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HIV Seroconversion and Disinfection of Injection Equipment among Intravenous Drug Users, Baltimore, Maryland

David Vlahov,¹ Alvaro Muñoz,¹ David D. Celentano,³ Sylvia Cohn,¹ James C. Anthony,^{1,2} Howard Chilcoat,² and Kenrad E. Nelson¹

To examine the putative protective effect of disinfectant use on HIV seroconversion among intravenous drug users, we conducted a nested case-control study comparing 22 black heterosexual HIV seroconverters with 95 persistent seronegatives matched on gender, use of cocaine, date of study entry, and duration of follow-up. For intravenous drug users who reported using disinfectant all the time, the odds of seroconversion was 0.77 (95% CI: 0.25-2.38) compared with those who reported no use of disinfectants; for those who used disinfectants some of the time, the corresponding odds ratio was 0.91 (95% CI: 0.26-3.31). The odds ratio for use of disinfectant all the time was 0.63 (95% CI: 0.10-3.91) for those injecting at galleries and 1.08 (95% CI: 0.35-3.11) for those not injecting at galleries. These data suggest a limited protective effect of disinfectant use in the field which may be more beneficial to those injecting in shooting galleries. (*Epidemiology* 1991;2:444-446)

Keywords: human immunodeficiency virus, acquired immunodeficiency syndrome, substance abuse, prevention, disinfectants.

Intravenous drug users are at increased risk of infection with human immunodeficiency virus (HIV), primarily through the use of contaminated injection equipment.¹ The risk factors for HIV infection among a large cohort of intravenous drug users in Baltimore include: frequency of injection, cocaine injection, using shooting galleries, female gender, homosexual/bisexual orientation, and black race.² Several strategies to prevent HIV infection among intravenous drug users have been proposed: promoting abstinence from drug use, reducing the frequency of high-risk behaviors, the use of sterile injection equipment, and disinfection of equipment. Beginning in 1986, the San Francisco Mid-City Consortium began promoting sodium hypochlorite (bleach) as a needle and syringe disinfectant.³ In vitro studies showed HIV to be

highly susceptible to chemical disinfectants, including bleach and alcohols.^{4,5} Because bleach is inexpensive, widely available, and recognized as a cleaning agent, its use and distribution have been widely accepted as a preventive strategy. The purpose of this study was to examine the putative protective effect of disinfectant use on HIV seroconversion among active intravenous drug users.

Subjects and Methods

As described in detail elsewhere,⁶ between February 1988 and March 1989, intravenous drug users were recruited into our cohort study, principally by word of mouth. Eligibility criteria were age 18 years or older, drug injection within the prior 11 years, and freedom from acquired immunodeficiency syndrome (AIDS). At baseline, 703 persons were HIV positive, and 2,218 seronegatives were encouraged to return at six-month intervals for continuing study; 1,331 seronegatives returned at least once for repeat serologic screening. As part of the interviews, we collected demographic information, a recall of frequency of injection, type of drug injected, number of different needle-sharing partners, use of shooting galleries, number of sexual partners, and details of

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sexual practices. In addition, participants who reported sharing needles and syringes were asked to describe the procedures they used to prepare their injection equipment immediately before use. This open-ended question was coded by the interviewer by type of solution used and technique described. After June 1989, we asked how frequently drug users used procedures to clean or disinfect their equipment. Neither interviewer nor subjects were aware of the subject's HIV seroconversion status at the time of interview. Antibody to HIV-1 was screened by ELISA, and repeat positive tests were assayed by Western blot using standard criteria.⁶

To investigate the hypothesized protective association between disinfection of injection equipment with bleach or alcohol and HIV seroconversion, we conducted a matched case-control analysis nested within a prospective study. To each documented HIV seroconverter, up to five persistently negative controls were matched on potentially confounding variables (gender, cocaine use, date of study entry, and duration of follow-up). As only 7 of 97 seroconverters were white, they were excluded, as were subjects who denied needle sharing. Analysis was limited to participants interviewed after June 1989 when questions on disinfection frequency were added to the interview. To incorporate the matching factors and study several exposures simultaneously, we used a conditional logistic regression model.⁷

Results

From February 1988 through December 1990, 97 seroconverters were detected among 1,331 subjects returning for repeat serologic rescreening. Of these, 90 were black, with no history of homosexual behavior; 39 of them reported recent needle sharing. Of these, 22 (56%) had their first seropositive visit after June 1989. The remaining seroconverters are excluded from further analysis. Of the 22 seroconverters and 95 matched seronegative controls, 40% were 34 years of age and older, nearly two-thirds reported injecting more than once a day, one-half reported more than one needle-sharing partner, and 27% visited shooting galleries. Overall, 79% reported use of bleach or alcohol to disinfect injection equipment, of whom 58% reported such use "all the time."

Table 1 shows a modest protective estimated association between needle disinfection and HIV seroconversion using conditional logistic regression (model 1). Compared with subjects who reported no bleach or alcohol use, the odds ratio for seroconversion among those reporting disinfection some of the time and among those reporting disinfection all the time were 0.91 and 0.77, respectively. By comparison, the odds ratio associ-

TABLE 1. Conditional Logistic Regression Analysis of HIV Seroconversion and Use of Disinfectants* among 22 Intravenous Drug-Using Seroconverters and 95 Matched† HIV Seronegative Controls, Baltimore, Maryland, 1989–1990

Model 1: Frequency of disinfection variables only			
Characteristic	Odds Ratio	95% CI	
No disinfectant use	1.00	—	
Disinfectant use			
"Less than all the time"	0.91	0.26–3.31	
"All the time"	0.77	0.25–2.38	
(Deviance: 70.82)			
Model 2: Interaction of Gallery Use and Disinfectant Use "All the Time" Relative to "Not All the Time"			
Gallery Use	Disinfectant Use "All the Time"	Odds Ratio	95% CI
No	No	1.00	—
No	Yes	1.08	0.35–3.11
Yes	No	1.00	—
Yes	Yes	0.63	0.10–3.91

(Deviance 67.853)

*Disinfectants = sodium hypochlorite (bleach) or alcohol.

†Matching criteria: date of study entry (± 3 mos), time of follow-up (control duration greater than seroconverters), gender, and injection of cocaine (yes/no) in past six months.

ated with shooting galleries was 2.45 and was 1.66 for more than one shooting partner (data not shown).

Owing to our limited study size, we formed a new reference group by combining all subjects that reported disinfection "less than all the time" or never. In a model that included disinfection and gallery use, we detected an interaction term with an intriguing trend. Namely, among intravenous drug users who reported no use of shooting galleries, there was no protective effect by disinfectant. On the other hand, the odds ratio for HIV-1 seroconversion among gallery users who reported frequent use of disinfectants was 0.63, compared with gallery users who did not report frequent use of disinfectants (Table 1, model 2).

Discussion

If disinfection with bleach or alcohol protects against HIV infection, then HIV-negative intravenous drug users who practice disinfection should have a lower rate of seroconversion than those not practicing disinfection. These preliminary data suggest only a modest decrease in risk of HIV seroconversion with increased frequency of

disinfection. More important, however, the data point toward the possibility that bleach or alcohol disinfection all the time may be more beneficial for intravenous drug users who attend high-risk shooting galleries.

Clearly, there are some methodological limitations inherent in our analysis. The small study size limits our precision, and there are concerns with selection bias, in that individuals who engage in more risky behaviors may be more likely to adopt use of bleach. In addition, differential reporting of use and frequency of disinfection might underestimate our associations. Certainly, socially desirable responses may be operating, and the reliability of our measures of disinfection is unknown. Finally, the potential role of sexual transmission cannot be excluded, although earlier studies have noted that parenteral modes tend to overwhelm sexual modes of transmission among actively injecting intravenous drug users.^{8,9}

With methodological limitations acknowledged, two principles of disinfection merit consideration, namely, bioburden and contact time.¹⁰ First, bioburden involves the amount of protein material present in contaminated injection equipment to which a disinfectant might bind and therefore be unavailable for virucidal activity. Reduction of bioburden through mechanical cleaning with a dilute detergent before disinfecting might enhance the effects of disinfectants on infectious agents. Second, contact time involves the duration of contact between disinfectant and the infectious agent. *In vitro* studies have reported efficacy of bleach or alcohol against HIV-1 when contact time has been at least one minute.^{4,5}

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