Published in final edited form as:
Health Place. 2009 December ; 15(4): 999–1005. doi:10.1016/j.healthplace.2009.04.004.

Social and Environmental Influences Shaping Risk Factors and Protective Behaviors in two Mexico-US Border Cities

Rebeca Ramos[1], **João B. Ferreira-Pinto**[2], **Kimberly C. Brouwer**[3], **Maria Elena Ramos**[4], **Remedios M. Lozada**[5], **Michelle Firestone-Cruz**[3], and **Steffanie A. Strathdee**[3]

[1] US Mexico Border Health Association

[2] College of Health Sciences, University of Texas at El Paso

[3] Division of International Health, Department of Medicine, University of California, San Diego, California, USA

[4] Programa Compañeros, Ciudad Juárez, Chihuahua, México

[5] Patronato Pro-COMUSIDA, Tijuana, Baja California, México

Abstract

The economic, social, cultural and political milieus that influence HIV risk behaviors along the U.S.-Mexico border are understudied. In an effort to appropriately inform interventions targeting structural influences, we compared injecting drug using populations living in two cities—Ciudad Juárez, Chihuahua and Tijuana, Baja California— situated on the Mexico-U.S. border. These populations presented with similar demographic profiles, but differed significantly in terms of social and environmental influences that can influence both risk and protective factors (e.g., family drug use, migration, drug use patterns). We observed distinct behavioral and structural influences in these two border cities that will require tailored intervention strategies to reduce HIV transmission.

Introduction

In recent years, there has been growing appreciation that the social and structural environment in which behaviors are exhibited plays a crucial role in shaping the natural history of addiction and associated risk behaviors that predispose to blood borne and sexually transmitted infections, including HIV (Rhodes et al. 2005). Many theories of health behavior, such as the Health Belief model (Becker 1974; Janz and Becker 1984; Rosenstock 1966) and the Theory of Reasoned Action (Fishbein and Ajzen 1975; Jazen and Fishbein 1980) place the responsibility for health and disease on the individual. Interventions based on these theories primarily aim to reduce high risk behaviors by modifying individual beliefs and attitudes. The Social-Ecological Model (McLeroy et al. 1988; Stokols 1996) and the Risk Environment framework (Rhodes et al. 1999) are examples of theories that attempt to incorporate macro-, meso- and micro- level factors that influence how diseases are transmitted. In this context, we refer to structural factors arising from the risk environment, which Rhodes describes as the

Corresponding Author: Steffanie A. Strathdee, Ph.D., Department of Family and Preventive Medicine, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0622.

social or physical space in which a variety of factors exogenous to the individual interact to increase HIV transmission risks (Rhodes et al. 1999; Rhodes et al. 2005).

The influence of social and environmental factors on health varies according to the culture, economy, and geographical location of groups or populations, and these factors may act as barriers or facilitators for health-related risk behaviors. Border regions are particularly appropriate environments to examine these influences, since there are often stark differences in policies, priorities, and available resources in response to major health problems in neighboring countries. The 2000-mile Mexico-U.S. border region is a 'natural laboratory' for studying these differences, since both countries differ in language, culture, and stage of economic development. The Mexican side of this border is home to approximately five million people, most of whom are poor and without access to a comprehensive health prevention and care (US-Mexico Border Health Commission 2002). Some authors maintain that U.S. influences have created a new cultural identity in among inhabitants of these border communities (Myers 1997; Weaver 2001). In their assessment of six Mexican-U.S. border cities, (Ciudad Juárez, Matamoros, Tijuana, Reynosa, Nogales, and Camargo), Arreola and Curtis posit that certain structural characteristics appear distinctive to the border region, such as tourist districts, *maquiladora* industrial parks, and street networks oriented toward ports of entry to facilitate the movement of trade goods (Arreola and Curtis 1993). We agree with these observations and stress that the location of Ciudad Juárez and Tijuana on major commercial transport routes, through which illicit drugs are also transported, may increase access to drugs and their negative health consequences.

There is growing concern among health care providers along the Mexico-U.S. border about the twin threats of drug addiction and HIV and the types of prevention interventions which would be most effective in this bi-national context (Maxwell et al. 2006; Strathdee and Magis-Rodriguez 2008). Although HIV prevalence among male injecting drug users (IDU) in Ciudad Juárez and Tijuana appears to be low at 3% (Frost et al. 2006). To date, most studies of IDUs have focused on individual risk behaviors that place them at risk of disease. The social, cultural, economic and political milieus where IDUs live —which are equally important to inform the design of appropriate behavioral interventions—have not been given adequate consideration.

Located in the Mexican state of Chihuahua, Ciudad (Cd.) Juárez, Mexico, is situated at the approximate mid-point along the border between Mexico and the United States and is part of a 2-million people metroplex which includes the cities of El Paso in Texas and Las Cruces in New Mexico. Juárez had a population of 1,313,338 in 2005 with a 1.32 percent growth rate per year between 2000 and 2005 (INEGI 2005). In 2005, there were 29 million northbound border crossings from Cd. Juárez to El Paso (US Department of Transportation 2004). Situated on a major trafficking route for heroin and cocaine, Cd. Juárez is ranked second only to Tijuana in the prevalence of illicit drug use and is estimated to have twice the national average of drug users (CONADIC 1998). A 2001 study using a capture-recapture methodology, estimated that there were approximately 6000 IDUs and as many as 186 *picaderos* (drug injecting locations) in Cd. Juárez (Cravioto et al. 2003).

Tijuana is located in the Mexican state of Baja California adjacent to San Diego, CA. The border crossing between Tijuana and San Diego is the busiest in the world; in 2005 alone, there were 45 million registered northbound crossings from Tijuana to San Diego County (US Department of Transportation 2004). Tijuana is also situated on a major drug trafficking corridor, whereby heroin, cocaine and methamphetamine are transported into the U.S. (Brouwer et al. 2006; Bucardo et al. 2005). Tijuana, as well as Cd. Juárez, has witnessed local drug consumption markets grow, and is reported to have three times the national average of individuals consuming illicit drugs (Rodriguez et al. 2002). It is estimated that there are about 10,000 IDUs and over 200 shooting galleries ['*picaderos*'] in the city (Strathdee et al. 2005).

There is a rising HIV prevalence among female sex workers and pregnant women that has been linked to drug use (Strathdee, Philbin et al. 2008; Viani et al. 2006)

We hypothesized that IDU populations in these two Mexican cities differ in terms of behavioral factors that constitute both risk factors and protective factors, as well as social and environmental factors, which may differentially influence the spread of HIV and related blood-borne infections. We also describe failings in the health delivery system—which represent opportunities still left to explore—as well as successful structural interventions in both cities.

Methods

Study Population

Cross-sectional interviewer-administered surveys were conducted among 206 IDUs in Ciudad Juárez and 222 IDUs in Tijuana between February and April 2005. As previously described (Frost et al. 2006), participants were selected through respondent-driven sampling (RDS), which is a variation of snowball sampling that enables researchers to obtain a more representative sample of hard-to-reach populations and to adjust for bias in recruitment (Heckathorn 2002). Briefly, a diverse group of "seeds" —heterogeneous in age, gender, drug of choice, and recruitment venue—were selected based on diversity of gender, location of recruitment, and drug of choice. After providing informed consent, seeds underwent an interview, were briefly educated on how to refer other eligible IDUs, and were given three uniquely coded coupons to refer their peers. This process was repeated until a sample size of approximately 200 was achieved in each site. The eligibility criteria were a minimum age of 18 years, having injected drugs within the previous month, and being capable of providing informed consent.

Data collection

Upon enrollment, trained staff administered quantitative surveys eliciting information on socio-economic factors (income, education, sources of income), social influences (marital status, drug use among family members and household members, number of hours spent on the street), migration history (place of birth, and where appropriate, duration of time lived in the city, travel to another country, deportation), and environmental influences (e.g., homelessness, injecting drugs outside and at a *picadero*, circumstances surrounding incarceration). Next, we measured individual behaviors that have been considered potential risk factors for HIV infection such as drug use practices, types of drugs used alone and in combination, and among males, having had sex with other males. In terms of protective factors, we measured knowledge of Hepatitis C virus (HCV) and HIV, needle cleaning practices, use of sterile needles, attendance at needle exchange programs (NEPs), and having received HIV testing, drug abuse treatment, or medical care. Questions pertained to lifetime experiences and those occurring in the prior six months.

After the interview, participants were screened for HIV and HCV antibody using standard enzyme immunoassays, and syphilis antibody with the rapid plasma reagin (RPR) and *Treponema pallidum* particle agglutination assay (TPPA) tests, as previously described (Frost et al. 2006). Syphilis titers ≥1:8 were considered suggestive of incident infection. Hepatitis B core antibody testing was available only for subjects in Ciudad Juárez. All subjects received pre- and post-test counseling.

Statistical Analysis

Descriptive statistics were used to compare socio-demographic, social, environmental and behavioral characteristics by city. Specifically, Chi-square or Fisher's exact tests were used to compare categorical variables, and t-tests or Wilcoxon's tests were used to compare continuous

variables, where appropriate. Univariate logistic regression was used to identify individual and structural HIV risk and protective factors, treating Tijuana as the reference group.

To adjust for possible bias in sampling, RDS adjustments for each infection were calculated in the RDSAT software (version 5.6.0, October, 2006, Cornell University), which applies overall sampling and degree weights to account for the effects of differential recruitment and network size and to estimate an 'equilibrium' ratio applied to sample frequencies of each group (Heckathorn 2002).

Results

Analyses were based on 427 subjects (205 subjects in Ciudad Juárez and 222 subjects in Tijuana); one subject in Ciudad Juárez was excluded due to a missing value for HIV testing history. Table 1 summarizes basic demographic data relating to the Cd. Juárez (9 seeds, 197 recruits) and Tijuana (15 seeds, 207 recruits) study populations. Both populations were predominantly male, with a median age of 34 years. Approximately one third had completed high school, and less than half earned more than 3000 pesos per month (approximately $300 USD). Roughly one quarter were married or in a common-law relationship. None of these variables differed significantly between cities. IDUs in Cd. Juárez were significantly more likely to report having any family member who used drugs compared to IDUs in Tijuana (54.6% vs. 42.4%, p=0.01). However, of these, 78.8% in Cd. Juárez versus 87.0% in Tijuana had an immediate family member who used drugs (i.e., parent, sibling, child).

In terms of migration history, only 30% of participants from Tijuana were born in the Mexican state of Baja California, while 83% from Ciudad Juárez were born in the state of Chihuahua. The median time participants had resided in Tijuana was 10 years (interquartile range [IQR], 5–18) and 16 years in Ciudad Juárez (IQR, 10–27, $P < 0.01$). Compared to Cd. Juárez, subjects from Tijuana were significantly more likely to have recently migrated to the city, to have lived or worked outside Mexico in the past decade. Of note, IDUs living in Tijuana were 12 times more likely to have been deported from the U.S compared to those living in Cd. Juárez (Table 1).

In terms of environmental factors, IDUs in Tijuana were significantly more likely to report being homeless, and to inject outside or at a shooting gallery. The median time per day participants spent on the street was 20 hours (IQR, 12–24) in Tijuana, compared to 12 hours (IQR, 8–15) in Ciudad Juárez ($P < 0.01$). IDUs in Tijuana were also more likely to have been arrested, and to have been arrested for carrying used syringes. Although the median number of times participants had been incarcerated was identical in both cities, IDUs in Tijuana were nearly twice as likely to have injected inside jail/prison.

Table 2 summarizes individual-level risk behaviors and types of drugs used by route of administration in Cd. Juárez and Tijuana. While the median age of first injection was similar for both cities, at 18 to 19 years of age, 98% of participants in Ciudad Juárez reported injecting at least once per day compared to 74% in Tijuana ($P < 0.01$). Participants in Tijuana were significantly more likely to report sharing of syringes and other injection paraphernalia compared to their counterparts in Cd. Juárez.

Among men, approximately 44% in Tijuana versus 14% in Ciudad Juárez reported having had sex with men (Table 2, $P < 0.01$). RDS adjustment did not alter the wide disparity in the proportion of men who had sex with men between cities. Similarly, a higher proportion of subjects reported selling sex in exchange for money, goods or drugs in Tijuana versus Cd. Juárez (P=0.01), but similar proportions reported buying sex from other men in both cities.

With respect to drugs ever used, there were no differences between cities in terms of the percentages of who had used inhalants or marijuana/hash, swallowed tranquilizers or injected heroin. However, subjects in Tijuana were significantly more likely to smoke heroin, crack or methamphetamines compared to those in Cd. Juárez. In terms of injecting drugs, similar percentages in both cities had injected heroin, cocaine or heroin and cocaine combined, but IDUs in Tijuana were significantly more likely to have injected methamphetamine alone or in combination with other drugs (Table 2).

With respect to knowledge of risks (Table 3), the majority were aware of how HIV was transmitted, whereas only one third were aware of how HCV was transmitted; in both cases, there were no differences between cities. However, IDUs in Tijuana were significantly more likely to know an HIV-infected person, and a significantly higher percentage felt that they were at high risk of HIV infection compared to IDUs in Tijuana.

While similar proportions of IDUs in both cities reported using sterile syringes in the last 6 months, IDUs in Tijuana were nearly twice as likely to report cleaning syringes than those in Cd. Juárez. However, in comparison with Tijuana, a higher proportion of IDUs in Cd. Juárez who cleaned their syringes had learned to use bleach prior to injecting (34.3%) compared to 24.6% in Tijuana ($p=0.04$). Although IDUs in Tijuana were less likely to be aware of the existence of a local needle exchange programs (NEPs) than IDUs in Cd. Juárez, among those that were aware of the program in their city, IDUs in Tijuana were nearly 5 times as likely to use the NEP. Similar percentages in both cities reported ever having had an HIV test, having received drug treatment, or received medical care in the prior six months; however, the percentage of the IDUs who had ever had an HIV test was low (34% overall).

In terms of health status indicators, crude prevalence of HIV and HCV antibody was 3% and 96% overall. There were no differences by city in terms of crude or RDS-adjusted prevalence estimates of HIV or HCV infection. However, compared to IDUs in Cd. Juárez, IDUs in Tijuana were three times more likely to have ever been diagnosed with an STI, were more significantly more likely to test positive for syphilis antibody, and to have syphilis titers > 1:8, which is suggestive of active infection. Hepatitis B seroprevalence was only determined for Cd. Juárez, where it was low (only one person was positive out of a total of 206 participants).

Discussion

In our comparison of IDUs recruited in two Mexico-US border cities, participants in Cd. Juárez and Tijuana were similar in terms of many socio-demographic characteristics traditionally examined in epidemiologic studies of IDU populations, including age, gender, education, income and time since first injection. HIV and HCV prevalence were also nearly identical, at 3% and 96%, respectively. However, these similarities on the surface masked a number of important contextual differences upon closer examination. These findings have important implications with respect to the response to epidemics of blood-borne and sexually transmitted infections in both cities, and their U.S. neighbors.

Although our study excluded non-residents of Tijuana and Ciudad Juárez, and would therefore tend to underestimate IDUs who were highly mobile, IDUs in Tijuana and Cd. Juárez differed markedly in terms of their mobility. The majority of IDUs living in Tijuana were more likely to have migrated to the city, have lived or worked in another country (usually the U.S.), and were more likely to have been deported, whereas the majority of IDUs living in Cd. Juárez had been born in that city. Cross border mobility in Cd. Juárez has been reported to mostly include short-range trips between Cd. Juárez and El Paso Texas, or sporadically to Las Cruces, New Mexico which is 40 miles from El Paso (Ramos 1990; Ramos and Ortega 1991). The greater mobility observed among IDUs in Tijuana compared to Cd. Juárez may be the result of the

geographical distance between the pair of cities under discussion. Travel cost between El Paso and Cd. Juárez, which are contiguous cities, is smaller than between Tijuana and San Diego, which are 20 miles apart. IDUs travelling to the US from Tijuana therefore tend to embark on longer journeys. Moreover, travelling longer distances increases the possibility of being stopped and questioned by law enforcement or immigration officers.

Mobility has been identified as an important driver of Mexico's HIV epidemic, especially among migrant males who are more likely to have sex with other men, and to pay for sex with males and females, compared to non-migrants (Ramos et al. 1996) (McLeroy et al. 1988; Rachlis et al. 2007; Rhodes et al. 1999). Recently, we documented a four-fold increased in the odds of HIV infection among male IDUs who had been deported from the U.S. compared to those who had never been deported, which suggests that U.S. immigration policies and support programs for deportees should be evaluated in terms of their impact on both sides of the border (Strathdee, Philbin et al. 2008).

The high rates of mobility and deportation we observed in Tijuana may help explain why IDUs in this city were more likely to be homeless, inject outside or at a *picadero*, and spend the majority of their time 'on the street.' Lack of housing and safer places to inject have been consistently associated with hurried injections, needle sharing and HIV infection (Latkin et al. 1994; Riley et al. 2007). In contrast, IDUs in Cd. Juárez reported more markers of stability including part-time employment and having odd jobs, and being married or living common law.

The greater degree of residential stability in Cd. Juárez may help explain why IDUs in Cd. Juárez were more likely to report having family members who used drugs compared to their counterparts in Tijuana. The foundation of Cd. Juárez in 1659 predates that of Tijuana (1889) by more than 200 years, and it was part of a south-north transshipment route for goods, centuries before the Spanish invasion. Among the more lucrative trades in the twentieth and twenty-first centuries was the shipment of alcohol and illicit drugs. The drug-based economic sector has therefore fostered an ingrained drug culture in Cd. Juárez that transcends multiple generations, which nourishes the aspirations of wealth, particularly among those experiencing poverty and power disparities. This is exemplified in the folk hero status ascribed to drug users in *narcocorridos*. A *corrido* is a kind of Mexican folk songs, based on polkas brought to Mexico by Central European immigrants in the 19th century. In the 20th century *corridos* began to describe the lives of the poor and destitute, as nourish well as immigrants to the United States. The focus on drug culture -- the "narco" in the name *narcocorrido* -- is a phenomenon of the past couple of generations. These folk songs are a cultural manifestation of a multi-generational drug culture that has developed a "narrative of resistance" in the face of social isolation and political neglect (Edgerg 2003).

Although use of many illicit drugs was similar between the two cities, IDUs in Tijuana were more likely than in Cd. Juárez to report injecting, snorting or ingesting methamphetamine, both alone and in combination with other drugs. In a prior qualitative study conducted among IDUs in the same cities in 2004, a well-established methamphetamine epidemic was observed in Tijuana, while methamphetamine use was minimal in Cd. Juárez (Case et al. 2008). This is an important distinction, since methamphetamine use is associated with high levels of unprotected sex, drug use 'binging' and violent, chaotic behaviors (Drumright et al. 2006). Among female sex workers in Tijuana, methamphetamine is often used to help 'stay awake' (Bucardo et al. 2004; Patterson et al. 2008). While the low proportion of female IDUs in this study was similar to a more recent IDU study in Tijuana (Strathdee, Lozada, Ojeda et al. 2008), the small number of females may have limited our ability to capture important patterns in methamphetamine use or other behaviors that have been associated with HIV infection (Patterson et al. 2008). While there is growing evidence that methamphetamine use is now on the rise in Cd. Juárez (Shedlin

and Ramos 2008), the extent to which methamphetamine has become entrenched in Tijuana's drug use culture may be a harbinger of rising rates of HIV and STIs.

An important structural difference between these two cities, which has implications for the evaluation of harm reduction programs, is the level of awareness and utilization of NEPs. Awareness of the existence of a local NEP was higher in Cd. Juárez than in Tijuana, which is likely due in part to the historical context of the introduction of harm reduction prevention practices in Mexico. The first NEP was introduced in Cd. Juárez in the early 1990's by the non-governmental organization (NGO) Programa Compañeros, A.C that was founded by some of the authors. Between 2004 and 2008, over 120,000 syringes were distributed in Cd. Juárez, primarily with funds provided by US foundations. Another NGO founded the second NEP in Mexico in Tijuana in 2003 (Philbin et al. 2009). Despite higher levels of NEP awareness in Cd. Juárez, utilization of NEPs was higher in Tijuana, which may be due to the existence of better-financed programs than in Cd. Juárez, where resources committed to expanding NEPs have been inconsistent. Public financing through Mexico's federal Ministry of Health has also been uneven, although the Ministry published a document supporting NEPs in 2003 (Philbin et al. 2009). By 2006, there were only a total of 64,281 publicly funded syringes distributed in Mexico among an estimated 4474 IDUs. The majority of these interactions—78% of IDUs contacted and 99.3% of distributed syringes—occurred in Tijuana (Philbin et al. 2009). Our data support the continued expansion of NEPs in both cities.

We observed significant differences between these two cities in terms of the influence of the criminal justice system. While the proportion of IDUs that had been arrested and incarcerated in both cities was similar, three quarters of IDUs in Tijuana reported having been arrested for carrying used syringes, whereas slightly less than half reported this occurrence in Cd. Juárez. Although there is a lack of responsiveness of the police and courts — especially insufficient protective orders and other judgments —to the Ministry of Health's support of NEPs, police in Tijuana routinely arrest IDUs for carrying syringes, even in the absence of drug paraphernalia laws. We recently showed that prior arrests for carrying sterile and used syringes were independently associated with three-fold increased odds of needle sharing in these cities (Pollini et al. 2008). A recent study of barriers to NEPs utilization among IDUs in Tijuana suggested that fear of arrest may hinder some IDUs' desire to obtain syringes at NEPs (Strathdee, Lozada, Magis-Rodriguez et al. 2008). These observations have led to a steady decline in confidence in the criminal justice system among service providers in both cities, and the reluctance among IDUs to enroll in NEPs. Since injecting drug use appears common during incarceration, our data support the need for NEP and other harm reduction programs in jail/prison settings, especially in Tijuana where injecting drugs while incarcerated was especially common.

Although prevention programs in both cities have promoted similar protective behaviors among IDUs, some learned protective behaviors, such as obtaining syringes at pharmacies, and disinfection of used syringes with bleach, were significantly more prevalent in Cd. Juárez than in Tijuana. Accordingly, inappropriate syringe disinfection measures, such as rinsing syringes with water, were more common in Tijuana. This difference may be the result of the existence of a more established prevention program with a long history of service in Cd. Juarez that includes educating providers and allied health personnel, including pharmacists and the police. On the other hand, since IDUs in Tijuana tended to have lived in the city for shorter durations, these observations could reflect higher risk behaviors among male migrant IDUs, which has been previously reported (Magis-Rodriguez et al. 2005).

In conclusion, although the demographic profile of IDUs in Cd. Juárez and Tijuana was similar, a closer examination of the data showed that they differed significantly in terms of social and environmental factors that influence HIV risk and protective behaviors. These findings suggest

that the same 'cookie cutter' prevention approaches should not be used in both cities. Since only one third of the IDUs in our study had ever had an HIV test, there is great need to expand voluntary counseling and testing within the context of broader prevention programs that incorporate access to sterile syringes and drug abuse treatment. Beyond the subgroups of IDUs mentioned above, other high risk subgroups such as male IDUs who are also MSM, warrant targeted interventions. These men can be infected with HIV through either parenteral or sexual transmission routes, and the proportion of male IDUs who report MSM in both cities was unusually high. An earlier investigation by our team showed that MSM-IDUs had a higher risk profile, and also had a larger number of female lifetime sex partners (Deiss et al. 2008).

The higher levels of mobility and homelessness among Tijuana IDUs, compared to that observed in Cd. Juárez, suggests that programs that bring the messages to these at risk populations (such as mobile programs) should be expanded. In partnership with CENSIDA (Centro Nacional de Control y Prevención de SIDA), the Mexican Ministry of Health developed a fleet of brightly colored mini-vans painted with caricatures of condoms and equipped with loudspeakers and a large video screen, named by the public as "condonetas" (i.e., "condom mobiles") (Philbin et al. 2009). In Cd. Juárez, the mobile units have incorporated more comprehensive medical services in an effort called "El Cuete Saludable" (Healthy "Works"). These mobile "street clinics" provide a broader range of health services to IDUs such as abscess treatment, and TB and HIV testing.

In Cd. Juárez, where drug use is more commonly observed in families, network-based approaches may prove to be an effective alternative to increasing access to services, including HIV testing. Since 2004 Programa Compañeros has been using *Pasa la Voz (Spread the Word),* an HIV prevention programinspired by RDS methodology to increase access to HIV prevention services, including HIV testing services through familial and social network contacts. *Pasa la Voz* increased the percentage of at-risk individuals seeking HIV tests to 49.9%, which compares favorably to traditional one-on-one outreach methods which achieved HIV testing coverage of 22.7%. The staff time employed to obtain each HIV test declined from 22.7 hours per test to 3.68 hours (Ramos et al. 2008).

It has been suggested that HIV prevention interventions among IDUs which focus solely on individual-level behavior change can expect to achieve only a partial reduction of HIV transmission risk, perhaps 25%–40% (Blankenship et al. 2000; Coyle et al. 1998) (Heimer et al. 1996). Poundstone (2004) and Rhodes (2005) argue for structural interventions that take into account the risk environment of IDUs (Poundstone et al. 2004; Rhodes 2002). Further, Rhodes and colleagues (2005) contend that structural HIV prevention is unavoidably political in that it calls for community actions and structural changes within a broad agenda concerned with alleviating inequity in health, welfare and human rights. Our findings concur with this broader framework for change, and suggest that interventions aimed at interrupting ongoing transmission of HIV and related infections will need to take into account more than individual level considerations, or simply their geographic location on the Mexico-US border. Since HIV has no passport, HIV/STI prevention, diagnosis and treatment should be a shared responsibility between bordering countries. Considering that one quarter of Mexico's population lives on $2 per day, (WHO 2008) and health care expenditure per capita is $655 in Mexico and ten-fold greater in the U.S., Mexico's northern neighbor should shoulder more of this responsibility.

We recommend that the Mexican governments consider structural changes beyond traditional harm reduction approaches, such as NEPs. Our data support the need for bold approaches to prevention such as medically supervised safer injection facilities (to replace the unhygienic "picaderos" (Cravioto et al. 2003), which have been associated with reductions in high risk behavior in other cities, especially Vancouver, Canada (Kerr et al. 2008). Our data also support the expansion and subsidizing of drug abuse treatment centers. Existing services rarely offer

methadone or buprenorphine maintenance, which the World Health Organization considers to be essential drugs. Expanding these services would be a cost-effective approach to promote recovery from addiction and help IDUs become functional members of the society.

References

Arreola, DD.; Curtis, JR. Mexican border cities: landscape anatomy and place personality. Tucson, AZ: University of Arizona Press; 1993.

Becker MH. The health belief model and personal health behavior. Health Education Monographs. 1974

Blankenship KM, Bray SJ, Merson MH. Structural interventions in public health. AIDS, 14 Suppl 2000;1:S11–S21.

Brouwer KC, Case P, Ramos R, Magis-Rodriguez C, Bucardo J, Patterson TL, Strathdee SA. Trends in production, trafficking, and consumption of methamphetamine and cocaine in Mexico. Subst Use Misuse 2006;41(5):727–727.

Bucardo J, Brouwer KC, Magis-Rodriguez C, Ramos R, Fraga M, Perez SG, Patterson TL, Strathdee SA. Historical trends in the production and consumption of illicit drugs in Mexico: implications for the prevention of blood borne infections. Drug Alcohol Depend 2005;79(3):293–293.

Bucardo J, Semple SJ, Fraga-Vallejo M, Davila W, Patterson TL. A qualitative exploration of female sex work in Tijuana, Mexico. Arch Sex Behav 2004;33(4):351–351.

Case P, Ramos R, Brouwer KC, Firestone-Cruz M, Pollini RA, Fraga MA, Patterson TL, Strathdee SA. At the borders, on the edge: use of injected methamphetamine in Tijuana and Ciudad Juarez, Mexico. J Immigr Minor Health 2008;10(1):33–33.

CONADIC. Consejo Nacional de Adicciones Secretaria de Salud y Asistencia - El consumo de drogas en México: diagnóstico, tendencias y acciones. Secretaría de Salud. 1998

Coyle SL, Needle RH, Normand J. Outreach-based HIV prevention for injecting drug users: a review of published outcome data. Public Health Rep 1998;113(Suppl 1):19–30. [PubMed: 9722807]

Cravioto P, Medina-Mora ME, de la Rosa B, Galvan F, Tapia-Conyer R. Patterns of heroin consumption in a jail on the northern Mexican border: barriers to treatment access. Salud Publica Mex 2003;45 (3):190–190.

Deiss RG, Brouwer KC, Loza O, Lozada RM, Ramos R, Cruz MA, Patterson TL, Heckathorn DD, Frost SD, Strathdee SA. High-risk sexual and drug using behaviors among male injection drug users who have sex with men in 2 Mexico-US border cities. Sex Transm Dis 2008;35(3):249–249.

Drumright LN, Patterson TL, Strathdee SA. Club drugs as causal risk factors for HIV acquisition among men who have sex with men: a review. Subst Use Misuse 2006;41(10–12):1601–1601.

Edgerg, M. El Narcotraficante: narcocorridos and the construction of a cultural persona on the US Mexico Border. University of Texas Press; 2003.

Fishbein, M.; Ajzen, I. Belief, attitude, intention, and behavior: an introduction to theory and research. Reading, MA: Addison-Wesle; 1975.

Frost SD, Brouwer KC, Firestone Cruz MA, Ramos R, Ramos ME, Lozada RM, Magis-Rodriguez C, Strathdee SA. Respondent-driven sampling of injection drug users in two U.S.-Mexico border cities: recruitment dynamics and impact on estimates of HIV and syphilis prevalence. J Urban Health 2006;83(6 Suppl):i83–i97. [PubMed: 17072761]

Heckathorn D. Respondent-driven sampling II: Deriving valid population estimates from chain-referral samples of hidden populations. Social Problems 2002;49:11–34.

Heimer R, Bluthenthal RN, Singer M, Khoshnood K. Structural impediments to operational syringe-exchange programs. AIDS Public Policy J 1996;11(4):184–184.

INEGI. Instituto Nacional de Estadístia y Geografía (2005) Mexico y sus municipios. Instituto Nacional de Estadística. 2005

Janz NK, Becker MH. The Health belief model: a decade later. Health Educ Q 1984;11(1):47–47.

Jazen, I.; Fishbein, M. Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice-Hall; 1980.

Kerr T, Montaner J, Wood E. Supervised injecting facilities: time for scale-up? Lancet 2008;372(9636): 355–355.

Latkin C, Mandell W, Vlahov D, Oziemkowska M, Knowlton A, Celentano D. My place, your place, and no place: behavior settings as a risk factor for HIV-related injection practices of drug users in Baltimore, Maryland. Am J Community Psychol 1994;22(3):430–430.

Magis-Rodriguez C, Brouwer KC, Morales S, Gayet C, Lozada R, Ortiz-Mondragon R, Ricketts EP, Strathdee SA. HIV prevalence and correlates of receptive needle sharing among injection drug users in the Mexican-U.s. border city of Tijuana. J Psychoactive Drugs 2005;37(3):339–339.

Maxwell JC, Cravioto P, Galvan F, Ramirez MC, Wallisch LS, Spence RT. Drug use and risk of HIV/AIDS on the Mexico-USA border: a comparison of treatment admissions in both countries. Drug Alcohol Depend 2006;82(Suppl 1):S85–S93. [PubMed: 16769452]

McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. Health Educ Q 1988;15(4):377–377.

Myers, DJ. Latin American cities: internationally embedded but nationally Influential. Vol. 1. University of New Mexico; 1997.

Patterson TL, Semple SJ, Staines H, Lozada R, Orozovich P, Bucardo J, Philbin MM, Pu M, Fraga M, Amaro H, Torre AL, Martinez G, Magis-Rodriguez C, Strathdee SA. Prevalence and correlates of HIV infection among female sex workers in 2 Mexico-US border cities. J Infect Dis 2008;197(5):732–732.

Pollini RA, Brouwer KC, Lozada RM, Ramos R, Cruz MF, Magis-Rodriguez C, Case P, Burris S, Pu M, Frost SD, Palinkas LA, Miller C, Strathdee SA. Syringe possession arrests are associated with receptive syringe sharing in two Mexico-US border cities. Addiction 2008;103(1):108–108.

Poundstone KE, Strathdee SA, Celentano DD. The social epidemiology of human immunodeficiency virus/acquired immunodeficiency syndrome. Epidemiol Rev 2004;26:22–35. [PubMed: 15234945]

Rachlis B, Brouwer KC, Mills EJ, Hayes M, Kerr T, Hogg RS. Migration and transmission of blood-borne infections among injection drug users: understanding the epidemiologic bridge. Drug Alcohol Depend 2007;90(2–3):119–119.

Ramos RL. Migratory patterns and the spread of HIV across the Mexico United States border. Salud Fronteriza 1990;1:23–32.

Ramos, RL.; Ferreira-Pinto, JB.; Shedlin, M. Migrants and Female Sex Workers: HIV/AIDS in the U.S. Mexico Border. Boulder, CO: Westview Press; 1996.

Ramos RL, Ortega H. HIV prevention among female sex workers. Revista Latinoamericana de Psicologia 1991;2(12):15.

Ramos RL, Shulman LC, Green NL. Pasa la voz: healthy women spread the word about HIV prevention services. Texas Public Health Journal 2008;60:20–22.

Rhodes T. The ‘risk environment’: a framework for understanding and reducing drug-related harm. International Journal of Drug Policy 2002;13:85–94.

Rhodes T, Singer M, Bourgois P, Friedman SR, Strathdee SA. The social structural production of HIV risk among injecting drug users. Soc Sci Med 2005;61(5):1044–1044.

Rhodes T, Stimson GV, Crofts N, Ball A, Dehne K, Khodakevich L. Drug injecting, rapid HIV spread, and the ‘risk environment’: implications for assessment and response. AIDS 1999;13(Suppl A):S259–S269. [PubMed: 10885783]

Riley ED, Gandhi M, Hare C, Cohen J, Hwang S. Poverty, unstable housing, and HIV infection among women living in the United States. Curr HIV/AIDS Rep 2007;4(4):186–186.

Rodriguez CM, Marques LF, Touze G. HIV and injection drug use in Latin America. AIDS 2002;16 (Suppl 3):S34–S41. [PubMed: 12685923]

Rosenstock IM. Why people use health services. Milbank Mem Fund Q 1966;44(3):Suppl-127.

Shedlin, M.; Ramos, RL. Methamphetamine use among male and female populations. XVIII International AIDS Conference; Mexico City, Mexico.

Stokols D. Translating social ecological theory into guidelines for community health promotion. Am J Health Promot 1996;10(4):298–298.

Strathdee SA, Fraga WD, Case P, Firestone M, Brouwer KC, Perez SG, Magis C, Fraga MA. “Vivo para consumirla y la consumo para vivir” [“I live to inject and inject to live”]: high-risk injection behaviors in Tijuana, Mexico. J Urban Health 2005;82(3 Suppl 4):iv58–iv73. [PubMed: 16107441]

Strathdee, SA.; Lozada, R.; Magis-Rodriguez, C.; Abramovitz, D.; Vera, A.; Alvelais, J.; Brouwer, KC.; Pollini, RA. Predictors of needle exchange program utilization during its implementation and expansion in Tijuana, Mexico. International conference on AIDS; Mexico City, Mexico.

Strathdee SA, Lozada R, Ojeda VD, Pollini RA, Brouwer KC, Vera A, Cornelius W, Nguyen L, Magis-Rodriguez C, Patterson TL, Proyecto El Cuete. Differential effects of migration and deportation on HIV infection among male and female injection drug users in Tijuana, Mexico. PLoS ONE 2008;3 (7):e2690. [PubMed: 18665250]

Strathdee SA, Magis-Rodriguez C. Mexico's evolving HIV epidemic. JAMA 2008;300(5):573–573. [PubMed: 18677030]

Strathdee SA, Philbin MM, Semple SJ, Pu M, Orozovich P, Martinez G, Lozada R, Fraga M, de la Torre A, Staines H, Magis-Rodriguez C, Patterson TL. Correlates of injection drug use among female sex workers in two Mexico-U.S. border cities. Drug Alcohol Depend 2008;92(1–3):140–140.

US Department of Transportation. Statistics on U.S. border crossing. Bureau of Transportation Statistics. 2004

US-Mexico Border Health Commission. Healthy border 2010: an agenda for improving health in the United States-Mexico border. US-Mexico Border Health Commission. 2002

Viani RM, Araneta MR, Ruiz-Calderon J, Hubbard P, Lopez G, Chacon-Cruz E, Spector SA. Perinatal HIV counseling and rapid testing in Tijuana, Baja California, Mexico: seroprevalence and correlates of HIV infection. JAIDS 2006;41(1):92–92.

Weaver T. Time, space and articulation in the development of the US-Mexico border. Human Organization 2001;2(60):120–120.

WHO. County profile for Mexico. World Health Organization. 2008

Table 1

Individual, Social and Environmental Influences among Injection Drug Users in Tijuana versus Ciudad Juárez, Mexico

Baseline Characteristics	Total N=428	Tijuana N=222	Cd. Juárez N=206	Odds Ratio\ (95% C.I.)	P-value
Percent unless indicated					
Demographics					
Median age (IQR)	34 (28, 40)	34 (29, 40)	33 (28, 42)	--	0.594
Female	8.2	8.6	7.8	1.11 (0.56–2.22)	0.765
Socio-economic factors					
Completed secondary school	29.7	32.1	27.2	1.27 (0.84–1.92)	0.264
Average monthly income ≥3000 pesos	42.5	39.7	45.4	0.79 (0.53–1.18)	0.256
Sources of income, past 6 months:					
Job with pay	24.5	26.6	22.3	1.26 (0.81–1.96)	0.308
Informal work/odd jobs	56.5	43.7	70.4	0.33 (0.22–0.49)	<0.001
Family/friends	8.4	4.1	13.1	0.28 (0.13–0.61)	0.001
Illegal source (e.g. prostitution, selling drugs etc.)	18.7	22.5	14.6	1.71 (1.04–2.81)	0.035
Social Influences					
Married/common law	26.7	23.0	30.7	0.67 (0.44–1.03)	0.070
Family uses drugs	48.3	42.4	54.6	0.61 (0.42–0.90)	0.012
Migration					
Lived in city of interview < 5 years	13.4	23.3	2.9	10.1 (4.22–24.0)	<0.001
Lived or worked outside Mexico in past 10 years	35.1	39.8	30.1	1.54 (1.03–2.30)	0.035
Deportation from U.S.	8.7	15.5	1.5	12.4 (3.76–41.2)	<0.001*
Structural/environmental vulnerability					
Homeless	46.5	55.4	36.9	2.13 (1.44–3.13)	<0.001
Normally injected drugs outside	15.9	27.1	3.9	9.22 (4.29–19.9)	<0.001
Median (IQR) # hours spent daily on the street	13.5 (10, 24)	20.0 (12, 24)	12 (8, 15.3)	--	<0.001
Normally injected drugs at shooting gallery	38.2	57.0	18.0	6.06 (3.89–9.45)	<0.001
Ever been arrested	93.2	95.9	90.3	2.55 (1.13–5.73)	0.020
Ever arrested for carrying used needle/ syringe	61.2	74.2	46.2	3.35 (2.19–5.10)	<0.001
Mean (SD) # times in jail/prison	1 (0, 3)	1 (0, 3)	1 (0, 2)	--	0.353

Baseline Characteristics	Total N=428	Tijuana N=222	Cd. Juárez N=206	Odds Ratio\ (95% C.I.)	P-value
Ever injected in jail	50.1	57.7	41.4	1.94 (1.30–2.88)	0.001

*Fisher's Exact Test

Table 2

Risk Behaviors of Injection Drug Users in Tijuana versus Ciudad Juárez, Mexico

Baseline Characteristics	**Total N=428**	**Tijuana N=222**	**Cd. Juárez N=206**	**Odds Ratio\ (95% C.I.)**	**P-value**
Percent unless indicated					
Individual risk behaviors					
Median (IQR) duration (years) of injection	12.5 (8, 19)	13 (9, 20)	12 (7, 17)	--	0.200
Receptive needle sharing often or always	27.2	31.7	22.4	1.60 (1.04–2.47)	0.030
Shared injection paraphernalia often or always	41.8	48.5	35.1	1.74 (1.70–2.59)	0.006
Ever had sex with a male (men only)	29.6	45.7	12.6	5.83 (3.50–9.70)	<0.001
In past 6 months, **sold** sex in exchange for money, drugs, goods or shelter*	15.2	19.8	9.6	2.32 (1.20–4.51)	0.011
In past 6 months, **bought** sex in exchange for money, drugs, goods or shelter*	15.2	12.4	18.5	0.63 (0.34–1.15)	0.131
Drugs Ever Used					
Used inhalants like glue, gasoline	59.2	61.1	57.1	1.18 (0.80–1.74)	0.400
Marijuana/Hash	89.5	89.6	89.3	1.03 (0.56–1.92)	0.914
Swallowed tranquilizers (e.g. Diazepam, Valium, Ativan)	63.6	65.2	62.0	1.15 (0.77–1.71)	0.492
Smoked Heroin	32.2	37.2	26.3	1.68 (1.11–2.54)	0.013
Chased heroin by itself	11.3	11.3	11.3	1.00 (0.55–1.83)	0.990
Smoked crack cocaine	49.6	57.9	40.8	2.00 (1.36–2.94)	<0.001
Smoked/inhaled methamphetamines	49.5	80.1	16.6	20.2 (12.3–33.2)	<0.001
Injected heroin by itself	98.1	98.2	98.1	1.08 (0.27–4.37)	0.915
Injected cocaine by itself	68.7	68.5	68.9	0.98 (0.65–1.47)	0.918
Injected cocaine and heroin combined	72.6	72.9	72.3	1.03 (0.67–1.57)	0.904
Injected methamphetamine by itself	36.7	66.2	4.9	38.4 (19.2–76.9)	<0.001
Injected methamphetamine and heroin combined	42.9	80.5	2.4	166 (64.5–429)	<0.001**

*N=177 for Tijuana and N=146 for Cd. Juárez

**Fisher's Exact Test

Table 3

Protective Behaviors, Attitudes and Health Status among Injection Drug Users in Ciudad Juárez and Tijuana, Mexico

Baseline Characteristics	**Total N=428**	**Tijuana N=222**	**Cd. Juárez N=206**	**Odds Ratio (95% C.I.)**	**P-value**
Percent unless indicated					
Knowledge of risks					
Knows how HIV is transmitted (self-reported)	89.0	88.7	89.3	0.94 (0.51–1.73)	0.848
Knows how hepatitis C is transmitted (self- reported)	36.7	39.0	34.2	1.23 (0.83–1.84)	0.308
Personally knows an HIV-positive person	48.0	62.9	32.0	3.60 (2.41–5.37)	<0.001
Higher perceived risk of HIV infection compared to others	67.1	72.8	60.7	1.73 (1.14–2.63)	0.010
Preventive Individual Behaviors					
Used new/sterile needles/syringes often or always in last 6 months	41.1	39.5	42.7	0.88 (0.60–1.29)	0.506
Cleaned needles/syringes often or always in last 6 months	53.4	61.1	45.1	1.91 (1.30–2.81)	0.001
Obtained syringes most often from pharmacies (last 6 months)	85.5	79.2	92.2	3.12 (1.71–5.72)	<0.001
Of those aware of NEPs, used NEPs in last 6 months*	68.8	87.5	59.4	4.79 (0.93– 24.72)	0.048
Structural/Environmental Protection					
Aware of any needle or syringe exchange programs area	11.0	7.2	15.1	0.44 (0.23–0.82)	0.009
Ever tested for HIV	34.1	37.8	30.1	1.41 (0.95–2.16)	0.091
Ever received drug treatment	47.5	50.2	44.7	1.25 (0.85–1.83)	0.250
Received medical attention in last 6 months	75.3	71.1	79.3	0.64 (0.40–1.02)	0.060
Health status *(Crude/RDS adjusted (95%CI))*					
Hepatitis C antibody positive	96.0	96.5/97.2 (93.8–99.5)	95.5/95.8 (92.7–98.4)	1.24 (0.47–3.27)	0.669
Ever diagnosed with a STI	6.4	9.5	3.0	3.43 (1.36–8.68)	0.006
Syphilis antibody positive	9.2	14.1/26.0 (11.3–39.3)	3.6/3.1 (0.7–6.4)	4.36 (1.87–10.1)	<0.001
Syphilis antibody titer of ≥1:8	4.8	6.8/12.1 (1.8–23.5)	2.6/2.6 (0.4–5.6)	2.77 (0.99–7.76)	0.064**
HIV-positive	2.9	2.7/0.6 (0.1–1.4)	3.0/3.0 (0.05–5.9)	0.91 (0.29–2.87)	0.874

N=16 for Tijuana and N=32 for Cd. Juárez

** Fisher's Exact Test