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The relationship of sexual dyad and personal network characteristics and individual attributes to unprotected sex among young injecting drug users

V. Anna Gyarmathy^{1,2} and Alan Neaigus^{1,3}

¹National Development and Research Institutes, Inc., New York, NY

²Johns Hopkins Bloomberg School of Public Health, Department of Mental Health, Baltimore, MD

³Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY

Abstract

We examine in the heterosexual partnerships (dyads) of IDUs the correlates of engaging in unprotected sex on three levels: individual attributes, social network characteristics, and dyad characteristics. Unprotected sex was significantly less likely to occur in dyads where the participant injected daily or had high safe-sex attitude scores, and in dyads where both members encouraged each other to use condoms. Unprotected sex was significantly more likely to occur in dyads that smoked crack together, shared needles with each other, and where the participant knew that the sex partner had concurrent sex partners. In the sexual dyads of IDUs there is a combined risk of unsafe injecting and unsafe sex. Both injecting and sexual risk, and their combination need to be addressed in interventions that target the sexual partnerships of IDUs. Such interventions should also aim to reduce injected and non-injected crack and other stimulant use associated with high-risk sex.

Keywords

Injecting drug users; Risk behaviors; Risk networks; Sexual risk; Dyad analysis

INTRODUCTION

Among injecting drug users (IDUs), sharing injection paraphernalia is a risk factor for parenteral infection with the human immunodeficiency virus (HIV), and hepatitis B and C (HBV and HCV) viruses (Des Jarlais et al. 2003; Garfein et al. 1998; Neaigus et al. 1996). In addition to parenteral risk, IDUs have a higher risk than the general population of acquiring HIV and HBV through unprotected sexual exposure either with their regular or casual partners, or by exchanging sex for money or drugs (Booth et al. 2000; Booth et al. 1993; Strathdee and Sherman, 2003). Moreover, IDUs are more likely than the general population to transmit infection because many IDUs are infected themselves (Padian et al. 1997).

While there has been a reduction in the parenteral risk of infection among IDUs due to the increasing availability of legal, sterile syringes and prevention interventions (Kral et al. 2004; Nelson et al. 2002; Semaan et al. 2002), the risk of sexual acquisition or transmission of HIV, HBV and other sexually transmitted diseases (sexual risk) still remains high among

IDUs, because unsafe sex has been more difficult to prevent (Booth et al. 2000; Dolezal et al. 1999; Evans et al. 2003; Friedman et al. 2002). Younger IDUs may be especially at risk for both acquiring and potentially transmitting HIV and HBV, because they may be more likely than older IDUs to share injecting paraphernalia, engage in unprotected sex, have concurrent sex partners (i.e., have sex with more than one partner in a given time period), and have high-risk injecting or sexual risk networks (Fennema et al. 1997; Fuller et al. 2003; Kral et al. 2003; van Ameijden and Coutinho, 1998).

Several studies have examined factors at the individual level that may be associated with sexual risk among younger IDUs, such as access to economic resources, drug use characteristics and sexual and/or physical abuse during childhood or adolescence (Klein and Chao, 1995; Somlai et al. 2003). For example, exchanging sex for money may be a way for women to obtain economic resources for their drug addiction (Weeks et al. 1998). Cocaine and other stimulant injection may increase sexual risk, probably due to increased sexual activity and more partners (Maranda et al. 2004; Somlai et al. 2003). Sexual and physical abuse may lead to unsafe sex through lack of control over sexual activities due to shame and revictimization (Miller et al. 2002; Whiffen and Macintosh, 2005). In addition, sexual risk may be different among women than among men, possibly because women are more likely to have older, IDU sex partners and because of social influence of pressure from their male sex partners to engage in unprotected sex (Absalon et al. 2006; Doherty et al. 2000; Evans et al. 2003; Frajzyngier et al. 2007; Friedman et al. 1999a).

Factors at the social network level are also important to examine, because the sexual transmission of HIV and similarly transmitted pathogens, such as HBV, occurs through sexual behaviors occurring in the context of intimate social contact (Neaigus et al. 1994). Previous studies have investigated the role of social networks as they relate to injecting and other drug use risk, and also the effect of overall social network characteristics on the sexual risk behavior of drug users (El-Bassel et al. 2006; Latka et al. 2006; Sherman and Latkin, 2001). Little is known though about the relationship of partnership characteristics between an IDU and his or sex partner (dyad) to engaging in unprotected sex. Examining attributes of unprotected sex on the partnership-level as opposed to the individual or overall social network level is necessary, because sex predominantly occurs in social relationships involving two people, i.e., between couples with no others present. In the following, we will examine the correlates of engaging in unprotected sex in the heterosexual dyads of IDUs. We hypothesize that engaging in unprotected sex is influenced at three levels of causation: at the individual level (by the study participant's individual attributes such as demographic background, history of sexual abuse, drug use characteristics, and personal attitudes); at the level of the participant's overall personal network i.e., the participant and his or her direct social ties with social, drug use and sexual network members (by network characteristics such as the size of the personal social and risk networks, defined as the number of direct social ties that the participant reported); and at the dyad level (namely by the characteristics of the sex partner as reported by the study participant and/or of the relationship between the participant and the sex partner).

METHODS

Participants

Between February 1999 and February 2003, IDUs were recruited in the East Village / Lower East Side neighborhoods of New York City for a study investigating their network and behavioral risks of infection with HIV, HBV and HCV. Participants were recruited from non-drug-treatment settings, although some may have been in drug treatment at the time of recruitment. We utilized a combination of targeted outreach and chain-referral methods (Heckathorn, 1997; Sifaneck and Neaigus, 2001). We identified through key informants and ethnographic observations in the area of recruitment locations where drug users congregate.

Study recruiters approached people in these locations who appeared to be injecting drug users or involved in other kinds of illicit drug use (targeted outreach) (Friedman et al. 1999b; Sherman and Latkin, 2002). In addition, all participants were given coupons to bring back people who they knew were also injecting drugs, and these candidates were screened for study eligibility (chain referral). Although data on participation rates were not collected or were not possible for those who responded to recruitment flyers or were offered coupons by participants already in the study, all those who were subsequently screened eligible (N=385) participated in the study. Nevertheless the composition of the sample was comparable to that obtained by other studies conducted independently in the area (Des Jarlais et al. 2003; Des Jarlais et al. 2005). After providing their informed consent, eligible participants were administered a computer assisted structured face-to-face interview in private at a research office in the area of recruitment and were paid \$30 at the completion of each interview. Referrals to drug treatment and health and social services were made available upon request. Those eligible were 18 years of age or older and had injected heroin, cocaine or methamphetamines within the prior 30 days. To determine and verify eligibility, ethnographic methods, structured screening questionnaires, inspection of arms and other visible body sites for fresh needle marks, as well as urine toxicology tests and, if negative on the urine test, a hair test for heroin and cocaine were used.

Measures

Individual-level variables—Participants were interviewed about their sociodemographic and drug treatment background, individual attributes that may increase their personal susceptibility, self-reported infection status, drug use and sexual risk behaviors, drug and sexual risk network and dyad characteristics. The dependent variable in this analysis is having unprotected sex in the past 30 days with a partner who was nominated as a member of the participant's sexual network (dyad-level variable).

Sociodemographic background variables included gender, age, race/ethnicity, income in the past six months (less than \$5000 vs. higher), current homelessness, marital status, and highest level of education (at least high school vs. less education). We also asked whether participants are currently in drug treatment. Personal susceptibility variables included having ever experienced sexual or physical abuse, feeling depressed in the past seven days (Radloff, 1977), and perceived severity of heroin dependence (Gossop et al. 1992). Participants were asked about current same-gender sexual orientation, and whether they had ever been told by a doctor or other health care professional that they were infected with HIV, HBV or HCV. Drug use behavior variables assessed the type of drug injected and frequency of injecting in the past 30 days for: crack, cocaine, heroin, speedball (heroin and cocaine injected together), and amphetamines, and overall frequency of injecting in the past 30 days. A composite safe sex attitude score (ranging from 0-6 based on the sum of responses, each response generating a value of 0 or 1) was created based on disagreement with the following five statements: “steady partners do not need to use condoms”, “there is little risk of HIV when having oral sex without a condom”, “there is little risk of HIV when having vaginal sex without a condom”, “there is little risk of HIV when having anal sex without a condom”, “it’s OK to have sex with a partner who refuses to use a condom”; and agreement with the statement: “people should always use a condom with partners they don’t know well”.

Social network-level variables—Two kinds of network data were collected: 1. aggregate network data; and 2. nominated network data. Aggregate sex and injecting risk network variables were based on questions which asked about the number of people that participants had vaginal or anal sex with or injected with in the past 30 days. These variables include all partners, both those nominated and any other partners, e.g. anonymous partners. Nominated sex and injecting risk network variables were based on questions which asked participants to

name those people they had contact with in the past 30 days and whom they received support or advice from, had sex with, or injected with in the past 30 days. The size, density (the number of actual ties among nominated network members divided by the number of all potential ties) and the average length of time they had known all their network members (support or advice, sex and injecting network combined) was also calculated. Exchanging sex for money or drugs in the past 30 days was assessed.

Dyad-level variables—Dyad-level variables included relationship, behavioral and partner characteristics of the nominated sexual network members. Relationship characteristics included emotional closeness; duration of the relationship (in months); and time since the participant first had sex with the sex partner (in months). Behavioral characteristics referred to the past 30 days and included daily contact; using alcohol, crack/cocaine, marijuana, methamphetamines together; injecting together, sharing cookers, sharing needles; daily sexual contact; and discussing condom use. Partner characteristics included the ethnicity of the nominated sex partner; whether the sex partner is an IDU; whether the participant knows that the sex partner has another sex partner; and whether the participant knows that the sex partner is infected with HIV.

Dyad-level composite variables, each with three categories, were constructed for self-reported HIV infection status and communication about condom use based on a combination of characteristics of the participant (self-reported by the participant) and those of the sex partner (reported about the sex partner by the participant). Infection status for HIV was: 1. concordant presumptive negative (neither participant nor the sex partner was reported being infected), 2. discordant (either the participant or the sex partner was reported being infected while the other was not reported being infected), and 3. concordant positive (both the participant and the sex partner were reported being infected). Communication about condom was categorized as: 1. neither encouraged the other to use condoms, 2. one person (either the participant or the sex partner) encouraged the other to use condoms, and 3. both the participant and the sex partner encouraged each other to use condoms.

Data analyses

Of the 385 eligible participants who were interviewed at baseline, 254 participants reported being sexually active in the past 30 days and 209 (82% of 254) reported information about their sexual dyads. Those who did not report dyads compared to those who reported dyads were not significantly different in terms of gender, age, race/ethnicity, education, income, homelessness, or in the number of aggregate sex partners that they reported having any unprotected sex with. Since same-sex dyads may have different characteristics than heterosexual dyads, same-sex dyads were excluded from the analysis. Of the 209 participants who reported sexual dyads, 7 participants (3% of 209) were excluded for reporting only same-sex sexual dyads. This analysis is based on the remainder 202 participants and a total of 235 heterosexual dyads that they reported.

To assess potential gender differences on the candidate correlate variables, preliminary univariate analyses were conducted stratified by gender. However, no statistically significant (Chi-square $p < 0.05$) gender differences were found in any of the candidate correlate variables as they related to the dependent variable. Consequently, the sample was pooled and gender was used as a potential correlate variable only.

Univariate analyses were conducted to select candidate variables for inclusion in multivariate analyses. For the univariate analyses, contingency tables to describe distribution and univariate generalized estimating equations (GEE) with corresponding p-values to assess association were conducted. GEE was used to take into account the correlation among nominated network members due to the clustering of network members within individual participants (Liang and

Zeger, 1986). Variables with statistically significant ($p < 0.05$) or marginal ($0.05 < p < 0.20$) associations in the univariate analysis were chosen for multivariate GEE analyses. Multivariate GEE models with backwards elimination were used to assess significant associations with the dependent variable. Adjusted odds ratios (aOR) and 95% confidence intervals (95% CI) are reported.

RESULTS

Participant characteristics

The analysis sample ($n=202$) was predominantly of White race/ethnicity: about three quarters were White ($n=152$, 75.2%), 13.9% ($n=28$) Hispanic, 3.5% ($n=7$) African American, and 7.4% ($n=15$) Other. The mean age was relatively young, 24.1 years ($SD=4.5$, range 18-39; 95th percentile: 31 years). About half were male (57%), homeless (54%), had income below \$5000 in the past six months (49%), or graduated from high school (48%). The majority was single (88%), and only a few were currently in treatment (5%). Two men (1% of total, 2% of men) and 28 women (14% of total, 33% of women) reported being sexually attracted to their own gender. The mean number of years since injecting initiation was 4.1 years ($SD=3.0$). About two-thirds (61%) reported daily drug injection, mostly heroin (any heroin injecting $n=187$, 93%; daily heroin injecting $n=115$, 57%). Self-reported HIV, HBV and HCV infections were 1%, 8%, and 17%, respectively. Participants reported a mean of 2.1 aggregate sex partners ($SD=5.2$, range 1-50) and a mean of 1.2 nominated sex partners ($SD=0.5$, range 1-4). Unprotected sex was reported in about two thirds (66.8%, $n=157$) of the 235 heterosexual dyads that were reported by the 202 participants.

Univariate analysis

In univariate analysis, significant individual attribute correlates of engaging in unprotected sex within dyads were injecting daily and having a higher safe-sex attitude score (both protective) (table 1). Significant social and risk network characteristics associated with engaging in unprotected sex within dyads included a lower number of nominated sex partners and a smaller nominated social network size (table 2). Significant dyad-level correlates associated with engaging in unprotected sex within dyads included being emotionally very close to the sex partner, having daily contact with the sex partner, drinking alcohol together, the sex partner being an injecting drug user, having daily sexual contact, knowing that the nominated sex partner has another sex partner and sharing needles or sharing cookers with the sex partner. Either the participant or the sex partner, or both encouraging each other to always use condoms was protective.

There were three dyads where the participant was an MSM, three dyads where the participant injected amphetamines, and three dyads where the couple used methamphetamines together. In all these dyads, participants reported having unprotected sex. Due to the zero cells, these variables were not included in the multivariate analysis.

Multivariate analysis

In multivariate analysis the individual attributes of injecting daily and having a higher safe-sex attitude score were inversely and significantly associated with having unprotected sex within a dyad. While none of the personal social and risk network characteristics stayed significant in the final multivariate model, several dyad-level risk correlates of engaging in unprotected sex within a dyad remained significant, including sharing needles with the sex partner, smoking crack or sniffing cocaine together, and knowing that the sex partner has another sex partner. Compared to none of the partners encouraging the use of condoms (reference category), both partners encouraging each other to always use condoms was

protective, and either the participant or the sex partner encouraging the other to always use condoms was protective but marginally significant.

DISCUSSION

In this analysis, we assessed the sexual risk for HIV and other sexually transmitted infections among a sample of IDUs in New York City. Our results point to a combined risk of both unsafe injecting and unsafe sex: those who shared needles were more likely than those who did not share to also have unprotected sex. However, daily injecting was a protective factor for unsafe sex, and may indicate IDUs who engage in sex-for-drugs transactions where condom use may be more frequent (Gossop et al. 1993). In addition, we also found a combination of unsafe sexual behaviors and high-risk sex networks: those whose partners have concurrent sex partners are more likely to have unprotected sex than those who report that their partners are monogamous.

Needle sharing and sexual risk were found to be associated in previous studies as well (Evans et al. 2003; Unger et al. 2006). Possible explanations for this co-occurrence of sexual and injecting risk may be a higher level of trust that is present in intimate relationships, including trust about disclosing infection status, or relationship dynamics that prevent some IDUs from refusing to engage in sexual or injecting risk with an emotionally close or primary sex partner (Gyarmathy et al. 2006; Neaigus et al. 1995; Unger et al. 2006). In addition, syringe sharing in a sexual relationship among IDUs may reflect a sense of fatalism about preventing the transmission of infection in the relationship, due to the notion among sex partners who are also injecting partners that “they have unprotected sex anyway” (Gyarmathy and Neaigus, 2006), indicating that engaging in one type of risky behavior (sexual risk) somehow justifies engaging in another type of risky behavior (injecting risk). It is also possible that IDUs in sexual or injecting relationships may have a rational assessment of their risk, because if they believe that they are in exclusive or monogamous relationships, their risk of exposure is lower.

Participants in dyads where the participant knew that his or her nominated sex partner had other partners were more likely than those in monogamous dyads to have unprotected sex. Patterns of infection transmission involve the role of bridges, i.e. individuals who have both infected and uninfected, or high-risk and lower-risk partners. When an infected network is connected to an uninfected network through bridge individuals, infection can travel from the infected network to the uninfected one, and potentially spread among the susceptible individuals within the previously uninfected network (Aral et al. 1999; Morris et al. 1996; Neaigus et al. 2001). Examining such potential bridges would allow us to identify the transmission dynamics within a given population and the direction of infection. IDUs with partners that have multiple sex partners may act as a bridge of sexual transmission of HIV and other sexually transmitted infections between high-prevalence and low-prevalence populations (Neaigus et al. 2001).

Encouragement to use condoms by both the participant and the nominated sex partner was the strongest correlate: participants in those dyads in which both encouraged each other to use condoms were 98% less likely to engage in unprotected sex. In addition, having higher safer sex attitudes was also a highly significant protective factor. These findings suggest that couples/network behavior modification can be used in sexual risk reduction interventions among IDUs. These interventions targeting the sexual partnerships of IDUs (many of which are also injecting partnerships) could involve comprehensive risk reduction, i.e. reduce both sexual and injecting risk. In addition, the promotion of safer sex attitudes should be integrated into these interventions.

MSM IDUs constitute a special population among IDUs (Lambert et al. 2005). While the number of MSM participants in this study was small, it is suggestive that all heterosexual dyads

of MSM participants reported having unprotected sex. Previous studies have pointed out that MSM IDUs who also have sex with women have high rates of unprotected sex with their female partners (Kral et al. 2005; Rietmeijer et al. 1998). Within the group of MSM IDUs, those who have sex with both men and women are an especially high-risk bridge population. In a study examining the injecting and sexual risk correlates of HIV, HBV and HCV seroprevalence among new IDUs in New York City, MSM were more likely to have been infected with HIV and HBV (Neaigus et al. 2007).

Some non-significant results are noteworthy, including the lack of an association between unprotected sex and selling sex, and unprotected sex and HIV discordance (although the number of those who self-reported being HIV positive was very small). Other research has found that while women who sell sex use condoms with commercial partners most of the time, they are less likely to use condoms with their non-commercial partners (Cusick, 1998; Gyarmathy et al. 2003). Our findings also show that participants in dyads where the participant or the sex partner sells sex are as likely to report unprotected sex as in dyads where neither sells sex. Partners of sex workers who may not use condoms consistently for commercial vaginal or anal intercourses are thus at high risk of acquiring HIV and sexually transmitted infections through exposure to infected clients of their partners. In the univariate analysis of this study, we found a marginally significant positive association between HIV discordance and using condoms, which suggests that those IDUs who know they are HIV infected may be less likely to engage in unprotected sex with partners who they believe to be uninfected (Friedman et al. 1994). However, the finding that almost half of discordant couples reported having unprotected sex is disconcerting. Dyads where one partner is a sex worker or HIV discordant dyads may act as bridges of infection with HIV and other sexually transmitted diseases.

We found that the use of certain drugs, such as crack, cocaine and amphetamines was associated with unsafe sex. Couples that used non-injected crack or cocaine together were more likely than those who did not use these drugs together to engage in unprotected sex. Non-injected use of crack has not only been found to be associated with a higher probability of engaging in unprotected sex, but it also may be a marker for selling sex (Booth et al. 2000; Somlai et al. 2003). In addition, the use of amphetamines and methamphetamines has been shown to be related not only to unsafe sex but also to multiple and casual/anonymous sex partners, and unsafe injecting (Lorvick et al. 2006; MMWR, 2006). All dyads in this study where either the participant injected amphetamines or the couple smoked methamphetamines together reported unprotected sex. (None of these dyads had participants that were MSM). While the number of such dyads is small in our sample, this finding is suggestive of high-risk sexual behaviors associated with the use of methamphetamine or amphetamines.

A limitation of the study is that dyad analysis captures only strong sexual ties within a network and does not assess those weak ties where sexual partners are not nominated. Hence, in this dyad analysis we were unable to assess correlates of unprotected sex in relationships that are, for example, more casual or anonymous. In addition, 18% of those participants who reported being sexually active in the past 30 days did not report dyads. However, a subsequent analysis revealed that those who did not report dyads compared to those who reported dyads were not significantly different in terms of gender, age, ethnicity, education, income, homelessness, or in their report of having any unprotected sex with non-nominated sex partners. Another limitation is the small number of women in the sample. While no gender differences were found in our preliminary analysis, a larger sample size may have revealed gender differences in unsafe sex behaviors. In addition, some forms of stigmatized sex, e.g. sex work or having sex with men among men may have been underreported. There may also have been factors which limited communication among sex partners regarding sex partnerships outside of the dyad and/or disclosure of infection status. Since the sample is predominantly white, generalization to non-

whites may not be possible or appropriate. Finally, our reliance on network sampling to obtain our study population raises the issue that the sample is non-random and thus may not be representative of all injecting drug users in New York. However, we used established methods for sampling “hidden” populations of injecting drug users.

This study shows that there seems to be an overlap of injecting and sexual risk among IDUs and their sex partners. As such, in order to prevent the transmission of HIV and other sexually transmitted diseases, both injecting and sexual risk, and their combination have to be addressed in counseling, especially in couples or network counseling, since these behaviors occur in dyads/networks. In addition, the use of crack and other stimulants that may be non-injected increases sexual risk, so prevention work among IDUs may need to incorporate the role of poly drug use and both injected and non-injected stimulant use as a combined risk for unsafe sex. Those IDUs who engage in unsafe sex may be part of a “core group” and be the source for the sexual spread of HIV and other STIs. In particular, communication and social influence within dyads is important and finding ways to promote positive communication and social influence seems necessary to reduce sexual risk. Similarly, promoting individual attitudes to reduce sexual risk is necessary.

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References

- Absalon J, Fuller CM, Ompad DC, Blaney S, Koblin B, Galea S, Vlahov D. Gender differences in sexual behaviors, sexual partnerships, and HIV among drug users in New York City. *AIDS and Behavior* 2006;10:707–15. [PubMed: 16676223]
- Aral SO, Hughes JP, Stoner B, Whittington W, Handsfield HH, Anderson RM, Holmes KK. Sexual mixing patterns in the spread of gonococcal and chlamydial infections. *American Journal of Public Health* 1999;89:825–833. [PubMed: 10358670]
- Booth RE, Kwiatkowski CF, Chitwood DD. Sex related HIV risk behaviors: differential risks among injection drug users, crack smokers, and injection drug users who smoke crack. *Drug and Alcohol Dependence* 2000;58:219–26. [PubMed: 10759032]
- Booth RE, Watters JK, Chitwood DD. HIV risk-related sex behaviors among injection drug users, crack smokers, and injection drug users who smoke crack. *American Journal of Public Health* 1993;83:1144–8. [PubMed: 8342724]
- Cusick L. Non-use of condoms by prostitute women. *AIDS Care* 1998;10:133–46. [PubMed: 9625898]
- Des Jarlais DC, Diaz T, Perlis T, Vlahov D, Maslow C, Latka M, Rockwell R, Edwards V, Friedman SR, Monterroso E, Williams I, Garfein RS. Variability in the incidence of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus infection among young injecting drug users in New York City. *American Journal of Epidemiology* 2003;157:467–71. [PubMed: 12615611]
- Des Jarlais DC, Perlis TE, Settembrino JM. The use of electronic debit cards in longitudinal data collection with geographically mobile drug users. *Drug and Alcohol Dependence* 2005;77:1–5. [PubMed: 15607835]
- Doherty MC, Garfein RS, Monterroso E, Latkin C, Vlahov D. Gender differences in the initiation of injection drug use among young adults. *Journal of Urban Health* 2000;77:396–414. [PubMed: 10976613]
- Dolezal C, Meyer-Bahlburg HF, Liu X, Ehrhardt AA, Exner TM, Rabkin JG, Gorman JM, Marder K, Stern Y. Longitudinal changes in sexual risk behavior among HIV+ and HIV- male injecting drug users. *American Journal of Drug and Alcohol Abuse* 1999;25:281–303. [PubMed: 10395161]

- El-Bassel N, Gilbert L, Wu E, Chang M. A Social Network Profile and HIV Risk Among Men on Methadone: Do Social Networks Matter? *Journal of Urban Health* 2006;83:602–13. [PubMed: 16755389]
- Evans JL, Hahn JA, Page-Shafer K, Lum PJ, Stein ES, Davidson PJ, Moss AR. Gender differences in sexual and injection risk behavior among active young injection drug users in San Francisco (the UFO Study). *Journal of Urban Health* 2003;80:137–46. [PubMed: 12612103]
- Fennema JS, Van Ameijden EJ, Van Den Hoek A, Coutinho RA. Young and recent-onset injecting drug users are at higher risk for HIV. *Addiction* 1997;92:1457–65. [PubMed: 9519489]
- Frajzyngier V, Neaigus A, Gyarmathy VA, Miller M, Friedman SR. Gender differences in injection risk behaviors at the first injection episode. *Drug and Alcohol Dependence* 2007;89:145–52. [PubMed: 17276623]
- Friedman SR, Chapman TF, Perlis TE, Rockwell R, Paone D, Sotheran JL, Des Jarlais DC. Similarities and differences by race/ethnicity in changes of HIV seroprevalence and related behaviors among drug injectors in New York City, 1991–1996. *Journal of Acquired Immune Deficiency Syndromes* 1999a;22:83–91. [PubMed: 10534151]
- Friedman, SR.; Curtis, R.; Neaigus, A.; Jose, B.; Des Jarlais, DC. New York: Plenum; 1999b.
- Friedman SR, Flom PL, Kottiri BJ, Neaigus A, Sandoval M, Fuld J, Curtis R, Zenilman JM, Des Jarlais DC. Consistent condom use among drug-using youth in a high HIV-risk neighbourhood. *AIDS Care* 2002;14:493–507. [PubMed: 12204152]
- Friedman SR, Jose B, Neaigus A, Goldstein M, Curtis R, Ildefonso G, Mota P, Des Jarlais DC. Consistent condom use in relationships between seropositive injecting drug users and sex partners who do not inject drugs. *AIDS* 1994;8:357–361. [PubMed: 8031514]
- Fuller CM, Vlahov D, Latkin CA, Ompad DC, Celentano DD, Strathdee SA. Social circumstances of initiation of injection drug use and early shooting gallery attendance: implications for HIV intervention among adolescent and young adult injection drug users. *Journal of Acquired Immune Deficiency Syndromes* 2003;1:86–93. [PubMed: 12514419]
- Garfein RS, Doherty MC, Monterroso ER, Thomas DL, Nelson KE, Vlahov D. Prevalence and incidence of hepatitis C virus infection among young adult injection drug users. *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology* 1998;18:S11–S19. [PubMed: 9663618]
- Gossop M, Griffiths P, Powis B, Strang J. Severity of dependence and route of administration of heroin, cocaine and amphetamines. *British Journal of Addiction* 1992;87:1527–1536. [PubMed: 1458032]
- Gossop M, Griffiths P, Powis B, Strang J. Severity of heroin dependence and HIV risk. I. Sexual behaviour. *AIDS Care* 1993;5:149–57. [PubMed: 8329480]
- Gyarmathy VA, Neaigus A. The effect of personal network exposure on injecting equipment sharing among Hungarian IDUs. *Connections* 2006;15:29–42.
- Gyarmathy VA, Neaigus A, Számádó S. HIV risk behavior history of prison inmates in Hungary. *AIDS Education and Prevention* 2003;15:561–9. [PubMed: 14711168]
- Gyarmathy VA, Neaigus A, Ujhelyi E, Szabó T, Rácz J. Strong HIV and hepatitis disclosure norms and frequent risk behaviors among Hungarian drug injectors. *Drug and Alcohol Dependence* 2006;82:S65–9. [PubMed: 16769448]
- Heckathorn DD. Respondent-driven sampling: A new approach to the study of hidden populations. *Social Problems* 1997;44:174–199.
- Klein H, Chao BS. Sexual abuse during childhood and adolescence as predictors of HIV-related sexual risk during adulthood among female sexual partners of injection drug users. *Violence Against Women* 1995;1:55–76. [PubMed: 12346572]
- Kral AH, Anderson R, Flynn NM, Bluthenthal RN. Injection Risk Behaviors Among Clients of Syringe Exchange Programs With Different Syringe Dispensation Policies. *Journal of Acquired Immune Deficiency Syndromes* 2004;37:1307–1312. [PubMed: 15385739]
- Kral AH, Lorvick J, Ciccarone D, Wenger L, Gee L, Martinez A, Edlin BR. HIV prevalence and risk behaviors among men who have sex with men and inject drugs in San Francisco. *Journal of Urban Health* 2005;82:i43–50. [PubMed: 15738321]
- Kral AH, Lorvick J, Gee L, Bacchetti P, Rawal B, Busch M, Edlin BR. Trends in human immunodeficiency virus seroincidence among street-recruited injection drug users in San Francisco, 1987–1998. *American Journal of Epidemiology* 2003;157:915–22. [PubMed: 12746244]

- Lambert E, Normand J, Stall R, Aral S, Vlahov D. Introduction: new dynamics of HIV risk among drug-using men who have sex with men. *Journal of Urban Health* 2005;82:i1–8. [PubMed: 15738326]
- Latka MH, Metsch LR, Mizuno Y, Tobin K, Mackenzie S, Arnsten JH, Gourevitch MN. Unprotected sex among HIV-positive injection drug-using women and their serodiscordant male partners: role of personal and partnership influences. *Journal of Acquired Immune Deficiency Syndromes* 2006;42:222–8. [PubMed: 16760799]
- Latkin CA, Forman-Hoffman VL, D'Souza G, Knowlton AR. Associations between medical service use and HIV risk among HIV-positive drug users in Baltimore, MD. *AIDS Care* 2004;16:901–8. [PubMed: 15385245]
- Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. *Biometrika* 1986;73:13–22.
- Lorvick J, Martinez A, Gee L, Kral AH. Sexual and injection risk among women who inject methamphetamine in San Francisco. *Journal of Urban Health* 2006;83:497–505. [PubMed: 16739050]
- Maranda MJ, Han C, Rainone GA. Crack cocaine and sex. *Journal of Psychoactive Drugs* 2004;36:315–22. [PubMed: 15559679]
- Miller CL, Spittal PM, LaLiberte N, Li K, Tyndall MW, O'Shaughnessy MV, Schechter MT. Females experiencing sexual and drug vulnerabilities are at elevated risk for HIV infection among youth who use injection drugs. *Journal of Acquired Immune Deficiency Syndromes* 2002;30:335–41. [PubMed: 12131571]
- MMWR. Methamphetamine use and HIV risk behaviors among heterosexual men—preliminary results from five northern California counties, December 2001–November 2003. *Morbidity and Mortality Weekly Report* 2006;55:273–7. [PubMed: 16543881]
- Morris M, Podhisita C, Wawer MJ, Handcock MS. Bridge populations in the spread of HIV/AIDS in Thailand. *AIDS* 1996;10:1265–1271. [PubMed: 8883589]
- Neaigus A, Friedman SR, Curtis R, Des Jarlais DC, Furst RT, Jose B, Mota P, Stepherson B, Sufian M, Ward T, Wright JW. The relevance of drug injectors' social networks and risk networks for understanding and preventing HIV infection. *Social Science and Medicine* 1994;38:67–78. [PubMed: 8146717]
- Neaigus A, Friedman SR, Goldstein MF, Ildefonso G, Curtis R, Jose B. Using dyadic data for a network analysis of HIV infection and risk behaviors among injecting drug users. *NIDA Research Monograph* 1995;151:20–37. [PubMed: 8742759]
- Neaigus A, Friedman SR, Jose B, Goldstein MF, Curtis R, Ildefonso G, Des Jarlais DC. High risk personal networks and syringe sharing as risk factors for HIV infection among new drug injectors. *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology* 1996;11:499–509. [PubMed: 8605596]
- Neaigus A, Gyarmathy VA, Miller M, Frajzyngier V, Zhao M, Friedman SR, Jarlais DC. Injecting and sexual risk correlates of HBV and HCV seroprevalence among new drug injectors. *Drug and Alcohol Dependence* 2007;89:234–243. [PubMed: 17289298]
- Neaigus A, Miller M, Friedman SR, Des Jarlais DC. Sexual transmission risk among noninjecting heroin users infected with human immunodeficiency virus or hepatitis C virus. *Journal of Infectious Diseases* 2001;184:359–363. [PubMed: 11443564]
- Nelson KE, Galai N, Safaeian M, Strathdee SA, Celentano DD, Vlahov D. Temporal trends in the incidence of human immunodeficiency virus infection and risk behavior among injection drug users in Baltimore, Maryland, 1988–1998. *American Journal of Epidemiology* 2002;156:641–53. [PubMed: 12244033]
- Padian NS, Shiboski SC, Glass SO, Vittinghoff E. Heterosexual transmission of human immunodeficiency virus (HIV) in northern California: results from a ten-year study. *American Journal of Epidemiology* 1997;146:350–357. [PubMed: 9270414]
- Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement* 1977:385–401.
- Rietmeijer CA, Wolitski RJ, Fishbein M, Corby NH, Cohn DL. Sex hustling, injection drug use, and non-gay identification by men who have sex with men. Associations with high-risk sexual behaviors and condom use. *Sexually Transmitted Diseases* 1998;25:353–60. [PubMed: 9713915]

- Semaan S, Des Jarlais DC, Sogolow E, Johnson WD, Hedges LV, Ramirez G, Flores SA, Norman L, Sweat MD, Needle R. A meta-analysis of the effect of HIV prevention interventions on the sex behaviors of drug users in the United States. *Journal of Acquired Immune Deficiency Syndromes* 2002;30(Suppl 1):S73–93. [PubMed: 12107362]
- Sherman SG, Latkin CA. Intimate relationship characteristics associated with condom use among drug users and their sex partners: a multilevel analysis. *Drug and Alcohol Dependence* 2001;64:97–104. [PubMed: 11470345]
- Sherman SG, Latkin CA. Drug users' involvement in the drug economy: implications for harm reduction and HIV prevention programs. *Journal of Urban Health* 2002;79:266–77. [PubMed: 12023502]
- Sifaneck S, Neaigus A. The ethnographic accessing, sampling and screening of hidden populations: Heroin sniffers in New York City. *Addiction Research and Theory* 2001;9:519–543.
- Somlai AM, Kelly JA, McAuliffe TL, Ksobiech K, Hackl KL. Predictors of HIV sexual risk behaviors in a community sample of injection drug-using men and women. *AIDS and Behavior* 2003;7:383–93. [PubMed: 14707535]
- Strathdee SA, Sherman SG. The role of sexual transmission of HIV infection among injection and non-injection drug users. *Journal of Urban Health* 2003;80:iii7–14. [PubMed: 14713667]
- Unger JB, Kipke MD, De Rosa CJ, Hyde J, Ritt-Olson A, Montgomery S. Needle-sharing among young IV drug users and their social network members: The influence of the injection partner's characteristics on HIV risk behavior. *Addictive Behaviors* 2006;31:1607–18. [PubMed: 16459023]
- van Ameijden EJC, Coutinho RA. Maximum impact of HIV prevention measure targeted at injecting drug users. *AIDS* 1998;12:625–633. [PubMed: 9583603]
- Weeks MR, Grier M, Romero-Daza N, Puglisi-Vasquez MJ, Singer M. Streets, drugs, and the economy of sex in the age of AIDS. *Women and Health* 1998;27:205–29.
- Whiffen VE, Macintosh HB. Mediators of the Link between Childhood Sexual Abuse and Emotional Distress: A Critical Review. *Trauma, Violence and Abuse* 2005;6:24–39.

TABLE 1

Univariate correlates of having unprotected sex within a dyad – individual attributes. New York City, United States, 1999-2003, sexually active young injecting drug users (dyad N=235).

Characteristic	No unprotected sex % (N) Or mean (SD)	Unprotected sex % (N) or mean (SD)	OR (95%CI)
<i>Individual attributes</i>			
Female gender			
no	32.1 (44)	67.9 (93)	(reference category)
yes	34.7 (34)	65.3 (64)	0.9 (0.5 , 1.6)
White ethnicity			
no	38.6 (22)	61.4 (35)	(reference category)
yes	31.5 (56)	68.5 (122)	1.3 (0.7 , 2.5)
Age	24.2 (4.5)	24.2 (4.5)	1.0 (0.9 , 1.1)
Homeless			
no	34.0 (36)	66.0 (70)	(reference category)
yes	32.6 (42)	67.4 (87)	1.1 (0.6 , 1.9)
Income in last 6 months lt \$5000			
no	31.9 (38)	68.1 (81)	(reference category)
yes	34.5 (40)	65.5 (76)	0.9 (0.5 , 1.5)
High school degree			
no	32.2 (39)	67.8 (82)	(reference category)
yes	34.2 (39)	65.8 (75)	0.9 (0.5 , 1.6)
Currently in treatment			
no	34.4 (77)	65.6 (147)	(reference category)
yes	9.1 (1)	90.9 (10)	5.0 (0.6 , 40.8)
Severity of heroin dependence			
no	29.0 (27)	71.0 (66)	(reference category)
yes	35.9 (51)	64.1 (91)	0.7 (0.4 , 1.3)
Sexual abuse ever			
no	35.3 (65)	64.7 (119)	(reference category)
yes	25.5 (13)	74.5 (38)	1.7 (0.8 , 3.3)
Physical abuse ever			
no	30.2 (45)	69.8 (104)	(reference category)
yes	38.4 (33)	61.6 (53)	0.7 (0.4 , 1.2)
Depression			
no	36.4 (40)	63.6 (70)	(reference category)
yes	30.6 (38)	69.4 (86)	1.3 (0.8 , 2.3)
MSM			
no	33.6 (78)	66.4 (154)	(reference category)
yes	0.0 (0)	100 (3)	Zero cell, aOR cannot be computed
WSW			
no	32.0 (64)	68.0 (136)	(reference category)
yes	40.0 (14)	60.0 (21)	0.7 (0.4 , 1.4)
Inject daily			

Characteristic	No unprotected sex % (N) Or mean (SD)	Unprotected sex % (N) or mean (SD)	OR (95%CI)
no	24.1 (21)	75.9 (66)	(reference category)
yes	38.5 (57)	61.5 (91)	0.5* (0.3, 0.9)
Injecting crack any			
no	32.7 (73)	67.3 (150)	(reference category)
yes	41.7 (5)	58.3 (7)	0.7 (0.2, 2.1)
Injecting cocaine any			
no	32.1 (52)	67.9 (110)	(reference category)
yes	35.6 (26)	64.4 (47)	0.9 (0.5, 1.6)
Injecting heroin any			
no	12.5 (2)	87.5 (14)	(reference category)
yes	34.7 (76)	65.3 (143)	0.3 (0.1, 1.1)
Injecting speedball any			
no	32.4 (58)	67.6 (121)	(reference category)
yes	35.7 (20)	64.3 (36)	0.8 (0.5, 1.6)
Injecting amphetamine any			
no	33.6 (78)	66.4 (154)	(reference category)
yes	0.0 (0)	100 (3)	Zero cell, aOR cannot be computed
Safe sex attitude score	5.2 (0.9)	4.6 (1.2)	0.6** (0.5, 0.8)

*
p<0.05

**
p<0.01

TABLE 2

Univariate correlates of having unprotected sex within a dyad – social and risk network characteristics and dyad-level characteristics. New York City United States 1999-2003 sexually active young injecting drug users (dyad N=235).

Characteristic	No unprotected sex % (N) or mean (SD)	Unprotected sex % (N) or mean (SD)	OR (95%CI)
<i>Social and risk network characteristics</i>			
Number of all sex partners (aggregate network)	2.8 (6.2)	2.2 (4.4)	1.0 (0.9 , 1.0)
Number of all sex partners (nominated network)	1.6 (0.9)	1.3 (0.7)	0.6* (0.4 , 0.9)
Number of injecting partners (aggregate network)	3.1 (6.3)	2.2 (2.9)	1.0 (0.9 , 1.0)
Number of injecting partners (nominated network)	1.5 (1.0)	1.3 (1.1)	0.9 (0.7 , 1.1)
Size of nominated network	4.1 (2.0)	3.4 (2.3)	0.9* (0.7 , 1.0)
Density of nominated network	0.09 (0.20)	0.08 (0.21)	0.7 (0.2 , 2.6)
Average duration of relationships in nominated network	62.0 (56.5)	63.1 (62.3)	1.0 (1.0 , 1.0)
Sold sex			
no	32.9 (73)	67.1 (149)	(reference category)
yes	38.5 (5)	61.5 (8)	0.8 (0.2 , 2.6)
<i>Dyad level characteristics</i>			
Same-ethnicity partner			
no	28.6 (20)	71.4 (50)	(reference category)
yes	35.2 (58)	64.8 (107)	0.7 (0.4 , 1.3)
Very close emotionally			
no	43.3 (45)	56.7 (59)	(reference category)
yes	25.2 (33)	74.8 (98)	2.3** (1.3 , 4.0)
Duration of relationship (months)	36.2 (51.2)	36.3 (41.3)	1.0 (1.0 , 1.0)
Daily contact			
no	45.6 (41)	54.4 (49)	(reference category)
yes	25.5 (37)	74.5 (108)	2.5** (1.4 , 4.5)
Drank alcohol together			
no	41.3 (43)	58.7 (61)	(reference category)
yes	26.7 (35)	73.3 (96)	1.9* (1.1 , 3.4)
Smoked crack or sniffed cocaine together			
no	34.8 (69)	65.2 (129)	(reference category)
yes	24.3 (9)	75.7 (28)	1.8 (0.8 , 4.2)
Smoked methamphetamines together			
no	33.6 (78)	66.4 (154)	(reference category)
yes	0.0 (0)	100 (3)	Zero cell, aOR cannot be computed
IDU sex partner			
no	40.7 (44)	59.3 (64)	(reference category)
yes	26.8 (34)	73.2 (93)	1.9* (1.1 , 3.2)
Injected together			
no	38.5 (45)	61.5 (72)	(reference category)
yes	28.0 (33)	72.0 (85)	1.6 (0.9 , 2.8)

Characteristic	No unprotected sex % (N) or mean (SD)	Unprotected sex % (N) or mean (SD)	OR (95%CI)
Shared cookers			
no	37.8 (70)	62.2 (115)	(reference category)
yes	16.0 (8)	84.0 (42)	3.2 ^{**} (1.4, 7.0)
Shared needles (receptive or distributive)			
no	37.5 (75)	62.5 (125)	(reference category)
yes	8.6 (3)	91.4 (32)	6.8 ^{**} (2.0, 23.6)
Time since first had sex	18.0 (29.8)	32.7 (71.5)	1.0 (1.0, 1.0)
Daily sexual contact			
no	36.4 (72)	63.6 (126)	(reference category)
yes	16.2 (6)	83.8 (31)	2.9 [*] (1.1, 7.5)
Participant knows that the nominated sex partner has other sex partners			
no	51.0 (25)	49.0 (24)	(reference category)
yes	28.5 (53)	71.5 (133)	2.6 ^{**} (1.4, 4.9)
Partner sold sex (past 6 months)			
no	33.8 (69)	66.2 (135)	(reference category)
yes	29.0 (9)	71.0 (22)	1.2 (0.6, 2.7)
HIV status			
concordant negative	32.5 (74)	67.5 (154)	(reference category)
discordant	57.1 (4)	42.9 (3)	0.4 (0.1, 1.4)
concordant positive	0 (0)	0 (0)	N/A
Encouragement to always use condoms			
none encourages	23.8 (43)	76.2 (138)	(reference category)
one encourages	44.8 (13)	55.2 (16)	0.3 ^{**} (0.1, 0.7)
both encourage	88.0 (22)	12.0 (3)	0.04 ^{**} (0.01, 0.14)

*
p<0.05

**
p<0.01

TABLE 3

Multivariate correlates of having unprotected sex within a dyad. New York City, United States, 1999-2003, sexually active young injecting drug users (dyad N=235).

Characteristic	aOR (95%CI)	p-value
<i>Individual attributes</i>		
Inject daily	0.46 (0.28, 0.76)	0.0024
Higher safe sex attitude score	0.61 (0.45, 0.82)	0.0011
<i>Dyad level characteristics</i>		
Smoked crack or sniffed cocaine together	4.8 (1.3, 18.3)	0.0200
Shared needles (receptive or distributive)	4.5 (1.3, 16.3)	0.0202
Participant knows that the nominated sex partner has other sex partners	3.0 (1.3, 6.7)	0.0074
Encouragement to always use condoms		
none encourages	(reference category)	
one encourages	0.39 (0.15, 1.04)	0.0610
both encourage	0.02 (0.01, 0.09)	<.0001