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# Occupational Exposure to Human Immunodeficiency Virus (HIV)-infected Blood in Denver, Colorado, Police Officers

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The authors undertook a study of Denver, Colorado, police department officers to measure their risk of exposure to blood and human immunodeficiency virus (HIV) by type of work assignment and to document how exposures occurred. From December 1989 through March 1991, 137 officers reported an exposure to either blood or saliva, and 42 exposures to blood were independently documented. The overall rate of exposure to HIV-infected blood for medium and high risk assignments was 0.10 per 10,000 person-days. Thirty-two source persons underwent voluntary testing for HIV antibodies, and five (15.6%) were seropositive. Two thirds of the 42 blood exposures occurred in circumstances in which 1) there was little or no time for the officer to put on protective gloves and clothing because the officer was restraining or being assaulted by a suspect or 2) gloves would have not been protective because of penetration by needles. The authors conclude that Denver police officers rarely have percutaneous or mucosal exposures to blood, but when they do, the risk of exposure to HIV-infected blood is quite high. A health department can provide to police officers a number of services: evaluation of an incident involving contact with blood or body fluids to determine whether there was potential for disease transmission; information about modes of transmission and prevention of bloodborne diseases; serologic testing of source persons; HIV counseling for exposed officers and source persons; documentation for worker's compensation claims; and consultation regarding the use of zidovudine for postexposure prophylaxis. *Am J Epidemiol* 1994;139:910–17.

blood; HIV; occupational exposure; police

Although emergency medical workers have an increased risk of hepatitis B infection (1–3), there have been few reports published concerning occupational exposure of law enforcement personnel to hepatitis B virus or human immunodeficiency virus (HIV). A survey of policemen in Lancashire, England, found an increased prevalence of hepatitis B serologic markers among officers assigned to work at crime scenes (4), while a study of policemen and customs officers in New Zealand found no statistically significant difference between the prevalences of serologic markers in police officers and civilian controls (5). One case report from Canada described hepatitis B virus in a police officer who was probably infected by a bite from a prisoner (6). The lack of documentation of excess risk does not mean, however, that the occupational risk of contracting hepatitis B virus or HIV infection is zero.

Police officers may be exposed to blood or other potentially infectious body fluids in a number of ways: while administering first

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Abbreviation: HIV, human immunodeficiency virus; METRO, Multiple Enforcement Tactical Response Operations; SWAT, Special Weapons and Tactics.

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aid; while restraining, arresting, or searching a suspect; or while investigating crimes and handling evidence. In 1989, we undertook a study of officers in the Denver, Colorado, police department. The purposes of this study were to document how exposures occurred and to measure the risk of exposure to blood and HIV by type of work assignment. We did not attempt to document exposures to hepatitis B virus; instead, we apprised department officials of US Public Health Service recommendations for postexposure hepatitis B prophylaxis (7) and guidelines for prevention of transmission of HIV and hepatitis B virus to health care and public safety workers (8).

## MATERIALS AND METHODS

All officers employed by the Denver police department between December 21, 1989, and March 31, 1991, were included in the study population. Civilian and ancillary employees of the department were excluded.

Officers were instructed in personnel meetings and by written memorandum to report all exposures to blood or body fluids occurring on the job or during secondary, after-hours, department-approved employment (e.g., work as a bank guard or party security guard) by completing a standard incident reporting form and to obtain medical care for treatment and documentation of the exposure. The incident forms were reviewed by a health department epidemiologist who interviewed the officer regarding the circumstances and determined whether the incident could have transmitted HIV. For all exposures validated by the health department, the epidemiologist conducted an investigation to locate the source person and determine whether the person was infected with HIV.

Exposure to blood was defined as the officer's either 1) having contact with blood or a body fluid with visible blood on an open or fresh (<48 hours old) wound, skin lesion, or mucous membrane or 2) sustaining a needlestick or puncture wound with an object that had blood in it or on it (including a bite by a person who was bleeding in or around the mouth). The person who was the source of the blood was defined as HIV-infected if either medical records indicated HIV infection or an HIV antibody test performed on the source person following the exposure incident was positive. An HIV antibody test result was considered positive if the serum was repeatedly reactive by enzyme immunoassay and the Western blot examination met Centers for Disease Control and Prevention criteria (9). Contact with saliva, such as being spat upon, was not considered a potential exposure to HIV unless there was visible blood in the saliva.

The Denver police department provided us with a computerized roster of officers employed as of December 21, 1989, and updated the roster monthly to include information on new hires, transfers, and terminations. A unique identifying number and information on age, sex, race/ethnicity, and job assignment were provided for each officer. There were seven enforcement job assignments and three nonenforcement job assignments (figure 1). A group of five managerial officers in the Health Management Bureau of the department, all of whom had experience in enforcement assignments, ranked the job assignments a priori as high risk, medium risk, or low risk of exposure to body fluids.

To determine whether potential exposures were being reported, we distributed a self-administered questionnaire in February 1991 to all officers employed as of that date. In the survey instrument, exposure to blood was defined as above. Responses were anonymous. Officers were asked to report the number of on-the-job exposures to blood they had had during the preceding 12 months, whether the exposure(s) had been reported on an incident report form, and if not, what their reasons were for not reporting.

Incidence density rates of exposure to blood and exposure to HIV antibody-positive blood per 10,000 person-days were

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computed by job assignment and job risk category. The rates were compared using a $Z$ test.

## RESULTS

At the start of the study period, there were 1,333 officers on the Denver police force. The 1990 population of the City and County of Denver was 467,610, yielding a ratio of 2.85 officers per 1,000 population. The largest proportion of officers were assigned to street patrol (42.2 percent), followed by investigations (18.2 percent) (table 1). Ninety-one percent of the officers were male; in terms of ethnicity, 77 percent were non-Hispanic white, 16 percent were Hispanic, 6 percent were black, and 1 percent were of other racial/ethnic origin.

During the 15.3 months of the study, 137 officers reported an exposure to either blood or saliva (see figure 2). We were able to document 42 exposures to blood. There were 39 exposures from 34 identified source persons: 29 source persons each exposed one officer, and each of five other source persons exposed two officers. In addition, there were three reported needlestick exposures in which the source was not identified. Thirty-two source persons underwent voluntary testing for HIV antibodies, and five (15.6 percent) were found to be seropositive. None of the five infected persons had pre-

**High Risk**

Patrol - Patrol precincts, respond to disturbances, effect arrests, render aid.

Urban Street Crime - Patrol high crime areas, motorcycle and gang units; similar to patrol but more specialized duties.

METRO/SWAT - Multiple Enforcement Tactical Response Operations (METRO)/Special Weapons and Tactics (SWAT); handle barricaded or hostage situations, high risk warrants/drug raids, VIP protection, canine searches, civil disturbances, enforcement in parks.

**Medium Risk**

Traffic - Respond to crashes, traffic control, traffic enforcement.

Vice/Narcotics - Undercover narcotics investigations; enforce liquor, prostitution, and gambling laws.

Airport - Security, sick cases, disturbances, traffic control at airport.

Investigations - Crime investigations, primarily off-site.

**Low Risk (nonenforcement jobs)**

Community Services

Staff Services

Administration

**Secondary Employment**

Police officers may take secondary jobs as bank guards, party security guards, etc., during off-hours, with the approval of the Department.

**FIGURE 1.** Description of job assignments of police officers, by a priori risk of exposure to body fluids, Denver, Colorado, December 1989–March 1991.

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**TABLE 1. Distribution of police officers by job assignment, Denver, Colorado, December 1989–March 1991**

| Job assignment | % of total workforce ($n$ = 1,333) |
|---|---|
| Patrol | 42.2 |
| Investigations | 18.2 |
| Staff services | 7.6 |
| Traffic | 6.8 |
| Administration | 6.4 |
| Airport | 4.1 |
| Community services | 4.1 |
| Vice/narcotics | 3.8 |
| Urban street crime | 3.5 |
| METRO/SWAT* | 3.3 |

* Multiple Enforcement Tactical Response Operations/Special Weapons and Tactics.

viously had a positive HIV antibody test. One source person refused testing and was subsequently lost to follow-up; for the other, the attending psychiatrist determined that the source person had no HIV risk behaviors and therefore did not permit HIV testing.

The median age of the 34 source persons was 28 years (range, 17–46 years). Eighty-eight percent were male; by race/ethnicity, 26.5 percent were non-Hispanic white, 47.1 percent were Hispanic, and 26.5 percent were black. Seven source persons (20.6 percent) gave a history of injecting drug use, one (2.9 percent) admitted to prostitution, and five (16.7 percent) of the 30 male source persons admitted to having had sex with other men. Two of the five HIV-infected source persons admitted both to having had sex with other men and to injecting drug use.

The 42 exposures occurred in the following ways: 24 (57.1 percent) involved blood contact with nonintact skin, six (14.3 percent) involved blood contact with mucous membranes, six (14.3 percent) resulted from bites, four (9.5 percent) were from needlesticks, and two (4.8 percent) involved lacerations by objects with blood on the surface of the object. Of the six bite exposures, there were four in which the officer was not certain whether the source person was bleeding in or around the mouth. One of these four source persons was HIV antibody-positive.

Circumstances of the 42 exposures were grouped as follows: restraining or subduing a person ($n$ = 27, 64.3 percent); providing first aid ($n$ = 10, 23.8 percent); searching either a person or premises or gathering evidence ($n$ = 4, 9.5 percent); and assault by a person ($n$ = 1, 2.4 percent). Twenty-seven (64.3 percent) exposures occurred outside a building or on the street, 10 (23.8 percent) occurred inside a home or business, four (9.5 percent) occurred in the police station or jail, and one (2.4 percent) occurred in transit to a police station. The seven injecting drug users exposed officers on patrol, airport, Multiple Enforcement Tactical Response Operations (METRO)/Special Weapons and Tactics (SWAT), traffic, and urban street crime assignments, but not on the vice/narcotics and investigations job assignments. Four blood exposures involving men who had sex with men were sustained by officers on patrol and METRO/SWAT assignments, as well as by one off-duty officer working at a secondary job.

The five HIV-infected source persons exposed six police officers, all of whom were HIV antibody-negative when a serum specimen was tested shortly after exposure. These six officers, together with three officers exposed by needlesticks from unknown sources and two officers exposed to one source person who refused testing while in jail and was not locatable after release from jail, were followed for 6 months after their exposures. None of the 11 officers had HIV antibody seroconversions during that time. Three of the six exposures to HIV antibody-positive blood were sustained by officers on patrol assignment, two were sustained by officers on traffic assignment, and one was sustained by an officer working off-duty in secondary employment (table 2).

The rate of exposure to blood by job assignment ranged from 0.09 per 10,000 person-days for investigation assignments to 1.52 per 10,000 person-days for assignment to urban street crime (table 2). The combined rate for high and medium risk job assignments was 0.76 per 10,000 person-days. The differences in rates of blood exposure between patrol and investigation as-

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signments (1.02 vs. 0.09) and between high and medium risk assignments (1.03 vs. 0.35) were statistically significant ($p < 0.01$ for both comparisons). The overall rate of exposure to HIV-infected blood for high and medium risk assignments was 0.10 per 10,000 person-days.

Responses were received from 85.7 percent of the 1,269 officers surveyed anonymously in February 1991. The distribution of respondents by job assignment was similar to that of all officers in the department. One hundred and thirty-six (12.5 percent) of 1,087 officers stated that they had been exposed a total of 430 times during the previous year. Of the officers stating that they had had at least one exposure, 77 (56.6 percent) stated that they did not report the incident. Of these, the five most frequent responses given to explain why they did not

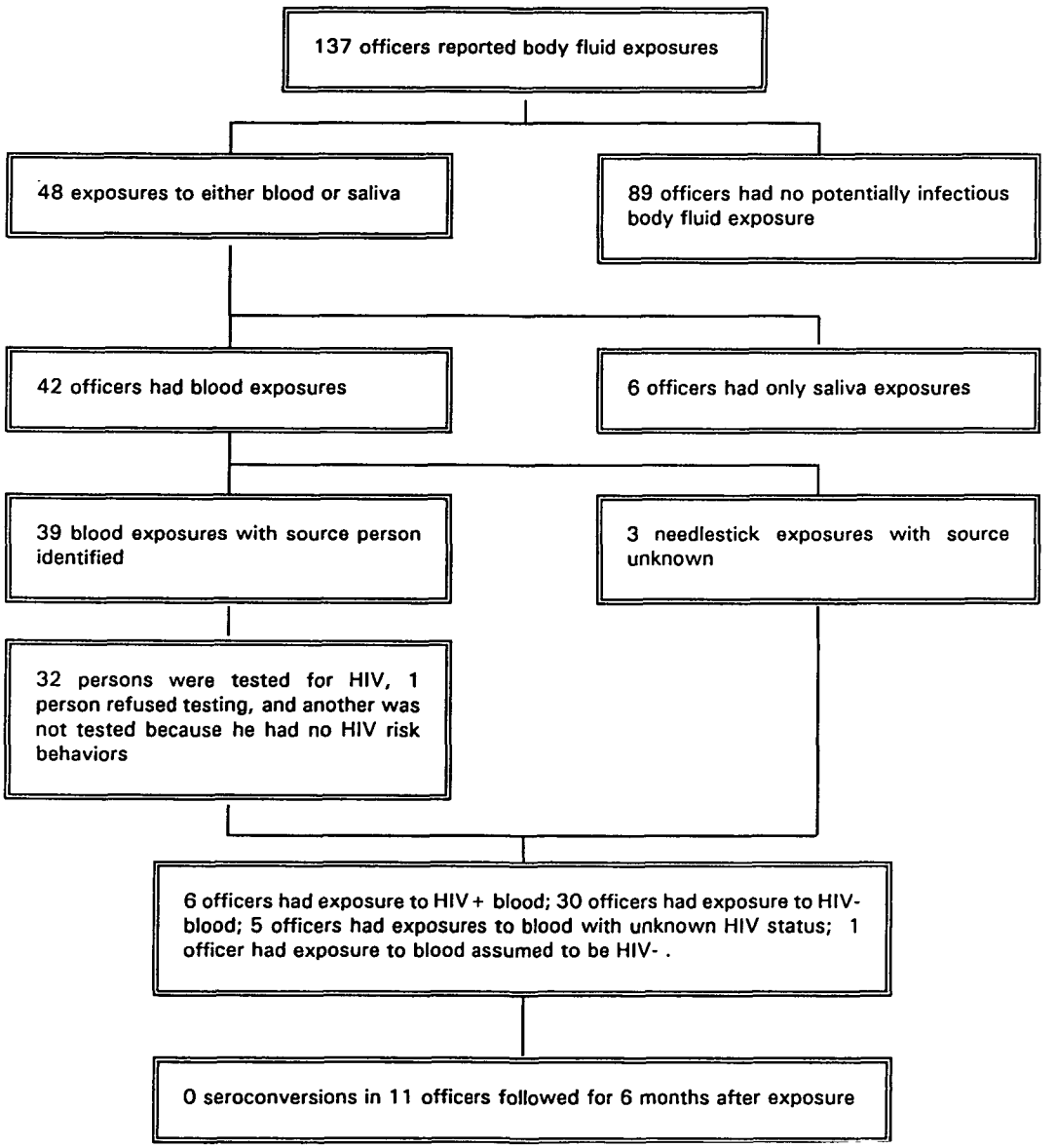


**FIGURE 2.** Results of an investigation of reported potential exposures to human immunodeficiency virus (HIV) among Denver, Colorado, police officers, December 1989–March 1991. HIV+, seropositive for HIV antibodies; HIV–, seronegative for HIV antibodies.

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**TABLE 2. Rate of exposure (per 10,000 person-days) to blood and to HIV* antibody-positive blood, by job assignment and risk category, among police officers, Denver, Colorado, December 1989–March 1991**

| Assignment | Total no. of person-days | Exposures to blood | | Exposures to HIV-positive blood | |
|---|---|---|---|---|---|
| | | No. | Rate | No. | Rate |
| METRO/SWAT* | 20,039 | 2 | 1.00 | 0 | |
| Urban street crime | 6,579 | 1 | 1.52 | 0 | |
| Vice/narcotics | 18,771 | 2 | 1.06 | 0 | |
| Investigations | 113,581 | 1 | 0.09† | 0 | |
| Airport | 25,358 | 1 | 0.39 | 0 | |
| Patrol | 284,443 | 29 | 1.02 | 3 | 0.11 |
| Traffic | 43,631 | 3 | 0.69 | 2 | 0.46 |
| Staff services | 43,338 | 0 | | | |
| Community services | 40,628 | 0 | | | |
| Administration | 22,833 | 0 | | | |
| Off-duty, second job | N/A* | 3 | | 1 | |
| High risk‡ | 311,061 | 32 | 1.03 | 3 | 0.09 |
| Medium risk§ | 201,341 | 7 | 0.35‖ | 2 | 0.10 |

* HIV, human immunodeficiency virus; METRO/SWAT, Multiple Enforcement Tactical Response Operations/Special Weapons and Tactics; N/A, not available.
† Patrol had a greater rate than investigations ($p < 0.01$).
‡ Urban street crime, METRO/SWAT, and patrol.
§ Traffic, vice/narcotics, airport, and investigations.
‖ High risk was greater than medium risk ($p < 0.01$).

report the exposure were as follows: "I was unsure whether it was an exposure" (50.6 percent); "I was worried that it might seem like I was making a big deal out of nothing" (24.7 percent); "I didn't know I was required to report it" (24.7 percent); "I figured that nothing could be done anyway if I had gotten infected" (23.4 percent); and "I felt that the source person probably didn't have the virus" (23.4 percent).

## DISCUSSION

We found that these Denver police officers had exposure to blood in every type of enforcement assignment, but the actual rate of such an exposure was quite small: The rates by job assignment varied from 0.09 to 1.52 per 10,000 person-days, and the overall rate of exposure to HIV-infected blood was 0.10 per 10,000 person-days. Applied to a single person working 250 days per year, a rate of one exposure per 10,000 person-days translates to one exposure every 40 years.

These rates are based on self-reports, and the anonymous survey showed that a majority of the officers who thought they had had at least one exposure did not report the exposure. Thus, the observed incidence may be falsely low. We were not able to validate exposures through direct observation, but it is doubtful that the true rate for the population would be significantly greater than the observed exposure rate. This is because few of the unreported incidents were likely to have been real exposures. Of the 137 reported incidents, only 31 percent met our definition of exposure. This finding was similar to that in a study of emergency medical personnel conducted in Columbus, Ohio, between 1987 and 1991, in which health department officials considered 25 percent of all reported exposures significant (10). The proportion of unreported incidents that would meet the exposure definition would likely be smaller than the proportion of reported incidents, because the anonymous survey indicated that the two most frequent reasons for not reporting incidents were "I was unsure if it was an exposure" and "it might seem like I was making a big deal out of nothing."

In contrast to the small rate of exposure was the finding of a high HIV seropositivity rate (15.6 percent) among source persons. For comparison, in metropolitan Denver in

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1990, the HIV seropositivity rate was 0.05 percent among childbearing women, 5.3 percent among all persons undergoing voluntary HIV antibody testing at the three public counseling and testing sites, 8.8 percent among persons who admitted to injecting drug use and underwent testing at the three counseling and testing sites, and 0.80 percent among persons tested blindly in a sentinel acute-care hospital (August 1988 through December 1991) (unpublished data, Colorado Department of Health). Of the commonly identified HIV exposure categories (11), injecting drug use is the activity most likely to lead to interaction with police officers, and we found that officers on five different types of medium to high risk assignments had exposures involving injecting drug users. Our conclusion is that Denver police officers rarely have percutaneous or mucosal exposures to blood, but when they do, their risk of exposure to HIV-infected blood is relatively high.

Furthermore, two thirds of the 42 blood exposures occurred in circumstances in which 1) there was little or no time for the officer to put on protective gloves and clothing because the officer was restraining or being assaulted by a suspect or 2) gloves would have not been protective because of penetration by a needle. The fact that none of the 11 officers followed for 6 months had an HIV seroconversion is not surprising, because the risk of infection after needlesticks from known HIV-infected sources is approximately 0.5 percent (1).

A health department can assist police officers by evaluating whether contact with blood or body fluids has potential for disease transmission and by providing information to officers about what constitutes an exposure to blood and how such exposures can be prevented. In instances where significant exposures to blood have occurred, the health department can investigate to determine whether the source person is HIV-infected, ordering serologic tests if necessary. If there are protections for confidentiality of information and if appropriate counseling is given to both the source person and the exposed person, the infection status of the source person can be communicated to an exposed officer, providing peace of mind when it is negative. When the infection status is positive, the officer must be provided with emotional support, advice, and documentation for a worker's compensation claim, and the health department may called upon to provide consultation to the exposed person or his or her physician regarding the use of zidovudine for postexposure prophylaxis. In 1990, a law was enacted in Colorado giving state and local health departments the responsibility for and authority to carry out this role. Despite promulgation of the Occupational Safety and Health Administration rules concerning exposure to bloodborne pathogens (12), the Colorado Department of Health continues to receive requests from public safety workers and hospitals for assistance in evaluating exposures.

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