Recent Incarceration Independently Associated with Syringe Sharing by Injection Drug Users

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SYNOPSIS

Objectives. Few prospective studies are available on the relationship between incarceration and HIV risk among injection drug users (IDUs). The authors evaluated self-reported rates of syringe sharing and incarceration among a cohort of IDUs.

Methods. This study analyzed syringe lending by HIV-infected IDUs and syringe borrowing by HIV-negative IDUs among participants enrolled in the Vancouver Injection Drug Users Study (VIDUS). Since serial measures for each individual were available, variables potentially associated with each outcome (syringe lending and borrowing) were evaluated using generalized estimating equations for binary outcomes.

Results. The study sample consisted of 1,475 IDUs who were enrolled into the VIDUS cohort from May 1996 through May 2002. At baseline, 1,123 (76%) reported a history of incarceration since they first began injecting drugs. Of these individuals, 351 (31%) reported at baseline that they had injected drugs while incarcerated.

Among 318 baseline HIV-infected IDUs, having been incarcerated in the six months prior to each interview remained independently associated with syringe lending during the same period (adjusted odds ratio [OR]=1.33; 95% confidence interval [CI] 1.06, 1.69; p=0.015). Similarly, among the 1,157 baseline HIV-negative IDUs, having been incarcerated in the six months prior to each interview remained independently associated with reporting syringe borrowing during the same period (adjusted OR=1.26; 95% CI 1.12, 1.44; p<0.001).

Conclusions. Incarceration was independently associated with risky needle sharing for HIV-infected and HIV-negative IDUs. This evidence of HIV risk behavior should reinforce public health concerns about the high rates of incarceration among IDUs.

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In North America, policy makers have responded to the HIV epidemic among injection drug users (IDUs) primarily by allocating resources to criminal justice interventions. Reliance on law enforcement has resulted in record incarceration rates, and it has been estimated that there are 100,000 more nonviolent drug offenders in U.S. prisons than the entire incarcerated population of the European Union, despite the EU's much larger population.[1] The incarceration of illicit drug users also has major implications for public health due to the potential for transmission of infectious disease during incarceration.[2–4] This may be of particular concern with regard to HIV transmission, which has been documented among inmates in a Scottish prison[4,5] and suspected in several other settings as a result of syringe sharing between incarcerated IDUs.[6–8]

In Canada, the potential for HIV transmission in prison has been a concern for many years.[9–11] A recent report found that reported cases of HIV infection in Canadian federal penitentiaries rose from 24 in 1989 to 223 in 2001,[12] raising fears that HIV may be rapidly spreading in this setting.[13] A recent cohort study of IDUs in Vancouver demonstrated that having been incarcerated in the last six months was independently associated with risk of HIV seroconversion.[14] This association was not fully evaluated since the objective of this earlier study was to evaluate the risks of HIV seroconversion related to injection cocaine.[14] Nevertheless, an external evaluation of the data suggested that 21% of HIV infections among IDUs in Vancouver in 1996–2001 may have been attributable to infection during incarceration.[15]

It is not known if selection factors or elevated rates of syringe sharing among incarcerated addicts may explain these earlier findings. The present study was therefore conducted to evaluate rates of incarceration and HIV risk behavior using data from a prospective cohort study of IDUs.

METHODS

Study sample

Beginning in May 1996, individuals who report having injected illicit drugs in the previous month have been recruited into the Vancouver Injection Drug User Study (VIDUS), an ongoing prospective cohort study that has been described in detail elsewhere.[14,16,17] Briefly, as of May 2002, 1,478 study subjects had been recruited through self-referral and street outreach. Data collection for the project is conducted in a storefront office. Individuals are eligible if they have injected illicit drugs at least once in the previous month, resided in the greater Vancouver region, and provided written informed consent. Evidence of recent injection drug use is required via inspection of needle tracks. Ethical approval for the project was provided by the University of British Columbia's Ethics Committee for Human Experimentation. At baseline and at six-month intervals, subjects provide blood samples for HIV and hepatitis C serology and complete an interviewer-administered questionnaire. The questionnaire elicits sociodemographic data including information on housing and incarceration, as well as data on illicit drug use, HIV risk behaviors, and attendance at drug treatment. Participants are provided a nominal monetary stipend ($20 CDN) at each study visit, and pre- and post-test counseling are offered through the study.

Statistical analyses

For the purposes of the present study, we hypothesized that IDUs who reported having been incarcerated at some point during the six months prior to the interview would be more likely to report syringe sharing during this period than those who had not been incarcerated within a six-month period. We defined the primary endpoints in this analysis to be distributive sharing ("lending") of used syringes by HIV-positive subjects and receptive sharing ("borrowing") of used syringes by HIV-negative subjects.

In the VIDUS questionnaire, participants are asked to report any syringe lending or borrowing that occurred in the six-month period prior to the interview. For the present study, we first sought to evaluate factors associated with reporting syringe lending during the six months prior to the interview among HIV-positive IDUs. Similarly, for participants who were HIV-negative at enrollment, we evaluated factors associated with syringe borrowing during the six months prior to the interview. Baseline HIV-negative individuals who became HIV-infected during follow-up were "censored out" of the analysis of syringe borrowing after their first HIV-positive visit. Data for these individuals obtained subsequent to HIV seroconversion were included in the analyses of syringe lending, with the first follow-up visit after the HIV-positive visit used as the baseline measure.

As a preliminary analysis, we compared rates of syringe lending among HIV-positive IDUs and syringe borrowing among HIV-negative IDUs during the six months prior to each follow-up visit, while stratifying IDUs according to reported incarceration in the prior six-month period (yes vs. no). To adjust for potential confounding due to differences between incarcerated and non-incarcerated subjects, we also performed multivariate analyses, as follows.

Since analyses of the factors associated with each outcome (lending for HIV-positives or borrowing for HIV-negatives) included serial measures for each subject, we used generalized estimating equations (GEE) for binary outcomes with logit link for the analysis of correlated data to determine which factors were independently associated with the outcome in each analysis.[18] The median number of semiannual follow-up visits for HIV-infected individuals was 6 (interquartile range [IQR] 3–8), and the median number of semiannual follow-up visits was 5 (IQR 2–8) for HIV-negative IDUs. These methods provided standard errors adjusted by multiple observations per person using an exchangeable correlation structure.

Variables of interest included baseline sociodemographic characteristics: age, gender, ethnicity (defined as Aboriginal vs. other), education level (completed high school vs. less than high school), and years injecting, as well as time-updated variables including residence in Vancouver's Downtown Eastside (designated the HIV-epicenter), unstable housing, incarceration, heroin and cocaine injection, crack cocaine smoking, methadone maintenance therapy, sex-trade involvement, requiring help injecting, and binge use of drugs. To be consistent with our previous work,[19] we defined living arrangements such as single room occupancy hotels or homelessness as "unstable housing," we defined daily injection of cocaine or heroin or daily smoking of crack as "frequent use," and we defined injecting of drugs more frequently than usual as "bingeing." Incarceration was defined as "being

in detention, prison, or jail overnight or longer." A history of ever having been incarcerated was assessed at baseline, and incarceration during the preceding six months was assessed at each visit.

Multivariate models were fit using an a priori–defined model-building protocol of adjusting for all variables that were statistically significant at the $p<0.05$ level in bivariate analyses. All statistical analyses were performed using SAS software, Version 8.0.[20]

RESULTS

From May 1996 through May 2002, 1,478 individuals were enrolled into the VIDUS cohort through ongoing recruitment. At the time of enrollment into the study, 1,123 (76%) reported having been "in detention, prison, or jail overnight or longer" since they first began injecting drugs. Of these individuals, 351 (31%) reported at their baseline interview that they had ever injected drugs in prison, jail, or detention.

Among the 1,478 individuals recruited during the study period, three individuals were excluded from further analyses due to missing data. Within the study sample ($N=1,475$), 318 individuals were found to be HIV-positive at baseline, and 1,157 individuals were HIV-negative.

Syringe lending by HIV-infected IDUs

The 318 individuals who were HIV-infected at baseline included 181 men (57%) and 137 women (43%). In this group, 114 (35.8%) self-identified as Aboriginal, and the median age was 34 (IQR 29–40). Among those who were HIV-negative at baseline, 117 became HIV-infected during follow-up; follow-up measures for these individuals subsequent to the first

HIV-positive test were included in the analysis of syringe lending. The demographic and risk characteristics of seroconverters in the study have been reported.[14,21] Crude inspection of the data, without adjustment for potential confounders, suggested elevated rates of syringe lending in the six months prior to the interview among IDUs who had also been incarcerated in the six months prior to the interview (not shown).

The results of GEE logistic analyses that took into account the serial measures on the same participant are presented in Table 1. In bivariate analyses, syringe lending among HIV-positive subjects was associated with: female gender (odds ratio [OR]=1.63), older age (OR=1.03 per year older), ethnicity (OR=0.77), years injecting (OR=1.02), residence in the HIV epicenter (OR=1.48), unstable housing (OR=1.39), incarceration within the last six months (OR=1.46), frequent heroin injection (OR=1.61), frequent cocaine injection (OR=2.40), sex-trade involvement (OR=1.95), requiring help injecting (OR=3.51), and binge drug use (OR=2.62).

Table 2 shows the results of the multivariate model that included all variables that were statistically significant in the bivariate analyses. Having been incarcerated in the last six months remained independently associated with syringe lending by HIV-positive IDUs (adjusted OR=1.33; 95% CI 1.06, 1.69; $p=0.015$). The adjusted ORs and 95% CIs for the other variables independently associated with syringe lending—daily cocaine injection, sex-trade involvement, requiring help injecting, and binge drug use—are shown in Table 2. These estimates were also adjusted for the demographic variables listed in the footnote to the table. When variables that were no longer significant in the multivariate model were

Table 1. Characteristics of baseline HIV-positive injection drug users and unadjusted logistic GEE estimates of factors potentially associated with syringe lending during follow-up period (n=435)

Characteristic	Unadjusted OR	95% CI	p-value
Gender (female vs. male)	1.63	1.32, 2.01	<0.001
Age (per year older)	1.02	1.00, 1.03	0.024
Ethnic background (Aboriginal vs. other)	0.77	0.62, 0.97	0.023
Education level (high school vs. less)	1.03	0.79, 1.33	0.852
Years injecting (per year longer)	1.02	1.00, 1.02	0.013
Reside in the HIV epicenter (yes vs. no)[a]	1.48	1.19, 1.85	<0.001
Unstable housing (yes vs. no)[a][b]	1.39	1.12, 1.71	0.002
Recent incarceration (yes vs. no)[b]	1.46	1.18, 1.82	<0.001
Frequent heroin injection (≥ daily vs. <daily)[b]	1.61	1.29, 2.00	<0.001
Frequent cocaine injection (≥ daily vs. <daily)[b]	2.40	1.94, 2.96	<0.001
Frequent crack smoking (≥ daily vs. <daily)[b]	0.89	0.68, 1.16	0.380
On methadone therapy (yes vs. no)[a]	1.20	0.96, 1.51	0.100
Sex-trade involvement (yes vs. no)[b]	1.95	1.55, 2.44	<0.001
Require help injecting (yes vs. no)[b]	3.51	2.82, 4.35	<0.001
Binge drug use (yes vs. no)[b]	2.62	2.12, 3.24	<0.001

NOTE: Gender, age, ethnic background, education level, and years injecting were fixed as baseline covariates.

[a]Current

[b]Last six months

GEE = generalized estimating equation

OR = odds ratio

CI = confidence interval

Table 2. Multivariate logistic GEE analysis of factors associated with syringe lending by baseline HIV-positive subjects during follow-up period (n=435)

Characteristic	Adjusted OR	95% CI	p-value
Recent incarceration			
No	1.0	—	—
Yes	1.33	1.06, 1.69	0.015
Cocaine injection			
<daily	1.0	—	—
≥daily	1.71	1.34, 2.19	<0.001
Sex-trade involvement			
No	1.0	—	—
Yes	1.53	1.15, 2.02	0.003
Require help injecting			
No	1.0	—	—
Yes	2.52	2.00, 3.16	<0.001
Binge drug use			
No	1.0	—	—
Yes	1.96	1.56, 2.46	<0.001

NOTES: Data were also adjusted for age, gender, ethnic background, residence in the HIV epicenter, unstable housing, frequent heroin use, and years injecting. The p-value remained <0.05 in the final multivariate model for age, gender, and ethnic background.

GEE = generalized estimating equation

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excluded, having been incarcerated in the last six months remained associated with syringe lending by HIV-positive IDUs (adjusted OR=1.36; 95% CI 1.08, 1.72; p=0.008).

Syringe borrowing by HIV-negative IDUs

The 1,157 individuals who were HIV-negative at baseline included 774 men (67%) and 383 women (33%). In this group, 265 individuals self-identified as Aboriginal (22.9%), and the median age was 36 (IQR 28–42). Again, crude inspection of the data suggested elevated rates of syringe borrowing in the six months prior to the interview among IDUs who had also been incarcerated during this period in unadjusted comparisons (not shown).

As shown in Table 3, in bivariate GEE logistic analyses, syringe borrowing among HIV-negative subjects was associated with: Aboriginal ethnicity (OR=0.67), residence in the HIV epicenter (OR=1.25), unstable housing (OR=1.46), recent incarceration (OR=1.48), frequent heroin injection (OR=1.50), frequent cocaine injection (OR=2.43), sex-trade involvement (OR=1.40), requiring help injecting (OR= 2.31), and binge drug use (OR=2.49).

Table 4 shows the results of the multivariate GEE analysis that included all variables that were significant in the bivariate analyses. Having been incarcerated in the six months prior to the interview was independently associated with syringe borrowing during the same period by baseline HIV-negative IDUs (adjusted OR=1.2; 95% CI 1.12, 1.44; p<0.001). The adjusted ORs and 95% CIs for the other

variables independently associated with syringe borrowing— daily cocaine injection, daily heroin injection, sex trade, requiring help injecting, and binge drug use—are shown in Table 4. As before, these estimates were adjusted for the demographic characteristics noted in the footnote to the table. When variables that were no longer significant in the multivariate model were excluded, having been incarcerated in the last six months remained associated with syringe borrowing by HIV-negative IDUs (adjusted OR 1.21; 95% CI 1.07, 1.38; p=0.003).

DISCUSSION

In the present study, we found that HIV-infected IDUs were significantly more likely to report lending a used syringe at six-month follow-up if they had been incarcerated during the same period. Similarly, among individuals who were HIV-negative at baseline, syringe borrowing was markedly elevated among individuals who had been incarcerated at least overnight at some point during the follow-up period.

Recent surveillance reports of HIV infection in prisons have suggested major increases since 1989 in the prevalence of hepatitis C seropositivity and the prevalence of HIV-infection among incarcerated individuals.[12,13] It is not known if rising rates of bloodborne diseases in prisons are due to selection of infected individuals out of the community or to risky behavior occurring within prisons. Of concern, a recent study from the VIDUS cohort reported that having been recently incarcerated was associated with a markedly elevated rate of incident HIV infection.[14,15] The present study suggests that this earlier finding may not be explained by selection biases. Further, it provides evidence to support the conclusion that HIV may be spreading in prisons, jails, and detention centers since we found that behaviors that can directly contribute to HIV infection were strongly and independently associated with reports of recent incarceration. These findings may not be surprising since previous cross-sectional studies have found the sharing of syringes to be common in Canadian prisons,[9,10,22] as well as in prisons in other countries.[4,7,23,24]

Several interventions have been proposed to reduce the transmission of bloodborne disease through the sharing of contaminated injection equipment by IDUs while incarcerated. These programs include efforts to provide bleach or other products to sterilize syringes, syringe exchange programs, and methadone maintenance therapy, which are in place to varying degrees in different settings.[24,25] Obviously, to reduce rates of bloodborne disease transmission in prisons, jails, and/or detention centers, these programs are in urgent need of implementation/expansion and evaluation.

While the rapid expansion and evaluation of HIV prevention measures in prisons, jails, and detention centers is an immediate priority, the burgeoning levels of incarceration and the rates of syringe sharing among illicit drug offenders raises several issues for policy makers.[1–8] First, it is noteworthy that bleach has been available in most provincial and federal prisons in Canada since 1995, and methadone treatment has been increasingly available since 1996.[26] As noted above, protecting the health of inmates, and the community at large upon their release, will require that bloodborne disease prevention programs be expanded. It should be

Table 3. Characteristics of baseline HIV-negative injection drug users and unadjusted logistic GEE estimates of factors potentially associated with syringe borrowing during follow-up period (n=1,157)

Characteristic	Unadjusted OR	95% CI	p-value
Gender (female vs. male)	0.87	0.72, 1.06	0.162
Age (per year older)	1.01	0.99, 1.02	0.163
Ethnic background (Aboriginal vs. other)	0.67	0.54, 0.82	<0.001
Education level (high school vs. less)	0.92	0.73, 1.16	0.468
Years injecting (per year longer)	1.00	0.99, 1.01	0.246
Reside in the HIV epicenter (yes vs. no)[a]	0.92	0.82, 1.03	0.141
Unstable housing (yes vs. no)[a]	1.46	1.20, 1.76	<0.001
Recent incarceration (yes vs. no)[b]	1.48	1.22, 1.80	<0.001
Frequent heroin injection (≥daily vs. <daily)[b]	1.50	1.23, 1.84	<0.001
Frequent cocaine injection (≥daily vs. <daily)[b]	2.43	2.01, 2.94	<0.001
Frequent crack smoking (≥daily vs. <daily)[b]	0.91	0.72, 1.15	0.459
On methadone therapy (yes vs. no)[a]	1.02	0.83, 1.25	0.854
Sex-trade involvement (yes vs. no)[b]	1.40	1.13, 1.73	0.002
Require help injecting (yes vs. no)[b]	2.31	1.90, 2.83	<0.001
Binge drug use (yes vs. no)[b]	2.49	2.05, 3.01	<0.001

NOTE: Gender, age, ethnic background, education level, and years injecting were fixed as baseline covariates.

[a]Current

[b]Last six months

GEE = generalized estimating equation

OR = odds ratio

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stressed that alternatives to incarceration, such as the treatment of addiction in the community, may be more cost-effective at reducing health, social, and economic harms of illicit drug use.[27–29] Expanded HIV prevention measures in prisons, jails, and detention centers should ideally be coupled with evaluations of diversion programs for nonviolent drug offenders.

A major limitation of the present study is that it we have identified only associations between incarceration and HIV risk behavior, and the study design was such that it was not possible to discern the extent to which syringe sharing occurred during or after release. One hypothesis is that incarceration promotes the sharing of syringes. Alternatively, people who are incarcerated may be at particularly high risk of syringe sharing. However, it is noteworthy that the associations between incarceration and syringe sharing (both lending and borrowing) persisted after adjustment for frequent drug use and other risk factors that may elevate the risk of syringe sharing. Furthermore, an ongoing qualitative evaluation of recently incarcerated addicts in the VIDUS cohort has suggested widespread syringe sharing in prison, jails, and detention centers due to limited syringe availability,[30] and the levels of injection drug use during incarceration reported at baseline in the present study were striking. A second limitation concerns the fact that, although some studies have suggested that self-reports of IDUs are valid,[31] syringe sharing is a stigmatized behavior and it is possible that lending and borrowing rates were underestimated.[32] Nevertheless, we know of no reason why syringe sharing would be reported differently by recently incarcerated IDUs and IDUs who have not been incarcerated. Furthermore, it is noteworthy that variables associated with syringe borrowing in the present study, including requiring help injecting,[33] bingeing,[34] frequent cocaine injection,[21] and incarceration,[14]

Table 4. Multivariate logistic GEE analysis of factors associated with syringe borrowing by baseline HIV-negative subjects during follow-up period (n=1,157)

Characteristic	Adjusted OR	95% CI	p-value
Recent incarceration			
No	1.0	—	—
Yes	1.26	1.12, 1.44	<0.001
Cocaine injection			
<daily	1.0	—	—
≥daily	1.38	1.21, 1.59	<0.001
Heroin injection			
<daily	1.0	—	—
≥daily	1.58	1.40, 1.80	<0.001
Sex-trade involvement			
No	1.0	—	—
Yes	1.50	1.30, 1.74	<0.001
Require help injecting			
No	1.0	—	—
Yes	2.66	2.33, 3.02	<0.001
Binge drug use			
No	1.0	—	—
Yes	1.78	1.58, 2.02	<0.001

NOTES: Data were also adjusted for unstable housing, residence in the HIV-epicenter, and ethnicity. The p-value remained <0.05 in the final multivariate model for unstable housing, residence in the HIV-epicenter, and ethnicity.

GEE = generalized estimating equation

OR = odds ratio

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have previously been associated with HIV seroconversion in the VIDUS cohort. Finally, although previous studies have reported HIV risk in diverse detention settings,[4,35] we used a broad definition of incarceration that included detention, prison, or jail overnight or longer and thus may have misclassified some individuals as incarcerated when they were only briefly detained overnight. If syringe sharing is less prevalent in these short stays than in longer stays, any such misclassification would have biased our study toward no association; yet in both lines of inquiry, independent associations persisted. A final limitation is that not all participants had complete follow-up throughout the study period, although we know of no reason why limited follow-up would bias our results.

The present study found that incarceration was independently associated with syringe lending by HIV-infected IDUs and syringe borrowing by HIV-negative IDUs. These findings add to the large and growing body of evidence from Canada[9–11,14,22] and elsewhere[4,5,7,24,36] that HIV transmission among incarcerated IDUs is a major public health concern that necessitates the implementation of an evidence-based HIV prevention program in prisons, jails, and detention centers. These findings should also raise public health concerns about the high rates of incarceration and syringe sharing among nonviolent drug offenders, and suggest that diversion strategies, such as community treatment programs,[37] deserve substantially greater consideration.

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