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Do law enforcement interactions reduce the initiation of injection drug use? An investigation in three North American settings



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ABSTRACT

Background: The prevention of drug injecting is often cited as a justification for the deployment of law enforcement and for the continuation of drug criminalization policies. We sought to characterize the impact of law enforcement interactions on the risk that people who inject drugs (PWID) report assisting others with injection initiation in three North American countries.

Methods: Cross-sectional data from PWID participating in cohort studies in three cities (San Diego, USA; Tijuana, Mexico; Vancouver, Canada) were pooled (August 2014–December 2016). The dependent variable was defined as recently (i.e., past six months) providing injection initiation assistance; the primary independent variable was the frequency of recent law enforcement interactions, defined categorically (0 vs. 1 vs. 2–5 vs. ≥ 6). We employed multivariable logistic regression analyses to assess this relationship while controlling for potential confounders.

Results: Among 2122 participants, 87 (4.1%) reported recently providing injection initiation assistance, and 802 (37.8%) reported recent law enforcement interactions. Reporting either one or more than five recent interactions with law enforcement was not significantly associated with injection initiation assistance. Reporting 2–5 law enforcement interactions was associated with initiation assistance (Adjusted Odds Ratio = 1.74, 95% Confidence Interval: 1.01–3.02).

Conclusions: Reporting interactions with law enforcement was not associated with a reduced likelihood that PWID reported initiating others into injection drug use. Instead, we identified a positive association between reporting law enforcement interactions and injection initiation assistance among PWID in multiple settings. These findings raise concerns regarding the effectiveness of drug law enforcement to deter injection drug use initiation.

1. Introduction

Injection drug use is associated with a high risk of blood-borne infection such as HIV and hepatitis C virus and, consequently, people who inject drugs (PWID) account for nearly a third of all HIV cases outside of sub-Saharan Africa (UNODC, 2016). Dual epidemics of injection drug use and blood-borne disease have been observed globally, particularly across urban centers in North America (Friedman et al., 2006; Strathdee et al., 2012). Experts have characterized these linked epidemics as syndemics, or, the interaction of multiple coexistent conditions in a population that

exacerbates disease morbidity and mortality (Singer and Clair, 2003). Data suggest that the risk of blood-borne disease transmission among PWID is highest during the period immediately after initiating this behavior and as such, this period is critical in driving the expansion of syndemics of injection drug use and blood-borne disease (Garfein et al., 1996; Vlahov et al., 2004). In response, experts have suggested that preventing injection initiation is likely to be more effective in reducing disease incidence than seeking to reduce a range of risks experienced by individuals after they initiate injection drug use (Bluthenthal and Kral, 2015; Vlahov et al., 2004; Werb et al., 2016a).

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Relatedly, previous research on the impact of law enforcement suggests that police interactions with PWID may increase behavioral risks for injection-driven disease transmission and thereby intensify syndemics (Cooper et al., 2005; Friedman et al., 2006; Small et al., 2006; Werb et al., 2016b; Werb et al., 2015; Werb et al., 2008). In North American settings, such as Vancouver and the San Francisco Bay area, studies have found that police surveillance discourages safer injection practices and access to needle exchange programs among PWID, while also increasing the risk that PWID perform rushed injections to avoid detection; the confiscation and destruction of injecting equipment by police also subsequently increased the risk that PWID reported sharing syringes (Bluthenthal et al., 1997; Small et al., 2006; Werb et al., 2008). PWID experiencing such intensified drug law enforcement were also less likely to carry sterile injecting equipment and more likely to experience syringe confiscations, even in settings like Canada, Mexico, and New York State where carrying sterile syringes is legal (Burriss and Vernick, 2002; Cooper et al., 2005; Mackey et al., 2014; Werb et al., 2008). Further, law enforcement interactions in some settings have been shown to discourage PWID access to harm reduction services such as needle exchanges and methadone maintenance therapy. This is particularly the case in Tijuana, where data suggest that PWID experience a higher probability of police extortion within 500 m of addiction treatment centers (Small et al., 2006; Werb et al., 2016b; Werb et al., 2015). These findings are in line with a large body of evidence highlighting the impact of intensified policing on disease transmission risk among PWID (Cooper et al., 2005; Friedman et al., 2006; UN General Assembly, 1993; Small et al., 2006; Werb et al., 2016b; Werb et al., 2015; Werb et al., 2008).

Despite this literature, limited research exists on how interactions between PWID and law enforcement may influence the risk that PWID initiate others into injection drug use. Conducting such research is important given that the prevention of drug injecting has been cited as a justification for the deployment of law enforcement and for the continuation of drug criminalization policies (Caulkins, 2005; Caulkins and Reuter, 2010; Caulkins and Tragler, 2016; Kleiman, 1993). These claims are consistent with deterrence theory, which suggests that increasing intensity of police presence will have a deterrent effect on certain illicit behaviors (Nagin, 2013).

Indeed, injection drug use has been established as a socially communicable behavior; that is, a behavior transmitted socially between individuals, dependent on an enabling environment (Sherman et al., 2002; Small et al., 2009). As such, studies suggest that instances of injection initiation are most commonly facilitated by PWID (Harocopos et al., 2009; Small et al., 2009), although socio-structural approaches to preventing these transitions remain mostly unexplored (Werb et al., 2016a). Specifically, samples of PWID have a range of 73%–89% of participants reporting that initiation events were facilitated by other PWID (Jauffret-Roustide et al., 2009; Morris et al., 2012; Werb, 2013).

The application of drug law enforcement, however, has been hypothesized to reduce the risk that individuals are initiated into injection drug use, based on a presumed deterrent effect; furthermore, experts have suggested that its effectiveness may be heightened with increased intensity or level of police numbers via a phenomenon known as ‘enforcement swamping’ (Caulkins, 2005; Kleiman, 1993; Nagin, 2013). These experts have posited that increased enforcement is effective in preventing the dissemination of drug use initiation at the beginning of an injecting epidemic, and effective at containing injecting once these practices have spread widely across a drug-using population (Tragler et al., 2001). However, the potential of this approach in reducing problematic forms of substance use has not been widely investigated beyond mathematical modeling approaches (Caulkins, 2005; Kleiman, 1993). Specifically, deterrence theory does not consider how drug law enforcement that targets established PWID may influence the risk that PWID expose non-injectors to injecting practices. Indeed, it is possible that targeting established PWID with drug law enforcement may reduce their level of contact with injection-naïve drug users by reducing the

visibility of open street drug scenes, or that this may inadvertently increase contact between these two populations through spatial dispersion of injection-using practices (Kolla et al., 2015; Nagin, 2013; Werb et al., 2008). Given the limited empirical evidence base on such approaches, clearly delineating the impact of varying levels of law enforcement interactions on the risk that PWID provide injection initiation assistance may therefore aid in optimizing preventive responses. Thus, using data from PWID in three North American settings, we sought to determine whether the frequency of interactions with law enforcement was associated with PWID providing injection initiation assistance to injection-naïve drug users.

2. Methods

2.1. Subjects and data collection

Preventing Injecting by Modifying Existing Responses (PRIMER) is a multi-site study that pooled data from prospective community-recruited cohort studies of PWID in an effort to investigate whether a range of socio-structural factors influencing disease transmission risk among PWID may also impact the risk that they provide injection initiation assistance to others. The methods used in the PRIMER study have been previously described in full (Werb et al., 2016a). For the present study, we included pooled quantitative data from three cohort studies of PWID participating in PRIMER: the *Proyecto El Cuete IV* (ECIV) cohort (Tijuana, Mexico), the *Study of Tuberculosis, AIDS, and Hepatitis C Risk* (STAHRII) cohort (San Diego, USA), as well as three linked cohorts of PWID in Vancouver: the *Vancouver Injection Drug User Study* (VIDUS; HIV-seronegative PWID), the *AIDS Care Cohort to evaluate Exposure to Survival Services* (ACCESS; HIV-seropositive people who use drugs), and the *At-Risk Youth Study* (ARYS; street-involved youth who use drugs). The PRIMER baseline was defined as the visit at which identical questions specific to providing injection initiation assistance were introduced into each cohort’s surveys. This was undertaken in August 2014 and coincided with follow-up 7 in ECIV, follow-up 4 in STAHRII, and follow-up 18 for the linked Vancouver-based cohort studies (Werb et al., 2016a). The cross-sectional analysis described herein employs data from the PRIMER baseline.

All cohort studies participating in PRIMER employed open and prospective designs, with similar community recruitment protocols, involving extensive street-based outreach by frontline staff as well as peers in city neighborhoods where PWID are known to congregate. All participants provided consent prior to enrollment. Participant eligibility for the current study is restricted to individuals who reported recent injection drug use at baseline. All cohort survey questionnaires are highly comparable, with identical survey items on the initiation of others introduced at the PRIMER baseline (Werb et al., 2016a). Other survey items are highly comparable as a result of the fact that ECIV and STAHRII were specifically designed as a linked binational study (Robertson et al., 2014), and that these surveys were modeled in part on the original VIDUS survey.

2.2. Analysis

Considering that injecting initiation appears to be a socially communicable phenomenon that is facilitated by the exposure of injecting practices by PWID to non-injectors (Werb et al., 2016a), the dependent variable was defined as reporting recently (i.e., past six months) assisting an individual to inject drugs who had never injected before. The primary independent variable of interest was defined as the frequency of recent (i.e., past six months) law enforcement interactions. Law enforcement interactions were defined as any type of encounters with authorities (e.g., police officers) including stops, detentions, arrests, and drug confiscations. We did not restrict to interactions related to drug or HIV prevention efforts. Based on available survey responses, this was defined categorically (0 encounters vs. 1 vs. 2–5 vs. ≥ 6) to

determine whether the frequency of interactions impacted injection initiation assistance risk. Other independent variables of interest included: city of residence (Tijuana vs. San Diego vs. Vancouver), age in years, gender identity (female vs. male), housing status (stable housing vs. other), and the frequency of recent injection drug use (none vs. less than daily use vs. daily use). Analyses included all participants that completed the PRIMER baseline questions across all participating cohort studies from August 2014 to December 2016 (ECIV, Tijuana; STAHR II, San Diego; VIDUS/ACCESS/ARYS, Vancouver). The Institutional Review Board of the University of California San Diego, School of Medicine provided ethical approval for this study (UCSD IRB 150866). Each cohort study was also approved by their respective institutional review boards.

Univariate cross-tabulations and multivariable logistic regression analyses were used to determine associations between the frequency of law enforcement interactions and reporting initiating others into injecting in the past six months. We fit a final confounding model wherein pre-specified variables (cohort, age, gender) were included as potential confounders in addition to injecting frequency in the past 6 months which was significant in the univariate analysis.

A sub-analysis was conducted to investigate the nature of law enforcement interactions experienced by participants. Across study settings, interactions with law enforcement were categorized as arrests or detentions, negative interactions, or neutral interactions. For this study, negative interactions were defined as instances where participants reported abuse by authorities or confiscation of their belongings. Neutral interactions were defined as instances where participants did not report being arrested, detained, or did not report any negative outcome during the interaction. Fisher’s exact test was used to determine significant differences when comparing cohorts. R Version 3.1.1 (Auckland, New Zealand) was used for all analyses.

3. Results

Participant characteristics at baseline are summarized in Table 1. The total number of participants was 2157; however, due to missing data on injection initiation questions, 35 (1.6%) participants were excluded from the analysis. Within a final combined sample of 2122 participants, the majority of participants were drawn from the Vancouver-based cohorts (n = 1236, 58.2%), followed by the Tijuana (ECIV; n = 532, 25.1%) and San Diego (STAHR II; n = 354, 16.7%) cohorts. Most participants were male (64.7%) and reported unstable housing status (57.7%). The mean age of participants was 45 years (standard deviation: 11). Among all participants, 87 (4.1%) reported

Table 1

Participant characteristics at baseline stratified by study cohort in Tijuana, Mexico; San Diego, USA; and Vancouver, Canada; 2014–2016 (n = 2157).

Characteristic	ECIV (n = 534)	STAHR II (n = 360)	VIDUS/ACCESS/ARYS (n = 1263)	Total (n = 2157)	p-value
Provided recent (i.e. past six months) injection initiation assistance					
No	509 (95.7%)	336 (94.9%)	1190 (96.3%)	2035 (95.9%)	0.499
Yes	23 (4.3%)	18 (5.1%)	46 (3.7%)	87 (4.1%)	
Age (mean (SD))	41.0 (8.7)	47.0 (11.2)	45.7 (11.6)	44.7 (11.1)	< 0.001
Gender					
Female/Transgender	205 (38.4%)	105 (29.3%)	451 (35.7%)	761 (35.3%)	0.019
Male	329 (61.6%)	253 (70.7%)	811 (64.3%)	1393 (64.7%)	
Stable housing					
No	204 (38.2%)	176 (48.9%)	864 (68.4%)	1244 (57.7%)	< 0.001
Yes	330 (61.8%)	184 (51.1%)	399 (31.6%)	913 (42.3%)	
Frequency of recent injection drug use					
None	92 (17.2%)	110 (30.6%)	502 (39.8%)	704 (32.6%)	< 0.001
Less than daily	38 (7.1%)	136 (37.8%)	374 (29.6%)	548 (25.4%)	
Daily	404 (75.7%)	114 (31.7%)	387 (30.6%)	905 (42.0%)	
Frequency of recent law enforcement interactions					
0	314 (58.8%)	193 (53.6%)	849 (67.6%)	1356 (63.1%)	< 0.001
1	80 (15.0%)	49 (13.6%)	155 (12.3%)	284 (13.2%)	
2–5	101 (18.9%)	78 (21.7%)	157 (12.5%)	336 (15.6%)	
≥6	39 (7.3%)	40 (11.1%)	95 (7.6%)	174 (8.1%)	

Table 2

Univariate association between participant characteristics and recent (i.e. past six months) injection initiation assistance in Tijuana, Mexico; San Diego, USA; and Vancouver, Canada; 2014–2016 (n = 2122).

Characteristic	Yes 87 (4%)	No 2035 (96%)	p-value
Cohort			
ECIV	23 (4.3%)	509 (95.7%)	0.469
STAHR II	18 (5.1%)	336 (94.9%)	
VIDUS/ACCESS/ARYS	46 (3.7%)	1190 (96.3%)	
Age (mean (SD))	38.8 (11.8)	45.0 (11.0)	< 0.001
Male gender			
No	24 (3.2%)	727 (96.8%)	0.137
Yes	63 (4.6%)	1305 (95.4%)	
Stable housing			
No	56 (4.6%)	1164 (95.4%)	0.223
Yes	31 (3.4%)	871 (96.6%)	
Frequency of recent injection drug use			
None	7 (1.0%)	673 (99.0%)	< 0.001
Less than daily	19 (3.5%)	520 (96.5%)	
Daily	61 (6.8%)	842 (93.2%)	
Frequency of recent law enforcement interactions			
0	37 (2.8%)	1295 (97.2%)	< 0.001
1	15 (5.4%)	264 (94.6%)	
2–5	24 (7.2%)	308 (92.8%)	
≥6	10 (5.8%)	162 (94.2%)	

recently providing injection initiation assistance and 802 (37.8%) reported recent law enforcement interactions. Among those who reported interactions, 284 (13.4%) reported one, 336 (15.8%) reported two to five, and 174 (8.2%) reported six or more interactions. Overall, 704 (32.6%) did not report injection drug use in the past six months.

Table 2 displays the combined univariate associations between the frequency of law enforcement interactions and the provision of injection initiation assistance. Reporting law enforcement interactions in the past six months, across all three levels of interactions, was associated with an increased likelihood of initiation assistance. Participants reporting two to five recent police interactions had the highest prevalence of providing injection initiation assistance (7.2%). Those participants who reported no recent interactions with law enforcement reported the lowest prevalence of injection initiation assistance (2.8%). These differences were statistically significant (p < 0.01).

In a multivariable regression model (Table 3), reporting two to five law enforcement interactions (Adjusted Odds Ratio [AOR] = 1.74, p < 0.05) was associated with reporting injection initiation assistance provision. Additionally, less than daily injecting (AOR = 3.11), daily injecting (AOR = 5.88), and San Diego cohort enrollment

Table 3

Multivariable logistic regression analysis of factors associated with providing recent (past six months) injection initiation assistance among people who inject drugs in Tijuana, Mexico; San Diego, USA; and Vancouver, Canada; 2014–2016 (n = 2122).

	Adjusted OR (95% CI)	p-value
Frequency of law enforcement interactions (<i>ref. 0 times</i>)		
1 time	1.47 (0.78–2.77)	0.229
2–5 times	1.74 (1.01–3.02)	0.048
≥ 6 times	1.15 (0.54–2.42)	0.720
Cohort (<i>ref. ECIV</i>)		
STAIR II	1.99 (1.01–3.89)	0.046
VIDUS/ACCESS/ARYS	1.44 (0.83–2.47)	0.191
Age (years)	0.96 (0.94–0.98)	< 0.001
Gender (<i>ref. female</i>)		
Male	1.62 (0.98–2.66)	0.059
Frequency of recent injection drug use (<i>ref. none</i>)		
Less than daily use	3.11 (1.29–7.50)	0.012
Daily use	5.88 (2.60–13.28)	< 0.001

Note: OR = odds ratio; CI = confidence interval.

(AOR = 1.99) were all associated with a greater odds of providing injection initiation assistance, while older age was inversely associated (AOR = 0.96 per year) (all p < 0.05). Male gender was marginally significant (AOR = 1.62, p < 0.10).

3.1. Results of sub-analysis

Table 4 presents the type of recent law enforcement interactions reported by participants. Across all cohorts, neutral interactions were the most common (46.5%), followed by arrests and detainment (41.1%), and negative interactions (24.7%), though we note variation between study sites. For instance, a significantly higher proportion of participants in Tijuana reported arrests and detainments compared with participants in Vancouver (70.7% vs. 24.0%, pn < 0.001), as well as a significantly lower proportion of neutral interactions (10.8% vs. 62.7%, p < 0.001). Participants in San Diego were only asked about negative interactions that occurred in Mexico and comparable data are therefore not available.

4. Discussion

In a multi-site analysis representing three countries, and despite adjustment for potential confounders, reporting interactions with law enforcement was not associated with a reduced likelihood that PWID reported initiating others into injection drug use. Specifically, reporting either one or more than five recent interactions with law enforcement was not significantly associated with injection initiation assistance. However, PWID who reported two to five recent interactions with law enforcement had significantly higher odds of providing injection

Table 4

The reported nature of interactions with law enforcement among participants who reported law enforcement interactions in the past six months in Tijuana, Mexico and Vancouver, Canada; 2014–2016 (n = 635). Categories are not mutually exclusive.

Cohort	ECIV (n = 222)	VIDUS/ACCESS/ ARYS (n = 413)	Total (n = 635)
Nature of interaction			
Arrested/Detained***	157 (70.7%)	99 (24.0%)	330 (41.1%)
Negative interaction ^a	57 (25.7%)	133 (32.2%)	198 (24.7%)
Neutral interaction ^{b, ***}	24 (10.8%)	259 (62.7%)	373 (46.5%)

***p < 0.001

^a Negative interactions: Participants reported abuse by authorities or confiscation of their belongings.

^b Neutral interactions: Participants did not report being arrested, detained, or did not report any negative outcome during the interaction.

initiation assistance compared with those who reported no law enforcement interactions. To our knowledge, this is the first empirical study to identify an association between law enforcement activity and providing injection initiation assistance. These findings do not support the hypothesized deterrent effect of drug law enforcement on the initiation of problematic forms of drug use, or the assumption that increased intensity of drug law enforcement is associated with an increased deterrent effect in this regard (Caulkins, 2005; Nagin, 2013).

The results presented herein have a number of potential interpretations. First, considering the null findings of the association between two strata of law enforcement interactions (0 encounters vs. 1, ≥ 6), we conclude that increased law enforcement is unlikely to have reduced the risk that participants in this study initiated others into injection drug use.

The marginally significant association detected between moderate levels of engagement with law enforcement and the provision of initiation assistance may imply that law enforcement interactions might actually increase the risk that PWID provide injection initiation assistance to others.

This finding has a number of potential interpretations. Based on previous literature, we posit that there may be an economic incentive among PWID to initiate others, given data demonstrating that injection-naïve individuals may offer to share drugs in exchange for the provision of injection initiation assistance (Kolla et al., 2015). However, given that drugs may be confiscated during interactions between PWID and law enforcement (Werb et al., 2008), this may incentivize PWID to initiate others based on a need for money or drugs (Kolla et al., 2015). This likely does not fully explain the association identified between moderate levels of law enforcement interactions and the provision of injection initiation assistance, though, given that we might therefore expect a similarly significant relationship between these variables in the other two strata. Instead, in both univariate and multivariable analyses, reporting two to five law enforcement interactions in the past six months was more strongly associated with the provision of injection initiation assistance among participants compared with reporting either fewer or more interactions. This may be related to the intensity of an individual’s injection drug use and their resultant self-selection into specific drug-using social networks.

To that end, we note that injection drug use initiation is dependent on practice sharing of injecting behaviors from PWID to injection-naïve individuals (Sherman et al., 2002; Small et al., 2009). Additionally, economically and socially marginalized PWID are more likely to experience unstable housing situations, untreated substance use disorders, and related adverse health outcomes (Werb et al., 2008). Individuals who are more street-entrenched, engage in higher intensity drug injecting, and who have been injecting longer, may naturally self-select into social networks that contain fewer individuals who are injection-naïve (Mars et al., 2014). This particular subpopulation of PWID may therefore be less likely to interact with non-PWID and, therefore, less likely to potentially initiate others. At the same time, the combination of increased intensity of injection drug use, low socioeconomic status, and use of street-based injecting venues may increase the risk that this subpopulation interacts with law enforcement. As such, reporting high levels of interactions with police may therefore serve as a proxy for these characteristics. It is noteworthy in this regard that previous studies suggest PWID who report low levels of law enforcement interactions may also be less likely to inject in public due to lower levels of marginalization and drug dependence (Navarro and Leonard, 2004; Small et al., 2006). Such PWID may have greater access to private injection settings; this may result in less sharing of injection practices with non-injectors, and, consequently, a reduced risk of being solicited to assist in injection initiation events (Sherman et al., 2002; Small et al., 2009; Small et al., 2006; Werb et al., 2016a). It is therefore possible that PWID who report a moderate number of interactions with law enforcement fall into a unique category consisting of PWID that participate in street-based drug-using scenes that include both injection and

non-injection drug use. These individuals may interact with law enforcement given this participation but may not be entrenched within “injection-only” drug-using networks.

In addition, we note that the differential association between the varying strata of law enforcement interaction intensity may be partially due to the types of interactions PWID experience. While this analysis did not specify the nature of police interactions, data demonstrate that the nature of encounters may influence health outcomes and behaviors (Nagin, 2013). For instance, studies have shown that differing policing strategies are associated with differing deterrent impacts and that the perceived legitimacy of police interactions can be a contributing factor to post-interaction behaviors (Hughes et al., 2017; MacCoun, 1993). While we sought to specifically explore the impact of intensity of policing in line with deterrence theory, our sub-analysis on the nature of law enforcement interactions provides some insight into the variation in the types of encounters with authorities that participants reported in different settings. However, sub-analytic results suggest that the type of interaction appears not be highly influential among the sample, given that there was a non-significant difference in the adjusted odds of reporting providing injection initiation assistance between participants in Tijuana and Vancouver, despite significant differences in the type of interactions experienced by participants in both settings. We note that future research is needed on how specific policing strategies influences how law enforcement interactions impact injection drug use initiation, from the perspective of both initiates and initiators.

Again, considering levels of policing, previous calls have been made for the intensified application of drug law enforcement or ‘enforcement swamping’ to deter drug use initiation, particularly at the beginning of the expansion of drug injection practices through a vulnerable population (Caulkins, 2005; Caulkins and Reuter, 2010; Caulkins and Tragler, 2016; Kleiman, 1993; Tragler et al., 2001). At later stages of the dissemination of injecting practices among such drug-using populations, experts have also suggested that implementing a mix of increased addiction treatment along with sustained drug law enforcement may be more effective in containing the number of individuals who initiate drug injecting (Tragler et al., 2001). Tijuana, San Diego, and Vancouver represent highly diverse settings wherein injecting practices have been disseminated widely among vulnerable drug-using populations. While limited, these results suggest that increased intensity of drug law enforcement is not likely to contain or reduce the incidence of injection initiation, given the null findings among two groups of PWID who reported interactions with law enforcement in addition to the marginally significant positive association found among PWID reporting two to five interactions. Further, assuming that increased intensity of enforcement interactions reduced the risk of injection initiation, we would expect to observe a protective effect of experiencing a high number of drug law enforcement interactions (i.e., 6 or more). We did not observe this result, suggesting that at best, increased enforcement interactions do not contain expanding injecting practices among vulnerable populations, and that they may in fact increase the risk of injection initiation incidence.

Based on these findings, we conclude that drug law enforcement is unlikely to act as a deterrent to injection drug use initiation, which is inconsistent with theory of deterrence (Nagin, 2013). All PWID in this multi-cohort analysis reside in cities with drug policies where possession of clean syringes or small amounts of otherwise illegal drugs has been decriminalized (Canada: *Controlled Drugs and Substances Act*; Mexico: *Ley de Narcomenudeo*) or where the severity of legal repercussions against drug use and possession have been reduced (California: *Proposition 47*) (Mackey et al., 2014; Porter, 2014; Werb et al., 2008). Still, the degree to which drug law enforcement reflects the broader legal status of the possession of drugs and drug paraphernalia varies (Werb et al., 2014; Werb et al., 2008). Law enforcement interactions with PWID have been shown to increase injection-related risks

along an individual’s injection drug use career via syringe confiscation and via spatial and economic barriers to addiction treatment and harm reduction interventions (Bluthenthal et al., 1997; Werb et al., 2016b; Werb et al., 2015; Werb et al., 2008). This study further suggests that drug law enforcement may be ineffective at reducing the risk that PWID initiate others and may also suggest, contrary to the tenets of the theory of deterrence (Caulkins, 2005; Kleiman, 1993; Nagin, 2013), that increased intensity of drug law enforcement, may be associated with an increased risk that PWID initiate others into drug injecting.

4.1. Limitations

This study has limitations typical of both observational research among drug-using populations as well as multi-site cohort studies. First, study participants were not randomly selected, and generalizability to the greater population of PWID in each setting cannot be assumed. Second, because of the cross-sectional nature of the analyses, we are limited to identifying associations between factors and caution that a causal relationship between law enforcement interactions and injection initiation assistance cannot be assumed. We also acknowledge that factors unexplored in these analyses may impact this association. Third, due to the nature of this multi-cohort study, heterogeneity in data collection may have impacted the results across sites. It is important to consider the heterogeneity among our study participants as they come from three different North American locations with varying drug policy environments, income levels, and drug use cultures. Finally, PRIMER sought to combine study samples across a range of settings that employed distinct survey instruments and we were therefore limited in the range of factors for which we were able to control. To address this limitation, we identified survey items most relevant to this analysis that were also identically reported across all three cohorts and excluding those that were not (e.g., data on public injecting was not solicited by all three cohorts and was therefore excluded). Notably, some factors of potential importance such as age of drug use initiation, age of injection initiation, and type of drugs consumed by participants were not included in this analysis. Given the rarity of the outcome (i.e., 87 events), we were limited in the number of factors we were able to include in the final multivariate model without overfitting, which may increase the probability of random error. We note, however, that these factors will be the subject of forthcoming analyses from the PRIMER study and may further define future analyses of our findings. Future research should therefore include qualitative methods that allow for greater in-depth understanding of individual pathways and socio-structural contexts experienced by PWID that may influence their risk of initiating others into injecting, particularly focused on the nature and type of law enforcement interactions that PWID experience.

Also, we note that, while some participants reported no injection drug use in the past six months, all participants injected at baseline, and those that report currently abstaining may still be at risk of providing injection initiation assistance. We note that results derived from an analysis excluding these participants were not statistically significantly different from those derived from the final model including all participants.

5. Conclusions

To our knowledge, this is the first study to identify a relationship between the frequency of law enforcement interactions and the likelihood that PWID report providing injection drug use initiation, and that this association was consistent across settings in all three North American countries. This study also suggests that assumptions regarding the potential deterrent effect of high-intensity drug law enforcement on the initiation of individuals into injection drug use is likely limited (Caulkins, 2005; Kleiman, 1993), while this approach

may in fact have the unintended effect of potentially increasing the risk that PWID initiate others into drug injecting. There is a large body of scientific literature delineating the multiple points of impact of drug law enforcement on the risk behaviors experienced by individuals across their injection drug-using careers, from increasing the risk that individuals engage in risky behaviors like syringe sharing (Small et al., 2006; Werb et al., 2008), to reducing the capacity of PWID to access harm reduction interventions (Bluthenthal et al., 1997), to impacting their capacity to access and sustain enrollment in addiction treatment (Werb et al., 2016b; Werb et al., 2015). The present findings identify another potential impact of drug law enforcement on increasing the risk that individuals are initiated into injection drug use. Longitudinal research is needed to delineate the nature of potential causal pathways between drug law enforcement interactions and injection initiation assistance provision among PWID. However, these results imply that efforts to prevent syndemics of injection drug use and blood-borne disease should ensure that enforcement-based efforts to deter drug use behaviors do not paradoxically increase risk of their expansion.

Conflict of interest statement

No conflict declared.

Role of funding

Nothing declared.

Contributors

All authors have read and approved the text. Melo and Werb collaborated on study design, interpretation of statistical analysis, and manuscript structure and content. Sun and Jain conducted statistical analysis of study data and informed interpretation and presentation. Melo drafted the manuscript. Garfein, Hayashi, Milloy, DeBeck, Strathdee, and Werb made significant contributions to manuscript revisions.

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References

Bluthenthal, R.N., Kral, A.H., 2015. Next steps in research on injection initiation incidence and prevention. *Addiction* 110, 1258–1259.

Bluthenthal, R.N., Kral, A.H., Lorrivick, J., Watters, J.K., 1997. Impact of law enforcement on syringe exchange programs: a look at Oakland and San Francisco. *Med. Anthropol.* Q. 18, 61–83.

Burris, S.S.S., Vernick, J., 2002. Syringe Access Law in the United States: A State of the Art Assessment of Law and Policy. Center for Law and the Public's Health at Johns Hopkins and Georgetown Universities, Baltimore, USA.

Caulkins, J.P., Reuter, P., 2010. How drug enforcement affects drug prices. *Crime Justice* 39, 213–271.

Caulkins, J.P., Tragler, G., 2016. Dynamic drug policy: optimally varying the mix of treatment, price-raising enforcement, and primary prevention over time. In: Dawid, H., Doerner, K.F., Feichtinger, G., Kort, P.M., Seidl, A. (Eds.), *Dynamic Perspectives on Managerial Decision Making: Essays in Honor of Richard F Hartl*. Springer International Publishing, Cham, pp. 11–35.

Caulkins, J.P., 2005. Drug policy: insights from mathematical analysis. *Ops. Res. Health Care*. Springer, pp. 297–331.

Cooper, H., Moore, L., Gruskin, S., Krieger, N., 2005. The impact of a police drug crackdown on drug injectors' ability to practice harm reduction: a qualitative study. *Soc. Sci. Med.* 61, 673–684.

Friedman, S.R., Cooper, H.L., Tempalski, B., Keem, M., Friedman, R., Flom, P.L., Des Jarlais, D.C., 2006. Relationships of deterrence and law enforcement to drug-related harms among drug injectors in US metropolitan areas. *AIDS* 20, 93–99.

Garfein, R.S., Vlahov, D., Galai, N., Doherty, M.C., Nelson, K.E., 1996. Viral infections in short-term injection drug users: the prevalence of the Hepatitis C, Hepatitis B, human immunodeficiency, and human T-lymphotropic viruses. *Am. J. Public Health* 86, 655–661.

Harocopos, A., Goldsamt, L.A., Kobrak, P., Jost, J.J., Clatts, M.C., 2009. New injectors and the social context of injection initiation. *Int. J. Drug Policy* 20, 317–323.

Hughes, C.E., Moxham-Hall, V., Ritter, A., Weatherburn, D., MacCoun, R., 2017. The deterrent effects of Australian street-level drug law enforcement on illicit drug offending at outdoor music festivals. *Int. J. Drug Policy* 41, 91–100.

Jauffret-Roustide, M., Le Strat, Y., Couturier, E., Thierry, D., Rondy, M., Quaglia, M., Razafandratsima, N., Emmanuelli, J., Guibert, G., Barin, F., 2009. A national cross-sectional study among drug-users in France: epidemiology of HCV and highlight on practical and statistical aspects of the design. *BMC Infect. Dis.* 9, 113.

Kleiman, M.A., 1993. Enforcement swamping: a positive-feedback mechanism in rates of illicit activity. *Math. Comput. Model.* 17, 65–75.

Kolla, G., Strike, C., Roy, É., Altenberg, J., Balian, R., Silver, R., Hunt, N., 2015. Initiation stories: an examination of the narratives of people who assist with a first injection. *Subst. Use Misuse* 50, 1619–1627.

MacCoun, R.J., 1993. Drugs and the law: a psychological analysis of drug prohibition. *Psychol. Bull.* 113, 497–512.

Mackey, T.K., Werb, D., Beletsky, L., Rangel, G., Arredondo, J., Strathdee, S.A., 2014. Mexico's ley de narcomenudeo drug policy reform and the international drug control regime. *Harm Reduct. J.* 11, 31.

Mars, S.G., Bourgois, P., Karandinos, G., Montero, F., Ciccarone, D., 2014. Every 'never' I ever said came true: transitions from opioid pills to heroin injecting. *Int. J. Drug Policy* 25, 257–266.

Morris, M.D., Brouwer, K.C., Lozada, R.M., Gallardo, M., Vera, A., Strathdee, S.A., 2012. Injection first A unique group of injection drug users in Tijuana. *Mexico Am. J. Addict.* 21, 23–30.

Nagin, D.S., 2013. Deterrence: a review of the evidence by a criminologist for economists. *Ann. Rev. Econom.* 5, 85–105.

Navarro, C., Leonard, L., 2004. Prevalence and factors related to public injecting in Ottawa, Canada: implications for the development of a trial safer injecting facility. *Int. J. Drug Policy* 15, 275–284.

Porter, N.D., 2014. The State of Sentencing 2014: Developments in Policy and Practice. The Sentencing Project. The sentencing project, Washington, D.C.

Robertson, A.M., Garfein, R.S., Wagner, K.D., Mehta, S.R., Magis-Rodriguez, C., Cuevas-Mota, J., Moreno-Zuniga, P.G., Strathdee, S.A., 2014. Evaluating the impact of Mexico's drug policy reforms on people who inject drugs in Tijuana, B.C., Mexico, and San Diego, CA, United States: a binational mixed methods research agenda. *Harm Reduct. J.* 11, 4.

Sherman, S.G., Smith, L., Laney, G., Strathdee, S.A., 2002. Social influences on the transition to injection drug use among young heroin sniffers: a qualitative analysis. *Int. J. Drug Policy* 13, 113–120.

Singer, M., Clair, S., 2003. Syndemics and public health: reconceptualizing disease in bio-social context. *Med. Anthropol. Q.* 17, 423–441.

Small, W., Kerr, T., Charette, J., Schechter, M.T., Spittal, P.M., 2006. Impacts of intensified police activity on injection drug users: evidence from an ethnographic investigation. *Int. J. Drug Policy* 17, 85–95.

Small, W., Fast, D., Krusi, A., Wood, E., Kerr, T., 2009. Social influences upon injection initiation among street-involved youth in Vancouver, Canada: a qualitative study. *Subst. Abuse Treat. Prev. Policy* 4, 1–8.

Strathdee, S.A., Magis-Rodriguez, C., Mays, V.M., Jimenez, R., Patterson, T.L., 2012. The emerging HIV epidemic on the Mexico-U.S. border: an international case study characterizing the role of epidemiology in surveillance and response. *Ann. Epidemiol.* 22, 426–438.

Tragler, G., Caulkins, J.P., Feichtinger, G., 2001. Optimal dynamic allocation of treatment and enforcement in illicit drug control. *Ops. Res.* 49, 352–362.

UN General Assembly, 1993. Vienna Declaration and Programme of Action. (Available at: <http://www.refworld.org/docid/3ae6b39ec.html>).

UNODC, 2016. World Drug Report. United Nations Office on Drugs and Crime. (Available at: <http://www.unodc.org/wdr2016/>).

Vlahov, D., Fuller, C.M., Ompad, D.C., Galea, S., Des Jarlais, D.C., 2004. Updating the infection risk reduction hierarchy: preventing transition into injection. *J. Urban Health* 81, 14–19.

Werb, D., Wood, E., Small, W., Strathdee, S., Li, K., Montaner, J., Kerr, T., 2008. Effects of police confiscation of illicit drugs and syringes among injection drug users in Vancouver. *Int. J. Drug Policy* 19, 332–338.

Werb, D., Mora, M.E.M., Beletsky, L., Rafful, C., Mackey, T., Arredondo, J., Strathdee, S.A., 2014. Mexico's drug policy reform: cutting edge success or crisis in the making? *Int. J. Drug Policy* 25, 823–825.

- Werb, D., Wagner, K.D., Beletsky, L., Gonzalez-Zuniga, P., Rangel, G., Strathdee, S.A., 2015. Police bribery and access to methadone maintenance therapy within the context of drug policy reform in Tijuana, Mexico. *Drug Alcohol Depend.* 148, 221–225.
- Werb, D., Garfein, R.S., Kerr, T., Davidson, P.J., Roux, P., Jauffret-Roustide, M., Auriacombe, M., Small, W., Strathdee, S., 2016a. A socio-structural approach to preventing injection drug use initiation: rationale for the PRIMER study. *Harm Reduct. J.* 13, 25.
- Werb, D., Strathdee, S.A., Vera, A., Arredondo, J., Beletsky, L., Gonzalez-Zuniga, P., Gaines, T., 2016b. Spatial patterns of arrests, police assault and addiction treatment center locations in Tijuana, Mexico. *Addiction* 111, 1246–1256.
- Werb, D., 2013. *Injection Career Trajectories Among Illicit Drug Users in Vancouver, Canada*. University of British Columbia <http://dx.doi.org/10.14288/1.0103375>.