Published in final edited form as:
AIDS Behav. 2010 February ; 14(1): 141–151. doi:10.1007/s10461-008-9518-6.

Injecting Equipment Sharing in Russian Drug Injecting Dyads

V. Anna Gyarmathy,
European Monitoring Centre for Drugs and Drug Addiction, Lisbon, Portugal
anna.gyarmathy@emcdda.europa.eu

Nan Li,
Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Karin E. Tobin,
Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Irving F. Hoffman,
University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Nikolai Sokolov,
Biomedical Center, St. Petersburg State University, St. Petersburg, Russia

Julia Levchenko,
Biomedical Center, St. Petersburg State University, St. Petersburg, Russia

Julia Batluk,
Biomedical Center, St. Petersburg State University, St. Petersburg, Russia

Andrei A. Kozlov,
Biomedical Center, St. Petersburg State University, St. Petersburg, Russia

Andrei P. Kozlov, and
Biomedical Center, St. Petersburg State University, St. Petersburg, Russia

Carl A. Latkin
Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Abstract

In this study, we investigated how individual attributes, dyad characteristics and social network characteristics may influence engaging in receptive syringe sharing, distributive syringe sharing and sharing cookers in injecting partnerships of IDUs in St Petersburg, Russia. We found that all three levels were associated with injecting equipment sharing, and that dyad characteristics were modified by characteristics of the social network. Self-reported HIV discordance and male gender concordance played a role in the risk of equipment sharing. Dyad interventions may not be sufficient to reduce injecting risk in IDU partnerships, but a combination of dyad and network interventions that target both IDU partnerships and the entire IDU population may be more appropriate to address injecting risk among IDUs.

Keywords

Injecting drug users; Risk networks; Injecting risk; Dyad analysis; Russia

Introduction

Risk environments are supra-individual factors that may influence the risk of HIV infection among injecting drug users (IDUs) (Rhodes et al. 1999). Social networks are a type of risk

environment that may have powerful influences on drug injecting and HIV risk. They can be described by, for example, their structure (e.g., network size, density, i.e., the extent of connections between network ties), composition (e.g., gender, ethnicity) and function (social support, drug use, sex), and can be approached at three levels (sociocentric, egocentric, and dyad) (De et al. 2007; Neaigus 1998). In addition, a network can also be described by the strength of ties: strong ties are close friends whereas weak ties are acquaintances (Granovetter 1983)—most risk behaviors occur within the context of strong ties (Valente and Vlahov 2001). The sociocentric network refers to all ties between all people in a social network. The egocentric or personal network is the direct ties of a given person. A tie between two people, referred to as a dyad, and can be viewed as the actual risk interaction within the social network. Thus, dyadic ties and their surrounding personal networks may have a unique influence on the individual level behavior based on the nature of the relationship within the network and/or within the dyad. Social networks have found to play a role in the initiation, continuation, and cessation of both drug use/injecting and HIV risk behaviors (De et al. 2007)—for example, larger IDU networks and higher network density have been found to be associated with injecting equipment sharing (Gyarmathy and Neaigus 2006; Latkin et al. 1996, 1994). Social network characteristics of other at-risk populations (men who have sex with other men) in Russia have been found to be significantly associated with HIV risk (Amirkhanian et al. 2006), but little is known about the social networks of Russian IDUs.

Partnership dissimilarity is one aspect of dyadic relationships that may influence interactions within the dyad and thus affect HIV risk. For example, IDUs who know that they are HIV infected may change their syringe sharing and other risk behaviors towards other IDUs they assume are HIV uninfected (Des Jarlais et al. 2004): they may engage in distributive syringe sharing less often to reduce the chance of infecting other IDUs who they believe are uninfected (Des Jarlais et al. 2004; Desenclos et al. 1993; Schlumberger et al. 1999). As such, the risk of receptive or distributive syringe sharing in injecting dyads may be influenced by the knowledge of HIV infected or uninfected status, or rather, perceived HIV discordance and HIV concordance.

Rates of HIV have dramatically increased in Eastern Europe after the 1990s (European Centre for the Epidemiological Monitoring of AIDS 2007; Friedman et al. 2006; Hamers and Downs 2003). In the Russian Federation alone, a cumulative total of over 370,000 HIV were detected by 2006, over 80% of which are related to drug injecting (Rhodes et al. 2006). St Petersburg is one of the largest cities in Russia, where prevalence of HIV among IDUs has been reported to be 30% (Kozlov et al. 2006). In Russia, syringes can be legally purchased in pharmacies without prescription, but IDUs are often treated poorly by pharmacists and harassed by the police (Sarang et al. 2008).

The aim of this analysis was to assess injecting equipment sharing among injecting dyads in a sample of injection drug users in St Petersburg, Russia, as part of a social network intervention among IDUs to prevent HIV. We hypothesize that injecting equipment sharing is influenced at three levels: at the individual level (influenced by individual characteristics); at the dyad level (influenced by dyad partnership characteristics); and at the personal network level (influenced by the characteristics of all personal network members of the participant) (Gyarmathy and Neaigus 2007). We also hypothesize that partnership dissimilarities also influence HIV risk behaviors with dyads, and that, for the same characteristics, the dyad level effect is modified by the effect of the social network. Assessing patterns of drug injecting equipment sharing in IDU networks will help develop appropriate interventions to reduce the prevalence of HIV and other blood-borne infections among the interconnected populations of IDUs.

Methods

Setting and Participants

IDUs were recruited to participate in a currently ongoing network intervention study in St. Petersburg, Russia. The study is a randomized controlled trial to assess the effect of a network-oriented peer-educator intervention to prevent HIV infection among IDUs and their HIV risk network members. A combination of street outreach and chain referral methods was used to recruit participants. We identified though 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 (street outreach) (Friedman et al. 1999; 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). About half (52%) were recruited through out-reach, and the rest through chain referral. Eligibility criteria were being 18 years old or older and having injected drugs in the past 30 days. Eligible participants provided written informed consent, completed an interviewer assisted risk survey, and received pre-test counseling and provided blood samples to test for HIV and HCV. HIV antibodies were detected using two consecutive enzyme immunological assays (EIA) (Vironostika HIV Uni-Form II *plus O*, Biomerieux, NL). Positive HIV EIA tests were confirmed with Western Blot (New LAV Blot I, BioRad, France). HCV antibodies were detected using Myrex anti-HCV (version 4.0) based on highly purified antigens which contain sequences from the core, NS3, NS4 and NS5 regions of HCV. Participants received food items (equivalent to USD 10) to participate. The Institutional Review Boards of the Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA and the St. Petersburg University, St. Petersburg, Russia approved the study. This report is based on data collected at baseline, between December 2004 and July 2007.

Measures and Variables

Individual level characteristics were age (dichotomized as under 30 vs. 30 and above), gender (female and male), having at least a high school education, marital status (single vs. non-singe), living with parents, homelessness, income in the past 3 months, working part time or full time, being unemployed, self-reported HIV infection (was never tested, self-reported HIV negative, self-reported HIV positive), past 3-month injecting of heroin (daily injector vs. non-daily injector) and of stimulants or speedball (any vs. none).

Nominated egocentric network data were collected by asking participants to name those people whom they had contact with in the past 6 months who provided physical assistance, material aid, health advice, drugs, and whom they used drugs with or had sex with, and participants were asked which of these network members injected drugs. In addition, participants were also asked to report which of the nominated network members knew which other nominated network members (network density). This egocentric network data was used to create the dyad level and social network level variables. Ties to these nominated network members are, by definition (Granovetter 1983), strong network ties.

Dyad level variables were as follows. An *injecting dyad* was defined as a dyad where the IDU participant reported that the network member was another IDU and that they used drugs together in the past 6 months. *Injecting equipment sharing variables*, the dependent variables in this analysis, assessed whether, during the past 6 months, the study participant engaged in (1) receptive needle sharing (participant got used syringes or needles from the network member); (2) distributive syringe sharing (participant gave used syringes or needles to the network member); and (3) sharing cookers within the injecting dyad. We assessed the following six relationship types within dyads: sexual partnership, trust, dependence on resources, social

support, social exposure and perception of network risk. *Sexual partnership* was assessed by whether the participant reported having sex with the network member and *trust* was assessed by assigning the network member a score greater than five on a scale of one (no trust) to ten (trust with my life). Using the operator "or", dependence on resources (five variables), social support (two variables), social exposure (two variables) and perception of network risk (two variables) binary measures were created the following way. The *dependence on resources* measure was created based on whether participant reported: 1. getting drugs from, or 2. giving drugs to, or 3. giving financial support to, or 4. sharing an apartment with the network member, or 5. having the network member pay for rent or groceries. The *social support* measure (emotional and informational support) assessed whether the participant reported that they discussed: 1. personal matters or 2. health-related matters with the network member. *Social exposure* measured whether participant and network member: 1. saw each other daily or 2. they got together to have fun and relax. The *perception of network risk* measure was created based on whether the participant reported that his or her network member also shared: 1. cookers or 2. needles with other injecting drug users. In addition, we assessed two types of partnership dissimilarity: gender dissimilarity and self-reported HIV dissimilarity. *Gender dissimilarity* was: 1. female concordant (both participant and network member are females), 2. gender discordant (either the participant or the network member is male and the other is female), and 3. male concordant (both participant and network member are males). For the analysis of receptive and distributive syringe sharing (directional sharing), *self-reported HIV dissimilarity* was coded as: 1. concordant perceived negative (neither participant nor the network member was reported being infected), 2. participant perceived negative and network member reported as infected, 3. participant reported being infected and network member is perceived negative, and 4. concordant positive (both the participant and the network member were reported being infected). For the analysis of sharing cookers (non-directional sharing), self-reported HIV dissimilarity was coded as: 1. concordant perceived negative, 2. discordant (either the participant or the network member was reported being infected while the other was not reported being infected), and 3. concordant positive. Note: HIV infection of the network member was reported by the participant based on his/her knowledge.

Social network level variables were binary variables that indicated whether the participant had any non-injecting and injecting network members that were sex partners, that participants trusted, depended on for resources, had social support relationship with, had social exposure to and (for IDU network members only) perceived as risky. In addition, altogether two binary network density variables were also created, one assessing the density of the non-injecting network (density of zero vs. density greater than zero, meaning two or more of the non-injecting network members knew each other) and one assessing the density of the injecting network (density of zero vs. density greater than zero, meaning two or more of the injecting network members knew each other).

Statistical Analysis

Participants were able to report up to 20 network members. Of the 619 eligible participants who were interviewed at baseline, 570 (92%) participants nominated altogether 1,692 injecting dyads, and 49 participants (8%) reported no dyads. The maximum number of reported injecting dyads was 12 (mean = 3, median = 3, SD = 1.6). Those who reported injecting dyads compared to those who did not report injecting dyads were significantly more likely to inject heroin daily (61 vs. 25%), and they were not significantly different regarding age, gender, any stimulant injecting, or any speedball injecting. This analysis is based on 570 participants and a total of 1,692 injecting dyads that they reported.

The unit of analysis was the injecting dyad. Univariate analyses were performed to select candidate variables for multivariate analyses. Univariate contingency tables are presented to

describe distribution and univariate generalized estimating equations (GEE) with corresponding *z*-statistics *P* values assessed associations. GEE was used to account for sampling dependence and the correlation among nominated network members as resulting from the clustering of network members within individual participants (Liang and Zeger 1986). Variables with associations of $P < 0.20$ in the univariate analysis were entered in multivariate GEE regression models. Multivariate GEE models with backwards elimination assessed significant associations with the dependent variables. Pearson product–moment correlation was used to assess correlation between the independent variables (Kenny et al. 2006).

Social network characteristics may modify individual or dyad level characteristics. This modifying effect of the social network can be tested by creating interaction composite variables between the social network variables and the individual/dyad level variables (Gyarmathy and Latkin 2008; Gyarmathy and Neaigus 2006; Neaigus et al. 2006). If the composite variables are significant, then the social network has a modifying effect on the other level variables. To test the hypothesis that, for the same characteristics, the dyad level effect is modified by the effect of the social network, when a partnership type variable was significant on both the social network level and the dyad level in the final multivariate model, the following dyad level composite variables were created and tested for significance: 1. characteristics absent from the network (reference), 2. characteristics present in the network but absent from the dyad, and 3. characteristics present in the dyad. To show the modifying effect of the social network, all levels of the composite variables stayed in the multivariate model, regardless of the significance level. Adjusted odds ratios (aOR) and 95% confidence intervals (95% CI) are reported.

Results

Participant Characteristics

Of the 570 participants, 58% were age 30 or above; approximately one-third (32%) were female, about half had at least a high school education (53%), were single (49%) or lived with parents (54%). One person reported being homeless. Over half (57%) reported making 8,000 Rubles (about USD 300) per month. Same-sex sexual relationships in the past 90 days were reported by 15 participants (3%; eight males and seven females). About one in ten (14%) reported working full time, a quarter working part time (25%), and almost two-thirds reported being unemployed (61%). About one-third (38%) reported never been tested for HIV, two in five (43%) reported being HIV negative, and one in five (20%) reported being HIV infected. HIV seroprevalence was 43%. Most participants were daily heroin injectors (61%); about one-third (29%) reported injecting some stimulants in the past 3 months, and few (6%) reported injecting speedball (a mixture of heroin and stimulants). Participants reported a mean of 2.7 (SD = 1.9) network members that they shared cookers with, 1.0 (SD = 1.2) network members that they engaged in receptive syringe sharing with, and 1.1 (SD = 1.3) network members they engaged in distributive syringe sharing with.

Of the 1,692 dyads, 29% reported receptive syringe sharing, 33% reported distributive syringe sharing and 82% reported sharing cookers (Table 1)—any syringe sharing (receptive of distributive) was reported by 41% of dyads and any injecting equipment sharing (receptive or distributive syringe sharing or sharing cookers) was reported by 85% of the dyads. There was significant and moderate correlation between sharing cookers and receptive syringe sharing (Pearson's $r = 0.24$), sharing cookers and distributive syringe sharing (Pearson's $r = 0.23$), and receptive and distributive syringe sharing (Pearson's $r = 0.51$). Altogether 15% were sexual partnerships, 41% trusting partnerships, 81% depended on each other for resources, 45% provided each other with social support, 65% had social exposure to each other, and 69% reported risk behavior of the network member (Table 1).

Univariate Analysis

Of the *individual attributes*, younger age was associated with all three types of sharing; daily heroin injecting with distributive syringe sharing; and any stimulant or speedball injecting with sharing cookers (Table 1). Of the *dyad variables*, sexual partnership, trusting partnership, dependence on resources, social support, social exposure, perception of network risk, HIV discrepancy and gender discrepancy were associated with all three types of sharing. Of the *social network characteristics*, any perception of network risk was a risk for all three types of sharing (Table 2). Having any sex partner IDUs, receiving social support from IDUs and having non-IDU sex partners were risk factors for both receptive and distributive syringe sharing but not for sharing cookers. A lower number of IDU network members was associated with distributive syringe sharing, whereas a higher number of IDU network members was associated with sharing cookers. Any dependence on resources of IDU network members and no social support from non-IDU network members was a risk for sharing cookers. A lower number of non-IDU network members was associated with receptive syringe sharing. Having social exposure to IDUs was associated with distributive syringe sharing. Having trusted non-IDU network members and non-IDU network density (two or more non-IDU network members knowing each other) were inversely associated with receptive syringe sharing and sharing cookers, but not with distributive syringe sharing. Having trusted IDU network members, IDU network density (two or more IDU network members knowing each other), dependence on resources of non-IDU network members, and any social exposure to non-IDU network members were not significantly associated with any of the sharing variables.

Multivariate Analysis

In multivariate models, the following variables showed significant association with injecting equipment sharing. Of the *individual variables*, younger age was associated with receptive and distributive syringe sharing, daily heroin injecting with distributive syringe sharing, and any stimulant or speedball injecting with sharing cookers (Table 3). Of the *dyad characteristics*, sexual partnership, dependence on resources and social exposure were associated with all three types of sharing. Trust in the partnership was associated with receptive syringe sharing and sharing cookers, but not with distributive syringe sharing. Social support was associated with distributive syringe sharing. In addition, compared to concordant HIV negative partnerships, partnerships where the ego reported being HIV negative and the partner was reported being HIV positive were less likely to engage in receptive syringe sharing, and partnerships where the ego reported being HIV positive and the partner was reported being HIV negative were less likely to engage in distributive syringe sharing. Concordant positive partnerships were more likely to engage in both receptive and distributive syringe sharing, and HIV discordant dyads were less likely to share cookers. Compared to dyads where both ego and partner were female, male dyads were significantly more likely to share cookers. Perception of network risk on only the dyad level was associated with receptive syringe sharing and sharing cookers, and both on the dyad and social network level with distributive syringe sharing the following way. Compared to dyads where the ego had no perception of network risk, dyads where the ego had perception of network risk outside the dyad were less likely, and dyads where the ego had perception of network risk in the dyad were more likely to engage in distributive syringe sharing. Of the *social network characteristics*, non-IDU network density (two or more non-IDU network members knowing each other) was inversely associated with sharing cookers.

Discussion

In this study, we investigated how individual attributes, dyad characteristics and social network characteristics may influence engaging in receptive syringe sharing, distributive syringe sharing and sharing cookers in Russian IDU dyads. We found that all three levels were associated with injecting equipment sharing, and that dyad characteristics were affected by

characteristics of the social network. In addition, self-reported HIV discordance and male gender concordance played a role in the risk of equipment sharing.

Some studies examining unsafe injecting among IDUs assess syringe/needle sharing regardless of the direction of sharing (Cox et al. 2008; Perngmark et al. 2008; Shearer et al. 2007), while others assess directional syringe/needle sharing (receptive vs. distributive) (Heimer et al. 2008; Magis-Rodriguez et al. 2005; Todd et al. 2008). In this study of Russian IDU dyads, while there was moderate correlation between receptive and distributive syringe sharing, we found slightly different patterns of association for them. For example, trust was associated with receptive syringe sharing, but not with distributive syringe sharing, and social support was associated with distributive syringe sharing but not with receptive syringe sharing, suggesting different relationship dynamics for receptive versus distributive syringe sharing. Trust may be a marker for vulnerability for risk behaviors within a relationship, while an unwanted consequence of social support among IDUs may be supplying each other with used injecting equipment.

An important finding of this study is that personal networks may influence unsafe injecting behavior within the injecting dyad. The reverse association of sharing cookers *within the dyad* and two or more non-IDU network members knowing each other *within the network* suggests a positive effect of non-IDUs probably through descriptive non-IDU social norms, peer surveillance, social control, and/or maybe more social integration (Gyarmathy and Neaigus 2005; Latkin et al. 1998; Latkin and Knowlton 2005; Smith et al. 2004). In addition, the association of receptive and distributive syringe sharing and the sharing of cookers with perception of network risk suggests that sharing in this population of IDUs may be a "social epidemic" (Gyarmathy and Neaigus 2006), whereby, through the diffusion of injecting practices within the population (Rogers 2003), the more IDUs perceive that their network members share injecting equipment with others, the more likely they are to share (Valente 1995). However, the injecting dyad's sharing behavior may have an additional effect for distributive syringe sharing as shown by our finding that IDUs are more likely to give their used syringes to those injecting dyad network members who they know also share with others than to those who do not share with others. IDUs risk perception may not only be based on an assessment of injecting practices as high risk and low risk (e.g., sharing vs. not sharing, cleaning vs. not cleaning), but it may also involve selective risk taking based on the risk assessment of the injecting dyad network members (Gyarmathy et al. 2006; Valente and Vlahov 2001). IDUs may assess other IDUs as high risk or low risk based on their knowledge about these other IDUs' syringe sharing practices and thus may be more likely to give their used syringes to those IDUs whom they consider high risk. This finding is in contrast with the finding related to unsafe sex among IDU sexual dyads, where the social network level had no association with the unsafe risk behavior (Gyarmathy and Neaigus 2007). The reason for this may be that while sex occurs (and is discussed) mainly in dyads, injecting may mostly occur (and is discussed) in groups larger than two people.

The associations of injecting equipment sharing with partnership dissimilarities are noteworthy. Russia is a gender conscious society, where strong gender inequalities exist in health, politics and society, with males exhibiting more risk behaviors, lower life expectancies, poor morbidity indicators, and interpersonal violence directed toward women (Somach et al. 2004). In that light, our finding that male–male dyads are more likely to share cookers than female–female or female–male dyads, is not surprising. The negative association of self-reported HIV discordance with injecting equipment sharing has several implications. We found that those IDUs who self-reported being HIV infected had lower odds of engaging in risk behaviors towards their perceived HIV negative injecting dyad network member. Such "informed altruism" (Des Jarlais et al. 2004) may aim to protect those who presume being HIV uninfected, but at the same time, IDUs may rely on a prevention method that is not entirely

effective. In this population, HIV seroprevalence was twice the prevalence of self-reported HIV, indicating that a large proportion of this IDU population is unaware of their HIV infection. HIV prevention programs among IDUs in Russia need to incorporate confidential testing and counseling, highlight existing HIV disclosure norms, and emphasize the importance of being uninfected with HIV (Gyarmathy et al. 2006).

Other studies have also found an association between injecting risk and sexual risk (Evans et al. 2003; Unger et al. 2006). Injecting and sexual risk may co-occur as a result of higher trust levels in intimate relationships, including trusting to disclose infection status, or as a consequence of relationship dynamics that make it difficult not to engage in high-risk behaviors (unsafe injecting or unprotected sex) with an intimate partner (Gyarmathy et al. 2006; Neaigus et al. 1995; Unger et al. 2006). Male IDUs who have sex with other males are a special population among IDUs (Lambert et al. 2005). In a post hoc analysis of this sample, we found that the number of male sex partner dyads ($n = 4$ out of 1,692; 0.2% or all dyads) in this study sample was small, so no conclusive analysis could be performed. More research is needed among Russian MSM injecting dyads to assess the injecting risk among male concordant dyads that are also sex partners.

Some non-significant results are noteworthy, including the lack of an association between two or more IDU network members knowing each other and injecting equipment sharing. A key to the success of HIV prevention network interventions is to increase interactions among IDUs to promote HIV prevention messages within their population (Neaigus 1998). Our finding that IDU network density was not associated either in the univariate or in the multivariate analysis with an increased risk of either receptive/distributive syringe sharing or sharing cookers, suggests that increasing network density in IDU networks in network interventions may lead to an increase of information flow about HIV prevention messages without increasing unsafe injecting.

A limitation of this analysis is that dyad analysis assesses risk behaviors in partnerships with strong ties but not non-nominated partnerships with weak ties (Gyarmathy and Neaigus 2007). However, the majority of risk behaviors takes place in relationships with strong ties (Valente and Vlahov 2001). This may be an explanation why we found a significant moderate correlation between receptive and distributive syringe sharing within the strong ties of dyads in this analysis, while in another analysis assessing all ties (both strong and weak) of Russian IDUs, there was no correlation between receptive and distributive syringe sharing (Gyarmathy et al. 2009). Within dyad relationships, many aspects of relationships may influence injecting risk behaviors, but we were examining only selected dyad partnership characteristics. Other dyad characteristics that we did not assess in this study may also be associated with unsafe injecting in dyads. The perception of network risk variable may be a true measure of network risk, but it may also be a validation of the dependent variable, or a proxy of other characteristics, such as closeness (people may disclose that they share with others to their closest friends). In addition, we did not collect data about the drawing order when sharing cookers, and considered sharing cookers as non-directional sharing.

This study shows that injecting equipment sharing in IDU dyadic partnerships may be influenced not only by individual characteristics and dyad characteristics, but also by social network characteristics, and the combination of dyad and network characteristics. As such, dyad interventions may not be sufficient to reduce injecting risk in IDU partnerships, but a combination of dyad and network interventions that target both IDU partnerships and the entire IDU population may be more appropriate to address injecting risk among IDUs in St Petersburg, Russia. In addition, our finding that receptive and distributive syringe sharing have different patterns of association suggests that both dyad/network interventions and individual counseling should address the two types of syringe sharing as two different behaviors that may

have different risk dynamics. One recommendation of network interventions is to increase the number of non-IDUs among the network members of IDUs, but they also caution that, as a reverse effect, those non-IDU network members may be at risk for starting to inject (Costenbader et al. 2006). The inverse association in this study of non-IDU network density with sharing cookers may offer a solution to this dilemma with the recommendation of increasing not the number of but the interaction between non-IDU network members within the social network of IDUs.

Acknowledgments

The study was funded by National Institute on Drug Abuse, Grant number R01 DA016142. The first author was funded by the Ruth L. Kirschstein award, Drug Dependence Epidemiology Training Program, National Institute on Drug Abuse, Grant T32 DA007292. We would like to thank all participants and study staff.

References

Amirkhanian YA, Kelly JA, Kirsanova AV, DiFranceisco W, Khoursine RA, Semenov AV, et al. HIV risk behaviour patterns, predictors, and sexually transmitted disease prevalence in the social networks of young men who have sex with men in St Petersburg, Russia. International Journal of STD and AIDS 2006;17:50–56. doi:10.1258/095646206775220504. [PubMed: 16409680]

Costenbader EC, Astone NM, Latkin CA. The dynamics of injection drug users' personal networks and HIV risk behaviors. Addiction (Abingdon, England) 2006;101:1003–1013. doi:10.1111/j.1360-0443.2006.01431.x.

Cox J, De P, Morissette C, Tremblay C, Stephenson R, Allard R, et al. Low perceived benefits and self-efficacy are associated with hepatitis C virus (HCV) infection-related risk among injection drug users. Social Science and Medicine 2008;66:211–220. doi:10.1016/j.socscimed.2007.08.022. [PubMed: 17920741]

De P, Cox J, Boivin JF, Platt RW, Jolly AM. The importance of social networks in their association to drug equipment sharing among injection drug users: A review. Addiction (Abingdon, England) 2007;102:1730–1739. doi:10.1111/j.1360-0443.2007.01936.x.

Des Jarlais DC, Perlis T, Arasteh K, Hagan H, Milliken J, Braine N, et al. "Informed altruism" and "partner restriction" in the reduction of HIV infection in injecting drug users entering detoxification treatment in New York City, 1990–2001. Journal of Acquired Immune Deficiency Syndromes 2004;35:158–166. doi:10.1097/00126334-200402010-00010. [PubMed: 14722449]

Desenclos JC, Papaevangelou G, Ancelle-Park R. Knowledge of HIV serostatus and preventive behaviour among European injecting drug users. The European community study group on HIV in injecting drug users. AIDS (London, England) 1993;7:1371–1377. doi:10.1097/00002030-199310000-00011.

European Centre for the Epidemiological Monitoring of AIDS. HIV/AIDS surveillance in Europe, end year report 2006. Vol. 73. Institute de Veille Sanitaire; Saint Maurice: 2007.

Evans JL, Hahn JA, Page-Shafer K, Lum PJ, Stein ES, Davidson PJ, et al. 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;80:137–146. doi:10.1093/jurban/jtg137. [PubMed: 12612103]

Friedman, SR.; Curtis, R.; Neaigus, A.; Jose, B.; Des Jarlais, DC. Social networks, drug injectors' lives, and HIV. Plenum; New York: 1999.

Friedman SR, Kippax SC, Phaswana-Mafuya N, Rossi D, Newman CE. Emerging future issues in HIV/AIDS social research. AIDS (London, England) 2006;20:959–965.

Granovetter M. The strength of weak ties: A network theory revisited. Sociological Theory 1983;1:201–233. doi:10.2307/202051.

Gyarmathy VA, Latkin CA. Individual and social factors associated with participation in treatment programs for drug users. Substance Use and Misuse 2008;43:1865–1881. doi:10.1080/10826080802293038. [PubMed: 19016169]

Gyarmathy VA, Neaigus A. Marginalized and socially integrated groups of IDUs in Hungary: Potential bridges of HIV infection. Journal of Urban Health 2005;82:iv101–iv112. doi:10.1093/jurban/jti112. [PubMed: 16107433]

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. The relationship of sexual dyad and personal network characteristics and individual attributes to unprotected sex among young injecting drug users. AIDS and Behavior. 2007 doi:10.1007/s10461-007-9285-9.

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–S69. doi:10.1016/S0376-8716(06)80011-6. [PubMed: 16769448]

Gyarmathy V, Li N, Tobin K, Hoffman I, Sokolov N, Levchenko J, et al. Correlates of unsafe injecting among injecting drug users in St Petersburg, Russia. European Addiction Research. 2009 in press.

Hamers FF, Downs AM. HIV in central and eastern Europe. Lancet 2003;361:1035–1044. doi:10.1016/S0140-6736(03)12831-0. [PubMed: 12660072]

Heimer R, Barbour R, Shaboltas AV, Hoffman IF, Kozlov AP. Spatial distribution of HIV prevalence and incidence among injection drugs users in St Petersburg: Implications for HIV transmission. AIDS (London, England) 2008;22:123–130.

Kenny, DA.; Kashy, DA.; Cook, W. Dyadic data analysis. The Guilford Press; New York, NY: 2006.

Kozlov AP, Shaboltas AV, Toussova OV, Verevochkin SV, Masse BR, Perdue T, et al. HIV incidence and factors associated with HIV acquisition among injection drug users in St Petersburg, Russia. AIDS (London, England) 2006;20:901–906. doi:10.1097/01.aids.0000218555.36661.9c.

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–i8. doi:10.1093/jurban/jti018. [PubMed: 15738326]

Latkin, C.; Knowlton, AR. Social network approaches to HIV prevention: Implications to community impact and sustainability. Trickett, EJ.; Pequegnat, W., editors. Oxford University Press; New York: 2005. p. 105-129.

Latkin CA, Mandell W, Knowlton AR, Vlahov D, Hawkins W. Personal network correlates and predictors of homelessness for injection drug users in Baltimore, Maryland. Journal of Social Distress and the Homeless 1998;7:263–278. doi:10.1023/A:1022943311679.

Latkin C, Mandell W, Oziemkowska M, Vlahov D, Celentano D. The relationships between sexual behavior, alcohol use, and personal network characteristics among injecting drug users in Baltimore, Maryland. Sexually Transmitted Diseases 1994;21:161–167. doi:10.1097/00007435-199405000-00006. [PubMed: 8073344]

Latkin C, Mandell W, Vlahov D, Oziemkowska M, Celentano D. People and places: Behavioral settings and personal network characteristics as correlates of needle sharing. Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology 1996;13:273–280. [PubMed: 8898673]

Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika 1986;73:13–22. doi:10.1093/biomet/73.1.13.

Magis-Rodriguez C, Brouwer KC, Morales S, Gayet C, Lozada R, Ortiz-Mondragon R, et al. HIV prevalence and correlates of receptive needle sharing among injection drug users in the Mexican-US border city of Tijuana. Journal of Psycho-active Drugs 2005;37:333–339.

Neaigus A. The network approach and interventions to prevent HIV among injection drug users. Public Health Reports 1998;113:140–150. [PubMed: 9722819]

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, Gyarmathy VA, Miller M, Frajzyngier VM, Friedman SR, Des Jarlais DC. Transitions to injecting drug use among noninjecting heroin users: Social network influence and individual susceptibility. Journal of Acquired Immune Deficiency Syndromes 2006;41:493–503. doi:10.1097/01.qai.0000186391.49205.3b. [PubMed: 16652059]

Perngmark P, Vanichseni S, Celentano DD. The Thai HIV/AIDS epidemic at 15 years: Sustained needle sharing among southern Thai drug injectors. Drug and Alcohol Dependence 2008;92:183–190. doi:10.1016/j.drugalcdep.2007.07.014. [PubMed: 17870252]

Rhodes T, Platt L, Maximova S, Latishevskaya N, Hickman M, Renton A, et al. Prevalence of HIV, hepatitis C and syphilis among injecting drug users in Russia: A multi-city study. Addiction (Abingdon, England) 2006;101:252–266. doi:10.1111/j.1360-0443.2006.01317.x.

Rhodes T, Stimson GV, Crofts N, Ball A, Dehne K, Khodakevich L. Drug injecting, rapid HIV spread, and the 'risk environment': Implications for assessment and response. AIDS 1999;13(suppl. A):S259–S269. [PubMed: 10885783]

Rogers, EM. Diffusion of innovations. 5th ed.. Free Press; New York, NY: 2003.

Sarang A, Rhodes T, Platt L. Access to syringes in three Russian cities: Implications for syringe distribution and coverage. International Journal of Drug Policy 2008;19(suppl. 1):S25–S36. [PubMed: 18313910]

Schlumberger MG, Desenclos JC, Papaevangelou G, Richardson SC, Ancelle-Park R. Knowledge of HIV serostatus and preventive behaviour among European injecting drug users: Second study. European community study group on HIV in injecting drug users. European Journal of Epidemiology 1999;15:207–215. doi:10.1023/A:1007578402083. [PubMed: 10395049]

Shearer J, Johnston J, Fry CL, Kaye S, Dillon P, Dietze P, et al. Contemporary cocaine use patterns and associated harms in Melbourne and Sydney, Australia. Drug and Alcohol Review 2007;26:537–543. doi:10.1080/09595230701499159. [PubMed: 17701517]

Sherman SG, Latkin CA. Drug users' involvement in the drug economy: Implications for harm reduction and HIV prevention programs. Journal of Urban Health 2002;79:266–277. doi:10.1093/jurban/79.2.266. [PubMed: 12023502]

Smith AM, Grierson J, Wain D, Pitts M, Pattison P. Associations between the sexual behaviour of men who have sex with men and the structure and composition of their social networks. Sexually Transmitted Infections 2004;80:455–458. doi:10.1136/sti.2004.010355. [PubMed: 15572613]

Somach, SD.; Kochkina, E.; Shlyk, E. Gender assessment for USAID, Russia—USAID Contract #: GEW-I-01-02-00019-00. 2004. www.devtechsys.com/publications/gender/assesments/Final%20Report,%20Russia.pdf: DevTech Systems, Inc

Todd CS, Abed AM, Scott PT, Botros BA, Safi N, Earhart KC, et al. Correlates of receptive and distributive needle sharing among injection drug users in Kabul, Afghanistan. The American Journal of Drug and Alcohol Abuse 2008;34:91–100. doi:10.1080/00952990701764771. [PubMed: 18161647]

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;31:1607–1618. doi:10.1016/j.addbeh.2005.12.007. [PubMed: 16459023]

Valente, TW. Network models of the diffusion of innovations. Hampton Press; Cresskill, NJ: 1995.

Valente TW, Vlahov D. Selective risk taking among needle exchange participants: Implications for supplemental interventions. American Journal of Public Health 2001;91:406–411. doi:10.2105/AJPH.91.3.406. [PubMed: 11236405]

AIDS Behav. Author manuscript; available in PMC 2011 February 1.

Table 1

Injecting dyad characteristics and univariate individual attribute and dyad characteristic correlates of engaging in unsafe injecting (percents represent row percents)

Characteristic	Total (*N*)	Receptive syringe sharing		Distributive syringe sharing		Sharing cookers	
		(%)	OR (95%)	(%)	OR (95%)	(%)	OR (95%)
Total	1,692	28.9		32.7		81.9	
Individual attributes							
Age							
Under 30	731	34.7	(reference)	39.9	(reference)	85.5	(reference)
30 and above	961	24.5	0.6 (0.5, 0.8)*	27.3	0.6 (0.5, 0.8)*	79.2	0.7 (0.5, 1.0)*
Daily heroin injecting							
No	574	27.5	(reference)	27.9	(reference)	79.4	(reference)
Yes	1,118	29.6	1.1 (0.9, 1.5)	35.2	1.5 (1.1, 1.9)*	83.2	1.3 (0.9, 1.9)
Any stimulant or speedball injecting							
No	1,141	27.6	(reference)	31.5	(reference)	79.4	(reference)
Yes	551	31.6	1.2 (0.9, 1.6)	35.4	1.3 (1.0, 1.7)	87.1	1.7 (1.1, 2.6)*
Dyad characteristics							
Sexual partnership							
No	1,444	24.2	(reference)	28.3	(reference)	80.7	(reference)
Yes	248	56.5	4.6 (3.5, 6.1)*	58.9	4.1 (3.1, 5.4)*	88.7	2.8 (1.7, 4.4)*
Trusting partnership							
No	997	23.0	(reference)	28.4	(reference)	78.6	(reference)
Yes	695	37.4	2.3 (1.9, 2.9)*	39.0	1.8 (1.5, 2.3)*	86.6	2.0 (1.6, 2.5)*
Dependence on resources							
No	317	12.6	(reference)	17.0	(reference)	72.2	(reference)
Yes	1,375	32.7	3.8 (2.7, 5.4)*	36.4	2.6 (1.9, 3.5)*	84.1	2.2 (1.7, 2.8)*
Social support							
No	936	22.2	(reference)	25.7	(reference)	77.8	(reference)
Yes	756	37.2	2.2 (1.8, 2.8)*	41.4	2.2 (1.8, 2.8)*	87.0	2.1 (1.6, 2.7)*
Social exposure							
No	592	16.6	(reference)	22.3	(reference)	73.3	(reference)

Characteristic	Total (*N*)	Receptive syringe sharing		Distributive syringe sharing		Sharing cookers	
		(%)	OR (95%)	(%)	OR (95%)	(%)	OR (95%)
Yes	1,100	35.5	3.1 (2.4, 4.0)*	38.4	2.3 (1.8, 3.0)*	86.5	2.5 (1.9, 3.1)*
Perception of network risk							
No	521	15.5	(reference)	13.1	(reference)	65.3	(reference)
Yes	1,171	34.8	2.8 (2.1, 3.8)*	41.5	5.5 (4.0, 7.7)*	89.3	3.5 (2.5, 5.0)*
Perceived HIV status							
Concordant negative	1,189	27.6	(reference)	33.7	(reference)	82.5	(reference)
Discordant	357	–	–	–	–	77.3	0.9 (0.9, 1.0)*
Ego positive and partner negative	197	31.0	1.0 (0.9, 1.1)	11.2	0.8 (0.7, 0.9)*	–	–
Ego negative and partner positive	160	14.4	0.8 (0.8, 0.9)*	32.5	1.0 (0.9, 1.0)	–	–
Concordant positive	146	52.7	1.3 (1.2, 1.4)*	54.1	1.2 (1.1, 1.4)*	88.4	1.0 (1.0, 1.1)
Gender discrepancy							
Both female	205	23.9	(reference)	25.9	(reference)	69.3	(reference)
Discordant	621	34.5	1.1 (1.0, 1.2)*	39.0	1.1 (1.1, 1.2)*	81.0	1.1 (1.0, 1.2)*
Both male	866	26.1	1.0 (0.9, 1.1)	29.9	1.0 (1.0, 1.1)	85.6	1.1 (1.0, 1.2)*

*GEE *z*-statistics $P < 0.05$

Table 2

Injecting dyad characteristics and univariate social network characteristic correlates of engaging in unsafe injecting (Percents represent row percents)

Characteristic	Total (*N*)	Receptive syringe sharing		Distributive syringe sharing		Sharing cookers	
		(%)	OR (95% CI)	(%)	OR (95% CI)	(%)	OR (95% CI)
Total	1,692	28.9		32.7		81.9	
Social network characteristics							
IDU network members							
Number of IDU network members—mean (SD)							
	4.2 (2.0)	4.1 (2.1)	0.9 (0.9, 1.0)	4.0 (1.9)	0.9 (0.9, 1.0)*	4.3 (2.1)	1.1 (1.0, 1.2)*
Any sex partner IDU network member							
No	765	26.3	(reference)	29.9	(reference)	82.4	(reference)
Yes	927	31.1	1.4 (1.0, 1.8)*	35.1	1.4 (1.0, 1.8)*	81.6	1.0 (0.7, 1.4)
Any trusted IDU network member							
No	400	25.8	(reference)	33.8	(reference)	79.5	(reference)
Yes	1,292	29.9	1.3 (0.9, 1.8)	32.4	1.0 (0.7, 1.4)	82.7	1.3 (0.9, 2.0)
Any dependence on resources of IDU network members							
No	25	20.0	(reference)	16.0	(reference)	60	(reference)
Yes	1,667	29.0	1.8 (0.7, 5.1)	33.0	2.8 (0.8, 10.1)	82.2	2.8 (1.0, 8.0)*
Any social support from IDU network members							
No	187	14.4	(reference)	21.4	(reference)	79.1	(reference)
Yes	1,505	30.7	2.4 (1.5, 4.0)*	34.2	1.8 (1.1, 3.0)*	82.3	1.1 (0.7, 2.0)
Any social exposure to IDU network members							
No	146	22.6	(reference)	22.6	(reference)	78.1	(reference)
Yes	1,546	29.5	1.5 (0.9, 2.6)	33.7	1.8 (1.1, 3.1)*	82.3	1.3 (0.7, 2.4)
Any perception of network risk							
No	307	14.3	(reference)	16.0	(reference)	64.2	(reference)
Yes	1,385	32.1	2.7 (1.8, 4.0)*	36.5	3.1 (2.1, 4.7)*	85.8	3.4 (2.3, 5.1)*
IDU network density (two or more IDU network members know each other)							
No	95	27.4	(reference)	34.7	(reference)	82.1	(reference)
Yes	1,597	29.0	1.1 (0.7, 1.7)	32.6	0.9 (0.6, 1.4)	81.9	1.0 (0.6, 1.9)
Non-IDU network members							

Characteristic	Total (*N*)	Receptive syringe sharing		Distributive syringe sharing		Sharing cookers	
		(%)	OR (95% CI)	(%)	OR (95% CI)	(%)	OR (95% CI)
Number of non-IDU network members—mean (SD)							
	1.9 (1.9)	1.7 (1.7)	0.9 (0.8, 1.0)*	1.9 (1.9)	1.0 (0.9, 1.0)	1.9 (1.9)	0.9 (0.8, 1.0)
Any sex partner non-IDU network member							
No	765	26.3	(reference)	29.9	(reference)	82.4	(reference)
Yes	927	31.1	1.4 (1.0, 1.8)*	35.1	1.4 (1.0, 1.8)*	81.6	1.0 (0.7, 1.4)
Any trusted non-IDU network member							
No	539	33.2	(reference)	35.6	(reference)	87.2	(reference)
Yes	1,153	26.9	0.7 (0.5, 1.0)*	31.4	0.8 (0.6, 1.0)	79.4	0.5 (0.4, 0.8)*
Any dependence on resources of non-IDU network members							
No	598	32.1	(reference)	33.9	(reference)	85.1	(reference)
Yes	1,094	27.1	0.8 (0.6, 1.1)	32.1	0.9 (0.6, 1.1)	80.2	0.7 (0.5, 1.0)
Any social support from non-IDU network members							
No	808	30.9	(reference)	35.0	(reference)	84.5	(reference)
Yes	884	27.0	0.8 (0.6, 1.1)	30.7	0.8 (0.6, 1.0)	79.5	0.7 (0.5, 1.0)*
Any social exposure to non-IDU network members							
No	754	31.3	(reference)	33.6	(reference)	84.6	(reference)
Yes	938	27.0	0.8 (0.6, 1.1)	32.1	0.9 (0.7, 1.2)	79.7	0.7 (0.5, 1.0)
Non-IDU network density (two or more non-IDU network members know each other)							
No	1,023	31.9	(reference)	33.4	(reference)	85.2	(reference)
Yes	669	24.4	0.7 (0.6, 1.0)*	31.7	0.9 (0.7, 1.2)	76.8	0.6 (0.4, 0.9)*

*GEE *z*-statistics $P < 0.05$

Table 3

Multivariate correlates of engaging in unsafe injecting

Characteristic	Receptive syringe sharing aOR (95% CI)	Distributive syringe sharing aOR (95% CI)	Shared cooker aOR (95% CI)
Individual attributes			
Age 30 and above	0.6 (0.5, 0.8)*	0.6 (0.4, 0.8)*	–
Daily heroin injecting	–	1.7 (1.2, 2.4)*	–
Any stimulant or speedball injecting	–	–	1.6 (1.0, 2.5)*
Dyad characteristics			
Sexual partnership	3.0 (2.2, 4.0)*	3.1 (2.2, 4.3)*	1.8 (1.2, 2.9)*
Trusting partnership	1.4 (1.1, 1.8)*	–	1.5 (1.2, 2.0)*
Dependence on resources	2.2 (1.5, 3.1)*	1.7 (1.2, 2.3)*	1.5 (1.1, 2.0)*
Social support	–	1.4 (1.1, 1.9)*	–
Social exposure	1.8 (1.4, 2.4)*	1.4 (1.1, 1.9)*	1.9 (1.4, 2.5)*
Perception of network risk	2.9 (2.1, 4.0)*	–	3.5 (2.5, 5.0)*
No perception of network risk	–	Reference	–
Perception of network risk outside the dyad	–	0.5 (0.3, 0.9)*	–
Perception of network risk within the dyad	–	3.9 (2.5, 6.2)*	–
Perceived HIV status			
Concordant negative	Reference	Reference	Reference
Discordant	–	–	0.6 (0.4, 0.8)*
Ego positive and partner negative	1.3 (0.8, 2.1)	0.2 (0.1, 0.4)*	–
Ego negative and partner positive	0.3 (0.2, 0.6)*	0.8 (0.5, 1.2)	–
Concordant positive	2.4 (1.5, 3.8)*	1.8 (1.1, 3.1)*	0.9 (0.5, 1.6)
Gender discrepancy			
Both female	–	–	Reference
Discordant	–	–	1.3 (1.0, 1.8)
Both male	–	–	2.1 (1.4, 3.0)*
Social network characteristics			
Non-IDU network density	–	–	0.6 (0.4, 0.9)*

*GEE z-statistics $P < 0.05$