Published in final edited form as:

Subst Use Misuse. 2017 July 29; 52(9): 1151–1159. doi:10.1080/10826084.2017.1299182.

Decreased odds of injection risk behavior associated with direct versus indirect use of syringe exchange: Evidence from Two California Cities

Czarina N. Behrends, Chin-Shang Li, and David R. Gibson

^aGraduate Group in Epidemiology, University of California, Davis, Davis CA 95616 USA

^cDepartment of Public Health Sciences, University of California, Davis, Davis, CA 95616 USA

^dDepartment of Public Health Sciences, University of California, Davis, Davis, CA 95616 USA

Introduction

There is now substantial evidence that syringe exchange programs (SEPs) are effective in preventing HIV risk behavior and HIV seroconversion among people who inject drugs (PWID) (Aspinall et al., 2014; Gibson et al., 2001; Palmateer et al., 2006; Wodak and Cooney, 2006). Nearly all of this evidence, however, comes from PWID who obtain syringes from an SEP directly. Much less is known about the benefits of so-called secondary exchange to PWID of receiving syringes indirectly from friends or acquaintances who visit an SEP for them. Secondary exchange is a naturally occurring and virtually ubiquitous phenomenon that greatly expands both the number of PWID reached by an SEP and the volume of syringes exchanged. Data gathered from 23 SEPs in California showed that 75–89% of clients engage in secondary exchange (Lorvick et al., 2006). By 2007, 89% of SEPs in the United States permitted secondary exchange, and 76% encouraged it (Des Jarlais et al., 2009; Tyndall et al., 2002); in addition, there is evidence that even programs that discourage secondary exchange do little to prevent it (Tyndall et al., 2002).

Secondary exchange occurs most frequently within established injecting networks comprised of close friends, sexual partners and family members (Brothers, 2016; Bryant and Hopwood, 2009; Craine et al., 2010; De et al., 2008; Fisher et al., 2013; Green et al., 2010; Huo et al., 2005; Lenton et al., 2006; Lorvick et al., 2006; Marshall et al., 2015; Murphy et al., 2004; Newland et al., 2016; Snead et al., 2003; Tyndall et al., 2002) but it may also involve PWID who acquire large numbers of syringes to sell or distribute outside their personal networks often at some distance from a fixed-site SEP (Lenton et al., 2006; Newland et al., 2016; Valente et al., 1998; Valente et al., 2001). In Baltimore, for example, it was estimated such high-volume “satellite” exchangers, representing less than 10% of SEP clients, accounted for nearly 65% of syringes distributed (Valente et al. 1998). Various kinds of formal satellite exchange have been implemented in the United States, Canada, Russia

*Corresponding author.

^bPresent address: Department of Healthcare Policy and Research, Weill Cornell Medical College, New York, NY 10065 USA

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

and China by drug user activists or outreach workers funded by government entities (Anderson et al., 2003; Hayashi et al., 2010; Irwin et al., 2006; Liu et al., 2007; Sears et al., 2001). In the United States, secondary syringe exchange (not including satellite exchange) occurs primarily in connection with stand-alone SEPs; in Britain and Australia, however, it also serves as an adjunct to large-scale syringe distribution through pharmacies and drug abuse treatment clinics (Bryant and Hopwood, 2009; Craine et al., 2010; Lenton et al., 2006).

Secondary syringe exchange not only increases the reach of SEPs and volume of syringes exchanged but also addresses many of the barriers to direct SEP use. These include geographic distance from SEP site, limited service hours, lack of transportation, police harassment in the vicinity of SEPs, fear of being identified as a PWID, and mental and physical disabilities (Anderson et al. 2003; Bluthenthal et al., 1997; Bryant and Hopwood, 2009; Murphy et al., 2004; Snead et al., 2003). Although secondary exchange recipients experience many of the same problems as PWID who do not have access to syringe exchange, they are able to overcome these barriers by finding others to exchange for them. This may be particularly important for women and younger and more recent-onset drug users who are much less likely to attend an SEP (Anderson et al., 2003; Craine et al., 2009; Murphy et al., 2004; Riehm et al. 2004). Secondary syringe exchange also benefits PWID in ways that go well beyond increasing access to sterile syringes, as secondary exchangers often serve a health care or “doctoring” function by providing PWID with information about safer injecting practices, drug overdose prevention, vein care and referrals to HIV and HCV testing and drug abuse treatment as well as resources for acquiring ancillary injection equipment such as drug cookers and filters, sterile water and swabs (Anderson, 2003; Brothers, 2016; Dechman, 2015; Fisher et al., 2013; Marshall et al, 2015; Newland et al., 2016; Snead et al., 2003).

While the descriptive qualitative data just cited suggest that secondary syringe exchange may play a vital role in preventing HIV infection, only three studies we are aware of have assessed its effectiveness using analytic designs such as pre-post comparisons or comparisons between primary and secondary exchange clients and nonclients (Huo et al., 2005; Murphy et al., 2004; Sears et al., 2001). In the first (Sears et al., 2001), young homeless PWID interviewed in the vicinity of a satellite SEP in San Francisco’s Golden Gate Park were compared with PWID recruited at a site geographically distant from the exchange, which was operated by a core group of four youth who were available to exchange syringes 24 hours a day, 7 days a week. Respondents at the intervention site were 73% less likely to share syringes than those at the comparison site. The exchange, however, was one of three components of a community-level intervention to prevent HIV, and the investigators were unable to determine whether the other components contributed to use of it. The second, mostly descriptive, study (Murphy et al., 2004) compared direct users of a fixed-site SEP in San Francisco with indirect users and nonusers referred by exchange clients. Indirect users were less likely than nonusers but more likely than direct users to report sharing syringes; the analysis, however, did not adjust for potential confounders. In the third study (Huo et al., 2005), direct users of a Chicago SEP and mixed direct/indirect exchange recipients were compared with non-recipients who were street-recruited at a site not served by the SEP. In multivariable analyses direct users and mixed direct/indirect users

were 60% and 50%, respectively, less likely than nonusers to report borrowing syringes. However, as only 5% of the mixed group had not visited the exchange at least once, the mixed direct/indirect users probably were not representative of PWID who obtained syringes only indirectly.

In contrast with the three studies just cited, which were conducted with data collected within circumscribed geographic areas and/or at syringe exchange sites, the current investigation was carried out with data from representative community samples of untreated PWID recruited independently of a satellite home-delivery syringe exchange program (see footnote 1, page 17) in Sacramento, California and a conventional fixed-site syringe exchange in San Jose, California. The samples recruited at each site included PWID who obtained syringes directly from the SEP, others who acquired them indirectly from friends or acquaintances who attended an SEP for them, and a third group who obtained syringes from other sources. Adjusting for a very wide array of potentially confounding variables, we assessed whether direct and indirect use of the SEPs was protective against high-risk injection behavior. Please note that while the satellite SEP evaluated in Sacramento was a secondary syringe exchange that involved home delivery of syringes, we assessed its own secondary (i.e., indirect) effects among friends and acquaintances of home-delivery recipients.

Methods

Data Source

Data for this project are from a cross-sectional study of 502 PWID interviewed in Sacramento in 1999–2000 (Study 1) and a prospective cohort study of 207 PWID who were first interviewed in San Jose in 1995–1996 and reinterviewed in 1996–1997 (Study 2). Although the data reported here are not recent, they are, for the reasons stated in the last paragraph, the best that are currently available and are contemporaneous with those of the three previous studies cited. The two study sites, Sacramento and San Jose, are approximately 120 miles distant from one another and had very similar PWID populations. However, the two syringe exchanges differed in their model of service delivery. While the Sacramento exchange offered home delivery of syringes, encouraged clients to use a sterile syringe for every injection and provided as many syringes clients required to meet that need, in San Jose clients were required to visit the exchange during its hours of operation and were generally limited to receiving one sterile syringe for every used syringe returned to the exchange. In terms of research participation, Sacramento respondents were involved in a two-city evaluation of a community-level intervention to prevent HIV in PWIDs for which Sacramento was the intervention site. In the analysis of data from this study, we adjusted for exposure to those aspects of the intervention which proved to be effective in preventing high-risk behavior (see Gibson et al., 2010). Data for Study 2 are from the follow-up interview of San Jose respondents but also included a measure of injection risk behavior from the baseline interview to adjust for self-selective use of the SEP by low-risk PWID.

¹To arrange “home delivery” clients paged the on-duty exchanger to schedule the exchange of syringes at a specified location, often the client’s home.

Sampling and Recruitment

Sampling of respondents at both sites employed targeted sampling methods whereby representative samples of hidden populations such as PWID are recruited in a systematic fashion (Watters and Biernacki, 1989). In Study 1, coroner's data on decedents from heroin drug overdose were used to develop a sampling frame for recruiting respondents by zip code, gender and race/ethnicity. In Study 2, records of the Santa Clara County Health Department HIV/AIDS outreach team were examined to establish quotas by gender, race/ethnicity and geographic district served by the team. Respondents at both sites were recruited by outreach workers with social contacts in the PWID community and interviewed by project staff face-to-face for 20–30 minutes in street settings (see footnote 2, page 17). Inclusion criteria for both studies included active (untreated) PWID age 18 years or older who reported any injection of heroin (alone or in a speedball combination of heroin and cocaine) during the previous 30 days. Of 338 respondents interviewed initially for Study 2, 257 (or 76%) were reached for a follow-up a mean 10.7 months after baseline. Extensive tracking information was gathered in Study 2 to assist the outreach team and interviewers in contacting respondents for follow-up interviews. Respondents also gave investigators permission to obtain current address data on them from public databases such as AFDC, SSI and General Assistance. Previous analysis showed that respondents lost to follow-up were more likely to be unstably housed or homeless, have less education and were less likely to have ever been enrolled in methadone maintenance treatment; in addition, they were less likely to have used the San Jose syringe exchange and more likely to report injection risk behavior (Gibson et al., 2002). Fifty of these 257 were excluded from the analysis as they had not injected in the previous 30 days, leaving an N of 207 available for analysis.

Variables

Virtually identical variables were employed in separate analyses of data from Studies 1 and 2 including sociodemographic and background information, HIV risk behaviors, and numbers of syringes obtained directly and indirectly from syringe exchange. To assess syringe sources each respondent was asked to report the number of syringes obtained directly from the syringe exchange during the previous 30 days, the number obtained indirectly from others who had exchanged for them, and the number of syringes obtained from other sources such as the black market or a street dealer, a pharmacist, a diabetic, and relative, friend or acquaintance. Respondents who received any syringes directly or indirectly from syringe exchange were classified direct and indirect syringe exchange users, respectively; nonusers of syringe exchange were respondents who reported obtaining syringes exclusively from other sources. There were nine respondents (1.8%) in Study 1 and

²As stated, Study 1 participants were involved in a two-city evaluation of a community-level HIV-prevention intervention that was implemented in Sacramento (the comparison site, San Diego, received no intervention). The two Sacramento project staff who conducted interviews at the Sacramento site were not involved in any aspect of the community intervention but both volunteered as syringe exchangers and in that role each would have had contact with some of the 46 Study 1 respondents who reported direct use of the exchange. While we cannot ascertain which interviewer exchanged with which respondent, it is likely that half of the 46, or 23, were interviewed by someone they exchanged with. This is a potential problem since these respondents would have been less likely to acknowledge high-risk behavior. Two features of this study, however, mitigate this problem. First, the questionnaire items asking about high-risk behavior were immediately preceded by instructions that gave respondents "permission" to acknowledge high-risk behavior. Second, in multivariable analysis we adjusted for socially desirable response tendency. See the Variables section for further discussion of these procedures and their advantages.

15 respondents (7.2%) in Study 2 who reported both direct and indirect SEP use and these respondents were classified as indirect users.

HIV injection risk behavior was measured in both studies with a nine-item assessment used to characterize respondents' injection risk in the past 30 days as low versus high. Respondents were judged to be at low risk if during the previous 30 days they 1) abstained from using a syringe that someone else had just used without first cleaning it with bleach or, 2) if they did use such a syringe, did so only with a regular sexual partner with whom they had a committed sexual relationship and whom they believed to be HIV-negative. Respondents were considered high risk if they reported borrowing unbleached syringes 1) from a regular sexual partner whose HIV status was unknown, 2) from someone other than a regular sexual partner, or 3) from any HIV-positive person. The nine-item assessment has been shown to be much more sensitive to the effects of experimental interventions with PWID than a single question asking about borrowing of used syringes (Gibson et al., 2002; Gibson and Young, 1994a, Gibson and Young, 1994b) and addresses possible misclassification bias for respondents in committed sexual relationships (see footnote 3, page 17). Please note that in addition to the nine-item assessment we also evaluated injection risk with measures of the borrowing of unbleached syringes, the sharing of other drug paraphernalia such as filters, cookers and rinse water and the practice of “backloading” or using a possibly infected syringe to divide drug doses with other PWID. To reduce underreporting of high-risk behavior, instructions immediately preceding questionnaire items about borrowing of syringes gave respondents “permission” to acknowledge high-risk injection (“There are reasons people share outfits, such as being dope sick and not having their own”). A previous study (Gibson and Young, 1994b) showed that the permission-giving instructions increased self-reported borrowing by about one-third.

In addition to the variables described above, a very wide array of potential confounders was chosen for inclusion in both analyses based on a comprehensive review of previous research on the effectiveness of syringe exchange (Gibson et al., 2001). Possible confounders included gender, race/ethnicity, age, sexual orientation, educational attainment, housing status (stably versus unstably housed/homeless), employment status (full- or part-time versus unemployed), number of heroin detoxification attempts, years in methadone maintenance treatment, injection location (in the home versus other locations), receipt of public assistance (General Assistance, AFDC, or SSI), years injected, injection frequency, age at first heroin use, injection of cocaine, methamphetamine and “speedball” combination of heroin with cocaine or methamphetamine, a rating of overall addiction severity adapted

³It may be objected that respondents who were in committed relationships with a primary sexual partner might be mistaken about the “exclusiveness” of their relationship, the HIV status of the partner, or the willingness of the partner to share injection equipment with another PWID. Only 45 of 283 (or 16%) respondents in Study 1 and 15 of 169 (or 9%) fell into the category of only borrowing syringes from an HIV-negative regular sexual partner. However, while the exclusiveness of the partnership or borrowing syringes from another drug user following a negative HIV test may be questioned, a recent review (Nasurruddin et al., 2016) showed 85% to 94% disclosure of HIV status between PWID and intimate sexual partners. Disclosure was less likely for regular sexual partners who were also PWID although the review found that HIV-positive PWID who did not disclose tended to practice safer injection behavior to protect their partners. Please note that while the nine-item composite measure of injection risk was the focus of our multivariate analysis, we also analyzed our data using an alternative outcome (borrowing of unbleached syringes) that did not take an intimate partner's HIV status into account. Tables 1 and 2 show the proportion of direct, indirect and nonusers of the syringe exchange in Studies 1 and 2 who reported this practice. The results are fully consistent with our multivariate findings, with direct users being at lowest risk, nonusers at highest risk, and indirect users at intermediate risk.

from the Addiction Severity Index (McLellan et al., 1992), social desirability, and in Study 1, exposure to several components of a community intervention that had been implemented in Sacramento shortly before the data for this project were collected (Gibson et al., 2010). Addiction severity was available only for Study 1. Social desirability was measured with a short form of the Marlowe-Crowne Social Desirability Scale (Strahan and Gerbasi, 1972). Previous work has shown that self-reported injection risk behavior is seriously contaminated by response bias and that adjusting for socially desirable response tendency can increase self-reported borrowing of syringes by about one-half (Gibson et al., 2002; Gibson et al., 1999; Gibson and Young, 1994b).

Data Analysis

Analyses were conducted separately for Studies 1 and 2. Descriptive analyses identified sociodemographic and behavioral variables that differed among direct users, indirect users, and nonusers of the SEPs. In univariable analyses, we then assessed the association between HIV risk injection risk and potential confounders. Chi-squared tests were used to assess relationships between categorical variables, and Kruskal-Wallis tests were used where one variable was ordinal categorical. In cases where Chi-square tests were not appropriate due to small cell sizes, Fisher's exact tests were used to examine the association of nominal categorical variables. Associations between continuous variables and respondents' risk status were assessed with *t* tests where the variables were normally distributed and with Wilcoxon Rank-Sum tests where they were not. Variables that showed statistically significant ($p < .05$) univariable associations with HIV risk behavior were included in the stepwise selection of variables for the multivariable logistic regression models examining the relationship between direct and indirect syringe exchange use and high-risk injection behavior. Our hypothesis was that direct and indirect use is associated with a reduction in risk behavior although assumptions of causality are limited by the cross-sectional design of Study 1.

Results

Study 1

Results from Study 1 appear in Tables 1 and 2. Table 1 compares the sociodemographic characteristics of behavioral risk profile of direct and indirect users and nonusers of the satellite SEP in Sacramento. Of the 502 respondents who met inclusion criteria for this study, 46 or 9.2% were direct users of the SEP, 158 or 31.5% were indirect users, and 298 or 57.3% were nonusers. While 42 of the 46 (91.3%) of direct users obtained their syringes exclusively from the SEP, 151 of the 158 (95.6%) indirect users had other sources of syringes. Direct users obtained a median of 100 syringes from the SEP during the previous 30 days while indirect users acquired a median of 40 syringes from the syringe exchange. Direct and indirect SEP were more likely to be non-Hispanic white and older and less likely to inject fewer than 30 times per month, while indirect users and nonusers were more likely to be unstably housed or homeless. In addition, direct users of the SEP were a third as likely as nonusers to report borrowing an unbleached syringe and half as likely to share drug paraphernalia or engage in the practice of "backloading." There were similar but somewhat attenuated associations of indirect use with borrowing unbleached syringes and backloading

but no difference in the sharing of other drug paraphernalia. Direct users were a twelfth as likely and indirect users were a ninth as likely as nonusers to be at high behavioral risk.

In the univariable analyses the following variables showed statistically significant associations with high-risk injection: African American versus non-Hispanic white (OR=0.61, 95% CI= 0.39–0.97), age (OR=0.96, 95% CI=0.95–0.98), homeless or unstably housed (OR=2.94, 95% CI=2.04–4.23), number of heroin detoxification attempts (OR=0.97, 95% CI=0.95–0.99), years in methadone maintenance treatment (OR=0.94, 95% CI=0.88–0.999), injection in location other than the home (OR=5.80, 95% CI=3.24–10.3); years injected (OR=0.98, 95% CI=0.96–0.995, injection frequency (OR=1.008, 95% CI=1.005–1.011), age at first heroin use (OR=0.95, 95% CI=0.96–0.998); any methamphetamine injection (OR=1.66, CI=1.09–2.52); any cocaine injection (OR=3.26, 95% CI=2.06–5.16); any “speedball” use of heroin and cocaine (OR=3.34, 95% CI=2.19–5.09); addiction severity (OR=1.48; 95% CI=1.18–1.88); socially desirable response tendency (OR=0.87, 95% CI=0.79–0.95), and exposure to several components of the community intervention.

The left-hand data column of Table 2 reports the results from the multivariable logistic regression for Study 1 after stepwise selection. After adjusting for confounders, direct use of the syringe exchange was associated with a 95% percent reduction in high-risk behavior (AOR=0.05), while indirect use was associated with a 46% reduction (AOR=0.54) when compared to nonusers. Four other variables (African American versus non-Hispanic white, “speedball” injection of heroin and cocaine, injection location and unstable housing) had independent effects on high-risk behavior with the four-fold increased risk associated with injecting in a location other than the home being particularly notable.

Study 2

Results from Study 2 are shown in Tables 2 and 3. Table 3 compares the sociodemographic characteristics and behavioral risk profile of direct and indirect users and nonusers of the conventional fixed-site SEP in San Jose. Of the 207 respondents in San Jose who met inclusion criteria for this study and who were injecting at the time of the follow-up interview, 75 (or 35.8%) were direct users of the SEP, 29 (or 13.9%) were indirect or mixed direct/indirect users, and 103 (or 50.2%) were nonusers of the SEP. Thirty-nine (39) of the 75 (52.0%) direct users used other sources of syringes compared with 20 of 29 (69.0%) of indirect users. Direct SEP users acquired a median of 14 syringes from the syringe exchange during the previous 30 days during which time indirect users obtained a median of 10 syringes from the syringe exchange. Direct SEP users were more likely to be Hispanic and indirect users more likely to be non-Hispanic white, while the latter were less likely than the former to be nonusers of the exchange. In addition, indirect users and nonusers were substantially more likely to be unstably housed or homeless. Direct users of the SEP were half as likely as nonusers to report borrowing an unbleached syringe and somewhat less likely to have shared other drug paraphernalia or backloaded a syringe. Direct users were less than half as likely to be at high behavioral risk, while indirect users were similarly advantaged.

In the univariable analyses the following variables showed statistically significant associations with high-risk injection behavior: female gender (OR=0.31, 95% CI=0.13–

0.75), injection in location other than the home (OR=7.06, 95% CI=2.40–20.7), injection frequency (OR=1.01, 95% CI=1.00–1.02), and “speedball” use of heroin and cocaine (OR=3.04, 95% CI=1.47–6.28).

The right-hand data column of Table 2 reports the results from the multivariable logistic regression for Study 2 after stepwise selection. The results indicate that after adjusting for potential confounders, direct use of the syringe exchange was associated with more than 69% reduction in high-risk injection behavior (AOR=0.31), while high-risk behavior was associated with a 38% reduction (AOR=0.62), although this latter result did not reach statistical significance. Two other variables (injection location other than the home and baseline risk behavior) had strong independent effects on high-risk injection behavior. The finding with regard to baseline risk behavior confirmed the need to adjust for self-selected use of SEP by low-risk PWID.

Discussion

The findings of both studies are consistent with results of previous research showing that direct use of SEPs is associated with reductions in high-risk injection behavior in PWID as well as with limited prior evidence suggesting an effect of indirect use of SEPs on high-risk behavior. However, the 95% and 69% reductions we found associated with direct use of syringe exchange in are larger than most reported in the literature but are comparable to the 73% reduction in syringe sharing reported by direct users of the satellite syringe exchange in Golden Gate Park, San Francisco (Sears et al., 2001).

The very large effect size associated with direct use of the Sacramento satellite SEP in Study 1 may be attributed in part to its distinctive operational model. Unlike conventional SEPs, which serve their clients from storefront or other fixed locations, the Sacramento Area Needle Exchange (SANE) was a home-delivery satellite exchange. In 1999–2000, when data for the study were collected, two volunteer staff were exchanging 435,000 syringes annually with 400 secondary exchange providers, each of whom supplied syringes to an average of ten additional PWID (Anderson et al., 2003; James Britton, Sacramento Area Needle Exchange, personal communication). As noted, SANE encouraged clients to use a sterile syringe for every injection and provided as many syringes as clients required to meet that need, which may account for the large differences between Sacramento and San Jose in the median number of syringes obtained by both direct and indirect users at the two sites (an additional factor, as shown in Tables 1 and 2, is that Sacramento respondents generally reported much higher levels of injection frequency). Data from Sacramento showed that 91% of direct users in Study 1 obtained all of their syringes from the SEP, a strong indication that their needs for sterile syringes were being fully met and thereby may have greatly reduced the likelihood that they would share syringes. In contrast, Study 2 data indicate that only 48% of direct SEP users obtained syringes exclusively from the San Jose SEP, a conventional fixed-site syringe exchange in San Jose that required potential clients to travel to locations where it was available only during certain hours certain days of the week and where some may have been reluctant to go for fear of encountering law enforcement or because they did not want to identify themselves as PWID. Nevertheless, the 69% reduction in risk behavior associated with direct use of the San Jose exchange is larger than that

reported in the literature. As points of reference, studies of other SEPs in the San Francisco Bay Area (Bluthenthal et al., 1998; Watters et al., 1994) showed clients were 43%–46% (AOR=0.54–0.57) less likely than nonclients to report sharing of syringes. The syringe-sharing outcome variable in those studies, however, differed from the nine-item measure used to define high-risk injection in the present investigation.

Operational differences between the Sacramento and San Jose SEPs could also have been partly responsible for the differential effectiveness of indirect syringe at the two sites since indirect users of the home-delivery exchange in Sacramento may have had better access to sterile syringes via direct users at the site. However, estimates for the protective effect of indirect use at the two sites were not all that different (46% reduced risk in Study 1, 38% in Study 2) and Study 2 results were not statistically significant, which was probably due to the much smaller sample size and resulting loss of statistical power.

While the effects of indirect syringe exchange documented in this paper are smaller than those associated with direct use, indirect use remains theoretically important for several reasons. First, while it may have smaller benefits for individuals, it can greatly increase both the number of PWID served by an SEP and the volume of syringes exchanged. For this reason, its public health benefits could thus approach or even exceed those of direct SEP use, particularly if restrictive one-for-one exchange policies in place at many SEPs were relaxed to permit wider distribution. Second, indirect SEP use meets the needs of PWID who for a variety of reasons would otherwise be unable or unwilling to attend an SEP and thereby reduces their risk of transmitting HIV; indirect use of syringe exchange could also be particularly helpful in poorly resourced communities or where PWID are geographically dispersed and less likely to use syringe exchange directly. Third, while secondary use of syringe exchange may discourage its primary use, there is evidence that over time indirect users of SEPs may gravitate to direct use. For example, a three-city cohort study of PWID found that after one year almost 40% of indirect users transitioned to direct SEP use (Green et al., 2010).

Drawbacks to secondary syringe exchange include the fact that its recipients do not benefit from the ancillary services that face-to-face clients of SEPs enjoy such as referrals to drug abuse treatment, screening for infectious diseases, provision of bleach, condoms and other prevention supplies, and education concerning HIV, HCV, vein care and drug overdose prevention (Des Jarlais et al., 2009). However, with proper training secondary exchange providers could provide many of the same services and, as members of recipients' social networks, might be especially effective in disseminating prevention messages. Peer-based interventions, particularly those involving active drug users, have shown particular promise in reducing HIV risk behavior and HIV seroconversion (Broadhead et al., 1998; Latkin, 1998; Needle et al., 2005; Weibel et al., 1996). Such interventions can and have been modified to include secondary syringe exchange. For example, a prototype hybrid syringe exchange/peer intervention was implemented in Vancouver, British Columbia; the program was formed by a drug user-organized advocacy group that trained volunteers to distribute sterile injection equipment and provided harm reduction education to PWID frequenting public places heavily impacted by injection drug use (Hayashi et al., 2010). Other innovations to improve secondary exchange syringe would involve paying and

professionalizing publicly-funded “satellite” exchange providers to identify and provide sterile syringes to social networks of PWID. Such programs have been shown to be effective in Kazan in the Russian Federation and in the Sichuan and Guangxi provinces in China (Irwin et al., 2006; Liu et al., 2007).

A caveat, however, is that secondary providers may put themselves at greater risk by performing these services. A number of studies show that secondary providers more often report borrowing and lending used syringes than PWID who exchange only for themselves (Tyndall et al., 2002; Bryant & Hopwood, 2009; Murphy et al., 2004; Valente et al., 2001; Riehman et al., 2004) and they are also at greater risk for accidental needlestick (Lorvick, et al., 2006). Syringe exchanges could address these problems by educating providers about their HIV-related risk, offering them accidental needlestick prevention training and furnishing them with sharps containers to safely return used syringes to the syringe exchange.

In closing, this study has both strengths and limitations. Its strengths include the representative community samples of PWID that were recruited independently of the SEPs in Sacramento and San Jose and the very wide array of potential confounders that we were able to consider in evaluating direct and indirect SEP effects. In addition, the principal outcome measure employed in this investigation addressed possible misclassification of respondents’ risk status. Furthermore, underreporting of high-risk behavior was addressed in the data collection with “permission giving” instructions to encourage respondents to acknowledge high-risk behavior and in the analysis by adjustment for socially desirable response tendency.

Study limitations include Study 1’s cross-sectional observational design which does not permit causal inference of SEP effectiveness, although in Study 2, by employing respondents’ baseline risk behavior as a covariate, we adjusted for self-selective use of the exchange by low-risk PWID. An additional limitation discussed in footnote 2 on page 17 concerns the approximately 23 direct users of syringe exchange in Study 1 who may have been interviewed by syringe exchange personnel. While the “permission giving” instructions and adjustment for socially desirable response tendency mitigated this problem, the protective effect of direct SEP use for these respondents may nevertheless be somewhat overestimated. A further caution is that although the data reported here are currently the best that are available for comparing direct with indirect syringe exchange, changes in SEP best practice that may have occurred since they were collected might alter our conclusions. Finally, our results may not generalize to those that would be obtained with other SEP models. The SEP evaluated in Study 1 in particular was an unusual home-delivery form of syringe exchange that may have been especially effective in meeting clients’ needs for sterile syringes. As the literature comparing direct and indirect syringe exchange is still quite small, further studies are indicated, particularly those involving cohorts that are followed prospectively.

Glossary

HIV seroconversion

Point at which HIV antibodies first become detectable (e.g., in blood or saliva)

Syringe exchange program

a program that exchanges used syringes for sterile syringes

Secondary exchange

Exchange of used syringes for sterile syringes by one person for others, usually within one's personal social networks

Satellite exchange

Exchange of used syringes for sterile syringes by one person for others outside one's personal social networks

Direct syringe exchange users

Those who acquire sterile syringes directly from a syringe exchange

Indirect syringe exchange users

Those who acquire sterile syringes from others who exchange syringes for them

References

- Anderson R, Clancy L, Flynn N, Kral A, Bluthenthal R. Delivering syringe exchange services through “satellite exchangers”: the Sacramento Area Needle Exchange, U.S.A. *International Journal of Drug Policy*. 2003; 14:461–466.
- Aspinall EJ, Nambiar D, Goldberg DJ, Hickman M, Weir A, Van Velzen E, Palmateer N, Doyle JS, Hellard ME, Hutchinson SJ. Are needle and syringe programmes associated with a reduction in HIV transmission among people who inject drugs: a systematic review and meta-analysis. *International Journal of Epidemiology*. 2014; 43:235–248. [PubMed: 24374889]
- Bluthenthal RN, Kral AH, Erringer RA, Edlin BR. Use of an illegal syringe exchange and injection-related behaviors among street-recruited injection drug users in Oakland, California, 1992 to 1995. *Journal of Acquired Immune Deficiency Syndromes*. 1998; 18:505–511.
- Bluthenthal RN, Kral AH, Lorvick J, Watters JK. Impact of law enforcement on syringe exchange programs: a look at Oakland and San Francisco. *Medical Anthropology*. 1997; 18:61–83. [PubMed: 9458668]
- Broadhead RS, Heckathorn DD, Weakliem DL, et al. Harnessing peer networks as an instrument for HIV prevention: Results from a peer-driven intervention. *Public Health Reports*. 1998; 113(Suppl): 42–57. [PubMed: 9722809]
- Brothers S. Merchants, samaritans, and public health workers: Secondary syringe exchanger discursive practices. *International Journal of Drug Policy*. 2016; 37:1–8. [PubMed: 27449813]
- Bryant J, Hopwood M. Secondary exchange of sterile injecting equipment in a high distribution environment: a mixed method analysis in southeast Sydney, Australia. *International Journal of Drug Policy*. 2009:324–328. [PubMed: 18693107]
- Craine N, Hickman M, Parry JV, Smith J, McDonald T, Lyons M. Characteristics of injecting drug users accessing different types of needle and syringe programs or using secondary distribution. *Journal of Public Health*. 2010; 32:328–335. [PubMed: 20208066]
- De P, Cox J, Boivin JF, Platt RW, Jolly AM. Social network-related risk factors for bloodborne virus infections among injection drug users receiving syringes through secondary syringe exchange. *Journal of Urban Health*. 2008; 85:77–89. [PubMed: 18038211]
- Deckman MK. Peer helpers' struggles to care for “others” who inject drugs. *International Journal of Drug Policy*. 2015; 26:492–500. [PubMed: 25630481]
- Des Jarlais DC, McKnight C, Goldblatt C, Purchase D. Doing harm reduction better: syringe exchange in the United States. *Addiction*. 2009; 104:1441–1446. [PubMed: 19215605]

- Fisher DG, Wilson H, Bryant J. Harm reduction knowledge and information exchange among secondary distributors in Sydney, Australia. *Drugs: Education, Prevention and Policy*. 2013; 20:67–73.
- Gibson DR, Young M. Importance of appropriate outcome measures in HIV behavioral research. *Journal of Acquired Immune Deficiency Syndromes*. 1994a; 7:631–632.
- Gibson DR, Young M. Assessing the reliability and validity of behavior. *NIDA Research Monographs*. 1994b; 143:218–235.
- Gibson DR, Hudes ES, Donovan D. Estimating and correcting for response bias in self-reported risk behavior. *Journal of Sex Research*. 1999; 36:95–101.
- Gibson DR, Flynn NM, Perales D. Effectiveness of syringe exchange programs in reducing HIV risk behavior and HIV seroconversion among injecting drug users. *AIDS*. 2001; 15:1329–1341. [PubMed: 11504954]
- Gibson DR, Brand R, Anderson K, Kahn JG, Perales D, Guydish J. Two- to six-fold decreased odds of risk behavior associated with use of syringe exchange. *Journal of Acquired Immune Deficiency Syndromes*. 2002; 31:237–242. [PubMed: 12394803]
- Gibson DR, Zhang G, Cassady D, Pappas L, Mitchell J, Kegeles S. Effectiveness of HIV prevention social marketing with injecting drug users. *American Journal Public Health*. 2010; 100:1828–1830.
- Green TC, Bluthenthal RN, Singer M, Beletsky L, Grau LE, Marshall P, Heimer R. Prevalence and predictors of transitions to and away from syringe exchange use over time in 3 U.S. cities with various syringe dispensing policies. *Drug and Alcohol Dependence*. 2010; 111:74–81. [PubMed: 20537814]
- Hayashi K, Wood E, Wiebe L, Qi J, Kerr T. An external evaluation of a peer-run outreach-based syringe exchange in Vancouver, Canada. *International Journal of Drug Policy*. 2010; 21:418–421. [PubMed: 20359877]
- Huo D, Bailey SL, Hershow RC, Ouellet L. Drug use and HIV risk practices of secondary and primary needle exchange users. *AIDS Education and Prevention*. 2005; 17:170–184. [PubMed: 15899754]
- Irwin K, Karchevsky E, Heimer R, Badrieva L. Secondary syringe exchange as a model for HIV prevention programs in the Russian Federation. *Substance Use and Misuse*. 2006; 41:979–999. [PubMed: 16809182]
- Latkin C. Outreach in natural settings: the use of peer leaders for HIV prevention among drug users' networks. *Public Health Reports*. 1998; 113(Supp):151–159. [PubMed: 9722820]
- Lenton S, Bevan J, Lamond T. Threat or opportunity? Secondary exchange in a setting with widespread availability of needles. *Substance Use and Misuse*. 2006; 41:845–864. [PubMed: 16809175]
- Liu B, Sullivan G, Wu Z. An evaluation of needle exchange programmes in China. *AIDS*. 2007; 21(Supp 8):S123–S128. [PubMed: 18172380]
- Lorvick J, Bluthenthal RN, Scott A, Gilbert ML, Riehman KS, Anderson RL, Flynn NM, Kral AH. Secondary syringe exchange among users of 23 syringe exchange programs. *Substance Use and Misuse*. 2006; 41:865–882. [PubMed: 16809176]
- Marshall Z, Deckman MK, Minichello A, Alcock L, Harris GE. Peering into the literature: A systematic review of the roles of people who inject drugs in harm reduction initiatives. *Drug and Alcohol Dependence*. 2015; 151:1–14. [PubMed: 25891234]
- McLellan AT, Kushner H, Metzger D, Peters R, Smith I, Grissom G, Pettinati H, Angeriu M. The fifth edition of the Addiction Severity Index. *Journal of Substance Abuse Treatment*. 1992; 9:199–213. [PubMed: 1334156]
- Nasarruddin, AM., Saifi, RA., Othman, S., Kamarulzaman, A. Opening up the HIV epidemic: A review of HIV seropositive status disclosure among people who inject drugs. *AIDS Care*. 2016. <http://dx.doi.org/10.1080/09540121.2016.1220485>
- Murphy S, Kelley M, Lune H. The health benefits of secondary syringe exchange. *Journal of Drug Issues*. 2004; 34:245–268.
- Needle RH, Burrows D, Friedman SR, et al. Effectiveness of community-based outreach in preventing HIV/AIDS among injecting drug users. *International Journal of Drug Policy*. 2005; :16.doi: 10.1016/j.drugpo.2005.02.009.

- Newland J, Newman C, Treloar C. “We get by with a little help from our friends”: Small-scale informal and large-scale formal distribution networks of sterile injecting equipment in Australia. *International Journal of Drug Policy*. 2016; 34:65–71. [PubMed: 27449331]
- Palmateer N, Kimber J, Hickman M, Hutchinson S, Rhodes T, Goldberg D. Evidence for the effectiveness of sterile injecting equipment provision in preventing hepatitis C and human immunodeficiency virus transmission among injecting drug users: a review of reviews. *Addiction*. 2010; 105:844–859. [PubMed: 20219055]
- Riehman KS, Kral AH, Anderson R, Flynn N, Bluthenthal RN. Sexual relationships, secondary syringe exchange and gender differences in HIV risk among drug injectors. *Journal of Urban Health*. 2004; 81:249–259. [PubMed: 15136658]
- Sears C, Guydish J, Weltzien EK, Lum PJ. Investigation of a secondary syringe exchange program for homeless young adult injection drug users in San Francisco, California, U.S.A. *Journal of Acquired Immune Deficiency Syndromes*. 2001; 27:193–201. [PubMed: 11404542]
- Snead J, Downing M, Lorvick J, Garcia B, Thawley R, Kegeles S, Edlin BR. Secondary syringe exchange among injection drug users. *Journal of Urban Health*. 2003; 80:330–348. [PubMed: 12791808]
- Strahan R, Gerbasi KC. Short, homogeneous versions of the Marlowe-Crowne Social Desirability Scale. *Journal of Clinical Psychology*. 1972; 28:191–193.
- Tyndall MW, Bruneau J, Brogly S, Spittal P, O’Shaghnessy MV, Schecter MT. Satellite needle distribution among injection drug users: policy and practice in two Canadian cities. *Journal of Acquired Immune Deficiency Syndromes*. 2002; 31:98–105. [PubMed: 12352156]
- Valente TW, Foreman RK, Junge B, Vlahov D. Satellite exchange in the Baltimore Needle Exchange Program. *Public Health Reports*. 1998; 113(Suppl 1):90–96. [PubMed: 9722814]
- Valente TW, Foreman RK, Junge B, Vlahov D. Needle-exchange participation, effectiveness and policy: syringe relay, gender and the paradox of public health. *Journal of Urban Health*. 2001; 78:340–349. [PubMed: 11419584]
- Watters JK, Biernacki P. Targeted sampling: options for the study of hidden populations. *Social Problems*. 1989; 36:416–430.
- Watters JK, Estilo MJ, Clark GL, Lorvick J. Syringe and needle exchange as HIV prevention for injection drug users. *JAMA*. 1994; 271:115–120. [PubMed: 8264065]
- Weibel WW, Jimenez A, Johnson W, et al. Risk behavior and HIV seroincidence among out-of-treatment injection drug users: A four-year prospective study. *Journal of Acquired Immune Deficiency Syndromes*. 1996; 12:282–289.
- Wodak A, Cooney A. Do needle syringe programs reduce HIV infection among injecting drug users: a comprehensive review of the international evidence. *Substance Use and Misuse*. 2006; 41:777–813. [PubMed: 16809167]

Table 1

Sociodemographic characteristics and behavioral risk profile of direct and indirect users and nonusers of the syringe exchange program in Sacramento, California, 1999–2000

Variable	Direct Users, percent (n=46)	Indirect Users, percent (n=158)	Nonusers, percent (n=298)
Gender			
Male	71.7	64.6	57.1
Female	28.3	35.4	42.9
Race/ethnicity *			
African American	26.1	17.8	28.9
Hispanic	19.6	22.9	23.8
Non-Hispanic White	52.2	54.8	38.6
Other	2.2	4.5	8.7
Age **			
18–29	13.0	26.6	19.1
30–39	8.7	21.5	24.2
40–49	45.7	33.5	30.2
50+	32.6	18.4	26.5
Education			
<12 years	28.3	33.5	32.9
12 years	32.6	46.2	45.2
>12 years	39.1	20.3	22.2
Unemployed	67.4	65.8	70.0
Unstable housing/homeless **	13.0	41.1	52.5
Injection frequency (times/month) **			
30	4.4	5.1	13.8
31–60	17.4	11.4	11.1
61–90	23.9	17.7	23.8
>90	54.4	65.8	51.3
Borrowed unbleached syringe **	17.4	48.1	60.7
Shared filter/cooker/rinse water **	34.8	75.3	75.8
Backloaded syringe **	13.0	20.9	35.2
High behavioral risk **	4.4	41.1	51.3

Note. Chi-squared and Kruskal-Wallis tests were used, respectively, for categorical and ordered categorical variables.

*
p<.05,

**
p<.01

Table 2

Multivariable logistic regression analyses of the effectiveness of direct versus indirect syringe exchange in reducing high-risk injection behavior in Sacramento and San Jose, California

	Study 1 (Sacramento) AOR (95% CI)^{a,b}	Study 2 (San Jose) AOR (95% CI)
Direct exchange use, previous 30 days	0.05 (0.01–0.22)	0.31 (0.12–0.81)
Indirect exchange use, previous 30 days	0.54 (0.33–0.87)	0.62 (0.17–2.25)
Gender (female)	NS	0.37 (0.14–0.97)
Race/ethnicity (African American versus non-Hispanic white)	0.53 (0.30–0.93)	NS
Injection frequency, previous 30 days	1.00 (1.00–1.01)	NS
Injected “speedball, previous 30 days	2.02 (1.18–3.46)	NS
Injection location, other versus home	4.30 (2.20–8.39)	6.37 (2.05–19.81)
Unstable housing/homeless	1.81 (1.16–2.83)	NS
High behavioral risk (baseline)	--	3.51 (1.52–8.09)

Note. AOR = adjusted odds ratio. CI = confidence interval. “Speedball” = combination heroin and cocaine. Observation period was 1999–2000 for Sacramento, 1996–1997 for San Jose.

^a Adjusted for exposure to components of community intervention implemented in 1998–1999; for details see Gibson et al., 2010.

^b No values are shown for baseline behavioral risk since it is applicable only for study 2.

Table 3

Sociodemographic characteristics and behavioral risk profile of direct and indirect users and nonusers of the syringe exchange program at follow-up in San Jose, California, 1996–1997

Variable	Direct Users, percent (n=75)	Indirect Users, percent (n=29)	Nonusers, percent (n=103)
Gender			
Male	65.3	62.1	62.1
Female	34.7	37.9	37.9
Race/ethnicity **			
African American	1.3	3.5	6.8
Hispanic	58.7	31.0	68.9
Non-Hispanic White	36.0	55.2	21.4
Other	4.0	10.3	2.9
Age			
17–29	6.7	3.5	10.7
30–39	28.0	27.6	32.0
40–49	49.3	51.7	46.6
50+	16.0	17.2	10.7
Education			
<12 years	40.0	35.7	43.1
12 years	25.3	35.7	38.2
>12 years	34.7	28.6	18.6
Unemployed	76.0	82.8	84.5
Unstable housing/homeless *	12.0	34.5	23.3
Injection frequency (times/month)			
30	40.0	55.2	52.4
31–60	25.3	17.2	15.5
61–90	20.0	24.1	14.6
>90	14.7	3.5	17.5
Borrowed unbleached syringe **	14.7	20.7	36.0
Shared filter/cooker/rinse water *	56.0	62.1	67.0
Backloaded syringe	18.7	13.8	23.3
High behavioral risk	12.0	13.8	25.2

Note. Chi-squared and Kruskal-Wallis tests were used, respectively, for categorical and ordered categorical variables.

* p<.05,

** p<.01