doi:10.1111/j.1360-0443.2006.01741.x

Examination of the association between syringe exchange program (SEP) dispensation policy and SEP client-level syringe coverage among injection drug users

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ABSTRACT

Aim To determine whether syringe exchange programs' (SEPs) dispensation policy is associated with syringe coverage among SEP clients. **Design** Cross-sectional samples of SEPs and their clients. **Setting** SEPs in California, USA. **Participants** Twenty-four SEPs and their injection drug using (IDU) clients ($n = 1576$). **Measurements** Clients were classified as having adequate syringe coverage if they received at least as many syringes from the SEP as their self-reported injections in the last 30 days. SEPs were classified based on their syringe dispensation policy. Dispensation schemes ranging from least restrictive to most are: unlimited needs-based distribution; unlimited one-for-one exchange plus a few additional syringes; per visit limited one-for-one plus a few additional syringes; unlimited one-for-one exchange; and per visit limited one-for-one exchange. **Findings** Adequate syringe coverage among SEP clients by dispensation policy is as follows: unlimited needs-based distribution = 61%; unlimited one-for-one plus = 50%; limited one-for-one plus = 41%; unlimited one-for-one = 42%; and limited one-for-one = 26%. In multivariate analysis, adequate syringe coverage was significantly higher for all dispensation policies compared to per visit limited one-for-one exchange. Using propensity scoring methods, we compared syringe coverage by dispensation policies while controlling for client-level differences. Providing additional syringes above one-for-one exchange (50% versus 38%, $P = 0.009$) and unlimited exchange (42% versus 27%, $P = 0.05$) generally resulted in more clients having adequate syringe coverage compared to one-for-one exchange and per visit limits. **Conclusion** Providing less restrictive syringe dispensation is associated with increased prevalence of adequate syringe coverage among clients. SEPs should adopt syringe dispensation policies that provide IDUs sufficient syringes to attain adequate syringe coverage.

Keywords HIV prevention, injection drug use, needle exchange programs, program effectiveness, sterile syringe access.

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Submitted 3 March 2006; initial review completed 13 June 2006; final version accepted 3 November 2006

INTRODUCTION

Syringe exchange programs (SEPs) are regarded by public health officials and scientists as an effective strategy for preventing HIV infection among injection drug users (IDUs), yet little is known about what models of SEPs are most effective [1,2]. Surveys of SEP operators in the United States have found differences in operational characteristics among SEPs such as syringe dispensation policies, distributed HIV prevention materials (i.e. bleach, condoms), distributed other injection materials (i.e. cookers, cotton, ties), availability of other social and medical services and numbers of syringes exchanged [3,4]. Differences in SEP operational characteristics have also been noted in other countries [5,6].

Several studies have found differences that in SEP operational characteristics are associated with health outcomes and risk behavior patterns among IDUs. Specifically, client-level outcomes have been associated with dispensation policies [7–9], locations and hours of operation [10,11], types of venues [12,13], availability of safer injection supplies [14], availability of medical and social services [15] and attitudes and beliefs of SEP staff [16]. More systematic consideration of whether and how differences in SEP operational characteristics are related to client-level outcomes is needed.

SEP operational characteristics have been codified in laws and regulations, making changes to them difficult. In the United States, statutory and regulatory requirements for strict one-for-one exchange have been enacted in five states and limits on the number of syringes exchanged have been noted in two states [17]. Elsewhere, strict one-for-one exchange is mandated legally in New Zealand and Belgium [18,19]. In Canada, some SEPs have limits on syringes exchanged per visit [16,20,21]. As drug injection-related HIV transmission continues to spread to new countries [22], it is vital that policy makers and SEP operators make decisions on program characteristics that optimize HIV prevention benefits.

In this paper, we describe variability in syringe dispensation policies among 24 SEPs in California and compare individual-level variables among clients who attend SEPs with different dispensation policies. In another manuscript that is currently under review, we show that syringe coverage percentage is a significant independent predictor of key injection-related HIV risk behaviors. Here, we examined whether syringe dispensation policy is an independent predictor of client syringe coverage. In addition, using propensity score weighting, we compared several key dispensation policies to determine specific elements of syringe dispensation that might improve syringe coverage among SEP clients.

METHODS

Study background, data sources and data collection procedures

To examine the impact of syringe dispensation policy on client syringe coverage, we used data from 24 California SEPs and their clients. Data were collected originally to examine the impact of a new law in California permitting local approval of SEPs. For this study, we recruited successfully 24 of the 25 SEPs operating in California from January 2001. Only one smaller SEP declined to participate. From SEP directors, we collected data on operational characteristics of SEPs in annual 2-hour interviews in 2001, 2002 and 2003. The director survey is comprised of items drawn from the Beth Israel/North American Syringe Exchange Network annual survey of US SEPs, the California Syringe Exchange Network (CaSEN) survey and a few additional items [3,4,23]. Areas covered in this survey include legal history, staffing, syringe exchange in each year of operation, annual client contacts, syringe dispensation policies, age minimum, syringe disposal arrangements, site location, times of operation (day of week, time of day), program services offered and referred, program obstacles, allies, and strategies for dealing with law enforcement and detailed budget information, among others.

Client-level data are based on annual convenience samples of up to 25 clients from each program between 2001 and 2003. Over the 3 years, the median number of clients interviewed per program was 70 and ranged from 43 to 79 clients. SEP clients were recruited at sites as they exited the programs. If they agreed to participate, clients underwent informed consent procedures, 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 semiprivate (e.g. interviewer's car or nearby location within sight of the SEP) face-to-face session with a trained research interviewer from RAND, University of California, Davis or University of California, San Francisco. The survey included items on HIV risk behaviors, HIV/AIDS knowledge, medical history, incarceration history and use of the SEP and other social and medical services. Respondents received $10 for participating in the study. We interviewed 1577 SEP clients between May 2001 and August 2003. Inclusion criteria for the study were SEP use and self-report drug injection in the last 30 days. All study procedures were reviewed and approved by the human subjects protection committees at the RAND Corporation, University of California Davis and University of California San Francisco.

Key study measures

Syringe coverage percentage

We calculated syringe coverage percentage for each IDU in the following way. Study participants were asked to report the number of syringes retained (syringes they did not intend to give, sell or trade with someone else) from their last SEP visit and their number of SEP visits in the last 30 days. These responses were multiplied and the result was divided by the total number of self-reported injections in the last 30 days (including skin pop/muscling injection). This result was then multiplied by 100 to generate a percentage of syringe coverage. IDUs

with a syringe coverage percentage of 100% or greater were considered to have adequate syringe coverage because they had received sufficient syringes to use a new syringe for each injection.

SEP dispensation policy categories

Each SEP was assessed annually on two dispensation policy domains—the relationship between syringes exchanged and new syringes received, and limits on syringes exchanged per visit. Three exchange types were observed: (1) needs-based distribution (IDUs receive as many syringes as they ask for without regard to the number returned for disposal), (2) one-for-one exchange plus some additional syringes (usually five to 10) and (3) strict one-for-one exchange. In terms of limits on syringes exchanged per visit we observed one program that had limits of 10 syringes per visit and another that had a limit of 50 syringes per visit. All others allowed unlimited exchange. Combining these two domains, we observed five program types: (1) unlimited needs-based distribution, (2) unlimited one-for-one plus, (3) per visit limited one-for-one plus, (4) unlimited one-for-one and (5) per visit limited one-for-one.

Potential confounding variables

In assessing whether syringe dispensation policy is associated with syringe coverage, we considered confounding variables selected from four domains—socio-demographic and socio-economic factors, drug use characteristics, health status and concern and contact with law enforcement. Socio-demographic and socio-economic factors included sex (male or female), race (white, African American, Hispanic, Native American, other), age (< 30 years, 30–39, 40–49 and 50 or older), education (< high school versus high school or more), monthly income (< $600 versus $600 +) and current homelessness (yes or no). Measures of drug use and HIV risk behaviors included injection years (< 10 years, 10–19 years, 20 or more years), intravenous and intramuscular injections in the last 30 days (< 60 times, 60–90, > 90), drugs injected in the last 30 days [any heroin, speedball (cocaine and heroin), cocaine, methamphetamine and crack cocaine], smoked crack cocaine in the last 30 days (yes or no), injected other IDU (yes or no) or were injected by another IDU (yes or no) in the last 30 days, currently in drug treatment (yes or no) and engaged in secondary syringe exchange in last 30 days (yes or no). Sex workers were participants that reported exchanging sex for drugs or money (sex work) in the last 6 months (yes or no). We also assessed whether participants currently had a steady sex partner (yes or no). Health status measures included HIV test results (positive or negative) based on study testing, and overdose (yes or no) and abscess (yes or no) in the last year based on self-report. Law enforcement involvement measures included currently on parole (yes or no), had been arrested for drug paraphernalia possession (syringes, etc.) in the last 6 months (yes or no), concern with arrest for drug paraphernalia possession (yes or no) and whether the participant had a medical prescription of syringes (yes or no).

Statistical analysis

Descriptive statistical information is provided on client-level characteristics by syringe dispensation policy. Two methods of analysis were used to examine predictors of syringe coverage. We used multivariate logistic regression to predict adequate syringe coverage (100% or more) from syringe dispensation policies while also adjusting for all potential confounders (listed in Table 1). Missingness was considered a valid level for these categorical variables. In addition, we included a site random effect to adjust for potential clustering within site.

We also used propensity score weighting [24–26]. In these analyses, we compare client outcomes by syringe dispensation policy by controlling for important client-level differences. This approach allows us to estimate what would have happened to the clients of programs with, for example, needs-based distribution—the 'treatment' group—if they had gone instead to a program with a different policy, the 'comparison'. The propensity score is the probability that a client with features $\mathbf{x}$ is in the treatment group, $p_i = P(t = 1 \mid \mathbf{x})$. Our propensity score method reweights clients in comparison programs so that they have the same distribution of features as the clients utilizing the treatment programs. The weighting creates observation weights that 'upweight' comparison clients that are similar to treatment clients. At the same time it 'downweights' comparison clients with features that are dissimilar to those clients of treatment programs. The size of the observation weights depends on the comparison user's similarity to the users of the treatment programs. Assigning comparison group users weights $w_i = p_i/(1\text{-}p_i)$ results in any weighted statistic of observed $\mathbf{x}$ (e.g. weighted means, quantiles, correlations) being the same as the unweighted statistic computed for the target group [26]. That is, the percentage of users in the treatment group using heroin will match the weighted percentage of heroin users in the comparison group. The two groups will even match on multiple factors simultaneously, such as the percentage of heroin users over age 40 years.

In randomized studies $P(t = 1 \mid \mathbf{x})$ is known and fixed in the study design. In observational studies it needs to be estimated but poor estimation of the propensity scores can also cause problems. Logistic regression is the common method for estimating propensity scores. In an attempt to remove as much selection bias as possible, this

Table 1 Syringe dispensation policy by selected client characteristics ($n = 1576$).

	Unlimited needs-based distribution (n = 278)	*Unlimited one-for-one plus (n = 487)*	*Limited one-for-one plus (n = 96)*	*Unlimited one-for-one (n = 624)*	*Limited one-for-one (n = 91)*
Gender*					
Female	38%	35%	23%	27%	33%
Age*					
< 30 years old	9%	25%	19%	11%	7%
30–39	22%	19%	18%	23%	8%
40–49	44%	36%	43%	36%	30%
50 or more	25%	20%	21%	30%	55%
Race*					
White	60%	58%	50%	50%	28%
African American	26%	15%	12%	17%	59%
Hispanic	8%	20%	30%	25%	10%
Native American	2%	3%	3%	6%	2%
Other	4%	4%	5%	2%	1%
Education*					
High school or more	75%	61%	63%	66%	63%
Homeless*					
Yes	32%	54%	57%	47%	41%
Income*†					
$600 +	72%	63%	53%	62%	62%
Injection years*					
< 10 years	20%	34%	28%	22%	18%
10–19 years	21%	18%	22%	22%	17%
20 + years	59%	48%	50%	56%	65%
Times injected *†					
< 60	42%	34%	27%	38%	46%
60–90	27%	28%	26%	24%	29%
> 90	31%	38%	47%	38%	25%
Inject heroin*†					
Yes	74%	82%	84%	77%	84%
Inject speedball*†					
Yes	35%	41%	53%	27%	12%
Inject powder cocaine*†					
Yes	16%	25%	38%	20%	7%
Inject crack cocaine*†					
Yes	5%	7%	12%	8%	3%
Inject methamphetamine*†					
Yes	35%	35%	26%	39%	24%
Smoked crack cocaine†					
Yes	30%	27%	41%	25%	47%
HIV*					
Positive	7%	4%	0%	5%	1%
Overdose, last year*					
Yes	12%	16%	21%	11%	4%
Abscess, last year					
Yes	41%	46%	46%	39%	41%
Concerned about arrest for drug paraphernalia†					
Yes	53%	57%	66%	57%	42%
Stopped for carrying drug paraphernalia*‡					
Yes	6%	16%	8%	10%	2%

Table 1 *Cont.*

	Unlimited needs-based distribution (n = 278)	*Unlimited one-for-one plus (n = 487)*	*Limited one-for-one plus (n = 96)*	*Unlimited one-for-one (n = 624)*	*Limited one-for-one (n = 91)*
Drug paraphernalia possession arrest*‡					
Yes	10%	18%	17%	13%	3%
Prescription for syringes*					
Yes	1%	6%	2%	4%	5%
Currently on parole*					
Yes	33%	39%	34%	26%	25%
Currently in treatment*					
Yes	21%	16%	10%	12%	29%
Steady sex partner†					
Yes	57%	53%	50%	51%	56%
Sex work‡					
Yes	4%	5%	4%	3%	3%
Injected other IDU*†					
Yes	42%	50%	48%	43%	34%
Injected by other IDU†					
Yes	28%	31%	31%	27%	29%
Secondary exchanger*					
Yes	72%	56%	51%	49%	35%
Syringe coverage*†					
< 50%	19%	34%	39%	38%	52%
50–99%	20%	16%	20%	20%	22%
100% or more	61%	50%	41%	42%	26%

*$P < 0.05$. †In last 30 days. ‡In the last 6 months.

study recorded data on a large number of potential confounders (see Table 1), many of which are correlated with one another. We estimated the propensity score using boosted logistic regression [27] as implemented in the generalized boosted modeling (gbm) package in R [28]. This method allows for the inclusion of many correlated covariates as well as their interactions by shrinking the coefficients. The degree of coefficient shrinkage was selected to minimize the difference between the distribution of client features between the treatment and comparison groups as described elsewhere [26]. More detailed analysis of propensity score weighting is provided elsewhere [24,26,29].

After constructing the weights, the only observed attribute on which the treatment and comparison users differ is the SEP dispensation policy. The difference between the average outcome of treatment users and the weighted average outcome of comparison users measures the treatment effect as shown in eqn 1, where t_i is a 0/1 indicator for membership in the target group, y_i is the outcome and $w(\mathbf{x}_i)$ is the propensity score weight for a subject with features $\mathbf{x}_i$.

$$\frac{\sum_{i=1}^{N} t_i y_i}{\sum_{i=1}^{N} t_i} - \frac{\sum_{i=1}^{N} (1-t_i) w(\mathbf{x}_i) y_i}{\sum_{i=1}^{N} (1-t_i) w(\mathbf{x}_i)} \qquad \text{eqn 1}$$

The first term in eqn 1 is the average outcome of the target group. Because t_i takes values 0 or 1, the t_is in this first term simply select out those in the treatment group. The second term is the weighted average of the comparison group. The $(1 - t_i)$ term selects out those users in the comparison group. Users that have weights near 0 (i.e. comparison users that appear nothing like the treatment group users) will simply not contribute a great deal of their y_i to the weighted average. Equation 1 estimates what is known as the treatment effect on the treated (see Imbens [30], which refers to eqn 1 as the sample average treatment effect on the treated, SATT).

We used this technique to compare various types of SEP dispensation policies with adequate syringe coverage as the outcome. We conducted several types of comparison, including incremental changes in syringe dispensation, along a continuum of restrictiveness. We also

compared SEPs with and without limits on per visit exchanges, and SEPs that offered one-for-one plus exchange with those that offered strict one-for-one exchange.

RESULTS

Overall sample characteristics were as follows. Roughly half the participants were racial and ethnic minority members and 32% were female. Over 75% had injected heroin, over 33% injected methamphetamine and 25% injected cocaine in the last 30 days. Mean injection frequency for the sample was 88.2 [standard deviation (SD) = 94.7]. Mean receptive syringe sharing was 7.00 (SD = 37.8), mean distributive syringe sharing was 6.18 (SD = 25.9) and syringe re-use was 4.03 (SD = 16.7).

Among SEP types, five SEPs provided needs-based distribution to 278 clients, nine SEPs provided unlimited one-for-one plus exchange to 487 clients, four SEPs provided one-for-one plus with limit to 96 clients, 12 SEPs provided one-for-one exchange without limit to 624 clients and two SEPs provided one-for-one exchange with limits to 91 clients. Table 1 reports client-level variables by syringe dispensation policy.

In multivariate regression analysis, we found that adequate syringe coverage increased as restrictions on dispensation policies decreased (Table 2), while controlling for all of the variables listed in Table 1.

To control more effectively for client-level differences that are associated with different SEPs, we replicated the above analysis using a propensity score weighting methodology and a three-level outcome (syringe coverage < 50%, between 50% and 99% and 100% or more). Table 3 reports those comparisons that were significantly different using this method. These findings confirmed the multivariate model. Clients of unlimited needs-based distribution and unlimited one-for-one plus exchange had a higher prevalence of adequate syringe coverage compared to clients of more restrictive syringe dispensation models. We also found that unlimited one-for-one plus exchange clients had a higher prevalence of adequate syringe coverage compared to unlimited one-for-one exchange, and that unlimited one-for-one exchange clients had a higher prevalence of adequate syringe coverage compared to per visit limited one-for-one exchange. Not all pairwise comparisons were significant, however. No significant syringe coverage differences were observed comparing unlimited needs-based distribution programs to unlimited one-for-one

Table 2 Multivariate logistic regression analysis predicting adequate syringe coverage (100% or more).

	Coverage 100% or more Adjusted OR (95% CI)
Per visit limited one-for-one	Referent
Unlimited one-for-one	3.52 (1.60, 7.72)
Per visit limited one-for-one plus	4.44 (1.71, 11.56)
Unlimited one-for-one plus	5.11 (2.25, 11.62)
Unlimited need-based distribution	5.34 (2.24, 12,72)
Concerned about paraphernalia arrest	0.77 (0.60, 0.99)
Homeless	0.78 (0.60, 1.00)
Secondary exchanger	1.45 (1.13, 1.87)
Smoked crack cocaine, last 30 days	0.71 (0.54, 0.95)
Injection frequency, last 30 days	
< 60	Referent
60–90	0.29 (0.22, 0.40)
> 90	0.19 (0.14, 0.26)

Table 3 Propensity score results comparing syringe dispensation policy to client-level syringe coverage.

	Syringe coverage < 50%	*Syringe coverage 50–99%*	*Syringe coverage 100% +*	*P*
Unlimited need-based distribution* versus	19%	20%	61%	0.003
All other	29%	19%	52%	
Unlimited one-for-one plus* versus	34%	16%	50%	0.01
All other except need-based distribution	40%	19%	40%	
Unlimited one-for-one plus* versus	34%	16%	50%	0.02
Unlimited one-for-one	41%	18%	40%	
Unlimited one-for-one* versus	32%	19%	49%	0.001
Limited one-for-one	52%	22%	26%	

*Indicates the least restrictive of the comparison.

plus and unlimited one-for-one plus to per visit limited one-for-one plus. Due to an insufficient number of similar subjects, we were unable to compare unlimited one-for-one exchange with limited one-for-one exchange and limited one-for-one plus exchange with limited one-for-one exchange.

DISCUSSION

Using two different analytical techniques, we found that SEPs that provide less restrictive dispensation policies have more clients with adequate syringe coverage. These findings are in line with other studies that have documented that syringe re-use is lower when SEPs have less restrictive dispensation policies [7,9] and that IDUs who receive more syringes are less likely to share syringes [31].

Operational protocols and policies for SEPs have been developed without the benefit of empirical data or even a strong theoretical perspective to guide policy and protocol choices. As SEPs have gained greater political acceptance in the United States government entities, such as health and police departments, have begun imposing regulations on program operations, including locations and exchange policies [10,11,32]. Similarly, in New Zealand and Belgium more restrictive dispensation policies have been made laws. These regulations may reduce the effectiveness of SEPs.

From a quality improvement perspective, this study suggests that SEPs should consider providing syringes in the least restrictive manner possible [7,9,33]. Therefore, if an SEP limits the number of syringes exchanged per visit they should remove these limits, and if they provide one-for-one exchange they should provide additional syringes with each exchange to increase the odds that clients will be able to adhere to the 'one shot for one syringe' public health recommendation.

These data also have implications for other means of providing sterile syringe access to IDUs. For instance, many over-the-counter pharmacy sale options, such as the 2005 California pharmacy law (Senate Bill 1159), limit the number of syringes that can be sold or purchased [8,34,35]. Similarly, pharmacy-related restrictions could exist in other countries as law or professional practice [36]. These limits may inhibit the public health benefits of the policy change that has permitted pharmacy sales. Finally, legalizing over-the-counter syringe sales and even SEPs without legalizing possession of syringes for IDUs is likely to impede the public health benefits of such policy changes [37,38]. It is worth noting that in this study we found that IDUs who were concerned with possible arrest for possessing drug paraphernalia were less likely to have syringe coverage of 100% or more. This finding confirms other research that has noted increased injection-related HIV risk among IDUs due to concern with arrest for possessing drug paraphernalia [39,40].

Study results should be considered in light of the several limitations. The study was cross-sectional, and thus cannot establish the causal direction between dispensation policies and syringe coverage. Further, with the exception of HIV test results, all data are based on participant self-reports that are subject to social desirability and recall bias. However, studies on reliability and validity of injection-related HIV risk assessment measures used in this study have been reported as acceptable [41,42]. In addition, we used convenience sampling techniques and have small sample sizes from many of the SEPs in this study. This sample cannot be considered to be representative of SEPs clients. Further, our models of syringe coverage did not consider comprehensively other sources of sterile syringes. However, only 4% (62/1577) of participants reported pharmacy purchase of syringes (non-prescription pharmacy purchase of syringes was illegal during the study period). Re-running the analyses without these subjects did not change the observed associations.

In 2000, 29% of SEPs in the United States provided one-for-one exchange and 29% limited the number of syringes that could be exchanged per visit. Some of these policies are due to state law [8], others may be due to local laws and regulations. Whatever the source of these more restrictive policies, the data in this study strongly suggest that such policies should be reconsidered for purposes of HIV prevention.

Acknowledgements

We would like to acknowledge syringe exchange programs in California for their collaboration with this research project and all the research participants. This study was funded by the Centers for Disease Control and Prevention (grant no. R06/CCR918667), National Institutes on Drug Abuse (grant no. R01 DA14210) and the University-wide AIDS Research Program (IS02-DREW-705).

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