DRUG INJECTION RATES AND NEEDLE-EXCHANGE USE IN NEW YORK CITY, 1991–1996

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ABSTRACT Objectives included (1) to develop methods for identifying injection drug users with accelerating injection habits so they might be referred to counseling and treatment and (2) to investigate behavioral correlates of accelerating injection habits, including syringe-exchange program utilization. Data on drug use, enrollment in methadone maintenance, and demographic variables were obtained from 328 subjects who were seronegative for human immunodeficiency virus (HIV) who attended anywhere from 4 to 11 quarterly study visits for interview, HIV pretest counseling and risk reduction counseling, and blood donation for HIV antibody testing. Subjects were recalled 2 weeks after each study visit to receive their results and post-test counseling. We characterized subjects according to their patterns of drug injection as accelerating, decelerating, or stable, using intraindividual regression analyses and categorization rules, and by syringe-exchange use as consistent users, sporadic users, or nonusers. The present subjects included 52% with decelerating, 29% with stable, and 19% with accelerating rates of drug injection. There were 128 subjects (39%) who were categorized as consistent users of syringe-exchange programs, 84 (25%) were categorized as sporadic users, and 116 (35%) were categorized as nonusers. All syringe-exchange groups showed significantly decelerating drug injection. Rates of decline were significantly less, however, among consistent syringe-exchange users than sporadic or nonusers of syringe exchanges. Categorical analysis also showed significant differences among groups, with 30% of consistent syringe-exchange program users having accelerating rates of drug injection compared to 9% of nonusers and 17% of sporadic users. That consistent syringe-exchange users included a larger proportion of individuals whose drug habits were accelerating than did sporadic users or nonusers of syringe exchanges suggests a need for improved identification and counseling of such subjects by syringe-exchange program staff. The present statistical approaches may be of value in targeting such efforts. The ability of a syringe-exchange program to attract a disproportionate share of drug users

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with accelerating rates of drug injection underscores the importance of these programs to HIV prevention efforts.

INTRODUCTION

Needle-exchange programs have been shown to be associated with reduced human immunodeficiency virus (HIV) incidence among injection drug users in New York City.¹ Concern has been voiced, however, that use of syringe-exchange programs might be associated with adverse effects, including increased drug injection.² Although there is no evidence to date that syringe-exchange programs cause increases in illicit drug use, it is important to understand the relationships between trends in drug use and the use of syringe-exchange programs. Information on such relationships is needed to address the potential spread of HIV among drug injectors and the many other health and social problems associated with drug use.

We followed (with frequent recall visits) a cohort of injection drug users at risk for HIV infection. The subjects were recruited by various means and differed widely in their temporal patterns of drug injection and use of syringe-exchange programs: Some reported using syringe exchanges at each study visit, others never reported using syringe exchanges, and yet others reported using syringe exchanges at some, but not all, study visits. Longitudinal data from the cohort thus provided an excellent sample for testing the utility of statistical methods for identifying drug injectors with accelerating drug injection habits and for investigating the correlation of accelerating drug injection with syringe-exchange use.

METHODS

Potential study subjects were HIV-seronegative injection drug users recruited from three hospital-based methadone maintenance clinics located in Manhattan, New York City, and from community outreach. Entry into the cohort required a history of injection drug use in the 6 months prior to enlistment and a willingness to undergo HIV antibody testing. Subjects recruited via community outreach included (1) individuals enlisted from a storefront in southern Manhattan where several drug-related research projects were conducted and (2) individuals who responded to flyers distributed by already enrolled subjects, by medical providers, and by project staff stationed at an information table in the main entry corridor of one of the participating hospitals. Recruitment occurred between October 1991 and December 1994 as part of cohort studies designed to investigate HIV seroincidence and symptoms of primary HIV infection. The last study visit occurred in July 1996.

At each study visit, subjects donated blood for HIV testing, received HIV pretest and risk reduction counseling, and responded to interviewer-administered questionnaires that inquired into demographic, behavioral, and medical information. Interview responses used in the present analyses included weekly rates of alcohol and drug use (in units of ounces of alcohol used/week or uses of specific drugs/week), drug injection rates (in units of injections/week), sources of needles and syringes used for injections, and enrollment in methadone maintenance treatment programs in the prior 3-month period. Subjects returned approximately 2 weeks after each study visit to receive HIV test results and HIV post-test counseling. All procedures involving human subjects were approved by the committees on human experimentation at each of the institutions involved.

Subjects returned for anywhere from 1 to 15 study visits. To provide greater stability in the measures of rates of change in behaviors over time, used herein as dependent variables, only those subjects with at least 4 interviews ($n = 344$) were included. A comparison of those with less than 4 visits ($n = 276$) and those with 4 or more visits showed that they did not differ with respect to gender; ethnicity; years of education; source of income; rate of alcohol consumption (in ounces of alcohol consumed per week); rate of use of any drugs (in uses per week); drug injection rate; rates of using crack, cocaine, heroin, or marijuana; frequency of sharing needles; use of bleach to sterilize needles; or cigarette smoking rates. They did differ somewhat in that those with 4 or more visits tended to be a bit older and to use both methadone maintenance and "shooting galleries" less often.

When needle-exchange groups were formed, 16 did not fit any of the groups, leaving 328 for analysis. We also identified a subset of 221 subjects (from the 328) with injection rates of at least once per week. Analyses of this subset were conducted to ensure that subjects started from a high enough injection rate so that declining trends were possible.

Two different dependent variables were used to classify subjects by their temporal patterns of drug injection. The first was individual regression slopes; intraindividual temporal trends of drug injection rates were calculated by linearly regressing individuals' standardized drug injection rates (i.e., the subject's rates at visits less the subject's mean rate calculated from all visits, divided by the subject's mean rate) against calendar time over each subject's total number of visits. The standardized regression coefficients (i.e., the β -coefficient divided by its standard error) for each person were used as the dependent variable. Individual regression slopes for particular slope variables were calculated only if at least three eligible visits could be included.

The second dependent variable was a composite categorical change variable based on the individual regression slopes and a set of discrete criteria. First, the intraindividual slopes also were categorized as negative trend (decreasing use), no trend, or positive trend (increasing use). A *P* value of 0.2 or less for the slope was used to define a negative trend or positive trend; *P* values greater than 0.2 were defined as no trend. *P* values were used for this classification rather than β values because they tended to have less variability among subjects with small numbers of visits. In addition, rules for classifying injection rates as accelerating or decelerating were created similar to those used by Shore et al.³ The specific criteria for decelerating and accelerating use were based on a comparison of the "starting drug injection rate" (in units of injections/week), as reported at the interview just prior to the period of first reported syringe-exchange use or nonuse, and the "ending drug injection rate," calculated as the mean drug injection rate for the last two visits during the period of syringe-exchange use or nonuse. The definitions used for the discrete criteria were as follows:

- Decelerating use: (1) Ending drug injection rate per week $\leq$ (Starting drug injection rate - 2.5) or (2) Ending drug injection rate $\leq$ (Starting drug injection rate - 2) and ending drug injection rate also is ≤ 0.4 times Starting drug injection rate.
- Accelerating use: (1) Ending drug injection rate $>$ (Starting drug injection rate + 2.3) or (2) Ending drug injection rate $\geq$ (Starting drug injection rate + 2) and ending drug injection rate also is ≥ 2 times starting drug injection rate.
- No change: Any drug injection rate patterns that did not meet the criteria for decelerating or accelerating use.

Composite change categories consisted of all subjects who met the definition for change based on the categories of either the individual temporal regression slopes or the discrete criteria; those who did not meet either definition were put in the no change category.

Subjects were classified into one of three different syringe-exchange use groups following methods similar to those used in the analysis of Des Jarlais et al.¹ of the association of syringe-exchange use with HIV seroincidence. Consistent syringe-exchange users were defined as those who reported using syringe exchanges as a source of needles and syringes at three consecutive visits (during which they also reported drug injection) with no visits thereafter at which syringe exchange use was not reported (unless they stopped injecting). This definition caused data on the rate of drug injections during visits preceding the onset of

consistent syringe-exchange use to be deemed "ineligible." Sporadic syringe-exchange users were those who stopped using syringe exchange for one or more periods during which they also reported drug injection following a period in which they reported syringe-exchange use. Nonusers were defined as subjects who reported drug injection without reporting syringe-exchange use at any visit. Subjects who reported syringe-exchange use only on their last visit or last two visits were not included in any group. The present categorization of subjects by syringe-exchange use did not take into account whether any other needle sources were used concomitant with syringe exchange, although for the majority, when syringe exchange was used, it was the only source given. Note that many of the subjects in this report also contributed person-years at risk to previous analyses assessing the impact of syringe-exchange utilization on HIV seroincidence.¹ The present report, however, includes additional time accrued by the cohort and new analyses.

We planned to interview subjects every 3 months, but the median time between interviews proved to be 3.8 months. The median duration between first and last study visits was 29.7 months (90% range 13.9–44.9 months). Complete follow-up was defined as attendance at 10 or more study visits or a last study visit of January 1, 1996, or later. Using this definition, 58.5% of the 328 subjects had complete follow-up. Completeness of follow-up did not vary by gender, age, race, Hispanic ethnicity, needle-exchange group, or category of change in drug injection rate (i.e., accelerating, decelerating, or stable injection rates over time).

RESULTS

As shown in Table I, the study population was similar demographically to other methadone maintenance populations that have been studied in New York City (i.e., racially diverse, majority male, and mean age in the mid- to late 30s) (see, e.g., Refs. 4 and 5). Although enrollment in methadone maintenance was reported at approximately three-quarters of subject visits, heroin injection was reported at a similar percentage of visits. Substantial majorities of subject visits included reports of having shared works or having injected cocaine in the prior 6 months.

Table II shows a cross tabulation of the categorical classification system for slopes of drug injection rates by categories of syringe-exchange use. Of nonusers of syringe-exchange programs, 9% had increasing trends in drug injection rates versus 17% of sporadic users and 30% of consistent users of syringe-exchange programs. Mantel's chi-square test for trend,⁶ comparing the proportions of consistent syringe-exchange users to nonusers with decelerating, stable, or accelerating drug injection rates, indicated a highly significant trend ($P = .001$) in the

TABLE I Sociodemographic and Drug Use Characteristics of Drug Injectors with Four or More Visits (N = 328)

Characteristic	
Age at study enrollment (mean)	39.5 years (range 20–67)
Gender (%)	
Female	22.0
Male	78.0
Ethnicity (%)	
White	41.2
Black	29.3
Hispanic	28.0
Asian	0.6
Native American	0.6
Other	0.3
Age at first injection (mean)	19.7 years (range 8–50)
Years of injecting reported at the time of cohort enrollment (mean)	19.7 years (range 0–52)
Study visits at which subjects reported being in methadone maintenance treatment programs during the prior 6 months (%)	74.3% (range 0–100)
Subjects (%) who, in the 6 months preceding enrollment,	
Shared works	62.8
Injected heroin	75.3
Injected cocaine	59.1

direction of greater drug injection with time among consistent syringe-exchange users than nonusers. The test for trend also was significant ($P = .004$) when sporadic syringe-exchange users were compared to nonusers, similarly in the direction indicative of greater drug injection with time among sporadic users. In all three syringe-exchange groups, however, the majority of individuals declined or remained stable regarding drug injection rates.

The means and standard deviations of the standardized slopes (i.e., the normal-

TABLE II Temporal Trends in Frequency of Drug Injection Rates by Consistency of Syringe Exchange Use

Group	Temporal Trend in Drug Injection Rates			Total
	Decelerating n (row %)	Stable n (row %)	Accelerating n (row %)	
Nonusers of syringe exchange	78 (67)	28 (24)	10 (9)	116
Sporadic users of syringe exchange	39 (46)	31 (37)	14 (17)	84
Consistent users of syringe exchange	53 (41)	36 (28)	39 (30)	128
Total	170	95	63	328

ized rates of change in drug injection) of consistent, sporadic, and nonusers of syringe exchanges are shown in Table III. All groups declined on average in their drug usage over time. However, the consistent users of syringe exchanges declined significantly less than the sporadic or nonusers of syringe exchanges. Limiting the analysis to those who had an injection rate of at least once per week on the first visit made no qualitative difference in the results. When compared to nonusers of syringe exchanges, the mean of the standardized slopes of consistent users was shifted significantly in the direction of less decline with time ($P = .005$).

DISCUSSION

The most important findings from the present study were (1) the average rates of drug injection declined over time among consistent, sporadic, and nonusers of syringe-exchange programs, and (2) the majority of individuals in the study had patterns of decelerating or stable drug injection rates whether they used needle-exchange programs consistently, sporadically, or not at all. The data reported here were collected from 1991 through 1996. "Underground" syringe-exchange programs were operating on a small scale and without legal authorization in the city from 1990 to the middle of 1992. In the middle of 1992, the programs received legal authorization from the New York State Department of Health and public funding from the state government, and they expanded greatly. If the presence of government-approved syringe-exchange programs were to increase drug injection in the community, we thus would have expected to see evidence of such a trend within the drug injectors in our cohort. To the contrary, however, the study indicates that implementation of syringe-exchange programs in New York City was not associated with widespread increases in drug injection. The overall trend among subjects instead was toward decreasing drug injection over time.

TABLE III Mean Rates of Change with Time in Standardized Drug Injection Rates According to Syringe Exchange Use

Group	Mean Rates of Change Over Time in Standardized Drug Injection Rates* (95% Confidence Interval)
Nonusers of syringe exchange	-1.22 (-1.46, -0.98)
Sporadic users of syringe exchange	-0.69 (-1.04, -0.35)†
Consistent users of syringe exchange	-0.41 (-0.71, -0.10)‡

*Negative values represent a decrease in drug injection rate.

† $P = .003$ for comparison with first group using a nonparametric Wilcoxon test.

‡ $P = .0001$ for comparison with first group using a nonparametric Wilcoxon test.

We did observe that 30% of consistent syringe-exchange users increased their drug injection over time, a percentage that exceeded the 21% and 9% observed among sporadic or nonusers of syringe exchange, respectively. Such persons probably would have increased their drug injection whether or not they had obtained drug injection equipment at syringe-exchange programs.⁷ As has been shown in San Francisco, California,⁸ persons injecting at high frequencies may have been more likely than others to enter New York City syringe-exchange programs. In Seattle, Washington, persons injecting more than daily and those engaging in "backloading" of syringes also have been shown to be less likely to stop using syringe-exchange programs.⁹ The provision of sterile equipment to such persons can provide important harm reduction both to these individuals and to those with whom they might otherwise have shared needles and syringes.

Ordinarily, one would expect high injection frequency and temporally increasing drug injection rates to be positive risk factors for HIV infection. Indeed, since early in the New York City HIV epidemic, we have observed a relationship between high drug injection frequency and HIV infection.¹⁰ In this cohort, even though the consistent syringe-exchange users were less likely to be decreasing their drug use, they were also less likely to become infected with HIV (the HIV incidence rate among consistent syringe-exchange users was 1.5/100 person-years at risk versus a rate of 5.3/100 person-years at risk among nonusers of the syringe exchanges).¹ The modest differences in increasing/decreasing drug injection between users and nonusers of syringe exchange thus seem to have been more than offset by the protective effect of syringe-exchange use against incident HIV infection.

Eliminating the injection behaviors of drug users like those in the present study represents a formidable challenge. Our research staff provided risk reduction counseling to subjects at each study visit. This included advice to abstain from drug injection, to enroll in drug treatment if not already enrolled, and if injections were to continue, to use syringe-exchange programs to obtain sterile needles and syringes. All subjects furthermore were provided with HIV testing and pretest and post-test counseling at each study visit. Those subjects who also used the syringe-exchange programs should have been offered risk reduction at these programs. The finding that one-fourth of the subjects who consistently or sporadically obtained their needles and syringes from syringe-exchange programs nonetheless increased their drug injection rates underscores how difficult it is to achieve positive change in this population.

A central premise of syringe-exchange programs is that protection of clients from blood-borne infections should be provided whether clients are able or

interested in reducing their injection drug use.⁸ Our study has shown that repetitive interviewing of drug injectors and relatively simple statistical methods like those presented here can identify for counseling and referral persons with accelerating drug use. The present data suggest that syringe-exchange programs would be appropriate sites for targeted counseling and referral programs directed at such persons. We note that New York syringe-exchange programs do have some capacity for referrals to drug abuse treatment, and that several programs have also conducted "treatment readiness" sessions to help high-frequency drug users prepare for and benefit from placement into treatment programs. Pilot programs could assess the efficiency of different regimens for identifying persons with accelerating drug use, including various times between interviews and the minimum numbers of interviews needed. We suggest that a starting point in this process might consist of monthly interviews, for a minimum of 4 months, of persons using syringe-exchange or drug treatment programs about their frequency of drug injection. Monthly interviewing would make recall of prior responses unlikely. Use of computer-assisted interviewing techniques could facilitate obtaining the data needed for such analyses rapidly and at low cost. Immediate referral to caseworkers then might help in focusing limited resources on those most in need.

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