

Prevalence of Drug Injection, Sexual Activity, Tattooing, and Piercing Among Prison Inmates

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Prisoners engage in a range of risk behaviors that can lead to the transmission of viral infections, such as HIV, hepatitis B and hepatitis C. In this review, we summarize the epidemiologic literature from 2007 to 2017 on 4 key risk behaviors for human immunodeficiency virus and hepatitis C virus among prisoners globally: drug injection, sexual activity, tattooing, and piercing. Of 9,303 peer-reviewed and 4,150 gray literature publications, 140 and 14, respectively, met inclusion criteria covering 53 countries (28%). Regions with high levels of injection drug use were Asia Pacific (20.2%), Eastern Europe and Central Asia (17.3%), and Latin America and the Caribbean (11.3%), although the confidence interval for Latin America was high. Low levels of injection drug use in prison were found in African regions. The highest levels of sexual activity in prison were in Europe and North America (12.1%) and West and Central Africa (13.6%); low levels were reported from the Middle East and North African regions (1.5%). High levels of tattooing were reported from Europe and North America (14.7%), Asia Pacific (21.4%), and Latin America (45.4%). Prisons are burdened with a high prevalence of infectious diseases and risk behaviors for transmission of these diseases, and, commonly, a striking lack of evidence-based infection control measures, even when such measures are available in the surrounding community. Given that most prisoners return to these communities, failure to implement effective responses has repercussions not only prisoner health but also for public health.

AIDS; HIV; prison; risk taking; tuberculosis; viral hepatitis

Abbreviations: CI, confidence interval; HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IDU, injection drug use; MSM, men who have sex with men; PWID, people who inject drugs.

INTRODUCTION

Prisoners engage in a range of risk behaviors that can cause the transmission of human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV). These behaviors include sharing contaminated syringes, unsafe sex, tattooing, and skin piercing. Objective indications of the occurrence of risk behaviors by inmates are positive urinalysis results indicating drug use (though not necessarily via injection), and finding drugs and injecting paraphernalia. Analysis of the contents of syringes confiscated from Australian prisoners confirmed injection had occurred, because HCV RNA was detected (1). Analysis of wastewater from Spanish prisons detected metabolites of drugs (2), although the route of drug administration is unknown. Finding contraband tattooing and piercing equipment confirms these risk behaviors occur (3).

Prisons continue to be settings where HIV prevalence is many-fold higher than in the surrounding communities (4). The world prison census was about 10.2 million in 2013; of these prisoners, 3.8% had HIV, 15.1% had HCV, and 4.8% had chronic HBV infection. These infections are influenced by the overrepresentation of people who inject drugs (PWID) and men who have sex with men (MSM) in prison (4). Most prisoners are male, accounting for 80%–95% of prison populations (5).

Low rates of HIV transmission within prisons are reported in most studies (4), although several large outbreaks have been the result of drug injection. In Lithuania's Alytus prison, an HIV outbreak resulted in 284 inmates being infected in 6 months, doubling the number of national HIV cases (6, 7). An outbreak in a Russian prison in Nizhnekamsk resulted in more than 400 of 1,824 inmates acquiring HIV, again in a brief period (8). In Ukraine, an HIV outbreak was attributed to unprotected sex

and drug injection in prison (9). Small HIV outbreaks from drug injection and/or sex occurred in Scotland (10) and Australia (11), where 12 and 4 inmates, respectively, were infected even though HIV prevalence was very low. Although these studies are old, there are no more recent reports of outbreaks.

According to a prospective study of HCV transmission in New South Wales prisons, the HCV incidence is 14.08 per 100 person-years among PWID (12). Tattooing was identified as an independent risk factor for in-prison HCV transmission (13, 14). In the United States, Georgia's prison system recorded an outbreak of 7 cases of hepatitis B in 2001 that were attributed to sex (15). Piercing in prison and penile implantation, the insertion of beads under the skin, may transmit HIV (16, 17).

A comprehensive review of risk behaviors in prison can be the basis for policy change and the introduction and evaluation of risk reduction policies directed at these behaviors. In this article, we systematically review the epidemiologic literature on drug injection, sex, tattooing, and piercing among prisoners and conclude with some observations about methodological issues when studying risk behaviors in prison.

LITERATURE REVIEW

To provide a contemporary overview of the situation, we limited our review to papers published after December 2006. Published articles from peer-reviewed literature were identified from the following databases: Institute for Scientific Information Web of Science, Embase, PubMed/MEDLINE, and Cochrane Library. Gray literature was also sought (18). We considered 4 key risk behaviors; drug injection, sex, tattooing, and piercing. The search included publications in English, French, Spanish, German, Portuguese, and Arabic. Keywords appear in Web Appendix 1 (available at <https://academic.oup.com/aje>). We retrieved additional studies from reference lists of included publications.

Data were analyzed to produce prevalence estimates for each risk behavior. Only studies with numerators and denominators in terms of numbers of prisoners reporting the behaviors and the total prison sample were included in the meta-analysis (i.e., studies that provided data in percentages only were excluded). All meta-analyses were performed using random effects models, which account for interstudy variation, given the expected heterogeneity between studies. Heterogeneity was assessed using the I^2 statistic, which describes the percentage of variation between studies that is due to heterogeneity rather than chance. Regions with fewer than 3 studies of a risk behavior were excluded from the meta-analysis; thus, scarcity of data precluded pooled estimates for some regions or behaviors. Analyses were conducted in Stats Direct 3 (StatsDirect, Cheshire, United Kingdom).

RESULTS

Our search of databases identified 8,571 peer-reviewed and 4,150 gray literature publications, of which 154 met inclusion criteria (Figure 1). Data on inmates' risk behavior were found for 53 of the 189 countries (28%) listed by the Joint United Nations Programme on HIV/AIDS in 2017 (Web Table 1) (19).

Figure 2 shows the prevalence of the 3 risk behaviors. Injection drug use (IDU) and tattooing were prevalent in the Asia Pacific, Latin America, Caribbean, Western and Central Eur-

ope and North America regions. Sex was the least prevalent risk behavior, except in the West and Central Africa region.

Findings of the meta-analysis

We determined from our meta-analysis the prevalence of each risk behavior, the 95% confidence interval, and the I^2 value by region (Web Table 1). Regions with high levels of IDU were Asia Pacific (20.2%), Eastern Europe and Central Asia (17.3%), and Latin America and the Caribbean (11.3%), although that confidence interval is wide. In contrast, low levels of IDU were found in East and Southern Africa (0.6%) and West and Central Africa (0.5%). The highest levels of sexual activity in prisons were in the Western and Central Europe and North America region (12.1%) and West and Central Africa (13.6%), with reports of low levels of activity coming from the Middle East and North African regions (1.5%). Tattooing data were limited but high levels were reported in the Western and Central Europe and North American regions (14.7%), Asia Pacific (21.4%), and Latin America (45.4%) regions.

Injection drug use

IDU before imprisonment. Data on IDU before imprisonment were found for 40 countries. Low levels of IDU were reported from Ethiopia (0.5%) (20), Sri Lanka (4.3%) (21), Moldova (3.9%) (22), Tajikistan (4.2%) (23), Brazil (0%–10.2%) (24–30), Jamaica (0%) (31), Bulgaria (7.3%) (32), France (5.5% (33) and 7.7% (34)), and Turkey (5.5%) (35). Moderate levels of IDU were reported from Pakistan (39%) (36), Azerbaijan (31.6% (37) and 33.7% (38)), Bosnia and Herzegovina (17.4%) (39), Kyrgyzstan (35.4%) (40), Lebanon (14.2%) (41), Belgium (15.2%) (32), Czech Republic (22.1%) (32), Germany (31%) (32), Hungary (10.4% (32) and 37.8% (42)), Ireland (26%) (43), Israel (32%) (44), Latvia (21.1%) (32), Portugal (12.6%) (32), and Scotland (32%) (45). Reports of high levels of IDU came from Taiwan (62.8%) (46) and Ukraine (48.7%) (47). Various levels of IDU before imprisonment came from Australia (37%–74.6%) (48–53), Iran (2%–42%) (54–60), Croatia (2.5%–35%) (32, 61, 62), Spain (7%–25.9%) (63–66), and the United States (3.6%–67.5%) (67–76).

IDU before imprisonment was higher among women than men in the following countries (data reported as men vs. women): Australia (40.1% vs. 52.4%) (49), Finland (57.3% vs. 63.6%) (77), Ireland (24% vs. 44%) (43), Scotland (31% vs. 60%) (45), and the United States (19.1% vs. 35.8%) (78). IDU before imprisonment was lower among women in the following countries: Sri Lanka (4.6% vs. 2.9%) (21), Brazil (0%–1.7% vs. 0%–1.3%) (29), and Croatia (24.7% vs. 19.2%) (61).

Data on IDU before imprisonment among drug-using prisoners were as follows: China, 80.6% (78.5% men; 86.6% women) (79), Sri Lanka (15.8%) (80), Taiwan (63.5% (81) and 88.2% (82)), Iran (18.3% (83) and 78.4% (84)), Canada (12.2%) (85), France (67.8%) (86), Sweden (90.7%) (87), Switzerland (39.9%) (88), and the United States (49.2%–75.7%) (89–92).

High levels of IDU before imprisonment among prisoners living with HCV were found for Australia (86%) (93), Bosnia and Herzegovina (9.5%) (94), Italy (68%) (95), Spain (72.1%–82.9%) (96–98); among prisoners living with HIV in Indonesia (95.1%) (99), Malaysia (77.5% (100), and 83.7% (101)), Ukraine

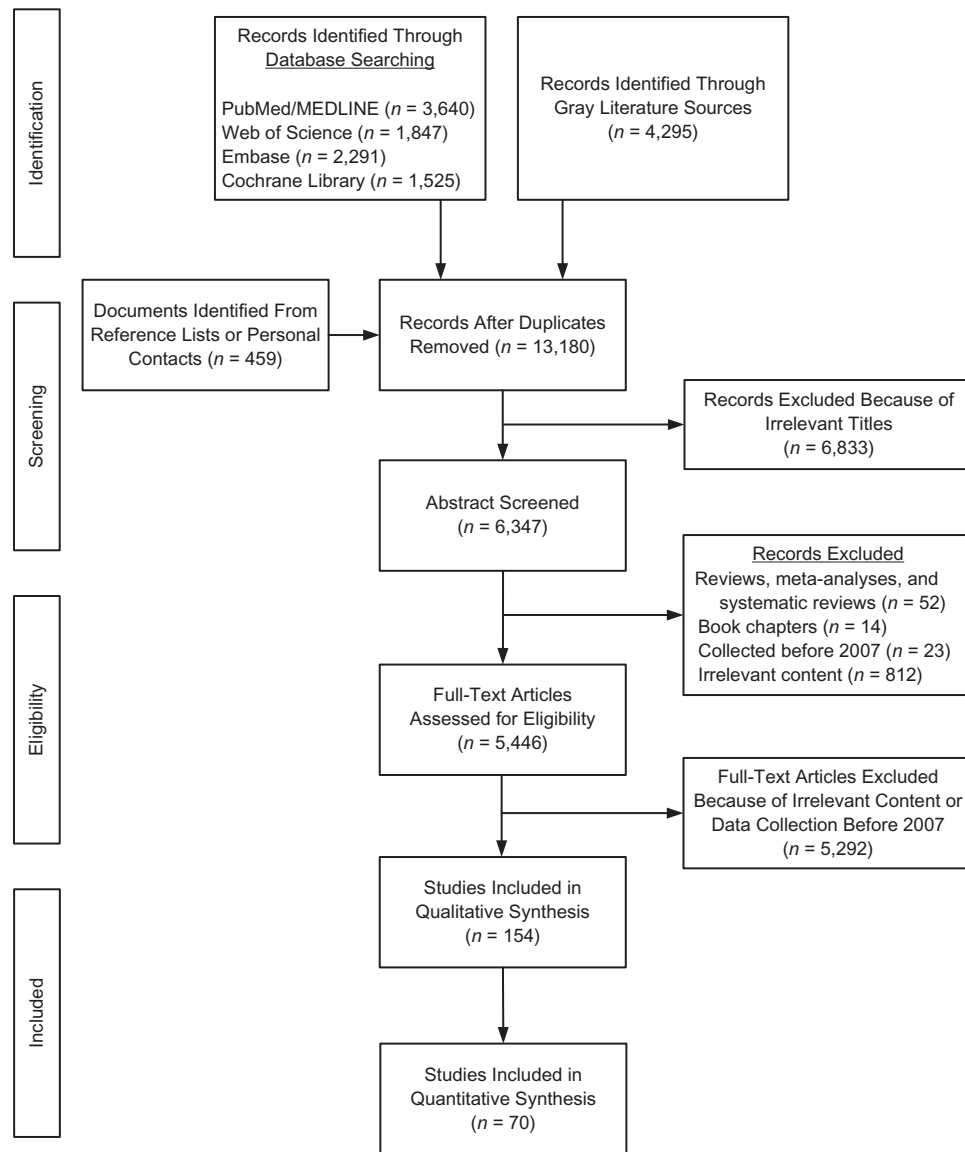


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram of studies published 2007–2017 and included in this review.

(57.9%–82.5%) (102), Israel (58.7%) (103), and Italy (80.5%) (104); and among HBV-positive prisoners in Iran (41.8%) (105).

Data on a history of shared IDU before imprisonment were found for Australia (16%–70%) (12, 48, 106, 107), Indonesia (94.5%) (108), Malaysia (53.1% (109), 66% (100)), Taiwan (16.9% (82), 40.6% (46)), Azerbaijan (12.7%) (37), Kyrgyzstan (11.2%) (40), Ukraine (74.1%) (110), Brazil (32.5%) (28), Iran (37.4%) (111), Lebanon (4.5%) (41), Croatia (19%) (62), France (1.8% (33), 49.8% (86)), Spain (7.9% (112), 55.3% (113)), Scotland (69%–86%) (114–118), and the United States (2.8%–90%) (69, 91, 92, 119, 120).

IDU in prison. The level of IDU before imprisonment reflects the proportion of PWID who enter prison, with few reports of

drug initiation in prison (Web Figure 1), although a few prisoners (7% in Brazil (28) and 4% in England (121)) reported this. Levels of IDU within prison were reported in 36 countries, with rates ranging from 0.8% to 64% among men, from 1% to 62.5% among women, and from 0.2% to 82.7% for both sexes. Of note, a zero prevalence of shared IDU or needles while in prison was noted in Pakistan (36), Ethiopia (122), Burkina Faso (123), and Nigeria (124), where data for lifetime practices were also scarce.

Low levels of IDU in prison came from both African regions (i.e., East and Southern Africa, and West and Central Africa). Data were reported from Lesotho (0.8%, and 2.5%) (125), with similar levels reported in Senegal (0.6%) (126) and Togo (0.6% (126) and 0.9% (127)). Taiwan (0.2%) (128) reported the lowest

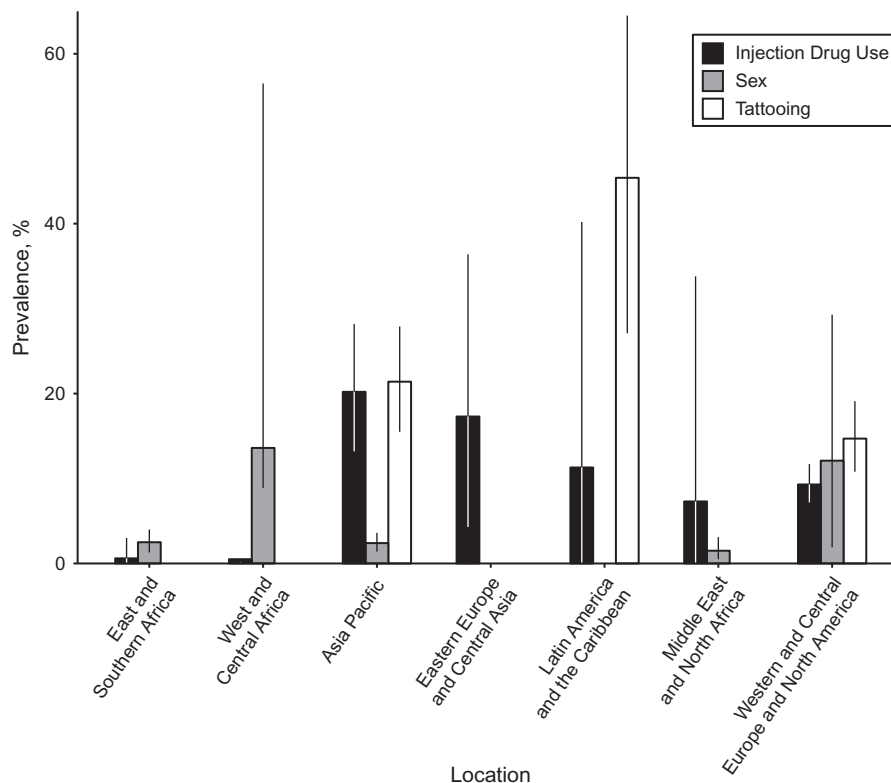


Figure 2. Prevalence of injection drug use, sex, and tattooing in prison by region, 2007–2017.

level of IDU in prison in the Asia Pacific Region, followed by 0.7% in Hungary (32), 0.37% in Lebanon (41), 1.9% in Portugal (32), 8.4% in Bosnia and Herzegovina (39) in the Eastern Europe and Central Asia region. A slightly higher level of IDU in prison was noted in Latin America and the Caribbean, ranging from 5% in Guatemala (129) to 9.2% in Brazil (130).

Moderate levels of IDU in prison were reported in France (24.2%) (86), Serbia (38.2%) (131), Iran (40.1%) (111), and Indonesia (56%) (108). The highest prevalence of IDU during prison were found in Mexico (61%) (132), England (64%) (121), the United States (62.5%) (92), Australia (82%) (93), and Kyrgyzstan (82.6%) (40).

Moderate levels of IDU in prison among people with HCV were reported in China (40.8%) (79), whereas lower levels were found in Bosnia and Herzegovina (1.5%) (94). The highest rate of PWID living with HCV who injected drugs in prison came from Spain (7.3% (96), 10.1% (97) and 82.7% (112)). Among those living with HIV, just over half of men and women in Ukraine (56.8%) (110) reported IDU while in prison; there were similar reports from Indonesia (39.3% (99) and 56% (108)).

Episodes of sharing needles within prison were reported in 3 Australian studies only, with a similar prevalence for both male and female prisoners in Queensland (96.6% and 92.9% respectively) (133). Lower levels of needle sharing were noted in a combined study across Queensland and New South Wales among both sexes in a sample of PWID (21.7%–25.1%) (134). Similar accounts of sharing were recorded from 37 prisons in New South Wales (19%–36%) (135).

Sexual risk behavior

Male sexual risk behavior before imprisonment. We found data from 6 countries on sexual risk behavior before imprisonment; most came from inmates who identified as MSM. Multiple reports of inmates engaging in anal sex before imprisonment came from 2 countries: Brazil (0.5% (29), 3.9% (29), 5.5% (24) and 8.2% (30)) and the United States (3.7% (71), 17.3% (75), 18.1% (136), 50.6% (78), and 51.2% (69)). Male inmates' reports of prior MSM were low, ranging from 0.3% in Croatia (61) to 3.7% (56) in Iran, and up to 13.5% in Australia (137). Among studies of the general prison population, who are mostly men, reports by MSM before imprisonment ranged from 2.5% in Scotland (45) to 8.6% in Lebanon (41). The only report from HIV-positive inmates having anal sex before imprisonment came from Israel (6.5%) (138).

Sexual risk behavior in prison. Data for sexual risk behavior were found from 18 countries, with most reports coming from samples of general prison populations (Web Figure 2). Most reports were of low levels of sexual risk behavior and these came from Jamaica (0%) (31), Togo (0.3%) (127), Indonesia (0.5%) (139), Iran (0.6%) (140), and the United States (0.7%–1.1%) (141). Countries that reported high levels of sexual risk behavior were Spain (34.7%) (142) and the United States (53%) (143). Among male inmates, the few reports came from Iran (2%–3%) (59), Germany (3.6%) (144), and Mexico (32.9%) (145).

Reports of sexual assault in prison came from male (1.6%) and female (1.9%) inmates in Ethiopia (20), and inmates in

Tanzania (1.2%) (146), Bosnia (1.65%) (39), and Germany (22.9%) (147). Some male inmates (2.3%) reported being coerced into having sex in Australia (53).

Tattooing

Prior tattooing. Reports of tattooing before imprisonment were found from 15 countries. Varying levels were identified, ranging from 3.3% to 60% in Iran (55–58, 111, 148) to 8% in Scotland (45). Moderate levels of tattooing before imprisonment were found in Azerbaijan (27%) (37), Brazil (27.4%–55.8%) (25, 26, 28, 130), France (42%) (149), Bosnia and Herzegovina (46.3%) (39), Moldova (54.4%) (22), the United States (59.5% (67), and 66.6% (150)), and Scotland (59% (116), 61% (118), and 62% (117)). Australia had the highest level of tattooing before imprisonment (73% (12) and 86% (93)). High levels were reported among male inmates in Australia (60%) (133), Croatia (42%) (62), Brazil (from 44% to 79.1%) (29), and Lesotho (42%) (125). Female inmates reported lower levels of tattooing before imprisonment in Iran (36.1%) (58); levels increased in Australia (56.7%) (133) and Brazil (48.1% (29), 62% (27), and 72.4% (29)). In Finland, women reported similar levels of tattooing before imprisonment as their male counterparts (59.1% and 57.3%, respectively) (77). Overall, little difference was noted in tattooing before imprisonment between male or female prisoners.

Among PWID, very high levels of tattooing before imprisonment were found Australia (72%–74.2%) (48, 135) and among Iranian male inmates (60.2% (111)); lower levels were reported among Indonesian drug users (26.4%) (151). Reports of prior tattooing among HIV-positive inmates indicated high levels in Indonesia (39.3%) (99), but low levels in Italy (10.1%) (152) and Iran (3.3%) (56). A large proportion of Australian inmates (86%) living with HCV reported receiving a tattoo before entering prison (93).

Tattooing in prison. The prevalence of tattooing in prison is reported for 13 countries in Web Figure 3. Moderate levels among general prison populations were found in Hungary (14.3%) (42), Scotland (7.7%–11.2%) (116–118, 125), Lesotho (28%) (125), Fiji (25%) (153), Serbia (13.1%) (131), and Bosnia and Herzegovina (11.2%) (39). A low level of tattooing was found among general prisoners in Iran (5.3%) (140).

Australia (13.4%) (133) and the United States (8.7%) (150) were the only countries with data on female prisoners receiving a tattoo during imprisonment. Comparatively, 6 countries reported on male prisoners: Burkina Faso (0%) (123), Lebanon (2.2%) (41), Bosnia and Herzegovina (17.5%) (94), the United States (19.3%) (150), and Australia (24.6%) (133). The highest report of ever receiving a tattoo while in prison was found among men in Brazil (57.6%) (30).

The prevalence of general prisoners who reported within prison tattooing and who were living with HCV ranged from 5% in Bosnia and Herzegovina (94) to 8.4% in Spain (97). Greater levels were observed for both male and female prisoners living with HIV in Ukraine (15.8%) (102) who reported receiving a tattoo during imprisonment.

Piercing

Piercing before imprisonment. Reports of piercing before imprisonment were found for 9 countries. Among general

prisoners, high levels were reported in Australia (74.2%) (48), Brazil (65%) (26), the United States (53.3%) (67), and France (42%) (149). Moderate levels were reported among general prison populations in Moldova (27.5%) (22), Pakistan (21%) (36), and Scotland (3% (45), 22%–23% (116–118)). Reports of low levels of piercings before imprisonment came from Bosnia (11.1%) (39) and Indonesia (13.7%) (99).

More accounts of piercing before imprisonment were found for men than women. Data were sparse for women; the only report was from Brazil (19.7%–50% (27, 29)). A few male inmates in Australia (5.8%) (17) reported receiving penile implants before imprisonment. Brazil provided several reports of men who received a piercing before imprisonment (2.8%–94% (27, 29)).

In Australia, 77% of general prisoners reported ever having received a piercing before entering prison (12). Similar levels were identified among prisoners living with HIV and among Indonesian male inmates (9.5%) (99) and general prisoners in Italy (10.1%) (152).

Piercing in prison. Few data exist on the prevalence of within-prison piercing. We found reports of low levels of such activity among general prison populations in Bosnia (1.1%) (39), the United States (1.3%) (150), and Scotland (1.3%–2%) (116–118, 150).

From the few existing data, male prisoners appeared more likely to receive a piercing within prison than did female prisoners. The highest proportion of men receiving a piercing while in prison was found in Fiji, where 28% indicated having penile beading, a form of piercing, within prison (153). Of the 3.8% of Australian male inmates who reported prior penile implants, 73% indicated they received them while in prison (17); another sample of male inmates in Australian prisons (14.6%) also reported receiving a piercing in prison (133). Significantly lower levels of in-prison piercing were found among male Brazilian inmates (0.4%) (25). According to reported data, 12% of women in Australian prisons were reported to have ever received a piercing in prison (133).

DISCUSSION

Overall, we found a high prevalence of HIV risk behaviors in prison settings internationally in the context of a high background prevalence of infections (4). Outbreaks of infection (and in the case of HCV, reinfection) are cause for concern. Our findings underscore the critical importance of evidence-based prevention and harm reduction measures in prison settings. With an estimated 30 million people passing through prisons globally each year (154), failure to bring evidence-based infection control to scale in prison settings, particularly those where the prevalence of infection is high, will have a substantial and measurable effect on public health (155, 156).

Needle and syringe programs (63) and opioid substitution treatment (157) reduce the risks of acquiring HIV by reducing the shared use of syringes and the level of IDU, but coverage remains poor (158–160). Iran reported 2 large HIV outbreaks in prisons, with hundreds infected (161). These outbreaks were the impetus for the introduction of needle and syringe programs and expansion of methadone programs in prison. More work is required to identify and overcome barriers to uptake and scaling up of these interventions in prison settings, particularly where

IDU is common (162). It was beyond the scope of this review to consider which drugs were being injected, but with increasing use and injection of methamphetamines around the world (163), which presents the same risks as heroin injection, there is a need to identify effective treatment in prison. Prison needle and syringe programs remain critical, but additional research is required to identify other scalable responses, and, in particular, to determine the potential for agonist treatments for methamphetamine dependence. Preliminary evidence has not been encouraging (164); psychologically based interventions appear to hold more promise in the treatment of amphetamine dependence (165).

We found few studies on sexual risk behavior in prison. In most of these studies, the reported prevalence was low, with the exception of some studies based on selected samples (e.g., MSM). Sexual activity in prison is almost always between people of the same sex, is highly stigmatized in almost all settings, and criminalized in some countries. It is also likely that IDU is a stigmatized activity. As such, it is likely that the actual prevalence of these activities in prisons is higher than that reported, although even in studies in which considerable effort has been made to minimize reporting bias, relatively low prevalence of sexual activity (and an even lower prevalence of rape or sexual assault) has been found in prisons, particularly among men (166).

Nevertheless, given the elevated prevalence of HIV and other sexually transmitted infections in prisoners (4, 167) and absence of condoms in most prison settings (168), sexual activity in prison carries a comparatively high risk of transmission of infection. There is evidence that condom provision does not increase sexual activity among prisoners (166) and good evidence that consistent condom use reduces transmission of sexually transmitted infections in these settings (169). Additional research is required to document existing coverage of condoms in prisons globally.

In most studies, a high proportion of prisoners had been tattooed, although some studies did not ask whether the tattoo was acquired in the community or in prison. Among the studies that did report on tattooing in prison, the prevalence was high in most and, in some regions, piercing or other body-modification practices (e.g., penile beading) were prevalent. In the absence of sterile equipment, tattooing, piercing, and other body-modification practices in these settings pose a risk for the transmission of blood-borne infections. In another study, researchers found that among prisoners with a history of IDU, those who continued to inject in prison were more likely to be HCV exposed, to have received a tattoo in prison, and to have a history of risky sexual behavior, highlighting the concentration of risk in a subset of the prison population and the potential for such infections to spread beyond the population of PWID (170).

We observed large variation in prevalence estimates both within and between regions. It is unclear from the available data (and given methodological limitations discussed later in this section) to what extent these reflect real differences between settings versus variability due to sampling bias and/or underreporting. It is a widely held view that prisons reflect and amplify the prevalence of infection in the surrounding community (4) and it is likely that the extent of this amplification varies between settings as a function of, among other things, incarceration rates, criminal justice responses to drug use and sexual behavior in the community and in prison, the prevalence of infection and risk behaviors

in prison settings, and coverage of evidence-based responses to these risk behaviors.

We also observed important gaps in the evidence, predictably concentrated in low- and middle-income countries, which account for most of the world's prisoners (5). Given the critical role of prison settings in responding to HIV and HCV epidemics more broadly, the almost complete lack of data on blood-borne viral risk behaviors in prisons in many low- and middle-income countries is a significant barrier to advocating for the introduction of and informing the scale-up of evidence-based responses in these settings. There remains an urgent need for investment in epidemiologic studies of infectious disease and associated risk behaviors, and of the coverage of evidence-based responses to reduce infection risk in prisons in low- and middle-income countries.

Evidence indicates that inmates have attempted to reduce their risk of infection. Reported strategies include decontaminating syringes with bleach or a flame (3), although the effectiveness of these methods is questionable, especially with regard to neutralizing the hepatitis C virus. There have also been reports of inmates in Australia using plastic bread bags and margarine as makeshift condoms and lubricants to protect themselves (168).

We restricted the focus of our review to drug injection, sexual activity, tattooing, and skin piercing, although other possible risk behaviors have been reported. In an Australian study, researchers reported that the occurrence of bloody fights (42%) and being stabbed (32%) were common among a sample of prisoners and linked these behaviors to HCV acquisition (12). In Australia, a prison officer was deliberately injected by a prisoner with a blood-filled syringe and infected with HIV; the officer subsequently died (171). In the United States, a sheriff acquired hepatitis C after blood splashed in his eyes as he broke up a fight between inmates (172). Although these incidents do not reflect inmates' risk behaviors under investigation, they highlight the risky nature of the prison setting for those who work there.

Methodological issues

Our prevalence estimates were limited by the quality of the original studies, including their variability of methods, sampling, and geographic areas that we used for comparing countries. Studies of stigmatized and illegal behaviors are often susceptible to underreporting, and these demand characteristics are particularly salient in prison settings, where the consequences of engaging in proscribed behaviors can be significant. Underreporting of stigmatized behaviors is almost inevitable but can be minimized through careful research design and implementation. It is pivotal that studies of such behaviors in prison settings be conducted ethically and independently of correctional authorities and correctional health providers. Research participants are unlikely to disclose such behavior if they fear doing so may have consequences for their management or health care in prison. Some researchers have gone to even greater lengths to minimize demand characteristics, such as in an Australian study, in which researchers used computer-assisted telephone interviews conducted over an unmonitored telephone line into the prison to ask questions about sexual behavior in prison (166). An alternative approach is to recruit participants in prison to minimize sampling bias, and to delay telephone interviewing until after release from prison to minimize reporting bias (173).

Our meta-analysis also may be limited by heterogeneity in classification of risk behaviors. Definitions and recall periods researchers used to classify IDU, sex in prison, and tattooing varied across studies and may have resulted in underestimation of the prevalence of these behaviors in prison.

Summary and future research

Standardized monitoring would enable researchers to detect change and enhance comparison of behaviors around the world. "HIV prevention, treatment and care in prisons and other closed settings: a comprehensive package of interventions" was developed by the United Nations Office on Drugs and Crime (174) as a resource to support countries in an effort to mount an effective response to HIV and acquired immunodeficiency syndrome in prisons and other settings. The availability and coverage of effective harm-reduction services in prisons are disproportionate to the incidence of HIV in prison (175). An enormous gap exists in the introduction and expansion of interventions in prisons (159), leading to missed opportunities to prevent, diagnose, and treat HIV and other infections (8). We recommend wider adoption of the UN package, which, of course, should be underpinned by good data on current coverage and program evaluation.

Prisons are burdened with a high prevalence of infectious diseases, a high prevalence of risk behaviors for transmission of these diseases, and, in most settings, a striking lack of evidence-based infection control measures, even when such measures are available in the surrounding community. Given that most prisoners return to these communities, failure to implement effective responses has repercussions not only prisoner health but also for public health.

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REFERENCES

- Dolan K, Larney S, Jacka B, et al. Presence of hepatitis C virus in syringes confiscated in prisons in Australia. *J Gastroenterol Hepatol*. 2009;24(10):1655–1657.
- Postigo C, de Alda ML, Barceló D. Evaluation of drugs of abuse use and trends in a prison through wastewater analysis. *Environ Int*. 2011;37(1):49–55.
- Bonnycastle KD. The social organisation of penal tattooing in two Canadian federal male prisons: locating sites of risk for empirically-based health care interventions. *Howard J Crim Justice*. 2011;50(1):17–33.
- Dolan K, Wirtz AL, Moazen B, et al. Global burden of HIV, viral hepatitis, and tuberculosis in prisoners and detainees. *Lancet*. 2016;388(10049):1089–1102.
- Walmsley R. World prison population list. 10th ed. London, United Kingdom: International Centre for Prison Studies; 2013. http://www.prisonstudies.org/sites/default/files/resources/downloads/wppl_10.pdf. Accessed January 29, 2016.
- Caplinskiene I, Caplinskas S, Griskevicius A. [Narcotic abuse and HIV infection in prisons]. *Medicina (Kaunas)*. 2003;39(8):797–803.
- Dolan K, Kite B, Black E, et al. HIV in prison in low-income and middle-income countries. *Lancet Infect Dis*. 2007;7(1):32–41.
- Dolan K, Moazen B, Noori A, et al. People who inject drugs in prison: HIV prevalence, transmission and prevention. *Int J Drug Policy*. 2015;26(suppl 1):S12–S15.
- Gunchenko A, Kozhan N. HIV infection in the penitentiaries of Ukraine. *Zh Mikrobiol Epidemiol Immunobiol*. 1998;(1):31–33.
- Taylor A, Goldberg D, Emslie J, et al. Outbreak of HIV infection in a Scottish prison. *BMJ*. 1995;310(6975):289–292.
- Dolan KA, Wodak A. HIV transmission in a prison system in an Australian state. *Med J Aust*. 1999;171(1):14–17.
- Luciani F, Bretaña NA, Teutsch S, et al. A prospective study of hepatitis C incidence in Australian prisoners. *Addiction*. 2014;109(10):1695–1706.
- Hellard ME, Hocking JS, Crofts N. The prevalence and the risk behaviours associated with the transmission of hepatitis C virus in Australian correctional facilities. *Epidemiol Infect*. 2004;132(3):409–415.
- Post JJ, Dolan KA, Whybin LR, et al. Acute hepatitis C virus infection in an Australian prison inmate: tattooing as a possible transmission route. *Med J Aust*. 2001;174(4):183–184.
- Centers for Disease Control and Prevention. Hepatitis B outbreak in a state correctional facility, 2000. *MMWR Morb Mortal Wkly Rep*. 2001;50(25):529–532.
- Bjekić M. Artificial penile nodules: a case series of three patients. *Serb J Dermatol Venerol*. 2013;5(4):165–170.
- Yap L, Butler T, Richters J, et al. Penile implants among prisoners—a cause for concern? *PLoS One*. 2013;8(1):e53065.

18. Ali H. Searching the grey literature to access information on drugs, alcohol, and HIV/AIDS Research: an update: a resource to identify drug and HIV/AIDS related databases and websites. Sydney, New South Wales, Australia: National Drug and Alcohol Research Centre, University of New South Wales; 2010. <https://ndarc.med.unsw.edu.au/sites/default/files/ndarc/resources/TR.314.pdf>. Accessed August 2, 2017.
19. UNAIDS. Countries. <http://www.unaids.org/en/regionscountries/countries>. Accessed March 29, 2018.
20. United Nations Office on Drugs and Crime. Rapid assessment of HIV situation in prison settings in Ethiopia. 2013. https://www.unodc.org/documents/hiv-aids/publications/UNODC_UNAIDS_WB_2007_HIV_and_prisons_in_Africa-EN.pdf. Accessed April 20, 2017.
21. Niriella MA, Hapangama A, Luke HP, et al. Prevalence of hepatitis B and hepatitis C infections and their relationship to injectable drug use in a cohort of Sri Lankan prison inmates. *Ceylon Med J*. 2015;60(1):18–20.
22. Bacusca AI, Coman AE, Felea D, et al. Epidemiology of B/C virus infection hepatitis in the Northern Moldavian correctional facilities risk factors. *Rev Med Chir Soc Med Nat Iasi*. 2014;118(2):463–470.
23. Winetsky DE, Almukhamedov O, Pulatov D, et al. Prevalence, risk factors and social context of active pulmonary tuberculosis among prison inmates in Tajikistan. *PLoS One*. 2014;9(1):e86046.
24. de Albuquerque AC, da Silva DM, Rabelo DC, et al. Seroprevalence and factors associated with human immunodeficiency virus (HIV) and syphilis in inmates in the state of Pernambuco, Brazil. *Cien Saude Colet*. 2014;19(7):2125–2132.
25. El Maerawi I, Carvalho HB. Prevalence and risk factors associated with HIV infection, hepatitis and syphilis in a state prison of São Paulo. *Int J STD AIDS*. 2015;26(2):120–127.
26. Falquetto TC, Endringer DC, de Andrade TU, et al. Hepatitis C in prisoners and non-prisoners in Colatina, Espírito Santo, Brazil. *Braz J Pharm Sci*. 2013;49(4):737–744.
27. Puga MA, Bandeira LM, Pompilio MA, et al. Prevalence and incidence of HCV infection among prisoners in Central Brazil. *PLoS One*. 2017;12(1):e0169195.
28. Santos BF, de Santana NO, Franca AV. Prevalence, genotypes and factors associated with HCV infection among prisoners in Northeastern Brazil. *World J Gastroenterol*. 2011;17(25):3027–3034.
29. Sgarbi RV, Carbone A da Silva, Paíão DS, et al. A cross-sectional survey of HIV testing and prevalence in twelve Brazilian correctional facilities. *PLoS One*. 2015;10(10):e0139487.
30. Witzel C de L, Fortaleza CM, de Souza CS, et al. Nasopharyngeal carriage of *Staphylococcus aureus* among imprisoned males from Brazil without exposure to healthcare: risk factors and molecular characterization. *Ann Clin Microbiol Antimicrob*. 2014;13:25.
31. Andrinopoulos K, Kerrigan D, Figueroa JP, et al. HIV coping self-efficacy: a key to understanding stigma and HIV test acceptance among incarcerated men in Jamaica. *AIDS Care*. 2010;22(3):339–347.
32. European Monitoring Centre for Drugs and Drug Addiction. Prisons and drugs in Europe: the problem and responses. 2012. http://www.emcdda.europa.eu/attachements.cfm/att_191812_EN_TDSI12002ENC.pdf. Accessed April 14, 2017.
33. Sannier O, Verfaillie F, Lavielle D. [Risk reduction and drug use in detention: study about the detainees of Liancourt Penitentiary]. *Presse Med*. 2012;41(7–8):e375–e385.
34. Jacomet C, Guyot-Lénat A, Bonny C, et al. Addressing the challenges of chronic viral infections and addiction in prisons: the PRODEPIST study. *Eur J Public Health*. 2016;26(1):122–128.
35. Keten D, Emin Ova M, Sirri Keten H, et al. The prevalence of hepatitis B and C among prisoners in Kahramanmaraş, Turkey. *Jundishapur J Microbiol*. 2016;9(2):e31598.
36. Memon AR, Shafique K, Memon A, et al. Hepatitis B and C prevalence among the high risk groups of Pakistani population. A cross sectional study. *Arch Public Health*. 2012;70(1):9.
37. Azbel L, Wickersham JA, Wegman MP, et al. Burden of substance use disorders, mental illness, and correlates of infectious diseases among soon-to-be released prisoners in Azerbaijan. *Drug Alcohol Depend*. 2015;151:68–75.
38. Polonsky M, Azbel L, Wegman MP, et al. Pre-incarceration police harassment, drug addiction and HIV risk behaviours among prisoners in Kyrgyzstan and Azerbaijan: results from a nationally representative cross-sectional study. *J Int AIDS Soc*. 2016;19(4 suppl 3):20880.
39. Ravlija J, Vasilj I, Marjanović I, et al. Risk behaviour of prison inmates in relation to HIV/STI. *Psychiatr Danub*. 2014;26(suppl 2):395–401.
40. Azbel L, Polonsky M, Wegman M, et al. Intersecting epidemics of HIV, HCV, and syphilis among soon-to-be released prisoners in Kyrgyzstan: implications for prevention and treatment. *Int J Drug Policy*. 2016;37:9–20.
41. Mahfoud Z, Kassak K, Kreidieh K, et al. Prevalence of antibodies to human immunodeficiency virus (HIV), hepatitis B and hepatitis C and risk factors in prisoners in Lebanon. *J Infect Dev Ctries*. 2010;4(3):144–149.
42. Tresó B, Barcsay E, Tarján A, et al. Prevalence and correlates of HCV, HVB, and HIV infection among prison inmates and staff, Hungary. *J Urban Health*. 2012;89(1):108–116.
43. Drummond A, Codd M, Donnelly N, et al. Study on the prevalence of drug use, including intravenous drug use, and blood-borne viruses among the Irish prisoner population. Dublin, Ireland: National Advisory Committee on Drugs and Alcohol; 2014. <http://www.drugsandalcohol.ie/21750/13/Technical%20report.pdf>. Accessed April 19, 2017.
44. Einat T, Chen G. What's love got to do with it? Sex in a female maximum-security prison. *Prison J*. 2012;92(4):484–505.
45. Taylor A, Munro A, Allen E, et al. Low incidence of hepatitis C virus among prisoners in Scotland. *Addiction*. 2013;108(7):1296–1304.
46. Feng MC, Feng JY, Chen YH, et al. Prevalence and knowledge of sexual transmitted infections, drug abuse, and AIDS among male inmates in a Taiwan prison. *Kaohsiung J Med Sci*. 2012;28(12):660–666.
47. Azbel L, Wickersham JA, Grishaev Y, et al. Burden of infectious diseases, substance use disorders, and mental illness among Ukrainian prisoners transitioning to the community. *PLoS One*. 2013;8(3):e59643.
48. Dolan K, Teutsch S, Scheuer N, et al. Incidence and risk for acute hepatitis C infection during imprisonment in Australia. *Eur J Epidemiol*. 2010;25(2):143–148.
49. Indig D, Topp L, Ross B, et al. 2009 NSW inmate health survey: key findings report. Sydney, New South Wales, Australia: Justice Health; 2010:16. <http://www.justicehealth.nsw.gov.au/publications/inmate-health-survey-aboriginal-health-report.pdf>. Accessed April 12, 2017.
50. Kraemer S, Gately N, Kessell J. HoPE (Health of Prisoner Evaluation): pilot study of prisoner physical health and psychological wellbeing. 2009. https://www.ecu.edu.au/_data/assets/pdf_file/0006/685581/HoPE-Health-of-Prisoner-Evaluation-Report-online-version.pdf.

51. Larney S, Monkley DL, Indig D, et al. A cross-sectional study of susceptibility to vaccine-preventable diseases among prison entrants in New South Wales. *Med J Aust.* 2013; 198(7):376–379.
52. Reekie JM, Levy MH, Richards AH, et al. Trends in HIV, hepatitis B and hepatitis C prevalence among Australian prisoners – 2004, 2007, 2010. *Med J Aust.* 2014;200(5): 277–280.
53. Simpson PL, Reekie J, Butler TG, et al. Factors associated with sexual coercion in a representative sample of men in Australian prisons. *Arch Sex Behav.* 2016;45(5):1195–1205.
54. Alavi SM, Bakhtiarinia P, Eghtesad M, et al. A comparative study on the prevalence and risk factors of tuberculosis among the prisoners in Khuzestan, South-West Iran. *Jundishapur J Microbiol.* 2014;7(12):e18872.
55. Asli AA, Moghadami M, Zamiri N, et al. Vaccination against hepatitis B among prisoners in Iran: accelerated vs. classic vaccination. *Health policy.* 2011;100(2–3):297–304.
56. Navadeh S, Mirzazadeh A, Gouya MM, et al. HIV prevalence and related risk behaviours among prisoners in Iran: results of the national biobehavioural survey, 2009. *Sex Transm Infect.* 2013;89(suppl 3):iii33–iii36.
57. Nokhodian Z, Ataei B, Kassaian N, et al. Seroprevalence and risk factors of hepatitis C virus among juveniles in correctional center in Isfahan, Iran. *Int J Prev Med.* 2012; 3(suppl 1):S113–S117.
58. Nokhodian Z, Yazdani MR, Yaran M, et al. Prevalence and risk factors of HIV, syphilis, hepatitis B and C among female prisoners in Isfahan, Iran. *Hepat Mon.* 2012;12(7):442–447.
59. Zamani S, Farnia M, Torknejad A, et al. Patterns of drug use and HIV-related risk behaviors among incarcerated people in a prison in Iran. *J Urban Health.* 2010;87(4):603–616.
60. Ziaee M, Sharifzadeh G, Namaee MH, et al. Prevalence of HIV and hepatitis B, C, D infections and their associated risk factors among prisoners in Southern Khorasan Province, Iran. *Iran J Public Health.* 2014;43(2):229–234.
61. Burek V, Horvat J, Butorac K, et al. Viral hepatitis B, C and HIV infection in Croatian prisons. *Epidemiol Infect.* 2010; 138(11):1610–1620.
62. Vilibic-Cavlek T, Gjenero-Margan I, Retkovic B, et al. Sociodemographic characteristics and risk behaviors for HIV, hepatitis B and hepatitis C virus infection among Croatian male prisoners. *Int J Prison Health.* 2011;7(1):28–31.
63. Ferrer-Castro V, Crespo-Leiro MR, García-Marcos LS, et al. Evaluation of needle exchange program at Pereiro de Aguiar prison (Ourense, Spain): ten years of experience. *Rev Esp Sanid Penit.* 2011;14(1):3–11.
64. Marco A, Gallego C, Caylà JA. Incidence of hepatitis C infection among prisoners by routine laboratory values during a 20-year period. *PLoS One.* 2014;9(2):e90560.
65. Sánchez Recio R, Alonso Pérez de Ágreda JP, Santabábara Serrano J. Sexually transmitted infections in male prison inmates: risk of development of new diseases. *Gac Sanit.* 2016;30(3):208–214.
66. Saiz de la Hoya P, Marco A, García-Guerrero J, et al. Hepatitis C and B prevalence in Spanish prisons. *Eur J Clin Microbiol Infect Dis.* 2011;30(7):857–862.
67. Alvarez KJ, Befus M, Herzig CT, et al. Prevalence and correlates of hepatitis C virus infection among inmates at two New York State correctional facilities. *J Infect Public Health.* 2014;7(6):517–521.
68. Beckwith CG, Kurth AE, Bazerman LB, et al. A pilot study of rapid hepatitis C virus testing in the Rhode Island Department of Corrections. *J Public Health (Oxf).* 2016;38(1):130–137.
69. Feaster DJ, Reznick OG, Zack B, et al. Health status, sexual and drug risk, and psychosocial factors relevant to postrelease planning for HIV+ prisoners. *J Correct Health Care.* 2013; 19(4):278–292.
70. Holliday RC, Braithwaite RL, Yancey E, et al. Substance use correlates of depression among African American male inmates. *J Health Care Poor Underserved.* 2016;27(2A): 181–193.
71. Khan MR, Golin CE, Friedman SR, et al. STI/HIV sexual risk behavior and prevalent STI among incarcerated African American men in committed partnerships: the significance of poverty, mood disorders, and substance use. *AIDS Behav.* 2015;19(8):1478–1490.
72. Kim AY, Nagami EH, Birch CE, et al. A simple strategy to identify acute hepatitis C virus infection among newly incarcerated injection drug users. *Hepatology.* 2013;57(3): 944–952.
73. Rice JP, Burnett D, Tsotsis H, et al. Comparison of hepatitis C virus treatment between incarcerated and community patients. *Hepatology.* 2012;56(4):1252–1260.
74. Rowell TL, Wu E, Hart CL, et al. Predictors of drug use in prison among incarcerated Black men. *Am J Drug Alcohol Abuse.* 2012;38(6):593–597.
75. Stein MS, Spaulding AC, Cunningham M, et al. HIV-positive and in jail: race, risk factors, and prior access to care. *AIDS Behav.* 2013;17(suppl 2):S108–S117.
76. Wenger PJ, Rottnek F, Parker T, et al. Assessment of hepatitis C risk factors and infection prevalence in a jail population. *Am J Public Health.* 2014;104(9):1722–1727.
77. Viitanen P, Vartiainen H, Aarnio J, et al. Hepatitis A, B, C and HIV infections among Finnish female prisoners—young females a risk group. *J Infect.* 2011;62(1):59–66.
78. Barskey AE, Babu AS, Hernandez A, et al. Patterns and trends of newly diagnosed HIV infections among adults and adolescents in correctional and noncorrectional facilities, United States, 2008–2011. *Am J Public Health.* 2016;106(1): 103–109.
79. Zhang L, Yap L, Reekie J, et al. Drug use and HIV infection status of detainees in re-education through labour camps in Guangxi Province, China. *Int J Environ Res Public Health.* 2015;12(5):4502–4519.
80. Dissabandara LO, Dias SR, Dodd PR, et al. Patterns of substance use in male incarcerated drug users in Sri Lanka. *Drug Alcohol Rev.* 2009;28(6):600–607.
81. Ko NY, Yen CF, Chen CH, et al. Applying the transtheoretical model to the readiness to change blood-borne virus transmission behaviors among drug-dependent inmates. *Am J Addict.* 2010;19(5):433–439.
82. Peng EY, Yeh CY, Cheng SH, et al. A case-control study of HIV infection among incarcerated female drug users: impact of sharing needles and having drug-using sexual partners. *J Formos Med Assoc.* 2011;110(7):446–453.
83. Khajedaluee M, Babaei A, Vakili R, et al. Sero-prevalence of bloodborne tumor viruses (HCV, HBV, HTLV-I and KSHV infections) and related risk factors among prisoners in Razavi Khorasan Province, Iran, in 2008. *Hepat Mon.* 2016;16(12): e31541.
84. Shahbazi M, Farnia M, Moradi G, et al. Injecting drug users retention in needle-exchange program and its determinants in Iran prisons. *Int J High Risk Behav Addict.* 2015;4(2):e23751.
85. Kouyoumdjian FG, Calzavara LM, Kiefer L, et al. Drug use prior to incarceration and associated socio-behavioural factors among males in a provincial correctional facility in Ontario, Canada. *Can J Public Health.* 2014;105(3):e198–e202.

86. Michel L, Trouiller P, Chollet A, et al. Self-reported injection practices among people who use drugs in French prisons: Public health implications (ANRS-Coquelicot survey 2011–2013) [published online ahead of print November 3, 2017]. *Drug Alcohol Rev.* (doi:10.1111/dar.12620).
87. Konstenius M, Jayaram-Lindström N, Guterstam J, et al. Methylphenidate for attention deficit hyperactivity disorder and drug relapse in criminal offenders with substance dependence: a 24-week randomized placebo-controlled trial. *Addiction.* 2014;109(3):440–449.
88. Favrod-Coune T, Baroudi M, Casillas A, et al. Opioid substitution treatment in pretrial prison detention: a case study from Geneva, Switzerland. *Swiss Med Wkly.* 2013;143:w13898.
89. Gordon MS, Kinlock TW, Couvillion KA, et al. Gender differences among prisoners with pre-incarceration heroin dependence participating in a randomized clinical trial of buprenorphine treatment. *J Offender Rehabil.* 2013;52(5):376–391.
90. McKenzie M, Zaller N, Dickman SL, et al. A randomized trial of methadone initiation prior to release from incarceration. *Subst Abus.* 2012;33(1):19–29.
91. McNamara BC, Losikoff PT, Huguenin L, et al. Increasing hepatitis C prevalence and associated risk behaviors among incarcerated young adults. *J Urban Health.* 2014;91(2):376–382.
92. Staton-Tindall M, Harp KL, Minieri A, et al. An exploratory study of mental health and HIV risk behavior among drug-using rural women in jail. *Psychiatr Rehabil J.* 2015;38(1):45–54.
93. Lloyd AR, Clegg J, Lange J, et al. Safety and effectiveness of a nurse-led outreach program for assessment and treatment of chronic hepatitis C in the custodial setting. *Clin Infect Dis.* 2013;56(8):1078–1084.
94. Hodžić H, Bajramović A, Obradović Z, et al. Intravenous drugs abuse as the main risk factor of increasing hepatitis C infection prevalence in prisoners in Zenica, Bosnia and Herzegovina. *Med Glas (Zenica).* 2017;14(1):73–78.
95. Iacomi F, Iannicelli G, Franceschini A, et al. HCV infected prisoners: should they be still considered a difficult to treat population? *BMC Infect Dis.* 2013;13:374.
96. Marco A, Antón JJ, Saiz de la Hoya P, et al. Personality disorders among Spanish prisoners starting hepatitis C treatment: prevalence and associated factors. *Psychiatry Res.* 2015;230(3):749–756.
97. Marco A, Esteban JI, Solé C, et al. Hepatitis C virus reinfection among prisoners with sustained virological response after treatment for chronic hepatitis C. *J Hepatol.* 2013;59(1):45–51.
98. Saiz de la Hoya P, Portilla J, Marco A, et al. Directly observed therapy for chronic hepatitis C: a randomized clinical trial in the prison setting. *Gastroenterol Hepatol.* 2014;37(8):443–451.
99. Nelwan EJ, Van Crevel R, Alisjahbana B, et al. Human immunodeficiency virus, hepatitis B and hepatitis C in an Indonesian prison: prevalence, risk factors and implications of HIV screening. *Trop Med Int Health.* 2010;15(12):1491–1498.
100. Bachireddy C, Bazazi AR, Kavasey R, et al. Attitudes toward opioid substitution therapy and pre-incarceration HIV transmission behaviors among HIV-infected prisoners in Malaysia: implications for secondary prevention. *Drug Alcohol Depend.* 2011;116(1–3):151–157.
101. Bick J, Culbert G, Al-Darraj HA, et al. Healthcare resources are inadequate to address the burden of illness among HIV-infected male prisoners in Malaysia. *Int J Prison Health.* 2016;12(4):253–269.
102. Azbel L, Wickersham JA, Grishaev Y, et al. Correlates of HIV infection and being unaware of HIV status among soon-to-be-released Ukrainian prisoners. *J Int AIDS Soc.* 2014;17:19005.
103. Chen G, Gueta K. Child abuse, drug addiction and mental health problems of incarcerated women in Israel. *Int J Law Psychiatry.* 2015;39:36–45.
104. Pontali E, Bobbio N, Zaccardi M, et al. Blood-borne viral co-infections among human immunodeficiency virus-infected inmates. *Int J Prison Health.* 2016;12(2):88–97.
105. Salem F, Hekmat S, Aghasadeghi MR, et al. Prevalence and risk factors of hepatitis B virus genotype D amongst inmates in Alborz Province, Iran: a cross-sectional survey. *Jundishapur J Microbiol.* 2013;6(6):e10221.
106. Cameron B, Galbraith S, Li H, et al. Correlates and characteristics of hepatitis C virus-specific T-cell immunity in exposed uninfected high-risk prison inmates. *J Viral Hepat.* 2013;20(4):e96–e106.
107. Watkins RE, Mak DB, Connelly C. Identifying high risk groups for sexually transmitted infections and blood borne viruses upon admission to prison in Western Australia. *Rural Remote Health.* 2011;11(2):1621.
108. Culbert GJ, Waluyo A, Iriyanti M, et al. Within-prison drug injection among HIV-infected male prisoners in Indonesia: a highly constrained choice. *Drug Alcohol Depend.* 2015;149:71–79.
109. Al-Darraj HA, Kamarulzaman A, Altice FL. Latent tuberculosis infection in a Malaysian prison: implications for a comprehensive integrated control program in prisons. *BMC Public Health.* 2014;14:22.
110. Izenberg JM, Bachireddy C, Wickersham JA, et al. Within-prison drug injection among HIV-infected Ukrainian prisoners: prevalence and correlates of an extremely high-risk behaviour. *Int J Drug Policy.* 2014;25(5):845–852.
111. Kassaian N, Adibi P, Kafashaian A, et al. Hepatitis C virus and associated risk factors among prison inmates with history of drug injection in Isfahan, Iran. *Int J Prev Med.* 2012;3(suppl 1):S156–S161.
112. Marco Mourinho A, da Silva Morán A, Ortiz Seuma J, et al. Predictors of adherence to treatment of chronic hepatitis C in drug-dependent inmate patients in four prisons in Barcelona, Spain. *Rev Esp Salud Publica.* 2010;84(4):423–431.
113. Marco Mourinho A, Gallego Castellví C, García de Olalla P, et al. Late diagnosis of HIV infection among prisoners. *AIDS Rev.* 2013;15(3):146–151.
114. Carnie J, Broderick R. Scottish prisoner survey 2008. Edinburgh, United Kingdom: Scottish Prison Service; 2008. http://www.sps.gov.uk/nmsruntime/saveasdialog.aspx?fileName=Prisoner_Survey_2008.pdf. Accessed April 6, 2017.
115. Carnie J, Broderick R. Scottish prisoner survey 2009. Edinburgh, United Kingdom: Scottish Prison Service; 2009. www.sps.gov.uk/nmsruntime/saveasdialog.aspx?fileName=Prisoner_Survey_2009.pdf. Accessed April 6, 2017.
116. Carnie J, Broderick R. Scottish prisoner survey 2011. Edinburgh, United Kingdom: Scottish Prison Service; 2011. http://www.hepatitisScotland.org.uk/files/4913/9323/9642/Prisoner_Survey_-_Bulletin_20113696_724_1.pdf. Accessed April 6, 2017.
117. Carnie J, Broderick R. Scottish prisoner survey 2013. Edinburgh, United Kingdom: Scottish Prison Service; 2013. <http://www.sps.gov.uk/Corporate/>

- [PrisonerSurvey2013MainBulletin.aspx](#). Accessed April 6, 2017.
118. Carnie J, Broderick R. Scottish prisoner survey 2015. Edinburgh, United Kingdom: Scottish Prison Service; 2015. <http://www.sps.gov.uk/Corporate/Publications/Publication-4565.aspx>. Accessed April 6, 2017.
 119. Adams LM, Stuewig JB, Tangney JP. Relation of borderline personality features to preincarceration HIV risk behaviors of jail inmates: evidence for gender differences? *Personal Disord*. 2016;7(1):40–49.
 120. Cropsey KL, Lane PS, Hale GJ, et al. Results of a pilot randomized controlled trial of buprenorphine for opioid dependent women in the criminal justice system. *Drug Alcohol Depend*. 2011;119(3):172–178.
 121. Wright NM, Tompkins CN, Farragher TM. Injecting drug use in prison: prevalence and implications for needle exchange policy. *Int J Prison Health*. 2015;11(1):17–29.
 122. Busi S, Oltaye Z. Assessment of magnitude of sexually transmitted infections, sexual and reproductive health status among prisoners aged between 18–49 years in Tabor Prison, Hawassa, Ethiopia. *Momona Ethiopian J Sci*. 2016;8(1):89–97.
 123. Ouédraogo O, Garanet F, Sawadogo S, et al. Vulnerability of male prisoners to HIV/AIDS in Ouagadougou, Burkina Faso. *Sante Publique*. 2015;27(5):749–756.
 124. Adoga MP, Banwat EB, Forbi JC, et al. Human immunodeficiency virus, hepatitis B virus and hepatitis C virus: sero-prevalence, co-infection and risk factors among prison inmates in Nasarawa State, Nigeria. *J Infect Dev Ctries*. 2009;3(7):539–547.
 125. Akeke VA, Mokgatle M, Oguntibeju OO. Prevalence of risk factors for transmission of HIV and blood-borne viruses in a prison population. *Afr J Microbiol Res*. 2009;3(7):379–384.
 126. Jaquet A, Wandeler G, Tine J, et al. HIV infection, viral hepatitis and liver fibrosis among prison inmates in West Africa. *BMC Infect Dis*. 2016;16:249.
 127. Ekouevi DK, D'almeida S, Salou M, et al. HIV seroprevalence among inmates in Togo. *Med Mal Infect*. 2013;43(7):279–285.
 128. Huang YF, Yang JY, Nelson KE, et al. Changes in HIV incidence among people who inject drugs in Taiwan following introduction of a harm reduction program: a study of two cohorts. *PLoS Med*. 2014;11(4):e1001625.
 129. Rodríguez BEA, Pinzón Z, Huaman BJ, et al. Prevalence of HIV, syphilis, drugs use and sexual risk behaviours among prisoners in Guatemala, 2012. *Sex Transm Infect*. 2013;89(suppl 1):A202.
 130. Rosa Fd, Carneiro M, Duro LN, et al. Prevalence of anti-HCV in an inmate population. *Rev Assoc Med Bras (1992)*. 2012;58(5):557–560.
 131. Vasic M, Krstic M, Terzic Z, et al. Risk behaviours for sexually transmitted diseases among prisoners in Serbia. *Eur J Public Health*. 2012;22:160.
 132. Pollini RA, Alvelais J, Gallardo M, et al. The harm inside: injection during incarceration among male injection drug users in Tijuana, Mexico. *Drug Alcohol Depend*. 2009;103(1–2):52–58.
 133. Butler T, Richters J, Yap L, et al. *Sexual Health and Behaviour of Queensland Prisoners*. Perth and Sydney, Australia: National Drug Research Institute; 2010. https://kirby.unsw.edu.au/sites/default/files/kirby/report/SHP_QLD-Prisoner-Report-2010.pdf. Accessed April 19, 2017.
 134. Moore E, Winter R, Indig D, et al. Non-fatal overdose among adult prisoners with a history of injecting drug use in two Australian states. *Drug Alcohol Depend*. 2013;133(1):45–51.
 135. Bretaña NA, Boelen L, Bull R, et al. Transmission of hepatitis C virus among prisoners, Australia, 2005–2012. *Emerg Infect Dis*. 2015;21(5):765–774.
 136. Rodríguez-Díaz CE, Rivera-Negrón RM, Clatts MC, et al. Health care practices and associated service needs in a sample of HIV-positive incarcerated men in Puerto Rico: implications for retention in care. *J Int Assoc Provid AIDS Care*. 2014;13(6):492–496.
 137. Richters J, Butler T, Schneider K, et al. Consensual sex between men and sexual violence in Australian prisons. *Arc Sex Behav*. 2012;41(2):517–524.
 138. Mor Z, Vider H, Grotto I, et al. P6.058 universal HIV screening of inmates in Israeli prisons: should the policy be updated? *Sex Transm Infect*. 2013;89(suppl 1):A387.
 139. Nelwan EJ, Indrati AK, Isa A, et al. Effect of HIV prevention and treatment program on HIV and HCV transmission and HIV mortality at an Indonesian Narcotic prison. *Southeast Asian J Trop Med Public Health*. 2015;46(5):880–891.
 140. Roshanfekr P, Farnia M, Dejman M. The effectiveness of harm reduction programs in seven prisons of Iran. *Iran J Public Health*. 2013;42(12):1430–1437.
 141. Beck AJ, Berzofsky M, Caspar R, et al. *Sexual Victimization in Prisons and Jails Reported by Inmates, 2011–12*. Washington, DC: US Bureau of Justice Statistics; 2013. <https://www.bjs.gov/content/pub/pdf/svpjri1112.pdf>. Accessed April 6, 2017.
 142. Corbeto EL, Carnicer-Pont D, Lugo R, et al. Sexual behaviour of inmates with Chlamydia trachomatis infection in the prisons of Catalonia, Spain. *Sex Health*. 2012;9(2):187–189.
 143. Harawa NT, Sweat J, George S, et al. Sex and condom use in a large jail unit for men who have sex with men (MSM) and male-to-female transgenders. *J Health Care Poor Underserved*. 2010;21(3):1071–1087.
 144. Klatt T, Hagl S, Bergmann MC, et al. Violence in youth custody: risk factors of violent misconduct among inmates of German young offender institutions. *Eur J Criminol*. 2016;13(6):727–743.
 145. Bautista S, Fernández-Cerdeño A, Juárez-Figueroa L, et al. P1-S2.71 sexually transmitted infections in Mexico-City's penitentiary centers: the Ponte a Prueba: put yourself to the test “study”. *Sex Transm Infect*. 2011;87(suppl 1):A153.
 146. Mutayoba B, Ngowi B, Kohi W, et al. HIV prevalence and related risk factors in prison settings: findings from a rapid situational assessment in mainland Tanzania [Abstract]. Presented at the 20th International AIDS Conference, Melbourne, Australia, 2014.
 147. Barth T. Relationships and sexuality of imprisoned men in the German penal system—a survey of inmates in a Berlin prison. *Int J Law Psychiatry*. 2012;35(3):153–158.
 148. Azarkar Z, Sharifzadeh G. Evaluation of the prevalence of hepatitis B, hepatitis C, and HIV in inmates with drug-related convictions in Birjand, Iran in 2008. *Hepat Mon*. 2010;10(1):26–30.
 149. Roux P, Sagaon-Teyssier L, Lions C, et al. HCV seropositivity in inmates and in the general population: an averaging approach to establish priority prevention interventions. *BMJ Open*. 2014;4(10):e005694.
 150. Abiona TC, Balogun JA, Adefuye AS, et al. Body art practices among inmates: implications for transmission of bloodborne infections. *Am J Infect Control*. 2010;38(2):121–129.
 151. Prasetyo AA, Dirgahayu P, Sari Y, et al. Molecular epidemiology of HIV, HBV, HCV, and HTLV-1/2 in drug abuser inmates in central Javan prisons, Indonesia. *J Infect Dev Ctries*. 2013;7(6):453–467.

152. Sanarico N, D'Amato S, Bruni R, et al. Correlates of infection and molecular characterization of blood-borne HIV, HCV, and HBV infections in HIV-1 infected inmates in Italy: an observational cross-sectional study. *Medicine (Baltimore)*. 2016;95(44):e5257.
153. Kinner SA, Winter R, Saxton K. A longitudinal study of health outcomes for people released from prison in Fiji: the HIP-Fiji project. *Australas Psychiatry*. 2015;23(6 suppl): 17–21.
154. United Nations Office on Drugs and Crime. *Prevention of Spread of HIV amongst Vulnerable Groups in South Asia*. New Delhi, India: United Nations Office on Drugs and Crime, Regional Office for South Asia; 2008. https://www.unodc.org/pdf/india/our_work_sa_prisons.pdf. Accessed April 18, 2017.
155. Hammett TM, Harmon MP, Rhodes W. The burden of infectious disease among inmates of and releasees from US correctional facilities, 1997. *Am J Public Health*. 2002; 92(11):1789–1794.
156. Stone J, Martin NK, Hickman M, et al. Modelling the impact of incarceration and prison-based hepatitis C virus (HCV) treatment on HCV transmission among people who inject drugs in Scotland. *Addiction*. 2017;112(7):1302–1314.
157. Altice FL, Azbel L, Stone J, et al. The perfect storm: incarceration and the high-risk environment perpetuating transmission of HIV, hepatitis C virus, and tuberculosis in Eastern Europe and Central Asia. *Lancet*. 2016;388(10050): 1228–1248.
158. World Health Organization. *Interventions to Address HIV in Prisons: Needle and Syringe Programmes and Decontamination Strategies*. 2007. http://apps.who.int/iris/bitstream/10665/43758/1/9789241595810_eng.pdf. Accessed August 7, 2017.
159. Kamarulzaman A, Reid SE, Schwitters A, et al. Prevention of transmission of HIV, hepatitis B virus, hepatitis C virus, and tuberculosis in prisoners. *Lancet*. 2016;388(10049): 1115–1126.
160. World Health Organization. *Guide to Starting and Managing Needle and Syringe Programmes*. 2007. http://apps.who.int/iris/bitstream/10665/43816/1/9789241596275_eng.pdf. Accessed August 7, 2017.
161. Farnia M, Ebrahimi B, Shams A, et al. Scaling up methadone maintenance treatment for opioid-dependent prisoners in Iran. *Int J Drug Policy*. 2010;21(5):422–424.
162. Stöver H, Hariga F. Prison-based needle and syringe programmes (PNSP)—still highly controversial after all these years. *Drugs (Abingdon Engl)*. 2016;23(2):103–112.
163. United Nations Office on Drugs and Crime. *World Drug Report*. Vienna, Austria: United Nations Office on Drugs and Crime; 2016.
164. Ballester J, Valentine G, Sofuoglu M. Pharmacological treatments for methamphetamine addiction: current status and future directions. *Expert Rev Clin Pharmacol*. 2017;10(3): 305–314.
165. Alammehrjerdi Z, Ezard N, Clare P, et al. Brief cognitive-behavioural therapy for methamphetamine use among methadone-maintained women: a multicentre randomised controlled trial. *J Addict Res Ther*. 2016;7:294.
166. Butler T, Richters J, Yap L, et al. Condoms for prisoners: no evidence that they increase sex in prison, but they increase safe sex. *Sex Transm Infect*. 2013;89(5):377–379.
167. Niveau G. Prevention of infectious disease transmission in correctional settings: a review. *Public Health*. 2006;120(1):33–41.
168. Dolan K, Lowe D, Shearer J. Evaluation of the condom distribution program in New South Wales Prisons, Australia. *J Law Med Ethics*. 2004;32(1):124–128.
169. Scott N, McBryde E, Kirwan A, et al. Modelling the impact of condom distribution on the incidence and prevalence of sexually transmitted infections in an adult male prison system. *PLoS One*. 2015;10(12):e0144869.
170. Kinner SA, Jenkinson R, Gouillou M, et al. High-risk drug-use practices among a large sample of Australian prisoners. *Drug Alcohol Depend*. 2012;126(1–2):156–160.
171. Egger S, Lecturer S, Heilpern H. HIV/AIDS and Australian prisons. In: Norberry J, Gaughwin M, Gerull S-A, eds. *HIV/AIDS and Prisons: Proceedings of a Conference Held 19-21 November 1990*. Canberra, Australian Capital Territory, Australia: Australian Institute of Criminology; 1991. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.558.589&rep=rep1&type=pdf>. Accessed August 8, 2017.
172. Rosen HR. Acquisition of hepatitis C by a conjunctival splash. *Am J Infect Control*. 1997;25(3):242–247.
173. Dolan KA, Wodak AD, Hall WD. A bleach program for inmates in NSW: an HIV prevention strategy. *Aust N Z J Public Health*. 1998;22(7):838–840.
174. United Nations Office on Drugs and Crime. *Prevention, Treatment and Care in Prisons and Other Closed Settings: a Comprehensive Package of Interventions*. Vienna, Austria: United Nations Office of Drugs and Crime; 2013. https://www.unodc.org/documents/hiv-aids/HIV_comprehensive_package_prison_2013_eBook.pdf. Accessed August 8, 2017.
175. Sander G, Scandurra A, Kamenska A, et al. Overview of harm reduction in prisons in seven European countries. *Harm Reduct J*. 2016;13(1):28.