

Title : Gender-Specific Situational Correlates of Syringe Sharing during a Single Injection Episode

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Abstract :

Factors associated with syringe sharing differ between women and men; however, it is uncertain whether these hold within the setting of a single injection episode. A questionnaire eliciting information about the last injection episode with others present was administered to participants in a cohort of Montréal injection drug users (IDUs). Logistic regression was used to identify correlates of syringe sharing and to test potential gender differences in relation to syringe sharing. Data from 467 participants revealed significant differences between men and women with regard to situational factors; however, the relationships between situational factors and syringe sharing did not vary according to gender. In multivariate models including both genders, syringe sharing was associated with various attributes of other IDUs who were present as well as alcohol use during that specific episode. These results highlight the relevance of situational factors in injection drug use activity, regardless of gender.

Key words : Injection drug users, HIV, gender, event analysis

Introduction

The population of injection drug users (IDUs) recruited in prevention studies is predominantly male (Hagan *et al.*, 2007). Results from most studies cannot be easily generalized to women. Researchers have recently increased their attention to potential gender differentials among IDUs. Such research has the potential to determine whether the factors associated with syringe sharing and human immunodeficiency virus (HIV) infection are similar or differ between genders.

Numerous differences have been identified between the characteristics and behaviors of male and female IDUs. For example, female IDUs tend to be younger,

more likely to engage in sex work, and more likely to inject heroin versus cocaine than male IDUs (Breen *et al.*, 2005; Lum *et al.*, 2005). Freeman *et al.* (1994) highlighted the particular risks associated with having a drug-using sex partner; females in their sample were significantly more likely than males to report injecting with a sex partner in the previous six months, having a sex partner who is also an IDU, and having a sex partner inject them after injecting himself. Further, higher proportions of female IDUs than male IDUs appear to share syringes with their partners (Frajzyngier *et al.*, 2007; Lum *et al.*, 2005; Platt *et al.*, 2005; Sherman *et al.*, 2001). Females have also been found more likely to be injected by another IDU (Evans *et al.*, 2003). Most of this research has used measures of behavior collected through questionnaires pertaining to events that occur over the course of the three or six months preceding the survey.

Cross-sectional and prospective studies have indicated that while characteristics of the interpersonal relationships between injection partners are universally important determinants of syringe sharing, having an injection partner who is also a sex partner or spouse is particularly predictive of syringe sharing among female IDUs (Evans *et al.*, 2003; Fitzgerald *et al.*, 2007; Sherman *et al.*, 2001; Tortu *et al.*, 2003). In a multivariate analysis of the circumstances surrounding initiation into injection drug use among young IDUs, Frajzyngier *et al.* (2007) extended this finding, observing two factors related to social interaction (being initiated by a sex partner, and having at least two other people present) that were associated with syringe/injection equipment sharing among women, but not among men. Additionally, the results of qualitative and quantitative studies converge in indicating that sex work is a significant risk factor for women who inject (Cruz *et al.*, 2007; Platt *et al.*, 2005). One study suggested that alcohol use may be one

factor that is a determinant of syringe sharing among men but not among women (Sherman *et al.*, 2001).

Although differences between women and men in the factors associated with syringe sharing are becoming evident, it is uncertain whether these carry over into the context of a single injection episode, or event. Event-level research involves questioning participants about the circumstances and behaviors related to a single “incident” or set of incidents that presented an opportunity for high-risk behavior, as opposed to asking about factors that might have occurred at multiple times over the months preceding a survey. Event-level analyses offer several noteworthy advantages to analyses of behaviors expressed over several months. For example, they can strengthen the basis for causal inference when investigating correlates of risky behavior as they ensure that the risky behavior occurred at the time of a *specific* event (Leigh, 2002). They also allow examination of relevant variables concerning situational context (e.g., location, or time of the day) and the attributes of the sex or injection drug use partners involved in an episode, details that may be difficult for participants to recall when being asked about behaviors that might have occurred on multiple occasions over several months. Finally, they can yield greater accuracy in responses and reduce cognitive burden on the respondent by focusing on a particular occasion (Ross *et al.*, 1993).

Application of event-level methodology in IDU research is novel. Rhodes (2002) has suggested shifting our focus in IDU research to specific risk environments, or places and times where individuals are more likely to engage in harmful behavior. This challenge is justified by a growing body of evidence which emphasizes that HIV prevention strategies focusing solely on the attributes of the individual IDU are less

successful than those which account for contextual influences (Rhodes, 2002). Accordingly, a recent study by Koester *et al.* (2005) describes interviewing heroin users specifically about their “last injection episode”. These authors noted two factors which influenced drug preparation behaviors during injection preparation: the location of the episode, and the quantity of heroin injected. Participants whose last episodes occurred in locations without privacy (e.g., alleys, cars, or parks) and where there was one quarter gram or less of heroin present were more likely to report the common use of a cooker. Similarly, location and presence of a dopesick IDU, in addition to years of injecting history, were independently associated with use of a formerly used, non-bleached syringe for drug preparation. Likewise, Tortu *et al.* (2003) used event-level methodology, collecting detailed information about participants’ “most recent injection event” to identify individual, dyadic, and situation-specific determinants of injection-related risk during these events. After interviewing 185 women, they found that injecting with someone the participant had injected with previously, and injecting with a spouse or primary partner, were associated with sharing syringes, other injection equipment, or drugs, after adjusting for other factors.

In 2004, we began administering a questionnaire about recent injection episodes to participants of an ongoing longitudinal study of active IDUs in Montréal, Canada. An extensive syringe exchange program has been well-established for more than ten years in Montréal; unlimited syringes are legally and widely available either free through exchange programs or for a nominal fee throughout the city, with access sites situated in the places where they are most needed (Bruneau *et al.*, 2008). In spite of the availability of syringe exchange, Montréal surveillance data have shown an increase in

the incidence of HIV from 3.5 cases per 100 person-years between 1998 and 2002 to 4.9 cases per 100 person-years between 2003 and 2006 (Secteur Vigie et Protection, 2006). There has also been an increase in the incidence of hepatitis C, from 26 cases per 100 person-years from 1997-2003, to 55 cases per 100 person-years from 2003-2006 (Secteur Vigie et Protection, 2006). These data illustrate the need to continually fine-tune and update our understanding of the context of risk among IDUs. In this report, we evaluate gender differences with regard to situational correlates of syringe sharing during high-risk injection episodes.

Methods

Participants

The Saint-Luc Cohort (Montréal) is an ongoing dynamic cohort of active IDUs, initiated in 1988. To enter, an individual must be at least 18 years old, residing in the Montréal area and an active injection drug user for the six months prior to entry. Participants return to the study site at six month intervals for administration of a behavioral questionnaire and serological testing. Baseline and follow-up questionnaires elicit detailed information about sociodemographic characteristics, history of drug use, current drug use, injection behavior, acquisition of syringes, and sexual behavior. Questionnaires are administered by trained interviewers face-to-face with IDUs in a confidential setting. Participants receive fifteen Canadian dollars per visit as compensation for their time and contribution. Further details about the Saint-Luc cohort are described elsewhere (Bruneau *et al.*, 2001).

Measures

In 2004, an auxiliary questionnaire was developed to obtain more detailed information about participants' last episode of injection. The questionnaire was a modified version of that developed by Tortu *et al.* (2003). It was translated to French and back-translated to English for verification. In its original form the instrument was designed to include a series of "analogous" items for which a measure of agreement of 99% was obtained on 22 pairs of analogous items (Tortu *et al.*, 2003). Questions in the instrument pertain to the circumstances of the injection episode (location, time, and number of persons present), attributes of each person present during the episode (age, sex, relationship with index participant, prior sexual cohabitation, and injection drug use experiences shared between the index participant and others present), behaviors of, and in relation to, each person present (syringe sharing, equipment sharing, and syringe lending), and specific items concerning drugs that were used (injection and non-injection drug use as well as source of money used to purchase drugs).

This questionnaire was administered at each visit to each participant answering "yes" to the following question: "In the past four weeks, did you inject yourself with someone who was injecting at the same time?" Only the first, completed questionnaire that met the following inclusion criteria for each participant was included in the present analysis: at least one other person present injected, the episode occurred at a single location, and the episode occurred within four weeks of the study visit date. Bilingual research team members were available to ensure interviewing in either French or English. All participants gave their informed consent.

The outcome of interest was answering "yes" to the question, "During the episode did you use a syringe that had been used by another person?" (hereafter

referred to as “syringe sharing”). Syringe sharing has been established as the main source of HIV transmission among IDUs (Nicolosi *et al.*, 1990). Participants were also asked whether they shared other injection equipment, such as mixing containers, cookers, water, etc., during the episode. This, however, is a separate behavior, less reliably recalled (Stimson *et al.*, 1998) and not the focus of the present study.

To identify episode-specific situational factors associated with syringe sharing, we extracted data from the general questionnaire completed on the same date as the auxiliary questionnaire, and from the auxiliary questionnaire itself. A conceptual framework by Rhodes (2002) was used as a starting point to inform a more specific focus on situational influences in the context of a single injection episode. Rhodes discusses the risk environment as the social or physical space in which both micro factors (e.g., interpersonal relationships, peer group influence, or the immediate setting in which drugs are used) and macro factors (e.g., laws and economies that produce and relegate risk) interact to affect the likelihood of injection drug-related harm. Based on this framework as well as related current literature (Koester *et al.*, 2005; Tortu *et al.*, 2003), categories of relevant variables hypothesized to be related to risk behavior during an injection episode with other IDUs were selected for analysis (Table I).

Given that only 13% of participants reported more than one other person present during the episode, variables relating to other persons present during an episode were dichotomized: if at least one other person present had the attribute of interest (e.g., being female) the participant was coded as “positive,” regardless of whether others present also had that attribute. These attributes were treated as having a situational effect on participants’ risk of syringe sharing whether present in one injection partner or

many. A variable to indicate whether respondents had a relevant intimate relationship was created and defined as ever having had sex with *and* ever having lived with another person who was present during the episode. This combination, although not accounting for the time period for each behavior, was considered to be a better indication of intimate partnership than each individual component because each individual component could carry other meanings (having had sex could indicate a casual sexual relationship; and having lived together could indicate being roommates).

Data analyses

Descriptive analyses were used to characterize the data. Comparisons of characteristics (including the outcome) between men and women were examined using a two-sided *t*-test for independent samples for continuous data and a chi-square test for grouped data.

Logistic regression was used to identify situational predictors of syringe sharing according to gender and for the overall sample. Two strategies were employed to evaluate an effect of gender. First, sub-sets of the sample were stratified by gender, and the effects of independent variables were compared across strata. Secondly, independent variables associated with syringe sharing and statistically significant at a probability value of 0.05 in univariate analyses were entered one by one into bivariate models including gender. Multiplicative interaction terms (containing both gender and the independent variable under examination) were added to these models, and potential interactions assessed; any added interaction term with a Wald statistic significant at a probability value of 0.10 was considered indicative of gender-specific variation. Variables that remained statistically significant at $p=0.10$ in multivariate models were

considered for inclusion in final models. Covariate pairs were initially examined for correlation, and for collinear pairs only one of the variables was included in a multivariate model. Age is known *a priori* to be an important influence and was included in all models (Miller *et al.*, 2007). Gender, as a variable of primary interest, was also included in all models based on the full cohort. Model-building procedures were based on those described in Hosmer and Lemeshow (2000). All statistical analyses were done using R version 2.4.1 (2006).

Results

General characteristics

Of 851 cohort participants who presented for a visit between November 9, 2004 and March 16, 2007, 467 (54.9%) completed an auxiliary questionnaire about their most recent episode of injection. The remaining 384 participants did not report injecting with others in the previous four weeks. Of these, 382 (81.8%) were male, 84 (18.0%) were female, and 1 (0.2%) was transgender (this participant was excluded from analyses that compared genders and was treated as a missing value for the gender variable in analyses of the full cohort). Eighty-five percent of the participants spoke French as their first language, 40.7% reported living in some form of unstable housing (a shelter, hotel, on the street, or in prison), 23.2% had been incarcerated in the previous six months, and 16.5% had completed education beyond a high school degree. Seven percent were HIV-positive and 72.6% were hepatitis C-positive (confirmed by laboratory testing).

The range of the length of episodes of drug use reported by participants was 5 minutes to 6 days (mean: 5.5 hours; median: 1 hour). While the majority of episodes lasted one hour or less, there was a wide distribution of their lengths with 15.0% of

episodes lasting longer than 10 hours. Eighty-seven percent of participants reported only one other person present during the episode, 11.3% reported two or three other persons present, and the remaining 1.9% reported between four and eight other persons present.

Ninety-one (19.5%) participants injected only heroin during the episode. Three hundred two (64.7%) injected only cocaine, 13 (2.8%) injected heroin and cocaine, and 61 (13.1%) injected another drug (alone or in combination with cocaine and heroin). Injection of heroin alone was compared with injection of any other drug or combination of drugs in analyses.

INSERT TABLE I HERE

Comparison of characteristics by gender

Comparisons between men and women are shown in Table II. Compared with women, men were on average older, and less likely to engage in prostitution, inject with an intimate partner, and inject only heroin during an episode; they were more likely to inject with a female and use non-injection drugs such as alcohol or cocaine. More women shared syringes than men; however, this difference was not statistically significant.

INSERT TABLE II HERE

Comparison of correlates of syringe sharing by gender

Univariate analysis of the entire sample revealed several significant correlates of syringe sharing; gender-stratified results are presented in Table III. Stratification indicated generally similar effects in point estimates for men and women, with one noteworthy exception. Having more than one other person present during the episode

was associated with higher risk of syringe sharing among men, but no such association was apparent for women. No statistically significant interactions were observed between gender and the variables used in analyses, as shown in Table III.

INSERT TABLE III HERE

Multivariate correlates of syringe sharing

Multivariate estimates for the overall cohort are presented alongside crude estimates in Table IV. The magnitude and significance of most correlates of syringe sharing in univariate analyses changed little when other factors were accounted for in multivariate models, with the some exceptions. A “protective” effect of injecting only heroin became stronger and statistically significant when adjusting for other factors. Also, the effect of female gender in the univariate model was attenuated in the full multivariate model.

INSERT TABLE IV HERE

Discussion

The results of this study indicate that, in a single injection episode, the situational correlates of sharing syringes with injection partners did not differ between men and women, despite absolute gender differences in many such factors associated with participation in that injection episode. For example, injecting with an intimate partner was associated with a nearly equivalent odds of syringe sharing for men (odds ratio 2.20) and women (odds ratio 2.40). Women, however, were almost 3 times as likely to inject with an intimate partner when injecting with others as compared to men. Likewise, alcohol use increased the risk of syringe sharing by similar magnitudes for men (odds ratio 2.20) and women (odds ratio 2.27), but men were more likely to use alcohol during

the episode (27% vs. 14%). The effects of *one* factor did indeed differ (i.e., having more than one other person present); however, this factor was not associated with syringe sharing in multivariate models. This suggests that the aforementioned differences between men and women IDUs widely referenced in the IDU literature derive not from a difference in the influences of situational factors on risk, but rather, from the fact that many of these risky situational factors arise more frequently among women than among men. Indeed, the two risk factors most strongly associated with sharing, i.e., the presence of an intimate partner, or a person in whom the participant places “confidence”, were also those reported more frequently by women than by men in our study.

Nevertheless, the finding that episode-specific situational correlates of syringe sharing do not vary according to gender is unanticipated in light of a growing body of research that suggests gender differences and calls for more attention to these issues in research on IDUs. In particular, the lack of a gender difference in syringe sharing associated with injecting with an intimate partner contrasts with other reports indicating that injecting with a sex partner or spouse is more strongly associated with syringe sharing among women than among men (Evans *et al.*, 2003; Fitzgerald *et al.*, 2007). There are several possible explanations for this discrepancy. Use of an event-level methodology in this study means, by definition, that injection with an intimate partner occurred during the same episode in which a syringe was shared. In contrast, most other studies of IDUs use global measures, i.e., injection with a sex partner at some point during the *previous three months* and syringe sharing at some point during the *previous three months* (Evans *et al.*, 2003). Such general associations allow for syringe sharing to have occurred at episodes different from the one in which the intimate partner

was present. Alternatively, the circumstances of a binge may be powerful enough to overwhelm the gender differences detected in other studies. As described by Miller *et al.* (2006), binge behavior differs in significant ways from normal patterns of consumption. Our use of an event-level approach also means that we could not account for the frequency of injecting. Thus, if women are equally likely as men to share syringes with an intimate partner at a given episode but inject more frequently, then this may also help explain the discrepant findings of our study. Our study furthermore differed from others in the definition of “intimate partner,” which we defined as someone with whom the participant had lived and had sex.

Notwithstanding the absence of an effect modifying influence of gender, our analysis highlights several episode-specific correlates of syringe sharing. The seemingly contradictory effects where having confidence in one’s injection partners “protects” against sharing, while having had an intimate relationship with injection partners “increases” the risk of sharing, might be partially explained by the qualitative research of Des Jarlais *et al.* (2004) and others (Friedman *et al.*, 2007). Extensive care-taking within groups or dyads of IDUs often ensures that syringes are not shared between HIV-positive and HIV-negative individuals. Thus, having confidence in partners may be a marker of trust that one’s partners will not allow risky behavior such as syringe sharing during an injection episode. By contrast, having had an intimate relationship with partners may be a marker of serostatus disclosure between partners, thus allowing sharing within concordant dyads. The pronounced influence of interpersonal factors was also demonstrated by the association between use of new syringes by other IDUs and syringe sharing of the index IDU. In episodes where all other IDUs present used a new

syringe for every injection, the participant was five-times less likely to share syringes (OR 0.18, 95% CI 0.10, 0.34). This is a powerful reminder of value of policies that ensure ample accessibility and supply; provision of clean syringes affects not only the behaviors of the syringe recipients but those of their peers as well.

The “protective” effect of injecting in a public place was surprising, given other research—including the event-level study by Koester *et al.* (2005)—in which injecting in a public place was associated with a greater risk of syringe sharing (Latkin *et al.*, 1994; Small *et al.*, 2007). As explained by Koester *et al.* (2005), this finding has generally been attributed to the notion that IDUs injecting in places where privacy and safety are compromised seek to inject as quickly as possible. Our discrepant results may be explained by cultural differences between different settings (i.e., Montréal as compared with other cities). The “protective” effect of injecting in public places in this study also points to the complexity of social relationships during injection episodes. Injection partners of participants who injected in public places were twice as likely to be strangers or acquaintances as the partners of participants who injected in a home or rented room (data not presented). Individuals may be less willing to share syringes with unfamiliar partners.

Several studies have drawn attention to the prevalent use of illicit income-generating activities such as drug dealing and sex work by IDUs to cover the costs of injection drugs, and some have related these activities to syringe sharing (Bourgois, 1998; De Beck *et al.*, 2007; Sherman and Latkin, 2002). The association between illegal activities (especially activities other than prostitution, which mostly relate to the movement and sale of drugs) and syringe sharing found in this study strengthens prior

research in this area. Other findings from this study are not novel (e.g., alcohol use as a risk factor and injecting heroin exclusively as a protective factor for syringe sharing); however, they add to the strength of existing evidence by confirming the relationship within a particular episode (Hudgins *et al.*, 1995; Stein *et al.*, 2000; Stein *et al.*, 2002).

The most salient correlates found in our analyses relate to interpersonal factors. Other studies have similarly noted the important influence of IDU networks on individual risk-taking (Koester *et al.*, 2005; Lakon *et al.*, 2006). This highlights the need to focus interventions on relationships among IDUs. Risk reduction counseling should account for emotional reliance on intimate partners and possibly allow for joint counseling sessions that enable an exploration of how partners affect each other's behavior during an injection episode.

Future event-level studies may expand on what has been examined in this study, potentially by asking participants to specify the temporality of non-injection drug use, alcohol use, and injection drug use within an episode. In this study there was a two-fold increase in the likelihood of sharing syringes among those who used alcohol, but it is uncertain whether alcohol use preceded syringe sharing, thus limiting the capacity for causal inference. Future research is encouraged to explore the complex relationship between injecting in a public space and sharing syringes, as well as the powerful influence of interpersonal factors, such as history of intimacy.

The limited number of female participants precluded stratified multivariate analyses for each gender separately. This lack of power is an alternative explanation for the fact that we did not detect different relationships between men and women. We attempted to partially overcome limited statistical power by testing interactions with

gender, rather than engaging in further analyses stratified by gender.

Because obtaining answers to detailed questions about a particular episode can be problematic, especially if an interviewee was intoxicated at the time of the episode, our data are subject to reporting errors. Recall errors were probably minimized, however, as participants were interviewed only about episodes occurring within the previous four weeks. Limited information was available on the psychometric properties of the questionnaire, and we were unable to provide a full assessment of its validity and reliability. An unclear and problematic issue is that we cannot be sure how different individuals interpreted the concept of “having confidence in others.” This will be addressed in future refinement of the questionnaire.

Being injected by someone else has been reported to correlate both with syringe sharing (Unger *et al.*, 2006) and being female (Evans *et al.*, 2003). Thus, selecting for participants who injected with someone who was injecting at the same time may have introduced the effect of inflating the association between being female and sharing syringes.

We opt for caution in generalizing our results. A single episode is not necessarily representative of general exposures over a longer period of drug use, and the Saint-Luc Cohort may not be representative of IDU populations outside of primarily French-speaking Montréal. Participants included in these analyses were seen on average for 2.5 study visits prior to completing the questionnaire. On this basis it is possible that the overall risks of IDUs in the larger population were underestimated as some participants may have reduced their sharing behavior over the course of receiving study-related counseling. This limitation, however, implies that we may have focused on risk

behaviors less amenable to change through current prevention strategies, for which improved understanding is especially important. We also acknowledge that the subset of participants included in this study may differ from the larger Saint-Luc cohort. Among the 384 participants excluded from our analyses, 46.2% never injected in the company of other IDUs over the prior six months. This finding is not unexpected, given the inclusion criteria for this study. This proportion did not significantly differ by gender (46.4% among men; 44.4% among women).

Our results provide evidence for the importance of situational correlates of episode-specific syringe sharing among injection drug users. Studies that question participants about habitual behaviors over the course of six-month periods or lifetimes can provide only general information about factors associated with syringe sharing. Complementary research on specific episodes allowing for coding of outcomes and exposures at the same point in time can add substantive, and more specific, knowledge about situational factors that affect injection behavior. Together, these two approaches can help refine our understanding of differences between men and women IDUs by considering both the frequencies and effects of the situational risk factors for syringe sharing among the two groups. If gender differences are important with regard to relationships between syringe sharing and the correlates of injection episodes, they may be overwhelmed in the context of a binge and overemphasized when measured in relation to broader periods of time.

References

- Bourgois, P. (1998). The moral economies of homeless heroin addicts: confronting ethnography, HIV risk, and everyday violence in San Francisco shooting encampments. *Substance Use and Misuse*, 33, 2323-2351.
- Breen, C., Roxburgh, A., and Degenhardt, L. (2005). Gender differences among regular injecting drug users in Sydney, Australia, 1996-2003. *Drug and Alcohol Review*, 24, 353-358.
- Bruneau, J., Lamothe, F., Soto, J., Lachance, N., Vincelette, J., Vassal, A., and Franco, E.L. (2001). Sex-specific determinants of HIV infection among injection drug users in Montreal. *Canadian Medical Association Journal*, 164, 767-773.
- Bruneau, J., Daniel, M., Kestens, Y., Zang, G., and G n reux, M. (2008). Associations between HIV-related injection behaviour and distance to and patterns of utilisation of syringe-supply programs. *Journal of Epidemiology and Community Health*, 62, 804-810.
- Cruz, M.F., Mantsios, A., Ramos, R., Case, P., Brouwer, K.C., Ramos, M.E., Fraga, W.D., Latkin, C.A., Miller, C.L., and Strathdee, S.A. (2007). A qualitative exploration of gender in the context of injection drug use in two US-Mexico border cities. *AIDS and Behavior*, 11, 253-262.
- De Beck, K., Shannon, K., Wood, E., Li, K., Montaner, J., and Kerr, T. (2007). Income generating activities of people who inject drugs. *Drug and Alcohol Dependence*, 91, 50-56.
- Des Jarlais, D.C., Perlis, T., Arasteh, K., Hagan, H., Milliken, J., Braine, N., Yancovitz, S., Mildvan, D., Perlman, D.C., Maslow, C., and Friedman, S.R. (2004). "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*, 35, 158-166.

Evans, J.L., Hahn, J.A., Page-Shafer, K., Lum, P.J., Stein, E.S., Davidson, P.J., and Moss, A.R. (2003). Gender differences in sexual and injection risk behavior among active young injection drug users in San Francisco (the UFO Study). *Journal of Urban Health*, 80, 137-146.

Fitzgerald, T., Lundgren, L., and Chassler, D. (2007). Factors associated with HIV/AIDS high-risk behaviours among female injection drug users. *AIDS Care*, 19, 67-74.

Frajzyngier, V., Neaigus, A., Gyarmathy, V.A., Miller, M., and Friedman, S.R. (2007). Gender differences in injection risk behaviors at the first injection episode. *Drug and Alcohol Dependence*, 89, 145-152.

Freeman, R.C., Rodriguez, G.M., and French, J.F. (1994). A comparison of male and female intravenous drug users' risk behaviors for HIV infection. *The American Journal of Drug and Alcohol Abuse*, 20, 129-157.

Friedman, S.R., de Jong, W., Rossi, D., Touze, G., Rockwell, R., Des Jarlais, D.C., and Elovich, R. (2007). Harm reduction theory: users' culture, micro-social indigenous harm reduction, and the self-organization and outside-organizing of users' groups. *The International Journal on Drug Policy*, 18, 107-117.

Hagan, H., Des Jarlais, D.C., Stern, R., Lelutiu-Weinberg, C., Scheinmann, R., Strauss, S., and Flom, P.L. (2007). HCV synthesis project: preliminary analyses of HCV prevalence in relation to age and duration of injection. *International Journal of Drug Policy*, 18, 341-351.

- Hosmer, D., and Lemeshow, S. (2000). *Applied Logistic Regression*. (2nd ed.). Wiley-Interscience Publication.
- Hudgins, R., McCusker, J., and Stoddard, A. (1995). Cocaine use and risky injection and sexual behaviors. *Drug and Alcohol Dependence*, 37, 7-14.
- Koester, S., Glanz, J., and Baron, A. (2005). Drug sharing among heroin networks: Implications for HIV and hepatitis B and C prevention. *AIDS and Behavior*, 9, 27-39.
- Lakon, C.M., Ennett, S.T., and Norton, E.C. (2006). Mechanisms through which drug, sex partner, and friendship network characteristics relate to risky needle use among high risk youth and young adults. *Social Science and Medicine*, 63, 2489-2499.
- Latkin, C., Mandell, W., Vlahov, D., Oziemkowska, M., Knowlton, A., and Celentano, D. (1994). My place, your place, and no place: behavior settings as a risk factor for HIV-related injection practices of drug users in Baltimore, Maryland. *American Journal of Community Psychology*, 22, 415-430.
- Leigh, B.C. (2002). Alcohol and condom use: a meta-analysis of event-level studies. *Sexually Transmitted Diseases*, 29, 476-482.
- Lum, P.J., Sears, C., and Guydish, J. (2005). Injection risk behavior among women syringe exchangers in San Francisco. *Substance Use and Misuse*, 40, 1681-1696.
- Miller, C.L., Kerr, T., Frankish, J.C., Spittal, P.M., Li, K., Schechter, M.T., and Wood, E. (2006). Binge drug use independently predicts HIV seroconversion among injection drug users: implications for public health strategies. *Substance Use and Misuse*, 41, 199-210.

- Miller, C.L., Strathdee, S.A., Li, K., Kerr, T., and Wood, E. (2007). A longitudinal investigation into excess risk for blood-borne infection among young injection drug users (IUDs). *The American Journal of Drug and Alcohol Abuse*, 33, 527-536.
- Nicolosi, A., Musicco, M., Saracco, A., Molinari, S., Ziliani, N., and Lazzarin, A. (1990). Incidence and risk factors of HIV infection: a prospective study of seronegative drug users from Milan and northern Italy, 1987-1989. *Epidemiology*, 1, 453-459.
- Platt, L., Rhodes, T., Lowndes, C.M., Madden, P., Sarang, A., Mikhailova, L., Renton, A., Pevzner, Y., Sullivan, K., and Khutorskoy, M. (2005). Impact of gender and sex work on sexual and injecting risk behaviors and their association with HIV positivity among injecting drug users in an HIV epidemic in Togliatti City, Russian Federation. *Sexually Transmitted Diseases*, 32, 605-612.
- R Development Core Team. (2006). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing.
- Rhodes, T. (2002). The 'risk environment': a framework for understanding and reducing drug-related harm. *International Journal on Drug Policy*, 13, 85-94.
- Ross, M.W., Wodak, A., Miller, M.E., and Gold, J. (1993). Sexual partner choice in injecting drug users from a "critical incident" measure: Its implications for estimating HIV spread. *Sexological Review*, 1, 77-92.
- Secteur Vigie et Protection, Direction de la Santé Publique, Agence de la santé et des services sociaux de Montréal. (2006). *Recrudescence d'infections par le virus de l'immunodéficience humaine (VIH) et le virus de l'hépatite C (VHC) chez les utilisateurs de drogues injectables (UDI) de Montréal*. Retrieved September 15, 2008, from <http://www.santepub-mtl.qc.ca/Mi/itss/vihsida/31082006.html>

- Sherman, S.G., Latkin, C.A., and Gielen, A.C. (2001). Social factors related to syringe sharing among injecting partners: a focus on gender. *Substance Use and Misuse*, 36, 2113-2136.
- Sherman, S.G., and Latkin, C. A. (2002). Drug users' involvement in the drug economy: Implications for harm reduction and HIV prevention programs. *Journal of Urban Health*, 79, 266-277.
- Small, W., Rhodes, T., Wood, E., and Kerr, T. (2007). Public injection settings in Vancouver: physical environment, social context and risk. *The International Journal on Drug Policy*, 18, 27-36.
- Stein, M.D., Hanna, L., Natarajan, R., Clarke, J., Marisi, M., Sobota, M., and Rich, J. (2000). Alcohol use patterns predict high-risk HIV behaviors among active injection drug users. *Journal of Substance Abuse Treatment*, 18, 359-363.
- Stein, M.D., Charuvastra, A., Anderson, B., Sobota, M., and Friedmann, P.D. (2002). Alcohol and HIV risk taking among intravenous drug users. *Addictive Behaviors*, 27, 727-736.
- Stimson, G.V., Jones, S., Chalmers, C., and Sullivan, D. (1998). A short questionnaire (IRQ) to assess injecting risk behaviour. *Addiction*, 93, 337-347.
- Tortu, S., McMahon, J.M., Hamid, R., and Neaigus, A. (2003). Women's drug injection practices in East Harlem: an event analysis in a high-risk community. *AIDS and Behavior*, 7, 317-328.
- Unger, J.B., Kipke, M.D., De Rosa, C.J., Hyde, J., Ritt-Olson, A., and Montgomery, S. (2006). 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*, 31, 1607-1618.

Table I: Categories of independent variables hypothesized as relevant to situational behavior during a single episode with other injection drug users present

Category	Variables included in analysis
Circumstances of episode	Location of episode (participant's home, home of friend or partner, rented room, or public place); length of episode; total number of injections by participant during episode; number of persons present during episode
Availability of syringes	All other persons present had a new syringe for every injection
Injection drug used	Heroin only versus cocaine (alone or with heroin)
Non-injection drugs used	Alcohol; cocaine
Source of money for drugs	Legal activities as compared with prostitution or other illegal activities
Relationship with other person(s) present	Gender of other person(s); intimacy with other person(s); confidence in other person(s); history of syringe sharing with other person(s)
Personal experience	Age; time since first injection drug use; engaged in prostitution in last six months; Hepatitis C and HIV serostatus

Table II: Comparison of characteristics of male and female injection drug users who completed questionnaires about most recent episode of injection (men relative to women)

Variable	Men (n = 382) % or Mean (SD)	Women (n = 84) % or Mean (SD)	Difference (95% CI)
Age, years	38.8 (9.6)	32.7 (10.0)	6.1 (3.7, 8.5) *
Time since first injection drug use, years	14.3 (9.5)	12.2 (9.1)	2.0 (-0.2, 4.2)
Length of episode, hours	5.5 (10.6)	5.8 (18.0)	-0.3 (-4.4, 3.8)
Total number of injections by participant during episode	5.5 (11.2)	5.2 (16.6)	0.2 (-3.6, 4.0)
Engaged in prostitution in last six months	8.6	32.1	-23.5 (-34.6, -12.4) *
HIV-positive at study visit	8.1	2.4	5.7 (0.8, 10.7) *
Location of episode:			
Participant's home	34.2	50.6	-16.4 (-28.9, -3.8) *
Home of friend, partner, or family member	20.5	16.9	3.6 (-6.2, 13.4)
Rented room or hotel	7.5	2.4	5.1 (0.1, 10.1) *
Public place	37.7	30.1	7.6 (-4.2, 19.4)
More than one other person present during episode	13.4	13.1	0.3 (-8.0, 8.5)
Other person(s) present during episode ^a :			
is female	29.8	17.9	12.0 (1.9, 22.1) *
is an intimate partner of participant ^b	17.0	47.6	-30.6 (-42.7, -18.6) *
is someone in whom participant places "confidence" ^c	55.8	70.2	-14.5 (-26.2, -2.8) *
has shared syringes with participant prior to episode	35.8	56.0	-20.2 (-32.5, -7.8) *
All other persons present had a new syringe for every injection	64.7	64.3	0.4 (-11.3, 12.1)
Source of money used to provide drugs for			

episode:			
prostitution	5.2	13.1	-7.9 (-16.1, 0.4)
other illegal activities (not prostitution)	8.9	8.3	0.6 (-6.6, 7.7)
Non-injection drugs used by participant during episode:			
Alcohol	26.7	14.3	12.4 (3.0, 21.8) *
Cocaine	14.7	8.3	6.3 (-1.3, 13.9)
Participant injected only heroin during episode	15.2	39.3	-24.1 (-35.9, -12.3) *
Participant used a syringe that had already been used by another person during episode	16.0	20.2	-4.3 (-14.3, 5.8)

NOTE: Student's *t*-test for independent samples used to compare means. Chi-square test used to compare proportions.

LEGEND: SD, standard deviation. CI, confidence interval. * denotes significant confidence interval at alpha value of 0.05. ^a Only one other person was present during episode for 87% of participants. For those with more than one other person present, variables represent characteristic of at least one other person. ^b Intimate partner is defined as someone participant has lived with and had sex with. ^c Confidence is defined as answering 7 or more to the question, "On a scale of 1 to 10, how much confidence do you have in this person? 1 = no confidence, 10 = total confidence."

Table III: Results of univariate and bivariate analyses testing effect modification by gender for variables associated with syringe sharing during last injection episode

Variable	Men (n = 382)		Women (n = 84)		All (n = 467)		Bivariate OR with interaction term ‡	(95% CI)	P-value of interaction term
	Univariate OR	(95% CI)	Univariate OR	(95% CI)	Bivariate OR †	(95% CI)			
Age, years	1.01	(0.98, 1.04)	1.01	(0.96, 1.07)	-	-	-	-	-
Time since first injection drug use, years	1.01	(0.98, 1.03)	1.02	(0.96, 1.07)	-	-	-	-	-
Length of episode, hours	1.01	(0.99, 1.03)	1.00	(0.97, 1.03)	-	-	-	-	-
Total number of injections by participant during episode	1.01	(0.99, 1.03)	1.00	(0.96, 1.03)	-	-	-	-	-
Engaged in prostitution in last six months	1.79	(0.77, 4.17)	1.65	(0.55, 4.93)	-	-	-	-	-
Location of episode (reference: home of participant): Home of friend, partner, or family member	0.92	(0.45, 1.90)	0.77	(0.18, 3.28)	-	-	-	-	-

Rented room or hotel	0.89	(0.31, 2.56)	n/d	-	-	-	-	-	-
Public place	0.53	(0.27, 1.04)	0.38	(0.10, 1.54)	-	-	-	-	-
More than one other person present									
during episode	2.02	(1.00, 4.06) *	0.86	(0.17, 4.40)	1.73	(0.91, 3.29)	0.86	(0.17, 4.40)	0.35
Other person(s) present during									
episode ^a :									
is female	1.66	(0.94, 2.94)	1.57	(0.43, 5.71)	-	-	-	-	-
is an intimate partner of									
participant ^b	2.20	(1.16, 4.16) *	2.40	(0.79, 7.26)	2.21	(1.27, 3.82)	2.40	(0.79, 7.26)	0.86
is someone in whom participant									
places "confidence" ^c	0.49	(0.28, 0.86) *	0.38	(0.13, 1.15)	0.47	(0.28, 0.77)	0.38	(0.13, 1.15)	0.69
has shared syringes with									
participant prior to episode	5.29	(2.92, 9.57) *	4.81	(1.26, 18.28) *	5.21	(3.03, 8.96)	4.81	(1.26, 18.28)	0.90
All other persons present had a new									
syringe for every injection	0.26	(0.15, 0.46) *	0.15	(0.05, 0.50) *	0.24	(0.14, 0.39)	0.15	(0.05, 0.50)	0.42
Source of money used to provide									
drugs for episode:									
prostitution	2.04	(0.71, 5.89)	1.88	(0.43, 8.21)	1.96	(0.83, 2.74)	1.88	(0.43, 8.21)	0.93
other illegal activities (not									
prostitution)	2.55	(1.15, 5.69) *	3.75	(0.73, 19.16)	2.75	(1.34, 5.62)	3.75	(0.73, 19.16)	0.68

Non-injection drugs used by

participant during episode:

alcohol	2.20	(1.24, 3.89) *	2.27	(0.59, 8.68)	2.21	(1.31, 3.74)	2.27	(0.59, 8.68)	0.97
cocaine	1.01	(0.47, 2.18)	0.64	(0.07, 5.66)	-	-	-	-	-

Participant injected only heroin during

episode	0.45	(0.17, 1.18)	0.40	(0.12, 1.37)	-	-	-	-	-
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LEGEND: OR, odds ratio. CI, confidence interval. n/d, not defined due to zero value in one cell. [†] Model includes variable of interest as well as gender; OR presented for variable of interest. [‡] Model includes variable of interest, gender, and multiplicative interaction term between gender and variable of interest; OR presented for variable of interest. * denotes significance at alpha level of 0.05. ^a Only one other person was present during episode for 87% of participants. For those with more than one other person present, variables represent characteristic of at least one other person. ^b Intimate partner is defined as someone participant has lived with and had sex with. ^c Confidence is defined as answering 7 or more to the question, “On a scale of 1 to 10, how much confidence do you have in this person? 1 = no confidence, 10 = total confidence.”

Table IV: Results of univariate and multivariate analyses of predictors of syringe sharing during last injection episode for cohort participants (n = 467)

Variable	Univariate		Multivariate	
	OR	(95% CI)	OR	(95% CI)
Age, years	1.01	(0.98, 1.03)	0.99	(0.96, 1.03)
Gender (female)	1.34	(0.73, 2.43)	1.16	(0.53, 2.56)
Time since first injection drug use, years	1.01	(0.98, 1.03)	-	-
Length of episode, hours	1.01	(0.99, 1.02)	-	-
Total number of injections by participant during episode	1.01	(0.99, 1.02)	-	-
Engaged in prostitution in last six months	1.78	(0.93, 3.37)	-	-
Location of episode (reference: home of participant):				
Home of friend, partner, or family member	0.87	(0.46, 1.65)	0.92	(0.40, 2.15)
Rented room or hotel	0.74	(0.27, 2.08)	0.79	(0.23, 2.74)
Public place	0.48	(0.27, 0.89) *	0.47	(0.22, 1.00)
More than one other person present during episode	1.73	(0.91, 3.29)	-	-
Other person(s) present during episode ^a :				
is female	1.60	(0.95, 2.67)	-	-
is an intimate partner of participant ^b	2.23	(1.32, 3.77) *	2.59	(1.19, 5.64) *
is someone in whom participant places "confidence" ^c	0.49	(0.30, 0.80) *	0.36	(0.19, 0.66) *
has shared syringes with participant prior to episode	5.21	(3.05, 8.91) *	4.95	(2.60, 9.42) *
All other persons present had a new syringe for every injection	0.24	(0.14, 0.39) *	0.18	(0.10, 0.34) *
Source of money used to provide drugs for				

episode:				
prostitution	2.06	(0.88, 4.84)	2.57	(0.91, 7.24)
other illegal activities (not prostitution)	2.75	(1.35, 5.63) *	3.28	(1.35, 7.98) *
Non-injection drugs used by participant during				
episode:				
alcohol	2.12	(1.26, 3.55) *	2.05	(1.05, 3.98) *
cocaine	0.93	(0.45, 1.92)	-	-
Participant injected only heroin during episode	0.49	(0.23, 1.02)	0.24	(0.09, 0.63) *

LEGEND: OR, odds ratio. CI, confidence interval. n/d, not defined due to zero value in one cell. * denotes significance at alpha level of 0.05. ^a Only one other person was present during episode for 87% of participants. For those with more than one other person present, variables represent characteristic of at least one other person. ^b Intimate partner is defined as someone participant has lived with and had sex with. ^c Confidence is defined as answering 7 or more to the question, “On a scale of 1 to 10, how much confidence do you have in this person? 1 = no confidence, 10 = total confidence.”