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Impact of Length of Injecting Career on HIV Incidence among People WHO Inject Drugs

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Abstract

We examined the relationship between duration of injecting career and HIV seroconversion among people who inject drugs (PWID) in Vancouver, Canada. Data were derived from HIV-negative PWID enrolled in a prospective cohort study. We employed Kaplan-Meier methods and Cox regression to investigate the effect of length of time since injection drug use initiation on time to HIV seroconversion. In multivariable Cox analysis, duration of injecting career was negatively associated with time to HIV seroconversion (adjusted hazard ratio = 0.82; 95% confidence interval [CI]: 0.69–0.97). Our findings highlight the need for interventions that target individuals who participate in high-risk drug use behaviors.

Keywords

injection drug use; injecting career; HIV incidence

INTRODUCTION

Injection drug use is associated with a multitude of health risks, including soft tissue infections (e.g., abscesses and cellulitis) and blood-borne infections (e.g., Human Immunodeficiency Virus [HIV] and Hepatitis C Virus [HCV]) [1, 2]. The prevalence of HIV

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Contributors

Lianping Ti, Paul Nguyen and Thomas Kerr designed the study and wrote the protocol. Jacqueline Montain conducted literature searches and provided summaries of previous research studies. Paul Nguyen conducted the statistical analysis. Jacqueline Montain wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of Interest

All authors declare that they have no conflicts of interest.

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infection is at least 22 times greater among people who inject drugs (PWID) than among the general population based upon available data from 49 countries worldwide; and at least 50 times greater for PWID in 11 countries [3]. It is well known that, unlike other high-risk populations (e.g., men who have sex with men, sex workers), where HIV transmission is mainly driven by unprotected sexual intercourse, HIV infection among PWID is mainly transmitted via the sharing of unsterile syringes.

With evidence suggesting that conventional drug-control and enforcement policies, including punitive mandatory minimum sentencing and compulsory drug detention are not adequate in reducing injection drug use and the high prevalence of HIV infection among PWID [2, 4–8], world leading public health and medical bodies are strongly recommending comprehensive strategies that include interventions to reduce the number of people injecting drugs, reduce transmission of HIV among PWID, and provide treatment for those who are HIV positive [2, 4, 7, 9–15]. In the interest of minimizing risk of HIV infection in the most cost-effective manner, it has been shown that HIV interventions are best targeted toward the most vulnerable subgroups of PWID [4, 6, 16].

Early studies of HIV prevalence and incidence among PWID provided equivocal evidence concerning the complex relationship between potential changes in risk-taking behavior over time and HIV infection [17–20]. While increasing rates of HIV infection over time have been observed, they were associated strictly with current chronological age of the drug user or the age at initiation of injection drug use, leaving increasing rates to be interpreted as a result of any or all of escalating network risk, behavioral risk, or cumulative exposure over time [21]. More recent cross-sectional studies specifically investigated duration (‘shorter duration’ vs. ‘more experienced’ drug users) as a variable of interest, although inconsistent definitions of ‘short duration’ and/or the use of chronological age as a proxy for actual duration of drug use itself make the interpretation difficult [17, 22, 23]. Additionally, the research to date was also limited by the inherent disadvantage in cross-sectional studies such that actual time of infection remains unknown, and specific behavior around time of infection therefore only roughly measurable [18]. In order to assess if PWID with different durations of drug use should be targeted with more intensive prevention strategies, we undertook this study to identify the impact of duration of injection drug use career on HIV incidence rates among individuals participating in an open prospective cohort study of PWID in Vancouver, Canada [24].

We hypothesized that risk-taking behaviors of PWID vary according to the length of time that study participants had been injecting drugs, contributing to differences in rates of HIV seroconversion between PWID with shorter duration and longer duration injecting careers. Thus, the primary explanatory variable of interest was length of injecting career, defined as the number of years since initiation of injecting drugs.

METHODS

Participant recruitment

The Vancouver Injection Drug User Study (VIDUS) is a prospective cohort study of PWID who have been recruited through self-referral and street outreach from Vancouver’s

Downtown Eastside since May 1996. The cohort has been described in detail previously [25]. In brief, persons were eligible to enroll in the VIDUS study if they had injected illicit drugs at least once in the previous month and resided in the Greater Vancouver region at enrollment. All participants complete an interviewer-administered questionnaire and provide a blood sample at baseline and semiannual follow-up visits. All study participants provided informed consent, and participants were given a stipend (\$20) at each study visit. The study has been reviewed and approved by Providence Health Care/University of British Columbia's Research Ethics Board. The present study was conducted between May 1996 and May 2013.

Measures

The primary outcome of interest in this analysis was time to HIV seroconversion. The date of HIV seroconversion was estimated using the midpoint between the last negative and first positive antibody test result dates. Analyses were restricted to study participants who were HIV negative at time of enrollment and had at least one follow-up visit during the study. Consistent with the large body of previous research in this area, and given that risk of HIV seroconversion is known to be shaped by an array of individual and contextual variables, a range of potential covariates were considered for inclusion in the model. Based on previous literature [26–32], demographic and environmental secondary variables for this analysis included: gender (male vs. female); age (per 10 years older); Indigenous ancestry (yes vs. no); incarceration in the last 6 months (yes vs. no); participation in sex work in the last 6 months (yes vs. no); and practice of unprotected sex in the last 6 months (yes vs. no). In addition, secondary drug use variables included: syringe borrowing in the last 6 months (yes vs. no); daily use of each of crack smoking, cocaine injection and heroin injection in the last 6 months (yes vs. no); requiring help injecting drugs in the last 6 months (yes vs. no); and enrollment in methadone maintenance therapy (MMT) in the last 6 months (yes vs. no). It was hypothesized that being male [33], age (per 10 years older) [34] and enrollment in methadone maintenance therapy (MMT) in the last 6 months [35] were negatively associated with HIV seroconversion; while having Indigenous ancestry [36], being incarcerated in the last 6 months [37], and participating in sex work [38, 39], unprotected sex [40–42], syringe borrowing [43], requiring help injecting drugs [44], or daily use of cocaine, crack or heroin in the last 6 months [45] were positively associated with HIV seroconversion.

Statistical analyses

As an initial step, Kaplan-Meier methods were employed to estimate the cumulative incidence of HIV seroconversion, stratified by the median length of time injecting drugs at baseline. The log-rank test was used to compare the cumulative incidence curves of both groups. As the next step, using bivariable and multivariable Cox regression analyses, the hazard ratios were calculated to assess the independent effect of length of injecting career on time to HIV seroconversion. We constructed the multivariable confounding model using a variable selection process described previously by Maldonado and Greenland [46]. While there can be limitations to conventional stepwise approaches to model selection including the potential for low sensitivity in screening for confounders [47], we aimed to find the most parsimonious model that describes the data. Given that age and length of time injecting were

highly collinear variables, we excluded age from the multivariable analysis before proceeding with this process. We first fitted a full model containing all variables with $p < 0.05$ in the bivariable analyses, and then proceeded to fit a series of reduced models, noting the value of the coefficient associated with the primary variable of interest. After comparing the value of the coefficient associated with the primary variable of interest in the full model to the value of the coefficient in each of the reduced models, we removed the secondary variable associated with the smallest relative change from further consideration. We continued this iterative process until the minimum change of the value of the coefficient for length of time injecting exceeded 5%. Remaining variables were considered confounders in the multivariable analysis. All statistical analyses were performed using the SAS software version 9.3 (SAS, Cary, NC). All p-values were from two-sided statistical tests.

RESULTS

Among 1639 baseline HIV-negative PWID recruited into the VIDUS cohort, the median age at baseline was 36 years (interquartile range, or difference between the third (75th percentile) and first quartile (25th percentile) accordingly, was [IQR]: 28–42). The median length of time injecting at baseline was 13 years (IQR: 5–23). After 5 years of follow-up, the cumulative incidence of HIV seroconversion for this entire sample was 8.27% (95% confidence interval [CI]: 6.96%–9.81%). After 5 years of follow-up, the cumulative incidence among PWID who reported a history of <13 years of injecting drugs at baseline was 10.13% (95% CI: 8.08%–12.66%) while those with a history of ≥13 years of injecting was 6.64% (95% CI: 5.09%–8.64%). After 10 years of follow-up, the cumulative incidence of HIV seroconversion for the entire sample was 10.04% (95% CI: 8.46%–11.90%); while the cumulative incidence among PWID who reported a history of <13 years of injecting drugs at baseline was 11.88% (95% CI: 9.54%–14.76%) while those with a history of ≥13 years of injecting was 8.47% (95% CI: 6.44%–11.09%). As shown in Figure 1, this difference in cumulative incidence was statistically significant ($p = 0.016$).

Table 1 presents the bivariable and multivariable Cox regression results of time to HIV seroconversion. In the bivariable analysis, the length of injecting career (per 10 years longer) was negatively associated with the time to HIV seroconversion (hazard ratio [HR] = 0.72; 95% CI: 0.62–0.85). Other variables found to be negatively associated with time to HIV seroconversion in bivariable analysis included male gender (HR = 0.57; 95% CI: 0.41–0.80); older age (HR = 0.71; 95% CI: 0.61–0.83); and enrollment in methadone maintenance therapy (MMT) (HR = 0.50; 95% CI: 0.33–0.76), while Indigenous ancestry (HR = 2.06; 95% CI: 1.48–2.89); incarceration in the last 6 months (HR = 1.64; 95% CI: 1.14–2.34); participation in sex work (HR = 1.68; 95% CI: 1.13–2.51); syringe borrowing (HR = 1.99; 95% CI: 1.38–2.87); daily cocaine use (HR = 4.31; 95% CI: 3.04–6.12); daily heroin use (HR = 1.90; 95% CI: 1.35–2.69); and required help injecting (HR = 2.29; 95% CI: 1.60–3.28) were positively associated with the outcome.

In the multivariable analysis, after adjusting for male gender, incarceration, daily heroin injection and enrollment in MMT, the length of injecting career (per 10 years longer) remained independently and negatively associated with time to HIV seroconversion (adjusted hazard ratio [AHR] = 0.82; 95% CI: 0.69–0.97). In examining effects of

confounding variables on the final multivariable model, both male gender (21.4%) and enrollment in MMT (21.2%) were found to have the largest relative change on the value of the coefficient of the primary variable of interest.

DISCUSSION

In the present study, we found that longer length of time injecting remained independently associated with reduced rate of HIV incidence in multivariable analysis, after adjusting for various confounders. Our findings are consistent with a small body of literature reporting an association between longer duration of injection drug use and a decrease in incidence of HIV seroconversion [17–19, 48–50]. In particular, one study conducted in Amsterdam reported an independent and negative association between duration of injection drug use and HIV incidence, and like the present study, also reported HIV incidence to be decreased for PWID indicating a duration of injection drug use >13 years [19].

It is possible that the association between longer length of time as an injection drug user and decreased rate of HIV incidence may be attributed to differences in associated risk behaviors and attitudes that evolve as PWID become more familiar with drug injecting. While the present study has highlighted duration of injecting career as an independent predictor of time to HIV seroconversion; there additionally exists a large body of research in this setting and other settings which explores the relationship between unsafe drug injection practices and other unsafe behaviors and HIV incidence [34, 44, 51, 52]. Previous studies in other settings have documented that people who have injected drugs for a shorter duration of time engage in risky injection practices, such as borrowing of syringes and other injecting paraphernalia and requiring help injecting [19, 48, 49]. Additionally, studies have shown that PWID who have spent a shorter duration of time injecting drugs are less likely to participate in HIV prevention programs, such as needle and syringe distribution programs and drug addiction treatment [22, 53–55]. There is also evidence to suggest that PWID who are earlier in injection careers may be less likely to self-identify themselves as PWID and therefore may underestimate their risk of infection, thus making them less likely to take advantage of existing prevention resources and available precautions [23]. The social context of injecting which surrounds newly initiated PWID may also have a strong influence on specific practices and habits formed [56, 57]. In particular, PWID who exhibit greater dependence on others for injecting early in their injection careers may be less likely to adopt safer injecting practices if unsafe injecting is the norm in their social network [58–60].

In light of the above, our findings have implications for policy makers and public health practitioners to develop and implement HIV prevention programs and policies specific to PWID with shorter duration of drug injecting careers. Improvements in HIV prevention can occur through better targeting of interventions, ensuring that individuals at greater risk of contracting the virus have the knowledge, tools and appropriate environments to reduce drug-related harm [16, 61]. This study highlights PWID with <13 years injecting drugs as a key demographic for such approaches, as evidenced by the fact that longer duration of injection drug use was strongly associated with decreased risk of HIV infection. As such, harm reduction programs and HIV prevention efforts focused on reducing unsafe injection practices [35, 62, 63] (i.e. needle and syringe programs, MMT, voluntary counselling and

testing, and provision of information and treatment options) and providing safer environment interventions [64–66] (i.e. supervised injection facilities, peer-based supports) should target PWID with shorter duration of drug injecting careers in this setting.

There are several limitations to this study. The present study is not a random sample of PWID in Vancouver. Accordingly, the findings presented herein may not be generalizable to other PWID populations in Vancouver or elsewhere. Due to the observational nature of this study, residual or unmeasured confounding may be present. Further, there may be some reporting biases (e.g., socially desirable reporting and recall bias) related to our explanatory variables as these measures relied on self-report. However, it is expected that the influence of socially desirable reporting and recall bias for the outcome variable is minimal given that the outcome was a hard measure of time to HIV seroconversion measured via serologic analyses. Additionally, it is noted that the semiannual followup of participants in this study provides a relatively broad measurement window and temporal resolution. Finally, duration of injection drug use is not necessarily an inherently risky behavior and therefore may be an indirect measure to predict HIV seroconversion. Nevertheless, we found an independent relationship between duration on injection drug use and HIV seroconversion, even after adjusting for various risk and protective factors, including incarceration, daily heroin use, and enrolment in MMT.

In the present study, longer length of time engaging in drug-injecting was independently and negatively associated with risk of HIV seroconversion, following adjustment for other known risk factors for HIV infection among PWID. These findings may assist in the development of interventions that target individuals who have injected drugs for a shorter duration of time and who are at elevated risk for acquiring HIV infection due to potentially unsafe injection practices.

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References

1. Binswanger IA, et al. High prevalence of abscesses and cellulitis among community-recruited injection drug users in San Francisco. *Clinical Infectious Diseases*. 2000; 30:579–81. [PubMed: 10722447]
2. Wood E, et al. The health care and fiscal costs of the illicit drug use epidemic: the impact of conventional drug control strategies, and the potential of a comprehensive approach. *BC Medical Journal*. 2003; 45(3)
3. HIV/AIDS, J.U.N.P.o. Global report: UNAIDS report on the global AIDS epidemic 2012. 2012. JC2417E

4. Vlahov D, Robertson AM, Strathdee SA. Prevention of HIV infection among injection drug users in resource-limited settings. *Clinical Infectious Diseases*. 2010; 50(S3):S114–S121. [PubMed: 20397939]
5. Beyrer C, et al. Time to act: a call for comprehensive responses to HIV in people who use drugs. *The Lancet*. 2010; 376(9740):551–563.
6. Degenhardt L, et al. Prevention of HIV infection for people who inject drugs: why individual, structural and combination approaches are needed. *The Lancet*. 2010; 376:285–301.
7. Strang J, et al. Drug Policy and the public good: Evidence for effective interventions. *The Lancet*. 2012; 379:71–83.
8. Hankins C. Overview of the current state of the epidemic. *Current HIV/AIDS Reports*. 2013; 10(2): 113–123. [PubMed: 23579359]
9. WHO. World Health Organization Expert Committee on Drug Dependence - Twentieth Report. World Health Organization; 1974.
10. Ball A, et al. Evidence for action: a critical tool for guiding policies and programmes for HIV prevention, treatment and care among injecting drug users. *International Journal of Drug Policy*. 2005; 16:1–6.
11. WHO. Effectiveness of sterile needle and syringe programming in reducing HIV/AIDS among injecting drug users: Evidence for Action Technical Papers. 2004.
12. WHO. Policy guidelines for collaborative TB and HIV services for injecting and other drug users - An integrated approach: Evidence for Action Technical Papers. 2008.
13. WHO. WHO, UNODC, UNAIDS technical guide for countries to set targets for universal access to HIV prevention, treatment and care for injecting drug users - 2012 revision. 2012.
14. Ball AL. HIV, injecting drug use and harm reduction: a public health response. *Addiction*. 2007; 102(5):684–690. [PubMed: 17506148]
15. Piot P, Quinn TC. Response to the AIDS pandemic a global health model. *New England Journal of Medicine*. 2013; 368(23):2210–2218. [PubMed: 23738546]
16. Piot P, et al. Coming to terms with complexity: a call to action for HIV prevention. *The Lancet*. 2008; 372(9641):845–859.
17. Rezza G, et al. Understanding the dynamics of the HIV epidemic among Italian intravenous drug users: a cross-sectional versus a longitudinal approach. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 1994; 7(5):500–503.
18. Van Ameijden E, et al. The harm reduction approach and risk factors for human immunodeficiency virus (HIV) seroconversion in injecting drug users, Amsterdam. *American Journal of Epidemiology*. 1992; 136(2):236–243. [PubMed: 1415145]
19. Fennema JSA, et al. Young and recent-onset injecting drug users are at higher risk for HIV. *Addiction*. 1997; 92(11):1457–1465. [PubMed: 9519489]
20. Nicolosi A, et al. Parenteral and sexual transmission of human immunodeficiency virus in intravenous drug users: a study of seroconversion. *American Journal of Epidemiology*. 1992; 135(3):225–233. [PubMed: 1312300]
21. Bautista CT, et al. Effects of duration of injection drug use and age at first injection on HCV among IDU in Kabul, Afghanistan. *Journal of Public Health*. 2010; 32(3):336–341. [PubMed: 20421237]
22. Des Jarlais DC, et al. Risk behavior and HIV infection among new drug injectors in the era of AIDS in New York City. *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology*. 1999; 20(1):67–72. [PubMed: 9928732]
23. Vlahov D, et al. Comparison of HIV risk by duration of injection drug use. *Substance Use and Misuse*. 2011; 46:181–191. [PubMed: 21303238]
24. HIV/AIDS, J.U.N.P.o. Minutes of the 24th Meeting of the UNAIDS Programme Coordinating Board (8 June 2009) UNDOC PCB(24)/09.9.Rev.1. 2009
25. Wood E, et al. Baseline self-perceived risk of HIV infection independently predicts the rate of HIV seroconversion in a prospective cohort of injection drug users. *International Journal of Epidemiology*. 2005; 34:152–158. [PubMed: 15561747]

26. Craib KJ, et al. Risk factors for elevated HIV incidence among Aboriginal injection drug users in Vancouver. *Canadian Medical Association Journal*. 2003; 168(1):19–24. [PubMed: 12515780]
27. Spittal PM, et al. Risk factors for elevated HIV incidence rates among female injection drug users in Vancouver. *Canadian Medical Association Journal*. 2002; 166(7):894–899. [PubMed: 11949985]
28. Strathdee SA, Sherman SG. The role of sexual transmission of HIV infection among injection and non-injection drug users. *Journal of Urban Health*. 2003; 80:iii7–iii14. [PubMed: 14713667]
29. Tyndall MW, et al. Intensive injection cocaine use as the primary risk factor in the Vancouver HIV-1 epidemic. *Aids*. 2003; 17(6):887–893. [PubMed: 12660536]
30. Clarke JG, et al. Active and former injection drug users report of HIV risk behaviors during periods of incarceration. *Substance abuse*. 2001; 22(4):209–216. [PubMed: 12466681]
31. Patrick DM, et al. Determinants of HIV seroconversion in drug users during a period of rising prevalence in Vancouver. *International journal of STD & AIDS*. 1997; 8(7):437–445. [PubMed: 9228591]
32. Lamothe F, et al. Seroprevalence of and risk factors for HIV-1 infection in injection drug users in Montreal and Toronto: a collaborative study. *CMAJ: Canadian Medical Association Journal*. 1993; 149(7):945. [PubMed: 8402423]
33. Ahamad K, et al. Gender influences on initiation of injecting drug use. *The American journal of drug and alcohol abuse*. 2014; 40(2):151–156. [PubMed: 24405226]
34. Broz D, et al. Prevalence of HIV infection and risk behaviors among younger and older injecting drug users in the United States, 2009. *AIDS and Behavior*. 2014; 18(3):284–296. [PubMed: 24242754]
35. Ahamad K, et al. Effect of low-threshold methadone maintenance therapy for people who inject drugs on HIV incidence in Vancouver, BC, Canada: an observational cohort study. *The Lancet HIV*. 2015; 2(10):e445–e450. [PubMed: 26423652]
36. Bingham B, et al. Generational sex work and HIV risk among Indigenous women in a street-based urban Canadian setting. *Culture, health & sexuality*. 2014; 16(4):440–452.
37. Milloy M, et al. Incarceration is associated with used syringe lending among active injection drug users with detectable plasma HIV-1 RNA: a longitudinal analysis. *BMC infectious diseases*. 2013; 13(1):565. [PubMed: 24289651]
38. Shannon K, Csete J. Violence, condom negotiation, and HIV/STI risk among sex workers. *JAMA*. 2010; 304(5):573–574. [PubMed: 20682941]
39. Shannon K, et al. Global epidemiology of HIV among female sex workers: influence of structural determinants. *The Lancet*. 2015; 385(9962):55–71.
40. Dosekun O, Fox J. An overview of the relative risks of different sexual behaviours on HIV transmission. *Current Opinion in HIV and AIDS*. 2010; 5(4):291–297. [PubMed: 20543603]
41. Patel P, et al. Estimating per-act HIV transmission risk: a systematic review. *Aids*. 2014; 28(10):1509–1519. [PubMed: 24809629]
42. Varghese B, et al. Reducing the risk of sexual HIV transmission: quantifying the per-act risk for HIV on the basis of choice of partner, sex act, and condom use. *Sexually transmitted diseases*. 2002; 29(1):38–43. [PubMed: 11773877]
43. Kerr T, et al. Syringe sharing and HIV incidence among injection drug users and increased access to sterile syringes. *American journal of public health*. 2010; 100(8):1449–1453. [PubMed: 20558797]
44. Cheng T, et al. High Prevalence of Assisted Injection Among Street-Involved Youth in a Canadian Setting. *AIDS and Behavior*. 2015:1–8. [PubMed: 24668254]
45. Tavitian–Exley I, et al. Influence of different drugs on HIV risk in people who inject: systematic review and meta-analysis. *Addiction*. 2015; 110(4):572–584. [PubMed: 25582153]
46. Maldonado G, Greenland S. Simulation study of confounder-selection strategies. *American journal of epidemiology*. 1993; 138(11):923–936. [PubMed: 8256780]
47. Greenland S. Modeling and variable selection in epidemiologic analysis. *American journal of public health*. 1989; 79(3):340–349. [PubMed: 2916724]

48. van Ameijden EJ, et al. Risk factors for the transition from noninjection to injection drug use and accompanying AIDS risk behavior in a cohort of drug users. *American Journal of Epidemiology*. 1994; 139(12):1153–1163. [PubMed: 8209874]
49. Doherty MC, et al. Correlates of HIV infection among young adult short-term injection drug users. *Aids*. 2000; 14(6):717–726. [PubMed: 10807195]
50. Vlahov D, et al. Association of drug injection patterns with antibody to human immunodeficiency virus type 1 among intravenous drug users in Baltimore, Maryland. *American Journal of Epidemiology*. 1990; 132(5):847–856. [PubMed: 2239899]
51. Bruneau J, et al. Trends in human immunodeficiency virus incidence and risk behavior among injection drug users in Montreal, Canada: A 16-year longitudinal study. *American journal of epidemiology*. 2011; 173(9):1049–1058. [PubMed: 21362739]
52. Nelson KE, et al. Temporal trends in the incidence of human immunodeficiency virus infection and risk behavior among injection drug users in Baltimore, Maryland, 1988–1998. *American journal of epidemiology*. 2002; 156(7):641–653. [PubMed: 12244033]
53. Hacker MA, et al. The role of "Long-term" and "New" injectors in a declining HIV/AIDS epidemic in Rio de Janeiro, Brazil. *Substance Use & Misuse*. 2005; 40:99–123. [PubMed: 15702651]
54. Neaigus A, et al. High-risk personal networks and syringe sharing as risk factors for HIV infection among new drug injectors. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 1996; 11(5):499–509.
55. Buxton MB, et al. Association between injection practices and duration on injection among recently initiated injection drug users. *Drug and Alcohol Dependence*. 2004; 75:177–183. [PubMed: 15276223]
56. Friedman, SR. *AIDS Prevention and Mental Health*. New York: Kluwer Academic; 2002. *Social Networks, Drug Injectors' Lives, and HIV/AIDS*.
57. Harocopos A, et al. New injectors and the social context of injection initiation. *International Journal of Drug Policy*. 2009; 20:317–323. [PubMed: 18790623]
58. Davis M, Rhodes T, Martin A. Preventing hepatitis C: 'Common sense', 'the bug' and other perspectives from the risk narratives of people who inject drugs. *Social Science & Medicine*. 2004; 59(9):1807–1818. [PubMed: 15312916]
59. Day CA, et al. Initiation to heroin injecting among heroin users in Sydney, Australia: cross sectional survey. *Harm Reduction Journal*. 2005; 2(1):2. [PubMed: 15713226]
60. Abelson J, et al. Some characteristics of early-onset injection drug users prior to and at the time of their first injection. *Addiction*. 2006; 101(4):548–555. [PubMed: 16548934]
61. Bertozzi SM, et al. Making HIV prevention programmes work. *The Lancet*. 2008; 372(9641):831–844.
62. Hyshka E, et al. Needle exchange and the HIV epidemic in Vancouver: lessons learned from 15 years of research. *International Journal of Drug Policy*. 2012; 23(4):261–270. [PubMed: 22579215]
63. Markwick N, et al. Willingness to engage in peer-delivered HIV voluntary counselling and testing among people who inject drugs in a Canadian setting. *Journal of epidemiology and community health*. 2014 p. jech-2013-203707.
64. McNeil R, et al. People Knew They Could Come Here to Get Help : An Ethnographic Study of Assisted Injection Practices at a Peer-Run 'Unsolicited' Supervised Drug Consumption Room in a Canadian Setting. *AIDS and Behavior*. 2014; 18(3):473–485. [PubMed: 23797831]
65. McNeil R, Small W. 'Safer environment interventions': A qualitative synthesis of the experiences and perceptions of people who inject drugs. *Social Science & Medicine*. 2014; 106:151–158. [PubMed: 24561777]
66. Ti L, et al. Willingness to access peer-delivered HIV testing and counseling among people who inject drugs in Bangkok, Thailand. *Journal of community health*. 2013; 38(3):427–433. [PubMed: 23149569]

HIGHLIGHTS

- The effect of length of injection drug use career on HIV seroconversion is examined.
- Kaplan-Meier methods and Cox regression are applied to data from a prospective cohort study.
- Results indicate length of injection drug use is negatively associated with HIV seroconversion.
- HIV prevention efforts should target people who have injected drugs for a shorter length of time.

Figure 1.
Cumulative incidence of HIV seroconversion among injection drug users, stratified by median length of injecting career at baseline (13 years)

Table 1

Bivariable and multivariable Cox regression analyses of factors associated with time to HIV seroconversion among injection drug users in Vancouver, Canada, 1996–2013 (n=1639)

Characteristic	Unadjusted		Adjusted	
	Hazard Ratio (95% CI ^{**})	<i>p</i> -value	Hazard Ratio (95% CI ^{**})	<i>p</i> -value
Years Injecting [*] (per 10 years longer)	0.72 (0.62–0.85)	<0.001	0.82 (0.69–0.97)	0.019
Gender (male vs. female)	0.57 (0.41–0.80)	0.001	0.61 (0.44–0.85)	0.003
Age [*] (per 10 years older)	0.71 (0.61–0.83)	<0.001	--	--
Indigenous Ancestry (yes vs. no)	2.06 (1.48–2.89)	<0.001	--	--
Incarceration [*] (yes vs. no)	1.64 (1.14–2.34)	0.007	1.41 (0.97–2.06)	0.073
Sex Work [*] (yes vs. no)	1.68 (1.13–2.51)	0.011	--	--
Syringe Borrowing [*] (yes vs. no)	1.99 (1.38–2.87)	<0.001	--	--
Daily Cocaine Use [*] (yes vs. no)	4.31 (3.04–6.12)	<0.001	--	--
Daily Heroin Use [*] (yes vs. no)	1.90 (1.35–2.69)	<0.001	1.54 (1.09–2.17)	0.014
Daily Crack Use [*] (yes vs. no)	1.10 (0.76–1.59)	0.610	--	--
Required Help Injecting [*] (yes vs. no)	2.29 (1.60–3.28)	<0.001	--	--
Unprotected Sex [*] (yes vs. no)	1.21 (0.85–1.74)	0.292	--	--
Enrolled in Methadone Maintenance Therapy [*] (yes vs. no)	0.50 (0.33–0.76)	0.001	0.58 (0.39–0.88)	0.010

* Behavior refers to activities in the last six months and is time-updated.

** CI = confidence interval.