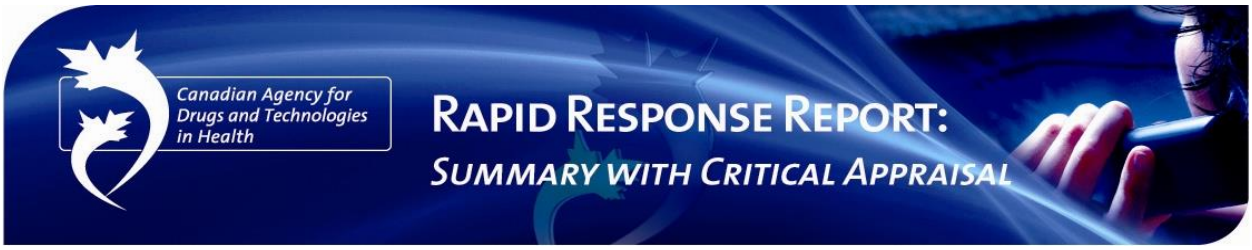

TITLE: Needle Exchange Programs in a Correctional Setting: A Review of the Clinical and Cost-Effectiveness

DATE: 3 September 2015

CONTEXT AND POLICY ISSUES

Needle/syringe exchange programs refer to protocols that provide sterile injection equipment (mainly syringes and needles) to injection drug users (IDUs) in exchange for unsterilized equipment. Implementation modalities vary, with options for in-person distribution by healthcare professionals, trained staff from non-governmental organizations, and automated needle-dispensing machines. In a correctional setting, trained inmates may be used as peer outreach workers to distribute sterile injection equipment. Needle and syringe exchange programs are a potentially important way to reduce the risk of infection from sharing used injecting equipment, and there is evidence to support their ability to minimize the risk of transmission of blood-borne infection such as hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV) associated with sharing needles and syringes.[1-9]

In spite of the enforcement environment, illegal drug use persists in correctional facilities, although at a reduced frequency.[1,7,10] The majority of IDUs in prison continue to inject drugs, although they may have access to smaller quantities and/or fewer opportunities to do so than outside prison.[2,4,9] Even so, injection drug use in prison comes with an elevated risk of infection transmission because of the scarcity of sterile needles/syringes, the higher prevalence of sharing injecting equipment, and the rapid turnover of prison population which changes injecting partners more frequently than in the community setting.[1,4,10] According to a policy discussion document published in 2005, Correctional Service Canada (CSC) found that 11% of federal male prisoners surveyed in 1995 injected drugs in prison with 41% of them reporting that their equipment was either not clean or that they did not know whether or not it was clean at the time of use.[11]

Available studies suggest that injection drug use is the single most important risk factor in the transmission of HCV in Canada, accounting for approximately 60% to 70% of the estimated 2,200 to 4,000 new cases a year.[5,6] In addition to the Canadian experience, evidence from around the world demonstrates that sharing injection equipment is a high risk factor for the

transmission of HBV, HCV and HIV in prisons.[11] The overall rate of HIV infection in the Canadian federal correctional system is estimated to be 1.7%, which is more than 10 times higher than the rate in the general population (0.13%).[11] Given that the prevalence of blood-borne diseases such as HIV, HCV and HBV is elevated in the incarcerated population largely due to the over-representation of people who inject drugs and share injection equipment, it may be sound public health policy to make sterile injection equipment available to people in prison to curtail the risk of transmission of these disease, especially since most drug-using prisoners eventually return to the general community. However, the effectiveness of needle exchange programs in the correctional setting for improving health outcomes and reducing associated costs is unclear and it is unknown whether there is a preferred model for such a program in this setting.

The aim of this report is to summarize available evidence on the effectiveness and cost-effectiveness of needle exchange programs to reduce harm associated with injection drug use in prisons, to facilitate the evaluation of the benefits of the program in correctional settings.

RESEARCH QUESTIONS

1. What is the clinical effectiveness and harms of needle exchange programs for adults in a correctional setting?

2. What is the comparative clinical effectiveness and harms of different models of needle exchange for adults in a correctional setting?

3. What is the cost-effectiveness of needle exchange programs for adults in a correctional setting?

KEY FINDINGS

There was evidence that needle/syringe exchange programs significantly reduced the sharing of injection equipment in correctional settings without increasing overall drug use or drug injecting. Needle exchange programs also reduced the incidence of drug overdose and injection abscesses. Implementation of needle/syringe exchange program did not result in needles or syringes being used as weapons against staff or other prison inmates.

METHODS

Literature Search Methods

A limited literature search was conducted on key resources including Ovid Medline, PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, ECRI, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 1995 and August 6, 2015.

Rapid Response reports are organized so that the evidence for each research question is presented separately.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Adults in a correctional setting

Intervention	• Needle exchange programs (including exchange and distribution of clean needles without exchange):
	  ○ Distribution by prison nurses or physicians based in a medical unit or other area of the prison
	  ○ Distribution by prisoners trained as peer outreach workers
	  ○ Distribution by external non-governmental organizations or other health professionals that come to the prison for this purpose
	  ○ Distribution by one-for-one automated needle-dispensing machines
	• Safe injection sites

Comparator	• No needle exchange (including before-after studies and program evaluations) • Program types compared to each other
Outcomes	• Harm reduction (harm to inmates and/or prison staff) • Seroconversion rates (including background prevalence) • Risk behavior change (e.g. reduced needle sharing), number/type of institutional incidents, number/type of contraband seizures • Costs, cost-effectiveness, cost per harm avoided
Study Designs	HTA/Systematic Reviews/Meta-Analyses, Randomized Controlled Trials, Non-Randomized Studies, Economic Evaluations

Exclusion Criteria

Articles were excluded if they did not meet the selection criteria outlined in Table 1, they were duplicate publications, or were published prior to 1995.

Critical Appraisal of Individual Studies

All of the included studies had non-randomized design. They were critically appraised using the Black and Down checklist for measuring study quality.[12] Summary scores were not calculated for the included studies; rather, a review of the strengths and limitations of each included study were described.

SUMMARY OF EVIDENCE

Quantity of Research Available

A total of 185 citations were identified in the literature search. Following screening of titles and abstracts, 174 citations were excluded and 11 potentially relevant reports from the electronic search were retrieved for full-text review. Six potentially relevant publications were retrieved from the grey literature search. Of the 17 potentially relevant articles, 13 publications were excluded for various reasons, while four publications met the inclusion criteria and were included in this report. Appendix 1 describes the PRISMA flowchart of the study selection.

Additional references of potential interest that did not meet the selection criteria are provided in Appendix 5

Summary of Study Characteristics

Study Design

All the included studies had non-randomized design without control groups with one described as cross-sectional,[7] while the others were before-after studies.[1,3,8]

Country of Origin

Two studies.[1,3] were conducted in Germany and were published in years 2000[1] and 2006[3]. One study each was conducted in Spain[7] and Switzerland[8] and were published in 2012 and 1999, respectively.

Patient Population

Each of the studies from Germany[1,3] was conducted in two prisons; one each for females and males. One of them[1] reported that 50% of the inmates had a history of illegal drug use. The female prison inmates for this study[1] were juvenile and adults while the male inmates were adults only. The study included 169 female and 83 male IDUs. There was no information about the history of their injection drug use habits or syringe sharing behavior at baseline. Information about the background prevalence of HIV, HBV and HCV was not provided in this study. The second study[3] from Germany included 117 female and 57 male inmates. The majority (76% females and 88% males) had previously been in prison. The median age was 31 years (interquartile range 27 to 34 years), and most of them (95%) reported previous injection drug use. Majority of the IDUs (72%) had injected for at least five years, and most (91%) reported injecting drugs in the six months prior to their imprisonment. Two-thirds of the IDUs had ever engaged in syringe sharing with other IDUs, and 17% had done so in the six months prior to their imprisonment. Drug-using inmates who were participating in methadone treatment programs were excluded from both of the German studies.[1,3]. Baseline seroprevalence for HIV, HBV and HCV was 18%, 53% and 83%, respectively. Information about the type of correctional facility and the length of sentences was not provided in either of the two studies.

The study conducted in Spain,[7] involved 429 prison inmates over a 10-year period. They were described as ranging in age from <25 years to >45 years, with the majority (53.1%) in the 31 to 45 year bracket. There was no information reported about their gender. Evaluation of a sample revealed that most (85%) of the inmates had previously been convicted of various crimes and

25.6% had ever used illegal drugs; and 20.5% of all inmates had used drugs in the last 30 days before the study. Twelve percent (12.0%) of the inmates had a history of intravenous drug use, 6.4% in the last 30 days before the study. At baseline, 45.8% (25 out of 56) of the inmates reported sharing needles for intravenous drug use and the prevalence of HIV and HCV infection were 21% and 40%, respectively[7]. Information about the type of correctional facility and the length of sentences was not provided.

The study from Switzerland[8] was conducted in a female prison. The mean age of the inmates (n=137) who participated in interviews for the pilot phase of the study was 32 ± 8 years. About one-third (34%) of the participants had been imprisoned previously. Sixty-two participants (45%) reported ever using heroin or cocaine regularly (i.e. at least three times a week for a year), with 45 of them (73%) doing so in the last month before the study interview and while in prison.[8] Forty-two (68%) of the participants who used drugs did so by intravenous injection, with 88% of them (37 out of 42) doing so in the last month before the study interview and while in prison.[8]The majority of participants (82%) had been incarcerated because of drug-related offences and the mean length of sentence was 36 ± 28 months. The baseline prevalence of HIV, HBV and HCV was 21%, 2% and 40%, respectively. There was no information provided about the type of correctional facility.

Interventions and Comparators

All the studies involved exchanging sterile syringes and needles for unsterile ones from prison inmates. In both of the studies conducted in Germany,[1,3] automated syringe dispensing machines were installed in strategic places in the female prisons, while the male prisons had person-to-person exchanges between inmates and social workers from a non-governmental organization or staff of the drug counselling service and the health care unit. The study in Spain[7] used an in-person exchange model for all inmates to allow the provision of information and health-related advice during the exchange act, and to encourage the program users to adopt hygienic habits. Although, details about the individuals who gave out the sterile equipment were not provided, it may be inferred from the reason for adopting the model that such persons may have had some training/qualification. The study in Switzerland[8] used automated syringe dispensing machines. None of the studies had a comparator intervention.

Outcomes

Outcomes of interest included changes in the prevalence and/or transmission (seroconversion) rates of HIV, hepatitis B (HBV) and hepatitis C (HCV). Changes in the overall prevalence of injection drug use and risk behaviors such as injection equipment sharing and threat of harm to inmates and/or prison staff as a result of the program were also assessed.

Summary of Critical Appraisal

The strengths and limitations of the individual studies are summarized and presented in Appendix 3.

It is unknown whether the included studies were planned *a priori* or they were post hoc evaluations following the implementation of the needle exchange programs in the various reasons. In this regard, none of the studies[1,3,7,8] performed sample size calculations to determine the threshold of statistical significance in changes in the outcome of interest.

All the included studies[1,3,7,8] clearly stated their objectives, the interventions of interest, and outcomes to be measured. All participants were drawn from a population of prison inmates who injected drugs and is therefore likely to be representative of the general population of people who inject drugs in prisons. However, all the studies were conducted in European countries and the generalizability of their findings in Canada is unknown.

With the exception of two studies[1,3] which stated that drug user undergoing methadone treatment were excluded, inclusion and exclusion criteria were not discussed in any of the studies beyond that the participants were prisoners who injected drugs. Therefore, it is unknown if there were differences in the characteristics among the participants, such as participation in educational programs and other harm reduction activities, which could have confounded the results. Furthermore, prison inmate populations turn over quickly with some prisoners being released while others begin their incarceration. However, none of the studies[1,3,7,8] described any measure to account for the changing population over the course of the studies. Thus, it is unknown how the differences in the characteristics of different prisoners influenced the reported outcomes. For example, it is unknown whether the reported changes in seroprevalence in blood-borne diseases over time were the sole results of intervention or due to a greater sero-negative population among new prisoners incarcerated after the previous outcome determinations were made.

Two studies[1,3] conducted in both male and female prisons used automatic dispensing machines for needle exchange in the female prisons and a hand-to-hand distribution method in male prisons. One study[8] among female prisoners only used automated machines while another study[7] which did not identify the sexes of participants used the hand-to-hand distribution method only. The different models of needle exchange made comparison across groups and studies difficult. For example, where both settings were involved in the study, participation in male prisons was lower than in the female prisons. However, it was not conclusively known whether the difference in needle exchange models completely accounted for this observation, or there was a generally lower acceptance of needle exchange programs in male inmates than in the female population.

Many outcomes, including prevalence of drug use, frequency of injecting drugs, and sharing of injection equipment were self-reported by the prisoners who injected drugs, raising questions about the reliability of these outcomes. Furthermore, since all the studies were non-randomized and lacked control groups, it is not possible to directly ascribe seroconversions in blood-borne diseases (HIV, HBV, and HCV) to the needle exchange intervention alone. The contribution of other harm reduction programs such as counselling, addiction treatment, and education about safer sexual behavior, or other changes to prison policies or drug enforcement over time, to the reductions in seroconversion rates cannot be ruled out.

Summary of Findings

Four non-randomized studies[1,3,7,8] on needle/syringe exchange programs in prisons were included in this report. Two studies[3,7] reported on changes in the prevalence or seroconversion of HIV, HBV, and HCV in prison following introduction of the programs. Two studies[7,8] reported on prevalence or frequency of injection drug use, and three studies[1,3,7] reported on needle sharing among prison inmates who injected illegal drug. None of the studies[1,3,7,8] found evidence of actual harm or risk of harm related to the needle/syringe exchange programs in prisons.

What is the clinical effectiveness and harms of needle exchange programs for adults in a correctional setting?

One study[7] reported a decline in the prevalence of HIV and HCV from 21% and 40%, respectively at baseline to 8.5% and 26.1% respectively at 10 years follow-up, following the introduction of an in-person needle distribution model. However, the prevalence of HBV did not change significantly (2% versus 2.1%) within the same time period. Another study[3] reported that no HIV or HBV seroconversions were observed at 24 months follow-up, adding that the introduction of the needle/syringe exchange program may have contributed to absence of seroconversion despite the overall seroprevalence rates of 18% and 53% for HIV and HBV, respectively at baseline. However, HCV seroconversions occurred in four out of 22 participants who were seronegative at baseline. Seroprevalence for HCV was 82% at baseline.

One study[7] found a decrease in the frequency of injection drug use, reporting that the percentage of inmates who injected drugs at least once daily declined from 25% at baseline to 9.1% at 10 years follow-up, while the proportion of those who injected drugs less than once a week increased from 30.4% at baseline to 63.2% in the same time period. Another study[8] reported that a significant decrease from baseline was observed in the proportion of inmates who injected drugs by 12 months (i.e. from 29% to 16%, $P < 0.1$), and one out of 57 inmates (2%) reported having used heroin or cocaine in the month preceding the interview at two years ($P < 0.001$).

One study[7] reported a 38.7% reduction ($P < 0.1$) from baseline in the proportion of inmates who shared injection equipment after 12 months, while another study[3] reported that syringe sharing rate among drug-using inmates declined from 71% at baseline to 11% in 4 months and subsequently to zero by the 3rd follow-up and beyond. Another study[1] reported that seven inmates reported sharing needles after the needle/syringe exchange program was introduce compared with 54 inmates at baseline.

One study[1] reported that in the course of the needle/syringe exchange program, there were no incidents of drug overdose among female prisoner population and there was one case of drug overdose among male prisoners compared to 19.4% and 31%, respectively at baseline. The study also found a decrease in the rate of abscesses among IDUs during the exchange program, and reported that the general mood of female prisoner had improved along with their weight and other laboratory values.[1]

Three of the studies[1,3,8] reported that evidence of harm related to the needle/syringe exchange program in prisons such as an overall increase in injection drug use, or violence involving needles against staff or other inmates was not observed. One study[7] found no evidence of increased injection drug use following implementation of the needle/syringe exchange program, and no incidents of violence involving injection equipment were reported during the study. One study[8] reported that a woman who previously sniffed drugs in prison reported shifting to injecting drugs.

What is the comparative clinical effectiveness and harms of different models of needle exchange for adults in a correctional setting?

The literature search for this review did not find any study on which compared the clinical effectiveness and harms of different models of needle exchange for adults in a correctional setting. However, two studies[1,3] involving female and male prisons found that the participation in

the female prisons where syringes were exchanged through automated dispensing machines was higher than in the male prisons where in-person needle/syringe exchange models were used. The author stated that lack of anonymity in the male prisons was one of the factors that discouraged owing to concerns of some inmates that being identified as drug addicts could jeopardize future benefits including parole.

What is the cost-effectiveness of needle exchange programs for adults in a correctional setting?

The literature search for this review did not find any study on the cost-effectiveness of needle exchange programs for adults in a correctional setting

Limitations

Appendix 3 provides further details of the limitations of individual studies. The following are some general limitations of the studies included in this report.

One limitation is the fact that the median time of follow-up (12 months) was too short to demonstrate a long-term preventive effect. If new infections occurred at the end of the observation period the seroconversions would not have been detected in prison.

Since all the studies were non-randomized and lacked control groups it is not possible to directly ascribe seroconversions in blood-borne diseases (HIV, HBV, and HCV) to the needle exchange intervention alone.

High fluctuations occur in the number (and possibly characteristics) of inmates because as some prisoners get released, new offenders are incarcerated although not to the same extent. Thus without a clear measure to account for the potential confounding factors introduced by new inmates, it is uncertain whether the reported outcomes can be attributed solely to the needle exchange intervention.[8]

While the in-person model of exchange allowed provision of information and health-related advice (including referral for further help where necessary) during the exchange act, its lack of anonymity may have discouraged participation. On the other hand, although automated machines afforded users anonymity, those needing extra help may not be identified in a timely manner.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

Evidence from the included studies in this report suggest that needle/syringe exchange programs may have the potential to reduce the prevalence or seroconversion of HIV and HCV in prison. Furthermore, needle/syringe exchange programs could potentially reduce the prevalence and/or frequency of injection drug use in prisons, overdosing, and significantly reduce injection equipment sharing behavior which is a known risk factor for blood-borne disease such as HIV, and HCV. In addition, availability of sterile needles and syringes through the exchange programs resulted in improved hygiene leading to a decreased in the incidence of abscesses among inmates who inject drugs. No evidence of actual harm or risk of harm in prisons was found as a result of the needle/syringe exchange programs.

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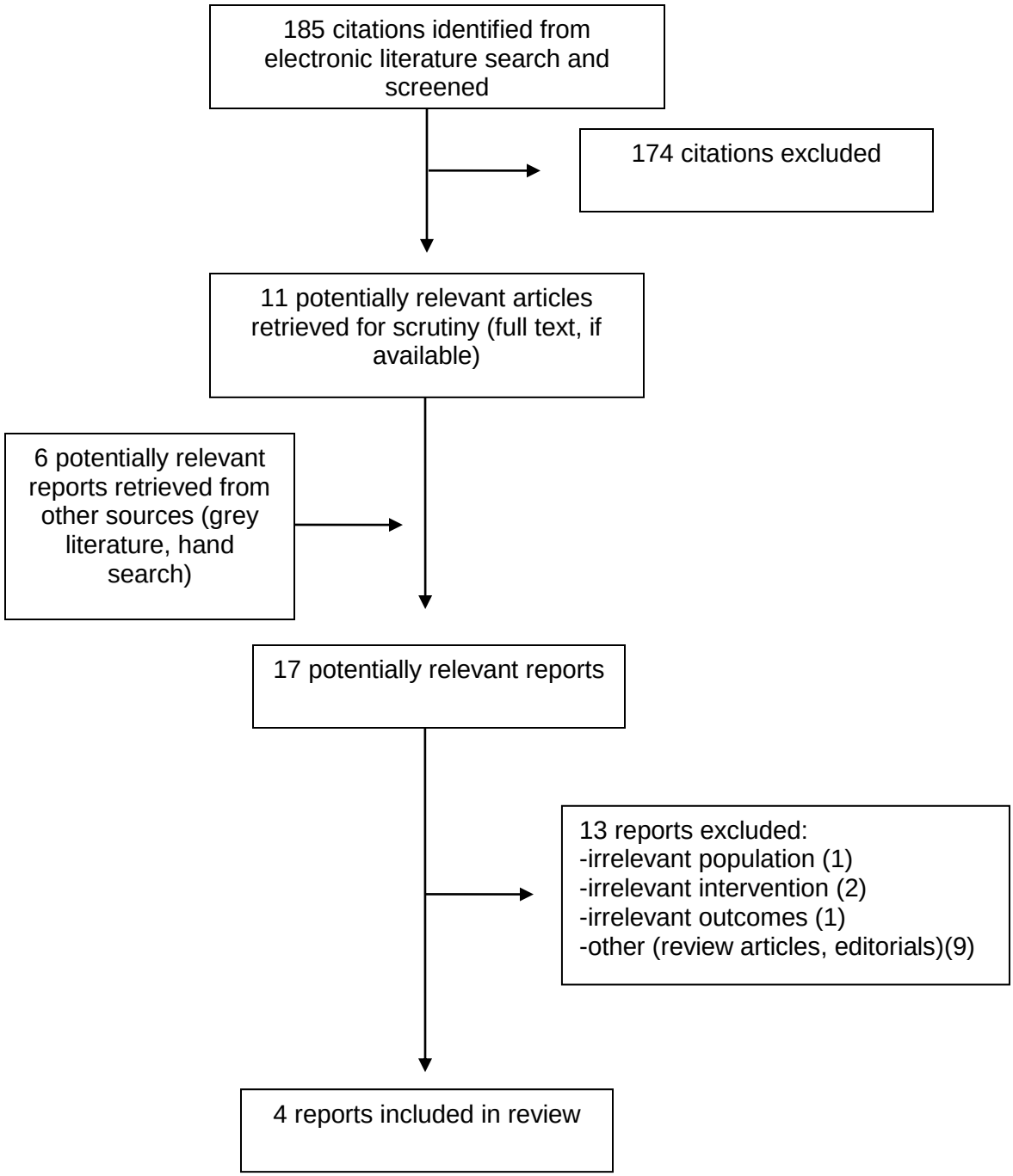
APPENDIX 1: Selection of Included Studies



APPENDIX 2: Characteristics of Included Publications

Table A1: Characteristics of Included Clinical Studies

First Author, Publication Year, Country, Study Name	Study Design	Patient Characteristics	Intervention(s)	Comparator(s)	Clinical Outcomes
Ferrer-Castro 2012[7] Spain	Cross-sectional observational study	429 prison inmates injection drug user	In-person provision of sterile needles and syringes by prison staff in exchange for used ones	None	Changes from baseline in risk behavior and prevalence of HIV, HBV, and HCV at 3, 6, and 12 month, and at 10 years.
Stark, 2006,[3] Germany	Before-after, non-randomized study	174 prison inmates (117 females, 57 males), median age 31 year (IQR 27 to 34 years) who were injection drug users.	Automated [a] or in-person provision of sterile syringes and needles alone with a skin disinfection pads in exchange for used syringes (or dummy for a new entrant).	None	Seroprevalence for HIV, HBV, and HCV at 24 months follow-up (June 2001) versus values at baseline (October 1998)
Jacob, 2000[1] Germany	Before-after, non-randomized study involving a dynamic, process accompanying, multi-methodological [b] approach.	252 prison inmates (169 female and 83 male) who were injection drug users	A 2-year pilot project to provide sterile syringes and needles alone among drug users either through automation [a] or in-person exchange for used ones to drug-addicted inmates. Information about methods of harm prevention was provided along with the sterile injection equipment.	None	The prevention of the spread of infectious diseases in prison. Changes in needle sharing and drug use behavior among inmates who injected drugs.
Nelles, 1999[8] Switzerland	Before-after, non-randomized study	Female prison inmates (n=161) incarcerated because of drug-related offences (n=37 for IDUs during imprisonment); mean age 32 ± 8 years	A 12-month harm reduction program which included syringe exchange	None	Changes in use and injection of drugs and the sharing of syringes.

HBV =, hepatitis B; HCV = hepatitis C; HIV = human immunodeficiency virus; IDU = injection drug user; IQR = inter quartile range

[a] Multi-methodological approach was defined as documentation of the project practice, half standardized, longitudinal examination of inmates and staff, qualitative examination of management, selected groups of prisoners, staff and external organizations for at least two times.
[b] At the female prison, inmates accessed sterile syringes through an automated dispensing machines while staff of the drug counselling service and health care unit of the male prison distributed sterile syringes to inmates.

APPENDIX 3: Critical Appraisal of Included Publications

Table A2: Strengths and Limitations of Non-randomized studies using Downs' and Blacks' Checklist[12]	
Strengths	**Limitations**
Ferrer-Castro, 2012[7]	
• The intervention of interest and the main study outcomes to be measures were clearly described. • Majority of inmates identified as injection drug user participated in the program. Thus, the study participants were representative of the population of interest. • The in-person exchange model allowed contact of participants with qualified staff who provided information and health-related advice during each exchange, and encouraged adoption of hygienic habits. • There was a long duration of continuous follow-up (10 years) allows for assessment of the long-term effects of the program.	• Although strict confidentiality was promised to participants, lack of anonymity discouraged some eligible inmates from participating because they were concerned that being identified as drug users could negatively affect their chances of accessing prison benefits. • Outcomes concerning drug use and equipment sharing were self-reported by participants as responses to interviews and could have reliability issues. • It is unknown how the prevalence of the infectious diseases (HIV, HBV, and HCV) was ascertained. • Only 71% of syringes distributed were returned. Furthermore, the average number of participants in the program reduced overtime although number of syringes and needle distributed per month remained fairly constant, and inmates generally reported decline in personal drug use. These suggest lack of rigor in monitoring and the probability of inmates engaging in exchanges both for themselves and others; a situation which could confound assessment of the effectiveness of the program.
Stark, 2008[3]	
• Anonymous questionnaires administered by external interviewers were used to minimize socially undesirable response. • The study employed a systematic testing protocol for HIV, HBV, and HCV infection during follow-up to detect new infections. • The investigators had no conflicting interests which could be a source of potential bias in the study.	• The median time of follow-up in the study was 12 months, considered too short to demonstrate a long-term preventive effect. Seroconversions would not have been detected in prison if new infections occurred at the end of the observation period. • Participants received information leaflets and counselling on risk and harm reduction issues. Therefore, in the absence of a control group, it is not possible to conclude that the outcomes of the study were solely due to the provision of sterile injection equipment, since the impact of intensified counselling and education about risks of parenterally transmitted infections cannot be ruled out.

Table A2: Strengths and Limitations of Non-randomized studies using Downs' and Blacks' Checklist[12]	
Strengths	**Limitations**
Jacob, 2000[1]	
• The intervention of interest and the main study outcomes to be measures were clearly described. • Automatic syringe dispensers allocated in strategic places in the female prison afforded anonymity leading to high acceptability and high participation of inmates who were IDUs. • Percentage of returned syringes were high (>98%) in both the female and male prisons suggesting either good cooperation from IDU inmates, or good monitoring from prison staff, or both.	• The hand-to-hand exchange model used in the male prison implied lack of anonymity for which many IDUs refused to participate for fear of future recrimination for being drug addicts. • The authors did not report on conflict of interest. Therefore, it is unknown whether the researchers had any competing interest with potential to cause bias in the conduct and/or reporting of the study.
Nelles, 1999[8]	
• The intervention of interest and the main study outcomes to be measures were clearly described. • Automatic syringe dispensers allocated in strategic places in six divisions of the prison afforded anonymity and encouraged participation of inmates who were IDUs. • Statistical analysis were thorough allowing the delineation of outcomes for various subgroups and analysis to determine linkages between measured outcomes and potential causal factors.	• The samples in this study were small and participants were all female. Therefore, the study conclusions may applicable only to similar conditions of the study without being generalizable in other prison settings. • Although the total number of syringes which were exchanged was reported (n=5335) there was not enough information to know is all the syringes given out were recovered. However, automated machines are noted for their strict one-for-one exchange, although there have been reports of vandalism and damage by prisoners in order to cheat. The proportion of unreturned or missing syringes gives an indication of monitoring rigor and the potential for continuing injection equipment sharing.

HBV =, hepatitis B; HCV = hepatitis C; HIV = human immunodeficiency virus; IDU = injection drug user;

APPENDIX 4: Main Study Findings and Author's Conclusions

Table A3: Summary of Findings of Included Studies	
Main Study Findings	**Author's Conclusions**
Ferrer-Castro, 2012[7]	
• There was a significant decreased in the prevalence of HIV and HCV at the 10-year follow-up (from 21% and 40% at baseline to 8.5% and 26.1%, respectively; *P* <0.01 in each case). The prevalence of HBV showed no significant difference between the two timepoints (2% at baseline versus 2.2% at 10 years follow-up). • The percentage of inmates who injected drugs at least once daily declined from 25% at baseline to 9.1% at 10 years follow-up. • The percentage of inmates who injected drugs less than once a week rose from 30,4% at baseline to 63.2% at 10 years follow-up. • Significantly lower percentage of inmates reported sharing needles for intravenous drug use at 12 months (7.1% [1 out of 14]) compared with 45.8% (25 out of 56) at baseline (*P* <0.01). At the 10-year follow-up assessment, 81.8% (18 out of 22) denied having shared needles for drug abuse compared with 54.2% at 6 months.	"After ten years of development of the NEP, there was a significant decrease in the prevalence of HIV and HCV in the prison population at the centre, and the program is accepted as beneficial by most of the inmates and staff participating in the survey."[7] page 3
Stark, 2008[3]	
• Seroprevalences for HIV, HBV, and HCV were 18, 53, and 82% at baseline. • At 24 months' follow-up, there were no seroconversions for HIV and HBV. However, HCV seroconversions occurred in four out of 22 participants who were seronegative at baseline. All inmates who seroconverted denied sharing syringes while in prison, and risk factors such as tattooing, piercing or sexual risk behavior.	• The provision of sterile injection equipment for IDUs in prison settings where it is feasible may contribute to a substantial reduction of syringe sharing. While HIV and HBV seroconversions was prevented through NSP, the prevention of HCV infection may require additional strategies such as counselling against the practice of frontloading/backloading and the sharing of other injection paraphernalia including spoons and cookers.[3]

Table A3: Summary of Findings of Included Studies	
Main Study Findings	**Author's Conclusions**
• Syringe sharing in the prison reduced from 71% at baseline to 11% in 4 months (first follow-up) and to zero at the 3rd and further follow-ups. • Overall, there was no evidence that the availability of sterile syringes led to an increase in drug consumption. • No adverse events (e.g. overall increase in injection drug use, violence involving needles against staff or other inmates) possibly related to the NEP program were observed.	
Jacob, 2000[1]	
• The daily number of exchange of needles was 23 in the female prison and 6 in the male prison for a total of 16,390 and 4,517, respectively over the project period. The percentage of returned syringes was 98.9% (167 missing) in the female prison and 98.3% (74 missing) in the male prison. • Before the NEP was started a total of 54 inmates stated that they had used an already used needle. After the start of the project none of the female inmates stated that she had used unsterile needle while four male inmates stated that they had used an unsterile needle for their last injection. • Before the NEP was started, 19.4% of drug users in the female prison and 31% of drug users in the male prison had taken overdoses. In the course of the NEP none of the female participants took an overdose, and only one case of overdose was observed in the male prison. • The medical evaluation among female participants revealed that their weight and other laboratory values were better than before the NEP, and their general mood had also improved, with fewer cases of psychological disorders that needed treatment. Assessment of these parameters in male participants was not reported.	• "Generally it can be stated that there is no official set of modalities regulating needle exchange programs: usually the projects launched are institution-specific." "Needle sharing is not of ritual importance to drug-addicted inmates. It is rather a spontaneous response to the non-availability of sterile injecting equipment."[1] page 334

Table A3: Summary of Findings of Included Studies	
Main Study Findings	**Author's Conclusions**
• A random sample taken in in the male prison revealed that no sero-conversion had occurred for either HIV or any form of hepatitis. Assessment of these parameters in female participants was not reported. • The occurrence rate of abscesses decreased among injection drug users during the project, and it was attributed to inmates being more careful in terms of hygiene (by using sterile needles) when injecting drugs. • An increase in drug consumption was not observed in either of the prisons, and neither inmates nor prison staff reported feeling threatened with unsterile needles.	
Nelles, 1999[8]	
• A total of 5335 syringes were exchanged in the 12-month pilot phase and 650 in the following year. • The proportion of IDUs who reported using or injecting drugs decreased significantly from baseline by 12 months (from 29% to 16%, respectively; *P*<0.1). • After 2 years, only one of 57 inmates (2%) reported having used heroin or cocaine in the month preceding the interview. (*P* <0.001). • There was no increase in drug use or injection, although one woman reported shifting from sniffing to injecting drugs in prison. • The risk of assault did not increase in this study.	• "The results, although limited by the nature and the size of the prison, suggest that syringe exchange has a role in the prison setting."[8] page 133 • "High levels of syringe exchange were observed when drugs were available in prison […] and in the time following inmates' monthly payment. […] These findings suggest that drug intake in prison is influenced by the availability of drugs and money."[8] page 138

HBV =, hepatitis B; HCV = hepatitis C; HIV = human immunodeficiency virus; IDU = injection drug user; NEP = needle exchange program; NSP = needle syringe program.

APPENDIX 5: Additional References of Potential Interest

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