

# MMWR™

MORBIDITY AND MORTALITY WEEKLY REPORT

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## Notice to Readers

Because of the furlough of U.S. government employees, CDC has restricted its activities to responses to emergencies and other public health matters of extreme urgency. This issue of *MMWR* contains two reports with immediate public health implications: one report provides measures for the prevention of hypothermia-related morbidity and death, and the other report summarizes the findings of a new study of factors associated with risk for and prevention of human immunodeficiency virus (HIV) infection in health-care workers following percutaneous exposure to HIV-infected blood. Other reports of public health importance and findings from the ongoing National Notifiable Disease Surveillance System will be published at a later date, and printed versions of this issue will be available to CDC's subscribers at a later date. The next scheduled issue will be Volume 44, Numbers 51 and 52, dated January 5, 1996, and will include the figure and tables on notifiable diseases for the weeks ending December 16, 23, and 30, 1995.

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### **Case-Control Study of HIV Seroconversion in Health-Care Workers After Percutaneous Exposure to HIV-Infected Blood — France, United Kingdom, and United States, January 1988–August 1994**

Health-care workers (HCWs) are potentially at risk for human immunodeficiency virus (HIV) infection through occupational exposures to blood. Although prospective studies indicate that the estimated risk for HIV infection after a percutaneous exposure to HIV-infected blood is approximately 0.3% (1,2), factors that influence this risk have not been determined. To assess potential risk factors, CDC, in collaboration with French and British public health authorities, conducted a retrospective case-control study using data reported to national surveillance systems in the United States, France, and the United Kingdom. This report describes the study and summarizes results that suggest that risk factors for HIV transmission include certain characteristics

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of the exposure and the source patient; in addition, postexposure use of zidovudine (ZDV) by HCWs was associated with a lower risk for HIV transmission.\*

Case-HCWs had a documented occupational percutaneous exposure to HIV-infected blood (i.e., a needlestick or a cut with a sharp object [e.g., scalpel or lancet]), HIV seroconversion temporally associated with the exposure, and no other concurrent exposure to HIV. Control-HCWs had a documented occupational percutaneous exposure to HIV-infected blood and were HIV seronegative at the time of exposure and at least 6 months later. Case-HCWs were identified through reports to national surveillance systems for occupationally acquired HIV infection operated by CDC, in cooperation with state and local health departments (United States), the National Public Health Network (Réseau National de Santé Publique) (France), and the Public Health Laboratory Service Communicable Disease Surveillance Center (United Kingdom). Control-HCWs were identified through reports to a passive surveillance project maintained by CDC since 1983 that includes data from approximately 300 health-care institutions in the United States (1).

The study included all case-HCWs reported in the United States whose exposure occurred during January 1988–August 1994 and all control-HCWs exposed after January 1988 whose 6-month follow-up evaluation was completed as of August 1994. Case- and control-HCWs reported in the United States before 1988 were excluded from the analysis because information on some variables was not routinely collected and because postexposure use of ZDV was infrequent before 1988 (1). For similar reasons, analysis was limited to case-HCWs reported in France since 1990 and in the United Kingdom since 1989.

Information obtained about HCWs included age; sex; occupation; work location; and whether postexposure antiretroviral agents were offered, whether they were used, how long after the exposure the first dose was used, daily dosage, and duration of treatment. Information about source patients included stage of HIV infection (acquired immunodeficiency syndrome [AIDS], symptomatic, or asymptomatic), use of antiretroviral drugs at the time of the HCW's exposure, and presence of terminal illness (i.e., death because of AIDS within 2 months after the exposure). Information about exposures included the type of device involved, gauge of hollow-bore needle, type of procedure being performed, whether the procedure was an emergency, use of gloves, time from use of the device to exposure, presence of visible blood from the source patient on the device, and severity of injury. Severity of injury was defined as superficial (surface scratch, no blood appeared), moderate (penetrated skin and blood appeared), or deep (deep puncture or wound with or without bleeding).

The study included 31 case-HCWs (23 from the United States, five from France, and three from the United Kingdom) and 679 control-HCWs (who were from 190 of the reporting health-care institutions). Of the 31 exposures sustained by case-HCWs, 29 (94%) were needlesticks (all with hollow needles) and two (7%) involved other sharp objects. Of the 679 exposures sustained by control-HCWs, 620 (91%) were needlesticks (including 594 hollow and 26 solid needles) and 59 (9%) involved other sharp objects.

For both case- and control-HCWs, 74% were exposed during 1990–1994, when ZDV postexposure use had become more common (1). During 1990–1994, 17 (81%) of

\*Single copies of this report will be available free until December 21, 1996, from the CDC National AIDS Clearinghouse, P.O. Box 6003, Rockville, MD 20849-6003; telephone (800) 458-5231 or (301) 217-0023.

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21 case-HCWs had been offered ZDV, and from September 1990 (when collection of information on whether ZDV was offered to control-HCWs became routine) through 1994, 268 (79%) of 338 control-HCWs were offered ZDV. ZDV postexposure prophylaxis was used by nine (29%) case-HCWs and 247 (36%) control-HCWs (crude odds ratio=0.7; 95% confidence interval [CI]=0.3–1.7). Regimens for case- and control-HCWs generally were 1000 mg/day for 3–4 weeks; the small number of case-HCWs who used ZDV precluded assessment of differences in ZDV regimens between case- and control-HCWs.

All variables that were statistically significant in the univariate analysis and variables potentially important for prevention (e.g., use of gloves, whether ZDV was offered, and whether ZDV was used) were examined using logistic regression analysis. Based on this analysis, factors associated with HIV transmission included a deep injury, device visibly contaminated with the source patient's blood, procedures involving a needle placed directly in a vein or artery, and terminal illness in the source patient. In addition, case-HCWs were significantly less likely to use ZDV than control-HCWs (adjusted odds ratio=0.2,  $p<0.01$ ) (Table 1)<sup>†</sup>. The crude odds ratio for ZDV use differed from the adjusted odds ratio because ZDV use was more frequent, among both case- and control-HCWs, for exposures characterized by the other factors. All factors in the model also were significant when the analysis was restricted to case-HCWs from the United States.

The degree of susceptibility to ZDV of HIV strains from source patients and case-HCWs is unknown. Information about antiretroviral treatment for source patients was available for seven case-HCWs and 124 control-HCWs who had used ZDV; five (71%) case-HCWs and 87 (70%) control-HCWs were exposed to blood from source patients who had been receiving ZDV at the time of the exposure.

*Reported by: State and territorial health depts. CDC Cooperative Needlestick Surveillance Group. D Abiteboul, MD, Institut National de Recherche et de Sécurité and Groupe d'Étude sur*

<sup>†</sup>Information on terminal illness in the source patient was missing for 19% of case-HCWs and 48% of control-HCWs; information on visible blood on device was missing for 3% of case-HCWs and 6% of control-HCWs. By recoding the missing values to zero and including missing value indicator variables for these factors in the model, these HCWs were retained in the analysis and their potential confounding influence could be assessed. No significant interactions were found among the risk factors in the model or between the risk factors and the missing value indicators. When all HCWs with missing values for any of the factors were excluded from the analysis, all of the factors remained significant, with similar adjusted odds ratios but larger confidence intervals.

**TABLE 1. Risk factors for HIV infection in health-care workers after percutaneous exposure to HIV-infected blood, based on a case-control study — France, United Kingdom, and United States, January 1988–August 1994**

Risk factor	Adjusted odds ratio*	(95% CI) <sup>†</sup>
Deep injury	16.1	(6.1–44.6)
Visible blood on device	5.2	(1.8–17.7)
Procedure involving needle placed directly in a vein or artery	5.1	(1.9–14.8)
Terminal illness in source patient	6.4	(2.2–18.9)
Postexposure use of zidovudine	0.2	(0.1– 0.6)

\*All were significant at  $p<0.01$ .

<sup>†</sup>Confidence interval.

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**Editorial Note:** The findings in this report indicate that, among the HCWs in this study, an increased risk for HIV infection following percutaneous exposures to HIV-infected blood was associated with three factors. First, the risk increased if the exposure involved a larger quantity of blood, indicated by 1) a device visibly contaminated with the patient's blood, 2) a procedure that involved a needle placed directly in a vein or artery, or 3) a deep injury. Second, the risk increased for exposures to blood from source patients with terminal illness, probably reflecting the higher titer of HIV in blood late in the course of AIDS or other factors, such as the presence of syncytia-inducing strains of HIV (3,4). Finally, the analysis of these data suggested that use of ZDV postexposure may be protective for HCWs. After controlling for other factors associated with HIV transmission risk, the model indicates that the risk for HIV infection among HCWs who used ZDV was reduced by approximately 79% (95% CI=43%–94%) (based on adjusted odds ratio=0.21; 95% CI=0.06–0.57). However, the limitations of the study design must be considered when interpreting these results.

A retrospective case-control study is not the optimal study design for assessing ZDV efficacy. The optimal approach—a prospective, placebo-controlled trial—has not been possible because of the requirement for a large number of HCWs and the relatively low rate of HIV seroconversion following occupational exposure (1). The findings of this study also are subject to at least five potential limitations. First, case- and control-HCWs were identified using different data sources. Second, if control-HCWs were more likely to have been offered or encouraged to use ZDV, then use of the drug might be statistically associated with lack of HIV seroconversion, even if ZDV is not truly protective; however, available evidence does not suggest that control-HCWs were more likely than case-HCWs to have been offered ZDV. Third, reporting bias may have resulted if HCWs preferentially reported exposures that they believed were more likely to result in HIV transmission; this tendency presumably would be similar for case-HCWs and control-HCWs. Fourth, ascertainment bias may have affected some data, particularly subjective variables such as severity of injury, because information for control-HCWs was obtained prospectively soon after exposure but information for most case-HCWs was obtained after HIV seroconversion; however, for most variables evaluated, objective documentation from incident reports and medical records was available. Finally, number of case-HCWs evaluated was small.

Although failures of postexposure ZDV to prevent HIV infection in HCWs have been documented (1), this is the first study of HCWs exposed to HIV that assesses the effectiveness of ZDV as postexposure prophylaxis. Studies involving animals have yielded inconclusive results (5). In studies involving humans, ZDV was reported to reduce the rate of perinatal HIV transmission (6) and to be beneficial in treating early HIV infection (7); however, the implications of these results for postexposure prophylaxis are uncertain. The short-term toxicity of ZDV in HCWs primarily has been gastrointestinal discomfort and fatigue (1,2,5,8).

ZDV is not approved by the Food and Drug Administration for use as postexposure prophylaxis. In a previous statement, the Public Health Service (PHS) concluded that a recommendation could not be made for or against the use of ZDV postexposure pro-

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phylaxis because of limited knowledge regarding its efficacy and toxicity (9). PHS recommends that HCWs who may be at risk for occupational exposure to HIV infection be informed of the considerations pertaining to the use of ZDV for postexposure prophylaxis, including the risk for HIV transmission after the exposure, factors that may increase or decrease this risk, and the limited knowledge regarding the potential efficacy and toxicity of ZDV postexposure prophylaxis (9). If a decision is made to use postexposure prophylaxis, it should be initiated promptly (9). PHS is evaluating the implications of the study summarized in this report and other available information in assessing the possible need for revision of recommendations for managing occupational exposure to HIV—particularly regarding postexposure use of antiretroviral agents.

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### **Hypothermia-Related Deaths — New Mexico, October 1993–March 1994**

Hypothermia is an unintentional lowering of the body temperature to  $\leq 95$  F ( $\leq 35$  C) (1). From 1979 through 1992, 10,550 persons in the United States died from hypothermia, an average of 754 deaths per year (range: 557–1021). Most of these deaths occurred during winter months in three distinct climatic areas: northern states characterized by moderate to severe cold temperatures during winter (e.g., Illinois and New York); southern states where rapid changes in temperature occur because of the effects of weather systems (e.g., North Carolina, South Carolina, and Virginia); and western states in areas of high elevations and profound declines in temperatures at night (e.g., New Mexico and Arizona). From October 1993 through March 1994, a total of 23 deaths attributed to hypothermia were reported to the New Mexico Office of the Medical Investigator. This report summarizes the investigations of four of these deaths and the epidemiology for all 23 cases.

*Hypothermia-Related Deaths — Continued***Case Reports**

**Case 1.** In November 1993, an 85-year-old man was found dead in a drainage ditch behind a factory approximately 1 mile from the nursing home in which he resided. He was fully clothed, and there were no indications of trauma. Water in the drainage ditch was 3 inches deep; the overnight ambient low temperature had been approximately 45 F (7 C). The man had last been seen by the nursing staff 12 hours before being found.

**Case 2.** On November 1, 1993, an 81-year-old woman was found dead in a shallow creek in an area of heavy plant growth known to house homeless persons. There were no indications of trauma. She had last been seen by her daughter on October 26 and was reported missing on November 1. She had a history of high blood pressure and arteriosclerotic coronary vascular disease.

**Case 3.** In January 1994, an 11-year-old boy was found in his bed wet, cold, and without a pulse. Attempts to revive him were unsuccessful. The toilet in a bathroom above his bedroom had overflowed and water had been dripping on him all night. He had a history of cerebral palsy, hydrocephalus, and seizure disorder; was blind, deaf, and unable to speak; and had impaired mobility that limited his ability to turn over.

**Case 4.** In February 1994, a fully clothed 34-year-old man was found dead behind a grocery store after an overnight low temperature of 13 F (–11 C). He had a history of alcohol abuse and cerebral injuries and he was found with a prescription vial of phenytoin in his pocket. He had last been seen alive in the field behind the store searching for a plastic sack in which to keep warm during a snow storm.

**Summary of Cases**

Of the 23 deaths, seven (30%) occurred during February, and 17 (74%) occurred among men. The average age of decedents was 49 years (range: 11–87 years). Eleven (48%) had evidence of recent alcohol abuse. Eight (35%) deaths occurred in McKinley County, which is in a desert area with elevations >5000 feet above sea level.

*Reported by: R Zumwalt, MD, D Broudy, MPH, Office of the Medical Investigator, New Mexico. Div of Environmental Hazards and Health Effects, National Center for Environmental Health, CDC.*

**Editorial Note:** From 1979 through 1992, the highest total number of deaths attributed to hypothermia occurred in Illinois (660), and the highest annual age-adjusted death rate (33 deaths per million persons) occurred in Alaska. However, the findings in this report underscore the risk for hypothermia-related deaths in states in other latitudes. Of the 10 states with the highest combined ranking for both number and rate of hypothermia deaths, only two (Illinois and Alaska) are characterized by severe winter weather; the winter climate is substantially milder in the other eight states (Alabama, Arizona, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Virginia).

From 1979 through 1992, national death rates for hypothermia varied by sex, race, and age. Although most deaths occurred among males (71%) and whites (61%), sex- and race-specific average annual death rates were higher for black males than white males (13.1 versus 3.2 deaths per million) and for black females than white females (4.1 versus 1.4 deaths per million).<sup>\*</sup> Approximately half of all hypothermia deaths occurred among persons aged >64 years. These demographic differences in hypo-

<sup>\*</sup>Numbers for other racial/ethnic groups were too small for meaningful analysis.

*Hypothermia-Related Deaths — Continued*

thermia mortality may reflect differences in socioeconomic status, nutritional status, condition of clothing, or ease of access to adequate shelter.

Factors associated with the increased risk for hypothermia in the very young and the elderly in mildly cool environments (65 F [18 C]) include an impaired shivering mechanism, lower levels of protective fat, limited mobility, lower metabolic rate, and chronic illness (2). Other risk factors associated with hypothermia for all groups include drinking alcoholic beverages, using neuroleptic medications, hypothyroidism, mental illness, starvation, dehydration, poverty, any immobilizing illnesses, and sustained contact with material that promotes conductive heat loss (e.g., water, solvents, and metals) (2).

The onset of hypothermia is insidious: early manifestations include shivering, numbness, fatigue, poor coordination, slurred speech, impaired mentation, blueness or puffiness of the skin, and irrationality (3). Early recognition and prompt treatment can prevent morbidity and death. Specific prevention measures during cold and inclement weather conditions include maintaining dry clothes and wearing layered, insulated clothing (particularly head gear, because 30% of heat loss occurs from the head) that does not retain moisture (e.g., wool or polypropylene). In addition, persons who are outdoors in such conditions for extended periods should increase their fluid and calorie intake, find adequate shelter, and avoid overexertion and sweating. Persons at increased risk for hypothermia during such periods should be monitored by family and neighbors.

High death rates in states with relatively mild winter climates reflect, in part, the need for increased efforts to inform the public and high-risk groups about the health risks of environmental cold and about measures for preventing hypothermia. During cold weather, health-care providers, public health agencies, community-services organizations, and others can reduce the occurrence of hypothermia-related morbidity and death by monitoring groups at elevated risk during cold weather and ensuring that adequate shelter is provided.

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