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Predictors of Needle Exchange Program Utilization During Its Implementation and Expansion in Tijuana, Mexico

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Abstract

Objective—Until the early 2000s, there was only one needle exchange program (NEP) offered in Mexico. In 2004, the second Mexican NEP opened in Tijuana, but its utilization has not been studied. We studied predictors of initiating NEP during its early expansion in Tijuana, Mexico.

Methods—From April 2006 to April 2007, people who inject drugs (PWID) residing in Tijuana who had injected within the last month were recruited using respondent-driven sampling. Weighted Poisson regression incorporating generalized estimating equations was used to identify predictors of initiating NEP, while accounting for correlation between recruiter and recruits.

Results—NEP uptake increased from 20% at baseline to 59% after 6 months. Among a subsample of PWID not accessing NEP at baseline ($n = 480$), 83% were male and median age was 37 years (Interquartile Range: 32–43). At baseline, 4.4% were HIV-infected and 5.9% had syphilis titers $>1:8$. In multivariate models, factors associated with NEP initiation ($p < .05$) were attending shooting galleries (Adjusted Relative Risk [ARR]: 1.54); arrest for track-marks (ARR: 1.38); having a family member that ever used drugs (ARR: 1.37); and having a larger PWID network (ARR: 1.01 per 10 persons). NEP initiation was inversely associated with obtaining syringes at pharmacies (ARR: .56); earning >2500 pesos/month (ARR: .66); and reporting needle sharing (ARR: .71).

Conclusions—Uptake of NEP expansion in Tijuana was vigorous among PWID. We identified a range of factors that influenced the likelihood of NEP initiation, including police interaction. These findings have important implications for the scale-up of NEP in Mexico.

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Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper

INTRODUCTION

There is growing consensus that needle exchange programs (NEP) fulfill a vital public health role in communities affected by injection drug use.¹ NEPs have been shown to be effective in preventing the spread of HIV and other blood borne viruses among people who inject drugs (PWID) as they reduce HIV risk behaviors such as the sharing of contaminated syringes.^{2,3} As such, expansion of NEPs in settings where injection drug use is prevalent is imperative to address ongoing HIV transmission among PWID.⁴

In Tijuana, located in the state of Baja California in Mexico's northwest border region, there are an estimated 6,000–10,000 PWID, 4% of whom are estimated to be HIV-seropositive.⁵ While the overall prevalence of HIV in Mexico is low, infection is concentrated among high-risk groups such as PWID, particularly along Mexico's northern border.⁴ In Tijuana, the majority of PWID reside in the *Zona Norte* (North Zone), a border neighborhood that is known for its high prevalence of injection drug use and the city's red light district.^{4,6} Of concern, PWID in the *Zona Norte* report being overcharged or refused services at pharmacies,⁵ or arrested for possessing needles,⁷ despite the fact that it is legal in Mexico to possess syringes and to purchase them from the approximately 1500 pharmacies in Tijuana, without a prescription.⁶ Previous research has found that refusal of services at pharmacies was associated with an increased likelihood of engaging in risky injection behaviors, such as receptive syringe sharing and reuse.⁸ This is of major concern, as refusal from pharmacies in Tijuana may perpetuate increased HIV risk among PWID if those in need of sterile syringes are unable to purchase them.⁸ Ensuring access to NEPs is therefore needed in order to reduce risky injection behaviors, and subsequent risk of HIV infection and transmission, among PWID in Tijuana.

The first NEP in Tijuana opened in 2004, run by the nongovernmental organization *PrevenCasa A.C.*;⁹ until 2007, this was only the second NEP in all of Mexico.¹⁰ By 2007, however, NEPs were officially sanctioned by the Mexican federal government body that oversees HIV prevention and treatment (ie, CENSIDA) and the Baja California Secretary of Health.¹¹ By 2010, a total of 19 NEPs were operational in Mexico, representing an approximate .4 NEPs per 1000 people.¹¹ In 2011, the Global Fund for AIDS, Tuberculosis and Malaria provided funding in order to further the expansion of NEP services in Mexico, providing sterile syringes to approximately 10,000 PWID in Tijuana, Ciudad Juárez, Hermosillo, and Sonora from 2011 to 2013.^{11,12} In Tijuana, the NEP operated by *PrevenCasa A.C.* dispenses a maximum of two syringes to PWID per visit, and distributes approximately 50,000 disposable syringes annually, as compared to the average annual total of 1.9 million syringes distributed by NEPs in Vancouver, Canada.^{13,14}

PWID have faced substantial barriers to NEP access in Tijuana.^{7,15–17} In this context, a growing body of literature has identified conceptual approaches for investigations of HIV risk among PWID.^{18,19} Specifically, the risk environment framework^{18,19} proposes that the implementation and use of harm reduction services such as NEP is subject to the different “cultural, economic, legal, policy, and political environments”¹⁹ which PWID experience. This suggests that individual-level behaviors that place PWID at higher risk of HIV infection (eg, syringe sharing and re-use) are influenced by an array of factors exogenous to the

individual, including NEP availability.^{15,18,19} These exogenous factors operate at micro, meso, and macro levels to constrain the range of choices that PWID have to avoid risky injection-related behaviors.^{15,18,20} Micro-level factors interact with factors at the meso- and macro-levels such as laws, policies, and legal environments to further shape individual behaviours that influence NEP utilization and heighten the risk of HIV infection experienced by PWID.^{18,20}

There are several characteristics of the risk environment specific to PWIDs in Tijuana that may heighten their vulnerability to HIV infection. For example, social factors, including street-level (ie, micro-level) policing practices may increase an individual's risk of HIV infection by hindering their access to NEPs.^{18,21} In Tijuana, arbitrary policing practices are often concentrated in a small number of neighborhoods, specifically those with drug markets in *Zona Norte* as well as other *delegaciones* (boroughs) such as Cerro Colorado.¹⁵ This form of targeted policing may influence where and how PWID inject, including increasing the likelihood that PWID will attend shooting galleries in order to evade detection, which in turn may increase their risk of syringe sharing.²² Furthermore, arbitrary policing practices, including the confiscation of syringes, physical abuse, and detainment, may also influence individual behaviors by discouraging PWID from carrying syringes or from accessing NEPs, as has been observed elsewhere.⁷

This study aimed to assess factors associated with NEP initiation during a period of early NEP expansion in Tijuana using the risk environment framework. Specifically, we hypothesized that social and structural factors, such as police interaction, were associated with NEP initiation.

MATERIALS AND METHODS

Sample and Recruitment

Proyecto El Cuete III is a prospective community-recruited cohort study of PWID in the Mexico-USA border city of Tijuana. In depth details on sample and recruitment methods have been previously reported.²² Briefly, eligible participants were recruited between April 2006 and April 2007 using respondent driven sampling (RDS), a chain-referral sampling method effective for recruitment among hidden populations.²³ In the present study, a diverse group of “seeds” varying on age, gender, and neighborhood of residence were recruited by community workers and given unique coupons to recruit up to three peers. Recruitment was completed in 17 waves, as subjects returning with coupons were also given coupons to recruit additional members from their own social network. Participants were screened for eligibility, which includes being 18 or older, having injected drugs within the previous month, and residing in Tijuana.

Study Instrument

At baseline and at 6-month follow-up interviews, participants completed semi-structured surveys administered by bilingual interviewers. Participants were asked about socio-demographic, behavioral, and contextual factors pertaining to injection drug use, NEP initiation, HIV and syphilis.

Laboratory Testing

At baseline and every 6 months thereafter, participants underwent an HIV test (Determine[®], Abbott Pharmaceuticals, Boston, MA). Samples testing positive were confirmed using a HIV-1 immunoassay and immunofluorescence assay at the San Diego Public Health Laboratory. Syphilis was detected via rapid plasma regain (RPR) test to assess levels of syphilis-specific antibodies, and positive tests were confirmed using the *Treponema pallidum* particle agglutination assay (TPPA; Fujirebio, Wilmington, DE).

Statistical Analyses

Descriptive statistics and trend tests were undertaken to assess NEP uptake across baseline and follow-up. Depending on the distributional assumptions, binary outcomes were examined using either Chi-Square or Fisher's exact tests and continuous outcomes were examined using Mann-Whitney *U*-tests. Analyses restricted to a subsample of PWID that did not report NEP use at baseline were then undertaken. For these analyses, we compared PWID in the subsample that reported initiating NEP use at the first 6-month follow-up with those that did not. Univariate and multivariate Poisson regressions with robust variance estimation, via generalized estimating equations, were performed to identify factors associated with initiation of NEP use.

The outcome of interest was defined as reporting, at the 6-month follow-up interview, NEP initiation during the previous 6 months. We identified a range of variables of interest consistent with the risk environment framework. Sociodemographic variables of interest included: age, sex, recent (ie, past 6 months) and monthly income (>2500 pesos vs. <2500 pesos). Social and individual variables of interest included: the number of PWIDs in participants' social networks, recently attending a shooting gallery, and homelessness. Structural and environmental variables of interest included: recently being arrested for track marks, recently being arrested for possessing syringes, and residing in *Zona Norte*. Variables of interest were assessed at both baseline and 6-month follow-up. At baseline, variables were assessed relative to "ever" and "previous 6 months" time frame. At follow-up, variables were assessed relative to the "previous 6-month" time frame. For the purposes of analysis, "unsafe source of syringes" was determined by self-reported response to the following questionnaire item: "*In the past 6 months, when you used a syringe for injecting (shooting) drugs, from where did you get the syringe?*" We then defined "unsafe source" as reporting obtaining syringes from a family member, shooting gallery, drug dealer, hit doctor or on the street in the past 6 months.

For model building, we used a manual procedure, where all the variables that attained a significance level $\leq .10$ in univariate regressions were considered for inclusion in a multivariate model. All the factors included in the final multivariate model were significant at the .05 significance level. To ensure the integrity of the final model, all 2- and 3-way interactions were explored and ruled out. Multicollinearity between predictor variables in the final model was also assessed and ruled out by appropriate values of the largest condition index and of the variance inflation factors. To control for potential biases that might have been introduced by RDS,^{23,24} adjustments were made to the univariate and multivariate regression models, as follows. To correct for differential recruitment effectiveness by NEP

initiation status, the models were weighted by inverse probability weights based on individualized recruitment weights, which were derived via RDS Analytical Tool (RDSAT). Additionally, to account for the correlation between recruiter and recruit, a variable indicating each participant's recruiter was used as a cluster variable. An exchangeable correlation structure within each cluster was assumed (ie, correlation between any two participants recruited by the same recruiter was assumed to be the same). All analyses were undertaken using SAS Version 9.4 (Cary, NC).

RESULTS

Among 619 participants that completed baseline and 6-month follow-up, NEP uptake increased from 20% ($n = 124$) at baseline to 59% ($n = 352$) after 6 months. Of those that completed at least one follow-up interview, the follow-up rate was 89%. All the main analysis was restricted to PWID not reporting NEP use at baseline ($n = 480$), of which 84% were male and the median age was 37 years (Interquartile Range [IQR]: 32–43). At baseline, 4.4% of participants were HIV-infected, with baseline HIV prevalence twice as high for females (8.0%) compared to males (4.0%). Overall, 5.9% of the sample had syphilis titers >1:8.

At baseline, participants that accessed NEPs were significantly less likely to report earning more than 2500 pesos per month (68.0% vs. 78.4% $p = .01$) and injecting at least once daily (86.6% vs. 93.3% $p = .02$) compared with participants that did not (Table 1). PWID that initiated NEP were also significantly more likely to report having a family member that ever used drugs (39.4% vs. 25.9% $p < .01$). However, at baseline, the two groups did not significantly differ on age, sex, receptive syringe sharing, being homeless, and residing in the *Zona Norte*.

As shown in Table 2, in univariate Poisson regression analysis, the likelihood of initiating NEP increased significantly (though marginally) for every 10 PWID injection partners in the prior 6 months (Relative Risk [RR] 1.01, 95% Confidence Intervals [CI]: 1.00–1.01, $p = .02$). PWID that reported injecting in a shooting gallery (RR = 1.34; 95%CI: 1.06–1.70, $p = .02$), and being arrested for having track marks (RR = 1.37, 95%CI: 1.01–1.86, $p = .05$) were also significantly more likely to initiate NEP. PWID that reported any receptive needle sharing (RR .81, 95%CI: .64–1.03, $p = .09$), attaining syringe more often from pharmacists (RR = .70, 95%CI: .55–.89, $p < .01$) or injecting at least once daily (RR = .66, 95%CI: .49–.89, $p = .01$) in the last 6 months were significantly less likely to initiate NEP.

Table 2 also presents the results of the multivariate Poisson regression analysis. As shown, initiating NEP was positively associated with reporting having a family member that ever used drugs (Adjusted Relative Risk [ARR] = 1.37; 95%CI: 1.06–1.77 $p = .02$) as well as having a larger PWID social network (ARR = 1.01; 95%CI: 1.00–1.01 $p < .01$, for every 10 additional PWID). In addition, injecting most often in shooting galleries (ARR = 1.54; 95%CI: 1.18–2.00 $p < .01$) and being arrested for track marks in the past 6 months (ARR = 1.38; 95%CI: 1.01–1.88 $p = .04$) was positively associated with reporting NEP initiation. Participants that obtained syringes most often from pharmacies (ARR = .56; 95%CI: .43–.73 $p < .01$), reported obtaining syringes from an unsafe source (ARR = .36; 95%CI: .15–.8, p

= .02), reported receptive needle sharing (ARR = .71; 95%CI: .53–.95, $p = .02$), and reported earning more than 2500 pesos per month (ARR = .65; 95%CI: .51–.85, $p < .01$) were significantly less likely to report initiating NEP use.

DISCUSSION

This study found that, among a sample of PWID in Tijuana, NEP initiation increased threefold in just over 6 months, indicating that these programs are feasible and in high demand among high-risk populations in Tijuana. We also found that a range of social, individual, and environmental barriers significantly limited access to NEPs. This has important implications in Tijuana and other settings where NEP expansion may be occurring.

In the present study, we detected a significant positive association between reporting being arrested for track marks and NEP initiation among PWID in Tijuana. Previous research from this setting has demonstrated that PWID who report drug-related arrests (ie, for syringe possession) have a higher risk of receptive syringe sharing.²⁵ As such, the present findings suggest that accessing NEPs may increase PWID risk of arrest by further corroborating that arrested individuals practice injection drug use. In addition, given the common practice of destroying syringes at the point of arrest by Tijuana law enforcement,²⁶ the present findings may also suggest that PWID who access NEPs are having their syringes destroyed by police, thereby decreasing the effectiveness of NEPs and further increasing the risk of syringe sharing.^{3,15} Therefore, exogenous factors such as policing practices that limit PWID ability to access sterile syringes likely need to be curtailed to successfully reduce injection-related harms among Tijuana's large PWID population.^{15,27}

A further possible interpretation of the association we observed between reporting interactions with police and initiating NEP is that those PWID who are most in need of NEP services are also those most vulnerable to arrest. This is consistent with the scientific literature on this topic. For example, a previous qualitative study by our group found that fear of police interaction was one of the major barriers to NEP initiation in Tijuana.¹⁰ In addition, Philbin et al., reported that policing in Yunnan Province, China was associated with a decrease in NEP use and fear of possessing used or unused syringes among PWID.¹⁶ In Philadelphia, PA, intensified policing practices were associated with decreased use of harm reduction services by a sample of PWID,²⁵ while 44% of a sample of PWID in Togliatti City, Russia reported avoiding carrying needles to evade being arrested.²⁸

However, there may be alternative explanations for the observed association between reporting previous arrest and NEP initiation. For instance, it may be that arrest for PWID status (ie, possessing track marks) is not deterring PWID from accessing NEP if they are without alternative sources of sterile syringes.⁸ To that end, previous research has found that PWID who access NEP are also more likely to display markers of social and economic vulnerability, such as homelessness.^{7,17} Pollini et al., have found that those PWID who are homeless and impoverished were more likely to be refused service at pharmacies in Tijuana.⁸ While we did not observe a significant association between homelessness and NEP initiation, earning less than 2500 pesos per month (a marker of economic vulnerability) was

nevertheless significantly associated with NEP initiation. We further observed that PWID that reported obtaining syringes most often from pharmacies were significantly less likely to initiate NEP. This may suggest that regardless of the potential barriers caused by arbitrary policing practices, NEPs in Tijuana are nevertheless filling a gap in service for PWID that cannot afford to purchase syringes or are turned away from pharmacies, while pharmacies are still being used by PWID that have the means to access them. Therefore, increasing scale-up and access to NEPs is imperative in order to decrease risky injection behaviours such as syringe sharing and re-use among PWID in Tijuana, especially given barriers to syringe purchase at pharmacies.

The present study also found that PWID that reported receptive syringe sharing were significantly less likely to initiate NEP than those not reporting receptive syringe sharing. This may indicate that NEP use may lead to reductions in risky injection behaviors among PWID in Tijuana, which may in turn imply a need for increased scale-up of NEPs in order to reduce risk of HIV acquisition.

We detected a significant positive association between injecting in shooting galleries (*picaderos*) and NEP initiation in Tijuana. Previous research has found a range of environmental factors associated with shooting gallery attendance, including police interaction.²⁹ PWID in Tijuana may perceive shooting galleries as a safer place to inject to avoid persecution from police associated with NEP initiation.^{6,17,29} This is of major concern, as shooting galleries have been previously associated with increased risk of receptive syringe sharing, and therefore an increased risk of HIV infection among PWID.²⁹ In this context, NEP utilization will likely be ineffective in reducing injection related HIV transmission in Tijuana if PWID are driven to inject in risky environments due to police pressure.^{6,29} Our data suggest that arbitrary policing practices need to be reduced to encourage PWID to favor NEPs over shooting galleries in Tijuana.

We also observed that participants with a larger PWID social network were more likely to initiate NEP as compared to individuals with smaller networks. In addition, participants that reported having family member that ever used drugs were also significantly more likely to initiate NEP. One interpretation of this result is that members of larger PWID networks are more likely to share information about NEP access with their peers, allowing for information about these services to spread throughout the network and thereby increase NEP initiation among the group.⁹

In Mexico, funding from the Global Fund to Fight AIDS, Tuberculosis and Malaria increased syringe distribution to approximately 10,000 PWID prior to this study period (ie, 2006–2007).¹² However, results of this study suggest that additional efforts to reduce barriers to NEP initiation may be needed in order to see successful long-term utilization of NEP services by PWID in Tijuana.^{30,31} Indeed, recent studies by our group indicate that even after scale up of NEP services by the Global Fund, many PWID still report experiencing a variety of barriers that limit their access to NEPs in Tijuana, including syringe confiscation,²⁶ police extortion,³² and arrest for drug possession.³⁰ This is of major concern given that carrying syringes is legal in Mexico, and that the possession of small amounts of illegal drugs for personal use is no longer a criminal offense.³³ In this context,

the present findings have important implications for the successful expansion of NEP in Tijuana, as they suggest that the scale-up of NEP services is likely to be ineffective in reducing injection related harms among PWID if these barriers persist.^{30,34} Additional efforts to address these barriers, such as the training and education of police officers on the public health benefits of NEP are required.³⁰ Fortunately, a new police education program to promote harm reduction has been initiated by our team in collaboration with the police department.³⁵ Ongoing studies of PWID will help determine whether this program is effective.

This study is subject to limitations consistent with the use of observational cohort data. First, data collected from the survey was self-reported by PWID participants and as such is subject to potential recall and social desirability bias. Reporting on sensitive subjects, such as sexual and injecting behaviours (eg, receptive needle sharing) may be underreported as a result of the stigma associated with these activities. Second, given that the data in this study dates to the period prior to a major drug policy reform in Mexico, findings may not be generalizable to the current population of PWID in Tijuana.

In summary, in our analysis of NEP initiation among a sample of PWID in Tijuana, we found substantial exogenous barriers that impacted the ability of PWID to access NEP services. Results from this study suggest that there is a commensurate need to work alongside community members and police to ensure optimal access to sterile syringes through NEPs. Educating law enforcement about the public health impacts of syringe confiscation and NEP access should be a priority in order to improve access to essential harm reduction services for PWID and reduce the burden of HIV among this population in Tijuana.

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TABLE 1

Characteristics of PWID who initiated NEP use in Tijuana, Mexico: 2006–2007

Baseline characteristics	NEP Use N = 284	No NEP Use N = 196	Total N = 480	p-value
Sociodemographics				
Median age (IQR)	37 (32, 43)	39 (34, 44)	37 (32, 43)	.02
Female	47 (16.5%)	32 (16.3%)	79 (16.5%)	.99
Average monthly income 2500 pesos ^a	193 (68.0%)	152 (78.4%)	345 (72.2%)	.01
Resides in Zona Norte	68 (23.9%)	65 (33.2%)	133 (27.7%)	.03
Social influence				
Family members ever used drugs	109 (39.4%)	49 (25.9%)	158 (33.9%)	<.01
Median number of PWID in social network	80 (41, 150)	69 (40, 120)	70 (40, 140)	.05
Individual behaviors/risk				
Any receptive needle sharing ^a	102 (35.9%)	83 (42.3%)	185 (38.5%)	.18
Got syringe most often from pharmacist ^a	195 (68.7%)	156 (79.6%)	351 (73.1%)	<.01
Injected heroin most often ^a	166 (58.5%)	136 (69.4%)	302 (62.9%)	.02
Injected at least once daily ^a	246 (86.6%)	182 (93.3%)	428 (89.4%)	.02
Injected most often at shooting gallery ^a	83 (29.2%)	39 (19.9%)	122 (25.4%)	.02
Positive HIV serostatus	15 (5.3%)	10 (5.1%)	25 (5.2%)	.99
Syphilis >1.8	28 (5.9%)	16 (5.7%)	12 (6.9%)	.81
Structural/Environmental factors				
Homeless ^a	38 (13.4%)	22 (11.2%)	60 (12.5%)	.57
Arrested in the past 6 months for having track marks ^b	49 (27.2%)	21 (17.2%)	70 (23.2%)	.05

^aLast 6 months;^bAmong those arrested in the past 6 months (N = 302).

TABLE 2

Univariate and multivariate factors associated with NEP initiation among PWID in Tijuana, Mexico

Baseline characteristics	Relative risk (95%CI)	Adjusted relative risk (95%CI) ^c
Sociodemographics		
Age (per year)	.99 (.98–1.01)	—
Female	.92 (.68–1.25)	—
Average monthly income >2500 pesos ^{a,b}	.74 (.58–.93)	.66 (.51–.85)
Social influence		
Family members ever used drugs ^b	1.36 (1.08–1.71)	1.37 (1.06–1.77)
Number of IDUs in social network (per 10 people) ^b	1.01 (1.00–1.01)	1.01 (1.00–1.01)
Individual behaviors		
Any receptive needle sharing ^{a,b}	.81 (.64–1.03)	.71 (.53–.95)
Got syringe most often from pharmacist ^{a,b}	.70 (.55–.89)	.56 (.43–.73)
Got syringe most often from unsafe source ^{a,b}	.50 (.22–1.10)	.36 (.15–.87)
Injected heroin most often ^{a,b}	.75 (.60–.93)	—
Injected at least once daily ^{a,b}	.66 (.49–.89)	—
Injected most often at shooting gallery ^{a,b}	1.34 (1.06–1.70)	1.54 (1.18–2.00)
Syphilis titer >1:8	.88 (.58–1.35)	—
Positive HIV serostatus	.94 (.58–1.53)	—
Structural/Environmental factors		
Homeless ^a	1.24 (.91–1.69)	—
Arrested in the past 6 months for carrying used needle/syringe	1.10 (.77–1.56)	—
Arrested in the past 6 months for carrying unused needle/syringe	1.13 (.77–1.66)	—
Arrested in the past 6 months for having track marks ^b	1.37 (1.01–1.86)	1.38 (1.01–1.88)

CI, confidence interval.

^aRefers to the past 6 months;^b*p*-value .10 in univariate model;^cAdjusted for all variables that achieved *p*-value <.10 in univariate model.