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## Cross-border drug injection relationships among injection drug users in Tijuana, Mexico

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### Abstract

**Background**—International borders are unique social and environmental contexts characterized by high levels of mobility. Among drug users, mobility increases risk for human immunodeficiency virus (HIV) in part through its effects on the social environment. However, the social dynamics of drug users living in border regions are understudied.

**Methods**—1056 injection drug users (IDUs) residing in Tijuana, Mexico were recruited using respondent-driven sampling (RDS) from 2006 to 2007, and underwent surveys and testing for HIV, syphilis, and tuberculosis (TB). Using logistic regression on baseline data, we identified correlates of having ever injected drugs with someone from the US.

**Results**—Almost half (48%) reported ever injecting drugs with someone from the US. In RDS-adjusted logistic regression, factors independently associated with having ever injected with someone from the US included: having greater than middle school education (Adjusted Odds Ratio [AOR] 2.91; 95% Confidence Interval [C.I.] 1.52, 5.91), speaking English (AOR 3.24, 95% C.I. 1.96, 5.36), age (AOR 1.10 per year; 95% C.I. 1.07, 1.14), age at initiation of injection drug use (AOR 0.90 per year; 95% C.I. 0.86, 0.94), homelessness (AOR 2.61; 95% C.I. 1.27, 5.39), and having ever been incarcerated (AOR 11.82; 95% C.I., 5.22, 26.77). No associations with HIV, syphilis, TB, drug use, or injection risk behavior were detected.

**Conclusion**—Findings suggest that IDU networks in Mexico and the US may transcend international borders, with implications for cross-border transmission of infectious disease. Binational programs and policies need to consider the structure and geographic distribution of drug using networks.

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## Keywords

HIV; injection drug use; Mexico; social networks; sexually transmitted infections; tuberculosis

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## 1. Introduction

International borders have captured the attention of public health researchers as mounting evidence suggests that they represent a unique “risk environment” (Rhodes, 2002) where policy, geography, culture, social norms, and disease interact to contribute to health risks. The neighboring cities of San Diego, California, USA and Tijuana, Baja California, Mexico form an extensive urban metropolis situated on one of the busiest land border crossings in the world; US officials estimated that approximately 13 million northbound vehicle crossings occurred in 2008 alone (U.S. Department of Transportation, 2008). The border crossing at San Ysidro, which separates San Diego from Tijuana, is also located on one of North America’s largest drug trafficking routes (Bucardo et al., 2005). “Spillover” from drug shipments along such routes can result in increased drug availability in local communities (Rachlis et al., 2007).

Tijuana has one of the highest rates of illicit drug use in Mexico. Surveys estimate there are approximately 10,000 injection drug users (IDUs) in Tijuana (Consejo Nacional contra las Adicciones, 2009). Northern Mexico is experiencing an evolving human immunodeficiency virus (HIV) epidemic, particularly among vulnerable groups such as IDUs (Strathdee and Magis-Rodriguez, 2008), who are also at high risk for tuberculosis (TB; Garfein et al., 2010; Garfein et al., 2009) and sexually transmitted infections (STIs) such as syphilis (Loza et al., 2010). As such, there is a critical need to understand the social and environmental factors that influence risk for HIV, STIs and TB at the US/Mexico border.

One factor that can influence infectious disease transmission in border regions is cross-border mobility (Apostolopoulos and Sonmez, 2007). Among IDUs, most research suggests that mobility can increase risk for HIV and other infectious diseases (Paschane and Fisher, 2000; Rachlis et al., 2007; Soskolne, 2007). This elevated risk is due in part to mobility-induced disruption of both the physical and social environment (Soskolne, 2007). Mobile individuals enter into new communities and form relationships with new individuals, while existing protective social resources may break down or become unavailable. Such changes in social network structure and composition can influence risk behavior; for example, immigration of new drug users into a network has been associated with increased injection risk behavior (Costenbader et al., 2006; Hoffmann et al., 1997). Mobility can also introduce individuals into networks that may have different norms about risk behavior or access to resources (Soskolne and Shtarkshall, 2002; Wohlfeiler, 2000).

Previous studies by our group and others suggest that Mexican IDUs in the border region are highly mobile (Brouwer et al., 2009; Rachlis et al., 2007; Strathdee et al., 2008a). More than three-quarters of a sample of IDUs residing in Tijuana, Mexico reported having ever traveled to the US (Brouwer et al., 2008). Because it is unlikely that IDUs stop injection drug use when they travel, the potential exists for Mexican IDUs to meet and interact with IDUs from the US. However, little is known about the extent to which Mexican IDUs interact with IDUs from the US, or whether there are unique characteristics of IDUs who have cross-border relationships with other IDUs. In the social and environmental context of an international border, interaction among IDU networks could contribute to the transmission of HIV, STIs or TB within and between countries (Apostolopoulos and Sonmez, 2007), suggesting that there is a need for intervention strategies tailored to this unique physical and social environment. We investigated correlates of having ever injected

with someone from the US among a sample of IDUs residing in Tijuana, Mexico. This analysis was undertaken to answer two primary research questions: 1) do IDUs from Tijuana, Mexico interact with IDUs from the US?, and 2) what are the sociodemographic and behavioral correlates of injecting with US-based IDUs?

## 2. Methods

### 2.1 Participants and recruitment

Data for this study were collected as part of a longitudinal study of behavioral and contextual factors associated with HIV, syphilis, and TB infection in a cohort of IDUs in Tijuana, Baja California, Mexico from 2006 to 2007 (Strathdee et al., 2008b). Eligibility criteria included: being  $\geq 18$  years old; having injected illegal drugs in the past month; ability to speak English or Spanish and provide written informed consent; and having no plans to permanently move out of Tijuana in the next 18 months (to allow for prospective follow-up).

Participants (n=1056) were recruited by indigenous outreach workers using respondent-driven sampling (RDS), a technique that has been employed elsewhere to sample “hidden populations” such as IDUs (Abdul-Quader et al., 2006; Heckathorn, 1997). Using this method, a diverse group of IDU “seeds” (heterogenous by age, gender and neighborhood) were selected and given coupons that they used to refer their peers to the study.

### 2.2 Measures

All data for this analysis were collected in the initial baseline assessment. Data were collected via an interviewer-administered survey, which elicited information on sociodemographic characteristics, drug use behavior, and social and mobility-associated characteristics. Demographic questions included: race/ethnicity, education (coded as less than middle school vs. middle school or more), ability to speak English, age, age at first injection, sex, homelessness (defined as sleeping in a car, abandoned building, shelter, shooting gallery, or on the streets), and lifetime history of incarceration.

Biological specimens were collected to test for HIV, syphilis, and TB infection. HIV antibody status was assessed using the “Determine”<sup>®</sup> rapid HIV antibody test (Abbott Pharmaceuticals, Boston, MA). Reactive samples were confirmed using an HIV-1 enzyme immunoassay and immunofluorescence assay. Syphilis serology used the rapid plasma reagin (RPR) test (Macro-Vuew; Becton Dickinson, Cockeysville, MD). RPR-positive samples were subjected to confirmatory testing using the *Treponema pallidum* particle agglutination assay (TPPA; Fujirebio, Wilmington, DE). Syphilis titers of  $\geq 1:8$  were considered consistent with active infection. TB infection was detected using the QuantiFERON TB Gold In-Tube assay ([QFT], Cellestis Ltd., Carnegie, Australia) according to the manufacturer’s instructions (Cellestis, 2007). Participants testing positive were referred to the Tijuana municipal health clinic for free care.

Drug use variables included frequency of lending or borrowing syringes in the past six months (coded on a 4-point Likert-type scale from “never” to “always”), frequency of injection, social context of injection (injecting with other people), and drug most frequently injected in the past six months. Social and mobility-associated characteristics included country of birth, duration of time lived in Tijuana, having been deported from the US to Tijuana, the number of people known by the participant who travel to the US at least once a year, having traveled to the US in one’s lifetime and in the past year, whether the index socialized with people who use drugs when s/he travels to the US, and having ever used drugs in the US. All study procedures were approved by the Institutional Review Boards of the University of California San Diego and Tijuana General Hospital.

## 2.3 Analysis

The dependent variable was a dichotomous variable indicating whether or not participants had ever injected drugs with someone from the US. Descriptive frequencies were generated for all independent variables of interest. First, we conducted descriptive analyses to understand the social and mobility-associated characteristics of the sample. Because many of the social and mobility-associated characteristics were highly correlated with each other and with the dependent variable, we did not include them in the regression models and instead present the descriptive findings separately to provide context for the regression results. Second, we performed univariable and multivariable logistic regressions to identify demographic and drug use characteristics associated with having ever injected with someone from the US. Independent variables associated with the dependent variable at  $p < 0.10$  in the univariable models were considered for inclusion in the multivariable model. The final model retains only those factors significantly associated with the dependent variable at  $p < 0.05$ .

The RDS sampling method may result in biased estimates due to differential recruitment effectiveness or recruitment patterns, and differences between groups with respect to network characteristics such as network size (Heckathorn, 2007). To correct for these potential biases, we adjusted our logistic regression models using inverse probability weights, based on individual recruitment weights (Abramovitz et al., 2009). The weights include a factor to control for respondent's heterogeneity of degree, derived via the RDS Analytical Tool (Volz et al., 2007). To account for correlations between recruiter and recruitee, we created a variable indicating who the recruiter of each index subject was, and used this variable as a cluster variable in the GEE algorithm. An exchangeable correlation structure within each cluster was assumed.

## 3. Results

Of the 1056 participants, almost half (48%) reported having ever injected with someone from the US. Almost all participants ( $n=1032$ , 98%) were born in Mexico. Social and mobility-associated characteristics of the participants are presented in Table 1. Not surprisingly, those who had ever injected with someone from the US were significantly more likely to report lifetime travel to the US. Those who had injected with someone from the US were more likely to report socializing with drug users when they travel to the US and were significantly more likely to have used drugs in the US. Finally, those who had ever injected with someone from the US were more likely to cite being deported from the US as the reason they moved to Tijuana.

In terms of demographic characteristics (Table 2), participants who injected with someone from the US were more likely to have completed at least middle school, were more likely to speak English, were older, started injecting at a younger age, were more likely to be male, and were less likely to report living in Tijuana their whole life. Participants who had ever injected with someone from the US were also more likely to have ever been incarcerated. Just over 4% of the sample was HIV antibody seropositive, with those who had injected with someone from the US being less likely to be HIV seropositive. There were no significant differences in syphilis or TB status.

In terms of drug use and injection risk behavior, almost all participants reported injecting at least once per day and most reported usually injecting with other people. Receptive and distributive syringe sharing were both reported by more than half of the sample. Slightly more than half reported injecting heroin most frequently in the past 6 months, while just over one-third reported injecting a mix of heroin and methamphetamine. None of the differences in drug use or injection risk behavior achieved statistical significance.

In RDS-adjusted multivariable logistic regression (Table 3), factors independently associated with having injected with someone from the US included: having greater than middle school education (Adjusted Odds Ratio [AOR] 2.91; 95% Confidence Interval [C.I.] 1.52, 5.91), speaking English (AOR 3.24, 95% C.I. 1.96, 5.36), older age (AOR 1.10 per year; 95% C.I. 1.07, 1.14), younger age at initiation of injection drug use (AOR 0.90 per year; 95% C.I. 0.86, 0.94), being homeless (AOR 2.61; 95% C.I. 1.27, 5.39), and having ever been in jail, prison, or adult detention (AOR 11.82; 95% C.I., 5.22, 26.77). None of the drug use or injection risk behavior variables were significantly associated with the dependent variable in multivariable analyses, nor were HIV, syphilis, or TB status.

#### 4. Discussion

In this sample of IDUs residing in Tijuana, almost half had ever injected with someone from the US. An examination of social and mobility-associated characteristics shows that these individuals may have considerable opportunities for meeting and socializing with US-based IDUs – most had traveled to the US in their lifetime and 7% had traveled to the US in the past year. Most also reported using drugs in the US, and more than half said that they socialized with other drug users while in the US. Qualitative interviews with injection drug using male deportees in Tijuana suggest that some male migrants initiated drug use while in the US, often with friends and/or female sexual partners (Ojeda et al., in press).

Tijuana-based IDUs who had injected with someone from the US were older, more established in their drug using careers, had completed more schooling, and were more likely to speak English. These findings suggest that Tijuana-based IDUs who have injected with US-based IDUs may be more familiar with the US culture, including the drug scene, and are more equipped to operate in a binational context. One of the strongest correlates of injecting with someone from the US was reporting a lifetime history of being in jail, prison, or adult detention. Though more research will be required to understand the location and temporality of these events, it is possible that IDUs in this sample interacted with other drug users while incarcerated or detained in the US. Importantly, more than half of those who had injected with someone from the US reported having been deported from the US. History of deportation has been associated with a host of health risks in this population, including less interaction with public health services (Brouwer et al., 2009) and elevated odds of HIV infection among men (Strathdee et al., 2008a). The complex relationships between seeking economic opportunity, initiation of drug use in the US, incarceration, deportation, and escalating drug use after deportation (Ojeda et al., in press) and their implications for health risks in this population warrant further investigation and intervention efforts.

Almost all participants reported injecting drugs at least daily, and most reported injecting with other people. More than half of the sample reported using previously used syringes and/or passing on their used syringes to other IDUs in the past 6 months, but rates of distributive and receptive syringe sharing did not differ across groups. Individuals who had injected with someone from the US were no more likely to test HIV antibody seropositive, to have markers of active syphilis infection, or to have been infected with TB after adjusting for other factors in the multivariable regression.

While injection risk behaviors did not differ between groups in this study, some evidence suggests that injection risk behavior may increase in the period immediately after migration (Ojeda et al., in press; Paschane and Fisher, 2000) and recent migrants may engage in riskier injection practices including sharing injection equipment and injecting in public places (Freeman et al., 1999). Therefore, it is possible that the frequency of syringe sharing reported over the past six months does not reflect those events most closely related to their migration experiences. Migration (whether voluntary or involuntary) has the potential to

disrupt social networks, including introducing individuals into new social networks that have different disease prevalence and different social norms regarding injection and prevention practices (Rachlis et al., 2007). Further, recent migrants are likely to be unfamiliar with prevention resources, such as sources of injection supplies.

While these data provide some evidence that there is drug use-related interaction between US- and Mexico-based IDUs, data regarding some aspects of the social interaction were unavailable to include in this analysis. First, it is unknown whether the injection events with people from the US occurred in the US or in Mexico. That is, the social and physical setting where US- and Mexico-based IDUs interact is unknown. The location of injection events has important implications for risk behavior, since the availability of prevention resources is different in the two settings. For example, syringes are available for purchase without a prescription in pharmacies in Tijuana, but not in San Diego (Pollini et al., 2010). It is also unknown whether the social norms regarding syringe and paraphernalia sharing are similar among IDU networks in Mexico and the US. Future studies to further explore the ecological context of cross-border drug use (both the physical and social setting) will be needed to understand the implications for injection risk behavior in the border region. Second, the timing of the injection events is unknown; data were only available about lifetime injection with someone from the US. More information about the timing and frequency of cross-border injection behavior will be required in order to make timely recommendations that can inform public health policy and interventions. While these findings are suggestive of the existence of cross-border injection relationships, little is known about the mechanisms of relationship formation or of the duration of the relationships. Future social network and/or qualitative research will be required to describe how IDUs from the US and Mexico meet, how they perceive their relationships in terms of their significance or value, and how long such relationships persist.

Our data were based on self-report, and may have been subject to recall bias and socially desirable reporting. The cross-sectional nature of the data precludes our ability to infer order of precedence. Further, data for this analysis were collected in 2006–2007, and certain historical events before and after that period are likely to have affected the frequency of both US- and Mexico-bound border crossing. Events prior to our data collection, such as heightened US border security after the terrorist attacks of September 11, 2001, may in part explain the low frequency of recent (vs. lifetime) travel to the US by Tijuana residents, while new requirements to present citizenship documentation at the border may have reduced Mexico-bound travel by US-based IDUs. Since the data collection period, increased violence and increased media coverage of drug-related violence in the US/Mexico border region may have had the effect of reducing Mexico-bound travel by US-based IDUs.

## 5. Conclusions

In this sample of Tijuana-based IDUs, nearly half reported having ever injected with someone from the US, suggesting that the presence of the geopolitical border may not inhibit social interaction among drug users in the US/Mexico border region. Based on the degree of lifetime mobility reported by this sample, there appears to be considerable opportunity for networks of IDUs in the US and Mexico to interact and to inject drugs together. Rates of injection risk behavior were uniformly high, which is a cause for concern, particularly in light of increasing HIV incidence and the already high prevalence of syphilis and TB among drug users and other vulnerable groups in the region (Garfein et al., 2009; Loza et al., 2010; Strathdee and Magis-Rodriguez, 2008). More work is needed to understand patterns of injection risk behavior in various locations and with different partner types. However, these data suggest that IDU networks along the US/Mexico border may not

be discrete or country-specific, and that effective prevention efforts must consider the binational structural and social environment.

In August 2009, Mexican President Felipe Calderon approved legislation decriminalizing the possession of small amounts of cocaine, heroin, methamphetamine, and marijuana for personal use (Consejo Nacional contra las Adicciones, 2010). In part, the rationale for this law was to re-direct scarce law enforcement resources towards higher-level offenders, while scaling up the availability of opioid-substitution treatment programs and moving towards a harm-reduction approach for drug users (Bustamante Moreno et al., 2010). Enactment of the law is expected to begin in August, 2010, with all Mexican states required to have the infrastructure and procedures in place by August 2012. The effects of this legal reform are not yet known, though one effect may be an increased “pull” for US-based IDUs to travel to Mexico to purchase and use drugs, which could increase the potential for social and drug-related interaction among IDU networks along the US/Mexico border. Research efforts are underway to examine the intended and unintended consequences of this law among IDUs in Mexico. Additional coordinated research efforts, including social network studies to elucidate the social and drug-using relationships among IDUs in border communities, will be needed in order to evaluate the potential effects of this structural change on both sides of the border. Prevention efforts targeted at mobile individuals, particularly outreach to inform mobile IDUs about local prevention resources such as sources of sterile injection supplies and the availability of drug treatment resources, may assist traveling or migrant IDUs in minimizing their injection-related risk behaviors.

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**Table 1**

Social and mobility-associated characteristics of IDUs residing in Tijuana who have and have not injected with someone from the US (N=1056).

	Ever injected with someone from the US		p-value
	Yes (n=504; 48%)	No (n=552; 52%)	
Ever traveled to US	483 (95.8%)	338 (61.2%)	<0.0001
Traveled to US in past year	49 (9.7%)	24 (4.4%)	0.34
Number of people you know who travel to US $\geq$ 1 time/year (median; IQR)	3.5 (0, 10.0)	3.0 (0, 6.0)	0.15
When you travel to US, do you hang out with people who use drugs?	272 (54.0%)	109 (19.8%)	<0.0001
Ever used drugs in the US	481 (95.4%)	128 (23.2%)	<0.0001
Deported from US to Tijuana	265 (52.6%)	148 (26.8%)	<0.0001

P-values obtained from Wald Chi-square from RDS-adjusted analyses.

**Table 2**

Demographic and drug use characteristics of IDUs residing in Tijuana who have and have not injected with someone from the US (N=1056).

	Ever injected with someone from the US		p-value
	Yes (n=504; 48%)	No (n=552; 52%)	
<b>Demographics</b>			
Race:			
Latino/Hispanic	396 (78.6%)	467 (84.6%)	0.26
White	7 (1.4%)	3 (0.54%)	0.99
Black	0	0	--
Indigenous	10 (2.0%)	15 (2.7%)	0.71
Education (middle school vs. less than middle school)	145 (28.8%)	76 (13.8%)	<0.0001
Speak English	335 (66.5%)	175 (31.7%)	<0.0001
Age (median; IQR)	38.7 (33.2, 44.5)	34.6 (29.6, 39.6)	<0.0001
Age at first injection (median; IQR)	19 (16, 23)	21 (17, 28)	<0.0001
Male (n, %)	450 (89.3%)	448 (81.2%)	0.02
Homeless	67 (13.3%)	73 (13.3%)	0.09
Lived in Tijuana for whole life	104 (20.6%)	146 (26.5%)	0.03
Ever been in jail, prison, adult detention	482 (95.6%)	474 (85.9%)	<0.0001
HIV: antibody positive	18 (3.6%)	29 (5.3%)	0.005
Syphilis: antibody titers $\geq$ 1:8	65 (12.9%)	98 (17.8%)	0.39
TB: IGRA positive (n=1020)	304 (62.4%)	377 (70.7%)	0.11
<b>Drug Use &amp; Injection Risk Behavior</b>			
Distributive syringe sharing (past 6 months)	318 (63.1%)	330 (59.8%)	0.78
Receptive syringe sharing (past 6 months)	306 (60.7%)	315 (57.1%)	0.56
Injects at least once per day	422 (85.3%)	428 (80.9%)	0.45
Usually injects with other people (past 6 months)	391 (77.6%)	441 (79.9%)	0.45
Drug most frequently injected (past 6 months)			
Heroin	296 (58.9%)	304 (55.5%)	0.89
Heroin & methamphetamine	186 (37.1%)	230 (42.0%)	0.95

P-values obtained from Wald Chi-square from RDS-adjusted analyses.

**Table 3**

RDS-adjusted Crude and Adjusted Odds Ratios showing factors associated with having ever injected with someone from the US.

	Univariable Models		Multivariable Model (n=1001)	
	Odds Ratio (OR)	95% Confidence Interval (C.I.)	Adjusted Odds Ratio (AOR)	95% Confidence Interval (C.I.)
<b>Demographics</b>				
Race:				
Hispanic/Latino*	0.72	0.41, 1.27	---	
Indigenous*	0.79	0.24, 2.65	---	
White*	1.01	0.12, 8.50	---	
Education (middle school vs. < middle school)	3.25	1.82, 5.82	2.91	1.52, 5.91
Speak English	4.26	2.52, 7.22	3.24	1.96, 5.36
Age (in years)	1.06	1.03, 1.08	1.10	1.07, 1.14
Age at first injection (in years)	0.93	0.89, 0.96	0.90	0.86, 0.94
Male	2.79	1.16, 6.70	---	
HIV: antibody positive	6.84	1.78, 26.24	---	
Syphilis: titers $\geq$ 1:8	0.74	0.38, 1.46	---	
TB: IGRA positive	0.68	0.42, 1.09	---	
Homeless	1.81	0.90, 3.61	2.61	1.27, 5.39
Lived in Tijuana for whole life	0.54	0.31, 0.93	---	
Ever been in jail, prison, adult detention	16.17	6.23, 42.00	11.82	5.22, 26.77
<b>Drug Use &amp; Injection Risk Behavior</b>				
Distributive syringe sharing (past 6 months)	1.07	0.66, 1.71	---	
Receptive syringe sharing (past 6 months)	1.15	0.72, 1.85	---	
Injects at least daily	0.76	0.38, 1.54	---	
Usually injects with other people	0.82	0.50, 1.36	---	
Drug most frequently injected in past 6 months:				
Heroin	0.96	0.58, 1.61	---	
Heroin & methamphetamine	0.98	0.58, 1.68	---	

\* reference group is all others