Published in final edited form as:

Drug Alcohol Depend. 2013 October 1; 132(3): 535–540. doi:10.1016/j.drugalcdep.2013.03.024.

PATTERNS OF INJECTION DRUG USE CESSATION DURING AN EXPANSION OF SYRINGE EXCHANGE SERVICES IN A CANADIAN SETTING

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Abstract

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Contributors

All authors had full access to all data and have read and approved the text as submitted to JECH. DW and EW performed initial analyses and drafted the manuscript. TK, JB, CR, and JM all contributed substantially to methodological issues and manuscript revisions.

Conflicts of Interest

All authors declare that (1) no authors have support from any companies for the submitted work; (2) no authors have relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) DW, TK, JB, JS, CR, and EW have no non-financial interests that may be relevant to the submitted work. JM has received grants from, served as an ad hoc adviser to, or spoken at events sponsored by Abbott, Argos Therapeutics, Bioject Inc., Boehringer Ingelheim, BMS, Gilead Sciences, GlaxoSmithKline, Hoffmann-La Roche, Janssen-Ortho, Merck Frosst, Panacos, Pfizer Ltd., Schering, Serono Inc., TheraTechnologies, Tibotec (J&J), and Trimeris.

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Background—Needle and syringe programmes (NSPs) have been shown to reduce HIV risk among people who inject drugs (IDU). However, concerns remain that NSPs delay injecting cessation.

Methods—Individuals reporting injection drug use in the past six months in the greater Vancouver area were enrolled in the Vancouver Injection Drug Users Study (VIDUS). Annual estimates of the proportion of IDU reporting injecting cessation were generated. Generalized estimating equation (GEE) analysis was used to assess factors associated with injecting cessation during a period of NSP expansion.

Results—Between May 1996 and December 2010, the number of NSP sites in Vancouver increased from 1 to 29 ($P < 0.001$). The estimated proportion of participants ($n = 2,710$) reporting cessation increased from 2.4% (95% Confidence Interval [CI]: 0.0% – 7.0%) in 1996 to 47.9% (95% CI: 46.8% – 48.9%) in 2010 ($P < 0.001$). In a multivariate GEE analysis, the authors observed an association between increasing calendar year and increased likelihood of injecting cessation (Adjusted Odds Ratio = 1.17, 95% CI: 1.15, 1.19, $P < 0.001$).

Conclusion—The proportion of IDU reporting injecting cessation increased during a period of NSP expansion, implying that increased NSP availability did not delay injection cessation. These results should help inform community decisions on whether to implement NSPs.

Keywords

injection drug use; cessation; needle exchange programme; Vancouver

1. INTRODUCTION

Implementing needle and syringe programmes (NSPs) is a key recommendation of international guidelines for the prevention of HIV infection among injection drug users (IDU; Donoghoe et al., 2009; UNAIDS, 2005). This recommendation is based on decades of research demonstrating the effectiveness of these programmes in reducing HIV risk behaviours and HIV incidence (Cochrane Collaborative Review Group on HIV Infection and AIDS, 2010; Strathdee and Vlahov, 2001), as well as their cost-effectiveness compared to other preventive approaches among IDU populations (Cohen et al., 2004).

Yet, NSPs remain controversial among the general public and policymakers. For example, research indicates that NSPs are not associated with increased drug injecting (Vlahov et al., 2001). However, some concerns persist regarding the possibility that NSPs may enable or encourage injection drug use, prolong the injection drug use careers of their clients, and/or discourage clients from seeking addiction treatment (Voth, 2008). These concerns may be related to findings of earlier studies that found associations between NEP use and HIV risk (Bruneau et al., 1997; Strathdee et al., 1997), and which subsequent studies found could be explained by the fact that NSPs attract high risk IDU (Wood et al., 2007). Collectively, these concerns have impeded global scale-up of NSPs, and have contributed to a situation wherein only an estimated 5% of drug injections worldwide are conducted using sterile equipment provided by a NSP (Degenhardt et al., 2010; Mathers et al., 2010).

Investigating the empirical foundations for such concerns could help to inform future actions to reduce injection drug-related harms, particularly in settings where these harms are at risk of escalating (Horton and Das, 2010). For example, in some US cities (e.g., Washington, D.C.) where HIV rates are particularly high among IDU, NSPs have been recently scaled back or closed (Kasperowicz, 2011), despite research demonstrating that increased access to NSPs improves use of sterile syringes among IDU (Cooper et al., 2011). Similarly, in Russia, with an IDU population estimated at 1.8 million (Beyrer et al., 2010), policymakers continue to oppose harm reduction measures, including NSPs (Haber et al., 2009). As a

result only 7% of Russian IDU report access to sterile injecting equipment through NSPs (Mathers et al., 2010). In the absence of such preventive interventions, IDU continue to account for over 60% of all HIV infections in Russia (Beyrer et al., 2010). In Thailand, where less than 1% of IDU have access to NSPs (Mathers et al., 2010), the government's State Council recently ruled that a notification in support of harm reduction by the country's Department of Disease Control was in breach of Thailand's 1979 Narcotic Act, on the basis that needle distribution encourages drug use (Matichon, 2011). As well, although the President's Emergency Plan for AIDS Relief (PEPFAR) recently released guidelines for funding NSPs as part of the US' international response to the spread of HIV (PEPFAR, 2010), legislation has since been introduced in the US House of Representatives that would bar the US from funding NSPs in foreign countries (US Congress, 2011).

Vancouver, Canada has been the site of a well-documented NSP expansion, beginning in the year 2000, when a single centralized syringe exchange programme was transformed into a decentralized, multi-site syringe distribution programme (Kerr et al., 2010). In the context of ongoing concerns regarding the potential for NSPs to encourage or prolong injection drug use, we sought to assess rates of injecting cessation among a sample of IDU in Vancouver during this period of NSP expansion.

2. METHODS

The study was conducted using STROBE guidelines for the reporting of observational studies (von Elm et al., 2007). First, to describe the pattern of NSP expansion, reports of the number of NSP sites in Vancouver during the study period were obtained from Vancouver Coastal Health, Vancouver's local health authority (Vancouver Coastal Health, 2011). We then conducted trend tests to determine whether the increase in NSP sites by calendar year was significant. Rates of injecting drug use cessation and re-initiation (i.e., a period of injection cessation followed by a resumption of injecting) were derived from the Vancouver Injection Drug Users Study (VIDUS), an open prospective community-recruited cohort of IDU in Vancouver. Beginning in May 1996, active IDU (i.e., those who reported injecting drugs in the previous month) were recruited in the Greater Vancouver region on an ongoing basis throughout the study period. All participants were recruited through street outreach and self-referral, and provided written informed consent prior to entering the study. At baseline and regular semi-annual follow up visits, study participants completed interviewer-administered questionnaires, provided blood samples for diagnostic testing, and underwent physical exam from a research nurse to inspect for stigmata of drug injecting. Participants were reimbursed \$20 for each visit and, when appropriate, were referred to additional health care services. Ethical approval for this study has been granted by the University of British Columbia/Providence Health Care Ethics Review Board.

The primary outcome for the current study was injecting cessation, defined as reporting no drug injecting in the prior six months. As noted above, we derived adjusted annual estimates of the proportion of cohort participants, and to control for a potential cohort effect (Keyes et al., 2010), whereby the number of IDU reporting drug use cessation might be expected to increase over time (Nelson et al., 2002), the proportions of those reporting cessation were adjusted for number of years of enrolment in the study. Annual estimates and 95% confidence intervals were then generated for the years 1996 to 2010.

At this stage, the graphical exploration of the data implied that the NSP site expansion coincided with increased injecting cessation. However, to address potential confounders, we conducted generalized estimating equation (GEE) analyses to determine if rates of cessation changed over time independent of potential confounders, such as rates of addiction treatment uptake. Specifically, univariate and multivariate GEE analyses for binary outcomes were

used to determine factors independently associated with injecting cessation among cohort participants. These methods provided modified standard errors adjusted by multiple observations per person using an exchangeable correlation structure (Liang and Zeger, 1986; Zeger and Liang, 1986). As in the first stage of the analysis, we adjusted for year of study recruitment to control for a potential cohort effect. We also adjusted for addiction treatment exposure (including enrolment in methadone treatment or other addiction treatment) to account for its potential effect in promoting injecting cessation. Additional variables were also investigated: age at study entry, gender, Aboriginal ancestry, number of years injecting at baseline, residency in Vancouver's downtown eastside neighbourhood (the site of a large open-air illicit drug market), homelessness, recent heroin injection, recent cocaine injection, recent speedball (i.e., heroin and cocaine in combination) injection, recent non-injection crack use, and frequent injection drug use (daily *vs.* less than daily). All behavioural variables refer to behaviours in the previous 6 months. In order to protect against endogeneity, and consistent with previous studies investigating cessation of injecting, all time-updated behavioural variables were lagged by one follow up questionnaire (Diggle et al., 2002; Shah et al., 2006). As such, behavioural variables refer to the 6 months prior to the follow-up questionnaire immediately preceding the first report of injecting cessation.

The multivariate GEE model was fit using a two-stage protocol. First, a decision to enter the primary independent variable of interest (i.e., calendar year) and key potential confounders (i.e., year of study enrolment, enrolment in methadone or other addiction treatment, and non-injection crack use) into the multivariate model was made *a priori*. All other independent variables were entered into the multivariate model based on a finding of statistical significance at the $P < 0.1$ level in univariate analysis.

All statistical analyses were performed using SPSS software version 19.0 (IBM, New York, NY). All P values are 2 sided.

The study sponsors had no role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

3. DISCUSSION

In total, 2,551 participants were recruited into the study and completed at least one follow up visit between May 1996 and December 2010, including 856 (33.6%) female and 697 (27.3%) individuals reporting Aboriginal ancestry. Participants contributed 10,180 person-years of follow up. Retention was high, with 87.6% of cohort participants reporting at least one follow-up visit, and the median number of follow up visits was 5 (Interquartile Range [IQR] = 2 – 12). Throughout the study period, 5,849 injecting cessation events were reported, while the number of NSP sites in Vancouver increased significantly from 1 in 1996 to 29 in 2010 ($P < 0.001$). In total, 1220 (47.8%) participants reported ceasing injection during the study period, among whom 911 (74.7%) reported a period of re-initiation of injecting during the study period.

Figure 1 presents a line graph of the adjusted proportion of participants reporting injecting cessation by year and a histogram depicting the increase in the number of NSP sites during this same period. Adjusting for year of baseline recruitment into the study, the proportion of IDU reporting injecting cessation increased from 2.4% (95% Confidence Interval [CI]: 0.0% – 7.0%) in 1996 (when eligibility for the study required drug injecting) to 47.9% (95% CI: 46.8% – 48.9%, $P < 0.001$) in 2010.

In a univariate GEE analysis, increasing calendar year was positively associated with injecting cessation (Odds Ratio [OR] = 1.22, 95% CI: 1.20 – 1.24, $p < 0.001$). Full univariate results are presented in Table 1. In a multivariate GEE model, increasing calendar

year (Adjusted Odds Ratio [AOR] = 1.17, 95% CI: 1.15 – 1.19, $P < 0.001$) and enrolment in methadone treatment (AOR = 1.23, 95% CI: 1.12 – 1.35, $P < 0.001$) were positively associated with injecting cessation. Later year of enrolment into the study (AOR = 0.87, 95% CI: 0.86 – 0.89, $P < 0.001$), residence in the DTES (AOR = 0.82, 95% CI: 0.76 – 0.90, $P < 0.001$), recent heroin injection (AOR = 0.44, 95% CI: 0.40 – 0.49, $P < 0.001$), recent cocaine injection (AOR = 0.51, 95% CI: 0.46 – 0.56, $P < 0.001$), recent speedball injection (AOR = 0.66, 95% CI: 0.60 – 0.72, $P < 0.001$), and frequent injection drug use (AOR = 0.78, 95% CI: 0.73 – 0.83, $P < 0.001$) were negatively associated with injecting cessation. Full multivariate results are presented in Table 2.

4. CONCLUSION

The current study found a significant increase in the proportion of IDU in Vancouver reporting injecting cessation during a 15-year period during which a significant increase in the number of NSP sites was also observed. The significant increase in the rate of injecting cessation over time persisted even after adjustment for other determinants of injecting cessation, such as addiction treatment exposure, non-injection crack use, and a possible cohort effect controlled for by adjustment for year of recruitment (Nelson et al., 2002; Vlahov et al., 1997).

This study has limitations consistent with the use of observational data. As a result, although we observed that an NSP site expansion coincided with increasing rates of injecting cessation, we are unable to explain a causal mechanism for this shift related to NSP implementation. Based on this study's findings, we conclude that NSP policy is unlikely to delay injecting cessation. Additionally, cohort participants were not recruited using random sampling and the potential exists that results may not be generalizable to the overall population of illicit drug users in our study setting. However, participant recruitment was ongoing throughout the study period, and it is noteworthy that data from government surveillance systems and other studies undertaken in the same setting are consistent with our own, suggesting that the cohort is likely representative of the broader IDU population in Vancouver (Buxton et al., 2007; Public Health Agency of Canada, 2006; Remis et al., 1998). Finally, it is possible that an age or cohort effect may have impacted upon the observed rate of injecting cessation (Nelson et al., 2002; Vlahov et al., 1997); however, increasing rates of injecting cessation over time were observed despite adjustment for age and year of recruitment into the cohort.

These results have implications for the debate surrounding the implementation of NSPs in a variety of settings and help to address a key concern often cited by those opposed to NSPs. Specifically, the present study demonstrates an increase in injecting cessation among a sample of IDU during a period of NSP expansion in Vancouver that saw not only an increase in the number of NSP sites, but also operational changes aimed at increasing sterile syringe availability. These included longer operating hours and a shift to syringe distribution from a strict one-for-one syringe exchange system (Kerr et al., 2010). This echoes research undertaken in other settings that has found that these programmes appear to be most effective when they employ a syringe distribution rather than exchange model (Broadhead et al., 1998; Drach et al., 2011; Grund et al., 1992; Latkin, 1998). While the increase in NSP sites was not linear throughout the study period, with local factors such as the consolidation of health services causing fluctuation in the number of NSPs, the results nevertheless imply that NSPs are unlikely to lengthen drug injecting careers in our study setting. This finding is consistent with a recent study from New York City where large-scale implementation of NSPs was associated with a decreased proportion of methadone treatment clients reporting injection drug use (Des Jarlais et al., 2010). Similarly, the results of the multivariate analysis indicate that accessing methadone treatment was independently associated with injecting

cessation, which is in line with past research demonstrating the important role of methadone in promoting injecting cessation (Mattick et al., 2009). Indeed, research from other settings suggests that use of NSPs results in lower HIV risk and increased access to basic health services among clients (Cao and Treloar, 2006), and that these programmes have the capacity to attract those IDU at risk of a variety of drug-related harms (Kerr et al., 2010; Strathdee and Vlahov, 2001; UNAIDS, 2005). This is highly relevant to the present study, and it is important to note that many IDU in the study who ceased injecting also experienced a period of relapse. Nevertheless, as shown in Figure 1, this study suggests that the proportion of drug users who were not injecting nevertheless increased on an annual basis. Though the proportion of IDU in the sample re-initiating was lower than the proportion reporting cessation, this finding nevertheless highlights the critical role of harm reduction interventions in reducing HIV transmission risk throughout an individual's drug-using career. Further, prior research has demonstrated that relapse is a common phenomenon among IDU who eventually abstain from injecting (Genberg et al., 2011; Shah et al., 2006). Interestingly, crack use was not associated with injecting cessation, suggesting that IDU that transition into non-injection crack use may nevertheless continue to inject other substances. This differs from previous research undertaken in other Canadian settings (Bruneau et al., 2004; Leonard et al., 2008).

In summary, the present study suggests that increasing NSP availability does not appear to contribute to delayed cessation of injection drug use (Buxton et al., 2007; Public Health Agency of Canada, 2006; Remis et al., 1998). Given a large body of research demonstrating the positive health impacts of NSPs on HIV risk and other public health concerns (Des Jarlais, 2000; Heimer et al., 1996; Kerr et al., 2010; Strathdee and Vlahov, 2001), as well as the low global coverage of this intervention (Mathers et al., 2010), policymakers considering NSP implementation should move quickly towards the provision of such programmes in settings marked by high rates of injecting drug use.

Acknowledgments

Role of Funding Source

Nothing declared. The study was supported by the US National Institutes of Health (R01DA011591, R01DA021525) and the Canadian Institutes of Health Research (MOP-79297).

All authors had full access to all data and have read and approved the text as submitted to AIDS. DW and EW performed initial analyses and drafted the manuscript. TK, JB, CR, and JM all contributed substantially to methodological issues and manuscript revisions. DW is supported by the Canadian Institutes of Health Research. TK and JS are supported by the Canadian Institutes of Health Research and the Michael Smith Foundation for Health Research. The authors thank the study participants for their contribution to the research, as well as current and past researchers and staff. We would specifically like to thank Deborah Graham, Peter Vann, Caitlin Johnston, Steve Kain, and Calvin Lai for their research and administrative assistance.

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Figure 1.
Proportion of Injection Drug Users Reporting Injection Cessation in Past 6 Months in Vancouver, Canada, 1996 – 2010.*
*Proportions adjusted for participant time from recruitment into the Vancouver Injection Drug Users Study

Table 1
Univariate Correlates of Injecting Cessation Among Injection Drug Users in Vancouver, 1996 – 2010 ($n = 2,551$)^{*}

Characteristic	Injecting Cessation Event ^{**}		Unadjusted Odds Ratio	95% CI	P value
	No $N = 17,220$ n (%)	Yes $N = 5,849$ n (%)			
Calendar Year					
Per Year Later	-- --	-- --	1.22	1.20, 1.24	<0.001
Age at Study Baseline					
Median (IQR)	36 (28.3 – 41.8)	35.7 (28.8 – 42.1)	1.00	1.00, 1.01	0.538
Gender					
Male	10,926 (63.4)	3,596 (61.5)			
Female	6,294 (36.6)	2,253 (38.5)	1.17	1.02, 1.32	0.024
Ethnicity					
Non-Aboriginal	11,967 (69.5)	3,889 (66.5)			
Aboriginal	5,253 (30.5)	1,960 (33.5)	1.49	1.27, 1.75	<0.001
Years Injecting at Baseline					
Median (IQR)	13.8 (5.9 – 23.5)	13 (4.6 – 24.1)	1.00	0.99, 1.00	0.341
Year of Enrolment					
Median (IQR)	1996 (1996 – 2000)	1996 (1996 – 2000)	0.97	0.96, 0.99	0.002
DTES Residence					
No	6,060 (35.2)	2,953 (50.5)			
Yes	11,159 (64.8)	2,896 (49.5)	0.60	0.54, 0.66	<0.001
Homeless					
No	13,235 (76.9)	5,054 (86.4)			
Yes	3,984 (23.1)	795 (13.6)	0.70	0.64, 0.78	<0.001
Methadone Treatment					
No	11,471 (66.6)	3,744 (64.0)			
Yes	5,749 (33.4)	2,105 (36.0)	2.06	1.87, 2.28	<0.001
Other Addiction Treatment					
No	10,755 (62.5)	3,491 (59.7)			
Yes	6,464 (37.5)	2,358 (40.3)	0.96	0.88, 1.05	0.355

Characteristic	Injecting Cessation Event**		Unadjusted Odds Ratio	95% CI	P value
	No N = 17,220 n (%)	Yes N = 5,849 n (%)			
Recent Heroin Injection					
No	6,705 (38.9)	4,791 (81.9)			
Yes	10,514 (61.1)	1,058 (18.1)	0.24	0.22, 0.26	< 0.001
Recent Cocaine Injection					
No	7,015 (40.7)	4,645 (79.4)			
Yes	10,204 (59.3)	1,204 (20.6)	0.27	0.25, 0.30	< 0.001
Recent Speedball Injection†					
No	9,319 (54.1)	5,018 (85.8)			
Yes	7,900 (45.9)	831 (14.2)	0.42	0.38, 0.46	< 0.001
Recent Non-Injection Crack Use					
No	6,155 (35.7)	2,777 (47.5)			
Yes	11,064 (64.3)	3,072 (52.5)	0.85	0.77, 0.95	0.003
Frequent Injection Drug Use‡					
No	9,082 (52.7)	4,417 (75.5)			
Yes	8,138 (47.3)	1,431 (24.5)	0.53	0.49, 0.57	< 0.001

Note: CI = Confidence Interval; IQR = Interquartile Range; DTES = downtown eastside.

* All behavioural variables refer to behaviours measured in the follow-up survey prior to the first report of cessation;

** Frequencies refer to the number of events throughout study period;

[†] Speedball refers to heroin and cocaine in combination;

[‡] Frequent refers to at least once daily.

Table II

Multivariate Generalized Estimating Equation Analysis of Correlates of Injecting Cessation Among Injection Drug Users in Vancouver ($n = 2,551$)^{*}

Characteristic	Adjusted Odds Ratio	95% CI	P value
Calendar Year			
Per Year Later	1.17	1.15, 1.19	< 0.001
Year of Enrolment			
Per Year Later	0.87	0.86, 0.89	< 0.001
Female			
Male vs. Female	1.04	0.90, 1.20	0.589
Ethnicity			
Non-Aboriginal vs. Aboriginal	1.03	0.90, 1.18	0.672
DTES Residence			
No vs. Yes	0.82	0.76, 0.90	< 0.001
Homeless			
No vs. Yes	0.92	0.84, 1.01	0.070
Methadone Treatment			
No vs. Yes	1.23	1.12, 1.35	< 0.001
Recent Heroin Injection			
No vs. Yes	0.44	0.40, 0.49	< 0.001
Recent Cocaine Injection			
No vs. Yes	0.51	0.46, 0.56	< 0.001
Recent Speedball Injection ^{††}			
No vs. Yes	0.66	0.60, 0.72	< 0.001
Recent Non-Injection Crack Use			
No vs. Yes	0.96	0.88, 1.04	0.324
Frequent Injection Drug Use [°]			
No vs. Yes	0.78	0.73, 0.83	< 0.001

Note: CI = Confidence Interval; DTES = downtown eastside.

^{*} All behavioural variables refer to behaviours measured in the follow-up survey prior to the first report of cessation

[†] Recent refers to the previous six months

^{††} Speedball refers to heroin and cocaine in combination

[°] Frequent refers to at least once daily