Published in final edited form as:

Drug Alcohol Depend. 2007 July 10; 89(2-3): 214–222. doi:10.1016/j.drugalcdep.2006.12.035.

Higher syringe coverage is associated with lower odds of HIV risk and does not increase unsafe syringe disposal among syringe exchange program clients

Ricky N. Bluthenthal^{1,2,*}, Rachel Anderson³, Neil M. Flynn³, and Alex H. Kral^{4,5}

¹ Health Program and Drug Policy Research Center, RAND Corporation, 1776 Main Street, PO Box 2138, Santa Monica, California, 90407-2138

² Urban Community Research Center, Sociology Department, California State University Dominguez Hills, 1000 East Victoria Street, Carson, California 90747

³ Department of Internal Medicine, Division of Infectious Diseases, University of California Davis Medical Center, 4150 V Street, Sacramento, California 95817

⁴ RTI International, San Francisco Regional Office, 28 Second Street, Suite 300, San Francisco, California 94105-3461

⁵ Department of Family and Community Medicine, University of California, San Francisco, 513 Parnassus Avenue, San Francisco, California 94143-0410

Abstract

Objective—To determine if adequate syringe coverage - “one shot for one syringe” - among syringe exchange program (SEP) clients is associated with injection-related HIV risk behaviors and syringe disposal.

Design—HIV risk assessments with 1,577 injection drug users (IDUs) recruited from 24 SEPs in California between 2001 and 2003. Individual syringe coverage was calculated as a proportion of syringes retained from SEP visits to total number of injections in the last 30 days.

Results—Participants were divided into four groups based on syringe coverage: <50%, 50% to 99%, 100% to 149%, and 150% or more. In multivariate logistic regression, SEP clients with less than 50% syringe coverage had significantly higher odds of reporting receptive syringe sharing in the last 30 days (Adjusted Odds Ratio [AOR]=2.3; 95% Confidence Interval [CI]=1.4, 3.6) and those with 150% or more coverage had lower odds of reporting receptive syringe sharing (AOR=0.5; 95 CI=0.3, 0.8) as compared to SEP clients with adequate syringe coverage of 100% to 149%. Similar associations were observed for other main outcomes of distributive syringe sharing and syringe re-use. No differences in safe syringe disposal were observed by syringe coverage.

Conclusions—Individual syringe coverage is strongly associated with safer injection behaviors without impacting syringe disposal among SEP clients. Syringe coverage is a useful measure for determining if IDUs are obtaining sufficient syringes to lower HIV risk.

* Corresponding author: RAND Corporation, 1776 Main Street, PO Box 2138, Santa Monica, California, 90407-2138; phone 310-393-0411 x6642; fax 310-260-8150; email: rickyb@rand.org.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Key Words/Phrases

Syringe coverage; HIV prevention; Needle exchange programs; Syringe disposal; California; Injection drug use

1.0 Introduction

Syringe exchange programs (SEPs) are widely regarded by scientists and public health officials as an effective strategy for preventing the spread of HIV among injection drug users (IDUs) (National Institutes of Health, 1997; Normand et al., 1995). Yet, little is known about what constitutes an effective “dose” of SEP access and utilization for individuals or a geographic area (Bastos and Strathdee, 2000; Des Jarlais and Braine, 2004; Kral and Bluthenthal, 2003), which deprives decision-makers of information needed to best combat the spread of HIV and viral hepatitis. There is a growing worldwide need to know how much SEP access and utilization is needed to achieve HIV infection control as IDU-related HIV transmission spreads to new regions and countries (Aceijas et al., 2004; Vazirian et al., 2005).

In the United States, the Centers for Disease Control and Prevention (CDC), along with other federal public health agencies, have recommended that IDUs who are unable or unwilling to cease drug injection only use each new syringe once and then safely dispose of it (Academy for Educational Development, 2000; Centers for Disease Control and Prevention, 2000; General Accounting Office, 1993). To date, the chief behavioral measure of the “one shot for one syringe” guidance has been syringe re-use. Syringe re-use has been measured typically by asking IDUs how often they re-used their new syringes before disposing of them (Heimer et al., 1998). Studies have found that syringe reuse declines as SEP participation increases (Heimer et al., 1998) and as SEPs provide more syringes through either need-based distribution or supplementing syringes exchanged (so-called 1 for 1 plus exchanges) (Bluthenthal et al., 2004; Kral et al., 2004). However, syringe re-use as a measure of “one shot for one syringe” has one chief limitation. It does not account for sterile syringe source among IDUs (i.e., attending SEPs or pharmacy) and thereby only indirectly relates individual behavior to SEP access and utilization patterns.

We seek to consider and evaluate a new measure of “one shot for one syringe.” In this paper, we calculate individual syringe coverage percentage and examine its association with syringe re-use, injection-related HIV risk, and syringe disposal. Syringe coverage percentage is calculated as follows: Monthly SEP visits multiplied by the number of syringes retained from the last SEP visit divided by the number of illicit drug injections in the last 30 days, and multiplying the result by 100 to obtain a percentage. Syringe coverage percentage provides may more information than syringe re-use since coverage percentages can be infinite. In addition, by considering sterile syringe source, it may be more relevant to the circumstances of sterile syringe access in many countries where multiple syringe access points exist (Moatti et al., 2001; Sheridan et al., 2000). Lastly, little is known about how many syringes IDUs need to achieve lower levels of HIV risk (Bastos and Strathdee, 2000; Des Jarlais and Braine, 2004; Kral and Bluthenthal, 2003); the syringe coverage measure used here may contribute to understanding what levels of syringe access are needed for this purpose.

Syringe disposal is also an important element of syringe distribution approaches (i.e. over-the-counter pharmacy sales), as some have contended that SEPs achieve their impact primarily through reduction in the circulation time of used syringes (Kaplan and Heimer, 1994). Appropriate disposal of syringes distributed through SEPs has been a persistent concern among policymakers and communities in the United States and elsewhere (Golub et al., 2005; Lewis et al., 2002; Springer et al., 1999). Yet, no research of which we are aware has examined the

association between the quantity of syringes received from an SEP and syringe disposal among IDUs.

In this study, we describe the range of syringe coverage percentages observed in a large cross-sectional sample of IDUs who use SEPs in California, USA. We determine whether syringe coverage is associated with syringe re-use and injection-related HIV risk behaviors. Lastly, we examine whether increased syringe coverage is associated with unsafe syringe disposal.

2.0 Methods

2.1 Study background, data sources, and data collection procedures

Data for these analyses come from a study assessing the impact of a California state law that permitted local jurisdictions to approve SEPs beginning in 2000. For this study, we approached all of the 25 SEPs operating in California in 2000, of which 24 (or 96%) agreed to participate. Client-level data is based on annual convenience samples of up to 25 SEP clients from each program in 2001, 2002, and 2003. SEP clients were recruited at sites as they completed their exchange. If they agreed to participate, clients provided informed consent, received HIV testing and counseling, and completed an interviewer-administered, brief HIV risk behavior assessment using a computer-assisted-personal-interview (CAPI) software program (Questionnaire Development System, NOVA Research Company, Bethesda, MD, USA) in a private or semi-private (e.g. interviewer car, table and chair set up half a block from SEP site) with a trained research interviewer from either the RAND Corporation, the University of California, Davis, or the University of California, San Francisco. The survey included items on HIV risk behaviors (i.e. drug injection and sexual practices), HIV/AIDS knowledge, medical history, incarceration history, syringe disposal practices, SEP utilization, and other social and medical services. Participants also underwent HIV testing using oral HIV testing and pre- and post-test counseling. For the HIV test, oral specimens were analyzed for HIV antibodies using enzyme immunoassay (EIA). Repeatedly EIA positive specimens underwent confirmatory testing using Western blot assay as described elsewhere (Centers for Disease Control, 1991). Participants received \$10 for completing study protocols.

We interviewed 1,577 SEP clients from these 24 programs between May 2001 and August 2003 in three annual waves. All study procedures were approved by the human subjects protection committees at the RAND Corporation, University of California, Davis, and University of California, San Francisco.

2.2 Key study measures

2.2.1 Syringe re-use—Re-use of new syringes was assessed by asking respondents the following item: “On average, when you get a brand new, never-used needle, how many times do you inject with it before you stop using it or get rid of it?” Those reporting one were classified as not reusing syringes and those reporting 2 or more classified as re-using syringes.

2.2.2 Injection risk behavior measures—Three injection-related HIV risk behaviors were assessed: receptive syringe sharing, distributive syringe sharing, and sharing cookers. SEP clients reporting injecting with syringes previously used by another IDU in the last 30 days were classified as “receptive syringe sharers.” Respondents reporting giving their used syringes to another IDU who then injected drugs with them in the last 30 days were classified as “distributive syringe sharers.” SEP clients reporting sharing a cooker in the 30 days prior to interview were classified as “cooker sharers.”

2.2.3 Syringe coverage—Each study participant was asked to report the number of syringes retained (syringes they did not intend to give, sell, or trade to someone else) from their last

SEP visit, their number of monthly SEP visits, and their total drug injections (including intravenous, subcutaneous, and intramuscular injections) in the last 30 days. The number of syringes retained was multiplied by monthly SEP visits and then divided by the total number of injections (including skin pop/muscling injection). The result was multiplied by 100 to generate a percentage of syringe coverage for each SEP client. We used syringes retained rather than syringes received from last SEP visit because many clients exchange syringes for other IDUs. This practice has been documented in the field for many years and continues to be examined by researchers (Lorvick et al., 2006; Snead et al, 2003; Valente et al., 1998).

We grouped subjects into four categories based on syringe coverage – 150% coverage or more, 100% to 149%, 50% to 99%, and less than 50% coverage. These grouping were used to examine the relative impact of different levels of syringe coverage on injection-related HIV risk and syringe disposal.

2.2.4 Syringe disposal—We only assessed syringe disposal options in the 2003 wave of data collection. Respondents in this wave were given seven response options for the questions, “How do you dispose of your syringes once you are done with them?” 1) return them to the exchange, 2) sell them, 3) give them away, 4) throw in trash can, 5) flush down the toilet, 6) leave them in a public place (like in a bush in a park), and 7) other. Subjects could reply with multiple answers. All subjects reporting returning syringes to the exchange were considered to have safely disposed of syringes. Those reporting disposal in locations other than the SEP were classified as unsafe. (Because disposal of syringes in garbage cans might be considered safe if done properly, we also ran analyses where we classified garbage can disposal as safe. It did not change the observed associations). In California during this period, the only locations offering public syringe disposal were restrooms in airports.

2.2.5 Potential confounding variables—In constructing models that examine the relationship between syringe coverage and syringe reuse, injection-related HIV risk behaviors and unsafe syringe disposal, we included confounding variables if previous research had found them to be associated with HIV risk behaviors or if they were also associated with syringe coverage in our dataset at the 0.05 level. Candidate confounding variables included in these models were: age (<30 years, 30 to 39, 40 to 49, and 50 or older), monthly income of \$1,000 or more (yes or no), currently homeless (yes or no), sexual orientation (heterosexual or bisexual, gay or lesbian), and injected heroin in the last 30 days (yes or no). We also included drug preference and patterns including drug preference (last 30 day injection of heroin, methamphetamine, cocaine, crack cocaine, and speedball [heroin/cocaine mixture]), last 30-day drug use frequency (<60, 60–89, 90+), and injection drug use years (<10 years, 10 to 19 years, 20 years plus). We classified SEP clients by whether the respondent had injected another IDU in the last 30 days (yes or no) or was injected by another IDU (yes or no). We also assessed in a yes or no item whether clients were exchanging syringes for other IDUs. Those responding “yes” were classified as secondary exchangers. Lastly, we controlled for concern with arrest for carrying drug paraphernalia (yes or no).

2.3 Statistical analysis

We first examined what individual-level factors are associated with adequate syringe coverage of 100% to 149%, in bivariate analysis, and then created several multivariate regression models to determine whether syringe coverage percentage was independently associated with syringe re-use, three kinds of injection-related HIV risk, and syringe disposal. Bivariate statistical analyses were conducted using Mantel Haenszel Chi square and Fisher’s exact tests. For the multivariate models, we included syringe coverage using 100% to 149% coverage as the referent group in each model as well as all factors found to be associated with the dependent variables ($p < 0.05$) in bivariate analyses. Since clients are clustered in the SEP that they

attended, we also forced SEP site into each model. Analyses were conducted using SPSS for Windows, version 11.5 (SPSS Inc., Chicago, Illinois).

3.0 Results

3.1 Sample characteristics

The overall demographic characteristics of the sample are as follows: 32% female, 52% white, 20% African American, 20% Hispanic, 5% Native American, and 3% other race/ethnicity, 15% were <30 years of age, 21% were 30 to 39, 37% were 40 to 49, and 27% were 50 years of age or older (median age=44, Interquartile Range [IQR]=35, 50). Sixty-five percent had obtained their high school diploma, general equivalence degree, or higher. Homelessness was reported by 47% of participants. In terms of income support, most reported receiving government support (29%), paid work (25%), or illegal or possibly illegal activities (16%). Four percent of participants were found to be HIV positive based on antibody testing by the study. In terms of drugs used, heroin injection in the last 30 days was reported by 78% of respondents, methamphetamine injection by 36%, and cocaine injection by 22%. Non-injection use of crack cocaine was reported by 29% of respondents, methamphetamine use by 20%, and heroin use by 11%. Median age at first illicit drug use was 14 (IQR=12, 16) and median age at first injection was 19 (IQR=16, 25).

3.2 Factors associated with syringe coverage

Syringe coverage was found to vary substantially, with 35% of clients having coverage of 150% or more, 12% having 100% to 149% coverage, 19% having coverage between 50% and 99%, and 34% having coverage less than 50%. Mean syringe coverage was 356% (mean SD=162%) and the median syringe coverage was 89% (IQR=32%, 220%). Substantial bivariate differences in syringe coverage were observed by socio-demographic, socioeconomic, and drug use patterns (see Table 1). IDUs aged forty and older and those who were not homeless were more likely to have syringe coverage of 150% or more. In terms of drug patterns and preferences, subjects with lower injection frequencies and no thirty-day injection of heroin, speedball (heroin/cocaine mixture), and powder cocaine were more likely to have higher syringe coverage as were IDUs who were in drug treatment. SEP clients who were concerned about possible arrest for possession of drug paraphernalia were less likely to have higher syringe coverage. On the other hand, syringe coverage increased with number of SEP visits, number of syringes received at last exchange visit, and for IDUs who engage in secondary exchange (exchanging syringes on behalf of IDUs unable or unwilling to attend the SEP). Safe syringe disposal was also higher among SEP clients with greater syringe coverage. In a multivariate logistic regression model, syringe coverage of 100% or more was inversely associated with being homeless (Adjusted odds ratio [AOR]=0.67; 95% Confidence Interval [CI]=0.52, 0.86), injecting heroin in the last 30 days (AOR=0.51; 95% CI=0.37, 0.72), using crack in the last 30 days (AOR=0.68; 95% CI=0.51, 0.91), and being injected by another IDU (AOR=0.61; 95% CI=0.47, 0.79). Respondents who reported being currently in drug treatment (AOR=2.02; 95% CI=1.45, 2.83) had higher odds of reporting syringe 100% or more than respondents who were not in drug treatment.

3.3 Syringe coverage and HIV risk behaviors

In Table 2, we report statistically significant bivariate results ($p<0.05$) for comparisons of our main dependent variables (syringe re-use, receptive syringe sharing, distributive syringe sharing, sharing cookers in the last 30 days) with our main independent variable (syringe coverage) and covariates. In bivariate analyses, higher syringe coverage was significantly associated with syringe reuse, all four injection-related risks, and safe syringe disposal. Of all the potential confounding variables, only being currently homeless and being a secondary exchanger were associated with all of the dependent variables.

In Table 3, we report the independent associations between syringe coverage and syringe reuse, receptive syringe sharing, distributive syringe sharing, and sharing cookers using multivariate models that controlled for confounding variables. In the models examining syringe re-use and receptive and distributive syringe sharing, three consistent relationships were observed. First, as compared to SEP clients with syringe coverage of 100% to 149%, those with coverage of less than 50% had significantly higher odds of reporting syringe re-use and receptive and distributive syringe sharing. Second, no statistical differences were observed in comparisons of coverage levels 50% to 99% and 100% to 149%. And third, SEP clients with coverage above 150% had significantly lower odds of reporting syringe re-use and receptive and distributive syringe sharing as compared to those with 100% to 149% coverage. For sharing cookers, only respondents with coverage of 150% or more had significantly different (and lower) odds of reporting sharing cookers as compared to our referent group (100% to 149% coverage). Among confounding variables, only homelessness was consistently associated with elevated HIV risk. The associations between syringe coverage and HIV injection risk did not change when coverage was entered into models as a continuous variable.

3.4 Syringe coverage and syringe disposal

We also examine whether syringe coverage was associated with safe syringe disposal (for 2003 wave only). In bivariate analysis, we found that safe syringe disposal was associated with higher syringe coverage ($p=.001$), income of less than \$1,000 per month ($p=0.007$), not being homeless ($p=0.01$), being heterosexual ($p=0.03$), not injecting other IDUs ($p=0.001$), not being injected by other IDUs ($p=0.002$), not being a secondary exchanger ($p=0.02$), not being concerned about arrest for possession of drug paraphernalia ($p=0.01$).

In a multivariate logistic regression model controlling for potential confounders (Table 4), we found no statistically significant differences in safe syringe disposal by level of syringe coverage. Among other factors, we found higher odds of safe syringe disposal among heterosexuals as compared to non-heterosexuals. Having income of \$1,000 or more a month, being injected by others, and concern with arrest for possessing drug paraphernalia were all associated with lower odds of safe syringe disposal.

4.0 Discussion

In a large sample of clients from 24 SEPs, we found that as syringe coverage percentage increased the odds of syringe re-use and injection-related HIV risk decreased significantly. As used here, syringe coverage provides a useful means of examining the relationship between quantity of new syringes received and adherence to the CDC guidelines of “one shot for one syringe.” By examining ranges of syringe coverage, we found that lower levels of syringe coverage (<50%) are associated with increased odds of receptive and distributive syringe sharing, but not cooker sharing. Equally important, we found that IDUs with syringe coverage of 150% or more were significantly less likely to share syringes and cookers than those with coverage between 100% and 149%. Together these results suggest that achieving 100% syringe coverage is important, but exceeding 100% coverage may be required to maximize the public health impact of syringe access.

In addition, we found no association between odds of safe syringe disposal and syringe coverage. This finding suggests that increasing the amounts of syringes that IDUs receive at SEPs does not result increased odds of unsafe syringe disposal by IDUs.

We also found that homelessness was consistently associated with greater odds of injection-related HIV risk in this sample. This finding is in line with other studies that have found homelessness to be associated with HIV risk (Galea and Vlahov, 2002; Reyes et al., 2005).

Developing intervention to reduce homelessness among chronic, long-term IDUs is urgently required.

4.1 Study Limitations

There are several study limitations. Our sample was cross-sectional and thus cannot establish the causal direction between syringe coverage and our outcome variables. Analytically, we have examined key potential confounders and interaction effects, yet these data cannot definitively prove that increasing syringe coverage among SEP clients will result in decreased in injection-related HIV risk behaviors. Further, with the exception of HIV test results, all data are based on participant self-report, which are potentially subject to recall bias and social desirability. To date, no reliability and validity studies have been conducted on SEP client reports of syringes received and syringes used. However, there is no reason to believe that there is differential misclassification based upon self-report bias in this study. Studies on reliability and validity of injection-related HIV risk assessment and drug use measures used in this study have been reported as acceptable (Dowling-Guyer et al., 1994; Needle et al., 1995; Weatherby et al., 1994). Lastly, our models of HIV risk did not consider community or program-level characteristics.

4.2. Implications for policy and practice

We think this syringe coverage measure may be useful for evaluating policy and programmatic issues related to SEPs and syringe access. By linking syringe coverage to utilization of SEPs and syringes retained from SEPs, our findings suggest that SEP dispensation policy (i.e. one-for-one exchange, need-based distribution) might be related to client syringe coverage. Subsequent analyses indicate that syringe dispensation policies of SEPs are associated with syringe coverage among clients (Bluthenthal et al., In press). This work builds on previous research that has suggested a strong association between SEP syringe dispensation policy and syringe re-use in this and other samples (Bluthenthal et al., 2004; Kral et al., 2004). At this point, additional research using longitudinal cohorts are needed to determine whether these associations are causal.

In addition, syringe coverage could be a useful measure for understanding the relative contributions of different syringe sources, such as pharmacies, SEPs, injection and sexual partners, street syringe sellers among others. This is particularly true in the United States where locales are increasingly removing barriers to over-the-counter pharmacy sales of syringes; at present only three states do not permit some form of non-prescription sale of syringes to adults (Delaware, New Hampshire, and New Jersey). Similarly, in countries with emerging HIV epidemics among IDUs, determining whether individual syringe coverage for at-risk IDUs is reaching thresholds sufficient to reduce injection-related HIV risk is vitally important.

The finding that higher syringe coverage was not associated with unsafe syringe disposal underscores one of the values of SEP schemes – the safe removal of harmful waste materials from communities. It also suggests that increasing the number of syringes exchanged per visit can be accomplished without increasing unsafe disposal of syringes.

This study has demonstrated that individual syringe coverage is highly associated with safer injection behaviors among SEP clients. These data suggest that SEPs might be able to lower injection-related risk by improving syringe coverage among their clients through encouraging more frequent visits, increasing hours and locations, and providing more syringes per visit. Methods for making other venues of sterile syringes available to IDUs should be considered with an aim of achieving the highest levels of syringe coverage for IDUs.

Acknowledgements

We would like to acknowledge syringe exchange programs in California for their collaboration with this research project and all of the research participants. This study was funded by the Centers for Disease Control and Prevention (grant # R06/CCR918667), National Institutes on Drug Abuse (grant # R01 DA14210), and Universitywide AIDS Research Program (IS02-DREW-705).

References

- Aceijas C, Stimson GV, Hickman M, Rhodes T. Global overview of injecting drug use and HIV infection among injecting drug users. *AIDS* 2004;18:2295–303. [PubMed: 15577542]
- Academy for Educational Development. *A Comprehensive Approach: Preventing Blood-Borne Infections Among Injection Drug Users*. Centers for Disease Control and Prevention; New York, New York: 2000.
- Bastos FI, Strathdee SA. Evaluating effectiveness of syringe exchange programmes: Current issues and future prospects. *Social Science and Medicine* 2000;51:1771–1782. [PubMed: 11128265]
- Bluthenthal RN, Ridgeway G, Schell T, Anderson RL, Flynn NM, Kral AH. Examination of the association between syringe exchange program (SEPs) dispensation policy and SEP client-level syringe coverage among injection drug users. *Addiction*. In press
- Bluthenthal RN, Malik R, Grau LE, Singer M, Marshall PA, Heimer R. Sterile syringe access conditions and variations in HIV risk among drug injectors in three cities. *Addiction* 2004;99:1136–46. [PubMed: 15317634]
- Centers for Disease Control and Prevention. Interpretative criteria used to report Western blot results for HIV-1-antibody testing -- United States. *Morbidity and Mortality Weekly (MMWR)* 1991;40:692–95.
- Centers for Disease Control and Prevention. *New Attitudes & Strategies: A Comprehensive Approach to Preventing Blood-borne Infections among IDUs*. Centers for Disease Control and Prevention; Atlanta, GA: 2000.
- Des Jarlais DC, Braine N. Assessing syringe exchange programs. *Addiction* 2004;99:1081–2. [PubMed: 15317623]
- Dowling-Guyer S, Johnson ME, Fisher DG, Needle R, Watters JK, Andersen M, Williams M, Kotranski L, Booth R, Rhodes F, Weatherby N, Estrada AL, Fleming D, Deren S, Tortu S. Reliability of drug users' self-reported HIV risk behaviors and validity of self-reported recent drug use. *Assessment* 1994;1:383–392. [PubMed: 9463494]
- Galea S, Vlahov D. Social determinants and the health of drug users: Socioeconomic status, homelessness, and incarceration. *Public Health Reports* 2002;117:S135–S145. [PubMed: 12435837]
- General Accounting Office. *Needle Exchange Programs: Research Suggests Promise as an AIDS Prevention Strategy*. U.S. General Accounting Office; Washington, D.C: 1993.
- Golub ET, Bareta JC, Mehta SH, McCall LD, Vlahov D, Strathdee SA. Correlates of unsafe syringe acquisition and disposal among injection drug users in Baltimore, Maryland. *Subst Use Misuse* 2005;40:1751–64. [PubMed: 16419554]
- Heimer R, Khoshnood K, Bigg D, Guydish J, Junge B. Syringe use and reuse: Effects of syringe exchange programs in four cities. *J Acquir Immune Defic Syndr* 1998;18(suppl 1):S37–S44.
- Kaplan EH, Heimer R. A circulation theory of needle exchange. *AIDS* 1994;8:567–74. [PubMed: 8060540]
- Kral AH, Anderson RL, Flynn NM, Bluthenthal RN. Injection risk behaviors among clients of syringe exchange programs with different syringe dispensation policies. *J Acquir Immune Defic Syndr* 2004;37:1307–12. [PubMed: 15385739]
- Kral AH, Bluthenthal RN. What is it about needle and syringe programs that make them effective for preventing HIV transmission. *International Journal of Drug Policy* 2003;14:361–63.
- Lewis BA, Koester SK, Bush TW. Pharmacists' attitudes and concerns regarding syringe sales to injection drug users in Denver, Colorado. *J Am Pharm Assoc (Wash)* 2002;42:S46–51. [PubMed: 12489615]
- Lorvick J, Bluthenthal RN, Scott A, Gilbert ML, Riehman KS, Anderson RL, Flynn NM, Kral AH. Secondary syringe exchange among users of 23 California syringe exchange programs. *Subst Use Misuse* 2006;41:865–82. [PubMed: 16809176]

- Moatti JP, Vlahov D, Feroni I, Perrin V, Obadia Y. Multiple access to sterile syringes for injection drug users: vending machines, needle exchange programs and legal pharmacy sales in Marseille, France. *Eur Addict Res* 2001;7:40–5. [PubMed: 11316925]
- Needle RN, Fisher DG, Weatherby N, Chitwood D, Brown B, Cesari H, Booth R, Williams ML, Watters JK, Andersen M, Braunsterin M. Reliability of self-reported HIV risk behaviors of drug users. *Psychology of Addictive Behaviors* 1995;9:242–250.
- National Institutes of Health. Interventions to prevent HIV risk behaviors. NIH Consensus Statement 1997;15:1–41.
- Normand, J.; Vlahov, D.; Moses, LE. Preventing HIV Transmission: The Role of Sterile Needles and Bleach. Washington, D.C: National Academy Press; 1995.
- Reyes JC, Robles RR, Colon HM, Matos TD, Finlinson HA, Marrero CA, Shepard EW. Homelessness and HIV risk behaviors among drug injectors in Puerto Rico. *Journal of Urban Health* 2005;82:446–55. [PubMed: 15917501]
- Sheridan J, Lovell W, Turnbull P, Parsons J, Stimson GV, Strang J. Pharmacy-based needle exchange (PBNX) schemes in south east England: a survey of service providers. *Addiction* 2000;95:1551–60. [PubMed: 11070530]
- Snead J, Downing M, Lorvick J, Garcia B, Thawley RE, Kegeles SM, Edlin BR. Secondary syringe exchange among injection drug users. *Journal of Urban Health* 2003;80:330–348. [PubMed: 12791808]
- Springer KW, Sterk CE, Jones TS, Friedman L. Syringe disposal options for injection drug users: A community-based perspective. *Subst Use Misuse* 1999;34:1917–1934. [PubMed: 10540978]
- Valente TW, Foreman RK, Junge B, Vlahov D. Satellite exchange in the Baltimore Needle Exchange Program. *Public Health Reports* 1998;113:90–96. [PubMed: 9722814]
- Vazirian M, Nassirimanesh B, Zamani S, Ono-Kihara M, Kihara M, Ravari SM, Gouya MM. Needle and syringe sharing practices of injecting drug users participating in an outreach HIV prevention program in Tehran, Iran: A cross-sectional study. *Harm Reduction Journal* 2005;2
- Weatherby N, Needle RH, Cesari H, Booth R, McCoy CB, Watters JK, Williams M, Chitwood DD. Validity of self-reported drug use among injection drug users recruited through street outreach. *Evaluation and Program Planning* 1994;17:347–355.

TABLE 1
Bivariate analysis of syringe coverage percent by client characteristics (n=1,577)

	Coverage <50% N (%)	Coverage 50 to 99% N (%)	Coverage 100% to 149% N (%)	Coverage 150% plus N (%)	P<
<i>Total</i>	537 (34%)	295 (19%)	191 (12%)	547 (35%)	
<i>Sex</i>	172 (35%)	85 (17%)	61 (12%)	177 (36%)	*
Female	365 (34%)	210 (20%)	130 (12%)	370 (34%)	n.s.
Male					
<i>Race</i>	279 (34%)	155 (19%)	99 (12%)	291 (35%)	0.04
White	88 (29%)	58 (19%)	42 (14%)	120 (39%)	
African American	129 (41%)	51 (16%)	33 (11%)	101 (32%)	
Hispanic	28 (39%)	19 (26%)	11 (15%)	14 (19%)	
Native American	13 (25%)	12 (23%)	6 (12%)	21 (40%)	
Other					
<i>Age</i>	112 (47%)	33 (14%)	27 (11%)	66 (28%)	<0.001
<30 years old	112 (35%)	75 (24%)	39 (12%)	95 (30%)	
30–39 years old	182 (31%)	114 (19%)	63 (11%)	232 (39%)	
40–49 years old	130 (31%)	73 (18%)	61 (15%)	154 (37%)	
50 years of age or more					
<i>Education</i>	213 (40%)	82 (15%)	59 (11%)	181 (34%)	0.004
< High School	323 (32%)	212 (21%)	127 (12%)	359 (35%)	
High School or more					
<i>Income</i>	318 (34%)	161 (17%)	116 (13%)	334 (36%)	*
<\$1,000	198 (34%)	121 (21%)	66 (11%)	195 (34%)	n.s.
\$1,000 or more					
<i>Homeless</i>	292 (40%)	144 (20%)	89 (12%)	206 (28%)	<0.001
Yes	243 (29%)	150 (18%)	102 (12%)	334 (40%)	
No					
<i>Currently on Parole</i>	191 (39%)	78 (16%)	50 (10%)	171 (35%)	0.02
Yes	344 (32%)	213 (20%)	104 (13%)	372 (35%)	
No					
<i>Sexual Orientation</i>	448 (34%)	250 (19%)	163 (12%)	455 (35%)	*
Heterosexual/Straight	74 (37%)	36 (18%)	22 (11%)	69 (34%)	n.s.
Gay, Lesbian, Bi					
<i>Drug Use Practices/Preferences Injection Frequency,</i>	124 (21%)	71 (12%)	80 (13%)	321 (54%)	<0.001
last 30 days	141 (35%)	99 (24%)	54 (13%)	113 (28%)	
<60 injections	272 (48%)	125 (22%)	57 (10%)	113 (20%)	
60 to 90 injections					
>90 injections					
<i>Inject Heroin, last 30 days</i>	461 (37%)	236 (19%)	152 (12%)	385 (31%)	<0.001
Yes	76 (23%)	59 (18%)	39 (12%)	162 (48%)	
No					
<i>Inject Speedball, last 30 days</i>	204 (39%)	104 (20%)	58 (11%)	163 (31%)	0.03
Yes	333 (32%)	191 (18%)	133 (13%)	382 (37%)	
No					
<i>Inject Methamphetamine, last 30 days</i>	179 (32%)	116 (21%)	68 (12%)	197 (35%)	*
Yes	358 (36%)	179 (18%)	123 (12%)	349 (35%)	n.s.
No					
<i>Inject Powder Cocaine, last 30 days</i>	126 (38%)	73 (22%)	42 (13%)	94 (28%)	0.03
Yes	411 (33%)	222 (18%)	149 (12%)	452 (37%)	
No					
<i>Inject Crack, last 30 days</i>	54 (49%)	14 (13%)	13 (12%)	29 (26%)	0.006
Yes	482 (33%)	281 (19%)	178 (12%)	517 (36%)	
No					
<i>Smoke Crack, last 30 days</i>	190 (43%)	88 (20%)	50 (11%)	121 (27%)	<0.001
Yes	345 (31%)	206 (19%)	141 (13%)	423 (38%)	
No					

	Coverage <50% N (%)	Coverage 50 to 99% N (%)	Coverage 100% to 149% N (%)	Coverage 150% plus N (%)	P <
Non-injection Methamphetamine, last 30 days					
Yes	107 (33%)	71 (22%)	46 (14%)	97 (30%)	*
No	429 (34%)	223 (18%)	145 (12%)	450 (36%)	n.s.
Years of injection					
<10 years	165 (41%)	70 (18%)	51 (13%)	113 (28%)	0.002
10–19 years	105 (33%)	68 (21%)	27 (9%)	119 (37%)	
20+ years	269 (31%)	156 (18%)	111 (13%)	313 (37%)	
Currently in drug treatment					
Yes	62 (26%)	38 (19%)	32 (13%)	109 (45%)	0.001
No	474 (36%)	257 (19%)	158 (12%)	437 (33%)	
Secondary exchanger					
Yes	251 (29%)	180 (21%)	99 (12%)	324 (38%)	<0.001
No	284 (40%)	115 (16%)	92 (13%)	223 (31%)	
Injected other					
Yes	263 (38%)	145 (21%)	80 (11%)	212 (30%)	0.002
No	274 (32%)	148 (17%)	110 (13%)	334 (39%)	
Injected by others					
Yes	178 (41%)	90 (20%)	49 (11%)	123 (28%)	0.001
No	359 (32%)	203 (18%)	141 (13%)	422 (38%)	
Concerned about arrest for drug paraphernalia					
Yes	327 (37%)	173 (20%)	112 (13%)	265 (30%)	<0.001
No	209 (30%)	121 (18%)	78 (11%)	282 (41%)	
Syringes retained, last SEP visit					
< 7 syringes	282 (70%)	40 (10%)	37 (9%)	47 (12%)	<0.001
7 to 15 syringes	163 (40%)	94 (23%)	43 (26%)	104 (26%)	
16 to 40 syringes	81 (21%)	101 (26%)	71 (18%)	140 (36%)	
41 or more syringes	11 (3%)	60 (16%)	40 (11%)	256 (70%)	
SEP visits, last 30 days					
One time	172 (48%)	58 (16%)	39 (11%)	93 (26%)	<0.001
Two or three times	182 (37%)	93 (19%)	57 (11%)	166 (33%)	
4 times	109 (24%)	90 (20%)	65 (15%)	182 (41%)	
5 times or more**	74 (28%)	54 (21%)	30 (11%)	106 (40%)	
Syringe disposal					
Safe	122 (34%)	63 (18%)	45 (13%)	129 (36%)	<0.001
Unsafe	64 (40%)	45 (28%)	22 (14%)	31 (19%)	

* n.s.=Not significant

** 2003 cross-sectional sample only.

TABLE 2

Factors significantly associated with injection-related HIV risk behaviors among SEP clients (N=1,577).

Characteristics	Syringe re-use	Receptive Syringe Sharing	Distributive Syringe Sharing	Shared cookers
Syringe coverage	418/527 (79%)	199/539 (38%)	223/528 (42%)	334/535 (62%)
<50%	179/295 (61%)	77/289 (27%)	79/294 (27%)	179/294 (61%)
50% to 99%	108/191 (56%)	35/191 (18%)	50/190 (26%)	100/191 (52%)
100% to 149%	188/546 (34%)	49/544 (9%)	66/546 (12%)	218/544 (40%)
150% plus				
Age	Not significant	79/238 (33%)	95/236 (40%)	147/237 (62%)
<30 years old		94/321 (29%)	103/326 (32%)	175/324 (54%)
30–39		128/587 (22%)	142/592 (24%)	316/595 (53%)
40–49		60/422 (14%)	81/420 (19%)	202/424 (48%)
50 or more				
Monthly Income \$1k plus	Not significant	Not significant	231/932 (25%)	Not significant
Yes			173/583 (30%)	
No				
Homeless	470/733 (64%)	208/729 (29%)	250/731 (34%)	439/736 (60%)
Yes	424/834 (51%)	153/831 (18%)	171/835 (21%)	398/837 (48%)
No				
Sexual Orientation	Not significant	290/1317(22%)	Not significant	Not significant
Heterosexual/Straight		58/200 (29%)		
Gay, Lesbian, Bi				
Injected Heroin, last 30 d	745/1240 (60%)	Not significant	355/1241 (29%)	730/1247 (59%)
Yes	155/337 (46%)		67/335 (20%)	111/335 (33%)
No				
Injected other	423/699 (61%)	221/696 (32%)	264/697 (38%)	466/703 (66%)
Yes	477/874 (54%)	141/870 (16%)	158/875 (18%)	374/875 (43%)
No				
Injected by others	Not significant	158/439 (36%)	162/445 (36%)	314/447 (70%)
Yes		203/1126 (18%)	260/1126 (23%)	526/1131 (47%)
No				
Secondary exchanger	433/863 (50%)	215/854 (25%)	251/863 (29%)	502/865 (58%)
Yes	464/711 (65%)	147/715 (21%)	170/711 (24%)	336/714 (47%)
No				
Concerned w/ arrest for paraphernalia	557/883 (63%)	223/874 (26%)	279/879 (32%)	521/885 (59%)
Yes	341/691 (49%)	139/693 (20%)	142/694 (21%)	318/694 (46%)
No				

Table 3

Multivariate logistic regression models of injection-related HIV risk among SEP clients (N=1,577).*

Characteristics	Syringe re-use	Receptive Syringe Sharing	Distributive Syringe Sharing	Shared cookers
Syringe coverage <50% 50 to 99% 100% to 149% 150% plus	2.64 (1.76, 3.95)~ 1.31 (0.86, 2.01) Referent 0.49 (0.33, 0.72)~	2.29 (1.44, 3.63)~ 1.48 (0.89, 2.44) Referent 0.47 (0.28, 0.80)~	1.63 (1.07, 2.49)~ 0.90 (0.56, 1.44) Referent 0.46 (0.29, 0.72)~	1.14 (0.77, 1.68) 1.15 (0.75, 1.76) Referent 0.61 (0.41, 0.89)~
Age <30 years old 30–39 years old 40–49 50 or more	Referent 1.07 (0.69, 1.66) 1.15 (0.75, 1.77) 0.87 (0.54, 1.39)	Referent 1.10 (0.70, 1.72) 0.85 (0.55, 1.33) 0.59 (0.35, 0.99)~	Referent 0.93 (0.60, 1.43) 0.75 (0.48, 1.15) 0.61 (0.38, 0.99)~	Referent 0.89 (0.58, 1.36) 0.88 (0.59, 1.33) 0.71 (0.46, 1.11)
Income \$1k +, mo Yes	0.78 (0.60, 1.01)	1.06 (0.80, 1.41)	1.14 (0.87, 1.50)	0.80 (0.63, 1.03)
Homeless Yes	1.57 (1.21, 2.04)~	1.53 (1.14, 2.04)~	1.66 (1.26, 2.19)~	1.38 (1.08, 1.78)~
Sexual Orientation Heterosexual Injected Heroin, last 30 days – Yes	1.10 (0.75, 1.60) 1.53 (1.10, 2.13)~	0.77 (0.52, 1.15) 1.16 (0.79, 1.72)	1.34 (0.89, 2.00) 1.26 (0.86, 1.83)	1.15 (0.80, 1.64) 3.59 (2.58, 5.01)~
Injected other Yes	1.26 (0.97, 1.63)	2.26 (1.69, 3.00)~	2.31 (1.76, 3.02)~	2.49 (1.96, 3.18)~
Injected by others Yes	0.92 (0.70, 1.23)	2.09 (1.57, 2.80)~	1.40 (1.05, 1.86)~	2.55 (1.94, 3.35)~
Secondary exchanger Yes	0.56 (0.43, 0.73)~	1.32 (0.98, 1.77)	1.34 (1.01, 1.77)~	1.60 (1.25, 2.05)~
Concerned w/ arrest for paraphernalia Yes	1.59 (1.23, 2.05)~	0.97 (0.73, 1.30)	1.41 (1.07, 1.86)~	1.22 (0.96, 1.55)

* Controlling for syringe exchange program.

~ Significant at p<0.05.

Table 4

Multivariate logistic regression model predicting safe syringe disposal among SEP clients in 2003 (N=476).*

Characteristic	Safe syringe disposal Adjusted Odds Ratio (95% Confidence Interval)
Syringe coverage	0.97 (0.48, 1.97)
<50%	0.68 (0.33, 1.44)
50 to 99%	Referent
100% to 149%	1.78 (0.83, 3.82)
150% plus	
Age	Referent
<30 years old	1.07 (0.45, 2.55)
30–39 years old	1.18 (0.52, 2.65)
40–49	1.33 (0.55, 3.21)
50 or more	
Income \$1,000 or more per month	0.57 (0.36, 0.92)~
Yes	
Homeless	0.68 (0.42, 1.11)
Yes	
Sexual Orientation	2.20 (1.10, 4.42)~
Heterosexual	
Injected Heroin, last 30 days	0.93 (0.50, 1.73)
Yes	
Injected other	0.83 (0.52, 1.33)
Yes	
Injected by others	0.60 (0.37, 0.98)~
Yes	
Secondary exchanger	0.85 (0.50, 1.43)
Yes	
Concerned w/ arrest for paraphernalia	0.61 (0.37, 0.97)~
Yes	

* Controlling for syringe exchange program.

~ Significant at p<0.05.