The Protective Effect of AIDS-Related Behavioral Change among Injection Drug Users: A Cross-National Study

ABSTRACT

Objective. This study assessed the relationship between self-reported acquired immunodeficiency syndrome (AIDS) behavioral change and human immunodeficiency virus (HIV) serostatus among injection drug users.

Methods. The study sample involved 4419 injection drug users recruited from drug abuse treatment and nontreatment settings in 11 cities in North America, South America, Europe, Asia, and Australia. The World Health Organization multisite risk behavior questionnaire was used, and either blood or saliva samples for HIV testing were obtained. Subjects were asked, "Since you first heard about AIDS, have you done anything to avoid getting AIDS?"

Results. The protective odds ratio for behavioral change against being infected with HIV was 0.50 (95% confidence interval = 0.42, 0.59). While there was important variation across sites, the relationship remained consistent across both demographic and drug use history subgroups.

Conclusions. Injection drug users are capable of modifying their HIV risk behaviors and reporting accurately on behavioral changes. These behavioral changes are associated with their avoidance of HIV infection. (*Am J Public Health.* 1996; 86:1780–1785)

Don C. Des Jarlais, PhD, Patricia Friedmann, MS, Holly Hagan, MPH, and Samuel R. Friedman, PhD, for the WHO Multi-Centre Study of AIDS and Injecting Drug Use

Introduction

Human immunodeficiency virus (HIV) infection has been reported among injection drug users in 80 countries, and very rapid increases in HIV infection have been reported in many areas.[1–4] Injection drug users who learn about acquired immunodeficiency syndrome (AIDS) and/or participate in a specific AIDS prevention program generally report lower frequencies of injection risk behavior than before they either knew about AIDS or participated in a given prevention program. A wide variety of prevention programs—including "education only," drug abuse treatment, syringe-exchange, outreach, and bleach distribution programs—have been associated with substantial reductions in self-reported HIV risk behavior among injection drug users.[5] Indeed, almost all studies of HIV prevention programs for these individuals have shown large numbers of subjects reporting risk reduction, although no study has shown them reporting anything close to complete risk elimination.

It has been quite difficult, however, to determine if these examples of self-reported risk reduction actually provide meaningful protection against HIV infection. Are the self-reports valid, or do social desirability effects[6,7] lead injection drug users to greatly exaggerate the extent of their risk reduction? Moreover, even if the self-reports are valid, are the changes of sufficient magnitude and duration to reduce the likelihood of these individuals becoming infected with HIV?

These scientific questions as to the validity of self-reports and the effectiveness of behavioral change in reducing HIV transmission also entail important public health considerations and political concerns. If self-reports of risk reduction are usually valid and are associated with lower rates of HIV infection, they could be used as outcome measures for many prevention programs. Given the need for the rapid implementation and evaluation of HIV prevention programs for injection drug users throughout the world, this is of great practical importance. Additionally, some political leaders have cited doubts about the ability of these drug users to change behavior as their primary reason for opposing any HIV prevention programs for persons who continue to inject drugs.[8] The issues of the validity of self-reports and the effectiveness of behavioral change thus directly relate to the political feasibility of implementing HIV prevention programs for injection drug users in many countries.

To our knowledge, there is currently only a single study indicating that injection drug users who report deliberate AIDS-related risk reduction are at lower risk of becoming infected with HIV. Among a sample of 173 HIV-seronegative injection drug users in Bangkok, those who reported that they "stopped sharing"

Don C. Des Jarlais and Patricia Friedmann are with the Chemical Dependency Institute, Beth Israel Medical Center, New York, NY. Holly Hagan is with the Seattle–King County Health Department, Seattle, Wash. Samuel R. Friedman is with the National Development and Research Institutes, Inc., New York, NY.

Requests for reprints should be sent to Don C. Des Jarlais, PhD, Chemical Dependency Institute, Beth Israel Medical Center, First Ave at 16th St, New York, NY 10003.

This paper was accepted May 17, 1996.

Editor's Note. See related editorial by Osborn (p 1698) in this issue.

The views expressed in this paper are the authors' and do not necessarily reflect those of the granting agencies or of the authors' institutions.

TABLE 1—Demographic Characteristics, Reported AIDS Risk Reduction, and HIV Seroprevalence among Injection Drug Users (n = 4419), by City: The WHO Multi-Centre Study of AIDS and Injecting Drug Use

	Median Age (Interquartile Range)	Male, %	Married/ Living as Married, %	Median Education (Interquartile Range)	Median Yrs Injecting (Interquartile Range)	Previously HIV Tested, %	Reported Risk Reduction, %	HIV Positive, %
Athens, Greece (n = 396)	28 (24–32)	77	14	9 (7–12)	7 (4–11)	55	88	0.5
Bangkok, Thailand (n = 590)	30 (25–33)	95	42	7 (4–10)	8 (3.5–13)	44	92	34
Berlin, Germany (n = 354)	27 (23–30)	55	9	10 (9–11)	7 (3–12)	92	87	16
Glasgow, Scotland (n = 452)	23 (21–26)	70	6	11 (10–11)	6 (4–8)	56	83	2
London, England (n = 482)	27 (23–31)	65	12	11 (10–12)	7 (4–12)	48	79	13
Madrid, Spain (n = 128)	24.5 (21–28)	81	9	8 (7–10)	6 (4–10)	70	71	61
New York, New York (n = 829)	37 (31–41)	76	19	11 (10–12)	19 (10–24)	52	79	48
Rio de Janeiro, Brazil (n = 128)	30 (25–33)	83	18	12 (9–14.5)	10 (4.5–14)	61	58	35
Santos, Brazil (n = 198)	27 (23–32)	59	29	5 (3–8)	6 (3–12)	69	50	64
Sydney, Australia (n = 416)	26 (22–31)	79	3	10 (9–12)	7 (4–12)	80	86	2
Toronto, Canada (n = 446)	30 (26–36)	77	14	11 (10–13)	11 (4–18)	74	86	5

drug injection equipment because of concern about AIDS were at significantly lower risk of seroconverting for HIV (adjusted odds ratio = 0.25; 95% confidence interval = 0.09, 0.72).[9] We report here on individual-level relationships between self-reported AIDS risk reduction and lower probabilities of prevalent HIV infection in a sample of 4419 injection drug users recruited from 11 cities on five continents.

Methods

This analysis was conducted as part of the World Health Organization (WHO) Multi-Centre Study of AIDS and Injecting Drug Use.[10] The study was approved by the local ethics review body for each participating organization. The data were collected from 1989 to 1991 in the different cities. Persons who had injected illicit drugs within the previous 2 months were recruited from drug abuse treatment programs and nontreatment settings (in most cities, through outreach and chain-referral sampling). After informed consent was obtained, a trained interviewer administered a standardized interview. Subjects were assured that information provided would be kept confidential and would not affect any drug abuse treatment or other services they might receive. Formal records of the numbers of subjects who declined to participate were not kept at all sites. Individual principal investigators did report, however, that a subject declining to participate was a relatively rare occurrence. It is estimated that at least 95% of the subjects who were asked to participate agreed to do so.

The questionnaire focused on drug use histories and on injection and sexual risk behavior in the 6 months prior to the interview. Questions were also asked about previous HIV tests and their results. After the interview, either a blood or a saliva specimen was obtained for HIV testing. Serum or saliva specimens were tested at local reference laboratories for anti-HIV with the use of enzyme-linked immunosorbent assays and confirmation by Western blot assays. (Saliva collection offers practical advantages over serum collection in many field settings. Additional information on HIV testing using saliva samples is available from the first author.)

A specific series of questions was used to ascertain subjects' deliberate behavioral changes in response to concerns about AIDS. Subjects were asked,

TABLE 2—Protective Effect of Self-Reported AIDS Risk Reduction among Injection Drug Users (n = 4419), by City

Reported or No Reported Risk Reduction, by City (No. Respondents)	HIV Positive		Odds Ratio (95% CI)	P
	No.	%		
Overall sample			0.50 (0.42, 0.59)	.000
Reported (3611)	729	20		
No reported (808)	273	34		
Athens			Undefined	.594
Reported (347)	2	0.6		
No reported (49)	0	0		
Bangkok			1.51 (0.75, 3.07)	.217
Reported (540)	187	35		
No reported (50)	13	26		
Berlin			0.53 (0.24, 1.20)	.093
Reported (308)	44	14		
No reported (46)	11	24		
Glasgow			0.12 (0.02, 0.63)	.001
Reported (374)	3	1		
No reported (78)	5	6		
London			0.34 (0.19, 0.61)	.000
Reported (381)	38	10		
No reported (101)	25	25		
Madrid			0.67 (0.28, 1.60)	.327
Reported (91)	53	58		
No reported (37)	25	68		
New York			0.99 (0.70, 1.40)	.951
Reported (656)	313	48		
No reported (173)	83	48		
Rio de Janeiro			0.28 (0.12, 0.63)	.001
Reported (74)	17	23		
No reported (54)	28	52		
Santos			0.31 (0.16, 0.59)	.000
Reported (99)	50	51		
No reported (99)	76	77		
Sydney			0.27 (0.05, 1.76)	.056
Reported (357)	5	1		
No reported (59)	3	5		
Toronto			0.67 (0.21, 2.84)	.485
Reported (384)	17	4		
No reported (62)	4	6		

"Since you first heard about AIDS, have you done anything to avoid getting AIDS?" Those who responded "yes," that they had changed their behavior, were then asked "What have you done?" in an open-format question, without specific prompts and with multiple responses recorded. For each risk reduction mentioned, the subject was then asked, "Have you maintained this change?" This series of questions thus required the subjects to summarize their own deliberate risk reduction over the entire period since they had first heard about AIDS. The subjects were not asked (1) about their levels of risk behavior prior to any changes they might have made, or (2) when changes were initiated. Most subjects reported having made more than a single change in behavior, and any attempt to obtain prechange risk behaviors and the timing of changes would have added considerably to both the time and the complexity of the questionnaire.

An analysis of the types and predictors of self-reported risk reduction and of the community-level effectiveness of the behavioral changes has been conducted for four cities in this study—Bangkok, Glasgow, New York, and Rio de Janeiro.[11] In each of these cities, changes in drug injection behavior were reported more often than changes in sexual behavior. The most commonly reported risk reduction was the "stopped/reduced sharing" of injection equipment. The most commonly reported sexual risk reductions were an increased use of condoms, greater selectivity in choosing sexual partners, and a reduced number of sexual partners. Moreover, preliminary content analyses of responses from injection drug users in New York indicated that those users who knew they were already HIV infected also reported among their AIDS-related behavioral changes efforts to avoid both reexposure to HIV and the transmission of HIV to others.

Results

Table 1 presents selected demographic characteristics, drug use behavior, HIV seroprevalence, and the percentage of subjects in each WHO study city who responded positively that they had changed their behavior in response to AIDS. The variation across the 11 cities in the percentage of subjects reporting deliberate risk reduction, as well as the relationships between risk reduction and current HIV seroprevalence levels among injection drug users, will be the subject of further analyses. (For example, there have been fewer HIV prevention programs in the Brazilian cities.[12])

Table 2 shows the relationship between self-reported AIDS behavioral change and HIV serostatus for the total WHO sample and for each participating city. For the sample as a whole, there was a substantial relationship between self-reported AIDS risk reduction and actual HIV-seronegative status. The protective odds ratio for behavioral change and HIV status was below 0.7 in 8 of the 11 cities. (In Athens, there were too few seropositives (2/396) for meaningful statistical testing.)

To examine potential interactions between demographic and behavioral factors with protective behavioral change, stratified analyses were conducted for subjects in the WHO study; these are presented in Table 3. The relationship between self-reported AIDS risk reduction and HIV-negative status is significant within all of the sociodemographic and drug history subgroups. The subgroup of persons who had injected with equipment used by others in the 6 months prior to the interview is particularly interesting; the protective effect associated with having made some risk reduction was still statistically significant, even among those who clearly had not achieved risk elimination.

The Breslow-Day test[13] for homogeneity of the odds ratios was used for the different subgroups in Table 3. (A visual inspection test can be conducted by looking for lack of overlap in the 95%

confidence intervals for the odds ratios within subgroups.) There was only one statistically significant difference in odds ratios. The relationship between self-reported risk reduction and HIV-seronegative status was stronger ($P < .001$ by Breslow-Day test) among subjects who reported previous HIV testing, although the relationship between reported behavioral change and HIV-seronegative status was statistically significant within both the previously tested and the not-tested groups. Voluntary HIV counseling and testing have themselves been associated with reducing risk behavior,[14–16] so these activities may have increased the degree of risk reduction among the tested subjects. Alternatively, HIV counseling and prevention testing may be correlated with the presence of other HIV prevention efforts in many of these cities.

Within the subgroup reporting negative results on a previous HIV test, it was possible to test a relationship between self-reported risk behavior and apparent HIV seroconversion. "Apparent HIV seroconverters" were operationally defined as persons who had reported seronegative results on a previous HIV test but who were anti-HIV seropositive on the test conducted as part of the WHO study. These subjects were contrasted with subjects who reported seronegative results on a previous HIV test and who were also anti-HIV seronegative on the WHO study test. Previous studies have indicated that injection drug user reports on previous HIV test results are relatively accurate.[9,17]

As shown in Table 4, among the group with negative results on a previous HIV test, self-reported behavioral change was significantly associated with remaining HIV seronegative from the previous HIV test to the time of the interview. Indeed, the relationship between risk reduction and apparent seroconversion remained statistically significant, even when the previously reported data from Bangkok subjects[9] were removed from the analysis. (Data are not reported here but are available from the first author.)

TABLE 3—Protective Effect of Self-Reported AIDS Risk Reduction among Injection Drug Users (n = 4419), by Selected Characteristics

Reported or No Reported Risk Reduction, by Characteristic (No. Respondents)	HIV Positive		Odds Ratio (95% CI)	P
	No.	%		
Overall sample			0.50 (0.42, 0.59)	.000
Reported (3611)	729	20		
No reported (808)	273	34		
Female			0.44 (0.31, 0.62)	.000
Reported (893)	173	19		
No reported (204)	72	35		
Male			0.52 (0.43, 0.63)	.000
Reported (2693)	555	21		
No reported (603)	201	33		
Age < 30 y			0.41 (0.32, 0.53)	.000
Reported (1999)	288	14		
No reported (422)	122	29		
Age ≥ 30 y			0.59 (0.46, 0.74)	.000
Reported (1612)	441	27		
No reported (386)	151	39		
Single			0.38 (0.30, 0.48)	.000
Reported (2206)	355	16		
No reported (493)	165	33		
Not single			0.71 (0.54, 0.93)	.009
Reported (1388)	373	27		
No reported (313)	107	34		
Education < 12 y			0.46 (0.38, 0.56)	.000
Reported (2446)	476	19		
No reported (611)	211	35		
Education ≥ 12 y			0.63 (0.45, 0.90)	.007
Reported (1136)	251	22		
No reported (194)	60	31		
Injected less than 7 years			0.44 (0.32, 0.60)	.000
Reported (1379)	181	13		
No reported (307)	79	26		
Injected 7 years or more			0.50 (0.41, 0.63)	.000
Reported (2104)	520	25		
No reported (467)	184	39		
Previously HIV tested			0.37 (0.30, 0.47)	.000
Reported (2226)	438	20		
No reported (420)	167	40		
Not previously HIV tested			0.73 (0.56, 0.95)	.017
Reported (1333)	284	21		
No reported (380)	103	27		
Injected with used syringes			0.49 (0.39, 0.6261)	.000
Reported (1538)	349	23		
No reported (440)	164	37		
Did not inject with used syringes			0.53 (0.41, 0.69)	.000
Reported (2032)	370	18		
No reported (358)	106	30		

Note. Subjects with missing data were omitted from individual analyses.

Discussion

There are many methodological factors that would work *against* finding a simple relationship between self-reported AIDS risk reduction and the actual avoidance of HIV infection. These would include (1) HIV infection occurring prior to behavioral change; (2) behavioral change that was insufficient to protect against HIV infection; (3) the underreporting of change due to psychological denial of previous risk behavior; (4) the overreporting of change due to denial of present risk behavior; (5) behavioral change among a high percentage of injection drug users in a local population, which may indirectly protect those who do not change their risk behavior; and (6) postinfection behavioral change to avoid reinfection or to protect sexual and drug injection partners from HIV infection. Additionally, the questionnaire did not

TABLE 4—Relationship between Self-Reported AIDS Risk Reduction and Apparent Seroconversion in Injection Drug Users

	Apparent Seroconversion		No Apparent Seroconversion		Odds Ratio (95% CI)	P
	No.	%	No.	%		
Reported risk reduction	110	7	1563	93	0.59 (0.37, 0.96)	.024
No reported risk reduction	25	11	211	89		

ask about respondents' risk behavior before they heard about AIDS. At least some subjects would have been engaged in minimal amounts of risk behavior before that time and would have correctly concluded that they did not need to change their behavior. Such subjects were simply included as "nonchangers" in our analyses.

Many, if not all, of these factors were probably operating for the subjects in this study, although undoubtedly the importance of these factors varied across the different cities. Behavioral change occurring after HIV infection appears to be particularly important in New York and Bangkok. Of course, in both Bangkok[14,18] and New York,[19] HIV had spread very rapidly prior to local awareness of an AIDS threat among injection drug users, and thus very large numbers of the HIV-infected users in these two cities became infected before they had an opportunity to change their behavior.

Nonetheless, despite the likely presence of many of the methodological factors noted above, all of which would have decreased the likelihood of observing a relationship between self-reported behavioral change and subjects remaining HIV seronegative, a substantial protective effect was observed in the sample as a whole from the multisite WHO study. The consistency of this relationship across the different demographic and drug use history subgroups further increases confidence in the validity and effectiveness of the self-reported behavioral changes.

As already noted, however, the WHO questionnaire did not ask about risk behavior prior to behavioral change, so it is not possible to know whether the subjects who reported risk reduction were at particularly high or low risk for HIV prior to making such changes. By the time of data collection for this study, syringe-exchange programs were already an important part of AIDS risk reduction in Glasgow, Sydney, Toronto, London, and New York. Previous research on syringe-exchange programs, however, suggests that exchanges tend to attract drug users who inject drugs frequently and engage in high levels of injection risk behavior.[20,21]

In a study of the Tacoma, Wash, syringe exchange, 94% of the participants reported (in response to the same question used in the WHO study) that they had changed their behavior to avoid getting AIDS. These syringe-exchange participants also reported a mean of 56 unsafe injections (injections with equipment used by others) per month prior to their first use of the exchange; this figure fell to 20 unsafe injections per month while they were using the exchange.[22] This prechange rate of 56 unsafe injections per month among the syringe-exchange participants in Tacoma certainly cannot be considered a low rate of HIV risk behavior. Thus, while it is not possible to know the prechange levels of risk behavior among subjects in the WHO study, the syringe-exchange research would suggest that at least a substantial proportion of those subjects were at high risk for HIV prior to their behavioral change.

In the great majority of AIDS risk reduction studies to date, the researchers have selected the time periods for pre- and postchange behavior (which have usually been rather short), have imposed the units of measurement for the risk reduction, and have attempted to associate the risk reduction with a single prevention activity. The specific set of questions used in this study, on the other hand, permitted the subjects to define risk reduction/behavioral change for themselves and to use the entire time period since they first heard about AIDS, while the kinds of risk reduction considered were not limited to the effects of a single program. It was also possible to obtain considerable detail about the type of behavioral change and about whether that change was maintained over time. Asking subjects about their own perceptions of changes in HIV risk behavior would thus appear to be a very valuable complement to asking questions in which the researchers alone defined those changes.

Finally, our findings provide cross-national evidence for the ability of persons who inject illicit drugs to modify their injection risk behavior in response to the threat of AIDS and to accurately report on those risk reductions, and these findings show as well that these behavioral changes can have a substantial protective effect against injection drug users becoming infected with HIV.

Statistical Afterword

In our analyses, we used conventional inferential statistics, with 95% confidence intervals and statistical significance probability values. The statistical inferences that can be drawn from these tests would refer to the population of injection drug users in these cities studied through the same sampling methods at the same point in historical time. This population is certainly diverse with respect to many factors (e.g., geography and drugs injected), but many researchers and public health officials will be much more concerned with their own local population of injection drug users. The data presented in Table 2 show important variation by city in the relationship between self-reported behavioral change and HIV status, and our Discussion section lists many potential reasons why the relationship may not hold in any given city. Thus, the protective odds ratio (and its 95% confidence limits) found for the total sample in this study should not be considered a good guide for what might be observed in any individual population of injection drug users in the world.

A second important limitation of the conventional inferential statistics used in our analyses is that they do not provide a good estimate of the epidemiological importance of AIDS-related behavioral change in a population of injection drug users. To the best of our knowledge, HIV seroprevalence stabilized in these cities at the level existing when large numbers of these users changed their behavior. These seroprevalence levels ranged from 1% to more than 50%. Thus, the timing of AIDS-related behavioral changes in a population of injection drug users—that is, whether the behavioral changes occur when seroprevalence is still low—will probably be more important than the specific value of the protective odds ratio for self-reported behavioral change and the avoidance of HIV infection. □

Acknowledgments

This research was supported by grant DA03574 from the US National Institute on Drug Abuse and by the WHO Multi-Centre Study of AIDS and Injecting Drug Use.

The authors would like to thank Thomas P. Ward for editorial assistance and expertise during the preparation of this manuscript.

References

1. Stimson GV. The health and social costs of drug injecting: the challenge to developing countries. Presented at the Sixth International Conference on the Reduction of Drug-Related Harm; March 26–30, 1995; Florence, Italy.
2. Stimson GV. Reconstruction of sub-regional diffusion of HIV infection among injecting drug users in South-East Asia: implications for early intervention. *AIDS.* 1994;8:1630–1632.
3. Des Jarlais DC, Friedman SR, Choopanya K, Vanichseni S, Ward TP. International epidemiology of HIV and AIDS among injecting drug users. *AIDS.* 1992;6:1053–1068.
4. Friedman SR, Des Jarlais DC. HIV among drug injectors: the epidemic and the response. *AIDS Care.* 1991;3:239–250.
5. Des Jarlais DC, Friedman SR. AIDS prevention programs for injecting drug users. In: Wormser GP, ed. *AIDS and Other Manifestations of HIV Infection.* 2nd ed. New York, NY: Raven Press; 1992:645–658.
6. Vlahov D, Anthony JC, Celentano D, Solomon L, Chowdhury N. Trends of HIV-1 risk reduction among initiates into intravenous drug use, 1982–1987. *Am J Drug Alcohol Abuse.* 1991;17:39–48.
7. Gibson DR, Young M, Choi K. Drug injectors may underreport drug risk but not sexual risk behavior. 10th International Conference on AIDS; August 7–12, 1994; Yokohama, Japan. Book 1:26. Abstract O77C.
8. Office of National Drug Control Policy. *Needle Exchange Programs: Are They Effective?* Washington, DC: Executive Office of the President, Office of National Drug Control Policy; July 1992. ONDCP Bull 7.
9. Des Jarlais DC, Choopanya K, Vanichseni S, et al. AIDS risk reduction and reduced HIV seroconversion among injection drug users in Bangkok. *Am J Public Health.* 1994;84:452–455.
10. WHO Collaborative Study Group. An international comparative study of HIV prevalence and risk behaviour among drug injectors in 13 cities. *Bull Narc.* 1993;45:19–46.
11. Des Jarlais DC, Friedman SR, Friedmann P, et al. HIV/AIDS-related behavior change among injecting drug users in different national settings. *AIDS.* 1995;9:611–617.
12. Ball A, Des Jarlais DC, Donoghoe M, et al. *Multi-Centre Study on Drug Injecting and Risk of HIV Infection.* Geneva, Switzerland: World Health Organization, Programme on Substance Abuse; July 1994.
13. Breslow NE, Day NE. *Statistical Methods in Cancer Research. Vol 1. Analysis of Case–Control Studies.* Lyon, France: International Agency for Research on Cancer; 1980.
14. Vanichseni S, Choopanya K, Plangsringarm K, et al. HIV testing and sexual behavior among drug injectors in Bangkok, Thailand. *J Acquir Immune Defic Syndr.* 1992;5:1119–1123.
15. Casadonte PP, Des Jarlais DC, Friedman SR, Rotrosen JP. Psychological and behavioral impact among intravenous drug users of learning HIV test results. *Int J Addict.* 1990;25:409–426.
16. Rugg DL, MacGowan RJ. Assessing the effectiveness of HIV counseling and testing: a practical guide. Background paper for WHO Global Programme on AIDS (GPA). Geneva, Switzerland: November 13–16, 1990.
17. McCusker J, Stoddard AM, McCarthy E. The validity of self-reported HIV antibody test results. *Am J Public Health.* 1992;82:567–569.
18. Wright NH, Vanichseni S, Akarasewi P, Wasi C, Choopanya K. Was the 1988 HIV epidemic among Bangkok's injecting drug users a common source outbreak? *AIDS.* 1994;8:529–532.
19. Des Jarlais DC, Friedman SR, Novick D, et al. HIV-1 infection among intravenous drug users in Manhattan, New York City. *JAMA.* 1989;261:1008–1012.
20. Normand J, Vlahov D, Moses LE, eds. *Preventing HIV Transmission: The Role of Sterile Needles and Bleach.* Washington, DC: National Academy Press; 1995.
21. Lurie P, Reingold AL, Bowser B, et al. *The Public Health Impact of Needle Exchange Programs in the United States and Abroad.* Atlanta, Ga: Centers for Disease Control and Prevention; September 1993; 1.
22. Hagan H, Des Jarlais DC, Purchase D, Friedman SR, Reid TR, Bell TA. An interview study of participants in the Tacoma, Washington, syringe exchange. *Addiction.* 1993;88:1691–1697.