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Association between public injecting and drug-related harm among HIV-positive people who use injection drugs in a Canadian setting: A longitudinal analysis

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Abstract

Background and Aims—Injecting illicit drugs in public settings has been linked to a higher risk of a range of drug-related harms, including overdose and HIV infection. However, the factors associated with public injecting among HIV-positive individuals have not been previously explored. We investigated the links between public drug injecting, drug-related harm, and HIV treatment measures among a cohort of HIV-positive persons who inject drugs (PWID) in a Canadian setting.

Methods—We used data from a prospective cohort of HIV-positive PWID recruited from community settings in Vancouver, Canada, linked to comprehensive clinical monitoring data in the context of an ongoing Treatment-as-Prevention (TasP) initiative to examine harms associated with public injecting. We used generalized linear mixed-effects analyses to identify longitudinal factors associated with self-reported public drug injection.

Results—Between 2005 and 2014, 626 HIV-seropositive PWID were recruited, of whom 213 (34%) reported public injection in the preceding 180 days. In a longitudinal multivariable model, public injection was positively associated with daily heroin injection (Adjusted Odds Ratio [AOR] = 2.63), incarceration (AOR = 1.78), and detectable plasma HIV-1 RNA viral load (VL, AOR = 1.42).

Conclusions—Public injecting was linked to numerous drug-related harms among HIV seropositive PWID in this setting. Given its link with detectable VL, an important marker of poor HIV treatment outcomes, our findings support prioritizing individuals engaged in public injecting with harm reduction strategies as well as clinical and social supports as a part of TasP-based efforts to prevent HIV-related morbidity and mortality, and HIV transmission.

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Keywords

Public injecting; HIV; HIV treatment; injection drug use; risk behaviour

INTRODUCTION

Injection drug use is a well-established risk factor for a wide range of legal, social and health-related harms, including HIV and hepatitis C virus (HCV) infection, high-risk sexual behaviour, incarceration and homelessness (Fischer et al.; Milloy et al., 2008; Spiller et al., 2015; Tsang et al., 2015). Although much research has focused on drug-related harm associated with individual-level practices, such as needle sharing, sex work, and polydrug use, the physical, social and structural contexts of illicit drug use are increasingly recognized as important determinants of harm.

There is a growing body of evidence to suggest that public injecting is associated with significant drug-related harm. Defined as injection drug use in any public place, including alleyways, hidden alcoves, and public toilets, the practice of public injecting has been associated with increased potential for physical assault, robbery, or police intervention, which in turn precipitates rushed injection and unsafe and less hygienic injection practices (Marshall et al., 2010; Small et al., 2007). Those who inject in public are more likely to be homeless, to exhibit higher intensity drug use and poly-drug use, to have a history of overdose, and to engage in HIV risk behaviours including syringe sharing and high risk sexual activity (Darke et al., 2001; Dietze et al., 2005; Klee and Morris, 1995; Latkin et al., 1994; Marshall et al., 2010). The social network characteristics of people who inject drugs (PWID) in public demonstrate that public injecting can facilitate interactions between members of different social networks, normalize high risk injection behaviour, and contribute to transmission of blood-borne pathogens (Tobin et al., 2010).

The previously well-characterized Downtown Eastside (DTES) neighbourhood in Vancouver, Canada is home to a large number of PWID with high levels of HIV infection, poverty, and homelessness (Maas et al., 2007). Public drug use is common in the DTES, with high rates of public injecting among local PWID (Kerr et al., 2003). Previous reports have described public drug injection environments in Vancouver, which are commonly unhygienic physical spaces that are open to threats of arrest and assault, functioning to impede an individual's ability to enact safe injection practices (Small et al., 2007). Although the link between public injecting and drug-related harms such as HIV transmission and accidental overdose are well-described, little is known about the possible link between public injecting and HIV treatment outcomes among HIV-positive PWID. In Vancouver's DTES, widespread access to antiretroviral treatment (ART) for HIV positive PWID in the context of Treatment-as-Prevention (TasP) initiatives has been associated with markers of improved HIV control, including reduced HIV viral load (VL) and reduced HIV drug resistance (Milloy et al., 2015). Therefore, the objective of this study is to characterize public injecting and its association with HIV treatment outcomes among a cohort of community-recruited HIV-positive PWID in the setting of an ongoing TasP initiative with universal no-cost access to healthcare.

METHODS

For these analyses, we used data from the AIDS Care Cohort to evaluate Exposure to Survival Services (ACCESS), an observational prospective cohort of HIV-seropositive illicit drug users. The study has been described in detail previously (Milloy et al., 2012a; Strathdee et al., 1998). In brief, community-based strategies of recruitment, including word-of-mouth, posters, and snowball sampling, were used to recruit HIV-seropositive drug users in Vancouver's DTES neighbourhood. Individuals are eligible for inclusion if they are HIV-seropositive as demonstrated by serology, are aged ≥ 18 years, and have used illicit drugs other than cannabis in the 30 days prior to the baseline interview. The ACCESS study has been approved by the University of British Columbia/Providence Healthcare Research Ethics Board. All participants provide written informed consent.

Following study recruitment and every 180 days thereafter, all ACCESS participants complete an interviewer-administered survey to elicit information including socio-demographic characteristics, drug-use patterns and HIV/AIDS risk behaviours. They also complete an examination by a study nurse, and a blood sample is drawn for analysis. At recruitment, individuals provide their personal health number (PHN), a unique and persistent identifier issued to all residents of British Columbia. Using this identifier, study staff establish a confidential linkage with the British Columbia Centre for Excellence in HIV/AIDS (BC-CfE) Drug Treatment Programme (DTP). Through the DTP, the BC-CfE provides HIV/AIDS treatment and care including medications and clinical monitoring to those living with HIV in BC, funded by British Columbia's no-cost universal medical system. A complete retrospective and prospective clinical profile is available for all ACCESS participants through the DTP, including all plasma HIV VL observations and CD4+ cell counts drawn as part of the study or ongoing clinical care. The clinical profile is linked to the DTP's pharmacy, British Columbia's sole source of ART. Records of antiretroviral agents used, as well as dose and date dispensed for all ART-exposed participants are available via the DTP pharmacy for all ART-exposed participant in British Columbia.

In this study, we included all individuals recruited to the ACCESS study between December 2005 and June 2014, who had ≥ 1 plasma VL (copies/mL) observation and ≥ 1 CD4 cell count (per 100 cells/mL) observation within ± 180 days of their baseline interview and self-reported any history of intravenous drug injection at baseline.

For these analyses, the primary outcome of interest was reporting any instance of drug injection in a public space in the previous 180 days. Our explanatory variables of interest included: gender (male vs. non-male); age (per year older); self-reported ethnicity (Caucasian vs. non-Caucasian); homelessness (yes vs. no); being in a stable relationship (yes vs. no); level of education (≥ high school diploma vs. <high school diploma); employment (yes vs. no); binge alcohol use, defined as reporting more intense alcohol consumption than usual (yes vs. no); heroin injection (≥ daily vs. < daily); cocaine injection (≥ daily vs. < daily); crack-cocaine use (≥ daily vs. < daily); crystal methamphetamine use (≥ daily vs. < daily); nonfatal overdose (yes vs. no); used syringe lending (yes vs. no); incarceration (yes vs. no); encounters with police (yes vs. no); and currently being engaged in methadone

maintenance therapy (MMT) (yes vs. no). Using the confidential linkage, we also included HIV/AIDS clinical measures including days of ART dispensed in the last 180 days (1 day vs. 0 days), HIV RNA VL (50 vs. 50 copies/mL plasma) and CD4 count (per 100 cells/mL). Binge alcohol use was defined according to National Institute on Alcohol Abuse and Alcoholism (NIAAA) criteria as an average of >3 alcoholic drinks per occasion or >7 drinks per week for women, or an average of >4 alcoholic drinks per occasion or >14 drinks per week for men (National Institute on Alcohol Abuse and Alcoholism, 2010 [cited 2017 March 25]). Days of ART dispensed included both directly observed therapy and ART dispensed from pharmacy without directly observed therapy. The range of days dispensed was 1–28. For both VL and CD4, we used the mean of all measures in the previous 180 days or, if none, the most recent observation; VL was further dichotomized at 50 c/mL (the Roche Amplicor Monitor assay [Roche Molecular Systems, Pleasanton, California, USA] was used to determine VL from participant blood samples). All variable definitions were identical to earlier studies (Miller et al., 2002; Strathdee et al., 1997b). All behavioural variables were treated as time-updated covariates and referred to the six-month period prior to each interview.

As a first step, we compared baseline characteristics of those who did and did not report any public injection using the Chi-square test for binary measures and Wilcoxon rank sum test for continuous measures. To estimate the longitudinal relationships between the outcome of interest and each explanatory variable, we used generalized linear mixed-effects analyses to identify factors associated with reporting public injecting. To fit the multivariable model, we used an *a priori* modeling building procedure based on backwards selection guided by the Akaike Information Criterion, as in previous studies (Barker et al., 2015; Cheng et al., 2015). Because of the highly correlated relationship between ART exposure and plasma VL non-detectability, we elected to exclude ART dispensation from the multivariable model building procedure.

RESULTS

Between December 2005 and June 2014, we recruited 855 HIV-seropositive illicit drug users. Of these, 229 (27%) were excluded as they did not report any history of injection drug use at baseline or lacked complete VL/CD4 information. The 626 individuals contributed 2913 interviews during the study period, equal to 1457 person-years of observation. Of the 626 HIV-seropositive illicit drug users included in the analysis, 213 (34%) had injected illicit drugs in public within 180 days of the baseline interview.

Table 1 presents the baseline characteristics of the analytic sample stratified by reporting recent public injection. Of note, compared to those who had not injected in a public space, public injectors were younger (39 vs. 44 years, $p < 0.001$) and more likely to be homeless (51 vs. 20%, $p < 0.001$). In addition, they were more likely to report at least daily heroin injection (35 vs. 8%, $p < 0.001$), daily cocaine injection (17 vs 6%, $p < 0.001$) and daily use of crack cocaine (52 vs. 31%, $p < 0.001$) and to have recently suffered an accidental overdose (11 vs. 4%, $p < 0.001$). Both recent incarceration (25 vs. 10%, $p < 0.001$) and reporting encounters with police (36 vs. 15%, $p < 0.001$) were more common among people reporting public injecting at baseline.

Table 2 shows the bivariable and multivariable mixed-effects analyses of factors associated with public injecting. Of note, in crude analyses, recent history of public injecting was more likely during periods including homelessness (Odds Ratio [OR] = 6.39, 95% Confidence Interval [CI]: 4.94 – 8.26) and was also associated with recent incarceration (OR = 3.16, 95% CI: 2.28 – 4.40); reporting encounters with police (OR = 3.51, 95% CI: 2.67 – 4.62) and lending used syringes (OR = 2.53, 95% CI: 1.06 – 6.01). Using data from the clinical linkage, public injection was linked to a lower likelihood of being engaged in ART as measured by having 1 day of ART dispensation in the previous 180 days (OR = 0.39, 95% CI: 0.29 – 0.53) and double the odds of having a detectable VL (OR = 2.05, 95% CI: 1.60 – 2.62).

In the final multivariable model (Table 3), public injection was independently associated with male gender (Adjusted Odds Ratio [AOR] = 1.82, 95% CI: 1.26 – 2.64), younger age (AOR = 0.42, 95% CI: 0.33 – 0.52), at least daily heroin injection (AOR = 2.63, 95% CI: 1.92 – 3.60), at least daily cocaine injection (AOR = 1.58, 95% CI: 1.10 – 2.25), at least daily crack use (AOR = 1.88, 95% CI: 1.44 – 2.44), recent incarceration (AOR = 1.78, 95% CI: 1.26 – 2.53), reporting encounters with police (AOR = 2.77, 95% CI: 2.08 – 3.69), and exhibiting a detectable HIV VL (AOR = 1.42, 95% CI: 1.10 – 1.83).

DISCUSSION

In the present study, we observed that public injecting was associated with reduced engagement in HIV treatment, reflected by lower likelihoods of ART dispensation and, in the multivariable model, higher likelihood of having a detectable HIV VL. Public injecting was found to be common among HIV-seropositive PWID, with one third of the study sample reporting public injection within 180 days of their baseline interview. In line with previous analyses among samples including both people at risk or living with HIV, our results showed that public injectors were more likely to be younger and to be men, to engage in heavier drug use and more frequent injection, and to be more likely to experience encounters with police (Debeck et al., 2011; Klee and Morris, 1995; Marshall et al., 2010; Small et al., 2007).

To our knowledge, this is the first report to describe an association between public injecting behaviour and a greater likelihood of detectable HIV VL. Our findings add to the body of literature demonstrating links between suboptimal access and adherence to ART and environmental exposures and conditions common among HIV-positive PWID, such as addiction and mental health issues, homelessness, and incarceration (Carrico et al., 2011; Cohn et al., 2011; McGowan et al., 2011; Milloy et al., 2012a; Milloy et al., 2012b). Even in areas where access to HIV treatment is universal, HIV-seropositive PWID continue to have poorer HIV-related health outcomes, including decreased survival (Obel et al., 2011; Samji et al., 2013). Our research suggests that those who inject drugs in public face barriers to engagement with and retention in necessary medical services such as HIV treatment and TasP programs, likely due to a constellation of factors associated with higher intensity drug use, including low levels of social support, repeated incarceration, and homelessness (Milloy et al., 2012a; Milloy et al., 2011; Suh et al., 1997). These findings raise significant concerns in the context of growing evidence for TasP strategies (Cohen et al., 2011; Montaner et al.,

2010), which seek to reduce HIV-related morbidity and mortality as well as HIV transmission through widespread scale-up of HIV testing and provision of immediate access to treatment and care (Milloy et al., 2012b; Wood et al., 2012).

Previous studies have described HIV prevalence and incidence among the larger population of HIV positive PWID within our setting. HIV-positivity has been previously associated with a low level of education, unstable housing, sex work, needle sharing, injection with others, and more frequent attendance in needle exchange programs (Strathdee et al., 1997b). In the context of community-wide ART expansion program, ART exposure and increased ART adherence were associated with reduced mean HIV VL, and a higher proportion of undetectable HIV VL (Milloy et al., 2015). Importantly, incidence rates of drug resistant HIV strains reduced over this period of time (Milloy et al., 2015), reinforcing the value of ART scale-up initiatives among hard to reach populations.

The present study describes an important sub-group of HIV-positive PWID in need of further engagement with HIV/AIDS treatment and ancillary care, such as psychosocial and clinical supports. Our study provides important evidence which may help optimize efforts to reach high-risk populations of PWID through TasP strategies among, in the context of the UN 90-90-90 Target (UNAIDS, 2014), as a key component of the call for the End of the AIDS Pandemic by 2030 within the recently approved UN-Sustainable Development Goals (SDGs) (United Nations General Assembly, 2015), which will require ongoing scale-up of TasP programs and improved engagement in HIV treatment for marginalized populations.

As we observed that periods of public injection were linked to both detectable VL and established risks for viral transmission among PWID, including incarceration (Milloy et al., 2013) and high-intensity drug use (Strathdee et al., 1997a; Voon et al., 2015), our findings suggest that HIV-positive individuals engaged in public injecting should be a priority population to engage in HIV prevention initiatives. Since the early 2000's, many countries have introduced safe injection facilities (SIF) as a part of larger public health initiatives to reduce the risks associated with public injection and increase contact with medical care and addiction treatment services (Broadhead et al., 2002). In our setting, a small SIF has been in operation since 2003 and has been shown to have successfully attracted individuals who engage in public injection (Reddon et al., 2011). The scientific evaluation of Insite documented HIV prevention benefits, including decreased public injection, decreased syringe sharing, and increased uptake of detoxification and addiction treatment services (Kerr et al., 2006; Kerr et al., 2005; Wood et al., 2004; Wood et al., 2006a; Wood et al., 2006b). These findings are echoed by international studies revealing that SIFs facilitate safer injecting practices, improve access to health services, and reduce public injecting and shooting gallery use (Kimber and Dolan, 2007; McNeil and Small, 2014; Milloy and Wood, 2009; Potier et al., 2014; Stoltz et al., 2007). It may be postulated that expanding the number and opening hours of SIFs may serve to further deter public injection by improving access and reducing wait times. Given the link described in this analysis between public injection and sub-optimal HIV treatment outcomes, the implementation and scale-up of supervised injection services might be considered as a part of TasP efforts, particularly if such programs can be used to engage and retain HIV positive PWID in HIV treatment.

Our study has some noteworthy limitations. As an observational study in which the outcome of interest was not randomly assigned, we cannot conclude that our findings are not affected by selection bias or confounding. However, our clinical data regarding HIV treatment was acquired through a comprehensive administrative database. Further, self-reported data has been previously used to measure drug use patterns and other characteristics in studies involving PWID and found to be valid (Darke, 1998). The current findings are not generalizable to other PWID populations that do not report public drug injection.

The present study has demonstrated an important association between public injection and HIV treatment outcomes among a cohort of HIV-seropositive PWID in a Canadian setting. This has important implications for both individual-level health outcomes and public health efforts targeting injection-related HIV transmission. While future research will be necessary to clarify the role of spatial and social factors contributing to elevated risk, it is likely that social marginalization and intense drug use contribute to compromised HIV management in complex ways. Our findings highlight how the provision of harm reduction services, including SIFs, might help optimize TasP-based efforts to address elevated levels of HIV associated morbidity and mortality and HIV infection among people who inject drugs. This will be essential to meet the ambitious UN 90-90-90 Target by 2020 so that we remain on track to ultimately achieve SDG 3.3 by 2030.

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Baseline characteristics of 626 HIV-positive people who use injection drugs stratified by recent public injection drug use, 2005 to 2014

Table 1

Characteristic	No public injection n (%) 213 (34.0)	Public injection n (%) 413 (66.0)	Odds Ratio	95% Confidence Interval	p-value
Gender					
Non-male	138 (33.4)	71 (33.3)	1.00		
Male	275 (66.6)	142 (66.7)	1.00	0.71 – 1.43	0.984
Age					
Median (IQR)	44 (38 – 48)	39 (33 – 45)			< 0.001
Ethnicity					
Non-Caucasian	185 (44.8)	85 (39.9)	1.00		
Caucasian	228 (55.2)	128 (60.1)	1.22	0.87 – 1.71	0.242
Homelessness [/]					
No	330 (79.9)	103 (48.4)	1.00		
Yes	83 (20.1)	109 (51.1)	4.17	2.91 – 5.98	< 0.001
Stable relationship					
No	307 (74.3)	157 (73.7)	1.00		
Yes	106 (25.7)	56 (26.3)	1.03	0.71 – 1.51	0.866
Education					
< High school diploma	225 (54.4)	122 (57.3)	1.00		
High school diploma	188 (45.6)	91 (42.7)	0.89	0.64 – 1.25	0.504
Employment [/]					
No	330 (79.9)	187 (87.8)	1.00		
Yes	83 (20.1)	26 (12.2)	0.55	0.34 – 0.89	0.014
Binge alcohol use [/]					
No	400 (96.9)	204 (95.8)	1.00		
Yes	13 (3.1)	9 (4.2)	1.36	0.57 – 3.23	0.488
Heroin injection [/]					
< Daily	382 (92.5)	140 (65.3)	1.00		
Daily	31 (7.5)	73 (34.7)	6.43	4.05 – 10.21	< 0.001

Characteristic	No public injection n (%) 213 (34.0)	Public injection n (%) 413 (66.0)	Odds Ratio	95% Confidence Interval	p-value
Cocaine injection ^I					
< Daily	387 (93.7)	176 (82.6)	1.00		
Daily	26 (6.3)	37 (17.3)	3.13	1.84 – 5.32	< 0.001
Crack cocaine use ^I					
< Daily	287 (69.5)	103 (48.4)	1.00		
Daily	126 (30.5)	110 (51.6)	2.43	1.73 – 3.42	< 0.001
Crystal Meth use ^I					
< Daily	398 (96.3)	201 (94.4)	1.00		
Daily	15 (3.7)	12 (5.6)	1.58	0.73 – 3.45	0.243
Non-fatal overdose ^I					
No	397 (96.1)	189 (88.7)	1.00		
Yes	16 (3.9)	24 (11.3)	3.15	1.63 – 6.07	< 0.001
Lent used syringe ^I					
No	404 (98.1)	206 (96.7)	1.00		
Yes	8 (1.9)	7 (3.3)	1.72	0.61 – 4.80	0.298
Recent incarceration ^I					
No	372 (90.1)	159 (74.6)	1.00		
Yes	31 (9.9)	54 (25.4)	3.08	1.97 – 4.82	< 0.001
Encounters with police ^I					
No	353 (85.4)	136 (63.8)	1.00		
Yes	60 (14.5)	77 (36.2)	3.33	2.25 – 4.93	< 0.001
MMT ^{I,2}					
No	226 (54.7)	120 (56.3)	1.00		
Yes	187 (45.3)	93 (43.7)	0.94	0.67 – 1.31	0.7
Antiretroviral therapy ^I					
0 days	125 (30.3)	92 (43.2)	1.00		
1 day	288 (69.7)	121 (56.8)	0.57	0.41 – 0.80	0.001
HIV-1 RNA viral load					
50 c/mL plasma	167 (40.4)	55 (25.8)	1.00		

Characteristic	No public injection n (%) 213 (34.0)	Public injection n (%) 413 (66.0)	Odds Ratio	95% Confidence Interval	p-value
> 50 c/mL plasma	246 (59.6)	158 (74.2)	1.95	1.35 – 2.81	0.002
CD4 cell count					
Median (IQR)	3.5 (2.0 – 4.7)	3.9 (3.3 – 4.5)			< 0.001

¹Refers to six month period prior to the baseline interview;

²Methadone maintenance therapy

Table 2
Bivariable and multivariable longitudinal mixed-effects analyses of factors associated with public injection among 626 HIV-positive people who use illicit drugs

Characteristic	Odds Ratio	95% CI	p-value	Adjusted Odds Ratio	95% Confidence Interval	p-value
Male gender (yes vs. no)	1.02	0.69–1.51	0.930	1.82	1.26 – 2.64	0.001
Age (Per 10 years older)	0.36	0.29 – 0.45	< 0.001	0.42	0.33 – 0.52	< 0.001
Caucasian (yes vs. no)	0.98	0.67 – 1.42	0.904			
Homeless (yes vs. no)	6.39	4.94 – 8.26	< 0.001			
Stable relationship (yes vs. no)	1.14	0.85 – 1.53	0.382			
Education (HS vs. <HS)	0.95	0.65 – 1.39	0.776			
Employment (yes vs. no)	0.92	0.66 – 1.29	0.634			
Binge alcohol (yes vs. no)	1.33	0.68 – 2.60	0.408			
Heroin injection (daily vs <daily)	4.14	3.05 – 5.62	< 0.001	2.63	1.92 – 3.60	< 0.001
Cocaine injection (daily vs <daily)	2.07	1.48 – 2.91	< 0.001	1.58	1.10 – 2.25	0.012
Crack use (daily vs <daily)	2.48	1.93 – 3.18	< 0.001	1.88	1.44 – 2.44	< 0.001
Crystal meth use (daily vs <daily)	1.49	0.83 – 2.66	0.180			
Overdose (yes vs. no)	1.66	1.08 – 2.54	0.020	1.48	0.95 – 2.31	0.083
Lent used syringe (yes vs. no)	2.53	1.06 – 6.01	0.036	2.40	0.99 – 5.82	0.052
Recent incarceration (yes vs. no)	3.16	2.28 – 4.40	< 0.001	1.78	1.26 – 2.53	0.001
Police encounter (yes vs. no)	3.51	2.67 – 4.62	< 0.001	2.77	2.08 – 3.69	< 0.001
MMT (yes vs. no)	0.82	0.54 – 0.96	0.026			
Antiretroviral therapy (1 day vs. 0 days)	0.39	0.29 – 0.53	< 0.001			
HIV-1 RNA viral load (>50 copies/mL vs. 50 copies/mL)	2.05	1.60 – 2.62	< 0.001	1.42	1.10 – 1.83	0.007
CD4 count (per 100 cells/mL)	0.93	0.87 – 1.00	0.042			