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Don C. Des Jarlais, Naomi Braine, Huso Yi, Charles F. Turner

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RESIDUAL INJECTION RISK BEHAVIOR, HIV INFECTION, AND THE EVALUATION OF SYRINGE EXCHANGE PROGRAMS

Don C. Des Jarlais, Naomi Braine, Huso Yi, and Charles Turner

This study assessed relationships between residual risk behavior (risk behavior among persons participating in effective HIV prevention programs) and HIV infection. Structured interviews and HIV tests were obtained from participants in six large U.S. syringe exchange programs. Program characteristics were obtained through interviews with the directors. Findings indicated that injection risk behaviors varied significantly across the six programs—from 10% to 27% of the participants at each program reported receptive sharing of needles and syringes in the 30 days prior to the interview. HIV prevalence ranged from 2.5% to 22.2% across the six programs. HIV prevalence among new injectors was strongly related to HIV prevalence among long–term injectors across the programs (r = .869). There was a consistent pattern of negative relationships between injection risk behaviors and HIV infection across the six programs (higher rates of risk behavior at a program associated with lower HIV infection). As a result, appropriate evaluation of HIV prevention programs may require not only information on continuing risk behavior and HIV infection among program participants but also historical information on the epidemiology of HIV in the local community.

Community outreach, access to sterile injection equipment, and drug abuse treatment have all been found to be effective in reducing risk behavior and HIV transmission among injection drug users (IDUs) (Metzger, Navaline, & Woody, 1998; National Institutes of Health, 1997; Needle, Coyle, Genser, & Trotter, 1995; Semaan et al., 2002; Strathdee & Vlahov, 2001). However, no individual HIV prevention program and no combination of HIV prevention programs have been able to eliminate risk behavior in any known IDU population at risk for HIV. "Residual risk behavior" (risk behavior that persists among some individuals even after participation in effective HIV preven-

Don C. Des Jarlais, Naomi Braine, and Huso Yi are with the Baron Edmond de Rothschild Chemical Dependency Institute, Beth Israel Medical Center, New York. Charles Turner is with the Research Triangle Institute, Program in Health and Behavior Measurement, Washington, DC.

Address correspondence to Don C. Des Jarlais, Baron Edmond de Rothschild Chemical Dependency Institute, Beth Israel Medical Center, 160 Water St., 24th Floor, New York, NY 10038, e-mail: dcdesjarla@aol.com

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tion programs) poses a problem for establishing and maintaining control over HIV epidemics.

The problem of residual risk behavior may be of increasing importance in the United States and other industrialized countries owing to several recent historical changes. "Treatment optimism" (the belief that new treatments for HIV reduce the seriousness of HIV disease) (Elford, Bolding, & Sherr, 2002; Seely, 2004), "prevention fatigue" (the difficulties in maintaining risk reduction efforts over long time periods) (Ostrow et al., 2002; Stockman et al., 2004), and the emergence of new drug use patterns, such as methamphetamine use (Molitor, Ruiz, Mikanda, Sun, & Anderson, 1999), may all lead to increases in residual risk behavior and a potential resurgence of HIV infection among high–risk populations.

The issue of residual risk behavior poses critical questions for the evaluation of HIV prevention programs. Are lower rates of risk behavior always an indication of better programs? Is there some threshold level of residual risk, below which further reductions do not make an appreciable difference in HIV transmission? If such a threshold exists, is it constant or does it vary across programs? In this report, we examine the problem of residual injection risk behavior (sharing of needles and syringes for injecting drugs) and its relationship to levels of HIV infection among participants in six syringe exchange programs (SEPs) in the United States. The programs are all very large exchanges, exchanging over 500,000 syringes per year. They are also all multiservice organizations, providing multiple services on–site and through referral. For example, all of these programs provide voluntary HIV counseling and testing, free condoms, and referral to drug abuse treatment among other services. These programs thus should not be considered as "just syringe exchanges" but rather as part of "relatively comprehensive" systems of HIV prevention for IDUs.

In this article we report evidence of substantial residual risk behavior among participants in all of the six programs, and significant variation among the programs, but no evidence of any resurgence in HIV infection among the participants. It appears that HIV transmission can be kept at a relatively low level among IDUs despite considerable residual risk behavior. We then consider the implications of residual risk behavior for the evaluation of HIV prevention programs.

METHODS

Data were collected as part of the National Syringe Exchange Evaluation Study. This study was structured to permit both analyses at the individual level—identifying relationships among the characteristics of individual exchange participants—and analyses at the program level—identifying relationships among the characteristics of the different programs. The North American Syringe Exchange Network compiled a list of SEPs in the United States, and this list was stratified according to the number of syringes the programs reported distributing in the year 2000. A total of 23 programs were sampled for the larger study, but HIV testing was only conducted with programs from the "very large" stratum, defined as those programs that reported distributing more than 500,000 syringes per year. As the analyses for this article require HIV test results, we are only using data from this subset. Ten programs met the size criteria for "very large," and six programs were randomly sampled from that population with no other criteria used for inclusion. HIV testing was done using saliva samples, which were collected using the OraSure collection device (OraSure Technologies, Inc., Bethlehem, PA), and tested by Lab*One*, (Lab*One*, Inc., Lenexa, KS).

Research participants were randomly selected from among SEP participants exchanging syringes on any given day. The only inclusion criterion was active participation in the exchange, and respondents were recruited after conducting an exchange. Interviewers used a table of random numbers between 1 and 5 to select subjects from among individuals waiting to exchange syringes. For example, if the first number selected from the table was 3, then the third person in line was selected for possible recruitment. This use of random numbers reduces the possibilities of selection bias among both interviewers and potential research respondents. If the random selection procedure selected someone who had already participated in the study, we allowed that person to participate again. A unique code number was generated for each person, using a formula that enabled identification of repeat participants and linkage of multiple interviews with the same respondent. This analysis excludes these repeat interviews, and uses only the first interview from each respondent. Respondents were compensated $15 for participation in the interview and saliva test, and all respondents who completed an interview also provided a saliva sample.

Reasons for refusal were documented at a sample of sites, and the majority involved scheduling constraints. Approximately 15% of refusals appear to be absolute refusals ("I'm too private," "No way," "Forty-five minutes is too long"). Another 1% specifically stated they have done the interview before and don't feel like doing it again. However, the majority of reasons (over 80%) given are contingent ("I have to get back to work," "I don't have time right now"), and some ask if they can come back later to do the interview. The overall refusal rate was 21% of recruitment encounters, but given the sampling method, a person who refused at one point in time might have been approached and completed the survey at another time.

All interviews were conducted using audio computer-assisted self–interviewing (ACASI) technology. A research assistant oriented the respondent to the interview program, constructed and entered the anonymous identifier, and then worked with the respondent to answer the first few demographic questions to ensure that the respondent was using the program correctly. The respondent then completed the interview without the research assistant viewing the answers. This interviewing method has been demonstrated to increase reporting of stigmatized and/or sensitive behaviors, including reports of HIV risk behavior among IDUs (Des Jarlais et al., 1996).

All drug use and injection risk variables reflect behavior in the 30 days preceding the interview. Respondents were asked how frequently in the last 30 days they had (a) rented or bought or (b) borrowed syringes that they thought had already been used by someone else (receptive sharing). Respondents were also asked how frequently in the last 30 days they had (a) rented or sold or (b) gave or loaned to someone else syringes that [the respondent] had already used (distributive sharing). Answers to each of these four questions were then coded to binary yes/no responses for receptive and for distributive sharing.

Data on program characteristics were obtained through a 45-minute telephone interview with the program directors. The interview included information on geographic location, services offered, sources of funding, and numbers of syringes exchanged.

The analyses reported here were conducted with the program as the primary unit of analysis. That is, we examined different program characteristics, including geographic location and HIV seroprevalence among program participants as predictors of residual risk behavior among program participants. Pearson correlation coefficients were used to assess the relationships between program characteristics, particu-

larly HIV prevalence and the percentages of respondents engaging in receptive and distributive syringe sharing. Ordinary least squares regression was used to control for demographic characteristics of the exchange participants in examining the relationships between syringe sharing and HIV prevalence across programs. Analyses were done separately for all respondents and with exclusion of amphetamine users, in order to assess whether the relationships between syringe sharing and HIV prevalence were the result of differences in amphetamine use across programs.

To preserve some confidentiality for the individual programs, we use geographic location only to identify the programs in this report.

The study was approved by the institutional review board of the Beth Israel Medical Center.

RESULTS

Table 1 presents selected sociodemographic characteristics of the respondents in the six different programs. There was considerable diversity among the respondents across programs, all of the differences were statistically significant. This is likely a reflection of the different geographic settings of the programs and the large sample size. The mean age ranged from 35 to 43 years old. The percentage of Whites ranged from 24% to 67%, the percentage of African Americans from 14% to 60%, and the percentage of Latino/as from 5% to 50%. The Latino/a group also undoubtedly varied geographically, with persons of Puerto Rican heritage concentrated in the East Coast programs. The percentage of females ranged from 23% to 37%. There were also significant differences in the percentages of subjects reporting male–with–male and female–with–female sexual activity.

Selected drug use behaviors are presented in Table 2. Again all of the differences across programs were statistically significant. Persons who reported that they "never" injected in the 30 days prior to the interview were likely to have been using the exchange for other services or exchanging syringes for friends, relatives, or sexual partners who injected. Although there was variation in the frequency of injection, the majority of respondents at all programs reported injecting once per day or more frequently. Heroin was injected by the great majority of respondents across all programs, with substantial variation in other drugs injected, particularly amphetamines, which were more frequently injected at the West Coast programs. While the mean time from first injection to the date of interview was substantial at all programs (ranging from 15 to 24 years), the percentage of "new injectors" (persons who have injected drugs for less than 6 years) ranged from 12% to 32% across the programs.

Injection risk behaviors are presented in Table 3. There were statistically significant differences across the programs in the percentages of respondents who reported receptive sharing (from 10% to 27%) and distributive sharing (from 12% to 31%). There was also significant variation in the use of other sources (other than the exchange) for obtaining needles and syringes, including sources relatively likely to be unsafe (dealers and "street" sources). Individual HIV status was significantly associated with distributive sharing. Among HIV-positive participants across all six programs, 12% reported distributive sharing, whereas among HIV-negative participants across all programs, 19% reported distributive sharing ($p < .02$).

HIV prevalence among all respondents at each program and among long–term injectors (persons injecting for 6 years or more) and among new injectors (persons injecting for less than 6 years) is presented in Table 3. HIV prevalence was lower at the West Coast programs. Prevalence among the long–term injectors would (at least par-

TABLE 1. Selected Socio–demographic Characteristics of Participants in Six U.S. Syringe Exchange Programs

	Whole *N* = 1799	West Coast 1 *N* = 349	West Coast 2 *N* = 359	Midwest *N* = 408	East Coast 1 *N* = 194	East Coast 2 *N* = 262	East Coast 3 *N* = 227	*p* Value
Age – *M* (*SD*)	39.2 (10.4)	40.3 (9.2)	34.5 (12.2)	41.2 (9.5)	42.8 (10.5)	39.2 (8.6)	38.1 (9.8)	< .001
Gender								
Male	69.1	68.2	66.3	71.3	77.3	61.5	73.1	.007
Female	30.5	31.5	33.4	28.4	22.7	37.4	26.9	
Transgendered	0.3	0.3	0.3	0.2		1.1		
Ethnicity								< .001
White	44.4	66.5	52.9	24.0	47.9	16.8	62.1	
Black	32.6	14.3	24.0	60.0	44.8	29.8	17.6	
Hispanic	16.8	6.9	14.2	14.0	4.6	50.0	13.7	
API or NA	3.4	9.5	3.6	0.7	2.6	1.5	1.3	
Other	2.8	2.9	5.3	1.2		1.9	5.3	
Sexual behavior [a]								
MSM	4.7	4.6	7.8	3.2	2.6	6.1	3.1	.015
WSW	3.9	4.9	4.2	2.9	1.0	6.9	3.1	.027
Education								< .001
< Some high school	33.8	35.1	23.5	41.7	36.8	44.4	18.9	
High school grad/GED	29.5	28.2	24.1	31.1	36.3	31.8	29.1	
College/Graduate school	36.7	36.8	52.4	27.2	26.9	23.8	52.0	
Income source[b]								
Regular job	44.4	39.4	50.6	43.9	41.8	38.3	52.9	.001
Government benefit	41.1	38.7	39.7	31.9	46.4	57.9	40.1	< .001
Illegal source	45.7	53.4	43.9	50.7	41.8	37.2	41.0	< .001
Housing [b, c]								< .001
Own house	45.9	30.7	41.6	52.7	55.7	49.4	51.5	
Someone else's	24.6	27.8	16.8	29.7	26.8	25.1	20.3	
Hotel/shelter	10.3	10.3	14.8	9.8	2.1	10.8	10.1	
Street/shanty	12.9	23.5	19.6	2.5	12.4	6.9	12.3	
Jail	2.9	4.0	3.4	2.5	1.5	1.9	3.5	
Other place	3.5	3.7	3.9	2.9	1.5	5.8	2.2	
Lived on "street" [b]	39.2	65.9	45.0	18.4	34.5	36.0	33.9	< .001

Note. API or NA = Asian/Pacific Islander or Native American; MSM = men who have sex with men; WSW = women who have sex with women. [a]Assessed by participants' sex behavior in the past month. [b]In the past 6 months. [c]"In the past 6 months, where did you live most of the time?"

TABLE 2. Drug Use and Injection History of Participants in Six U.S. Syringe Exchange Programs

	Whole $N = 1799$	West Coast 1 $N = 349$	West Coast 2 $N = 359$	Midwest $N = 408$	East Coast 1 $N = 194$	East Coast 2 $N = 262$	East Coast 3 $N = 227$	p Value
Frequency								< .001
Never	5.2	2.9	4.2	4.4	8.3	8.1	6.2	
< 1 or 1–6 times / week	25.1	22.4	19.9	20.3	24.0	36.2	33.9	
≥ 1 times / day	69.7	74.7	75.9	75.2	67.7	55.8	59.9	
Injection drugs								
Heroin	82.8	87.4	73.7	87.3	85.0	81.4	81.5	< .001
Cocaine	37.6	37.9	37.2	32.6	26.9	49.8	42.3	< .001
Speedball	38.7	45.3	31.6	43.4	30.6	44.4	32.2	< .001
Amphetamines	16.7	33.2	31.8	6.6	3.6	8.9	5.3	< .001
Others	14.7	26.6	17.9	6.6	12.0	15.1	7.5	< .001
Age of first injection—M (SD)	20.5 (8.7)	21.8 (10.1)	19.9 (8.0)	20.8 (7.8)	20.3 (8.7)	18.8 (9.2)	21.2 (8.3)	.001
Years of injection—M (SD)	19.0 (12.6)	18.6 (12.2)	14.9 (12.3)	20.4 (11.9)	23.5 (14.2)	21.4 (12.2)	17.2 (11.6)	< .001
New injectors (< 6 years)	19.1	19.2	31.5	15.2	15.5	12.2	17.6	< .001

TABLE 3. Injection Risk Behavior of Participants and HIV Prevalence in Six U.S. Syringe Exchange Programs

	Whole $N = 1799$	West Coast 1 $N = 349$	West Coast 2 $N = 359$	Midwest $N = 408$	East Coast 1 $N = 194$	East Coast 2 $N = 262$	East Coast 3 $N = 227$	p Value
Injection risk behavior								
Injected with a used syringe								
Receptive sharing	16.6	26.9	21.7	9.6	10.8	15.6	11.5	< .001
Distributive sharing	18.0	30.7	19.5	11.5	14.9	13.4	15.9	< .001
Sources of syringes other than SEP								
Dealer	11.1	19.8	9.2	5.9	11.9	12.2	8.4	< .001
Friend or family	13.5	21.5	10.6	11.0	12.4	13.7	11.0	< .001
Sex partner	8.2	14.3	8.1	7.1	3.6	9.2	4.0	< .001
On the street	15.5	23.8	15.0	8.1	19.1	19.8	8.8	< .001
Pharmacy or HCP	8.9	13.5	10.0	4.9	6.2	9.5	8.8	.002
HIV prevalence								
Total	10.6	2.0	7.2	10.3	13.9	21.4	14.5	< .001
Long–term injectors (≥ 6 years)	12.0	2.5	8.5	12.1	14.6	22.2	15.5	< .001
New injectors (< 6 years)	4.9	0.0	4.4	0.0	10.0	15.6	10.0	.003

Note. SEP = syringe exchange program; HCP =

tially) represent the history of the HIV epidemic among IDUs in the local area, as these HIV-positives participants are likely to have been infected for a relatively long time. HIV prevalence among the new injectors would (again at least partially) reflect relatively recent HIV infections. There were statistically significant differences across the six programs in HIV prevalence among both long–term and new injectors.

We used Pearson correlation coefficients to examine relationships between HIV prevalence between new and long–term injectors, between distributive and receptive sharing, and between injection risk behaviors and HIV prevalence across the programs. Although we examined a total of only six SEP programs, which does not provide much statistical power, very clear patterns were evident in these correlations across the six programs.

The pairwise correlation coefficients between HIV prevalence in the total program sample, the long–term, and the new injector groups across the six programs are presented in Table 4. All of these correlations were very high and statistically significant. The correlation between HIV prevalence between new and long–term injectors across the programs was .869, (R^2.755).

The correlations between receptive and distributive sharing among the three groups (total sample, long–term and new injectors) are also presented in Table 4. All of these correlations were relatively high, ranging from .318 to .982.

The correlations between HIV prevalence and injection risk behaviors are presented in Table 5. With the sample size of six programs, none of these correlations were statistically significant, but all 18 were negative. The correlations ranged from –.309 to –.810. There was clearly no evidence of a positive relationship between either receptive or distributive sharing and HIV prevalence among the total sample, or among long–term or new injectors across these six programs.

The race/ethnicity of the subjects also varied across the different sites (see Table 1), and race/ethnicity might have been a confounding factor in the negative correlations between injection risk behavior and HIV prevalence. We used multiple regression to model HIV prevalence as a function of syringe sharing. HIV prevalence was used as the dependent variable, race/ethnicity were used as control variables, and syringe sharing as an independent variable. Six different models were created: the two sharing variables (receptive and distributive sharing) by HIV prevalence in the three groups (whole sample at each program, new injectors at each program, and long–term injectors at each program). Because receptive and distributive sharing were highly correlated, it was not possible to use both of these variables in a single model. The regression coefficients are presented in Table 6. As with the simple correlation coefficients, all of the coefficients were negative. One regression coefficient, for receptive sharing among long–term injectors, was statistically significant.

As amphetamine use was concentrated in the West Coast programs, there is the possibility that it may have influenced the negative correlations between HIV prevalence and injection risk behaviors. There were not sufficient numbers of amphetamine users in the East Coast programs to use multiple regression to test whether amphetamine use was creating the pattern of negative correlations between the sharing variables and the HIV prevalence variables. Rather, we removed the amphetamine injectors from the analyses and recalculated the correlation coefficients. Again, all 18 correlations were negative, and there was little change in the absolute values of the correlations. (Data are not presented but are available from the first author.)

TABLE 4. Correlations: HIV Prevalence and Drug Risk Behaviors Among New and Long–Term Injectors in Six U.S. Syringe Exchange Programs ($N = 6$)

HIV prevalence	1	2	3	4	5	6
1. HIV–positive total sample	—					
2. HIV–positive long–term injectors	.998**	—				
3. HIV–positive new injectors	.897*	.869*	—			
Drug risk behaviors						
1. Receptive sharing— total sample	—					
2. Receptive—long–term injectors	.987**	—				
3. Receptive—new injectors	.466	.325	—			
4. Distributive sharing—total sample	.900*	.886*	.524	—		
5. Distributive—long–term injectors	.881*	.895*	.394	.982*	—	
6. Distributive—new injectors	.318	.196	.867*	.554	.419	—

*$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 5. Correlations: HIV Prevalence and Injection Risk Behaviors in Six U.S. Syringe Exchange Programs (*N* = 6)

	HIV–Positive—Total	HIV–Positive—Long term	HIV–Positive—New
Receptive sharing—total sample	–.650	–.680	–.364
Receptive—long–term injectors	–.580	–.612	–.309
Receptive—new injectors	–.688	–.701	–.492
Distributive sharing—total sample	–.771	–.810	–.475
Distributive—long–term injectors	–.679	–.722	–.405
Distributive—new injectors	–.783	–.794	–.606

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

DISCUSSION

First, we should note that the six programs in this report were a sample from the 10 "very large" syringe exchange programs in the United States at the time the study was initiated. Thus, the results may not necessarily apply to smaller programs. However, as the very large programs account for over 60% of all syringes exchanged per year in the United States, these results clearly do apply to a very large amount of syringe exchange activity in the country. We would specifically caution against applying these results to programs that do not provide relatively large numbers of syringes to their local IDU populations. The reasons for sharing syringes, the frequency of sharing syringes among those who do share, and the number of other persons with whom syringes are shared (mixing patterns) may all vary between a context of relatively large numbers of syringes exchanged and relatively few syringes exchanged.

In this study, we observed low to moderate levels of residual injection risk behavior among participants in six large U.S. syringe exchange programs. There were statistically significant differences among participants in the different programs, with from approximately 10% to approximately 30% of respondents of the different SEPs reporting either receptive or distributive sharing of needles and syringes.

HIV prevalence among the participants in the programs ranged from 2% to 22%. The HIV prevalence among the subjects in the Midwest and East Coast SEPs represents substantial declines from previous HIV prevalence levels among IDUs in these cites (Centers for Disease Control and Prevention, 2001). Although we do not have data on HIV incidence among the participants in these specific six programs, recent incidence data are available for IDUs in the East Coast sites and the Midwest site. The incidence rates were approximately 1/100 person–years at risk in each of the cities, a low rate consistent with the declining HIV prevalence (data are not presented but are available from the first author). The low HIV prevalence (2%) and lack of HIV infection among new injectors in one West Coast program also suggests low HIV incidence among IDUs at that site. Thus, the residual injection risk behavior does not appear to be driving much HIV transmission among the drug injectors in the cities of at least five of these six syringe exchange programs. A similar situation is occurring in Australia, where 15% to 20% of syringe exchange participants report sharing (in the 30 day prior to interview) and HIV prevalence remains low (under 3% among syringe exchange participants) (National Center for HIV Epidemiology, and Clinical Research, 2003).

It is very important to note that although there appears to be relatively little HIV transmission associated with residual injection risk behavior among the participants in these syringe exchange programs, this may not hold for transmission of hepatitis B

virus (HBV) and hepatitis C virus (HCV). Both HBV and HCV are more readily transmitted than HIV through sharing of needles and syringes and through sharing of drug preparation equipment (cookers, cottons, rinse water). Relatively high rates of HCV and HBV transmission without substantial HIV transmission have been observed among IDUs (Des Jarlais et al., 2003; Hagan et al., 1999). IDUs should be vaccinated to prevent HBV infection. Additional research is needed to develop new interventions to prevent HCV transmission among IDUs.

The correlations among injection risk behaviors present both expected and unexpected results. Receptive and distributive sharing were highly and significantly correlated across the six programs. This suggests that the same factors are responsible for the variation in receptive sharing are also responsible for variation in distributive sharing.

HIV prevalence was highly and significantly correlated between new and long–term injectors across the six programs. The correlation coefficient of .869 corresponds to HIV prevalence among long–term injectors "explaining" 76% of the variance in HIV prevalence among the new injectors. There are at least several ways in which higher HIV prevalence among long–term injectors could lead to higher HIV prevalence among new injectors. First, if new and long–term injectors share needles and syringes, then the risk of becoming infected with HIV among the new injectors is proportional to the HIV prevalence among the long–term injectors. Second, because IDUs are sexually active, high HIV prevalence among long–term injectors could lead to substantial sexual transmission of HIV within the local community (including injectors, non–injecting drug users and persons who do not use illicit drugs). This would put the new injectors at increased risk of becoming infected with HIV through unsafe sex behavior. Indeed, it is quite possible that some of the new injectors in the East Coast programs were infected through sexual transmission before they began injecting (Des Jarlais et al.). The high correlation between HIV prevalence among long–term and new injectors does illustrate the inertial quality of a high prevalence HIV epidemic. Once large numbers of people in a high–risk population become infected with HIV, even modest amounts of residual risk behavior can maintain the epidemic.

Contrary to "standard" epidemiological thinking in which higher levels of risk behavior drive higher levels of HIV infection, we did not find positive associations between injection risk behaviors and HIV prevalence. Indeed, we found a consistent pattern of negative correlations between injection risk behaviors and HIV prevalence across the six programs. The pattern of negative correlations between HIV prevalence and syringe sharing remained after adjusting for the two major differences (racial/ethnic distribution and amphetamine use) in the different programs.

There are several potential causal mechanisms that could explain this pattern of negative correlations. At an individual level, knowledge that one is HIV-positive may lead to less sharing, particularly less distributive sharing (Des Jarlais et al., 2004). As noted in the Results section, HIV-positive participants in this study were less likely to engage in distributive sharing, though the strength of the relationship at the individual-level was not sufficient to explain the program level relationship, and there was no individual level relationship between HIV serostatus and receptive sharing. At a program level, prior high HIV prevalence in the local IDU community may have helped establish very strong social norms against sharing needles and syringes among IDUs. Note that the participants in these six programs are relatively old (mean age of approximately 40), so that a large percentage of those in the East Coast cities would have

experienced the period in the early to mid–1990s when there were large numbers of IDUs with visible evidence of having AIDS. Such personal observation of people with AIDS may have helped generate strong social norms against sharing needles and syringes. The sterile needles and syringes available from the syringe exchanges would permit good compliance with social norms against sharing.

A third possibility should also be considered. IDUs in some areas continue sharing drug injection equipment, but with the majority of them confining their sharing to small stable groups of sex partners, relatives, and close friends. Within these groups, persons who are HIV-positive are very likely to know their status and to be the last to inject with shared needles and syringes (avoiding distributive sharing by positives) (Des Jarlais et al., 2004). This "partner restriction" and "informed altruism" would greatly reduce the likelihood of HIV transmission. Indeed sharing within small stable groups within a population with very low HIV prevalence—such as the West Coast 1 program —should not lead to much HIV transmission (though the transmission of HBV and HCV could be much more likely).

The pattern of negative correlations between injection risk behaviors and HIV infection levels in these six programs raises very interesting questions with respect to monitoring of HIV prevention programs. Our findings argue against using simple current levels of risk behavior or even simple current HIV prevalence and incidence data as sufficient measures. These data indicate that analysis of the relationship between risk behavior, seroprevalence, and incidence at a given point in time has to take into account the local history of the epidemic. Are incidence and prevalence increasing or decreasing among program participants, and from what initial levels? Our current findings reflect two different historical patterns for successful HIV prevention, which result in different associations between rates of current risk behavior and seroprevalence. In one pattern, seen most clearly in the West Coast 1 program, seroprevalence remains low enough that elevated levels of residual risk behavior can be tolerated without escalation of the epidemic; this pattern of long–term HIV prevention among IDUs has been demonstrated in multiple cities that implemented SEP while HIV rates were still very low (Des Jarlais et al., 1995). In a second pattern, seen most clearly in the East Coast 2 program, HIV spreads widely among IDUs early in the epidemic and then gradually reduces after implementation of SEP, resulting in relatively low rates of current risk behavior but continuing elevated HIV; this pattern demonstrates the ability of intervention to gradually reverse a significant epidemic, but the reduction in HIV prevalence occurs slowly (Des Jarlais et al., 2000; Des Jarlais, Perlis, et al., 2000). Both of these are examples of successful intervention, but follow different historical paths and result in different contemporary data. A program evaluation conducted in 2005 cannot accurately assess the efficacy of a contemporary intervention without examination of how the epidemic developed locally, when intervention was initiated, and how widespread and accessible the services have been for different affected populations.

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