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Health Outcomes for Clients of Needle and Syringe Programs in Prisons

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High levels of drug dependence have been observed in the prison population globally, and the sharing of injecting drug equipment in prisons has contributed to higher prevalence of bloodborne diseases in prisoners than in the general population. ~~WHO, UNODC, and UNAIDS have advised governments to institute~~Few prison needle and syringe programs (PNSPs~~), but few such programs)~~ exist. We conducted a systematic review to assess evidence regarding health outcomes of PNSPs. We searched peer-reviewed databases ~~(Medline, Embase, PsycINFO, and CINAHL)~~ for data relating to needle and syringe programs in prisons. The search methodology was conducted in accordance with ~~PRISMA MOOSE~~accepted guidelines. Five studies met review inclusion criteria, and all presented evidence associating PNSPs with one or more health benefits, but the strength of the evidence was low. The outcomes for which the studies collectively demonstrated the strongest evidence were prevention of ~~HIV~~human immunodeficiency virus and viral hepatitis. Few negative consequences from PNSPs were observed, consistent with previous evidence assessments. More research is needed on PNSP effectiveness, and innovative study designs are needed to overcome methodological limitations of previous research. Until stronger evidence becomes available, ~~policy-makers~~policymakers are urged to recognize that not implementing PNSPs has the potential to cause considerable harm, in light of what is currently known about the risks and benefits of ~~NSPs~~needle and syringe programs and PNSPs and about the high prevalence of ~~HIV, HBV and HCV~~human immunodeficiency virus and viral hepatitis in prisons.

~~Keywords~~

~~blood-borne~~bloodborne pathogens; drug ~~usage~~use; harm reduction; hepatitis, viral, human; HIV, needle-exchange programs; prisons; review, systematic

Abbreviations: HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; NSP, needle and syringe program; PNSP, prison needle and syringe program; PWID, people who inject drugs; WHO, World Health Organization.

INTRODUCTION

There are ~~ten~~10 million people in prisons worldwide, and high levels of drug dependence have been observed in prison populations (1, 2). Some people who injected drugs before they were incarcerated continue to do so while in prison, ~~while~~whereas other people initiate injecting drug use in prison (2–4). In studies in Australia, England, the Netherlands, and Thailand, the proportions of inmates who reported injecting drugs while in prison were 52%, 12%, 3~~%~~%, and 25%, respectively (2).

Health consequences of injecting drug use include exposure to bloodborne viruses as a result of sharing contaminated injecting equipment, and prison inmates often have higher prevalence of bloodborne diseases than does the general population. ~~A~~According to a 2016 meta-analysis ~~determined that,~~ worldwide prevalence of human immunodeficiency virus (HIV) among prison inmates is 3.8%, ~~while~~and 4.8% of inmates are living with chronic hepatitis B virus (HBV) infection. It was estimated that 15.1% of inmates are ~~antibody~~ positive for ~~the~~ hepatitis C virus

(HCV~~),~~) antibodies, meaning ~~that~~ they have been exposed to HCV but do not necessarily have chronic infection (4). ~~Another~~On the basis of findings of another meta-analysis ~~focusing~~, which focused specifically on HCV in prisons ~~reported an~~, researchers estimated more than one-quarter of inmates worldwide ~~to be~~are HCV antibody~~-~~ positive (5).

There is less evidence regarding the extent to which people are becoming infected with HIV, HBV, and HCV during periods of incarceration as opposed to acquiring these viruses before entering prison. Furthermore, injecting drug use is only ~~one~~1 of multiple transmission pathways that are commonly found in prisons~~, and~~; other practices, such as sharing contaminated tattooing equipment, also contribute to the spread of bloodborne viruses among inmates. However, the scarcity of injecting drug equipment in prisons leads to the available equipment being widely shared, and major outbreaks of HIV in several countries have been linked to injecting drug use among inmates (2, 6, 7). ~~Research~~Researchers also ~~has~~have documented new HCV infections attributable to injecting drug use among inmates (8).

~~The~~In 1983, the Amsterdam Health Department initiated the world's first ~~ever~~ government-run needle and syringe program (NSP) for people who inject drugs (PWID~~) in 1983.~~). Although preventing HBV transmission among PWID was the immediate concern, health officials soon recognized the NSP as a strategy for responding to the emerging HIV epidemic (9). ~~Following~~After the documented success of the Amsterdam NSP, similar programs were implemented in Australia, the United Kingdom, and the United States (10).

~~A number of~~Several systematic reviews of NSP research have been published. In a 2017 overview of systematic reviews, Fernandes et al. (11) focused on assessing evidence of the effectiveness of NSPs in reducing the spread of bloodborne infections among PWID. They excluded

evidence drawn solely from prison populations, in light of their assessment that prison and ~~non-prison~~nonprison populations have distinct characteristics. ~~Their study~~They found some review-level evidence that NSPs reduce HIV transmission among PWID. Findings were mixed regarding whether NSPs reduce HCV transmission. The researchers concluded that evidence relating to the ~~impact~~effect of NSPs is highly heterogeneous and of low methodological quality overall (11). Davis et al. (12) made a similar observation in a systematic review and meta-analysis focusing specifically on HCV risk. Among the ~~six~~6 studies that met their review criteria, pooled hazard ratios from ~~four~~4 studies indicated that NSPs had a statisticially significant harmful effect~~,~~ in terms of the association between NSP use and HCV seroconversion, ~~while~~whereas pooled risk ratios from ~~two~~2 studies indicated that NSP participation had no effect. The authors concluded that the existing empirical evidence ~~is~~was not sufficient to either recommend or discount NSPs as an HCV prevention strategy (12). In a Cochrane systematic review that only included studies comparing multiple study arms, ~~seven~~7 studies collectively provided weak evidence associating high NSP coverage with a lower risk of HCV acquisition (13).

Nonetheless, ~~in light~~on the basis of what is known about the potential benefits of NSPs, the World Health Organization (WHO) and other major public~~–~~health stakeholders have strongly endorsed this intervention, as have harm reduction service providers and members of communities affected by injecting drug use (14–16). As of 2016, 90 countries were reported to have at least ~~one~~1 operational ~~needle-and-syringe program~~NSP (17). At the same time, concerns have been raised about whether the existing evidence is strong enough to justify the intervention. Designing and executing scientifically robust research to investigate the efficacy and effectiveness of NSPs, whether in community or prison settings, is fraught

with challenges——from losing study participants to follow-up to the limited generalizability of findings due to ~~non-probablistic~~nonprobablistic sampling methodologies.

The international community has recognized the principle of equivalence in relation to the treatment of prisoners, meaning that governments have the obligation to provide prisoners with the same level of care that is available to the ~~non-prison~~nonprison population. In 1990, the United Nations General Assembly adopted a resolution that committed Member States to providing prisoners with "access to the health services available in the country without discrimination on the grounds of their legal situation" (18, p. 1). In 1993, in a recommendation addressing HIV in prisons, the Council of Europe similarly pronounced that "respect for the fundamental rights of prisoners, in particular the right to health care, entails the provision to prisoners of preventive treatment and health care equivalent to those provided to the community in general" (19, p. 1). WHO, the United Nations Office on Drugs and Crime ~~(UNODC),~~ and the Joint United Nations Programme on HIV/AIDS ~~(UNAIDS)~~ have further elaborated on governments' responsibilities in relation to the provision of equivalent health care to prisoners, as has the World Medical Association (20, 21).

~~A~~In 1992, a prison physician in Switzerland initiated the first known prison-based NSP (PNSP) ~~in 1992~~ (22, 23). The prison director's support for this activity proved to be atypical, and few other prisons followed suit (24). Harm Reduction International reported that only ~~eight~~8 countries worldwide were providing NSPs in at least ~~one~~1 prison in 2016: Armenia, Germany, Kyrgyzstan, Luxembourg, Moldova, Spain, Switzerland, and Tajikistan (17). There are reports of pilot PNSPs in other countries such as Iran and Romania (25, 26).

~~In~~By not implementing PNSPs more widely, governments are disregarding the advice of WHO, which first publicly supported PNSPs in 1993 (27). A landmark technical paper ~~co-published~~copublished in 2007 by WHO, ~~UNAIDS~~Joint United Nations Programme on HIV/AIDS, and ~~UNODC~~United Nations Office on Drugs and Crime presented a thorough assessment of the available evidence on PNSPs. The body of evidence as a whole had major methodological limitations, including extensive reliance on descriptive findings from evaluation studies. Generally, however, it supported the premise that PNSPs reduce the sharing of ~~non-sterile~~nonsterile injecting equipment. The dearth of evidence for serious, unintended, negative consequences of PNSPs was noted as well. According to WHO, opposing the implementation of PNSPs on the grounds of incomplete scientific evidence would be considered "both poor scientific judgment and bad public health policy" (8, p. 18, 28). ~~While acknowledging~~Although they acknowledged that more evidence was needed, WHO and the other agencies concluded that on the basis of what was then known, ~~"Prison~~"[p]rison authorities in countries experiencing or threatened by an epidemic of HIV infections among (injecting drug users) should introduce needle and syringe programs urgently and expand implementation to scale as soon as possible" (8, p. 18). In making the case for PNSPs, they cited the more widely available evidence of the benefits of ~~non-prison~~nonprison NSPs (8).

WHO reiterated the PNSP recommendation in 2014, basing its position on an updated literature review. The 2014 publication, like the 2007 one, noted additional possible benefits of PNSPs beyond reducing HIV transmission. These included reducing the risk of drug overdose and decreasing the incidence of abscesses caused by injecting drugs. Evidence from methodologically rigorous peer-reviewed studies remained quite limited (1).

There has been a sustained global movement to end the HIV epidemic for more than ~~two decades~~20 years (29, 30). More recently, growing recognition of the burden of disease from HBV and HCV has led to the emergence of globally coordinated responses to both diseases~~,~~ and, in 2016, WHO introduced the goal of eliminating viral hepatitis "as a major public health threat" by 2030 (31, p. 21). Injecting drug use is a major driver of the transmission of all ~~three~~3 diseases in prison populations. However, there do not appear to be any systematic reviews of evidence relating to health outcomes of prison-based NSPs. ~~This~~In this article ~~seeks~~, we seek to fill an important gap in the literature by presenting the first such study.

METHODS

A search was conducted in the following ~~four~~4 bibliographic databases to identify studies of ~~needle and syringe programs~~NSPs in prisons: MEDLINE (via Ovid), Embase (via Ovid), PsycINFO, (via Ovid) and Cumulative Index to Nursing and Allied Health Literature (CINAHL ~~(~~; via EBSCOhost). Each was searched from inception to January 26, 2017. Searches were conducted by combining terms related to prisons or prisoners (e.g., prisons, jail, penitentiary, correctional facility, custody, detainee ~~and,~~ incarcerated) and ~~needle and syringe programs~~NSPs (e.g., needles, syringes, exchange, provision, distribution, ~~and~~ program).

The appropriate indexing terms and free~~-~~text searches were applied for each database (Web Appendix 1, available at https://academic.oup.com/aje). Results were limited to include only records indexed as involving humans. No language or geographic restrictions were applied, but only articles in English, German ~~and~~, or Spanish were reviewed ~~due to~~, because of staff language capacity. After ~~removal~~

~~of~~removing duplicates, the titles and abstracts of the remaining records were manually screened to identify potentially relevant studies and to establish types of potential health outcomes. Google Scholar was used to check if the search string had missed any relevant studies.

A study was considered for inclusion if it focused on a ~~prison needle and syringe program,~~PSNP, if the authors had outlined how it was conducted, and ~~reported~~if any health outcomes observed as a result of the intervention~~.~~ were reported. Studies that did not aim to measure health outcomes among PWID in prisons~~,~~ but reported them as unintended benefits~~,~~ were also considered for inclusion. Health outcomes were defined as any change in the health status of study participants, including behavioral changes (e.g., reduced risk behavior) and infection rate changes in HIV and/or viral hepatitis. Health outcomes could have been measurable or they could have been self-perceived and self-reported by PNSP clients and/or providers. Studies reporting quantitative and/or qualitative findings on any health-related outcome of these programs were eligible for inclusion. Studies reporting results of PNSP as part of a package of interventions (e.g., harm reduction services) were considered for inclusion if a PNSP-specific subanalysis was conducted. All types of PNSP interventions were considered for inclusion, regardless of the type of needle and syringe distribution mode (e.g., hand-to-hand, vending machine). Original research articles and review articles, systematic or otherwise, were eligible for inclusion. Studies based on surveys, interviews, case studies, ethnographic research, and intervention research were all eligible for inclusion. Articles published as comments, editorials, letters, or narrative reviews were excluded, as were studies that addressed the epidemiology, diagnosis, or treatment of HIV, ~~TB~~tuberculosis, hepatitis and/or drug consumption without making reference to PNSPs.

A data extraction template was ~~utilized~~used and included bibliographic details, study design, intervention, and measureable health outcomes among clients of PNSPs. Two members of the study team reviewed the articles, extracted the data, and compared the findings.

All components of the search methodology were conducted in accordance with ~~PRISMA MOOSE~~Preferred Reporting Items for Systematic Reviews and Meta-Analyses and Meta-analysis of Observational Studies in Epidemiology guidelines for systematic reviews (32). Study quality was assessed by members of the study team, and limitations to the designs of included studies were noted. Due to the overall lack of studies included in the review, inconsistent study designs, different levels of measurements, and substantial variation between study settings, a statistical test for heterogeneity was not conducted.

RESULTS

The search yielded 745 records, of which 378 were eliminated because they were duplicates. Title and abstract screening of the remaining 367 articles resulted in the exclusion of 306 articles. All ~~of~~ the remaining 61 articles underwent full-text screening; ~~five~~5 met the inclusion criteria and were included in the final review (Figure 1). No other studies were identified through an additional Google Scholar search.

The studies included in the final analysis were conducted in Germany (n = 3), Spain (n = 1), and Switzerland (n = 1) (Table 1).

Ferrer-Castro et al. (33) tested prisoners in the Pereiro de Aguiar prison in Spain for HBV, HCV, and HIV in 1999, then again in 2009 after the introduction of a hand-to-hand PNSP (n = 362 at baseline~~, n = 425 at follow-up) (33).~~; n = 425 at follow-up). The authors found that HIV

prevalence dropped from 21% to 8% ($P \leq 0.01$) and HCV prevalence dropped from 40% to 26% ($P \leq 0.01$). There was no significant change in HBV antibody prevalence, which was already quite low (2%) at baseline.

Between 1996 and 1997, Heinemann et al. (34) conducted a mixed-methods study in a German prison~~, with;~~ data were gathered via survey, blood samples, and patient records, including drug consumption patterns ~~(34).~~. The researchers found no new HIV or hepatitis infections among PWID after the initiation of a PNSP. There was also no change in knowledge of hepatitis and associated risks. An increase in drug consumption among a subset of study participants taking methadone was observed.

In a comparative PNSP pilot study that took place in ~~one~~1 all-female (n = 169) and ~~one~~1 all-male (n = 83) prison in Germany, researchers reported no new HIV or hepatitis infections, an overall reduction in risk behavior, no overdoses at the all-female facility, and ~~one~~1 overdose at the all-male facility (35, 36). ~~The all-female prison observed~~There was a decrease in injecting-related abscesses and a decrease in psychological disorders requiring treatment~~. There was furthermore~~ at the all-female prison. Furthermore, there was no evidence of an increase in drug consumption.

Between 1994 and 1995, researchers conducted a PNSP pilot study in an all-female prison in Switzerland (n = 137) observed no new infections of HIV, HBV, or HCV during the study period (37). Likewise, no increased drug use was observed and participants discontinued the sharing of used syringes, except in ~~one~~1 documented case. However, there was no change in prisoner knowledge of HIV and ~~AIDS~~aquired immunodeficiency syndrome.

Finally, in a PNSP study in Berlin, Germany, ~~measured~~ HIV, HBV, and HCV seroconversions were measured among PWID in ~~one~~1 all-male and ~~one~~1 all-female prison (*n* = 174, both sexes) (38). The baseline ~~seroprevalences~~seroprevalence for HIV, HBV, and HCV ~~were~~was 18%, 53%, and 82%, respectively. No seroconversions occurred during follow-up (*n* = 124, both sexes), and ~~one~~1 new case of HCV was recorded in the all-male prison.

DISCUSSION

This systematic review was conducted to assess the current state of evidence regarding health benefits of PNSPs, an intervention recognized as an important HIV and HCV prevention strategy but rarely implemented in correctional settings worldwide. ~~While five~~Although 5 studies identified in our review presented evidence associating PNSPs with ~~one~~1 or more health benefits, the overall strength of the findings was low. However, the studies collectively indicated that PNSPs appear to contribute to the prevention of HIV, HBV, and HCV transmission among prison inmates. Anecdotal evidence suggested additional benefits, including decreased risk behavior, fewer drug use~~-~~related abscesses, decreased incidence of psychological disorders requiring treatment, increased uptake of other harm reduction services, improved infectious disease~~-~~related knowledge among inmates, and almost no drug overdoses. There were conflicting findings regarding whether PNSPs was associated with reduced drug consumption among study populations.

Paralleling the findings of ~~two non prison~~2 nonprison NSP reviews, ~~this~~we found in the present review ~~found~~that methodological weaknesses ~~to be~~were common (11, 12). Furthermore, the ~~five~~5 studies analyzed in this review encompass various study designs, interventions, prison settings,

and prison populations. It is also notable that only ~~two~~2 of the studies were published more recently than 2000. Taken together, these issues make it difficult to draw meaningful conclusions from the studies about the general effectiveness of PNSPs.

This situation likely reflects the inherent difficulty of conducting methodologically robust research on the provision of clean injecting equipment in prisons. High turnover in the prison population in many settings is an obstacle to following large numbers of individuals longitudinally~~,~~ (i.e., the transfer or release of study participants means ~~that~~ they are not available for follow-up unless there is a mechanism for tracking and retaining them in the study~~. Additionally~~). In addition, in some studies in our review, clean needles and syringes were provided ~~alongside~~along with other interventions such as condom distribution, health education activities, and referral to drug treatment services. This is consistent with evidence-based advice from ~~UNODC~~the United Nations Office on Drugs and Crime and other ~~UN~~United Nations agencies to implement PNSPs as part of a comprehensive package of harm reduction services (39). From a scientific standpoint, the simultaneous use of multiple interventions makes it difficult to attribute any observed changes to ~~one~~a specific intervention. From an ethical standpoint, however, it would not be acceptable to conduct a study that gave prison inmates access to ~~one~~1 intervention but not other interventions that have been shown to have health benefits. Therefore, it is necessary to explore other methodological approaches for assessing the effectiveness of PNSPs.

The question facing ~~policy-makers—~~policymakers—an urgent question in many settings, in light of the high HIV, HBV, and HCV prevalence in prison populations~~—~~—is whether ~~or not~~ to institute PNSPs on the basis of ~~the~~ existing ~~body of~~ knowledge. Typically, evidence-based medical and public health decision-making calls for a convincing demonstration of effectiveness~~—~~, or, at the minimum, a finding of efficacy in controlled

study situations—, before new interventions are endorsed as good practices. However, in the context of a public health crisis that health officials do not have the means to contain effectively, it may be justifiable to implement strategies on the basis of less-than-ideal evidence. For example, when the Thai government targeted all of the nation's sex work establishments with the "100% condom use" program to combat HIV in the early 1990s, there was little direct evidence that an intervention of that nature would reduce HIV transmission, and critics of the initiative questioned its feasibility. Thailand went on to experience a sharp decline in new HIV cases, and "100% condom use" became recognized as a key factor in enabling the country to avoid a much larger HIV epidemic (40, 41).

The potential risks and benefits of not scaling up a promising intervention need to be considered alongside the potential risks and benefits of taking action. In the case of PNSPs, the provision of clean injecting equipment to PWID outside of prisons is, in fact, considerably more than a "promising" approach to reducing transmission of bloodborne viruses. There is widespread consensus among diverse stakeholders regarding the beneficial public health impact of NSPs (8). WhileAlthough it is acknowledged that some of the available evidence does not embody the highest empirical standards in public health research, the perceived public health gains are of sufficient magnitude to warrant allocating financial and human resources to the provision of this intervention in many settings, and the failure to implement a NSP cannot be justified by the current body of evidence or lack thereof (42). SinceBecause clean injecting equipment has the same potential to protect the health of prisoners as non-prisonersit does for nonprisoners, it thus makes sense to provide this intervention unless one1 or more unique features of prison settings present health-related or safety-related concerns.

Opponents of PNSPs have suggested that providing clean injecting equipment to prisoners may result in harmful drug use~~-~~related outcomes (43). Not all ~~of~~ the studies identified in our review reported on this issue, but among those that did, researchers generally observed minimal or no harmful drug~~-~~use related outcomes. The exception is a 2001 study that found that prisoners on methodone substitution treatment were at a higher risk of taking drugs again ~~following~~after the initiation of a PNSP at a prison in Germany (35). It may be that some context-specific characteristics of prison populations and prison settings result in a different risk-benefit ratio than ~~non-prison~~nonprison settings, and it is important for future studies examining the ~~impact~~effect of PNSPs to continue looking for any evidence of harmful drug~~-~~use related outcomes in addition to evidence of health benefits (39).

Opponents of PNSPs also have suggested that needles might be used as weapons against other prisoners or staff, or might otherwise cause harm (44). ~~One~~In 1 of the studies in our review, it was reported that neither needles nor syringes were used as weapons~~, while;~~ the ~~others~~other studies did not address this issue. In a study that did not meet the review inclusion criteria, correctional officers who participated in an evaluation after 22 months of implementation of a PNSP in Spain reported that prisoners had never used needles as weapons (44). ~~Another~~In another study that did not meet review inclusion criteria, researchers showed that the availability of syringes and needles meant that prisoners no longer had to hide them, resulting in fewer injuries when staff conducted cell searches (45). However, authors of an article in our review reported seeing no improvement regarding the number of needles being hidden by inmates after the start of the PNSP (35). Future studies should continue to address this issue ~~as~~because strong observational evidence could be used ~~to~~ either to further corroborate the safety of PNSPs or ~~to~~ call attention to ways in which they might be improved.

Methodologies for future PNSP studies need to take into account that HCV can survive for a long ~~periods of~~ time outside the human body. In prison settings, it is not uncommon to share multiple objects that may be contaminated with HCV, such as razors, toothbrushes, and tattooing equipment (46, 47). This has implications for efforts to assess whether PNSPs reduce HCV transmission levels, ~~since~~because transmission can occur through pathways unrelated to injecting drug use. Mixed-methods approaches have the potential to help researchers account for such factors and to document incident cases of HCV in prison settings with greater certainty about transmission pathways.

The paucity of PNSPs worldwide raises the question of whether the stigmatized nature of injecting drug use has contributed to the lack of policy action (48). There does not appear to be any research addressing this issue, but the absence of PNSPs in many countries with high levels of HIV and HCV among prison populations is striking ~~in light of~~given the strong and consistent recommendations issued by ~~UN~~United Nations technical experts. It is particularly notable that WHO's first endorsement of PNSPs came in 1993 and that this agency reiterated its recommendation in favor of PNSPs ~~following~~after a 2014 evidence review (1, 8).

Efforts to overcome political resistance to PNSPs should directly address the issue of stigma and should encourage ~~policy-makers~~policymakers and their constituents to consider whether there is any basis in evidence for their concerns about the negative consequences of PNSPs. A related issue is that endorsing PNSPs constitutes a tacit acknowledgment that illegal drugs are circulating in prisons, and government officials may fear criticism for allowing such a situation to exist. Education about ~~the nature of~~ substance use disorders~~,~~ and about the factors that lead people with

substance use disorders to continue seeking drugs while in prison~~,~~ may help ~~to~~ reframe this issue, with PNSP presented as part of a comprehensive package of interventions that address inmates' health needs.

~~A further~~Another policy consideration ~~in relation~~relative to inmate health is the legal and human rights principle of equivalence. Where NSPs are available to PWID outside of prisons~~—~~, as is the situation in 90 countries worldwide~~—~~, the denial of the same service within prisons violates this principle (17). Again, there is a role for education: ~~making~~Making people more aware of the successful functioning of NSPs in the community, and of their health benefits, can foster an understanding of PNSPs as a necessary aspect of providing inmates with the same health services to which the general population is entitled.

It is also important for ~~policy-makers~~policymakers to understand the public health gains that can be achieved by implementing PNSPs. The high prevalence of bloodborne diseases in prison populations, coupled with the frequent movement of some individuals between prison and ~~non-prison~~nonprison settings, may facilitate the spread of these diseases, within and outside of prisons (7). Making more headway in regard to prison disease prevention can ~~therefore~~ be expected, therefore, to contribute to lowering disease incidence and prevalence in the community more broadly (8).

Prison-based harm reduction programs are vulnerable to budget restrictions and financial crises. This may be a factor contributing to the absence of PNSPs worldwide. Decreases in contributions allocated for harm reduction services from donors such as The Global Fund have increased the need for improved resource efficiency and alternative funding mechanisms to maintain prison-based interventions such as PNSPs (49). It is

unclear how current decreases in government and donor funding have directly affected PNSPs. However, many such programs are federally funded and are traditionally resource- challenged.

Findings from this review ~~lead~~led the authors to make ~~a number of~~several recommendations. ~~Firstly~~First, PNSPs should be scaled up in accordance with expert guidance~~,~~ and should be customized appropriately to meet the needs of different prison populations, ~~while~~whereas monitoring and evaluation should be incorporated into the ongoing operation of PNSPs (50). ~~Secondly~~Second, more research is needed on the effectiveness of PNSPs, and funders should make it a higher priority to support this work. Researchers should seek to identify innovative study designs that will overcome methodological limitations identified in this article. Research on PNSPs also needs to address questions relating to which service- delivery models are most suitable for different types of prison settings and populations~~, as well as~~ and to better ~~quantifying~~quantify the incidence of harmful effects of PNSPs such as increased drug use or needle-inflicted injuries. ~~Thirdly~~Third, the role of stigma in discouraging policy action on PNSPs should be addressed through multifaceted strategies, including education framing the injecting of illegal drugs in the context of substance use disorders and by engaging with prison staff in the development of programs.

This study has ~~a number of~~several limitations. As noted previously, the low overall methodological quality of the studies that met review inclusion criteria limits their value as evidence of the effectiveness of PNSPs for achieving health benefits. Furthermore, the challenge of choosing a suitable study design for assessing PNSP outcomes is complicated by logistical and ethical considerations, including those related to ~~the nature of~~ PNSPs as a component of a comprehensive harm reduction package as well as to the conduct of research in incarcerated

populations. ~~Since~~Because the studies presented in this review took place in European countries, there may be publication bias. A lack of standardized definitions for ~~"~~health outcomes~~"~~ led the study team to develop its own definitions, which may have resulted in selection bias. Due to the diversity of study settings, findings cannot be generalized to all prisons, and variation may exist between prison ~~subpopulations as they are differentiated~~subpopulationsdifferentiated by ~~gender~~sex, health status, drug consumption history, and other factors.

In conclusion, improvements in prison disease prevention ultimately will require systemic changes, including the strengthening of health systems as well as greater collaboration between ministries of justice, interior, and health. Winning greater support for PNSPs is not a simple undertaking, but it is essential for progressing toward major global targets in the fields of HIV and viral hepatitis (32, 51, 52). A less tangible but equally important benefit of getting PNSPs legitimized as a standard component of prison health care is that this will further affirm the health rights of people who inject drugs, opening the door to additional progress in reducing their marginalized status and improving their well-being.

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Figure 1. ~~PRISMA flow diagram~~Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram showing inclusion criteria. CINAHL, Cumulative Index to Nursing and Allied Health Literature.

Table 1. ~~(*n* = 5)~~ Studies of Health Outcomes Associated With Prison Needle and Syringe ~~Programs~~Programs (*n* = 5)

First ~~author, year~~Author, Year (Reference ~~no~~No.)	Title	Study ~~design~~Design	Target ~~population~~Population(s)	~~Number~~No. of ~~participants~~Participants	Intervention	Data ~~collection period~~Collection Period	Outcomes
Ferrer-Castro, 2012 (33)	Evaluation of a needle exchange program at Pereiro de Aguiar prison (Ourense, Spain): a ten-year experience	Cross-sectional	Male and female prisoners in O Pereiro de Aguiar (Spain)	Baseline: 362 men and women Follow-up: 425 men and women	Hand-to-hand approach used to exchange needles and syringes.	~~Prevalence data collected at baseline~~Baseline (1999) and at 10-year follow-up (2009~~).~~)	HCV prevalence decreased from 40% at baseline to 26% at follow-up. HIV prevalence decreased from 21% at baseline to 8% at follow-up.

Heinemann, 2001 (34)	Infektionsprophylaxe für Drogenkonsumenten im offenen Strafvollzug durch Vergabe steriler Einmalspritzen über Automaten (Prevention of ~~Bloodborne Virus Infections~~bloodborne virus infections among ~~Drug Users~~drug users in an ~~Open Prison~~open prison by ~~Syringe Vending Machines~~syringe vending machines)	Mixed methods	Male and female prisoners in Hamburg-Vierlande (Germany)	Before PNSP: 128 During PNSP: 338	Syringe dispensing machines used to distribute needles and syringes.	~~Data collected between~~ 1996 ~~and~~ – 1997~~.~~	No new HIV or hepatitis infections~~.~~ No change in knowledge of hepatitis in general, symptoms, disease, or transmission~~.~~ Increased drug consumption, together with methadone~~.~~

Jacob, 2000 (35)	The transfer of harm-reduction strategies into prisons: needle exchange programs in two German prisons	Mixed methods	Male prisoners in Lingen (Germany) Female prisoners in Vechta (Germany)	83 men 169 women	Hand-to-hand approach used to distribute needles and syringes in Lingen. Syringe dispensing machines used to distribute needles and syringes in Vechta.	Data collected from 1996 to 1998.	Decreased injection-related abscesses (Vechta).) Decreased psychological disorders requiring treatment (Vechta).) No overdoses occurred in Vechta; 1 overdose occurred in Lingen. No new HIV or hepatitis infections. Risk behavior decreased. No change in drug consumption.
Nelles 1998, 1998 (3637)	Provision of syringes: the cutting edge of harm reduction in prison?	Implementation	Female prisoners in Hindelbank (Switzerland)	137 women	—Syringe dispensing machines used	1994–1995	No new infections of HBV, HCV, or HIV. No increased drug consumption. 1 case of used-syringe sharing.

First ~~author, year~~Author, Year (Reference ~~no~~No.)	Title	Study ~~design~~Design	Target ~~population~~Population(s)	~~Number~~No. of ~~participants~~Participants	Intervention	Data ~~collection period~~Collection Period	Outcomes
					to distribute needles and syringes~~.~~ ~~Data collected from 1994 to 1995.~~		No change in knowledge of HIV and AIDS~~.~~

Stark, 2006 (3738)	A syringe exchange program in prison as prevention strategy against HIV infection and hepatitis B and C in Berlin, Germany	Implementation	Prisoners in one1 male-only and one1 female-only prison in Berlin (, Germany)	Baseline: 57 men , 117 women Follow-up: 43 men , 81 women	Hand-to-hand approach used to distribute needles and syringes via NGO representatives in male-only prison. Syringe dispensing machines used to distribute needles and syringes in female-	Data collected between 1999 and 2001 for male cohort. Data collected between 1998 and 2001 for female cohort.	Baseline: HIV, HBV, and HCV seroprevalencesseroprevalence rates were 18%, 53%%, and 82%, respectively (both cohorts combined). Follow-up: No new HBV or HIV infections in either cohort. Follow-up: 1 new HCV infection acquired while in prison (male).)

First ~~author, year~~Author, Year (Reference ~~no~~No.)	Title	Study ~~design~~Design	Target ~~population~~Population(s)	~~Number~~No. of ~~participants~~Participants	Intervention	Data ~~collection period~~Collection Period	Outcomes
					only prison.		

Abbreviations: AIDS, acquired immunodeficiency syndrome; HBV, hepatitis B virus~~,~~; HCV, hepatitis C virus~~,~~; HIV, human immunodeficiency virus; NGO, nongovernmental organization; PNSP, prison needle and syringe program.