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Personal Social Network Factors Associated with Overdose Prevention Training Participation

Karla D. Wagner¹, Ellen Iverson², Carolyn F. Wong³, Jennifer Jackson-Bloom², Miles McNeeley⁴, Peter J. Davidson¹, Christopher McCarty⁵, Alex H. Kral⁶, and Stephen E. Lankenau⁷

Karla D. Wagner: kdwagner@ucsd.edu; Ellen Iverson: eiverson@chla.usc.edu; Carolyn F. Wong: cawong@chla.usc.edu; Jennifer Jackson-Bloom: jejackson@chla.usc.edu; Miles McNeeley: mmcneeley@chla.usc.edu; Peter J. Davidson: pdavidson@ucsd.edu; Christopher McCarty: chrism@bebr.ufl.edu; Alex H. Kral: akral@rti.org; Stephen E. Lankenau: sel59@drexel.edu

¹Division of Global Public Health, Department of Medicine, University of California San Diego; 9500 Gilman Drive MC 0507, San Diego, CA 92093-0507

²Division of Adolescent Medicine, Children's Hospital Los Angeles, Keck School of Medicine, University of Southern California; 4650 Sunset Blvd., MS 2, Los Angeles, CA 90027

³Community, Health Outcomes and Intervention Research Program, The Saban Research Institute, Children's Hospital Los Angeles; 4650 Sunset Blvd., MS 30, Los Angeles, CA 90027 and Department of Pediatrics, Children's Hospital Los Angeles and Keck School of Medicine, University of Southern California

⁴Community, Health Outcomes and Intervention Research Program, The Saban Research Institute, Children's Hospital Los Angeles; 4650 Sunset Blvd., MS 30, Los Angeles, CA 90027

⁵Bureau of Economic and Business Research; Health Services Research, Management and Policy; University of Florida; PO Box 117145, Gainesville, FL 32611-7145

⁶Urban Health Program, RTI International, San Francisco Regional Office; 114 Sansome St., Suite 500; San Francisco, CA 94104 and Department of Family and Community Medicine, University of California San Francisco

⁷Department of Community Health and Prevention, Drexel University School of Public Health; 1505 Race Street, Bellet Building, Philadelphia, PA 19102-1192

Abstract

We investigated social network factors associated with participation in overdose prevention training among injection drug users (IDUs). From 2008-2010, 106 IDUs who had witnessed an overdose in the past year from two syringe exchange programs in Los Angeles provided data on: overdose prevention training status (trained vs. untrained), social networks, history of overdose, and demographics. In multivariate logistic regression, naming at least one network member who had been trained in overdose prevention was significantly associated with being trained (Adjusted Odds Ratio 3.25, 95% Confidence Interval 1.09, 9.68). Using social network approaches may help increase training participation. Limitations are noted.

Keywords

overdose; opioids; social networks; injection drug use; naloxone

Correspondence to: Karla D. Wagner, kdwagner@ucsd.edu.

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1. Introduction

Social network factors are an important source of influence on health behavior, including drug use and HIV risk (Latkin, Kuramoto, Davey-Rothwell, & Tobin, 2009; Latkin et al., 1995; Rothenberg et al., 1998). Both the norms transmitted through social connections (Davey-Rothwell & Latkin, 2007) and the structure and composition of networks (Costenbader, Astone, & Latkin, 2006; Rothenberg et al., 1998) have been found to influence HIV risk among injection drug users (IDUs). Social networks have also been found to be a promising avenue for disseminating interventions. Peer-based interventions that capitalize on social networks as an avenue to disseminate information and change social norms have been effective in reducing risk behaviors associated with blood-borne virus transmission among IDUs (Heckathorn, Broadhead, Anthony, & Weakliem, 1999; Latkin, Mandell, Vlahov, Oziemkowska, & Celentano, 1996). More recently, social network researchers have turned their attention to another health risk among drug users: drug overdose. Similar to findings from HIV research, social network factors can influence overdose risks. Latkin and colleagues (2004) found that having more IDUs in one's social network and having more network members with whom one has conflict were associated with recent overdose. In a longitudinal study Tobin and colleagues (2007) found that a measure of network structure – reporting increased connectedness among drug using network members (i.e., density; in this case, measured by asking which network members are friends with each other) – conferred a protective effect against non-fatal overdose.

The focus on drug overdose is significant because unintentional overdose is a leading cause of mortality among IDUs (Sporer, 1999) and is the second most common cause of accidental death in the United States (Paulozzi, 2008). Though national attention has increasingly focused on the prescription opioid use epidemic and its related morbidity and mortality, heroin overdose mortality rates have remained relatively stable (Coben et al., 2010). Worldwide, research suggests that between one quarter and over half of community-based samples of IDUs have ever experienced a non-fatal overdose (Bradvik, Hulenvik, Frank, Medvedeo, & Berglund, 2007; Latkin et al., 2004; Philbin et al., 2008; Pollini, McCall, Mehta, Vlahov, & Strathdee, 2006; Seal et al., 2001; Sergeev, Karpets, Sarang, & Tikhonov, 2003; Sherman, Cheng, & Kral, 2007).

An increasingly common intervention to reduce the high prevalence of opioid overdose among IDUs is the provision of overdose prevention training programs that train IDUs to prevent, recognize, and effectively respond to opioid overdoses in community settings (Baca & Grant, 2005; Bennett, Bell, Tomedi, Hulsey, & Kral, 2011; Enteen et al., 2010; Strang, 1999; Strang, Best, Man, Noble, & Gossop, 2000; Strang et al., 2008). These programs are generally accompanied by the distribution of naloxone, an opioid antagonist that specifically reverses the respiratory depression associated with opioid overdose and prevents death, with few side effects or negative consequences (Sporer & Kral, 2007). These programs have been shown to increase knowledge about naloxone and overdose (Green, Heimer, & Grau, 2008; Wagner et al., 2010) and improve behavioral responses to witnessed overdoses (Galea et al., 2006; Seal et al., 2005; Tobin, Sherman, Beilenson, Welsh, & Latkin, 2008; Wagner et al., 2010).

Though overdose prevention training programs are increasingly available, particularly in urban settings, not all IDUs access these programs. Little is known about the characteristics of IDUs who do or do not to participate in overdose prevention programs. Since social networks have been shown to be effective means of disseminating health information (Heckathorn et al., 1999; Valente, 1995) and have been found to be associated with risk for

overdose, the current study sought to understand whether social network factors are also associated with participation in overdose training programs.

2. Methods

2.1 Setting

This analysis draws data from a larger study designed to evaluate the effects of overdose prevention training programs offered by two community-based syringe exchange programs (SEPs) in Los Angeles: Homeless Health Care Los Angeles (HHCLA) and Common Ground Westside (CGW). HHCLA and CGW have provided overdose prevention training since 2006 and 2008, respectively. Briefly, the overdose prevention trainings at both sites included instruction on how to prevent overdose, how to recognize the symptoms of an overdose, and appropriate overdose response techniques including rescue breathing, calling 911, and administering naloxone. Trainings include both a didactic instructional component and a hands-on component, in which participants are encouraged to practice the response skills that they learn. Both programs prescribed naloxone and provided 2-3 doses of naloxone free of charge to training participants who successfully completed the program. HHCLA operates its program out of a storefront in the Skid Row area of downtown Los Angeles, which attracted a higher proportion of homeless individuals. CGW runs its program from two sites located on the West side of Los Angeles: an office in Santa Monica and an outdoor site in Inglewood. The HHCLA and CGW-Inglewood sites attracted a higher proportion of African Americans and Latinos.

2.2 Recruitment and Eligibility

Recruitment occurred between December 2008 and March 2010. We used convenience sampling at the HHCLA and CGW SEP sites to sample both *trained* individuals, who had received overdose prevention training from either program, and *untrained* individuals, who had never received training from HHCLA, CGW, or any other organization. Recruitment was conducted by the study interviewer, who approached potential participants in the waiting areas of the two programs and asked them if they would be interested in determining if they qualify for a research study being conducted by Children's Hospital. If an individual responded affirmatively, the interviewer assessed eligibility using a brief screening survey. Eligibility criteria for both *trained* and *untrained* participants included: aged 18 years, self-reported injection drug use in the past 30 days, and having witnessed an overdose in the past 12 months (in order to meet the aims of the larger study, which was investigating, among other things, overdose response behavior among trained and untrained participants). Three hundred and seventeen screeners were conducted; some individuals were screened more than once. Of those, 56 (18%) were ineligible because they had never witnessed an overdose, while 122 (38%) were ineligible because they had not witnessed an overdose within the past 12 months. All study procedures were approved by the Institutional Review Board at Children's Hospital Los Angeles.

2.3 Data Collection

The interviews were conducted using an instrument containing both closed-ended questions that generated quantitative data, and open-ended questions that generated qualitative data. The instrument was programmed with Techneos Entryware 6.3 (Techneos Systems Inc., 2009) and administered by an interviewer on a laptop computer while simultaneously being recorded with a digital recorder. This analysis was conducted using data from the quantitative social network module, which did not contain any open-ended questions. Interviews were conducted in private settings, such as an office, or semi-private settings, such as coffee shops or park benches. Following each interview, participants received \$25

cash remuneration and were provided with referrals for services (including the overdose prevention training program, if they were untrained).

2.4 Measures

2.4.1 Dependent Variable—The dependent variable for this analysis was a single indicator of whether the respondent had participated in an overdose training program at either HHCLA or CGW. We determined training status during the screening interview by asking potential respondents whether they had participated in the training program. We verified participants' responses by checking the records of training participants kept by each program.

2.4.2. Independent Variables—The final section of the interview included a social network module that used two "name generator" questions to elicit up to five network members (due to the space limitations conferred by including this measure in a larger survey instrument, we limited the number of members that each participant could name). We asked participants to list the names and/or initials of "people who are typically around when you inject drugs, whether they inject with you or not", and "people who are typically around when you use drugs in any way, whether they use with you or not." These name generators were chosen in order to identify members of the respondent's network that are most likely to be present in the event that he/she overdoses.

Next, we asked participants a series of standard "name interpreter" questions, which are typically included in personal network studies, and are designed to elicit basic demographic and behavioral information about each network member (Friedman, Neaigus, Jose, Curtis, & Des Jarlais, 1998). These included questions about each person's demographics, relationship to the respondent, and drug use behavior. Informed by Diffusion of Innovation Theory (Rogers, 1995) and empirical research that describes the diffusion of social norms through social connections and their ultimate influence on behavior (Latkin, Forman, Knowlton, & Sherman, 2003; Latkin et al., 2009), we also asked the respondent whether the contacts had participated in an overdose prevention training, and whether they have naloxone. A series of questions asked whether the network member provides various types of support (emotional, informational, material, and overdose-related). Closeness was determined by asking, "how close do you feel to this person a scale of 1-10" and influence was determined by asking "how much influence does this person have in your life" also on a scale of 1-10. Finally, we asked which of the network members know each other.

Using these items, we calculated a series of network composition variables to represent characteristics of each respondent's personal network, using established methods for egocentric network analysis (Valente, 2010). For example, we calculated the median age of network members, as well as the proportion of network members who have participated in an overdose prevention training program. Network size represents the average number of network members reported, and by design has a maximum value of 5. Network density is a measure of connectedness of the network (Valente, 2010) and was calculated by determining the number of connections between members reported by the respondent, divided by the total number of possible connections. Higher density indicates more connectedness – a density score of 1 indicates that all named network members know each other, a density score of 0 indicates that none knows each other.

2.5 Analysis

A total of 106 participants (30 trained and 76 untrained) were recruited. Of those, 73 (23 trained, 50 untrained) were recruited from HHCLA, and 33 (7 trained, 26 untrained) were recruited from CGW. First, we calculated descriptive statistics including proportions, and

measures of central tendency and dispersion for all variables of interest. Then we calculated bivariate statistics including chi-square and Wilcoxon Rank Sum tests to assess factors significantly associated with whether the participants had received overdose prevention training. Logistic regression was used to determine factors independently associated with participating in the overdose prevention training. Variables significant at $p < 0.10$ in bivariate analysis were considered for inclusion in the multivariate regression model. Data from the two sites were combined for this analysis, and a single variable was included in regressions to control for differences in recruitment site. After adjusting for recruitment site, those variables achieving statistical significance at $p < 0.05$ were retained in the final model. All analyses were conducted in Stata 11.2 (StataCorp, 2009).

3. Results

Of the 106 respondents, 30 (28%) had ever participated in an overdose prevention training program (i.e., “trained” respondents). Respondents named a median of five drug use network members (also the maximum as constrained by study design; Table 1); a total of 438 network members were named. Five individuals named zero network members. Of those, 3 were trained and 2 were untrained (Figure). Because they reported no network members, those 5 individuals were excluded from the remainder of the analyses.

In terms of demographics, the remaining 101 trained and untrained respondents were similar in age (41 vs. 45 years old, respectively, $p = 0.32$), ethnicity (44% vs. 41% White, respectively, $p = 0.24$), and gender (59% vs. 77% male, respectively, $p = 0.08$). About half of each group reported being single, and 60% identified as being homeless in the past 30 days. Self-reported HCV-positive status was 52% among the trained and 54% among the untrained respondents ($p = 0.84$). Only 2 respondents reported being HIV positive.

In terms of overdose experience, the trained and untrained groups did not differ statistically in terms of whether they had ever overdosed themselves (85% vs. 69%, respectively, $p = 0.10$; Table 1), the median number of overdoses they had ever witnessed (8 vs. 5, respectively, $p = 0.35$), the number of times they had helped someone who was overdosing (5 vs. 4, respectively, $p = 0.70$), or the proportion who said that they believe they have saved someone who was overdosing (93% vs. 85%, respectively, $p = 0.32$).

In terms of network characteristics, networks were mostly male, approximately the same age as the respondents (40 years old), and fairly dense (i.e., approximately $\frac{3}{4}$ of all possible network connections existed; Table 1). Approximately half of the network members were reported to use the SEP. Three primary differences emerged from the bivariate comparison of drug use network characteristics. Trained respondents were significantly more likely to name a sex partner as one of their network members (63% vs. 38%, $p = 0.03$), were more likely to name any trained network members (44% vs. 18%, $p = 0.006$), and were more likely to name any members who have naloxone (41% vs. 19%, $p = 0.03$). There were no differences in other network characteristics, including closeness, influence, or relationship type. With regards to social support, respondents identified between 50% and 80% of their network members as providing support in the four domains (material, informational, emotional, and help with overdose); there were no statistically significant differences between the trained and untrained groups. Naming trained members and naming members who have naloxone were highly correlated ($r = 0.79$), which was expected because naloxone is generally only available through the training, therefore we excluded the latter from the multivariate model. In multivariate logistic regression adjusting for recruitment site, only naming at least one trained network member was significantly associated with being in the trained group (Adjusted Odds Ratio 3.25, 95% Confidence Interval 1.09, 9.68; Table 2).

4. Discussion

Overdose prevention training programs exist to help IDUs prevent and respond more effectively to overdose in their community, but not everyone participates. In this sample recruited from two SEPs in Los Angeles, California, reporting that at least one network member was trained was associated with being trained. This suggests that social norms and social influence may be functioning to increase the value and importance of overdose prevention training among networks where at least one person has been trained, encouraging other network members to seek training. The fact that respondents in this study believed that at least some of their network members had been trained suggests that there may be active communication within the networks about overdose-related issues, which could be galvanized to increase the dissemination of prevention information and naloxone through the implementation of peer education campaigns. Alternately, this may represent the tendency for individuals to perceive that their network members are more like them, so if a respondent has been trained he/she may be more likely to assume that his/her contacts have also been trained, regardless of their actual training status. Future longitudinal research using full sociometric network techniques -- in which both the respondent and the network members are interviewed -- and assessing social norms related to overdose prevention training, will be needed to corroborate these findings.

Importantly, three quarters of study participants report having ever overdosed, highlighting the critical need for overdose prevention in this population. Individuals who have experienced a non-fatal overdose are seven times more likely to die from a subsequent overdose (Stoove, Dietze, & Jolley, 2009), therefore it is likely that this group will experience elevated morbidity associated with drug overdose. Though there were only five, the finding that some participants reported having no drug use network contacts is also worrisome. IDUs who are more isolated may engage in more HIV risk behaviors (Metsch et al., 1998; Miller & Neaigus, 2001), and can have less access to prevention services (Paquette, Bryant, & de Wit, 2011). Among those who die of drug overdose, being alone at the time of the incident may be a critical factor contributing to death (Davidson et al., 2003). Most programs include training about avoiding overdose (by not mixing drugs, using less after periods of abstinence, and not using alone); a continued emphasis on strategies for reducing one's own risk of overdose is warranted. Additionally, social network techniques could be used to identify and support network isolates who may be at even greater risk of fatal overdose and other negative health outcomes.

Though not significantly associated with training status, the finding that participants would ask a majority of their network members for help responding to an overdose supports the idea that one's drug-using peers are trusted and relied upon as sources of information about overdose response. Since, on average, only about half of the network members were reported to use the SEP, it is possible that the benefit of overdose prevention training provided to SEP clients could disseminate beyond those who access services directly. Peer driven interventions (PDIs) use peer opinion leaders to disseminate health information and change social norms within networks, in order to promote behavior change (Heckathorn et al., 1999; Valente & Pumpuang, 2007), and training peer leaders has been found to be an effective means of disseminating HIV prevention information through IDU networks (Latkin, 1998). A similar network-informed strategy, in which key network members (perhaps those who access the SEP on behalf of others, or "secondary exchangers") are trained to train their peers in overdose prevention, could be employed to increase the number of trained IDUs and the overall capacity of drug-using networks to protect their members.

Anecdotal reports from overdose training participants suggest that, for some, witnessing an overdose has two simultaneous effects: on the one hand, it inspires them to seek training so

that they can be better prepared to respond next time. On the other hand, for some individuals who were particularly traumatized by the experience, it may also inspire them to minimize their contact with other drug users in order to avoid witnessing another overdose – perhaps explaining why trained individuals were over-represented among those with no network ties. If this process of selectively cutting ties to network members who are perceived to be at higher risk of overdose is truly at work, it may explain why the network effects we observed were not stronger - there may be unmeasured psychological processes that explain training participation, as well. More research will be needed to understand the relative influence of psychological versus network influences. In the meantime, training individuals who are not current IDUs but who have intimate connections with IDUs through other network roles (e.g., family members, service providers, former IDUs who are currently in drug treatment or incarcerated) may increase the pool of trained responders in the community and circumvent the problem of selective isolation.

Other limitations of this analysis should be acknowledged. The convenience sample was small and restricted to one large urban location and people attending two SEPs, therefore findings may not be generalizable to other populations of IDUs or to people attending other programs. We adjusted for recruitment site in the analysis in order to control for some differences between the HHCLA and CGW samples, but there could be quantitative and qualitative differences in the networks of IDUs in these two locations that are not accounted for through this adjustment and will require additional research to elucidate. Data were cross-sectional and observational, therefore no causality can be implied from our results. Future studies assessing network and other individual and social characteristics before training enrollment may help uncover the processes that influence participation. Our measure of network size captured a maximum of five members due to the limitations of including network measures in a larger survey, therefore we do not have a good estimate of the true size of drug use networks in this population, and the measure of density is similarly affected (Friedkin, 1981). Finally, because the social network module was designed as a personal network study (rather than a whole network study), we did not require that respondents provided the real name of their network members, nor did we ask that they refer those individuals in to participate in the study. Therefore, all characteristics of network members are based on the respondents' self-reports and, as is conventional for personal or egocentric studies, we did not attempt to corroborate the respondents' reports. Personal network designs are appropriate for studies attempting to explore the relationship between network characteristics and individual characteristics (i.e., training status), and are particularly suited for use among hidden or marginalized populations, where recruiting whole networks is challenging (Fuhse & Mutzel, 2011). Nonetheless, future studies in which both the respondent and his/her network members are recruited could provide additional information about the structure of networks in this population and the dissemination of interventions through IDU networks.

5. Conclusion

Among IDUs, having drug use network contacts that have taken part in an overdose prevention training appears to be associated with one's own participation. Promoting peer education and having trained participants recruit their friends may help increase coverage of training programs, and capitalizing on the influential role of peer leaders to educate their networks may help increase the dissemination of information beyond the SEP. At the same time, identifying and supporting network isolates and/or those who typically use drugs alone is critical – some individuals who use alone may take part in the training because they know they are at risk, but they are less likely to be saved if they overdose themselves. Attention to social network factors, including the connections between people and the norms transmitted

via those connections, may help overdose prevention efforts to strengthen the capacity of IDU networks to respond to overdose in their community.

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Glossary

Overdose	the result of ingesting drugs or other substances in quantities greater than can be tolerated by the body. Opioid overdose is characterized by a set of signs or symptoms including: depressed respiration, decreased level of consciousness, and pinpoint pupils.
Opioid	a class of psychoactive chemicals that bind to opioid receptors in the central and peripheral nervous system. This classification includes both synthetic and natural substances. The more specific term “opiate” is limited to natural substances derived from the opium poppy
Naloxone (brand name: Narcan)	an opioid antagonist used to counter the effects of opioid overdose, including depression of the central nervous system and respiratory system

Figure.

Number of drug use alters named by trained and untrained respondents (N=106).

Table 1

Demographic, overdose-related, and network level characteristics, by training status for 101 respondents reporting at least one network contact.

	Trained (n=27)	Untrained (n=74)	
Ego/Individual characteristics: Demographics	N (%)	N (%)	p-value *
Age (Median [Q1, Q3])	41.0 (27-46)	44.5 (30, 52)	0.32
Race/ethnicity			0.24
Latino	7 (25.9%)	25 (33.8%)	
African American	3 (11.1%)	15 (20.3%)	
White	12 (44.4%)	30 (40.5%)	
American Indian/Alaska Native	1 (3.7%)	2 (2.7%)	
Mixed or Other	3 (11.1%)	2 (2.7%)	
Missing	1 (3.7%)	0 (0.0%)	
Male	16 (59.3%)	57 (77.0%)	0.08
Single (vs. married or partnered; n=98)	11 (42.3%)	37(51.4%)	0.43
Homeless (past 30 days)	16 (59.3%)	44 (59.5%)	0.99
HCV positive (vs. negative or unk.)	14(51.9%)	40 (54.1%)	0.84
HIV positive (vs. negative or unk.)	1 (3.7%)	1 (1.4%)	0.45
Ego/Individual characteristics: OD experience	Median (Q1, Q3)	Median (Q1, Q3)	p-value *
Ever overdosed (n, %)	23 (85.2%)	51 (68.9%)	0.10
# of times you have overdosed (n=74)	2 (1, 4)	3 (1, 4)	0.34
# of overdoses you have witnessed in your life	8 (3, 12)	5 (3, 12)	0.35
# of times you have helped someone who was overdosing	5 (2, 10)	4 (2, 10)	0.70
Believe you have saved someone who was overdosing (n, %)	25 (92.6%)	63 (85.1%)	0.32
Perceived risk of overdosing from taking drugs in next 6 months (1-4) †	1 (1, 2)	2 (1, 2)	0.77
Perceived risk of dying from overdose in next 6 months (1-4) †	2 (1, 3)	2 (1, 3)	0.87
Drug Use Network characteristics**	(n=27)	(n=74)	
	Median (Q1, Q3)	Median (Q1, Q3)	p-value *
Number of drug-use network alters (1-5)	5 (3, 5)	5 (4, 5)	0.15
% of alters who are male	75% (40, 80)	75% (60, 100)	0.59
Age of alters (years)	40 (30, 45)	39 (30, 47)	0.93
Density (0-1)	0.7 (0.5, 1.0)	1.0 (0.6, 1.0)	0.25
Years you have known alter	3.5 (2, 6)	3.3 (1, 9)	0.88
Named a sex partner as part of network (n, %)	17 (63.0%)	28 (37.8%)	0.03
Named any alters who are trained (n; %)	12 (44.4%)	13 (17.6%)	0.006
Named any alters who have naloxone (n, %)	11 (40.7%)	14 (18.9%)	0.03
Average closeness (1-10)	6 (5, 8)	6 (4, 8)	0.67
Average influence (1-10)	3 (.5, 5)	5 (2, 6.5)	0.25
% of alters who you talk to daily	50% (25, 80)	50% (20, 80)	0.89

	Trained (n=27)	Untrained (n=74)	
% of alters who are with you at least half the time when you use drugs	50% (20, 80)	40% (20, 60)	0.65
% of alters who are friends	60% (20, 100)	63% (40, 100)	0.43
% of alters who are relatives	0% (0, 0)	0% (0, 0)	0.20
% of alters who are associates	0% (0, 20)	0% (0, 20)	0.42
% of alters who use the syringe exchange program	60% (20, 100)	50% (20, 80)	0.38
% of alters who provide material support	75% (40, 100)	60% (25, 100)	0.92
% of alters who provide informational support	75% (20, 100)	60% (40, 100)	0.66
% of alters who provide emotional support	50% (40, 80)	60% (40, 100)	0.96
% of alters whom ego would ask for help with an OD	80% (60, 100)	80% (40, 100)	0.97

[†] 4-point Likert scale (1=very unlikely; 4=very likely)

* comparisons of medians were made using Wilcoxon Rank Sum test, comparisons of proportions were made using chi-squared test, all p-values are two-sided

Table 2

Unadjusted and adjusted* odds ratios for factors associated with participating in the OD prevention training, among those who reported 1 network member (N=101)

	OR	95% C.I.	AdjOR	95% C.I.
Male	0.43	0.17, 1.07	---	---
Named a sex partner in network	2.79	1.12, 6.95	1.90	0.69, 5.21
Named 1 network member who was trained	3.75	1.43, 9.87	3.25	1.09, 9.68
Named 1 network member who has naloxone**	2.94	1.12, 7.72	---	---

* adjusted for recruitment site

** excluded from multivariate analysis due to strong correlation with trained network members