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Needle Exchange and Sexual Risk Behaviors among a Cohort of Injection Drug Users in Chicago, Illinois

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Abstract

Objective—To examine the impact of a needle exchange program (NEP) on sexual risk behaviors of injecting drug users (IDUs).

Methods—Between 1997 and 2000, 889 IDUs in Chicago were recruited from NEPs and an area with no NEP into a cohort study. They were interviewed and tested for HIV at baseline and three annual follow-up visits. Random-effect logistic models were used to compare NEP users and non-users regarding the number of sex partners, number of unprotected sex acts, and frequency of condom use.

Results—Compared to NEP non-users, NEP users had a similar number of sex partners over time, but had 49% higher odds of using condoms with their main partners ($p=0.047$). At baseline, there was no difference between NEP users and non-users in episodes of vaginal intercourse, but over time the odds of having a higher number of unprotected instances of vaginal intercourse were reduced by 26% per year for NEP users but only 10% per year for non-users ($p=0.02$).

Conclusion—This study suggests that NEP participation may help reduce the absolute risk of HIV sexual transmission.

Keywords

Needle exchange programs; sexual behavior; intravenous substance abuse; longitudinal study

INTRODUCTION

Sharing syringes and other injection equipment has been the major route of HIV transmission among injection drug users (IDUs),^{1–3} but sexual transmission increasingly accounts for new HIV infections in this population.^{4–6} In contrast to the rapid and marked declines in injection risk practices observed over the past two decades in the United States, Western Europe, and Australia, the sexual risk practices of IDUs change slowly if at all.^{7–13} Among heterosexual adults who do not inject drugs in the United States, an estimated 80% of HIV infections were contracted through heterosexual contact with HIV-infected injection drug users based on studies conducted in early 1990s.¹⁴ The relative increase of AIDS cases among African Americans in recent years have been attributed to a higher level of concurrent sexual partnerships in African Americans.^{15, 16} In 2005, heterosexual contact accounted for 79% of newly diagnosed HIV and AIDS cases in females and 15% in males in the United States.¹⁵

One of the major interventions associated with declines in injection risk practices is needle exchange.^{17–21} Surveys indicate that condoms are provided in most needle exchange programs (NEPs) in North America,^{22, 23} but few studies have examined the effects of NEP use on sexual risk behaviors and the findings are not consistent. Early studies found NEP had no or little effect on sexual risk behaviors.^{17, 18} A more recent longitudinal study in Dublin also found no significant change in condom use among NEP attendees.²⁴ However, a recent cross-sectional study conducted among young injection drug users in Chicago found frequent NEP users were almost three-fold more likely than NEP nonusers to use condoms with regular sex partners.²⁵

In this paper, we examined the impacts of needle exchange use on three aspects of sexual risk behaviors (number of sex partners, frequency of condom use, and number of episode of unprotected vaginal intercourse) using data from a longitudinal study designed to evaluate the effectiveness of a needle exchange program in Chicago, Illinois. Although NEP non-users in this study were provided with street outreach, HIV education, risk reduction counseling, and condoms, we hypothesized that NEP users would have a lower level of sexual risk behaviors than non-users because 1) access to HIV prevention services and condoms was easier and more reliable at the NEP compared to street outreach and 2) the NEP constituted a more holistic HIV prevention setting than street outreach.

MATERIALS AND METHODS

Study Setting

The study setting and design have been described in detail elsewhere.²⁶ The NEP evaluated in this study was founded in 1996 through a collaboration between a community-based group, Chicago Health Outreach, and the University of Illinois at Chicago. The NEP was a legal entity funded by the Chicago Department of Public Health and the AIDS Foundation of Chicago. The NEP operated at three storefront offices (South Side, Northwest Side, and North Side) and a motorhome (West Side) that together served a racially and ethnically diverse population. All NEP sites conducted individual risk assessments and provided other risk reduction materials including condoms. A mostly indigenous staff at the storefront offices also offered other services, including street outreach, HIV counseling and testing, case management and referrals to offsite services such as drug treatment programs, and medical care for persons living with HIV.

The Southeast Side of Chicago had no NEP during the study period. Neighborhoods vary across the Southeast Side, as they do at the NEP sites, but for any particular community demographic characteristic, the Southeast Side resides within the range found at the NEP sites.

Study Design

Between 1997 and 2000, adult IDUs were enrolled at the aforementioned NEP sites into a prospective cohort study. Participants recruited as NEP users were required to have used the NEP at least twice ever and to have enrolled in the NEP at least 30 days before enrolling into the study. These criteria discouraged enrollment in the NEP only to qualify for the study and its compensation payment, and helped avoid recruiting the sizeable minority of one-time NEP users. Participation in the NEP was verified by checking its records. Less than 10% declined enrollment, most of whom said they did not have enough time to do the interview.

A comparison group of IDUs without local access to NEP were recruited in Southeast Side street settings and through chain referral sampling.^{27–29} Outreach workers, indigenous former IDUs, initiated recruiting by contacting IDUs in a variety of Southeast Side congregation areas. To reduce sampling bias from outreach workers recruiting only IDUs

they knew and liked, we encouraged persons contacted on the street and all control group participants to refer eligible persons to the study. Our staff provided all comparison group members with HIV education, client-centered risk reduction counseling, prevention materials including condoms, and referral to offsite services. Consistent with the study's longitudinal design, outreach staff spent much of their time in Southeast Side neighborhoods maintaining contact with study participants and, while doing so, promoting HIV risk reduction.

Eligible participants had to have injected drugs in the 6 months preceding the baseline interview, speak English or Spanish, and be at least 18 years old. Participants in our earlier National AIDS Demonstration Project (NADR) study were excluded because of the low levels of HIV risk practices they exhibited subsequent to that intervention.³ NEP users recruited at office-based NEPs were screened and interviewed at those sites. NEP users at the motorhome and IDUs recruited in the area with no NEP were screened and interviewed by study staff in offices rented from nearby community-based organizations and occasionally in cars.

After obtaining informed, signed consent, trained interviewers administered a standardized face-to-face interview in a private area, followed by pre-test counseling and a blood draw for HIV testing. Specimens repeatedly reactive in whole-virus lysate enzyme-linked immunosorbent assays were confirmed by Western blot. Participants were compensated \$25 for their time and effort in answering the survey and given appointments to return to receive their HIV test results and post-test counseling.

All participants, except those from the South Side NEP, were monitored at enrollment and three follow-up visits, separated by 12 months. South Side participants were only administered one follow-up visit because this site was later in the study. Data collection procedures at follow-up visits were the same as those at the baseline. The study was approved by the Institutional Review Board at the University of Illinois at Chicago.

Measures

To evaluate effectiveness of NEP on sexual risk behaviors, we compared IDUs who used a needle exchange program with those who did not use NEP in the 6 months prior to the baseline interview.

We examined three aspects of sexual risk behaviors: number of sex partners, number of unprotected sex acts, and frequency of condom use. A simulation study showed that changes in the number of sex partners is the preferred marker for estimating changes in the risk of contracting highly infectious sexually transmitted diseases (STDs) such as gonorrhea, whereas the number of unprotected acts of sexual intercourse is the better marker for less infectious diseases such as HIV.³⁰ Although studies indicate that the relative frequency of condom use is not a strong marker for STD incidence regardless of prevalence and infectivity, we examined this outcome because behavioral interventions that promote sexual risk reduction typically aim to increase condom use.

In this paper, "number of sex partners" was defined at baseline as the total number of sex partners in the last six months and – at follow-up – as the total number of sex partners since the last interview (12 months on average), regardless of partner type. Because of its skewed distribution, we recoded the number of sex partners as an ordinal variable: 0, 1, 2–4, 5 or more. "Multiple sex partners" was defined as having two or more sex partners. Frequency of condom use was assessed separately for vaginal intercourse with three types of partners (main, casual, and commercial) using a seven-category question: always, almost always, more than half the time, half the time, less than half the time, almost never, or never.

Frequency of condom use referred to “the last 6 months” at the baseline interview and “since the last interview” at follow-up visits. Because of bimodal distributions, these measures were recoded as three categories: always, sometime, or no condom use. “Commercial sex partners” were defined as sex partners who gave money/drugs for sex or received money/drugs for sex. We defined the number of unprotected sex acts as the total instances of vaginal intercourse without using a condom with one’s main sex partner in last 30 days and then recoded this as an ordinal variable (0, 1–4, 5–9, 10–19, 20 or more). Number of unprotected vaginal sex acts with casual partners and condom use in anal sex were not presented because these sexual behaviors were infrequent in this population.

Baseline measures examined as potential confounders and predictors included age, gender, race/ethnicity, education, married/common law relationship, self-reported homelessness in the past 6 months, main source of income in the past 6 months, monthly income, HIV status, sexually transmitted diseases (ever having gonorrhea, syphilis, chlamydia, herpes, pelvic infection, and other sexually transmitted diseases), age at first intercourse, sexual orientation, and drug treatment in the past 6 months. We also examined cocaine injecting and smoking in the past 6 months, because these practices have been found to predict greater sex risk.^{31–37} Most measures were recoded based on conceptual and distributional considerations.

Statistical Analysis

Continuous variables at enrollment were compared between NEP users and non-users using t tests or Wilcoxon rank-sum tests, and categorical variables were compared using Chi-square tests or Fisher’s exact tests. The frequency of condom use in vaginal sex act and the number of unprotected sex episodes were analyzed using random-effects ordinal logistic regression models (proportional odds models) to account for correlation among repeated measurements within subjects and the order of outcome categories.³⁸ The proportional odds assumption was tested and, if it did not hold, a partial proportional odds model was fitted. The proportion of multiple sex partners was analyzed using random-effects logistic regression models.³⁹ Specifically, intercept was allowed to vary across subjects in the models. We first examined whether there was an interaction between the study group (NEP non-users, NEP users) and visit time, after controlling for baseline demographics, sexual and drug use histories, and HIV status. If the group by time interaction term was not significant, we dropped this term and the reduced model essentially examined the averaged difference between NEP users and non-users. Other covariates were further dropped using a backward variable selection procedure with the study group always included. The final models include only variables that are significant ($p < 0.05$) or close to significant ($p < 0.10$). To have a population-averaged interpretation, we transformed the obtained regression coefficients and standard errors to marginalized odds ratios (OR) and corresponding 95% confidence intervals (CI).³⁹ Data were managed using SAS 9.1 (SAS institute, Cary, North Carolina) and statistical models were fit with the *xtlogit* and *gllamm* programs in Stata 9.0 (StataCorp, College Station, Texas).

RESULTS

Of 889 IDUs enrolled between 1997 and 2000, 717 (80.7%) reported using NEPs in the 6 months prior to baseline interview and 172 (19.3%) were NEP non-users. At baseline, NEP users had exchanged needles for a median of 12 months (median, interquartile range 4–36 months). Baseline characteristics of NEP users and non-users are summarized in Table 1. NEP users were younger and more likely to have a monthly income of at least \$1000, to be HIV positive and to recently have been in a drug treatment program, and less likely to consider themselves homeless or to smoke crack cocaine. No significant differences were observed between the two groups with respect to gender, race, marital status, education,

main source of income, proportion of having injected cocaine in the six months before baseline, history of having a sexually transmitted disease, and sexual orientation. Only 5% of study participants considered themselves to be homosexual or bisexual.

Table 2 shows the prevalence of sexual risk behaviors for NEP users and nonusers across 4 study visits. At baseline, about one half of study participants had one sex partner and nearly 30% had multiple sex partners. During follow-up, the proportion of study participants reporting sexual abstinence increased despite a longer recall time frame ("since the last interview") than at baseline (past 6 months). In the logistic model that adjusted for study visit, NEP users and non-users had no significant difference in the proportion of multiple sex partners (2 or more partners) across time ($p=0.40$).

At baseline, two-thirds of IDUs reported not using condoms during vaginal sex with their main sex partners in the past 6 months. NEP users were more likely than non-users to use condoms consistently with their main partners during vaginal sex across four study visits ($p=0.001$).

Overall, half of study participants always used a condom with their casual sex partners and there was only marginally significant difference between NEP users and non-users across study visits ($p=0.059$). About 17% of study participants had commercial sex in the 6 months prior to the baseline interview and less than 40% of these participants always used condoms. There was no significant difference between the two groups across study visits ($p=0.33$).

Finally, 43% of both NEP users and non-users reported unprotected vaginal intercourse with their main sex partners in the 30 days prior to the baseline interview. NEP users experienced a reduction in the number of episodes of unprotected vaginal sex, whereas non-users had little change during follow-up; the group by time interaction was significant in the univariate analysis ($p=0.014$).

Table 3 presents the adjusted odds ratios for sexual risk behaviors from the random-effects ordinal or binary logistic regression models. Note that an odds ratio of greater than 1 indicates increased risk for outcome variables "multiple sex partners" and "number of unprotected sex acts", whereas an odds ratio of less than 1 indicates increased risk for the three outcome variables of "condom use". NEP users and non-users had no significant difference in the proportion having multiple sex partners across four study visits. NEP users were more likely than non-users to wear a condom during vaginal sex with their main partners ($p=0.047$). There was no difference between the two groups in condom use during vaginal sex acts with casual and commercial sex partners. At baseline, there was no difference in number of unprotected vaginal sex episodes between the two groups. However, there was a significant differential change from baseline to follow-ups between the two groups ($p=0.02$); the odds of having a higher number of instances of unprotected vaginal intercourse were reduced by 26% per year in NEP group, whereas the odds declined only 10% per year in control group, after adjustment for age, gender, race/ethnicity, education, marital status, HIV status, age at first intercourse, sexual orientation, and smoking crack cocaine.

Older IDUs were less likely to have multiple sex partners, had less unprotected sex with main partners but were less likely to use a condom with commercial partners. Women tended to have multiple sex partners and more unprotected sex with their main partners but were more likely to use a condom with casual and commercial partners. African American, compared with other ethnic groups, tended to have multiple sex partners and more unprotected vaginal intercourse with main partners. As expected, participants who were married or lived with a person as if married were less likely to have multiple partners but less likely to use condom with their main or casual partners. Homeless persons were more

likely than the housed to have multiple partners. HIV-infected IDUs were less likely to have multiple partners and more likely to use condoms with all types of partners, and they significantly reduced the number of episodes of unprotected vaginal sex with their main partners. Last, IDUs who also smoked crack were more likely to have multiple sex partners and more unprotected intercourse with main partners.

DISCUSSION

The primary finding of this study is that while NEP users and non-users at baseline reported a similar number of instances of recent unprotected intercourse with their main partners, only NEP users experienced a substantial reduction in this behavior during the 3-year study follow-up. This finding suggests that use of an NEP may have contributed to reducing a behavior that best represents the absolute risk of HIV sexual transmission.

Of the relative sexual risk indicators, consistent condom use with regular partners was marginally significantly higher in NEP users than in non-users. In contrast, frequency of condom use with other partners and the number of sex partners were not different between the two groups. The significant difference we observed in the proportion of consistent condom use with main partners in the univariate analysis may have been due to differences between the two groups in HIV prevalence and crack smoking. Awareness of HIV infection has been shown in the current study and several previous studies of IDUs to be associated with fewer sexual risk practices,^{40–43} while smoking crack cocaine has been associated with greater sexual risk practices.^{33, 35–37}

Consistent with previous studies,^{10, 42, 44–46} we found IDUs were more likely to use condoms consistently with casual and commercial partners than with their main partners. Not using a condom with a main partner may be a way of showing trust,^{47–49} but this behavior puts both partners at risk of HIV infection. For example, findings from a study of drug users in Amsterdam suggest unprotected sexual contact that mainly occurs with a regular partner accounted for 23% of observed HIV seroconversions.⁵⁰ Even with casual partners, only about half of study participants at each round of data collection in the current study reported consistently using condoms. Clearly more work is needed to prevent the sexual transmission of HIV, particularly given that HIV infected people often delay or refrain from disclosing their HIV status to sex partners.^{51–53} In this study, we also found that an HIV-positive serostatus increased the odds of condom use 6-fold with regular partners but only 2-fold with casual or commercial partners.

Several limitations are relevant. First, behaviors were self-reported and thus may subject to recall bias. To minimize inaccuracy in reporting, the primary outcome, number of unprotected sex acts, asked about the past 30 days. Socially desirable reporting may have been present but we think it is unlikely because no systematic change across interviews was observed in the proportion of participants reporting condom use. Second, a sizeable number of subjects did not come back for follow-up interviews. However, attrition analysis showed that there were no significant differences at baseline between those followed and those not followed in the sexual risk behaviors we examined, suggesting that the results were unlikely to be biased due to selective lost to follow-up, although study efficiency (statistical power) was compromised. Third, NEP users and non-users were not comparable in several baseline characteristics, especially HIV status and crack smoking. Smoking crack has been associated with high-risk sexual behaviors^{33, 35, 37} and HIV-infected people are more likely to use condom with their regular sexual partner than uninfected persons.^{42, 43} We used proportional odds models to adjust for these imbalances and found consistent condom use was not associated with NEP use but the absolute number of instances of unprotected intercourse with a main partner decreased in NEP users more than non-users. Finally, study

findings may not be generalizable to other populations of IDUs since participants were not randomly selected.

Despite these limitations, this study suggests that participation in needle exchange programs may help to reduce the absolute risk of HIV sexual transmission. At the least, NEPs should be considered as a promising venue for accessing persons at high risk for sexually transmitted diseases including HIV and for providing sexual risk reduction interventions to this high-risk population.

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TABLE 1

Baseline characteristics by NEP use status

Characteristics	NEP (n=717)	Control (n=172)	p-value
	Mean (SD)	Mean (SD)	
Age at interview,	40.0 (10.7)	42.8 (7.4)	.001
Age at first intercourse, mean (SD)	14.0 (2.8)	13.9 (2.9)	.85
	n (%)	n (%)	
Gender			
Male	511 (71.3)	127 (73.8)	.50
Female	206 (28.7)	45 (26.2)	
Race/Ethnicity			
African American	325 (45.3)	77 (44.8)	.14
Non-Hispanic White	237 (33.1)	68 (39.5)	
Hispanic	150 (20.9)	25 (14.5)	
Others	5 (0.7)	2 (1.2)	
Education			
12 years	443 (61.9)	104 (60.5)	.73
< 12 years	273 (38.1)	68 (39.5)	
Married or common law			
Yes	266 (37.1)	61 (35.5)	
No	451 (62.9)	111 (64.5)	.73
Steady job, past 6 mo			
Yes	116 (16.2)	29 (16.9)	.82
No	601 (83.8)	143 (83.1)	
Monthly income			
\$1000	241 (34.0)	35 (20.5)	<.001
< \$1000	467 (66.0)	136 (79.5)	
Homeless, past 6 mo			
Yes	252 (34.1)	77 (44.8)	.022
No	465 (64.9)	95 (55.2)	
Inject cocaine, past 6 mo			
Yes	367 (51.2)	84 (48.8)	.61
No	350 (48.8)	88 (51.2)	
Smoke crack, past 6 mo			
Yes	361 (50.8)	107 (62.2)	.008
No	350 (49.2)	65 (37.8)	
Drug treatment, 6 mo			
Yes	332 (46.9)	49 (28.5)	<.001
No	385 (53.7)	123 (71.5)	
HIV serostatus			
Positive	129 (18.2)	14 (8.3)	.001
Negative	579 (81.8)	155 (91.7)	

Characteristics	NEP (n=717)	Control (n=172)	p-value
Sexually transmitted diseases, ever			
Yes	341 (47.6)	77 (44.8)	.55
No	376 (52.4)	95 (55.2)	
Sexual orientation			
Homosexual or bisexual	38 (5.3)	7 (4.1)	.70
Heterosexual	679 (94.7)	165 (95.9)	

TABLE 2

Percentage of sexual risk behaviors by NEP status and study visits*

Sexual risk behaviors**	Baseline/ Visit 1		Visit 2		Visit 3		Visit 4	
	NEP	Control	NEP	Control	NEP	Control	NEP	Control
Number of sex partners	(717)	(172)	(556)	(81)	(337)	(87)	(282)	(81)
0	17	18	19	28	24	17	27	22
1	55	49	49	40	53	55	45	51
2-4	18	20	20	21	12	14	18	14
5+	10	13	11	11	10	14	10	14
Multiple sex partners (2+)	28	33	31	32	23	28	27	27
Condom use, vaginal sex with main partner	(482)	(104)	(343)	(47)	(176)	(60)	(134)	(44)
No	65	78	62	72	65	80	57	82
Sometime	17	12	12	9	12	8	23	11
Always	18	11	27	19	23	12	19	7
Condom use, vaginal sex with casual partner	(194)	(54)	(175)	(25)	(87)	(24)	(81)	(27)
No	30	33	26	28	29	46	37	33
Sometime	20	20	21	28	16	8	9	19
Always	50	46	53	44	55	46	54	48
Condom use, vaginal sex with commercial partner	(107)	(41)	(98)	(14)	(47)	(12)	(41)	(16)
No	25	32	22	14	19	33	7	25
Sometime	42	24	31	64	19	17	34	38
Always	33	44	47	21	62	50	59	38
Number of unprotected vaginal sex acts in last month with main partner	(717)	(172)	(556)	(81)	(333)	(86)	(279)	(80)
0	57	57	68	58	68	55	78	63
1-4	13	6	10	10	9	7	6	10
5-9	5	9	6	7	7	10	4	9
10-19	14	13	7	15	5	9	6	9
20+	11	15	8	10	10	19	6	10

* Denominator numbers are in parentheses.

For number of sex partners and frequency of condom use, the recalled time frame was 6 months at baseline interview and 12 months at follow-up visits.

##

TABLE 3

Multivariate random-effects logistic regression models predicting sexual risk behaviors: Odds ratios and 95% confidence intervals

Predictors	Multiple sex partners	Condom use, vaginal sex with main partner	Condom use, vaginal sex with casual partners	Condom use, vaginal sex with commercial partner	Number of unprotected sex act
NEP use	0.88 (0.64–1.22)	1.49 (1.01–2.22)	1.39 (0.87–2.22)	1.04 (0.61–1.78)	0.80 (0.57–1.11)
Linear trend: year*	0.92 (0.85–1.00)			1.28 (1.07–1.53)	
In NEP nonusers					0.90 (0.78–1.04)
In NEP users					0.74 (0.68–0.81)
Age: per 10-year increase	0.71 (0.61–0.82)			0.74 (0.56–0.98)	0.67 (0.59–0.76)
Female	2.01 (1.49–2.69)		2.47 (1.64–3.71)	2.03 (1.26–3.27)	1.31 (1.01–1.70)
Race/ethnicity: white vs. Black	0.46 (0.33–0.64)	0.73 (0.52–1.02)			0.70 (0.53–0.92)
Race/ethnicity: Latino vs. Black	0.54 (0.37–0.78)	1.20 (0.83–1.75)			0.78 (0.57–1.07)
Education: 12 vs. < 12 years	0.77 (0.59–0.99)			0.53 (0.34–0.84)	1.31 (1.04–1.64)
Married/common law	0.63 (0.48–0.82)	0.48 (0.36–0.65)	0.72 (0.48–1.09)		2.64 (2.10–3.33)
Homelessness	1.69 (1.30–2.20)	0.68 (0.50–0.93)	0.74 (0.51–1.08)		
HIV positive	0.72 (0.50–1.03)	6.26 (4.07–9.63)	2.22 (1.26–3.91)	2.10 (1.11–3.95)	0.37 (0.26–0.52)
Sexually transmitted disease	1.76 (1.36–2.28)				
Age at first intercourse: per 3-year delay**	0.80 (0.69–0.92)				0.87 (0.77–0.98)
Homosexual or bisexual identity					0.67 (0.40–1.12)
Smoke crack cocaine	1.70 (1.30–2.21)				1.22 (0.97–1.54)
Inject cocaine			0.63 (0.43–0.93)		

* parameters should be interpreted with caution for multiple sex partners and frequency of condom use because the recalled time frame was 6 months at baseline interview and 12 months at follow-up visits

** the odds ratio for an individual who had first intercourse at age X years old was compared with individuals who had first sex at age $X-3$ years old; the standard deviation of age at first intercourse was 3 years so we chose it as the unit of difference for easy interpretation.