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The Harm Inside: Injection during incarceration among male injection drug users in Tijuana, Mexico

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Abstract

Limited access to sterile syringes and condoms in correctional facilities make these settings high risk environments for HIV transmission. Although incarceration among injection drug users (IDUs) is common, there is limited information regarding specific IDU risk behaviors inside. We examined correlates of incarceration, injection inside and syringe sharing inside among male IDUs recruited in Tijuana, Mexico, using respondent driven sampling (RDS) (n=898). An interviewer administered survey collected data on sociodemographic, behavioral and contextual characteristics. Associations with a) history of incarceration, b) injection inside, and c) syringe sharing inside were identified using univariate and multiple logistic regression models with RDS adjustment. Seventy-six percent of IDUs had been incarcerated, of whom 61% injected inside. Three quarters (75%) of those who injected shared syringes. U.S. deportation [adjusted odds ratio (AOR)=1.61; 95% confidence interval (CI): 1.07, 2.43] and migration (AOR=1.81; 95% CI: 1.12, 2.95) were independently associated with incarceration. Injection inside was independently associated with recent receptive syringe sharing (AOR=2.46; 95% CI: 1.75, 3.45) and having sex with a man while incarcerated (AOR=43.59; 95% CI: 1.65, 7.83). Sharing syringes inside was independently associated with having sex with a man while incarcerated (AOR=6.18; 95% CI: 1.78, 21.49). A majority of incarcerated IDUs reported injecting and syringe sharing during incarceration, and these IDUs were more likely to engage in sex with other men. Corrections-based interventions to reduce injection and syringe sharing are urgently needed, as are risk reduction interventions for male IDUs who have sex with men while incarcerated.

Keywords

IDU; incarceration; Mexico; deportation; needle sharing

1. Introduction

Incarceration is a common component of the life histories of injection drug users (IDUs). As many as 75–90% of IDUs report ever being incarcerated (Ball et al., 1994; Normand J. et al.,

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1995; Wood et al., 2005) and many report multiple incarcerations. In addition, IDUs are overrepresented among prisoners, accounting for as much as 25–40% of the prison population despite constituting <1% of the overall population in most countries (Vlahov and Putnam, 2006). Despite high rates of incarceration, however, few if any studies have looked at factors associated with incarceration among IDUs.

Once incarcerated, some IDUs continue to inject drugs on the inside. The World Health Organization (WHO) estimates that anywhere from 2% to 74% of prisoners inject drugs during their incarceration (World Health Organization, 2007); studies of IDUs document levels of injection inside from 16–65% (Covell et al., 1993; Kennedy et al., 1991; Koulierakis et al., 2000; Millson et al., 1995; Power et al., 1992; Thaisri et al., 2003; Wood et al., 2005). Lower prevalence estimates have generally been observed among current prisoners (Calzavara et al., 2003; Dufour et al., 1996; Van Haastrecht et al., 1998), who may be more reluctant to report injection inside than those who have already been released. There is also evidence that prisoners who did not inject prior to their incarceration may initiate injection behind bars, as has been reported in Ireland, Scotland, Canada, Russia and elsewhere (Allwright et al., 2000; Calzavara et al., 2003; Gore et al., 1997; Gore et al., 1995; Sarang et al., 2006).

Although illicit drugs are often available inside sterile syringes are not, making injection behind bars a significant public health concern. Qualitative studies describe prisons as environments in which a single syringe can circulate widely, being stored and re-used for months or years among large numbers inmates (Sarang et al., 2006; Small et al., 2005). Most quantitative studies have found that $\geq 60\%$ of IDUs who inject inside also share syringes (World Health Organization, 2007). Despite recommendations by the WHO, the Joint United Nations Program on HIV/AIDS (UNAIDS), and the United Nations Office on Drugs and Crime (UNODC) that prisoners be afforded at least the same access to sterile syringes as they would have in the community (United Nations office on Drugs and Crime, 2006), prison-based syringe exchange programs (SEPs) remain relatively rare. The majority of prison-based SEPs are located in Western Europe (e.g., Switzerland, Germany, Spain), although some have been initiated in former Soviet Republics such as Moldova, Kyrgyzstan, and Belarus (Davies, 2004; Dolan et al., 2003; Lines et al., 2005). In areas where prison-based SEPs have been established, these programs are considered to be of insufficient size or number to meet demand.

The combination of high injection rates and limited access to sterile syringes within prisons creates high risk environments for the transmission of HIV and other bloodborne pathogens. Transmission risk is heightened by the fact that HIV prevalence in prisons is usually much higher than in the general population (Jurgens and Betteridge, 2005). At least 20 low- and middle-income countries have documented HIV prevalence among IDUs in prison of 10% or more (Dolan et al., 2007). Prevalence in higher income countries is generally low but can vary significantly by facility or geographic area. For example, although the prevalence of HIV among the U.S. prisoners is 2% overall, prevalence among New York prisoners is 7% (Maruschak, 2006). HIV transmission during incarceration has been documented in countries including Scotland (Taylor et al., 1995), Australia (Dolan and Wodak, 1999), the and United States (Brewer et al., 1988; Horsburgh et al., 1990; Macalino et al., 2004).

Mexico's prison population has more than doubled since the mid 1990's, from 93,574 in 1995 to 212,841 in 2007 (Kings College London, 2008). This growth has been attributed to both rising crime rates and changes in sentencing procedures, particularly a 1994 Mexican criminal code reform that increased sentences associated with some crimes and removed the possibility of parole for others, including crimes against health ("delitos contra el salud") and drug trafficking (Azaola and Bergman, 2007). Despite the increases in drug-related incarcerations that resulted from this reform, data on injection drug use within Mexican prisons is limited. A study by Magis Rodriguez (Magis Rodriguez et al., 2002) estimated that IDUs comprise 24–

45% of prisoners in Mexican cities adjacent to the Mexico-U.S. border and that 40% to 83% of these prisoners have shared syringes inside. HIV prevalence among prisoners has been estimated at 0.6% in the state of Durango (Alvarado-Esquivel et al., 2005) and 1.3% and 2.5% in the Mexico-U.S. border cities of Ciudad Juarez and Tijuana, respectively (Magis-Rodriguez et al., 2000). In the latter study, all HIV-positive inmates had a history of injection drug use. In terms of interventions, syringe exchange programs were implemented on an informal, sporadic basis in prisons in the northern border cities of Ciudad Juarez and Tijuana, but were discontinued when the wardens who approved them were replaced and permission to continue the programs could not be obtained from their replacements (Ramos and Lozada, personal communications, 2008).

Given the dearth of information on incarceration and injection during incarceration among IDUs in Mexico, we investigated these risk behaviors within a cohort of IDUs in Tijuana, Mexico. In this paper, we describe the prevalence and correlates of incarceration, injection inside and syringe sharing inside to inform the development of future interventions.

2. Methods

2.1 Setting

The city of Tijuana, Mexico has a population of approximately 1.4 million persons (Instituto Nacional de Estadística Geografía e Informática, 2000) and is linked to San Diego, California, USA, by the San Ysidro border crossing. San Ysidro is the busiest border crossing in the world, accommodating more than >40 million legal border crossings annually (Bureau of Transportation Statistics Intermodal Transportation Database, 2008). In addition to legal crossings, the Tijuana-San Diego corridor constitutes a major drug trafficking route that transports heroin, methamphetamine, cocaine and other drugs from South America and Mexico northward to the U.S. (Brouwer et al., 2006a; Bucardo et al., 2005). Heightened border security has led to a “spillover” effect, whereby drugs that are not successfully transported to the U.S. are sold cheaply in Tijuana. These conditions have contributed to growth in both injection drug use and HIV infection. There are an estimated 10,000 IDUs living in Tijuana (Magis-Rodriguez et al., 2005), and as many as 1 in every 125 Tijuana residents ages 15–49 years is infected with HIV (Brouwer et al., 2006b).

2.2 Study population

Between April 2006 and April 2007, IDUs in Tijuana were recruited into a prospective study of behavioral and contextual factors associated with HIV, syphilis and TB infections (Strathdee et al., 2008a). Eligibility criteria included being age ≥ 18 years, having injected illicit drugs within the past month, ability to speak Spanish or English, being able to provide informed consent, and having no plans to permanently move out of the city in the following 18 months. The protocol was approved by the Institutional Review Boards of the University of California, San Diego and the Tijuana General Hospital.

Respondent-driven sampling (RDS) was used to recruit participants (Heckathorn, 1997). RDS is a peer referral method that allows researchers to track recruitment networks and apply statistical methods based upon analysis of network structure to provide both unbiased population estimates and measures of precision of those estimates. For this study, a diverse group of “seeds” (heterogeneous by age, gender and neighborhood) was selected and given uniquely coded coupons to refer their peers to the study. Waves of recruitment continued as subjects returning with their coupons were each given coupons to recruit further members of their own social networks. Recruitment and interviews were conducted by indigenous outreach workers through the use of a modified recreational vehicle and a storefront office.

A total of 1,056 IDUs were enrolled, of whom 898 (85%) were male. Given the generally lower prevalence of both drug use and injection among women, we sought to oversample female IDUs by offering seeds higher reimbursement for eligible female recruits than males (\$6 vs. \$5) and offering all female recruits 6 coupons to recruit their peers (vs. 3 coupons for each male recruit). Nonetheless, only 15% of enrolled subjects were female. We restricted this analysis to male participants because the small number of females who had been incarcerated (n=72) did not allow for meaningful analysis of their drug use behaviors during incarceration.

2.3 Data collection

Once enrolled, IDUs completed an interviewer-administered questionnaire eliciting information on sociodemographic, behavioral and contextual characteristics. The questionnaire also contained detailed questions on criminal justice history, including questions on interactions with police and experiences in jail or prison. The primary outcome variables of interest were based on response to the following three questions: a) “How many times in your life have you ever been in jail or prison?” which was converted into a binary (ever/never) variable; b) among those who had been in jail/prison “Did you ever inject drugs while in jail or prison?”; and c) among those who had injected while in jail/prison, “Did you ever use a needle/syringe while you were in jail or prison that someone else had already used before you?” For the purposes of this analysis, being in jail or prison is referred to as “incarceration” and using a needle/syringe that someone else had used before is referred to as “receptive syringe sharing.”

2.4 Statistical analysis

Separate analyses were undertaken for each of the three binary outcome variables. In each case, univariate logistic regression was used to identify variables associated with the outcome of interest at a level of significance $P \leq 0.10$. Variables that achieved this level of significance were entered into a multiple logistic regression model in a manual stepwise fashion, starting with those with the lowest P -value and proceeding through those with the highest value, to identify factors associated independently with the outcome. The likelihood ratio test was used to compare nested models to determine which variables were retained in multivariable models at a significance level of <5%. Interactions were explored for each of the variables retained in the final models.

We also explored potential effects of RDS on each of our three models. The RDS Analysis Tool (version 5.6.0; Cornell University, New York, NY, October 2006) was used to assess potential bias introduced by the non-random selection of seeds and a random effects logistic regression model using WinBUGS (version 1.4.1; Imperial College and Medical Research Council, United Kingdom, 2004) was used to identify effects that might arise from correlation between recruiters and recruits. A detailed account of these adjustment methods has been published previously (Strathdee et al., 2008b). The results of the RDS-adjusted and unadjusted models yielded similar estimates and we present the RDS-adjusted models herein.

3. Results

3.1 Study population

The median age of the 898 study participants was 36 years (interquartile range (IQR): 31–42 years). Most (68%) were born outside the state of Baja California, where Tijuana is located, and 42% reported being in Tijuana because they were deported from the U.S. Forty percent had graduated from secondary school and most (62%) cited informal employment or odd jobs as their primary source of income while 29% had a legal job with pay. A majority (51%) were never married. Twenty-one percent had been homeless in the past 6 months. Almost all (99%)

were current heroin injectors, 59% injected methamphetamine and 17% injected cocaine (either alone or in combination). Median years since first injection was 14 (IQR: 9–22).

Overall, 682 (76%) of the 898 study participants reported ever being incarcerated (RDS adjusted prevalence 0.74; 95% CI: 0.70, 0.78). The median number of incarcerations was 2 (IQR: 1–4). Almost all (94%) said it had been >6 months since their most recent incarceration. Among those ever incarcerated, 416 (61%) reported injecting while incarcerated (RDS adjusted prevalence 0.54; 95% CI: 0.42, 0.58); of these, 311 (75%) reported receptive syringe sharing while inside (RDS adjusted prevalence 0.71; 95% CI: 0.72, 0.85).

3.2 Factors associated with incarceration

Univariate associations with incarceration are presented in Table 1, Column a. IDUs who reported incarceration were more likely to have ever traveled to the U.S. compared to those who had not been incarcerated (83% vs. 71%) and were more likely to be living in Tijuana because they had been deported (46% vs. 30%). They were also more likely to have ever injected cocaine, either alone (60% vs. 46%) or in combination with heroin (64% vs. 49%); to ever inject methamphetamine alone (56% vs. 46%); and to have a longer history of injection (15 vs. 12 years). While most IDUs did not report recent cocaine injection, those with an incarceration history were significantly more likely to report injecting methamphetamine by itself in the past 6 months (38% vs. 28%) and to inject daily (85% vs. 79%). Formerly incarcerated IDUs were also more likely to report drug-related arrests, including arrest for possessing sterile syringes (38% vs. 28%), used syringes (43% vs. 35%), drugs (38% vs. 24%) and for having track marks (60% vs. 51%).

Table 2, Column a presents the multiple logistic regression model for factors independently associated with incarceration. These included ever traveling to the U.S.; being deported; having a longer injection history; recently injecting methamphetamine by itself; and ever being arrested for carrying drugs.

3.3 Factors associated with injecting drugs during incarceration

Univariate associations with injection during incarceration are presented in Table 1, Column b. IDUs who injected inside were significantly younger than those who had never injected inside (median: 36 vs. 38 years). They were also less mobile; 80% had traveled to the U.S. compared to 87% of those who had never injected inside, and fewer had been deported (40% vs. 55%). Those who injected inside had more varied drug use histories; they were more likely to have ever injected cocaine alone (66% vs. 50%), methamphetamine alone (60% vs. 48%), speedball (71% vs. 54%), and heroin and methamphetamine together (64% vs. 53%), and to report injecting methamphetamine alone (43% vs. 29%) or in combination with heroin (62% vs. 48%) in the past 6 months. They were more likely to engage in receptive syringe sharing in the past 6 months (71% vs. 49%) and to report a variety of drug-related interactions with police. These included ever being arrested for possessing used (49% vs. 34%) or unused (44% vs. 28%) syringes; having track marks (64% vs. 54%); and carrying drugs (43% vs. 29%). They were also more likely to report multiple incarcerations (76% vs. 66%) and almost four times as likely to report having sex with a man while incarcerated (11% vs. 3%).

The multiple logistic regression model presented in Table 2, Column b, shows that injecting drugs during incarceration was independently associated with ever injecting speedball, longer injection history, receptive syringe sharing in the past 6 months, arrest for sterile syringe possession and having sex with a man while incarcerated.

3.4 Factors associated with receptive syringe sharing during incarceration

Table 1, Column c, shows the univariate analysis for ever engaging in receptive syringe sharing during incarceration. IDUs who reported receptive sharing inside were more likely to have been homeless in the past 6 months (27% vs. 17%), to inject heroin by itself (99% vs. 95%), and to inject daily (89% vs. 78%). Those who had ever shared syringes inside were also more likely to have engaged in receptive syringe sharing in the past 6 months (74% vs. 62%), cite shooting galleries as their most common injection venue (32% vs. 19%) and report having sex with a man while they were incarcerated (14% vs. 3%).

The multiple logistic regression model in Table 2, Column c, shows that younger age, injecting heroin alone, injecting daily, injecting most often in a shooting gallery, having had multiple incarcerations and having sex with a man while incarcerated were all independently associated with receptive sharing inside.

4. Discussion

We documented high levels of incarceration among male IDUs in Tijuana, Mexico, as well as high levels of injection and syringe sharing during incarceration. Specifically, three quarters of male IDUs living in Tijuana had been incarcerated, of whom over half had injected drugs inside. Three quarters of those who injected inside also shared syringes.

The level of injection during incarceration documented in this study is relatively high compared to others studies, with a few notable exceptions: a prison-based study of 123 IDUs in Edinburgh that found a 67% prevalence of injection during incarceration (Dye and Isaacs, 1991), a community-based study of 50 IDUs in London that found a 66% prevalence of injection during incarceration (Carvell and Hart, 1990), and a study conducted in 10 Greek prisons that found 60% of 290 IDUs injected while incarcerated (Koulierakis et al., 2000). The high level of injection inside found in our study may be attributed in part to inefficiencies and lack of resources in the Mexican prison system in general, which are described as “fostering high levels of corruption in all its forms and modalities...[including] the introduction, sale and consumption of drugs” (Azaola and Bergman, 2007). This suggests that structural changes are needed to reduce illicit drug supplies and opportunities for drug use in jails and prisons in Tijuana and perhaps elsewhere in Mexico. The establishment of drug treatment programs within the correctional system, including opiate substitution therapies, can also reduce injection during incarceration (Dolan et al., 1996; Dolan et al., 1998; Heimer R. et al., 2005; Stallwitz and Stover, 2007). Unfortunately, we are unaware of any prison-based treatment programs in Mexico that incorporate the use of methadone, buprenorphine or other therapies for opiate dependence.

In contrast, high levels of sharing among those who inject while incarcerated is not unique to IDUs in Tijuana; in fact, most studies of syringe sharing inside have found that a large majority of IDUs who inject inside also share syringes (World Health Organization, 2007). In recent years, the Mexican government has taken steps toward expanding sterile syringe access in the community, funding syringe exchange vans in all 31 states and the Federal District where the capital Mexico City is located. Although the WHO, UNAIDS and UNODC recommend that prisoners be afforded at least the same access to sterile syringes as they would have in the community (United Nations office on Drugs and Crime, 2006), we are not aware of any prison-based syringe exchange programs currently operating in Mexico. These programs have been proven effective elsewhere in reducing syringe sharing behind bars without unintended negative consequences (Dolan et al., 2003; Lines et al., 2005; Stöver, 2003), and their implementation in correctional facilities should be a priority for HIV prevention efforts in Mexico. Since HIV prevalence is currently only 3% among male IDUs in Tijuana (Strathdee

et al., 2008a), there is ample opportunity to intervene by re-initiating SEPs and establishing drug treatment programs within the correctional system.

With regard to incarceration overall, IDUs with a history of migrating to the U.S or being deported from the U.S. shouldered a disproportionate burden. Almost half of the male IDUs in our study were living in Tijuana because they were deported from the U.S., and deportees were twice as likely to have a history of incarceration. Similarly, IDUs who had ever traveled to the U.S. were significantly more likely to have a history of incarceration. In a prior study (Strathdee et al., 2008a) we documented an independent association between deportation and prevalent HIV infection among male IDUs, although we could not determine whether these infections were more likely to have occurred in the U.S. or Mexico. Trans-border mobility has also been identified as an important risk factor in the acquisition of several communicable diseases including HIV (Hawkes and Hart, 1993; Mayer, 2000; McMichael, 2004; Soslone and Shtarkshall, 2002). The contribution that incarceration makes to the overall HIV risk scenario for U.S. deportees and migrants in Tijuana remains unclear. More research is required to characterize the circumstances under which deportees and migrants are incarcerated and the role of incarceration in their HIV risk, substance use trajectories and other adverse health experiences. In particular, the possibility that deportation contributes to the initiation or intensification of injection drug use and other HIV risk behaviors should be examined.

An important finding of our study was that IDUs who injected inside were significantly more likely to report having sex with a man during their incarceration. We also found an independent association between syringe sharing inside and having sex with a man inside, suggesting the existence of a group of IDUs who are at risk of HIV through both parenteral and sexual transmission during their incarceration. Prior community-based studies have found that men who have sex with men and also inject drugs (MSM-IDU) engage in riskier injection behaviors than non-MSM IDUs, including sharing syringes and injecting in shooting galleries (Celentano et al., 1991; Strathdee et al., 1997), and are at higher risk of HIV seroconversion (Kral et al., 2001; Shafer et al., 2002; Strathdee and Sherman, 2003). The importance of recognizing these dual transmission pathways and finding ways to provide access to condoms in addition to sterile syringes during incarceration cannot be understated. Further, additional research is needed to better characterize the circumstances under which IDUs have sex with other men in prison settings, particularly if it is done in exchange for drugs.

Another important finding of this study is the independent association between ever injecting while incarcerated and recent receptive syringe sharing. This suggests the possibility that injecting inside, where access to sterile syringes is limited and syringe sharing is common, may normalize syringe sharing behaviors and contribute to a higher likelihood of sharing after release. Given that most studies of incarceration and HIV risk are cross-sectional, prospective studies are needed to explore this hypothesized association. One study among IDUs in Australia (Dolan et al., 1996) found that although syringe sharing increased during incarceration, it returned to lower pre-incarceration levels after release. However, this was a small case-control study enrolling only 185 participants. Because of the complexity of the question, qualitative studies examining incarceration experiences and their role HIV risk behaviors and drug use trajectories would also be valuable.

In considering this hypothesized association between injection inside and recent syringe sharing, one might argue that incarceration increases fear of re-arrest after release, forcing IDUs underground and making it more likely that they will inject in shooting galleries, where syringes are commonly rented or shared, or to rush injections due to fear of police. Numerous studies, including two by our team in Tijuana (Miller et al., 2008; Pollini et al., 2008), have shown a relationship between fear of police or prior arrest for syringe possession and risky injection behaviors (Aitken et al., 2002; Cooper et al., 2005; Dovey et al., 2001; Rhodes et al.,

2003). However, we did not find an independent relationship between *incarceration* and recent receptive syringe sharing in this study, only injection during incarceration, which suggests that it is not incarceration itself that drives this association. Receptive syringe sharing during incarceration and recent syringe sharing were not independently associated with each other; however, this may in part be attributed to low power given the small number of IDUs who reported not sharing syringes despite injecting inside.

Our study is based on IDU self-report, which is subject to misreporting but has been found in prior studies to be highly reliable and valid (Darke, 1998). We did not enroll IDUs incarcerated at baseline and thus our findings may not represent the experiences of all IDUs with a history of incarceration. Similarly, our study enrolled only IDUs living in Tijuana and its results may not be generalizable to IDUs elsewhere. Because we asked about jail and prison in combination, we were not able to differentiate between these two settings. We did not ask the locations of the reported incarceration events, i.e., whether they were in Tijuana, elsewhere in Mexico, or even in the United States. We also did not ask when incarcerations took place beyond asking whether participants were incarcerated in the past 6 months. Accordingly, it is difficult to establish temporality between our outcome variables and covariates of interest. We were not able to discern from our data whether men who had sex with men while incarcerated also had sex with men outside of prison, which has implications for targeting sexual risk reduction behind bars. Finally, although we asked if syringes were shared during incarceration we did not ask whether efforts were made to clean the syringes between uses. However, we are unaware of any bleach distribution programs in jails and prisons in Tijuana, elsewhere in Mexico or in the United States, and cleaning with bleach is recommended only as a second-line strategy where syringe exchange is not an option (World Health Organization, 2007).

In summary, this study found that incarceration, injection during incarceration and syringe sharing inside were common among IDUs in Tijuana. Comprehensive HIV prevention programs that incorporate sterile syringe access are urgently needed to reduce the risk of HIV transmission during incarceration in Mexico. Additional research on the circumstances under which male IDUs engage in sex during incarceration is needed, as is research on whether injection inside, where syringes are commonly shared, contributes to high risk injection practices after release.

References

- Aitken C, Moore D, Higgs P, Kelsall J, Kerger M. The impact of a police crackdown on a street drug scene: evidence from the street. *Int J Drug Policy* 2002;13:193–202.
- Allwright S, Bradley F, Long J, Barry J, Thornton L, Parry JV. Prevalence of antibodies to hepatitis B, hepatitis C, and HIV and risk factors in Irish prisoners: results of a national cross sectional survey. *BMJ* 2000;321:78–82. [PubMed: 10884256]
- Alvarado-Esquivel C, Sablon E, Martinez-Garcia S, Estrada-Martinez S. Hepatitis virus and HIV infections in inmates of a state correctional facility in Mexico. *Epidemiol Infect* 2005;133:679–685. [PubMed: 16050514]
- Azaola, E.; Bergman, M. The Mexican Prison System. In: Cornelius, WASDA., editor. *Reforming the Administration of Justice in Mexico*. University of Notre Dame Press; Notre Dame, Indiana: 2007. p. 91-114.
- Ball, A.; Des Jarlais, DC.; Donoghoe, MC.; Friedman, SR.; Goldberg, D.; Hunter, GM.; Stimson, GV.; Wodak, A. *Multi-city study on drug injecting and risk of HIV infection*. World Health Organization; Geneva, Switzerland: 1994.
- Brewer TF, Vlahov D, Taylor E, Hall D, Munoz A, Polk F. Transmission of HIV-1 within a state-wide prison system. *AIDS* 1988;2:363–367. [PubMed: 3146264]
- 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* 2006a;41:707–727. [PubMed: 16603456]

- Brouwer KC, Strathdee SA, Magis-Rodriguez C, Bravo-Garcia E, Gayet C, Patterson TL, Bertozzi SM, Hogg RS. Estimated numbers of men and women infected with HIV/AIDS in Tijuana, Mexico. *J Urban Health* 2006b;83:299–307. [PubMed: 16736378]
- 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;79:281–293. [PubMed: 16102372]
- Bureau of Transportation Statistics Intermodal Transportation Database. 2008 [Accessed on, 16 September, 2008]. <http://www.transtats.bts.gov/bordercrossing.aspx>
- Calzavara LM, Burchell AN, Schlossberg J, Myers T, Escobar M, Wallace E, Major C, Strike C, Millson M. Prior opiate injection and incarceration history predict injection drug use among inmates. *Addiction* 2003;98:1257–1265. [PubMed: 12930213]
- Carvell ALM, Hart GJ. Risk behaviors for HIV-Infection among drug-users in prison. *BMJ* 1990;300:1383–1384. [PubMed: 2372588]
- Celentano DD, Vlahov D, Cohn S, Anthony JC, Solomon L, Nelson KE. Risk-factors for shooting gallery use and cessation among intravenous-drug-users. *Am J Public Health* 1991;81:1291–1295. [PubMed: 1928528]
- Cooper H, Moore L, Gruskin S, Krieger N. The impact of a police drug crackdown on drug injectors' ability to practice harm reduction: A qualitative study. *Soc Sci Med* 2005;61:673–684. [PubMed: 15899325]
- Covell RG, Frischer M, Taylor A, Goldberg D, Green S, McKeganey N, Bloor M. Prison experience of injecting drug users in Glasgow. *Drug Alcohol Depend* 1993;32:9–14. [PubMed: 8486087]
- Darke S. Self-report among injecting drug users: a review. *Drug Alcohol Depend* 1998;51:253–263. [PubMed: 9787998]
- Davies R. Prison's second death row. *Lancet* 2004;364:317–318. [PubMed: 15279001]
- Dolan K, Kite B, Black E, Aceijas C, Stimson GV. HIV in prison in low-income and middle-income countries. *Lancet Infect Dis* 2007;7:32–41. [PubMed: 17182342]
- Dolan K, Rutter S, Wodak AD. Prison-based syringe exchange programmes: a review of international research and development. *Addiction* 2003;98:153–158. [PubMed: 12534419]
- Dolan K, Wodak A, Hall W, Gaughwin M, Rae F. HIV risk behaviour of IDUs before, during and after imprisonment in New South Wales. *Addiction Research* 1996;4:151–160.
- Dolan KA, Wodak A. HIV transmission in a prison system in an Australian State. *Med J Aust* 1999;171:14–17. [PubMed: 10451665]
- Dolan KA, Wodak AD, Hall WD. Methadone maintenance treatment reduces heroin injection in New South Wales prisons. *Drug Alcohol Rev* 1998;17:153–158. [PubMed: 16203480]
- Dovey K, Fitzgerald J, Choi YJ. Safety becomes danger: dilemmas of drug-use in public space. *Health Place* 2001;7:319–331. [PubMed: 11682331]
- Dufour A, Alary M, Poulin C, Allard F, Noel L, Trottier G. Prevalence and risk behaviours for HIV infection among inmates of a provincial prison in Quebec City. *AIDS* 1996;10:1009–1015. [PubMed: 8853735]
- Dye S, Isaacs C. Intravenous drug misuse among prison inmates: implications for spread of HIV. *BMJ* 1991;302:1506–1506. [PubMed: 1855020]
- Gore SM, Bird AG, Burns S, Ross AJ, Goldberg D. Anonymous HIV surveillance with risk-factor elicitation: At Perth (for men) and Cornton Vale (for women) prisons in Scotland. *Int J STD AIDS* 1997;8:166–175. [PubMed: 9089027]
- Gore SM, Bird AG, Ross AJ. Prison rites: starting to inject inside. *BMJ* 1995;311:1135–1136. [PubMed: 7580709]
- Hawkes SJ, Hart GJ. Travel, migration and HIV. *AIDS Care* 1993;5:207–214. [PubMed: 8329484]
- Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. *Social Problems* 1997;44:174–199.
- Heimer R, Zambrano JA, Brunet A, Ortiz AM, Catania H, Newman RG. Methadone maintenance in a men's prison in Puerto Rico: A pilot program. *Journal of Correctional Health Care* 2005;11:295–305.

- Horsburgh CR, Jarvis JQ, McArthur T, Ignacio T, Stock P. Seroconversion to human immunodeficiency virus in prison inmates. *Am J Public Health* 1990;80:209–210. [PubMed: 2297070]
- Instituto Nacional de Estadística Geografía e Informática. XII Censo General de Población y Vivienda; Mexico. 2000.
- Jurgens R, Betteridge G. Prisoners who inject drugs: public health and human rights imperatives. *Health Hum Rights* 2005;8:46–74. [PubMed: 17136903]
- Kennedy DH, Nair G, Elliott L, Ditton J. Drug misuse and sharing of needles in Scottish prisons. *BMJ* 1991;302:1507. [PubMed: 1855021]
- Kings College London. World Prison Brief Online. 2008 [Accessed on, September 15 2008]. <http://www.kcl.ac.uk/depsta/law/research/icps/worldbrief>
- Koulierakis G, Gnardellis C, Agrafiotis D, Power KG. HIV risk behaviour correlates among injecting drug users in Greek prisons. *Addiction* 2000;95:1207–1216. [PubMed: 11092068]
- Kral AH, Bluthenthal RN, Lorrivick J, Gee L, Bacchetti P, Edlin BR. Sexual transmission of HIV-1 among injection drug users in San Francisco, USA: risk-factor analysis. *Lancet* 2001;357:1397–1401. [PubMed: 11356437]
- Lines R, Jürgens R, Betteridge G, Stöver H. Taking action to reduce injecting drug-related harms in prisons: the evidence of effectiveness of prison needle exchange in six countries. *Int J Prison Health* 2005;1:49–64.
- Macalino GE, Vlahov D, Sanford-Colby S, Patel S, Sabin K, Salas C, Rich JD. Prevalence and incidence of HIV, hepatitis B virus, and hepatitis C virus infections among males in Rhode Island prisons. *Am J Public Health* 2004;94:1847–1847.
- 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-US border city of Tijuana. *J Psychoactive Drugs* 2005;37:333–339. [PubMed: 16295018]
- Magis-Rodriguez, C.; Ruiz-Badillo, A.; Ortiz Mondragon, R.; Lozada, R.; Ramos, R.; Ramos, M.; Ferreira-Pinto, J. Injecting drug use and HIV/AIDS in two jails of the north border of Mexico. International Conference on AIDS; July 9–14; Durban, South Africa. 2000. Abstract no. ThPeD5469
- Magis Rodriguez C, Marques LF, Touze G. HIV and injection drug use in Latin America. *AIDS* 2002;16:S34–S41. [PubMed: 12685923]
- Maruschak, L. HIV in Prisons, 2004. Washington DC: US Department of Justice; 2006.
- Mayer JD. Geography, ecology and emerging infectious diseases. *Soc Sci Med* 2000;50:937–952. [PubMed: 10714918]
- McMichael AJ. Environmental and social influences on emerging infectious diseases: past, present and future. *Philos Trans R Soc Lond B Biol Sci* 2004;359:1049–1058. [PubMed: 15306389]
- Miller CL, Firestone M, Ramos R, Burris S, Ramos ME, Case P, Brouwer K, Fraga M, Strathdee S. Injecting drug users' experiences of policing practices in two Mexican-U.S. border cities: public health perspectives. *Int J Drug Policy* 2008;19:193–202.
- Millson P, Myers T, Rankin J, McLaughlin B, Major C, Mindell W, Coates R, Rigby J, Strathdee S. Prevalence of human immunodeficiency virus and associated risk behaviour in injection drug users in Toronto. *Can J Public Health* 1995;86:176–180. [PubMed: 7671202]
- Normand, J.; Vlahov, DLEM. Preventing HIV Transmission: The Role of Sterile Needles and Bleach. Washington, DC: National Academy Press; 1995.
- Pollini RA, Brouwer KC, Lozada RM, Ramos R, Cruz MF, Magis-Rodriguez C, Case P, Burris S, Pu M, Frost SDW, Palinkas LA, Miller C, Strathdee SA. Syringe possession arrests are associated with receptive syringe sharing in two Mexico-US border cities. *Addiction* 2008;103:101–108. [PubMed: 18028520]
- Power KG, Markova I, Rowlands A, McKee KJ, Anslow PJ, Kilfedder C. Intravenous drug use and HIV transmission amongst inmates in Scottish prisons. *Br J Addict* 1992;87:35–45. [PubMed: 1543939]
- Rhodes T, Mikhailova L, Sarang A, Lowndes CM, Rylkov A, Khutorskoy M, Renton A. Situational factors influencing drug injecting, risk reduction and syringe exchange in Togliatti City, Russian Federation: a qualitative study of micro risk environment. *Soc Sci Med* 2003;57:39–54. [PubMed: 12753815]

- Sarang A, Rhodes T, Platt L, Kirzhanova V, Shelkovnikova O, Volnov V, Blagovo D, Rylkov A. Drug injecting and syringe use in the HIV risk environment of Russian penitentiary institutions: qualitative study. *Addiction* 2006;101:1787–1796. [PubMed: 17156178]
- Shafer KP, Hahn JA, Lum PJ, Ochoa K, Graves A, Moss A. Prevalence and correlates of HIV infection among young injection drug users in San Francisco. *J Acquir Immun Defic Syndr* 2002;31:422–431.
- Small W, Kain S, Laliberte N, Schechter MT, O'Shaughnessy MV, Spittal PM. Incarceration, addiction and harm reduction: Inmates experience injecting drugs in prison. *Subst Use Misuse* 2005;40:831–843. [PubMed: 15974143]
- Soskolne V, Shtarkshall RA. Migration and HIV prevention programmes: linking structural factors, culture, and individual behaviour - an Israeli experience. *Soc Sci Med* 2002;55:1297–1307. [PubMed: 12231010]
- Stallwitz A, Stover H. The impact of substitution treatment in prisons - A literature review. *Int J Drug Policy* 2007;18:464–474. [PubMed: 18061872]
- Stöver H, Nelles J. Ten years of experience with needle and syringe exchange programmes in European prisons: A review of different evaluation studies. *Int J Drug Policy* 2003;14:437–444.
- Strathdee SA, Lozada R, Ojeda VD, Pollini RA, Brouwer KC, Vera A, Cornelius W, Nguyen L, Magis-Rodriguez C, Patterson TL. Differential effects of migration and deportation on HIV infection among male and female injection drug users in Tijuana, Mexico. *PLoS ONE* 2008a;3:e2690. [PubMed: 18665250]
- Strathdee SA, Lozada R, Pollini RA, Brouwer KC, Mantsios A, Abramovitz DA, Rhodes T, Latkin CA, Loza O, Alvelais J, Magis-Rodriguez C, Patterson TL. Individual, social, and environmental influences associated with HIV infection among injection drug users in Tijuana, Mexico. *J Acquir Immun Defic Syndr* 2008b;47:369–376.
- Strathdee SA, Patrick DM, Archibald CP, Ofner M, Cornelisse GA, Rekart M, Schechter MT, O'Shaughnessy MV. Social determinants predict needle-sharing behaviour among injection drug users in Vancouver, Canada. *Addiction* 1997;92:1339–1347. [PubMed: 9489050]
- Strathdee SA, Sherman SG. The role of sexual transmission of HIV infection among injection and non-injection drug users. *J Urban Health* 2003;80:iii7–14. [PubMed: 14713667]
- Taylor A, Goldberg D, Emslie J, Wrench J, Gruer L, Cameron S, Black J, Davis B, McGregor J, Follett E, Harvey J, Basson J, McGavigan J. Outbreak of HIV-Infection in a Scottish Prison. *BMJ* 1995;310:289–292. [PubMed: 7866169]
- Thaisri H, Lerwitworapong J, Vongsheree S, Sawanpanyalert P, Chadbanchachai C, Rojanawiwat A, Kongpromsook W, Paungtubtim W, Sri-ngam P, Jaisue R. HIV infection and risk factors among Bangkok prisoners, Thailand: a prospective cohort study. *BMC Infect Dis* 2003;3:1–8. [PubMed: 12659657]
- United Nations Office on Drugs and Crime. HIV/AIDS Prevention, Care, Treatment and Support in Prison Settings: A Framework for an Effective National Response. 2006 [Accessed on, November 14 2008]. http://www.unodc.org/pdf/HIV-AIDS_prisons_July06.pdf
- Van Haastrecht HJA, Bax JS, Van den Hoek A. High rates of drug use, but low rates of HIV risk behaviours among injecting drug users during incarceration in Dutch prisons. *Addiction* 1998;93:1417–1425. [PubMed: 9926547]
- Vlahov D, Putnam S. From corrections to communities as an HIV priority. *J Urban Health* 2006;83:339–348. [PubMed: 16739034]
- Wood E, Li K, Small W, Montaner JS, Schechter MT, Kerr T. Recent incarceration independently associated with syringe sharing by injection drug users. *Public Health Rep* 2005;120:150–156. [PubMed: 15842116]
- World Health Organization. Effectiveness of Interventions to Address HIV in Prisons. 2007 [Accessed on, November 2 2008]. http://www.who.int/hiv/idu/OMS_E4Acomprehensive_WEB.pdf

Table 1
Factors associated with incarceration, injection while incarcerated and receptive syringe sharing while incarcerated among male IDUs in Tijuana, Mexico.[†]

	Univariate odds ratio (95% confidence interval)		
	(a) Incarcerated (N=898)	(b) Injection while incarcerated (N=682)	(c) Receptive sharing while incarcerated (N=416)
Demographics			
Age (years)	1.02 (1.00, 1.04)**	0.97 (0.95, 0.99)**	0.97 (0.95, 1.00)*
Homeless past 6 months	1.42 (0.96, 2.12)*	1.31 (0.90, 1.90)	1.79 (1.02, 3.15)**
Ever traveled to US	1.92 (1.35, 2.75)**	0.64 (0.42, 0.98)**	0.73 (0.41, 1.31)
Deported to Tijuana	2.01 (1.45, 2.80)**	0.57 (0.41, 0.77)**	1.02 (0.65, 1.60)
Injection drug use history Lifetime			
Heroin alone	1.36 (0.35, 5.29)	3.98 (0.77, 20.67)*	2.98 (0.18, 48.08)
Cocaine alone	1.77 (1.30, 2.41)**	1.97 (1.44, 2.70)**	1.04 (0.65, 1.66)
Methamphetamine alone	1.48 (1.09, 2.01)**	1.64 (1.20, 2.24)**	0.87 (0.55, 1.37)
Speedball	1.86 (1.37, 2.54)**	2.04 (1.48, 2.81)**	1.14 (0.71, 1.85)
Heroin and meth together	1.31 (0.96, 1.78)*	1.55 (1.13, 2.12)**	1.47 (0.93, 2.31)*
Years since first injection	1.03 (1.02, 1.05)**	1.02 (1.01, 1.04)**	0.98 (0.95, 1.00)*
Past 6 months			
Heroin alone	0.84 (0.28, 2.55)	1.82 (0.65, 5.08)	7.73 (1.48, 40.44)**
Cocaine alone	1.46 (0.82, 2.61)	1.25 (0.74, 2.12)	1.17 (0.55, 2.45)
Methamphetamine alone	1.56 (1.12, 2.19)**	1.80 (1.30, 2.50)**	1.11 (0.71, 1.73)
Speedball	1.25 (0.77, 2.01)	1.55 (0.96, 2.48)*	0.92 (0.50, 1.69)
Heroin and meth together	1.31 (0.97, 1.78)*	1.78 (1.30, 2.43)**	1.33 (0.85, 2.09)
Injected daily	1.57 (1.06, 2.33)**	1.23 (0.80, 1.91)	2.42 (1.34, 4.36)**
Receptive syringe sharing	1.26 (0.92, 1.72)	2.51 (1.82, 3.46)**	1.75 (1.09, 2.79)**
Injected most often in a shooting gallery	1.11 (0.77, 1.58)	1.44 (1.00, 2.06)**	1.98 (1.15, 3.41)**
Average number of people injected with	1.03 (0.98, 1.07)	1.03 (0.99, 1.07)	0.96 (0.92, 1.00)*
Lifetime history of arrest and incarceration			
Arrested for sterile syringes	1.52 (1.09, 2.13)**	2.03 (1.46, 2.82)**	0.77 (0.50, 1.21)
Arrested for used syringes	1.39 (1.01, 1.91)**	1.81 (1.32, 2.49)**	1.26 (0.81, 1.97)
Arrested for track marks	1.42 (1.05, 1.93)**	1.54 (1.12, 2.10)**	1.13 (0.72, 1.79)
Arrested for carrying drugs	1.93 (1.34, 2.74)**	1.91 (1.37, 2.66)**	1.21 (0.77, 1.91)
>1 incarceration	NA	1.60 (1.14, 2.24)**	1.51 (0.92, 2.47)*
Sex with a man in jail/prison	NA	3.91 (1.81, 8.44)**	5.31 (1.61, 17.51)**

[†] Reference groups are a) never incarcerated, b) did not inject while incarcerated, c) injected while incarcerated but did not share syringes.

* $P \leq 0.10$

** $P < 0.05$

Table 2

Factors independently associated with incarceration, injection while incarcerated and receptive syringe sharing while incarcerated among make IDUs in Tijuana, Mexico.^{†*}

	Adjusted odds ratio (95% confidence interval)		
	(a) Incarcerated (N=863)	(b) Injection while incarcerated (N=681)	(c) Receptive sharing while incarcerated (N=404)
Age (per year)			0.97 (0.94, 1.00)
Ever traveled to US	1.81 (1.12, 2.95)		
Deported to Tijuana	1.61 (1.07, 2.43)		
Injected speedball		1.50 (1.06, 2.12)	
Years since first injection	1.06 (1.03, 1.09)	1.03 (1.01, 1.05)	
Injected heroin alone [‡]			8.50 (1.63, 44.21)
Injected methamphetamine alone [‡]	1.92 (1.24, 2.97)		
Injected daily [‡]			2.17 (1.19, 3.96)
Receptive syringe sharing [‡]		2.46 (1.75, 3.45)	
Inject most often in a shooting gallery [‡]			2.39 (1.30, 4.41)
Arrested for sterile syringes		1.98 (1.41, 2.77)	
Arrested for carrying drugs	2.03 (1.36, 3.02)		
>1 incarceration	NA		1.80 (1.05, 3.08)
Sex with a man in jail/prison	NA	3.59 (1.65, 7.83)	6.18 (1.78, 21.49)

[†] Models are adjusted for the RDS recruitment method. Reference groups are a) never incarcerated, b) did not inject while incarcerated, c) injected while incarcerated but did not share syringes.

* All values $P < 0.05$

[‡] past 6 months