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Bleach Use and HIV Seroconversion Among New York City Injection Drug Users

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Summary: We employed a nested case–control study design to evaluate the efficacy of bleach-cleaning of needles and syringes among injecting drug users (IDUs) as a means of preventing human immunodeficiency virus (HIV) infection. Sixteen HIV-seroconverters who responded to bleach use questions and who reported injecting with shared or used equipment in the 6 months prior to their first positive visit were compared with 89 controls. Controls had remained HIV-seronegative at two or more visits, reported injecting with shared or used equipment, responded to bleach-cleaning questions, and were seen at recall visits ± 6 months from the date of seroconversion of the index case. Risk factors associated with HIV seroconversion in univariate analyses were a history of sexual intercourse with an HIV-infected partner and the frequency of speedball (mixed heroin and cocaine) injections. After adjusting for confounders, we found no evidence that bleach use protected against HIV infection. **Key Words:** Disinfection—Injection drug users—HIV seroconversion—Prevention—Public health—Risk factors.

A primary focus of reduction of risk for human immunodeficiency virus (HIV) among injecting drug users (IDUs) in the United States has been the promotion of household bleach as a disinfecting agent for needles and syringes possibly contaminated with HIV. Current research findings have questioned the efficacy of the recommended 10% bleach solution, particularly as used by IDUs in real-life situations, for decontaminating needles and syringes that may contain viable HIV encapsulated in clotted blood (1–8). In response to these and other findings, the Centers for Disease Control and Prevention (CDC), the Center for Substance Abuse Treatment (CSAT), and the National Institute on Drug Abuse (NIDA) issued a "Community Alert Bulletin," urging a more aggressive abstinence message and stricter needle-cleaning guidelines emphasizing that "disinfectants do not sterilize equipment" (9).

In a study of African-American IDUs in Baltimore, Vlahov et al. (1) concluded that disinfectant use had a limited protective effect. Their study was restricted, however, to African-American injectors and the term "disinfectant" was operationalized to include use of either alcohol or bleach. Herein, we report an analysis of the prophylactic effectiveness of bleach in a multi-ethnic group of New York City IDUs who reported injecting with shared or used needles and syringes. Our goal in conducting these analyses was to evaluate the utility of bleach disin-

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fection and, thus, to confirm or refute the earlier findings.

METHODS

Description of Study

A cohort of New York City IDUs was recruited at various times: the first members were enrolled in 1984 from two methadone maintenance treatment programs (MMTPs) at mid-Manhattan, New York City hospitals and from the inpatient drug detoxification program affiliated with one of the two hospitals. In 1986, additional members were recruited from a third mid-Manhattan hospital's MMTP and one of the MMTPs used in 1984. Follow-up was conducted approximately once per year through 1989. In 1991, patients recruited from the three MMTPs were again recalled and new subjects were enlisted from these same three MMTPs and two additional MMTPs located in Harlem, northern Manhattan. In July 1992, funding for participation in the National Institute of Health's HIV Vaccine Preparedness Initiative (VPI) was obtained, and enrollment was expanded to include out-of-drug-treatment patients enlisted from a storefront located in southern Manhattan and from persons stopping at an information table set up in the main corridor of one of the participating hospitals.

At each time that new enlistment was conducted up to 1991, enrollment was open on a voluntary basis to all members of the cooperating MMTPs or drug detoxification programs. Financial incentives for participation ranged from $15 to $25 per interview. In July 1992 our recruitment policy was altered to develop the VPI subcohort by preferentially sampling persons who either did not know their HIV status or whose last HIV test result was negative. Recall among high-risk HIV-seronegative persons (defined as those reporting injecting, having sexual relations with IDUs, or having sexual intercourse with persons known to be HIV seropositive in the 6 months prior to interview) was accelerated to once every 3 months and once every 6 months among HIV-seronegative subjects not at "high risk." Incentives were modified among "high-risk" seronegatives to start at $15 and to increase thereafter by $5 at each subsequent 3-month recall until a maximum incentive of $30 was reached. In December 1993, the entire cohort consisted of 2,179 IDUs, and 210 sexual partners of IDUs and/or known HIV-infected persons.

Each subject-visit included the administration of a standardized questionnaire by trained interviewers, HIV antibody testing, and HIV risk-reduction counseling conducted after the interview. Since the beginning of the study, the questionnaires have included inquiries as to whether respondents had ever injected with used needles and syringes and if they had "shared" needles and syringes within the prior 6 months. Questions concerning the frequency of bleach use for needle/syringe disinfection were added late in 1986 when the strategy was first advanced in the IDU community (10).

A total of 48 HIV seroconverters were observed in the cohort between 1984 and June 1993. From these, a subgroup of 16 seroconverters who responded to bleach-use questions and who reported injecting with shared or used equipment in the 6 months prior to their first HIV-seropositive visit were identified. The gender, race/ethnicity, and age distributions of these 16 seroconverters were not statistically different from the other 32. Each case was matched with up to nine randomly selected controls who (a) also responded to questions about the frequency of bleach use; (b) were interviewed at least twice; (c) reported injecting with used or shared equipment in the 6 months prior to their follow-up visit; and (d) were interviewed at follow-up visits that took place within 6 months of the case's first HIV-seropositive visit. Subjects were not matched on gender, race, age, or frequency of injection to permit analysis of these variables. A total of 89 matched controls were identified, ranging from 2 to 9 per HIV seroconverter.

All seroconversions included in the present analysis occurred after mid-1986 because our bleach questions were added in 1986. Covariates used in the analysis represent HIV-related sexual and drug-using behaviors in the 6 months prior to the follow-up interview date. Frequency of injecting any drug and the drug-specific frequencies reported herein represent the average number of injections per month over the 6 months prior to interview.

HIV Antibody Testing

Testing for HIV antibodies using enzyme-linked immunosorbent assays (ELISAs) was conducted at each interview by the New York City Department of Health Bureau of Laboratories. Samples that were ELISA-reactive on duplicate testing were confirmed using the western blot technique.

Statistical Analysis

Conditional logistic regression analysis was employed to obtain estimates of univariate odds ratios as well as odds ratios adjusted for other covariates (11). Deviation scores were evaluated to assure the appropriateness of using a categorical rather than continuous variable for the number of drug injections per month. Bleach use, being the primary variable of interest, was further modeled with the other possible confounders and their interactions with use of a backward elimination approach. Confounders were retained in the final model when they were statistically significant ($p \leq 0.05$) or when they altered the adjusted odds ratio for bleach use by more than 10%. All analyses were performed using EGRET statistical software (12).

RESULTS

As shown in Table 1, the only significant risk factors for HIV seroconversion on univariate analysis were (a) a history of sexual intercourse with an HIV-seropositive partner; and (b) the frequency of speedball (mixed heroin and cocaine) injection. Increasing levels of bleach use were not consistently associated with decreasing odds ratios for HIV seroconversion in univariate analysis (Table 1). The possibility that the (nonsignificantly) increased risk among IDUs who reported "sometimes" using bleach was due to an increased injection frequency in this group therefore was explored. After adjusting for injection frequency, however, bleach use was not significant.

Bleach use, being the primary variable of inter-

TABLE 1. *Univariate conditional logistic regression predicting human immunodeficiency virus (HIV) seroconversion*

Categorical variables	No. of cases (n = 16)	No. of controls (n = 89)	OR (95% CI)	Likelihood ratio p value
Gender				
Male	9	71	1.0	
Female	7	18	2.80 (0.9–8.3)	0.07
Race/ethnicity				
Caucasian	7	48	1.0	
African-American	5	18	1.80 (0.5–6.6)	
Hispanic	4	23	1.08 (0.3–4.0)	0.66
Age (years)				
<30	2	9	1.0	
30–39	10	37	1.34 (0.2–7.5)	
≧40	4	43	0.48 (0.1–3.1)	0.23
Duration of follow-up (years)				
<1	6	48	1.0	
1–2	6	28	3.12 (0.5–20.1)	
3–4	4	13	4.56 (0.7–29.3)	0.23
Frequent recall[a]				
No	11	55	1.0	
Yes	5	34	0.15 (0.0–2.0)	0.15
Male–male sex[b]				
No	8/9	65/71	1.0	
Yes	1/9	6/71	0.84 (0.1–7.6)	0.87
Sex with an HIV-infected person				
No	8	78	1.0	
Yes	8	11	6.56 (2.1–20.5)	0.001
Frequency of bleach use				
Never	5	37	1.0	
Sometimes	9	34	2.42 (0.7–8.8)	
Always	2	18	0.90 (0.2–5.5)	0.27
Shooting gallery use				
No	12	71	1.0	
Yes	4	18	1.53 (0.4–5.2)	0.51
Current enrollment in a drug-treatment program				
No	1	7	1.0	
Yes	15	82	1.24 (0.1–11.4)	0.85
Number of injections per month				
<3/Month	3	20	1.0	
3–50/Month	5	46	0.66 (0.2–2.9)	
>50/Month	8	23	2.07 (0.5–8.5)	0.19
Speedball[c] injection frequency				
None	4	53	1.0	
<Daily	6	29	2.82 (0.7–10.8)	
≥Daily	6	7	10.68 (2.3–48.8)	0.003
Cocaine injection frequency				
None	4	30	1.0	
<Daily	6	41	1.09 (0.3–4.0)	
≥Daily	6	18	2.34 (0.6–9.5)	0.24
Heroin injection frequency				
None	6	29	1.0	
<Daily	8	48	0.75 (0.2–2.4)	
≥Daily	2	12	0.72 (0.1–4.5)	0.66

Cases matched to controls based on being (a) an injection drug user with used or shared equipment in the 6 months prior to their follow-up visit, (b) asked about frequency of bleach use, (c) interviewed at least twice in order to detect seroconversion, and (d) interviewed at follow-up visits that took place within 6 months of the case's first HIV-seropositive visit. OR, odds ratio; CI, confidence interval.

[a] Membership in the Vaccine Preparedness Initiative subcohort.

[b] Data for men only.

[c] Mixed heroin and cocaine.

est, was further modeled with other possible confounders and their interactions, using multiple logistic regression analysis. The frequency of bleach use was not significant ($p = 0.07$) after adjusting for sex with an HIV-seropositive partner, speedball injection frequency, frequent recall (i.e., membership in the HIV VPI subcohort), and gender. "Sometimes" using bleach was associated with a nonsignificantly increased risk when compared with those who reported they "never" used bleach, as was found in the univariate analysis. The only significant variables in the final logistic regression model (Table 2) were reported sex with an HIV-seropositive partner and frequent recall (i.e., membership in the HIV VPI subcohort).

DISCUSSION

The present study suggests that bleach use as employed by IDUs in everyday life in New York City has not been protective against HIV seroconversion. The findings thus are fully consistent with the preliminary data (1–4) that led to the issuance of the new guidelines concerning bleach use and risk reduction counseling.

The results must be viewed with caution as dictated by the small number of seroconverters and several sources of bias. We tried to induce behavior change in our subjects through counseling conducted at the end of each interview session. The association in our final multivariate model of frequent recall with a significantly reduced risk of seroconversion suggests that repeated counseling may have been effective in this regard. It is possible, however, that subjects responded to interview questions with what they believed to be socially desirable answers. Our measurements of bleach use also may not have been complete enough to show a protective effect. We did not, for example, attempt to ascertain the frequency of bleach use in different settings. If bleach use were more important for needles and syringes used in shooting galleries than for needles and syringes used with sexual partners, then analysis of data on bleach use and injection frequencies specific to each of these situations might have revealed a protective effect.

The present results, in conjunction with those that led us to conduct these analyses (1–8), suggest that efforts to slow the transmission of HIV among IDUs should not emphasize bleach use, but rather should focus on increasing access to sterile injection equipment, reducing the frequency of sharing injection equipment, and preventing unprotected sexual exposure to HIV. When legal or other barriers prevent access to sterile equipment, drug treatment counselors and other outreach workers

TABLE 2. *Multivariate conditional logistic regression predicting human immunodeficiency virus (HIV) seroconversion*

Variable	No. of cases (n = 16)	No. of controls (n = 89)	Adjusted OR (95% CI)	Likelihood ratio p value
Frequency of bleach use				
Never	5	37	1.0	
Sometimes	9	34	6.55 (0.8–55.8)	
Always	2	18	1.05 (0.1–15.9)	0.07
Sex with an HIV-infected person				
No	8	78	1.0	
Yes	8	11	7.44 (1.2–44.7)	0.02
Speedball[a] injection frequency				
None	4	53	1.0	
<Daily	6	29	2.20 (0.4–13.0)	
≥Daily	6	7	9.39 (1.0–85.9)	0.08
Frequent recall[b]				
No	11	55	1.0	
Yes	5	34	0.01 (0.0–1.9)	0.03
Gender				
Male	9	71	1.0	
Female	7	18	4.10 (0.7–25.1)	0.12

Likelihood ratio statistic on 7 *df* = 27.3, $p < 0.001$ (deviance = 31.0). Cases matched to controls based on being: (a) an injection drug user with used or shared equipment in the 6 months prior to their follow-up visit, (b) asked about frequency of bleach use, (c) interviewed at least twice in order to detect seroconversion, and (d) interviewed at follow-up visits that took place within 6 months of the case's first HIV-seropositive visit.

[a] Mixed heroin and cocaine.

[b] Membership in the HIV Vaccine Preparedness Initiative subcohort.

should represent the CDC/CSAT/NIDA "bleach protocol" in the specified order: (a) abstinence from drug use, (b) abstinence from injecting, (c) abstinence from sharing and re-use of injection equipment, and (d) proper bleach use if injecting with possibly contaminated needles or syringes continues (9,13–15). Broadhead (13) has found, however, that outreach workers have reversed the order of this "bleach protocol" in virtually all interactions with the goal of stopping the spread of HIV. CDC/CSAT/NIDA stress that "disinfectants do not sterilize equipment" and outreach workers must properly focus on abstinence from drug injection and abstinence from injecting with equipment used by others (9). This recommendation is crucial in areas already providing needle-exchange programs to the IDU community.

The efficacy of bleach use will need continued investigation in the future until such time as sterile syringes are routinely used by IDUs or effective HIV vaccines are developed. Future research might investigate issues such as the following: (a) whether the new guidelines regarding bleach are properly presented in the community and followed by IDUs who continue to engage in high-risk activities, (b) the efficacy of the revised approach to disinfecting needles in the field, and (c) the intrinsic and extrinsic processes motivating this subgroup to take these risks.

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