
Age (per year)	1.01	0.97 – 1.04	1.03	0.99 – 1.05
White	0.72	0.28 – 1.86	1.00	0.48 – 2.12
Education (per year)	0.97	0.85 – 1.09	0.98	0.90 – 1.07
Ever in Drug Treatment	2.08	1.29 – 3.36	1.33	0.93 – 1.92
Injection Drug Use (IDU)				
Current (past 30 days)	1.82	1.14 – 2.91	1.45	1.01 – 2.07
Lifetime	1.77	0.98 – 3.18	0.84	0.55 – 1.29
Years Injecting (per year)	1.07	1.02 – 1.11	1.05	1.02 – 1.09
Lifetime IDU non-Rx drugs*	1.97	1.22 – 3.18	1.16	0.81 – 1.67
Lifetime IDU Rx Opioids	1.73	1.03 – 2.92	1.04	0.71 – 1.54
DSM-IV Disorders				
MDD	1.09	0.63 – 1.88	0.91	0.60 – 1.38
GAD	1.40	0.83 – 2.35	0.98	0.66 – 1.46
PTSD	3.66	2.02 – 6.62	2.09	1.26 – 3.45
ASPD	2.43	1.51 – 3.93	1.46	0.99 – 2.14
Recent Substance Use				
Alcohol	1.19	0.74 – 1.93	1.25	0.87 – 1.79
Heroin	5.53	2.22 – 13.7	2.49	1.12 – 5.52
Illicit Methadone	0.69	0.43 – 1.12	1.45	1.00 – 2.10
OxyContin	1.32	0.79 – 2.21	0.89	0.60 – 1.31
Other Oxycodone	0.61	0.37 – 1.00	1.89	1.28 – 2.82
Hydrocodone	0.54	0.30 – 0.97	1.63	1.02 – 2.62
Benzodiazepines	1.40	0.72 – 2.72	0.81	0.49 – 1.31
Cocaine	2.31	1.38 – 3.89	1.31	0.85 – 1.98
Methamphetamine	1.15	0.28 – 4.81	4.39	1.55 – 12.4
Marijuana	1.61	0.99 – 2.65	1.56	1.08 – 2.27
Egocentric Network Factors				
# Support Members	1.33	1.12 – 1.57	1.18	1.01 – 1.37
# Drug Members	1.04	0.98 – 1.10	1.04	1.00 – 1.08
# Sex Members	1.00	0.94 – 1.05	1.04	1.00 – 1.08
Drug Ties	0.94	0.87 – 1.01	1.00	0.96 – 1.06
Drug Network Density	1.02	0.99 – 1.05	1.02	0.99 – 1.04
Sociometric Network Factors				
Outdegree Centrality	1.02	0.94 – 1.25	1.46	1.25 – 1.72
Indegree Centrality	0.96	0.82 – 1.13	1.04	0.92 – 1.17

Table 3

Nested Negative Binomial Models Examining Factors Independently Associated with Number of Non-fatal Overdose and Number of Witnessed Overdoses

	Non-Fatal ODs		Witnessed ODs	
	Adjusted Incidence Rate Ratio	95% CI	Adjusted Incidence Rate Ratio	95% CI
Block 1 - Individual Factors				
Ever in Drug Treatment	1.58	1.00 – 2.51		
Recent Injection Rx Opioids	1.58	1.01 – 2.49		
Post Traumatic Stress Disorder	2.71	1.52 – 4.86	1.79	1.10 – 2.91
Antisocial Personality Disorder	1.69	1.06 – 2.69		
Recent Methamphetamine Use			6.09	2.29 – 16.2
Age			1.02	1.00 – 1.05
<i>Block 1 Model Statistics</i>	X ² =34.5***		X ² =24.6***	
	Pseudo R ² =0.044		Pseudo R ² =0.050	
Block 2 - Network Factors				
# Support Network Members	1.19	1.01 – 1.40	1.23	1.06 – 1.44
Outdegree Centrality			1.34	1.16 – 1.56
<i>Block 2 Model Statistics</i>	X ² =4.40*		X ² =25.9***	
	Pseudo R ² =0.018		Pseudo R ² =0.036	

*
p<0.05

**
p<0.01

p<0.001