Journal of Urban Health: Bulletin of the New York Academy of Medicine, Vol. 85, No. 3
doi:10.1007/s11524-008-9271-1

Greater Drug Injecting Risk for HIV, HBV, and HCV Infection in a City Where Syringe Exchange and Pharmacy Syringe Distribution are Illegal

Alan Neaigus, Mingfang Zhao, V. Anna Gyarmathy, Linda Cisek, Samuel R. Friedman, and Robert C. Baxter

ABSTRACT *Comparing drug-injecting risk between cities that differ in the legality of sterile syringe distribution for injection drug use provides a natural experiment to assess the efficacy of legalizing sterile syringe distribution as a structural intervention to prevent human immunodeficiency virus (HIV) and other parenterally transmitted infections among injection drug users (IDUs). This study compares the parenteral risk for HIV and hepatitis B (HBV) and C (HCV) infection among IDUs in Newark, NJ, USA, where syringe distribution programs were illegal during the period when data were collected, and New York City (NYC) where they were legal. IDUs were nontreatment recruited, 2004–2006, serotested, and interviewed about syringe sources and injecting risk behaviors (prior 30 days). In multivariate logistic regression, adjusted odds ratios (AOR) and 95% confidence intervals (95% CI) for city differences are estimated controlling for potential city confounders. IDUs in Newark (n=214) vs. NYC (n=312) were more likely to test seropositive for HIV (26% vs. 5%; AOR=3.2; 95% CI=1.6, 6.1), antibody to the HBV core antigen (70% vs. 27%; AOR=4.4; 95% CI=2.8, 6.9), and antibody to HCV (82% vs. 53%; AOR=3.0; 95% CI=1.8, 4.9), were less likely to obtain syringes from syringe exchange programs or pharmacies (AOR=0.004; 95% CI=0.001, 0.01), and were more likely to obtain syringes from street sellers (AOR=74.0; 95% CI=29.9, 183.2), to inject with another IDU's used syringe (AOR=2.3; 95% CI=1.1, 5.0), to reuse syringes (AOR=2.99; 95% CI=1.63, 5.50), and to not always inject once only with a new, sterile syringe that had been sealed in a wrapper (AOR=5.4; 95% CI=2.9, 10.3). In localities where sterile syringe distribution is illegal, IDUs are more likely to obtain syringes from unsafe sources and to engage in injecting risk behaviors. Legalizing and rapidly implementing sterile syringe distribution programs are critical for reducing parenterally transmitted HIV, HBV, and HCV among IDUs.*

KEYWORDS *HIV, HBV, HCV, Drug injectors, IDU, Risk behaviors, Syringe exchange, Needle exchange, Pharmacy syringes.*

Neaigus, Zhao, Gyarmathy, and Cisek are with the Institute for International Research on Youth at Risk, National Development and Research Institutes, New York, NY, USA; Neaigus is with the Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY, USA; Gyarmathy is with the Department of Mental Health, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA; Friedman is with the Institute for AIDS Research, National Development and Research Institutes, New York, NY, USA; Friedman is with the Department of Epidemiology, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA; Baxter is with the North Jersey Community Research Initiative, Newark, NJ, USA.

Correspondence: Alan Neaigus, PhD, Institute for International Research on Youth at Risk, National Development and Research Institutes, 71 West 23rd Street, 8th Floor, New York, NY 10010, USA. (E-mail: neaigus@ndri.org)

INTRODUCTION

One of the main interventions to prevent the parenteral spread of human immunodeficiency virus (HIV) as well as the hepatitis B virus (HBV) and hepatitis C virus (HCV) among injection drug users (IDUs) has been legal sterile syringe distribution programs. Most studies that have evaluated syringe exchange programs (SEPs) have found that they have reduced the risk of infection with HIV, HBV, and HCV among IDUs.[1–10] However, the legalization of SEP and other syringe distribution programs (e.g., pharmacy sales) is not universal in the USA,[11–13] and the programs are often restricted in reaching IDUs because of laws limiting their operation and other factors, such as geographic location[14] and police harassment.[15,16]

In New York State, except for a very limited pilot program run by the New York City (NYC) Department of Health between 1988 and 1990, SEPs have been legal since 1992 when the New York State Department of Health (NYSDOH) provided a special waiver from the syringe possession laws to allow for the limited operation of SEPs in the state.[11] In January 2001, the Expanded Syringe Access Demonstration Program (ESAP) was established, which legalized the nonprescription purchase of syringes in participating pharmacies. Under ESAP, licensed pharmacies that were registered with the NYSDOH were allowed to sell up to ten syringes to adults who were 18 years of age or older.[17] As a result of an independent evaluation in January 2003, ESAP was extended through September, 2007. In the evaluation, preliminary data from Harlem indicated a downward trend in syringe sharing, increasing utilization of pharmacy syringe sources by IDUs, and no increase in discarded needles or syringes.[18,19]

By contrast, in New Jersey and in Newark, which is the largest city in the state, the distribution of sterile syringes for the purpose of injecting drugs was illegal prior to December 19, 2006. On that date, Governor Jon Corzine signed into law the "Bloodborne Disease Harm Reduction Act." The Act allows for the establishment of sterile syringe distribution programs, combined with facilitating access to drug abuse treatment for IDUs. However, the scope of the act is limited, since it authorizes the establishment of syringe access programs in no more than six municipalities, which must also be authorized by each municipal government. Furthermore, the legislation does not provide any funding for the programs, instead requiring a separate appropriation from the state or funding from cities that are authorized to establish programs. An additional $10 million was made available for drug treatment programs as part of the bill, but this was not dedicated to the syringe access programs but rather to drug treatment programs statewide.

These differences in the drug injecting "risk environment,"[20] i.e., in drug-injecting risk factors that are exogenous to the individual, such as laws governing the distribution of syringes, in NYC and Newark provide the context for a "natural experiment" to assess the efficacy of legalizing sterile syringe distribution to IDUs as a "structural" intervention.[21] Structural interventions are independent of the individual and involve the influence of macrolevel factors on individual infection risk among IDUs. Such quasiexperimental methods, with appropriate controls for possible confounding factors that are associated with city differences, can investigate city-level (or other jurisdictional-level) factors that are associated with the risk for HIV and other blood-borne infections among IDUs.

Studies of the efficacy of legal sterile syringe distribution programs that compare IDU populations are needed. One of the factors that may account for null or negative results in some studies of SEP efficacy, such as in Montreal[22] and Vancouver,[23] is that

they were conducted in the same population of IDUs with a possible selection bias from higher-risk IDUs attending the SEPs.[10,24–28] In addition, studies conducted in the same population can suffer from a contamination bias resulting from the diffusion of sterile syringes into the IDU population through IDU social networks and the "gray market"[29] that can decrease the measured effect of syringe distribution programs. It is also practically and ethically difficult to conduct randomized controlled studies among IDUs in the same population without providing access to sterile syringes for those not assigned to the treatment group, particularly since public health agencies in the USA have recommended SEPs as an effective intervention to reduce HIV and other parenterally transmitted diseases.[7,30–32]

The study was conducted in the NYC and Newark metropolitan area in the Northeast of the USA. Newark is approximately 10 mi (16 km) from NYC and geographically separated from it by the Hudson River. Approximately 8 million people reside in NYC and about 450,000 in the greater Newark area, comprising Newark and the contiguous cities of East Orange and Irvington. The population of Newark is predominantly nonwhite (54% African-American/black, 30% Hispanic [of any race/ethnicity], and 27% white), while in NYC, overall, the population is more heterogeneous by race/ethnicity (25% African-American/black, 27.0% Hispanic [of any race ethnicity], 35.0% white, and 10% Asian/Pacific Islander).[33]

In the following, we compare HIV, HBV, and HCV seroprevalence, syringe acquisition sources, and injecting risk behaviors among IDUs in NYC and Newark and assess whether city differences in infection prevalence, syringe sources, and injecting risk persist after potential confounders are controlled. The data were collected from May 2004 through December 2006, during which the distribution and possession of syringes for injecting drugs was illegal in Newark but was legal in NYC through SEPs and pharmacy sales.

MATERIALS AND METHODS

Sampling and Recruitment

Participants were recruited from May 2004 through December 2006 for a study of the neighborhood and social network context of HIV and hepatitis risk among IDUs and their sex partners. In each city, IDUs were recruited from nondrug treatment settings using identical methods, including targeted street outreach to recruit IDUs in high drug use areas and chain referral methods to recruit IDUs whom participants in the study had nominated as members of their injecting risk networks.[34–36] Targeted outreach involved social mapping to determine where and when IDUs could be found in the areas of recruitment. Study recruiters used this information to recruit potential participants. In the chain referral recruitment, study participants were offered a $10 incentive to refer their nominated IDU network members to the study. IDU participants in NYC were recruited from Manhattan (the East Village/Lower East Side and Harlem), the South Bronx, and Central Brooklyn, with the majority recruited from the East Village/Lower East Side. In Newark, most participants were recruited from the Central, West, and South Wards, where the population is predominantly African-American/black, and the North Ward, where there is a growing Hispanic population. Eligible drug-injecting participants were 18 years of age or older and injected drugs (heroin, cocaine, or methamphetamines) within the prior 30 days. Recent drug use was verified through urine drug toxicology tests (Varian On-Site CupKit) and recent injecting through visual inspection of arms or other visible body sites for fresh injecting marks.

After giving their informed consent, eligible participants were interviewed in private by a trained interviewer using a computer-based, structured questionnaire at research offices in the recruitment areas. Following the interview, participants were pretest counseled for HIV, HBV, and HCV. If they gave their informed consent, their blood specimens were collected by a trained phlebotomist/counselor. Drug treatment and health and social service referrals were provided on request. Those returning for their test results were offered referrals for further health and social services. Participants were paid $30.00 for the interview and pretest counseling. The Institutional Review Board at the National Development and Research Institutes reviewed all procedures involving human subjects.

Measurement and Variables

In the interview, participants were asked about their sociodemographic and other background characteristics, medical and drug dependence treatment history, the date (month and year) and their age when they first started to inject drugs, their drug use and injecting risk behaviors (last 30 days), and their syringe acquisition sources (last 30 days).

Participants' age, race/ethnicity, gender, education, homeless status, income level in the last 6 months, and receiving drug dependence treatment were self-reported. The variable 'years since initiated injecting' was created from the difference between the participant's interview date and the date when the participant injected drugs for the very first time.

Injecting risk behaviors included: receptive syringe sharing (injecting "…with a syringe which you are sure had been used before by another injector to inject drugs"), distributive syringe sharing (injecting "…with a syringe and [giving] it to another injector who used it to inject drugs"), injecting with a used syringe obtained from another injector, reusing a syringe that the participant had previously injected with, injecting with a new, sterile syringe once only that had been sealed in a wrapper (injecting "…with a new, sterile syringe that was sealed in a wrapper, used it once, and never used it again"), sharing a cooker, cotton, or rinse water, which had been used by other injectors, receptive syringe-mediated drug sharing (injecting "…with a syringe after another injector squirted drugs into it from his or her syringe"), and distributive syringe-mediated drug sharing ("…squirt[ing] drugs from your previously used syringe into another injector's syringe"). The city of recruitment was the city where the participant was recruited and injected drugs in the last 30 days.

Several variables were treated as potential confounders of city differences in injecting risk behaviors, including: sociodemographic characteristics (age, gender, race/ethnicity, education, homelessness, and income level), the number of years since initiating injecting, currently being in drug dependence treatment, the frequency of injecting drugs, the types of drugs injected (heroin, cocaine, and speedball—a mixture of heroin and cocaine), the types of noninjection drugs used (heroin, crack cocaine, and powder cocaine), whether the main injecting location was the participant's own home, and self-reported infection status for HIV, HBV, and HCV.

Blood specimens were tested for HIV-1 antibody (enzyme immunoassay [EIA] with Western Blot confirmation [Abbott]), antibody to the hepatitis B core antigen (HBVcAb; Abbott hepatitis B virus core antigen [recombinant] CORZYME immunoassay), and HCV antibody (Abbott HCV EIA 3.0). A positive test for the HBVcAb indicates ever being infected with the pathogen and does not, by itself, indicate current infection.

Statistical Analyses

Differences in sociodemographic and other background characteristics, drug use characteristics, and self-reported infection status by city were tested in bivariate analysis using the chi-square test or Fisher's exact test for categorical variables and the independent two-group t test for continuous variables. Those characteristics that were significantly different by city at $p<0.05$ were treated as potential city confounders. Because infection prevalence among IDUs is often associated with race/ethnicity[37,38] and the number of years since initiating injecting,[39] both the crude odds ratio (OR) of infection seroprevalence by city and the adjusted OR (AOR; adjusted by race/ethnicity and years since initiating injecting) were estimated. In addition, infection seroprevalence by city was examined separately for African-Americans and/or Hispanics, with adjustment for years since initiating injecting. The analyses of city differences in syringe sources and injecting risk behaviors were first analyzed in bivariate analysis to obtain the crude ORs by city and then in simultaneous multivariate logistic regression, controlled by potential city confounders, to estimate the city AORs and 95% confidence intervals (95% CIs). These multivariate analyses were conducted for the entire sample and a subsample of African-Americans and/or Hispanics. A confirmatory stepwise analysis was conducted by including the candidate confounders in the model using backward selection, with a significance level to stay of 0.05 and city forced in. All analyses were conducted using SAS v9.1 (SAS Institute, Cary, NC, USA).

RESULTS

Of the 566 participants recruited for the study, those who injected drugs in the 30 days prior to the interview ($N=526$) comprise the analysis sample, including 214 (41%) from Newark and 312 (59%) from NYC. Overall, the average age was 32.8 years, almost three quarters (72%) were male, and over half (55%) self-identified as African-American/Black or Hispanic race/ethnicity (Table 1). More than half did not graduate from high school or receive a general educational development (GED) diploma, and the majority reported being homeless and having an income of less than $5,000 in the last 6 months. The average number of years since initiating injecting was 10.5 years, and 18% currently received drug dependence treatment. The mean frequency of injecting in the last 30 days was 75 times. Most (93%) injected heroin by itself and about half cocaine by itself and speedball, but they may also have used other injection and noninjection drugs. Approximately a third used noninjection heroin and noninjection crack cocaine, and a fifth used noninjection powder cocaine. The most frequently reported injecting setting was the participant's home. Participants who self-reported a positive serostatus included 32% for HCV, 10% for HIV, and 5% for HBV. Newark participants were significantly older, more likely to be African-American/black, and less likely to be white, were more likely to be low income and to have injected for a greater number of years, and were less likely to be receiving drug dependence treatment. Those in Newark also injected more frequently, were less likely to inject heroin by itself and to use noninjection powder cocaine, and were more likely to inject speedball and to inject in their own home. Newark participants were more likely than those in NYC to report that they were HIV positive.

Of those tested, 67 (14%) were HIV positive, 214 (46%) HBVcAb positive, and 320 (66%) HCV positive (Table 2). The seroprevalence for each infection was consistently greater among Newark participants who, after adjustment for race/

TABLE 1 Sociodemographic background, drug use characteristics, and self-report of infection status among drug injectors in Newark, NJ and New York City, by city of recruitment, 2004–2006

	Total, *N* (%)	Newark, *N* (%)	NYC, *N* (%)	*p* value
Total	526 (100)	214 (40.7)	312 (59.3)	
Sociodemographics				
Age—mean (SD)	32.8 (8.8)	39.1 (7.1)	28.4 (7.0)	<0.0001
Male	379 (72.1)	152 (71.0)	227 (72.8)	0.6644
Race/ethnicity				<0.0001
African-American/black	110 (20.9)	96 (44.9)	14 (4.5)	
Hispanic	177 (33.7)	73 (34.1)	104 (33.3)	
White	223 (42.4)	44 (20.6)	179 (57.4)	
Other	16 (3.0)	1 (0.5)	15 (4.8)	
African American/black or Hispanic	287 (54.6)	169 (79.0)	118 (37.8)	<0.0001
Education				
Less than high school graduate or no GED	280 (53.3)	120 (56.3)	160 (51.3)	0.2544
Currently homeless	323 (61.4)	127 (59.3)	196 (62.8)	0.4214
Income<$5,000 in last 6 months	319 (60.6)	145 (67.8)	174 (55.8)	0.0059
Drug use background				
Years since initiated injecting—mean (SD)	10.5 (8.5)	13.4 (10.1)	8.5 (6.5)	<0.0001
Currently in drug dependence treatment	96 (18.3)	16 (7.5)	80 (25.6)	<0.0001
Drugs used in the past 30 days				
Drug injecting frequency (no. of times)—mean (SD)	75.0 (71.5)	92.0 (78.7)	63.4 (63.7)	<0.0001
Injected heroin by itself	488 (92.8)	192 (89.7)	296 (94.9)	0.0278
Injected cocaine by itself	272 (51.7)	115 (53.7)	157 (50.3)	0.4410
Injected speedball	279 (53.0)	154 (72.0)	125 (40.1)	<0.0001
Used noninjection heroin	171 (32.6)	77 (36.0)	94 (30.2)	0.1667
Used noninjection crack cocaine	197 (37.5)	81 (37.9)	116 (37.2)	0.8758
Used noninjection powder cocaine	110 (20.9)	33 (15.4)	77 (24.7)	0.0110
Most frequent injecting location in the past 30 days				
Participant's own home	272 (51.7)	141 (65.9)	131 (42.0)	<0.0001
Self-reported infection status				
HIV positive	51 (9.7)	42 (19.6)	9 (2.9)	<0.0001
HBV positive	25 (4.8)	10 (4.7)	15 (4.8)	0.9432
HCV positive	169 (32.1)	68 (31.8)	101 (32.4)	0.8858

ethnicity and years since initiating injecting, were more than three times more likely to test HIV positive (26% vs. 5%; AOR=3.2; 95% CI=1.6, 6.1), more than four times more likely to test HBV positive (70% vs. 27%; AOR=4.4; 95% CI=2.8, 6.9), and three times more likely to test HCV positive (82% vs. 53%; AOR=3.0; 95% CI=

TABLE 2 HIV, HBV, and HCV seroprevalence among drug injectors in Newark, NJ, and New York City, by city of recruitment, 2004–2006

	Total, *n* positive/*n* tested (% positive)	Newark, *n* positive/*n* tested (% positive)	NYC, *n* positive/*n* tested (% positive)	OR (95% CI)	AOR (95% CI)	*p* value
All participants[a]						
HIV+	67/487 (13.7)	52/199 (26.1)	15/288 (5.2)	6.5 (3.5–11.9)	3.2 (1.6–6.1)	0.0007
HBV+	214/469 (45.5)	142/204 (69.6)	72/265 (27.1)	6.2 (4.1–9.2)	4.4 (2.8–6.9)	<0.0001
HCV+	320/487 (65.6)	169/205 (82.4)	151/282 (53.4)	4.1 (2.7–6.3)	3.0 (1.8–4.9)	<0.0001
African American/Black or Hispanic[b]						
HIV+	58/266 (21.8)	49/159 (30.8)	9/107 (8.4)	4.9 (2.3–10.4)	4.0 (1.8–8.6)	0.0006
HBV+	154/267 (57.7)	114/165 (69.1)	40/102 (39.2)	3.5 (2.1–5.8)	3.0 (1.8–5.2)	<0.0001
HCV+	197/269 (73.2)	132/165 (80.0)	65/104 (62.5)	2.4 (1.4–4.2)	1.8 (1.02–3.3)	0.0414

[a]AOR adjusted by race/ethnicity and years since initiated injecting
[b]AOR adjusted by years since initiated injecting

1.8, 4.9). A similar pattern was found among African-American/black or Hispanic participants (Table 2).

The relationship of city of recruitment to syringe acquisition sources was sharply differentiated (Table 3). Very few (5%) in Newark reported that they obtained new sterile syringes from legal sources (SEP or pharmacy), while almost all (93%) in NYC reported that they obtained new sterile syringes from these sources (AOR = 0.004, 95% CI = 0.001, 0.01), including two thirds who obtained syringes from SEPs (either directly or from other SEP attendees) and almost half who obtained syringes from pharmacies. By contrast, there was a reverse pattern for obtaining illegal "new" syringes. Almost all (93%) participants from Newark obtained illegal "new" syringes and were more than 100 times more likely to do so than those from NYC (AOR = 117.1; 95% CI = 47.88, 286.33), with almost three quarters reporting that they obtained illegal "new" syringes from street sales and a fifth who reported that they obtained them from friends or relatives.

Newark participants were more likely to engage in unsafe injecting in the last 30 days (Table 4). They were over twice as likely to inject with a used syringe from another injector (19% vs. 8%, AOR = 2.32; 95% CI = 1.07, 5.04), three times more likely to reuse their own syringe (38% vs. 14%, AOR = 2.99, 95% CI = 1.63, 5.50), and over five times more likely to report that they did not always inject once only with a new sterile syringe that had been sealed in a wrapper (90% vs. 60%, AOR = 5.43, 95% CI = 2.86, 10.30). In the simultaneous multivariate model, there were no significant differences in receptive and distributive syringe sharing, although distributive syringe sharing tended to be greater among Newark IDUs. There were also no significant city differences in sharing cookers, cotton, or rinse water (however, substantial proportions in both cities reported this behavior) and in receptive and distributive syringe-mediated drug sharing. A subanalysis of injecting risk behaviors among African-American/black or Hispanic participants found no substantive change in the direction and magnitude of the AORs (data not shown), although injecting with a used syringe from another injector lost significance (16.0% in Newark vs. 8.5% in NYC; AOR = 1.8; 95% CI = 0.64, 5.12; $p < 0.27$). The confirmatory stepwise analysis replicated the significant city differences from the simultaneous multivariate analysis. In addition, city differences in receptive syringe sharing became significant

TABLE 3 Syringe acquisition sources among drug injectors in Newark, NJ, and New York City, by city of recruitment, 2004–2006

	Total, *N* (%)	Newark, *N* (%)	NYC, *N* (%)	OR (95% CI)	AOR (95% CI)[a]	*p* value
Total	526 (100)	214 (40.7)	312 (59.3)			
Legal new sterile syringe acquisition sources						
By going to a SEP yourself						
No	331 (62.9)	212 (99.1)	119 (38.1)	0.01	0.01	<0.0001
Yes	195 (37.1)	2 (0.9)	193 (61.9)	(0.001–0.02)	(0.001–0.03)	
From someone else who went to SEP						
No	482 (91.6)	212 (99.1)	270 (86.5)	0.06	0.11	0.0072
Yes	44 (8.4)	2 (0.9)	42 (13.5)	(0.01–0.25)	(0.02–0.55)	
From SEP by yourself or others						
No	316 (60.1)	210 (98.1)	106 (34.0)	0.01	0.01	<0.0001
Yes	210 (39.9)	4 (1.9)	206 (66.0)	(0.004–0.03)	(0.004–0.04)	
From a pharmacy						
No	369 (70.2)	207 (96.7)	162 (51.9)	0.04	0.03	<0.0001
Yes	157 (29.8)	7 (3.3)	150 (48.1)	(0.02–0.08)	(0.01–0.07)	
From SEP or pharmacy						
No	227 (43.2)	204 (95.3)	23 (7.4)	0.004	0.004	<0.0001
Yes	299 (56.8)	10 (4.7)	289 (92.6)	(0.002–0.01)	(0.001–0.01)	
Illegal "new" syringe acquisition sources						
From a person selling syringes on the street						
No	361 (68.6)	59 (27.6)	302 (96.8)	79.31	74.02	<0.0001
Yes	165 (31.4)	155 (72.4)	10 (3.2)	(39.48–159.3)	(29.9–183.2)	
From a friend or relative with syringes						
No	469 (89.2)	169 (79.0)	300 (96.2)	6.66	5.44	0.0001
Yes	57 (10.8)	45 (21.0)	12 (3.8)	(3.43–12.93)	(2.31–12.85)	
From other sources						
No	503 (95.6)	203 (94.9)	300 (96.2)	1.35	1.96	0.2576
Yes	23 (4.4)	11 (5.1)	12 (3.8)	(0.59–3.13)	(0.61–6.31)	
Any illegal new syringes acquisition						
No	296 (56.3)	15 (7.0)	281 (90.1)	120.3	117.1	<0.0001
Yes	230 (43.7)	199 (93.0)	31 (9.9)	(63.24–228.7)	(47.88–286.33)	

[a]AOR adjusted by age, race/ethnicity, income, years since initiated injecting, currently in drug dependence treatment, number of times injected in past 30 days, injected heroin in past 30 days, injected speedball in past 30 days, used noninjection cocaine in past 30 days, the most frequent injecting location is participant's own residence, and self-reported being HIV infected

(AOR=1.70; 95% CI=1.11, 2.62), with other significant covariates including a greater frequency of injecting in the last 30 days (AOR=1.003, 95% CI=1.001, 1.006) and, as a protective factor, participants reporting that their main injecting location was their own home (AOR=0.584; 95% CI=0.383, 0.890).

DISCUSSION

In this study, the risk of having been infected with HIV, HBV, and HCV was greater in Newark than in NYC, even after controlling for possible city confounders. Among African-American/black or Hispanic participants, populations that historically have had higher HIV infection rates than whites,[37,40] the risk of having been infected was also greater in Newark. However, the prevalence of HCV was disturbingly high in both cities.

TABLE 4 Injecting risk behaviors in the past 30 days among drug injectors in Newark, NJ and New York City, by city of recruitment, 2004–2006

	Total, *N* (%)	Newark, *N* (%)	NYC, *N* (%)	OR (95% CI)	AOR (95% CI)[a]	*p* value
Total	526 (100)	214 (40.7)	312 (59.3)			
Injected with a used syringe from another injector						
No	460 (87.5)	173 (80.8)	287 (92.0)	2.72	2.32	0.0337
Yes	66 (12.5)	41 (19.2)	25 (8.0)	(1.60–4.63)	(1.07–5.04)	
Reused own syringe						
No	403 (76.6)	133 (62.1)	270 (86.5)	3.91	2.99	0.0004
Yes	123 (23.4)	81 (37.9)	42 (13.5)	(2.56–6.00)	(1.63–5.50)	
Did not always inject once only with a new, sterile syringe that had been sealed in a wrapper						
No	147 (27.9)	22 (10.3)	125 (40.1)	5.79	5.43	<0.0001
Yes	379 (72.1)	192 (89.7)	187 (59.9)	(3.52–9.50)	(2.86–10.30)	
Receptive syringe Sharing						
No	398 (75.7)	150 (70.1)	248 (79.5)	1.65	1.54	0.1497
Yes	128 (24.3)	64 (29.9)	64 (20.5)	(1.11–2.47)	(0.86–2.79)	
Distributive syringe sharing						
No	386 (73.4)	149 (69.6)	237 (76.0)	1.38	1.64	0.0973
Yes	140 (26.6)	65 (30.4)	75 (24.0)	(0.93–2.04)	(0.91–2.94)	
Shared cooker/filter/rinse water						
No	318 (60.5)	121 (56.5)	197 (63.1)	1.32	1.08	0.7590
Yes	208 (39.5)	93 (43.5)	115 (36.9)	(0.92–1.88)	(0.65–1.82)	
Receptive syringe-mediated drug sharing						
No	436 (82.9)	168 (78.5)	268 (85.9)	1.67	1.43	0.2980
Yes	90 (17.1)	46 (21.5)	44 (14.1)	(1.06–2.63)	(0.73–2.81)	
Distributive syringe-mediated drug sharing						
No	442 (84.0)	175 (81.8)	267 (85.6)	1.32	1.07	0.8376
Yes	84 (16.0)	39 (18.2)	45 (14.4)	(0.83–2.11)	(0.53–2.17)	

[a]AOR adjusted by age, race/ethnicity, income, years since initiated injecting, currently in drug dependence treatment, number of times injected in past 30 days, injected heroin in past 30 days, injected speedball in past 30 days, used noninjection cocaine in past 30 days, the most frequent injecting location is participant's own residence, and self-reported being HIV infected

As expected, there were dramatic differences in syringe acquisition sources. Almost none of the Newark IDUs obtained syringes from legal sources, while almost all of those in NYC did. However, most IDUs in Newark obtained syringes that they considered "new" from other sources, particularly from street sales and from friends or relatives. IDUs in Newark, out of necessity, appear to have adapted to a risk environment in which sterile syringes were not legally available by obtaining syringes that they believed were "new" from other, potentially unsafe sources. Although we did not test such "new" syringes for HIV or hepatitis viruses, there is a risk that at least some of the illegal "new" syringes acquired by IDUs in Newark, particularly those from street sellers, who have no local access to sterile syringes from legal syringe distribution programs, may have been used previously and repackaged for sale.[41,42]

The city differences in injecting risk behaviors that involved the direct sharing of syringes indicate that IDUs in Newark are at greater risk of injecting with syringes previously used by other injectors. They were also more likely to reuse their own syringes, which would increase their likelihood of acquiring bacterial infections, and possibly injecting with syringes that other injectors may have used but of which they were unaware. Assuming that at least some of the illegal, "new" syringes diverted

from other sources are sterile, there was still insufficient "new" syringe coverage[43] in Newark from these "gray market" sources, since IDUs in Newark were more than five times more likely not to have always injected once only with a new sterile syringe that had been sealed in a wrapper. "Indirect" injecting equipment-sharing practices (e.g., sharing cookers) to prepare and distribute the drug solution were considerable in both cities and may account for the very high prevalence of HCV and substantial prevalence of HBV in both cities, since these pathogens can be efficiently transmitted through sharing drug preparation equipment.[44] In addition, since HBV is also efficiently transmitted through sex, unprotected sex with high-risk sex partners may have contributed to the substantial prevalence of HBV.[45] Even in cities with sterile syringe distribution programs, more needs to be done to prevent HBV and HCV infection among drug users. Specifically, given the high transmissibility of HBV and HCV, public health agencies, SEPs, and other harm reduction organizations need to place greater emphasis on protecting drug users from sharing drug preparation equipment in addition to sharing syringes[46] and on promoting hygienic injecting practices and preventing unsafe sex. Moreover, since an effective, safe, and inexpensive vaccine is available against HBV, greater efforts are needed to facilitate wider HBV vaccine coverage and uptake among drug users.

One of the limitations of the study is the possibility of an "ecological fallacy" in which the aggregate association of city differences in the legality of syringe distribution programs with infection seroprevalence, syringe sources, and injecting risk behaviors may not be reproduced at the individual level.[47] However, in this study, we controlled for several variables that may be potential confounders of city differences. Moreover, the findings from this study are confirmed by most of the studies conducted at the individual level, as cited previously, which demonstrate that IDUs who obtain their syringes from SEPs or other legal sources are at lower risk of parenterally transmitted HIV and other blood-borne infections than IDUs who do not. However, because only two cities were examined, the ability to generalize from the data is limited. A larger, multilevel study of the effect of city differences in the legality of sterile syringe distribution and in program implementation would provide a greater understanding of both city and individual effects (and their interaction) on injecting risk behaviors. With cross-sectional data, the temporal direction between city differences in sterile syringe provision and individual differences in injecting risk behaviors and infection cannot be definitively determined. However, the difference in legal syringe distribution between NYC and Newark predated by many years the recruitment of the sample and the period in which risk behaviors were measured. In addition, longitudinal studies, for example, in NYC by Des Jarlais et al.[1] and in Chicago by Huo and Ouellet,[10] have found that the use of SEPs is protective against HIV and parenteral infection risk for HBV and HCV. The use of self-report data may have contributed to the underreporting of more stigmatized behaviors, such as sharing syringes, although the bias may have been similar in both samples. While the methods used for sampling and recruiting in this study have been used by many other studies of nondrug treatment-recruited drug users, the sample is nonrandom, so that generalizations from the study's findings must be informed by an understanding of this possible limitation.

The efficacy of legally providing sterile syringes to IDUs to prevent infection with HIV and other blood-borne infections is supported by most studies that have examined the issue.[48] Moreover, other studies have found that sterile syringe programs are not associated with an increase in the initiation or resumption of injecting drug use.[48–52] The legal provision of sterile syringes is also likely to have long-term

consequences for reducing infection risk among IDUs.[10] Our present study provides yet further evidence that the provision of legal sterile syringes reduces the risk of HIV and other blood-borne infections. Similarly, in an earlier international comparison of HIV seroprevalence in cities with and without SEPs, the average annual change in seroprevalence was 11% lower in cities with SEPs than in cities without them.[53]

The disparities in infection prevalence and injecting risk behaviors between IDUs in Newark and NYC underscore the critical need to fully implement legal sterile syringe distribution programs in NJ and in other jurisdictions in the USA with minimum delay. In Newark, which has the most HIV/AIDS cases of any city in New Jersey, injection drug use accounted for 47% of 13,045 cumulative cases, followed by 31% for heterosexual contact, much of which is through sexual contact with IDUs.[54] In the 12-month period from July 1, 2005 through June 30, 2006, injection drug use directly accounted for 21% of 346 newly diagnosed HIV infections in Newark,[55] whereas in NYC, it directly accounted for 7% of 1,879 newly diagnosed HIV infections reported in 2005 among African-Americans and Hispanics combined.[56]

Given the extremely high HIV disease burden in New Jersey from injecting drug use, the rapid implementation of legal sterile syringe distribution programs for IDUs is a necessary and prudent public health initiative with proven efficacy that is strongly justified by the science. Although the continuation of restrictions on the use of federal funds for sterile syringe distribution is inconsistent with the recommendations of public health agencies in the USA[7,30–32] the implementation of legal sterile syringe distribution programs at the state and local level, such as those in NYC and potentially in Newark, can prevent avoidable infections with HIV and hepatitis among IDUs.

ACKNOWLEDGMENTS

The study was funded by the US National Institute on Drug Abuse, grant R01 DA014515 "HIV Risk and Neighborhood Networks of IDUs" (Principal Investigator: Alan Neaigus). We would like to thank Vera Frajzyngier for assisting in directing the data collection and other members of our research staff at the National Development and Research Institutes who worked on the study. The North Jersey Community Research Initiative (NJCRI) in Newark, NJ, USA, and their outreach staff provided major support for data collection in Newark, and Corey Rosmarin and the phlebotomy staff at NJCRI provided assistance in the collection of blood specimens for the Newark participants. This research would not have been possible without the consent of the drug users who agreed to participate in this study.

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