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Identification of a syndemic of blood-borne disease transmission and injection drug use initiation at the US-Mexico border

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Abstract

Background: Efforts to prevent injection drug use (IDU) are increasingly focused on the role that people who inject drugs (PWID) play in the assistance with injection initiation. We studied the association between recent (i.e., past 6 months) injection-related HIV risk behaviors and injection initiation assistance into IDU among PWID in the U.S.-Mexico border region.

Setting: *Preventing Injecting by Modifying Existing Responses* (PRIMER) is a multi-cohort study assessing social and structural factors related to injection initiation assistance. This analysis included data collected since 2014 from two participating cohorts in San Diego and Tijuana.

Methods: Participants were 18 years old and reported IDU within the month prior to study enrolment. Logistic regression analyses were conducted to assess the association between recent injection-related HIV risk behaviors (e.g., distributive/receptive syringe sharing, dividing drugs in a syringe, paraphernalia sharing) and recent injection initiation assistance.

Results: Among 892 participants, 41 (4.6%) reported recently providing injection initiation assistance. In multivariable analysis adjusting for potential confounders, reporting a higher number of injection-related risk behaviors was associated with an increased odds of recently assisting

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All authors had full access to all data and have read and approved the text as submitted to JAIDS. CR drafted the manuscript, SJ and SS performed methodological analyses. DW, LRS, CMR, JCM, RSG, and SAS contributed to manuscript revisions.

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others with injection initiation (Adjusted Odds Ratio per risk behavior: 1.3; 95% Confidence Interval: 1.0–1.6, $p=0.04$).

Conclusion: PWID who recently engaged in one or more injection-related HIV risk behavior were more likely to assist others in injection initiation. These results stress the syndemic of injection initiation and risk behaviors, which indicates that prevention of injection-related HIV risk behaviors might also reduce the incidence of injection initiation.

Keywords

injection initiation assistance; people who inject drugs; injection risk behaviors; Mexico-United States; HIV prevention

INTRODUCTION

San Diego, California, the 8th largest city in the U.S.,¹ is located at the western edge of the U.S.-Mexico border and is home to a large mobile population of people who inject drugs (PWID). Tijuana, Baja California, is the 5th largest Mexican city,² is contiguous with San Diego, California, and the most recent estimate from the Mexican National Center for HIV/AIDS Prevention and Control suggests that approximately 10,000 PWID reside there.³ Factors, such as injection practices, influencing the risk of acquiring and transmitting blood-borne infections among PWID in both cities have been identified. One recent study found that more than half of PWID in the San Diego-Tijuana region had recently engaged in HIV injection risk behaviors, and that current co-injection of methamphetamine and heroin was significantly associated with injection risk behaviors compared to co-injection of heroin or methamphetamine by itself (i.e., goofballs).⁴ Further, this binational region has been identified as a high-risk area where the transmission of blood-borne infections, namely HIV and hepatitis C virus (HCV), cluster synergistically with a range of other injection-related harms,^{5,6} cultivating a syndemic of excess disease burden among PWID in this region.⁷ This is due largely to the fact that the San Diego-Tijuana border region is a key node along a trans-continental drug trafficking route stretching from the Andean region in South America to the United States and Canada.⁸

While HIV prevalence among PWID appears to be similar in San Diego (7%)⁹ and Tijuana (4%),¹⁰ HCV prevalence substantially differs, ranging from 27% to 51% in San Diego,¹¹ and approximately 96% in Tijuana.¹² Of note, there is also evidence of current bidirectional cross-border HIV transmissions among risk groups, including PWID,¹³ along with cross-border population mixing of PWID. In a study undertaken among PWID in Tijuana, we found that injection initiation assistance was independently associated with reporting living in the U.S. for 1–5 years, compared to no history of migration to the US.¹⁴ We also previously reported on an association between recent distributive syringe sharing (i.e., passing on a used syringe or needle to another PWID) among San Diego-based PWID and engaging in cross-border injection drug use (IDU) in Mexico.¹⁵ While the social norms protective against IDU are comparatively weaker in the US,¹⁶ Tijuana's close proximity to San Diego, along with the migration of PWID from other parts of Mexico and deportees returning from the US, have contributed to the expansion of the PWID population.¹⁵ In the case of PWID in San Diego, the city's high-volume border crossing and status as a transit

point for drug trafficking also increases the availability of drugs commonly used by injection.^{5,15} As such, research seeking to characterize and respond to injection-related blood-borne disease transmission in this setting are increasingly considering the San Diego-Tijuana international metropolitan region as a single ‘risk environment’.¹⁷ Within this risk environment, the border heightens the syndemic of injection-related health and social harms among PWID, and complicates efforts to effectively respond to these harms.

Given the intersecting epidemics of IDU, injection-related social harms, and blood-borne infectious disease concentrated among PWID in this region, we approach our understanding of factors contributing to injection initiation from a Syndemics framework.¹⁸ A Syndemic is defined as a set of linked health problems involving two or more afflictions, interacting synergistically, which contribute to excess burden of disease in a population.⁷ In this context, the incidence of IDU initiation is increasingly understood as a socially communicable phenomenon that has its roots in the exposure to- and sharing of injection practices by established PWID with injection-naïve individuals.¹⁹ Given the high prevalence of injection-related risk behaviors among PWID in the San Diego-Tijuana region, determining their linkages with reports of injection initiation assistance provision may therefore provide unique insight into the syndemic of disease transmission risk and IDU initiation. Advancing our understanding of how injection-related disease transmission behaviors and IDU initiation intersect within populations of PWID is of critical public health relevance given data demonstrating the risk of blood-borne infections is higher within the first year of an individual’s injection initiation event.²⁰ We therefore aim to study the association between recent (i.e., past 6 months) injection-related risk behaviors and injection initiation assistance among a binational sample of PWID.

METHODS

Sample and procedures

This analysis was undertaken as part of the *Preventing Injection by Modifying Existing Responses* (PRIMER) study, a longitudinal multi-site study seeking to investigate social, structural and biomedical factors associated with IDU initiation via pooled analyses of data from existing cohort study mechanisms. The methods and rationale for this study have previously been described in full.²¹ The present analysis included data from two cohorts participating in the PRIMER study. Specifically, beginning in 2011, PWID in Tijuana, Baja California, Mexico and San Diego, California, U.S.A. were enrolled in two complementary prospective cohort studies (*Proyecto El Cuete IV* [ECIV] and Study of Tuberculosis, AIDS, and Hepatitis C Risk [STAHHR-II] respectively) that included interviewer-administered surveys at baseline and semi-annually for two years. A full description of both cohort methodologies is available elsewhere.²² Recruitment for both cohorts involved direct street- and venue-based outreach, and inclusion criteria were: being 18 years or older, having injected drugs in the past month, speaking English or Spanish, currently living in Tijuana or San Diego respectively, with no plans to move, and not currently participating in an intervention study. Data were collected during face-to-face interviews using computer assisted personal interview (CAPI) technology. The ECIV, STAHHR-II and PRIMER study protocols were approved by the Human Research Protections Program of the University of

California, San Diego. The ECIV study protocol was also approved by the Ethics Board at El Colegio de la Frontera Norte (Tijuana, Mexico).

Measures

As part of the PRIMER study, survey items soliciting data on participants' history of assistance with injection initiation were introduced in visit 7 of ECIV and the 24-month follow-up visit in STAHR II (i.e., beginning in September 2014). The outcome was defined as reporting having assisted someone to initiate IDU in the past 6 months. Items for both survey questionnaires also included a range of items related to sociodemographic characteristics, housing, drug use, and other behaviors. The primary independent variable of interest was defined as reporting one or more of four distinct injection risk behaviors: 1) distributive syringe sharing, 2) receptive syringe sharing (i.e., using a syringe that someone else has used first), 3) sharing a dose in a syringe (known as 'backloading'), and 4) sharing injection paraphernalia (i.e., water, cooker, and cotton). These four risk behaviors have previously shown to be associated with increased blood-borne disease transmission risk.^{23,24} Additional covariables of interest considered as potential confounders and included in the current study were: age, gender (woman, man), housing status (defined as living in a house or apartment owned by participants, their parents, friends, or partner vs. other), and injection frequency. All behavioral questions referred to the 6-month period prior to interview.

Statistical analyses

The present analysis was undertaken using data from the PRIMER baseline (i.e., ECIV visit 7; STAHR II 24-month follow-up visit). Descriptive statistics were calculated using data for each cohort separately first and then in combination. Cross-tabulations and Fisher's exact test evaluated univariate associations between reporting recent injection initiation assistance and potential risk factors among the combined sample. Injection risk behavior variables were highly correlated (ranging from $r = 0.83$ between distributive and backloading to $r = 0.91$ between distributive and receptive syringe use); therefore, we calculated the sum of injection risk behaviors on a scale of 0–4, corresponding to the number of risk behaviors that participants reported engaging in. This approach is adapted from previous work investigating the impact of multiple psychiatric comorbidities on suicide risk.²⁵ This summative approach further reflects the cumulative syndemic burden of injection risk behaviors among PWID on injection initiation events.²⁶ We tested for gender differences by injection risk behaviors (Supplementary Table 1). Multivariable logistic regression models were used to assess the association between the sum of recent injection risk behaviors and recent injection initiation provision. We employed a protocol whereby participant cohort, age, and gender were included *a priori* while other factors were included based on statistical significance in univariate analysis at a threshold of $p < 0.05$. We restricted the logistic regression analyses to PWID reporting having injected at least once in the past 6-months. We also performed independent multivariable models by gender (Supplementary Table 2). Statistical analyses were performed in R version 3.3.2. No adjustments were made for multiple comparisons.

RESULTS

A total sample of 892 participants enrolled in the San Diego ($n = 358$, 40.1%) and Tijuana ($n = 534$, 59.9%) cohorts completed the PRIMER baseline. Table 1 presents sociodemographic characteristics by cohort study. Overall, 41 (4.6%) participants reported assistance with injection initiation in the past 6 months; 23 (4.3%) in Tijuana and 18 (5.1%) in San Diego ($p = 0.63$). Compared to the Tijuana cohort, participants in the STAHR II (San Diego) cohort were significantly older (median age = 49, interquartile range [IQR] = 38.0–55.0 years old vs. median age = 40.4, IQR = 34.7–46.9 years old, $p < 0.001$), and were comprised of more male participants (70.5% vs. 61.6%, $p = 0.006$). In the past 6 months, San Diego participants reported lower levels of stable housing (51.4% vs. 61.8%, $p = 0.002$), a lower proportion of daily injection (31.6% vs. 75.7%, $p < 0.001$), engaging in higher levels of syringe sharing risk behaviors (64.4% vs. 52.5, $p < 0.001$), including distributive (50.2% vs. 30.1%, $p < 0.001$), receptive (48.3% vs. 33.9%, $p < 0.001$), backloading (53.1% vs. 32.8%, $p < 0.001$), and sharing of injecting paraphernalia (58.2% vs. 42.0%, $p < 0.001$). Despite having higher rates of individual syringe sharing risk behaviors, STAHR II participants, reported significantly fewer cumulative (sum) syringe risk behaviors compared with ECIV participants (median injection risk behaviors: 1 vs. 2, $p < 0.001$).

The subsequent analyses were performed with the participants that reported IDU in the past 6 months ($n=690$). Table 2 presents univariate associations between reporting having assisted someone into IDU in the past 6 months and variables assessing socio-demographic factors and injection-related risk behaviors. A significantly larger proportion of men compared to women reported recently assisting others with their injection initiation (6.7% vs. 2.9%, $p = 0.049$). There were no significant differences with respect to the level of stable housing (4.0% vs. 7.3%, $p = 0.060$) or median age (41.7, Interquartile Range [IQR] = 36.6–50.6 vs. 42.6, IQR = 35.0–50.2, $p = 0.968$) between those participants that did and did not report providing injection initiation assistance.

With respect to drug-related behaviors, there was no significant difference in the proportion of those who reported recently assisting with injection initiation with respect to recent injection frequency (i.e., less than daily 5.2% vs. daily = 5.4%, $p > 0.999$), levels of distributive syringe sharing (6.2% vs. 4.5%, $p = 0.399$), engagement in receptive syringe sharing (6.8% vs. 3.9%; $p = 0.127$), or backloading (6.6% vs. 3.9%; $p = 0.129$). In contrast, those who reported sharing injecting paraphernalia also reported significantly higher levels of injection initiation assistance compared with those who did not (6.8% vs. 2.8%; $p = 0.023$). The median sum of injection risk behaviors of participants reporting assisting others into injection was 3 (IQR = 2–4) compared with 2 (IQR = 0–4) among those who did not assist others into injection initiation ($p = 0.057$).

Finally, in multivariable logistic regression (Table 3), for each additional cumulative (sum) injection risk behavior, participants were 1.3 times more likely to provide injection initiation assistance (Adjusted Odds Ratio per risk behavior increase [AOR] = 1.3; 95% Confidence Intervals [CI] = 1.0–1.6). This means compared to PWID with no injection risk behaviors, those reporting all four injection risk behaviors at baseline were 5.2 times more likely to

have initiated others into IDU in the past 6 months. We detected no significant differences in the odds of providing injection initiation assistance by cohort, age, and gender.

DISCUSSION

Overall, 4.6% of a binational sample of PWID in the San Diego-Tijuana border region reported assisting with injection initiation in the past 6 months; and 60% reported recently engaging in at least one injection-related HIV risk behavior. Further, in a multivariable model, each additional injection risk behavior reported by participants was associated with an approximately 30% increase in the odds of injection initiation assistance, demonstrating that greater syndemic burden of cumulative injection risk behaviors is a significant risk factor for injection initiation. These findings have implications for the prevention of syndemic of injection-driven disease transmission.

This is, to our knowledge, the first study to identify an association between engaging in HIV injection risk behaviors and injection initiation assistance among established PWID. Of concern, over half of participants that reported providing injection initiation assistance also reported distributive syringe sharing (58.0%). This implies that recent IDU initiates in our setting are at high risk of HIV and HCV acquisition: first, the risk of being initiated with a used syringe has been shown to dramatically increase the risk of blood-borne infection;²⁷ second, these results imply the possibility of the dissemination of high-risk injection practices to recently-initiated PWID, who may then disseminate these practices to others, thereby establishing high-risk injecting behavioral norms. We note, however, the potential for bi-directional disease transmission may exist among established PWID and potential initiate dyads via sexual transmission, as previous studies in Tijuana have established that HIV-seropositivity among PWID is associated with syphilis,²⁸ implying that HIV transmission may be spread via both injection risk behaviors and unprotected sex. Regardless of the route of transmission risk, these may suggest that initiator-initiate relationships may act as key nodes in the expansion of epidemics of HIV and HCV via multiple transmission routes.

Unlike others,²⁹ and reports of providing injection initiation assistance or engaging in injection risk behaviors. However, it is possible that in the context of the San Diego-Tijuana border, a region that experiences intense stigma around providing injection initiation assistance,³⁰ as well as stigma surrounding HIV risk behaviors among women involved in the region's large sex work scene,³¹ such behaviors may be underreported among women. However, we do recognize the need to further identify the mechanisms associated with gender dynamics, substance use and HIV.³²

These results have specific implications for efforts to prevent syndemic of IDU and blood-borne disease transmission. Findings suggest the need for interventions to address the pooling of 'classic' injection risk behaviors—i.e., those that increase the risk of disease acquisition or transmission—and the sharing of IDU practices, which appears to be a necessary but not sufficient risk factor for the incidence of IDU initiation among vulnerable drug-using populations. In line with others, we note that interventions are needed not only to prevent injection initiation,³³ but that such interventions should also incorporate harm

reduction approaches for established PWID (i.e., sufficiently resourced syringe exchanges to reduce syringe injection risk practices), as well as recent IDU initiates to educate them regarding safer injection techniques to prevent vein damage and transmission of blood-borne infections. One such example is an intervention pioneered by Small and colleagues, in which ‘hit doctors’ (i.e., PWID who provide injection assistance to others for a fee) are trained to perform outreach in street-based drug scenes to provide safer injecting education for vulnerable PWID.³⁴ Adaptation of this model should be explored in other settings for PWID at risk of assisting others with injection initiation. By targeting factors contributing to established injectors assisting others with their injection initiation (i.e., social transmission of syringe risk behaviors) we may effectively disrupt the expansion of syndemic of IDU and transmission of blood-borne infections. There is, however, need for more research regarding the relationship between the people PWID that assist others into drug injecting and the people that begin injecting drugs. These interventions are especially pertinent in settings such as the Mexico-US border, where no Pre-Exposure Prophylaxis (PrEP) or Highly Active AntiRetroviral Therapy (HAART) programs tailored for PWID are currently in place.³⁵

These findings stress the unique risks related to IDU experienced by PWID on both sides of the San Diego-Tijuana border. The risks are influenced by the geopolitical separation imposed by the border, the region’s high volume deportation and migration flows,³⁶ and the border region’s status as a key drug trafficking hub.³⁷ As such, we analyzed the US-Mexico border region using data from comparable cohorts of PWID across the entirety of this international metropolitan region. The lack of a significant difference in the odds of recent injection initiation assistance provision among participants across both cohorts suggests initial validation of this approach. Additionally, we did not find a significant difference in recent injection initiation by cohort, which is in line with findings by Mehta and colleagues suggesting that HIV clusters straddle the San Diego- Tijuana region.¹³

This study has several limitations. First, given its cross-sectional nature, we cannot assume a causal relationship between injection risk behaviors and the provision of injection initiation assistance. Second, as a result of the construction of a composite variable we may have reduced our capacity to detect the individual contributions of specific risk behaviors on injection initiation risk. However, given that the risk behaviors were highly correlated, the composite variable provides a more grounded analysis than addressing each risk individually. Third, we were not able to determine whether PWID who engaged in injection risk behaviors did so with IDU initiates. Qualitative research is therefore needed to explore injection risk behavior engagement and transmission among established PWID and recent IDU initiates. Fourth, survey data did not allow for further exploration of the context of injection initiation assistance. However, previous qualitative research has found that injection initiation is both solicited by injection-naïve persons and offered by established PWID.^{30,38} Fifth, this analysis is based on self-reports and as such, we cannot assume unbiased reporting. In particular, it is probable that participants underreported injection initiation assistance provision given that it is a highly stigmatized behavior³⁹ associated with shame and guilt.⁴⁰ However, both of our field teams have years of experience working with the San Diego-Tijuana PWID population. We expect this may have increased response frequencies among PWID for survey items related to this sensitive topic. Finally, future

research should focus on the type of relationships between PWID that assist others with drug injection and injection naïve people.

In sum, PWID's reports of recently assisting with injection initiation increased as the number of reported HIV-associated injecting risk behaviors increased. Given the lack of health services tailored for PWID in this setting, preventive interventions should therefore include injection education for both recent initiates and initiators to reduce the dissemination of high-risk HIV injection behaviors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Sociodemographic characteristics and injection risk behaviors stratified by cohort study among PWID in San Diego and Tijuana, 2014 (n=892).

	Tijuana n=534		San Diego n=358		Total n=892		p- value
	n/median	%/IQR	n/median	%/IQR	n/median	%/IQR	
Injection initiation assistance **							
No	511	95.69	335	94.9	846	95.38	0.625
Yes	23	4.31	18	5.1	41	4.62	
Age (median/IQR)	40.42	34.74–46.93	49	38.00–55.00	42.94	35.48–51.00	<0.001
Sex							
Women *	205	38.39	105	29.49	310	34.83	0.006
Men	329	61.61	251	70.51	580	65.17	
Housing **							
Other	204	38.2	174	48.60	378	42.38	0.002
Stable	330	61.8	184	51.4	514	57.62	
Injection frequency **							
None	92	17.23	109	30.45	201	22.53	<0.001
Less than daily	38	7.12	136	37.99	174	19.51	
Daily	404	75.66	113	31.56	517	57.96	
Lifetime injection initiation assistance							
No	456	85.71	219	62.04	675	76.27	<0.001
Yes	76	14.29	134	37.99	210	23.73	
Any syringe sharing risk behaviors **							
No	190	35.58	170	47.49	360	40.36	<0.001
Yes	344	64.42	188	52.51	532	59.64	
Distributive syringe use **							
No	260	49.81	249	69.94	509	57.97	<0.001
Yes	262	50.19	107	30.06	369	42.03	
Receptive syringe sharing **							
No	270	51.72	222	66.07	492	57.34	<0.001
Yes	252	48.28	114	33.93	366	42.66	
Divide up drugs with someone in a syringe **							
No	245	46.93	240	67.23	485	55.18	<0.001
Yes	277	53.07	117	32.77	394	44.82	
Share injecting paraphernalia **							
No	218	41.76	207	57.98	425	48.35	<0.001
Yes	304	58.24	150	42.02	454	51.65	
Count of syringe sharing risk behaviors **							
0	190	35.58	170	47.49	360	40.36	<0.001

	Tijuana n=534		San Diego n=358		Total n=892		p- value
	n/median	%/IQR	n/median	%/IQR	n/median	%/IQR	
1	49	9.18	45	12.57	94	10.54	
2	41	7.68	44	12.29	85	9.53	
3	52	9.74	41	11.45	93	10.43	
4	202	37.83	58	16.2	260	29.15	
Count of syringe sharing risk behaviors (continuous) **	2	0–4	1	0–3	1	0–4	<0.001

Note: PWID: people who inject drugs;

IQR: interquartile range;

Significant values at $p < 0.05$ bolded;

* includes transgender women;

** past 6-months behaviors.

Table 2.

Injection risk behaviors among those that injected drugs by past 6 months injection initiation assistance in San Diego and Tijuana. PRIMER/STAHN II & El Cuete IV (n=690).

	No n=653		Yes n=37		p- value
	n/median	%/IQR	n/median	%/IQR	
Age	42.62	35.01–50.18	41.74	36.61–50.63	0.968
Sex					
Women *	231	97.06	7	2.94	0.049
Men	420	93.33	30	6.67	
Cohort					
Tijuana	422	95.48	20	4.52	0.218
San Diego	231	93.15	17	6.85	
Housing **					
Other	265	92.66	21	7.34	0.060
Stable	388	96.04	16	3.96	
Injection frequency **					
Less than daily	164	94.80	9	5.20	>0.999
Daily	489	94.58	28	5.42	
Any syringe sharing risk behaviors **					
No	170	96.59	6	3.41	0.244
Yes	483	93.97	31	6.03	
Distributive syringe use **					
No	317	95.48	15	4.52	0.399
Yes	335	93.84	22	6.16	
Receptive syringe sharing **					
No	320	96.10	13	3.90	0.127
Yes	330	93.22	24	6.78	
Divide up drugs with someone in a syringe **					
No	297	96.12	12	3.88	0.129
Yes	356	93.44	25	6.56	
Share injecting paraphernalia **					
No	244	97.21	7	2.79	0.023
Yes	409	93.17	30	6.83	
Count of syringe sharing risk behaviors **					
0	170	96.59	6	3.41	0.243
1	89	97.80	2	2.20	
2	75	92.59	6	7.41	
3	85	94.44	5	5.56	
4	234	92.86	18	7.14	

	No n=653		Yes n=37		p- value
	n/median	%/IQR	n/median	%/IQR	
Count of syringe sharing risk behaviors (continuous) **	2	0–4	3	2–4	0.057

IQR: interquartile range;

Significant values at $p < 0.05$ bolded;

* includes transgender women;

** past 6-months behaviors.

Table 3.

Multivariable logistic regression to assess risk factors associated with injection initiation assistance in the past 6-months in San Diego and Tijuana. PRIMER/STAHN II & El Cuete IV (n=886).

	AOR	CI 95%		p- value
Cohort				
Tijuana	1.00			
San Diego	1.69	0.83	3.44	0.143
Age	1.00	0.96	1.03	0.809
Sex				
Woman	1.00			
Men	2.27	0.97	5.32	0.060
Syringe risk count *	1.27	1.01	1.59	0.042

AOR: Adjusted Odds Ratio;

CI 95%: Confidence Intervals 95%;

Significant values at $p < 0.05$ bolded;

* Reference group: zero.