GUIDELINES FOR PREVENTION OF TRANSMISSION OF HUMAN IMMUNODEFICIENCY VIRUS AND HEPATITIS B VIRUS TO HEALTH-CARE AND PUBLIC-SAFETY WORKERS

A Response to P.L. 100-607
The Health Omnibus Programs Extension Act of 1988

ARTMENT OF HEALTH AND HUMAN SERVICES
h Service
Disease Control
itute for Occupational Safety and Health

The material in this report was developed by the

National Institute for Occupational Safety and Health
in collaboration with the
Center for Infectious Diseases
Centers for Disease Control

121460

Guidelines for Prevention of Transmission of Human Immunodeficiency Virus and Hepatitis B Virus to Health-Care and Public-Safety Workers

A Response to P.L. 100-607
The Health Omnibus Programs Extension
Act of 1988

U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control
Atlanta, Georgia

February 1989

DISCLAIMER

Mention of company name or product does not constitute endorsement by the National Institute for Occupational Safety and Health (NIOSH).

This document may be requested from:

NIOSH
Attention: Publications
4676 Columbia Parkway
Cincinnati, Ohio 45226

Multiple copies may be purchased from:

Superintendent of Documents
U. S. Government Printing Office (GPO)
Washington, DC 20402

GPO Stock Number 017-033-00442-1

121460

DHHS (NIOSH) PUBLICATION NO. 89-107

TABLE OF CONTENTS

I. Introduction

A. Background

This document is a response to recently enacted legislation, Public Law 100-607, The Health Omnibus Programs Extension Act of 1988, Title II, Programs with Respect to Acquired Immune Deficiency Syndrome ("AIDS Amendments of 1988"). Subtitle E, General Provisions, Section 253(a) of Title II specifies that "the Secretary of Health and Human Services, acting through the Director of the Centers for Disease Control, shall develop, issue, and disseminate guidelines to all health workers, public safety workers (including emergency response employees) in the United States concerning–

(1) methods to reduce the risk in the workplace of becoming infected with the etiologic agent for acquired immune deficiency syndrome; and

(2) circumstances under which exposure to such etiologic agent may occur."

It is further noted that "The Secretary [of Health and Human Services] shall transmit the guidelines issued under subsection (a) to the Secretary of Labor for use by the Secretary of Labor in the development of standards to be issued under the Occupational Safety and Health Act of 1970," and that "the Secretary, acting through the Director of the Centers for Disease Control, shall develop a model curriculum for emergency response employees with respect to the prevention of exposure to the etiologic agent for acquired immune deficiency syndrome during the process of responding to emergencies."

Following development of these guidelines and curriculum, "[t]he Secretary shall–

(A) transmit to State public health officers copies of the guidelines and the model curriculum developed under paragraph (1) with the request that such officers disseminate such copies as appropriate throughout the State; and

(B) make such copies available to the public."

B. Purpose and Organization of Document

The purpose of this document is to provide an overview of the modes of transmission of human immunodeficiency virus (HIV) in the workplace, an assessment of the risk of transmission under various assumptions, principles underlying the control of risk, and specific risk-control recommendations for employers and workers. This document also includes information on medical management of persons who have sustained an exposure at the workplace to these viruses (e.g., an emergency medical technicians who incur a needle-stick injury while performing professional duties). These guidelines are intended for use by a technically informed audience. As noted above, a separate model curriculum based on the principles and practices discussed in this document is being developed for use in training workers and will contain less technical wording.

Information concerning the protection of workers against acquisition of the human immunodeficiency virus (HIV) while performing job duties, the virus that causes AIDS, is presented here. Information on hepatitis B virus (HBV) is also presented in this document on the basis of the following assumptions:

- the modes of transmission for hepatitis B virus (HBV) are similar to those of HIV,
- the potential for HBV transmission in the occupational setting is greater than for HIV,
- there is a larger body of experience relating to controlling transmission of HBV in the workplace, and

- general practices to prevent the transmission of HBV will also minimize the risk of transmission of HIV.

Blood-borne transmission of other pathogens not specifically addressed here will be interrupted by adherence to the precautions noted below. It is important to note that the implementation of control measures for HIV and HBV does not obviate the need for continued adherence to general infection-control principles and general hygiene measures (e.g., hand washing) for preventing transmission of other infectious diseases to both worker and client. General guidelines for control of these diseases have been published (*1,2,3*).

This document was developed primarily to provide guidelines for fire-service personnel, emergency medical technicians, paramedics (see section IV, page 14), and law-enforcement and correctional-facility personnel (see section V, page 16). Throughout the report, paramedics and emergency medical technicians are called "emergency medical workers" and fire-service, law-enforcement, and correctional-facility personnel, "public-safety workers." Previously issued guidelines address the needs of hospital-, laboratory-, and clinic-based health-care workers and are reprinted in Appendix A (see page 31) and Appendix B (see page 36). A condensation of general guidelines for protection of workers from transmission of blood-borne pathogens, derived from the Joint Advisory Notice of the Departments of Labor and Health and Human Services (*4*), is provided in section III (see page 8).

C. Modes and Risk of Virus Transmission in the Workplace

Although the potential for HBV transmission in the workplace setting is greater than for HIV, the modes of transmission for these two viruses are similar. Both have been transmitted in occupational settings **only** by percutaneous inoculation or contact with an open wound, nonintact (e.g., chapped, abraded, weeping, or dermatitic) skin, or mucous membranes to blood, blood-contaminated body fluids, or concentrated virus. **Blood is the single most important source of HIV and HBV in the workplace setting.** Protection measures against HIV and HBV for workers should focus primarily on preventing these types of exposures to blood as well as on delivery of HBV vaccination.

The risk of hepatitis B infection following a parenteral (i.e., needle stick or cut) exposure to blood is directly proportional to the probability that the blood contains hepatitis B surface antigen (HBsAg), the immunity status of the recipient, and on the efficiency of transmission (*5*). The probability of the source of the blood being HBsAg positive varies from 1 to 3 per thousand in the general population to 5%–15% in groups at high risk for HBV infection, such as immigrants from areas of high endemicity (China and Southeast Asia, sub-Saharan Africa, most Pacific islands, and the Amazon Basin); clients in institutions for the mentally retarded; intravenous drug users; homosexually active males; and household (sexual and non-sexual) contacts of HBV carriers. Of persons who have not had prior hepatitis B vaccination or postexposure prophylaxis, 6%–30% of persons who receive a needle-stick exposure from an HBsAg-positive individual will become infected (*5*).

The risk of infection with HIV following one needle-stick exposure to blood from a patient known to be infected with HIV is approximately 0.5% (*6,7*). This rate of transmission is considerably lower than that for HBV, probably as a result of the significantly lower concentrations of virus in the blood of HIV-infected persons. Table 1 (see page 24) presents theoretical data concerning the likelihood of infection given repeated needle-stick injuries involving patients whose HIV serostatus is unknown. Though inadequately quantified, the risk from exposure of nonintact skin or mucous membranes is likely to be far less than that from percutaneous inoculation.

D. Transmission of Hepatitis B Virus to Workers

1. Health-care workers

In 1987, the CDC estimated the total number of HBV infections in the United States to be 300,000 per year, with approximately 75,000 (25%) of infected persons developing acute hepatitis. Of these infected individuals, 18,000–30,000 (6%–10%) will become HBV carriers, at risk of developing chronic liver disease (chronic active hepatitis, cirrhosis, and primary liver cancer), and infectious to others.

CDC has estimated that 12,000 health-care workers whose jobs entail exposure to blood become infected with HBV each year, that 500–600 of them are hospitalized as a result of that infection, and that 700–1,200 of those infected become HBV carriers. Of the infected workers, approximately 250 will die (12–15 from fulminant hepatitis, 170–200 from cirrhosis, and 40–50 from liver cancer). Studies indicate that 10%–30% of health-care or dental workers show serologic evidence of past or present HBV infection.

2. Emergency medical and public-safety workers

Emergency medical workers have an increased risk for hepatitis B infection (*8,9,10*). The degree of risk correlates with the frequency and extent of blood exposure during the conduct of work activities. A few studies are available concerning risk of HBV infection for other groups of public-safety workers (law-enforcement personnel and correctional-facility workers), but reports that have been published do not document any increased risk for HBV infection (*11,12,13*). Nevertheless, in occupational settings in which workers may be routinely exposed to blood or other body fluids as described below, an increased risk for occupational acquisition of HBV infection must be assumed to be present.

3. Vaccination for hepatitis B virus

A safe and effective vaccine to prevent hepatitis B has been available since 1982. Vaccination has been recommended for health-care workers regularly exposed to blood and other body fluids potentially contaminated with HBV (*5,14,15*). In 1987, the Department of Health and Human Services and the Department of Labor stated that hepatitis B vaccine should be provided to all such workers at no charge to the worker (*4*).

Available vaccines stimulate active immunity against HBV infection and provide over 90% protection against hepatitis B for 7 or more years following vaccination (*5*). Hepatitis B vaccines also are 70–88% effective when given within 1 week after HBV exposure. Hepatitis B immune globulin (HBIG), a preparation of immunoglobulin with high levels of antibody to HBV (anti-HBs), provides temporary passive protection following exposure to HBV. Combination treatment with hepatitis B vaccine and HBIG is over 90% effective in preventing hepatitis B following a documented exposure (*5*).

E. Transmission of Human Immunodeficiency Virus to Workers

1. Health-care workers with AIDS

As of September 19, 1988, a total of 3,182 (5.1%) of 61,929 adults with AIDS, who had been reported to the CDC national surveillance system and for whom occupational information was available, reported being employed in a health-care setting. Of the health-care workers with AIDS, 95%

reported high-risk behavior; for the remaining 5% (169 workers), the means of HIV acquisition was undetermined.

Of these 169 health-care workers with AIDS with undetermined risk, information is incomplete for 28 (17%) because of death or refusal to be interviewed; 97 (57%) are still being investigated. The remaining 44 (26%) health-care workers were interviewed directly or had other follow-up information available. The occupations of these 44 were nine nursing assistants (20%); eight physicians (18%), four of whom were surgeons; eight housekeeping or maintenance workers (18%); six nurses (14%); four clinical laboratory technicians (9%); two respiratory therapists (5%); one dentist (2%); one paramedic (2%); one embalmer (2%); and four others who did not have contact with patients (9%). Eighteen of these 44 health-care workers reported parenteral and/or other non-needle-stick exposure to blood or other body fluids from patients in the 10 years preceding their diagnosis of AIDS. None of these exposures involved a patient with AIDS or known HIV infection, and HIV seroconversion of the health-care worker was not documented following a specific exposure.

2. Human immunodeficiency virus transmission in the workplace

As of July 31, 1988, 1,201 health-care workers had been enrolled and tested for HIV antibody in ongoing CDC surveillance of health-care workers exposed via needle stick or splashes to skin or mucous membranes to blood from patients known to be HIV-infected (*16*). Of 860 workers who had received needle-stick injuries or cuts with sharp objects (i.e., parenteral exposures) and whose serum had been tested for HIV antibody at least 180 days after exposure, 4 were positive, yielding a seroprevalence rate of 0.47%. Three of these individuals experienced an acute retroviral syndrome associated with documented seroconversion. Investigation revealed no nonoccupational risk factors for these three workers. Serum collected within 30 days of exposure was not available from the fourth person. This worker had an HIV-seropositive sexual partner, and heterosexual acquisition of infection cannot be excluded. None of the 103 workers who had contamination of mucous membranes or nonintact skin and whose serum had been tested at least 180 days after exposure developed serologic evidence of HIV infection.

Two other ongoing prospective studies assess the risk of nosocomial acquisition of HIV infection among health-care workers in the United States. As of April 1988, the National Institutes of Health had tested 983 health-care workers, 137 with documented needle-stick injuries and 345 health-care workers who had sustained mucous-membrane exposures to blood or other body fluids of HIV-infected patients; none had seroconverted (*17*) (one health-care worker who subsequently experienced an occupational HIV seroconversion has since been reported from NIH [*18*]). As of March 15, 1988, a similar study at the University of California of 212 health-care workers with 625 documented accidental parenteral exposures involving HIV-infected patients had identified one seroconversion following a needle stick (*19*). Prospective studies in the United Kingdom and Canada show no evidence of HIV transmission among 220 health-care workers with parenteral, mucous-membrane, or cutaneous exposures (*20,21*).

In addition to the health-care workers enrolled in these longitudinal surveillance studies, case histories have been published in the scientific literature for 19 HIV-infected health-care workers (13 with documented seroconversion and 6 without documented seroconversion). None of these workers reported nonoccupational risk factors (see Table 2, pages 25, 26).

3. Emergency medical service and public-safety workers

   In addition to the one paramedic with undetermined risk discussed above, three public-safety workers (law-enforcement officers) are classified in the undetermined risk group. Follow-up investigations of these workers could not determine conclusively if HIV infection was acquired during the performance of job duties.

II. Principles of Infection Control and Their Application to Emergency and Public-Safety Workers

A. General Infection Control

Within the health-care setting, general infection control procedures have been developed to minimize the risk of patient acquisition of infection from contact with contaminated devices, objects, or surfaces or of transmission of an infectious agent from health-care workers to patients (*1,2,3*). Such procedures also protect workers from the risk of becoming infected. General infection-control procedures are designed to prevent transmission of a wide range of microbiological agents and to provide a wide margin of safety in the varied situations encountered in the health-care environment.

General infection-control principles are applicable to other work environments where workers contact other individuals and where transmission of infectious agents may occur. The modes of transmission noted in the hospital and medical office environment are observed in the work situations of emergency and public-safety workers, as well. Therefore, the principles of infection control developed for hospital and other health-care settings are also applicable to these work situations. Use of general infection control measures, as adapted to the work environments of emergency and public-safety workers, is important to protect both workers and individuals with whom they work from a variety of infectious agents, not just HIV and HBV.

Because emergency and public-safety workers work in environments that provide inherently unpredictable risks of exposures, general infection-control procedures should be adapted to these work situations. Exposures are unpredictable, and protective measures may often be used in situations that do not appear to present risk. Emergency and public-safety workers perform their duties in the community under extremely variable conditions; thus, control measures that are simple and uniform across all situations have the greatest likelihood of worker compliance. Administrative procedures to ensure compliance also can be more readily developed than when procedures are complex and highly variable.

B. Universal Blood and Body Fluid Precautions to Prevent Occupational HIV and HBV Transmission

In 1985, CDC developed the strategy of "universal blood and body fluid precautions" to address concerns regarding transmission of HIV in the health-care setting (*6*). The concept, now referred to simply as "universal precautions" stresses that **all patients should be assumed to be infectious for HIV and other blood-borne pathogens**. In the hospital and other health-care setting, "universal precautions" should be followed when workers are exposed to blood, certain other body fluids (amniotic fluid, pericardial fluid, peritoneal fluid, pleural fluid, synovial fluid, cerebrospinal fluid, semen, and vaginal secretions), or any body fluid visibly contaminated with blood. Since HIV and HBV transmission has not been documented from exposure to other body fluids (feces, nasal secretions, sputum, sweat, tears, urine, and vomitus), "universal precautions" do not apply to these fluids. Universal precautions also do not apply to saliva, except in the dental setting, where saliva is likely to be contaminated with blood (see Appendix A, page 32).

For the purpose of this document, human "exposure" is defined as contact with blood or other body fluids to which universal precautions apply through percutaneous inoculation or contact with an open wound, nonintact skin, or mucous membrane during the performance of normal job duties. An "exposed worker" is defined, for the purposes of this document, as an individual exposed, as described above, while performing normal job duties.

The unpredictable and emergent nature of exposures encountered by emergency and public-safety workers may make differentiation between hazardous body fluids and those which are not hazardous very difficult and often impossible. For example, poor lighting may limit the worker's ability to detect visible blood in

vomitus or feces. Therefore, **when emergency medical and public-safety workers encounter body fluids under uncontrolled, emergency circumstances in which differentiation between fluid types is difficult, if not impossible, they should treat all body fluids as potentially hazardous.**

The application of the principles of universal precautions to the situations encountered by these workers results in the development of guidelines (listed below) for work practices, use of personal protective equipment, and other protective measures. To minimize the risks of acquiring HIV and HBV during performance of job duties, emergency and public-safety workers should be protected from exposure to blood and other body fluids as circumstances dictate. Protection can be achieved through adherence to work practices designed to minimize or eliminate exposure and through use of personal protective equipment (i.e., gloves, masks, and protective clothing), which provide a barrier between the worker and the exposure source. In some situations, redesign of selected aspects of the job through equipment modifications or environmental control can further reduce risk. These approaches to primary prevention should be used together to achieve maximal reduction of the risk of exposure.

If exposure of an individual worker occurs, medical management, consisting of collection of pertinent medical and occupational history, provision of treatment, and counseling regarding future work and personal behaviors, may reduce risk of developing disease as a result of the exposure episode (*22*). Following episodic (or continuous) exposure, decontamination and disinfection of the work environment, devices, equipment, and clothing or other forms of personal protective equipment can reduce subsequent risk of exposures. Proper disposal of contaminated waste has similar benefits.

III. Employer Responsibilities

A. General

Detailed recommendations for employer responsibilities in protecting workers from acquisition of blood-borne diseases in the workplace have been published in the Department of Labor and Department of Health and Human Services Joint Advisory Notice and are summarized here (*4*). In developing programs to protect workers, employers should follow a series of steps: 1) classification of work activity, 2) development of standard operating procedures, 3) provision of training and education, 4) development of procedures to ensure and monitor compliance, and 5) workplace redesign. As a first step, every employer should classify work activities into one of three categories of potential exposure (see Table 3, page 27). Employers should make protective equipment available to all workers when they are engaged in Category I or II activities. Employers should ensure that the appropriate protective equipment is used by workers when they perform Category I activities.

As a second step, employers should establish a detailed work practices program that includes standard operating procedures (SOPs) for all activities having the potential for exposure. Once these SOPs are developed, an initial and periodic worker education program to assure familiarity with work practices should be provided to potentially exposed workers. No worker should engage in such tasks or activities before receiving training pertaining to the SOPs, work practices, and protective equipment required for that task. Examples of personal protective equipment for the prehospital setting (defined as a setting where delivery of emergency health care takes place away from a hospital or other health-care setting) are provided in Table 4 (page 28). (A curriculum for such training programs is being developed in conjunction with these guidelines and should be consulted for further information concerning such training programs.)

To facilitate and monitor compliance with SOPs, administrative procedures should be developed and records kept as described in the Joint Advisory Notice (*4*). Employers should monitor the workplace to ensure that required work practices are observed and that protective clothing and equipment are provided and properly used. The employer should maintain records documenting the administrative procedures used to classify job activities and copies of all SOPs for tasks or activities involving predictable or unpredictable exposure to blood or other body fluids to which universal precautions apply. In addition, training records, indicating the dates of training sessions, the content of those training sessions along with the names of all persons conducting the training, and the names of all those receiving training should also be maintained.

Whenever possible, the employer should identify devices and other approaches to modifying the work environment which will reduce exposure risk. Such approaches are desirable, since they don't require individual worker action or management activity. For example, jails and correctional facilities should have classification procedures that require the segregation of offenders who indicate through their actions or words that they intend to attack correctional-facility staff with the intent of transmitting HIV or HBV.

B. Medical

In addition to the general responsibilities noted above, the employer has the specific responsibility to make available to the worker a program of medical management. This program is designed to provide for the reduction of risk of infection by HBV and for counseling workers concerning issues regarding HIV and HBV. These services should be provided by a licensed health professional. All phases of medical management and counseling should ensure that the confidentiality of the worker's and client's medical data is protected.

1. Hepatitis B vaccination

   All workers whose jobs involve participation in tasks or activities with exposure to blood or other body fluids to which universal precautions apply (as defined above on page 6) should be vaccinated with hepatitis B vaccine.

2. Management of percutaneous exposure to blood and other infectious body fluids

   Once an exposure has occurred (as defined above on page 6), a blood sample should be drawn after consent is obtained from the individual from whom exposure occurred and tested for hepatitis B surface antigen (HBsAg) and antibody to human immunodeficiency virus (HIV antibody). Local laws regarding consent for testing source individuals should be followed. Policies should be available for testing source individuals in situations where consent cannot be obtained (e.g., an unconscious patient). Testing of the source individual should be done at a location where appropriate pretest counseling is available; posttest counseling and referral for treatment should be provided. It is extremely important that all individuals who seek consultation for any HIV-related concerns receive counseling as outlined in the "Public Health Service Guidelines for Counseling and Antibody Testing to Prevent HIV Infection and AIDS" (*22*).

   a. Hepatitis B virus postexposure management

      For an exposure to a source individual found to be positive for HBsAg, the worker who has not previously been given hepatitis B vaccine should receive the vaccine series. A single dose of hepatitis B immune globulin (HBIG) is also recommended, if this can be given within 7 days of exposure. For exposures from an HBsAg-positive source to workers who have previously received vaccine, the exposed worker should be tested for antibody to hepatitis B surface antigen (anti-HBs), and given one dose of vaccine and one dose of HBIG if the antibody level in the worker's blood sample is inadequate (i.e., <10 SRU by RIA, negative by EIA) (*5*).

      If the source individual is negative for HBsAg and the worker has not been vaccinated, this opportunity should be taken to provide hepatitis B vaccination.

      If the source individual refuses testing or he/she cannot be identified, the unvaccinated worker should receive the hepatitis B vaccine series. HBIG administration should be considered on an individual basis when the source individual is known or suspected to be at high risk of HBV infection. Management and treatment, if any, of previously vaccinated workers who receive an exposure from a source who refuses testing or is not identifiable should be individualized (*5*).

   b. Human immunodeficiency virus postexposure management

      For any exposure to a source individual who has AIDS, who is found to be positive for HIV infection (as defined in Appendix B, see page 42), or who refuses testing, the worker should be counseled regarding the risk of infection and evaluated clinically and serologically for evidence of HIV infection as soon as possible after the exposure. In view of the evolving nature of HIV postexposure management, the health-care provider should be well informed of current PHS guidelines on this subject. The worker should be advised to report and seek medical evaluation for any acute febrile illness that occurs within 12 weeks after the exposure. Such an illness, particularly one characterized by fever, rash, or lymphadenopathy, may be indicative of recent HIV infection. Following the initial test at the time of exposure,

seronegative workers should be retested 6 weeks, 12 weeks, and 6 months after exposure to determine whether transmission has occurred. During this follow-up period (especially the first 6-12 weeks after exposure, when most infected persons are expected to seroconvert), exposed workers should follow U.S. Public Health Service (PHS) recommendations for preventing transmission of HIV (*22*). These include refraining from blood donation and using appropriate protection during sexual intercourse (*23*). During all phases of follow-up, it is vital that worker confidentiality be protected.

If the source individual was tested and found to be seronegative, baseline testing of the exposed worker with follow-up testing 12 weeks later may be performed if desired by the worker or recommended by the health-care provider.

If the source individual cannot be identified, decisions regarding appropriate follow-up should be individualized. Serologic testing should be made available by the employer to all workers who may be concerned they have been infected with HIV through an occupational exposure as defined above (see page 6).

3. Management of human bites

On occasion, police and correctional-facility officers are intentionally bitten by suspects or prisoners. When such bites occur, routine medical and surgical therapy (including an assessment of tetanus vaccination status) should be implemented as soon as possible, since such bites frequently result in infection with organisms other than HIV and HBV. Victims of bites should be evaluated as described above (see page 9) for exposure to blood or other infectious body fluids.

(As noted below in Appendix A, page 32, saliva of some persons infected with HBV has been shown to contain HBV-DNA at concentrations 1/1,000 to 1/10,000 of that found in the infected person's serum (*24*). HbsAg-positive saliva has been shown to be infectious when injected into experimental animals and in human bite exposures (*25–27*). However, HBsAg-positive saliva has not been shown to be infectious when applied to oral mucous membranes in experimental primate studies (*27*) or through contamination of musical instruments or cardiopulmonary resuscitation dummies used by HBV carriers (*28,29*). Epidemiologic studies of nonsexual household contacts of HIV-infected patients, including several small series in which HIV transmission failed to occur after bites or after percutaneous inoculation or contamination of cuts and open wounds with saliva from HIV-infected patients, suggest that the potential for salivary transmission of HIV is remote (*7,30,31,32,33*). One case report from Germany has suggested the possibility of transmission of HIV in a household setting from an infected child to a sibling through a human bite (*34*). The bite did not break the skin or result in bleeding. Since the date of seroconversion to HIV was not known for either child in this case, evidence for the role of saliva in the transmission of virus is unclear (*34*).)

4. Documentation of exposure and reporting

As part of the confidential medical record, the circumstances of exposure should be recorded. Relevant information includes the activity in which the worker was engaged at the time of exposure, the extent to which appropriate work practices and protective equipment were used, and a description of the source of exposure.

Employers have a responsibility under various federal and state laws and regulations to report occupational illnesses and injuries. Existing programs in the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services; the Bureau of Labor Statistics,

Department of Labor (DOL); and the Occupational Safety and Health Administration (DOL) receive such information for the purposes of surveillance and other objectives. Cases of infectious disease, including AIDS and HBV infection, are reported to the Centers for Disease Control through State health departments.

5. Management of HBV- or HIV-infected workers

Transmission of HBV from health-care workers to patients has been documented. Such transmission has occurred during certain types of invasive procedures (e.g., oral and gynecologic surgery) in which health-care workers, when tested, had very high concentrations of HBV in their blood (at least 100 million infectious virus particles per milliliter, a concentration much higher than occurs with HIV infection), and the health-care workers sustained a puncture wound while performing invasive procedures or had exudative or weeping lesions or microlacerations that allowed virus to contaminate instruments or open wounds of patients (*35,36*). A worker who is HBsAg positive and who has transmitted hepatitis B virus to another individual during the performance of his or her job duties should be excluded from the performance of those job duties which place other individuals at risk for acquisition of hepatitis B infection.

Workers with impaired immune systems resulting from HIV infection or other causes are at increased risk of acquiring or experiencing serious complications of infectious disease. Of particular concern is the risk of severe infection following exposure to other persons with infectious diseases that are easily transmitted if appropriate precautions are not taken (e.g., measles, varicella). Any worker with an impaired immune system should be counseled about the potential risk associated with providing health care to persons with any transmissible infection and should continue to follow existing recommendations for infection control to minimize risk of exposure to other infectious agents (*2,3*). Recommendations of the Immunization Practices Advisory Committee (ACIP) and institutional policies concerning requirements for vaccinating workers with live-virus vaccines (e.g., measles, rubella) should also be considered.

The question of whether workers infected with HIV can adequately and safely be allowed to perform patient-care duties or whether their work assignments should be changed must be determined on an individual basis. These decisions should be made by the worker's personal physician(s) in conjunction with the employer's medical advisors.

C. Disinfection, Decontamination, and Disposal

As described in Section I.C. (see page 2), the only documented occupational risks of HIV and HBV infection are associated with parenteral (including open wound) and mucous membrane exposure to blood and other potentially infectious body fluids. Nevertheless, the precautions described below should be routinely followed.

1. Needle and sharps disposal

All workers should take precautions to prevent injuries caused by needles, scalpel blades, and other sharp instruments or devices during procedures; when cleaning used instruments; during disposal of used needles; and when handling sharp instruments after procedures. To prevent needle-stick injuries, needles should not be recapped, purposely bent or broken by hand, removed from disposable syringes, or otherwise manipulated by hand. After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in puncture-resistant containers for disposal; the puncture-resistant containers should be located as close as practical to the use area (e.g., in the

ambulance or, if sharps are carried to the scene of victim assistance from the ambulance, a small puncture-resistant container should be carried to the scene, as well). Reusable needles should be left on the syringe body and should be placed in a puncture-resistant container for transport to the reprocessing area.

2. Hand washing

Hands and other skin surfaces should be washed immediately and thoroughly if contaminated with blood, other body fluids to which universal precautions apply, or potentially contaminated articles. Hands should always be washed after gloves are removed, even if the gloves appear to be intact. Hand washing should be completed using the appropriate facilities, such as utility or restroom sinks. Waterless antiseptic hand cleanser should be provided on responding units to use when hand-washing facilities are not available. When hand-washing facilities are available, wash hands with warm water and soap. When hand-washing facilities are not available, use a waterless antiseptic hand cleanser. The manufacturer's recommendations for the product should be followed.

3. Cleaning, disinfecting, and sterilizing

Table 5 (see pages 29, 30) presents the methods and applications for cleaning, disinfecting, and sterilizing equipment and surfaces in the prehospital setting. These methods also apply to housekeeping and other cleaning tasks. Previously issued guidelines for health-care workers contain more detailed descriptions of these procedures and may be found in Appendix B (see page 40).

4. Cleaning and decontaminating spills of blood

All spills of blood and blood-contaminated fluids should be promptly cleaned up using an EPA-approved germicide or a 1:100 solution of household bleach in the following manner **while wearing gloves**. Visible material should first be removed with disposable towels or other appropriate means that will ensure against direct contact with blood. If splashing is anticipated, protective eyewear should be worn along with an impervious gown or apron which provides an effective barrier to splashes. The area should then be decontaminated with an appropriate germicide. Hands should be washed following removal of gloves. Soiled cleaning equipment should be cleaned and decontaminated or placed in an appropriate container and disposed of according to agency policy. Plastic bags should be available for removal of contaminated items from the site of the spill.

Shoes and boots can become contaminated with blood in certain instances. Where there is massive blood contamination on floors, the use of disposable impervious shoe coverings should be considered. Protective gloves should be worn to remove contaminated shoe coverings. The coverings and gloves should be disposed of in plastic bags. A plastic bag should be included in the crime scene kit or the car which is to be used for the disposal of contaminated items. Extra plastic bags should be stored in the police cruiser or emergency vehicle.

5. Laundry

Although soiled linen may be contaminated with pathogenic microorganisms, the risk of actual disease transmission is negligible. Rather than rigid procedures and specifications, hygienic storage and processing of clean and soiled linen are recommended. Laundry facilities and/or services should be made routinely available by the employer. Soiled linen should be handled as little as possible and with minimum agitation to prevent gross microbial contamination of the air and of persons handling the linen. All soiled linen should be bagged at the location where it was used. Linen soiled with blood

should be placed and transported in bags that prevent leakage. Normal laundry cycles should be used according to the washer and detergent manufacturers' recommendations.

6. Decontamination and laundering of protective clothing

   Protective work clothing contaminated with blood or other body fluids to which universal precautions apply should be placed and transported in bags or containers that prevent leakage. Personnel involved in the bagging, transport, and laundering of contaminated clothing should wear gloves. Protective clothing and station and work uniforms should be washed and dried according to the manufacturer's instructions. Boots and leather goods may be brush-scrubbed with soap and hot water to remove contamination.

7. Infective waste

   The selection of procedures for disposal of infective waste is determined by the relative risk of disease transmission and application of local regulations, which vary widely. **In all cases, local regulations should be consulted prior to disposal procedures and followed.** Infective waste, in general, should either be incinerated or should be decontaminated before disposal in a sanitary landfill. Bulk blood, suctioned fluids, excretions, and secretions may be carefully poured down a drain connected to a sanitary sewer, where permitted. Sanitary sewers may also be used to dispose of other infectious wastes capable of being ground and flushed into the sewer, where permitted. Sharp items should be placed in puncture-proof containers and other blood-contaminated items should be placed in leak-proof plastic bags for transport to an appropriate disposal location.

   Prior to the removal of protective equipment, personnel remaining on the scene after the patient has been cared for should carefully search for and remove contaminated materials. Debris should be disposed of as noted above.

IV. Fire and Emergency Medical Services

The guidelines that appear in this section apply to fire and emergency medical services. This includes structural fire fighters, paramedics, emergency medical technicians, and advanced life support personnel. Fire fighters often provide emergency medical services and therefore encounter the exposures common to paramedics and emergency medical technicians. Job duties are often performed in uncontrolled environments, which, due to a lack of time and other factors, do not allow for application of a complex decision-making process to the emergency at hand.

The general principles presented here have been developed from existing principles of occupational safety and health in conjunction with data from studies of health-care workers in hospital settings. The basic premise is that workers must be protected from exposure to blood and other potentially infectious body fluids in the course of their work activities. There is a paucity of data concerning the risks these worker groups face, however, which complicates development of control principles. Thus, the guidelines presented below are based on principles of prudent public health practice.

Fire and emergency medical service personnel are engaged in delivery of medical care in the prehospital setting. The following guidelines are intended to assist these personnel in making decisions concerning use of personal protective equipment and resuscitation equipment, as well as for decontamination, disinfection, and disposal procedures.

A. Personal Protective Equipment

Appropriate personal protective equipment should be made available routinely by the employer to reduce the risk of exposure as defined above. For many situations, the chance that the rescuer will be exposed to blood and other body fluids to which universal precautions apply can be determined in advance. Therefore, if the chances of being exposed to blood is high (e.g., CPR, IV insertion, trauma, delivering babies), the worker should put on protective attire before beginning patient care. Table 4 (see page 28) sets forth examples of recommendations for personal protective equipment in the prehospital setting; the list is not intended to be all-inclusive.

1. Gloves

Disposable gloves should be a standard component of emergency response equipment, and should be donned by all personnel prior to initiating any emergency patient care tasks involving exposure to blood or other body fluids to which universal precautions apply. Extra pairs should always be available. Considerations in the choice of disposable gloves should include dexterity, durability, fit, and the task being performed. Thus, there is no single type or thickness of glove appropriate for protection in all situations. For situations where large amounts of blood are likely to be encountered, it is important that gloves fit tightly at the wrist to prevent blood contamination of hands around the cuff. For multiple trauma victims, gloves should be changed between patient contacts, if the emergency situation allows.

Greater personal protective equipment measures are indicated for situations where broken glass and sharp edges are likely to be encountered, such as extricating a person from an automobile wreck. Structural fire-fighting gloves that meet the Federal OSHA requirements for fire-fighters gloves (as contained in 29 CFR 1910.156 or National Fire Protection Association Standard 1973, Gloves for Structural Fire Fighters) should be worn in any situation where sharp or rough surfaces are likely to be encountered (*37*).

While wearing gloves, avoid handling personal items, such as combs and pens, that could become soiled or contaminated. Gloves that have become contaminated with blood or other body fluids to which universal precautions apply should be removed as soon as possible, taking care to avoid skin contact with the exterior surface. Contaminated gloves should be placed and transported in bags that prevent leakage and should be disposed of or, in the case of reusable gloves, cleaned and disinfected properly.

2. Masks, eyewear, and gowns

Masks, eyewear, and gowns should be present on all emergency vehicles that respond or potentially respond to medical emergencies or victim rescues. These protective barriers should be used in accordance with the level of exposure encountered. Minor lacerations or small amounts of blood do not merit the same extent of barrier use as required for exsanguinating victims or massive arterial bleeding. Management of the patient who is not bleeding, and who has no bloody body fluids present, should not routinely require use of barrier precautions. Masks and eyewear (e.g., safety glasses) should be worn together, or a faceshield should be used by all personnel prior to any situation where splashes of blood or other body fluids to which universal precautions apply are likely to occur. Gowns or aprons should be worn to protect clothing from splashes with blood. If large splashes or quantities of blood are present or anticipated, impervious gowns or aprons should be worn. An extra change of work clothing should be available at all times.

3. Resuscitation equipment

No transmission of HBV or HIV infection during mouth-to-mouth resuscitation has been documented. However, because of the risk of salivary transmission of other infectious diseases (e.g., *Herpes simplex* and *Neisseria meningitidis*) and the theoretical risk of HIV and HBV transmission during artificial ventilation of trauma victims, disposable airway equipment or resuscitation bags should be used. Disposable resuscitation equipment and devices should be used once and disposed of or, if reusable, thoroughly cleaned and disinfected after each use according to the manufacturer's recommendations.

Mechanical respiratory assist devices (e.g., bag-valve masks, oxygen demand valve resuscitators) should be available on all emergency vehicles and to all emergency response personnel that respond or potentially respond to medical emergencies or victim rescues.

Pocket mouth-to-mouth resuscitation masks designed to isolate emergency response personnel (i.e., double lumen systems) from contact with victims' blood and blood-contaminated saliva, respiratory secretions, and vomitus should be provided to all personnel who provide or potentially provide emergency treatment.

V. Law-Enforcement and Correctional-Facility Officers

Law-enforcement and correctional-facility officers may face the risk of exposure to blood during the conduct of their duties. For example, at the crime scene or during processing of suspects, law-enforcement officers may encounter blood-contaminated hypodermic needles or weapons, or be called upon to assist with body removal. Correctional-facility officers may similarly be required to search prisoners or their cells for hypodermic needles or weapons, or subdue violent and combative inmates.

The following section presents information for reducing the risk of acquiring HIV and HBV infection by law-enforcement and correctional-facility officers as a consequence of carrying out their duties. However, there is an extremely diverse range of potential situations which may occur in the control of persons with unpredictable, violent, or psychotic behavior. Therefore, informed judgment of the individual officer is paramount when unusual circumstances or events arise. These recommendations should serve as an adjunct to rational decision making in those situations where specific guidelines do not exist, particularly where immediate action is required to preserve life or prevent significant injury.

The following guidelines are arranged into three sections: a section addressing concerns shared by both law-enforcement and correctional-facility officers, and two sections dealing separately with law-enforcement officers and correctional-facility officers, respectively. Table 4 (see page 28) contains selected examples of personal protective equipment that may be employed by law-enforcement and correctional-facility officers.

A. Law-Enforcement and Correctional-Facilities Considerations

1. Fights and assaults

   Law-enforcement and correctional-facility officers are exposed to a range of assaultive and disruptive behavior through which they may potentially become exposed to blood or other body fluids containing blood. Behaviors of particular concern are biting, attacks resulting in blood exposure, and attacks with sharp objects. Such behaviors may occur in a range of law-enforcement situations including arrests, routine interrogations, domestic disputes, and lockup operations, as well as in correctional-facility activities. Hand-to-hand combat may result in bleeding and may thus incur a greater chance for blood-to-blood exposure, which increases the chances for blood-borne disease transmission.

   Whenever the possibility for exposure to blood or blood-contaminated body fluids exists, the appropriate protection should be worn, if feasible under the circumstances. In all cases, extreme caution must be used in dealing with the suspect or prisoner if there is any indication of assaultive or combative behavior. When blood is present and a suspect or an inmate is combative or threatening to staff, gloves should always be put on as soon as conditions permit. In case of blood contamination of clothing, an extra change of clothing should be available at all times.

2. Cardiopulmonary resuscitation

   Law-enforcement and correctional personnel are also concerned about infection with HIV and HBV through administration of cardiopulmonary resuscitation (CPR). Although there have been no documented cases of HIV transmission through this mechanism, the possibility of transmission of other infectious diseases exists. Therefore, agencies should make protective masks or airways available to officers and provide training in their proper use. Devices with one-way valves to prevent the patients' saliva or vomitus from entering the caregiver's mouth are preferable.

B. Law-Enforcement Considerations

1. Searches and evidence handling

Criminal justice personnel have potential risks of acquiring HBV or HIV infection through exposures which occur during searches and evidence handling. Penetrating injuries are known to occur, and puncture wounds or needle sticks in particular pose a hazard during searches of persons, vehicles, or cells, and during evidence handling. The following precautionary measures will help to reduce the risk of infection:

- An officer should use great caution in searching the clothing of suspects. Individual discretion, based on the circumstances at hand, should determine if a suspect or prisoner should empty his own pockets or if the officer should use his own skills in determining the contents of a suspect's clothing.
- A safe distance should always be maintained between the officer and the suspect.
- Wear protective gloves if exposure to blood is likely to be encountered.
- Wear protective gloves for all body cavity searches.
- If cotton gloves are to be worn when working with evidence of potential latent fingerprint value at the crime scene, they can be worn over protective disposable gloves when exposure to blood may occur.
- Always carry a flashlight, even during daylight shifts, to search hidden areas. Whenever possible, use long-handled mirrors and flashlights to search such areas (e.g., under car seats).
- If searching a purse, carefully empty contents directly from purse, by turning it upside down over a table.
- Use puncture-proof containers to store sharp instruments and clearly marked plastic bags to store other possibly contaminated items.
- To avoid tearing gloves, use evidence tape instead of metal staples to seal evidence.
- Local procedures for evidence handling should be followed. In general, items should be air dried before sealing in plastic.

Not all types of gloves are suitable for conducting searches. Vinyl or latex rubber gloves provide little protection against sharp instruments, and they are not puncture-proof. There is a direct trade-off between level of protection and manipulability. In other words, the thicker the gloves, the more protection they provide, but the less effective they are in locating objects. Thus, there is no single type or thickness of glove appropriate for protection in all situations. Officers should select the type and thickness of glove which provides the best balance of protection and search efficiency.

Officers and crime scene technicians may confront unusual hazards, especially when the crime scene involves violent behavior, such as a homicide where large amounts of blood are present. Protective gloves should be available and worn in this setting. In addition, for very large spills, consideration should be given to other protective clothing, such as overalls, aprons, boots, or protective shoe covers.

They should be changed if torn or soiled, and always removed prior to leaving the scene. While wearing gloves, avoid handling personal items, such as combs and pens, that could become soiled or contaminated.

Face masks and eye protection or a face shield are required for laboratory and evidence technicians whose jobs which entail potential exposures to blood via a splash to the face, mouth, nose, or eyes.

Airborne particles of dried blood may be generated when a stain is scraped. It is recommended that protective masks and eyewear or face shields be worn by laboratory or evidence technicians when removing the blood stain for laboratory analyses.

While processing the crime scene, personnel should be alert for the presence of sharp objects such as hypodermic needles, knives, razors, broken glass, nails, or other sharp objects.

2. Handling deceased persons and body removal

For detectives, investigators, evidence technicians, and others who may have to touch or remove a body, the response should be the same as for situations requiring CPR or first aid: wear gloves and cover all cuts and abrasions to create a barrier and carefully wash all exposed areas after any contact with blood. The precautions to be used with blood and deceased persons should also be used when handling amputated limbs, hands, or other body parts. Such procedures should be followed after contact with the blood of **anyone**, regardless of whether they are known or suspected to be infected with HIV or HBV.

3. Autopsies

Protective masks and eyewear (or face shields), laboratory coats, gloves, and waterproof aprons should be worn when performing or attending all autopsies. All autopsy material should be considered infectious for both HIV and HBV. Onlookers with an opportunity for exposure to blood splashes should be similarly protected. Instruments and surfaces contaminated during postmortem procedures should be decontaminated with an appropriate chemical germicide following recommendations in Appendix B, page 40. Many laboratories have more detailed standard operating procedures for conducting autopsies; where available, these should be followed. (More detailed recommendations for health-care workers in this setting are found in Appendix B, page 39.)

4. Forensic laboratories

Blood from **all** individuals should be considered infective. To supplement other worksite precautions, the following precautions are recommended for workers in forensic laboratories.

a. All specimens of blood should be put in a well-constructed, appropriately labelled container with a secure lid to prevent leaking during transport. Care should be taken when collecting each specimen to avoid contaminating the outside of the container and of the laboratory form accompanying the specimen.

b. All persons processing blood specimens should wear gloves. Masks and protective eyewear or face shields should be worn if mucous-membrane contact with blood is anticipated (e.g., removing tops from vacuum tubes). Hands should be washed after completion of specimen processing.

c. For routine procedures, such as histologic and pathologic studies or microbiological culturing, a biological safety cabinet is not necessary. However, biological safety cabinets (Class I or II) should be used whenever procedures are conducted that have a high potential for generating droplets. These include activities such as blending, sonicating, and vigorous mixing.

d. Mechanical pipetting devices should be used for manipulating all liquids in the laboratory. Mouth pipetting must not be done.

e. Use of needles and syringes should be limited to situations in which there is no alternative, and the recommendations for preventing injuries with needles outlined under universal precautions should be followed.

f. Laboratory work surfaces should be cleaned of visible materials and then decontaminated with an appropriate chemical germicide after a spill of blood, semen, or blood-contaminated body fluid and when work activities are completed.

g. Contaminated materials used in laboratory tests should be decontaminated before reprocessing or be placed in bags and disposed of in accordance with institutional and local regulatory policies for disposal of infective waste.

h. Scientific equipment that has been contaminated with blood should be cleaned and then decontaminated before being repaired in the laboratory or transported to the manufacturer.

i. All persons should wash their hands after completing laboratory activities and should remove protective clothing before leaving the laboratory.

j. Area posting of warning signs should be considered to remind employees of continuing hazard of infectious disease transmission in the laboratory setting.

C. Correctional-Facility Considerations

1. Searches

Penetrating injuries are known to occur in the correctional-facility setting, and puncture wounds or needle sticks in particular pose a hazard during searches of prisoners or their cells. The following precautionary measures will help to reduce the risk of infection:

- A correctional-facility officer should use great caution in searching the clothing of prisoners. Individual discretion, based on the circumstances at hand, should determine if a prisoner should empty his own pockets or if the officer should use his own skills in determining the contents of a prisoner's clothing.

- A safe distance should always be maintained between the officer and the prisoner.

- Always carry a flashlight, even during daylight shifts, to search hidden areas. Whenever possible, use long-handled mirrors and flashlights to search such areas (e.g., under commodes, bunks, and in vents in jail cells).

- Wear protective gloves if exposure to blood is likely to be encountered.

- Wear protective gloves for all body cavity searches.

Not all types of gloves are suitable for conducting searches. Vinyl or latex rubber gloves can provide little, if any, protection against sharp instruments, and they are not puncture-proof. There is a direct trade-off between level of protection and manipulability. In other words, the thicker the gloves, the more protection they provide, but the less effective they are in locating objects. Thus, there is no single type or thickness of glove appropriate for protection in all situations. Officers should select the type and thickness of glove which provides the best balance of protection and search efficiency.

2. Decontamination and disposal

Prisoners may spit at officers and throw feces; sometimes these substances have been purposefully contaminated with blood. Although there are no documented cases of HIV or HBV transmission in this manner and transmission by this route would not be expected to occur, other diseases could be transmitted. These materials should be removed with a paper towel after donning gloves, and the area then decontaminated with an appropriate germicide. Following clean-up, soiled towels and gloves should be disposed of properly.

VI. References

1. Garner JS, Favero MS. Guideline for handwashing and hospital environmental control, 1985. Atlanta: Public Health Service, Centers for Disease Control, 1985. HHS publication no. 99-1117.

2. Garner JS, Simmons BP. Guideline for isolation precautions in hospitals. Infect Control 1983; 4 (suppl):245–325.

3. Williams WW. Guideline for infection control in hospital personnel. Infect Control 1983; 4(suppl):326–49.

4. U.S. Department of Labor, U.S. Department of Health and Human Services. Joint Advisory Notice: protection against occupational exposure to hepatitis B virus (HBV) and human immunodeficiency virus (HIV). Federal Register 1987; 52:41818–24.

5. Centers for Disease Control. Recommendations for protection against viral hepatitis. MMWR 1985; 34:313–324, 329–335.

6. Centers for Disease Control. Recommendations for prevention of HIV transmission in health-care settings. MMWR 1987; 36 (suppl 2S).

7. Centers for Disease Control. Update: Universal precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus, and other bloodborne pathogens in health-care settings. MMWR 1988; 37:377–382,387–88.

8. Kunches LM, Craven DE, Werner BG, Jacobs LM. Hepatitis B exposure in emergency medical personnel: prevalence of serologic markers and need for immunization. Amer J Med 1983; 75:269–272.

9. Pepe PE, Hollinger FB, Troisi CL, Heiberg D. Viral hepatitis risk in urban emergency medical services personnel. Annals Emergency Med 1986; 15(4):454–457.

10. Valenzuela TD, Hook EW, Copass MK, Corey L. Occupational exposure to hepatitis B in paramedics. Arch Intern Med 1985; 145:1976–1977.

11. Morgan-Capner P, Hudson P. Hepatitis B markers in Lancashire police officers. Epidemiol Inf 1988; 100:145–151.

12. Peterkin M, Crawford RJ. Hepatitis B vaccine for police forces [Letter]? Lancet 1986; 2:1458–59.

13. Radvan GH, Hewson EG, Berenger S, Brookman DJ. The Newcastle hepatitis B outbreak: observations on cause, management, and prevention. Med J Australia 1986; 144:461–464.

14. Centers for Disease Control. Inactivated hepatitis B virus vaccine. MMWR 1982; 26:317–322, 327–328.

15. Centers for Disease Control. Update on hepatitis B prevention. MMWR 1987; 36:353–360, 366.

16. Marcus R, and the CDC Cooperative Needlestick Surveillance Group. Surveillance of health care workers exposed to blood from patients infected with the human immunodeficiency virus. N Engl J Med 1988; 319:1118–23.

17. Henderson DK, Fahey BJ, Saah AJ, Schmitt JM, Lane HC. Longitudinal assessment of risk for occupational/nosocomial transmission of human immunodeficiency virus, type 1 in health care workers. Abstract #634; presented at the 1988 ICAAC Conference, New Orleans.

18. Barnes DM. Health workers and AIDS: Questions persist. Science 1988; 241:161–2.

19. Gerberding JL, Littell CG, Chambers HF, Moss AR, Carlson J, Drew W, Levy J, Sande MA. Risk of occupational HIV transmission in intensively exposed health-care workers: Follow-up. Abstract #343; presented at the 1988 ICAAC Conference, New Orleans.

20. Health and Welfare Canada. National surveillance program on occupational exposures to HIV among health-care workers in Canada. Canada Dis Weekly Rep 1987; 13–37:163–6.

21. McEvoy M, Porter K, Mortimer P, Simmons N, Shanson D. Prospective study of clinical, laboratory, and ancillary staff with accidental exposures to blood or body fluids from patients infected with HIV. Br Med J 1987; 294:1595–7.

22. Centers for Disease Control. Public Health Service guidelines for counseling and antibody testing to prevent HIV infection and AIDS. MMWR 1987; 36:;509–515.

23. Centers for Disease Control. Additional recommendations to reduce sexual and drug abuse-related transmission of human T-lymphotropic virus type III/lymphadenopathy-associated virus. MMWR 1986; 35:152–55.

24. Jenison SA, Lemon SM, Baker LN, Newbold JE. Quantitative analysis of hepatitis B virus DNA in saliva and semen of chronically infected homosexual men. J Infect Dis 1987; 156:299–306.

25. Cancio-Bello TP, de Medina M, Shorey J, Valledor MD, Schiff ER. An institutional outbreak of hepatitis B related to a human biting carrier. J Infect Dis 1982; 146:652–6.

26. MacQuarrie MB, Forghani B, Wolochow DA. Hepatitis B transmitted by a human bite. JAMA 1974; 230:723–4.

27. Scott RM, Snitbhan R, Bancroft WH, Alter HJ, Tingpalapong M. Experimental transmission of hepatitis B virus by semen and saliva. J Infect Dis 1980; 142:67–71.

28. Glaser JB, Nadler JP. Hepatitis B virus in a cardiopulmonary resuscitation training course: Risk of transmission from a surface antigen-positive participant. Arch Intern Med 1985; 145:1653–5.

29. Osterholm MT, Bravo ER, Crosson JT, et al. Lack of transmission of viral hepatitis type B after oral exposure to HBsAg-positive saliva. Br Med J 1979; 2:1263–4.

30. Lifson AR. Do alternate modes for transmission of human immunodeficiency virus exist? A review. JAMA 1988; 259:1353–6.

31. Friedland GH, Saltzman BR, Rogers MF, et al. Lack of transmission of HTLV-III/LAV infection to household contacts of patients with AIDS or AIDS-related complex with oral candidiasis. N Engl J Med 1986; 314:344–9.

32. Curran JW, Jaffe HW, Hardy AM, et al. Epidemiology of HIV infection and AIDS in the United States. Science 1988; 239:610–6.

33. Jason JM, McDougal JS, Dixon G, et al. HTLV-III/LAV antibody and immune status of household contacts and sexual partners of persons with hemophilia. JAMA 1986; 255:212–5.

34. Wahn V, Kramer HH, Voit T, Brüster HT, Scrampical B, Scheid A. Horizontal transmission of HIV infection between two siblings [Letter]. Lancet 1986; 2:694.

35. Kane MA, Lettau LA. Transmission of HBV from dental personnel to patients. J Am Dent Assoc 1985; 110:634–6.

36. Lettau LA, Smith JD, Williams D, et al. Transmission of hepatitis B virus with resultant restriction of surgical practice. JAMA 1986; 255:934–7.

37. International Association of Fire Fighters. Guidelines to prevent transmission of communicable disease during emergency care for fire fighters, paramedics, and emergency medical technicians. International Association of Fire Fighters, New York City, New York, 1988.

VII. Tables

Table 1. The Risk of HIV Infection
Following Needlestick Injury: Hypothetical Model

Prevalence of HIV Infection (A)	Probability of Infection Given Needlestick Injury with Blood Containing HIV (B)	Probability of Infection Given Random Needlestick (Unknown Serostatus) A * B = (C)	Probability of Infection Given 10 Random Needlesticks $1-(1-C)^{10}$	Probability of Infection Given 100 Random Needlesticks $1-(1-C)^{100}$
0.0001	0.001	0.0000001	0.000001	0.00001
0.0001	0.005	0.0000005	0.000005	0.00005
0.001	0.001	0.000001	0.00001	0.0001
0.001	0.005	0.000005	0.00005	0.0005
0.01	0.001	0.00001	0.0001	0.001
0.01*	0.005	0.00005	0.0005	0.005
0.05	0.001	0.00005	0.0005	0.005
0.05	0.005	0.00025	0.0025	0.025

* For example, if the prevalence of infection in the population is 0.01 (i.e., 1 per 100) and the risk of a seroconversion following a needlestick with blood known to contain HIV is 0.005 (i.e., 1 in 200), then the probability of HIV infection given a random needlestick is 0.00005 (i.e., 5 in 100,000). If an individual sustains 10 needlestick injuries, the probability of acquiring HIV infection is 0.0005 (i.e., 1 in 2,000); if the individual sustains 100 needlestick injuries, the probability of acquiring HIV infection is 0.005 (i.e., 1 in 200).

Table 2.
HIV-infected health-care workers with no reported nonoccupational risk factors and for whom case histories have been published in the scientific literature
Cases with Documented Seroconversion

Case	Occupation	Country	Type of Exposure	Source
1*	NS†	United States	Needlestick	AIDS patient
2	NS	United States	Needlestick	AIDS patient
3	NS	United States	Needlestick	AIDS patient
4	NS	United States	2 Needlesticks	AIDS patient, HIV-infected patient
5	NS	United States	Needlestick	AIDS patient
6	Nurse	England	Needlestick	AIDS patient
7	Nurse	France	Needlestick	HIV-infected patient
8	Nurse	Martinique	Needlestick	AIDS patient
9	Research lab worker	United States	Cut with sharp object	Concentrated virus
10	Home health-care worker	United States	Cutaneous#	AIDS patient
11	NS	United States	Nonintact skin	AIDS patient
12	Phlebotomist	United States	Mucous-membrane	HIV-infected patient
13	Technologist	United States	Nonintact skin	HIV-infected patient
14	NS	United States	Needlestick	AIDS patient
15	Nurse	Italy	Mucous membrane	HIV-infected patient
16	Nurse	France	Needlestick	AIDS patient
17	Navy medic	United States	Needlestick	AIDS patient
18	Clinical lab worker	United States	Cut with sharp object	AIDS patient

* AIDS case
† Not specified
# Mother who provided nursing care for her child with HIV infection; extensive contact with the child's blood and body secretions and excretions occurred; the mother did not wear gloves and often did not wash her hands immediately after exposure.

Table 2, continued.
HIV-infected health-care workers with no reported nonoccupational risk factors and for whom case histories have been published in the scientific literature

Cases without Documented Seroconversion

Case	Occupation	Country	Type of Exposure	Source
1	NS	United States	Puncture wound	AIDS patient
2	NS	United States	2 Needlesticks	2 AIDS patients
3	Research lab worker	United States	Nonintact skin	Concentrated virus
4	Home health-care provider	England	Nonintact skin	AIDS patient
5	Dentist	United States	Multiple needle-sticks	Unknown
6*	Technician	Mexico	Multiple needle-sticks and mucous-membrane	Unknown
7	Lab worker	United States	Needlestick, puncture wound	Unknown

* AIDS case

Table 3. Summary of Task Categorization and Implications for Personal Protective Equipment

Joint Advisory Notice Category[1]	Nature of Task/Activity	Personal protective equipment should be: Available?	Worn?
I.	Direct contact with blood or other body fluids to which universal precautions apply	Yes	Yes
II.	Activity performed without blood exposure but exposure may occur in emergency	Yes	No
III.	Task/activity does not entail predictable or unpredictable exposure to blood	No	No

[1] U.S. Department of Labor, U.S. Department of Health and Human Services. Joint advisory notice: protection against occupational exposure to hepatitis B virus (HBV) and human immunodeficiency virus (HIV). Washington, DC: US Department of Labor, US Department of Health and Human Services, 1987.

Table 4. Examples of Recommended Personal Protective Equipment for Worker Protection Against HIV and HBV Transmission[1] in Prehospital[2] Settings

Task or Activity	Disposable Gloves	Gown	Mask[3]	Protective Eyewear
Bleeding control with with spurting blood	Yes	Yes	Yes	Yes
Bleeding control with minimal bleeding	Yes	No	No	No
Emergency childbirth	Yes	Yes	Yes, if splashing is likely	Yes, if splashing is likely
Blood drawing	At certain times [4]	No	No	No
Starting an intravenous (IV) line	Yes	No	No	No
Endotracheal intubation, esophageal obturator use	Yes	No	No, unless splashing is likely	No, unless splashing is likely
Oral/nasal suctioning, manually cleaning airway	Yes[5]	No	No, unless splashing is likely	No, unless splashing is likely
Handling and cleaning instruments with microbial contamination	Yes	No, unless soiling is likely	No	No
Measuring blood pressure	No	No	No	No
Measuring temperature	No	No	No	No
Giving an injection	No	No	No	No

[1]The examples provided in this table are based on application of universal precautions. Universal precautions are intended to supplement rather than replace recommendations for routine infection control, such as handwashing and using gloves to prevent gross microbial contamination of hands (e.g., contact with urine or feces).

[2]Defined as setting where delivery of emergency health care takes place away from a hospital or other health-care facility.

[3]Refers to protective masks to prevent exposure of mucous membranes to blood or other potentially contaminated body fluids. The use of resuscitation devices, some of which are also referred to as "masks," is discussed on page 16.

[4]For clarification see Appendix A, page 33, and Appendix B, page 38.

[5]While not clearly necessary to prevent HIV or HBV transmission unless blood is present, gloves are recommended to prevent transmission of other agents (e.g., *Herpes simplex*).

Table 5. Reprocessing Methods for Equipment Used in the Prehospital[1] Health-Care Setting

Sterilization:	Destroys:	All forms of microbial life including high numbers of bacterial spores.
	Methods:	Steam under pressure (autoclave), gas (ethylene oxide), dry heat, or immersion in EPA-approved chemical "sterilant" for prolonged period of time, e.g., 6–10 hours or according to manufacturers' instructions. Note: liquid chemical "sterilants" should be used **only** on those instruments that are impossible to sterilize or disinfect with heat.
	Use:	For those instruments or devices that penetrate skin or contact normally sterile areas of the body, e.g., scalpels, needles, etc. Disposable invasive equipment eliminates the need to reprocess these types of items. When indicated, however, arrangements should be made with a health-care facility for reprocessing of reusable invasive instruments.
High-Level Disinfection:	Destroys:	All forms of microbial life **except** high numbers of bacterial spores.
	Methods:	Hot water pasteurization (80–100 C, 30 minutes) or exposure to an EPA-registered "sterilant" chemical as above, except for a short exposure time (10–45 minutes or as directed by the manufacturer).
	Use:	For reusable instruments or devices that come into contact with mucous membranes (e.g., laryngoscope blades, endotracheal tubes, etc.).
Intermediate-Level Disinfection:	Destroys:	*Mycobacterium tuberculosis*, vegetative bacteria, most viruses, and most fungi, but does **not** kill bacterial spores.
	Methods:	EPA-registered "hospital disinfectant" chemical germicides that have a label claim for tuberculocidal activity; commercially available hard-surface germicides or solutions containing at least 500 ppm free available chlorine (a 1:100 dilution of common household bleach—approximately ¼ cup bleach per gallon of tap water).
	Use:	For those surfaces that come into contact only with intact skin, e.g., stethoscopes, blood pressure cuffs, splints, etc., **and** have been visibly contaminated with blood or bloody body fluids. Surfaces **must** be precleaned of visible material before the germicidal chemical is applied for disinfection.

Low-Level Disinfection:	Destroys:	Most bacteria, some viruses, some fungi, but not *Mycobacterium tuberculosis* or bacterial spores.
	Methods:	EPA-registered "hospital disinfectants" (**no** label claim for tuberculocidal activity).
	Use:	These agents are excellent cleaners and can be used for routine housekeeping or removal of soiling in the **absence** of visible blood contamination.
Environmental Disinfection:		Environmental surfaces which have become soiled should be cleaned and disinfected using any cleaner or disinfectant agent which is intended for environmental use. Such surfaces include floors, woodwork, ambulance seats, countertops, etc.
IMPORTANT:		To assure the effectiveness of any sterilization or disinfection process, equipment and instruments must first be thoroughly cleaned of all visible soil.

[1]Defined as setting where delivery of emergency health-care takes place prior to arrival at hospital or other health-care facility.

Appendix A. Update: Universal Precautions for Prevention of Transmission of Human Immunodeficiency Virus, Hepatitis B Virus, and Other Bloodborne Pathogens in Health-Care Settings (Reprinted from Morbidity and Mortality Weekly Report, 1988; 37:377–382,387,388.)

Introduction

The purpose of this report is to clarify and supplement the CDC publication entitled "Recommendations for Prevention of HIV Transmission in Health-Care Settings" (*1*).*

In 1983, CDC published a document entitled "Guideline for Isolation Precautions in Hospitals" (*2*) that contained a section entitled "Blood and Body Fluid Precautions." The recommendations in this section called for blood and body fluid precautions when a patient was known or suspected to be infected with bloodborne pathogens. In August 1987, CDC published a document entitled "Recommendations for Prevention of HIV Transmission in Health-Care Settings" (*1*). In contrast to the 1983 document, the 1987 document recommended that blood and body fluid precautions be consistently used for all patients regardless of their bloodborne infection status. This extension of blood and body fluid precautions to all patients is referred to as "Universal Blood and Body Fluid Precautions" or "Universal Precautions." Under universal precautions, blood and certain body fluids of all patients are considered potentially infectious for human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other bloodborne pathogens.

Universal precautions are intended to prevent parenteral, mucous membrane, and nonintact skin exposures of health-care workers to bloodborne pathogens. In addition, immunization with HBV vaccine is recommended as an important adjunct to universal precautions for health-care workers who have exposures to blood (*3,4*).

Since the recommendations for universal precautions were published in August 1987, CDC and the Food and Drug Administration (FDA) have received requests for clarification of the following issues: 1) body fluids to which universal precautions apply, 2) use of protective barriers, 3) use of gloves for phlebotomy, 4) selection of gloves for use while observing universal precautions, and 5) need for making changes in waste management programs as a result of adopting universal precautions.

Body Fluids to Which Universal Precautions Apply

Universal precautions apply to blood and to other body fluids containing visible blood. Occupational transmission of HIV and HBV to health-care workers by blood is documented (*4,5*). **Blood is the single most important source of HIV, HBV, and other bloodborne pathogens in the occupational setting. Infection control efforts for HIV, HBV, and other bloodborne pathogens must focus on preventing exposures to blood as well as on delivery of HBV immunization.**

Universal precautions also apply to semen and vaginal secretions. Although both of these fluids have been implicated in the sexual transmission of HIV and HBV, they have not been implicated in occupational transmission from patient to health-care worker. This observation is not unexpected, since exposure to semen in the usual health-care setting is limited, and the routine practice of wearing gloves for performing vaginal examinations protects health-care workers from exposure to potentially infectious vaginal secretions.

Universal precautions also apply to tissues and to the following fluids: cerebrospinal fluid (CSF), synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid. The risk of transmission of HIV and HBV from these fluids is unknown; epidemiologic studies in the health-care and community setting are currently inadequate to assess the potential risk to health-care workers from occupational exposures to them. However, HIV has been isolated from CSF, synovial, and amniotic fluid (*6–8*), and HBsAg has been detected in synovial fluid, amniotic fluid, and peritoneal fluid (*9–11*). One case of HIV transmission was reported after a percutaneous exposure to bloody pleural fluid obtained by needle aspiration (*12*). Whereas aseptic procedures used to obtain these fluids for diagnostic or therapeutic purposes protect health-care workers from skin exposures, they cannot prevent penetrating injuries due to contaminated needles or other sharp instruments.

Body Fluids to Which Universal Precautions Do Not Apply

Universal precautions do not apply to feces, nasal secretions, sputum, sweat, tears, urine, and vomitus unless they contain visible blood. The risk of transmission of HIV and HBV from these fluids and materials is extremely low or nonexistent. HIV has been isolated and HBsAg has been demonstrated in some of these fluids; however, epidemiologic studies in the health-care and community setting have not implicated these fluids or materials in the transmission of HIV and HBV infections (*13,14*). Some of the above fluids and excretions

---

* The August 1987 publication should be consulted for general information and specific recommendations not addressed in this update.

represent a potential source for nosocomial and community-acquired infections with other pathogens, and recommendations for preventing the transmission of non-bloodborne pathogens have been published (*2*).

Precautions for Other Body Fluids in Special Settings

Human breast milk has been implicated in perinatal transmission of HIV, and HBsAg has been found in the milk of mothers infected with HBV (*10,13*). However, occupational exposure to human breast milk has not been implicated in the transmission of HIV nor HBV infection to health-care workers. Moreover, the health-care worker will not have the same type of intensive exposure to breast milk as the nursing neonate. Whereas universal precautions do not apply to human breast milk, gloves may be worn by health-care workers in situations where exposures to breast milk might be frequent, for example, in breast milk banking.

Saliva of some persons infected with HBV has been shown to contain HBV-DNA at concentrations 1/1,000 to 1/10,000 of that found in the infected person's serum (*15*). HbsAg-positive saliva has been shown to be infectious when injected into experimental animals and in human bite exposures (*16–18*). However, HBsAg-positive saliva has not been shown to be infectious when applied to oral mucous membranes in experimental primate studies (*18*) or through contamination of musical instruments or cardiopulmonary resuscitation dummies used by HBV carriers (*19,20*). Epidemiologic studies of nonsexual household contacts of HIV-infected patients, including several small series in which HIV transmission failed to occur after bites or after percutaneous inoculation or contamination of cuts and open wounds with saliva from HIV-infected patients, suggest that the potential for salivary transmission of HIV is remote (*5,13,14,21,22*). One case report from Germany has suggested the possibility of transmission of HIV in a household setting from an infected child to a sibling through a human bite (*23*). The bite did not break the skin or result in bleeding. Since the date of seroconversion to HIV was not known for either child in this case, evidence for the role of saliva in the transmission of virus is unclear (*23*). Another case report suggested the possibility of transmission of HIV from husband to wife by contact with saliva during kissing (*24*). However, follow-up studies did not confirm HIV infection in the wife (*21*).

Universal precautions do not apply to saliva. General infection control practices already in existence—including the use of gloves for digital examination of mucous membranes and endotracheal suctioning, and handwashing after exposure to saliva—should further minimize the minute risk, if any, for salivary transmission of HIV and HBV (*1,25*). Gloves need not be worn when feeding patients and when wiping saliva from the skin.

Special precautions, however, are recommended for dentistry (*1*). Occupationally acquired infection with HBV in dental workers has been documented (*4*), and two possible cases of occupationally acquired HIV infection involving dentists have been reported (*5,26*). During dental procedures, contamination of saliva with blood is predictable, trauma to health-care workers hands is common, and blood spattering may occur. Infection control precautions for dentistry minimize the potential for nonintact skin and mucous membrane contact of dental health-care workers to blood-contaminated saliva of patients. In addition, the use of gloves for oral examinations and treatment in the dental setting may also protect the patient's oral mucous membranes from exposures to blood, which may occur from breaks in the skin of dental workers' hands.

Use of Protective Barriers

Protective barriers reduce the risk of exposure of the health-care worker's skin or mucous membranes to potentially infective materials. For universal precautions, protective barriers reduce the risk of exposure to blood, body fluids containing visible blood, and other fluids to which universal precautions apply. Examples of protective barriers include gloves, gowns, masks, and protective eyewear. Gloves should reduce the incidence of contamination of hands, but they cannot prevent penetrating injuries due to needles or other sharp instruments. Masks and protective eyewear or face shields should reduce the incidence of contamination of mucous membranes of the mouth, nose, and eyes.

Universal precautions are intended to supplement rather than replace recommendations for routine infection control, such as handwashing and using gloves to prevent gross microbial contamination of hands (*27*). Because specifying the types of barriers needed for every possible clinical situation is impractical, some judgment must be exercised.

The risk of nosocomial transmission of HIV, HBV, and other bloodborne pathogens can be minimized if health-care workers use the following general guidelines:*

1. Take care to prevent injuries when using needles, scalpels, and other sharp instruments or devices; when handling sharp instruments after procedures; when cleaning used instruments; and when disposing of used needles. Do not recap used needles by hand; do not remove used needles from disposable syringes by hand; and do not bend, break, or otherwise

* The August 1987 publication should be consulted for general information and specific recommendations not addressed in this update.

manipulate used needles by hand. Place used disposable syringes and needles, scalpel blades, and other sharp items in puncture-resistant containers for disposal. Locate the puncture-resistant containers as close to the use area as is practical.

2. Use protective barriers to prevent exposure to blood, body fluids containing visible blood, and other fluids to which universal precautions apply. The type of protective barrier(s) should be appropriate for the procedure being performed and the type of exposure anticipated.

3. Immediately and thoroughly wash hands and other skin surfaces that are contaminated with blood, body fluids containing visible blood, or other body fluids to which universal precautions apply.

Glove Use for Phlebotomy

Gloves should reduce the incidence of blood contamination of hands during phlebotomy (drawing blood samples), but they cannot prevent penetrating injuries caused by needles or other sharp instruments. The likelihood of hand contamination with blood containing HIV, HBV, or other bloodborne pathogens during phlebotomy depends on several factors: 1) the skill and technique of the health-care worker, 2) the frequency with which the health-care worker performs the procedure (other factors being equal, the cumulative risk of blood exposure is higher for a health-care worker who performs more procedures), 3) whether the procedure occurs in a routine or emergency situation (where blood contact may be more likely), and 4) the prevalence of infection with bloodborne pathogens in the patient population. The likelihood of infection after skin exposure to blood containing HIV or HBV will depend on the concentration of virus (viral concentration is much higher for hepatitis B than for HIV), the duration of contact, the presence of skin lesions on the hands of the health-care worker, and—for HBV—the immune status of the health-care worker. Although not accurately quantified, the risk of HIV infection following intact skin contact with infective blood is certainly much less than the 0.5% risk following percutaneous needlestick exposures (*5*). In universal precautions, **all** blood is assumed to be potentially infective for bloodborne pathogens, but in certain settings (e.g., volunteer blood-donation centers) the prevalence of infection with some bloodborne pathogens (e.g., HIV, HBV) is known to be very low. Some institutions have relaxed recommendations for using gloves for phlebotomy procedures by skilled phlebotomists in settings where the prevalence of bloodborne pathogens is known to be very low.

Institutions that judge that routine gloving for **all** phlebotomies is not necessary should periodically reevaluate their policy. Gloves should always be available to health-care workers who wish to use them for phlebotomy. In addition, the following general guidelines apply:

1. Use gloves for performing phlebotomy when the health-care worker has cuts, scratches, or other breaks in his/her skin.

2. Use gloves in situations where the health-care worker judges that hand contamination with blood may occur, for example, when performing phlebotomy on an uncooperative patient.

3. Use gloves for performing finger and/or heel sticks on infants and children.

4. Use gloves when persons are receiving training in phlebotomy.

Selection of Gloves

The Center for Devices and Radiological Health, FDA, has responsibility for regulating the medical glove industry. Medical gloves include those marketed as sterile surgical or nonsterile examination gloves made of vinyl or latex. General purpose utility ("rubber") gloves are also used in the health-care setting, but they are not regulated by FDA since they are not promoted for medical use. There are no reported differences in barrier effectiveness between intact latex and intact vinyl used to manufacture gloves. Thus, the type of gloves selected should be appropriate for the task being performed.

The following general guidelines are recommended:

1. Use sterile gloves for procedures involving contact with normally sterile areas of the body.

2. Use examination gloves for procedures involving contact with mucous membranes, unless otherwise indicated, and for other patient care or diagnostic procedures that do not require the use of sterile gloves.

3. Change gloves between patient contacts.

4. Do not wash or disinfect surgical or examination gloves for reuse. Washing with surfactants may cause "wicking," i.e., the enhanced penetration of liquids through undetected holes in the glove. Disinfecting agents may cause deterioration.

5. Use general-purpose utility gloves (e.g., rubber household gloves) for housekeeping chores involving potential blood contact and for instrument cleaning and decontamination procedures. Utility gloves may be decontaminated and reused but should be discarded if they are peeling, cracked, or discolored, or if they have punctures, tears, or other evidence of deterioration.

Waste Management

Universal precautions are not intended to change waste management programs previously recommended by CDC for health-care settings (*1*). Policies for defining, collecting, storing, decontaminating, and disposing of infective waste are generally determined by institutions in accordance with state and local regulations. Information regarding waste management regulations in health-care settings may be obtained from state or local health departments or agencies responsible for waste management.

Reported by: Center for Devices and Radiological Health, Food and Drug Administration. Hospital Infections Program, AIDS Program, and Hepatitis Br, Div of Viral Diseases, Center for Infectious Diseases, National Institute for Occupational Safety and Health, CDC.

Editorial Note: Implementation of universal precautions does not eliminate the need for other category- or disease-specific isolation precautions, such as enteric precautions for infectious diarrhea or isolation for pulmonary tuberculosis (*1,2*). In addition to universal precautions, detailed precautions have been developed for the following procedures and/or settings in which prolonged or intensive exposures to blood occur: invasive procedures, dentistry, autopsies or morticians' services, dialysis, and the clinical laboratory. These detailed precautions are found in the August 21, 1987, "Recommendations for Prevention of HIV Transmission in Health-Care Settings" (*1*). In addition, specific precautions have been developed for research laboratories (*28*).

References

1. Centers for Disease Control. Recommendations for prevention of HIV transmission in health-care settings. MMWR 1987; 36(suppl no. 2S).

2. Garner JS, Simmons BP. Guideline for isolation precautions in hospitals. Infect Control 1983; 4 (suppl):245–325.

3. Immunization Practices Advisory Committee. Recommendations for protection against viral hepatitis. MMWR 1985; 34:313–24, 329–35.

4. U.S. Department of Labor, U.S. Department of Health and Human Services. Joint advisory notice: protection against occupational exposure to hepatitis B virus (HBV) and human immunodeficiency virus (HIV). Washington, DC: US Department of Labor, US Department of Health and Human Services, 1987.

5. Centers for Disease Control. Update: Acquired immunodeficiency syndrome and human immunodeficiency virus infection among health-care workers. MMWR 1988; 37:229–34, 239.

6. Hollander H, Levy JA. Neurologic abnormalities and recovery of human immunodeficiency virus from cerebrospinal fluid. Ann Intern Med 1987;106:692–5.

7. Wirthrington RH, Cornes P, Harris JRW, et al. Isolation of human immunodeficiency virus from synovial fluid of a patient with reactive arthritis. Br Med J 1987; 294:484.

8. Mundy DC, Schinazi RF, Gerber AR, Nahmias AJ, Randall HW. Human immunodeficiency virus isolated from amniotic fluid. Lancet 1987; 2:459–60.

9. Onion DK, Crumpacker CS, Gilliland BC. Arthritis of hepatitis associated with Australia antigen. Ann Intern Med 1971; 75:29–33.

10. Lee AKY, Ip HMH, Wong VCW. Mechanisms of maternal-fetal transmission of hepatitis B virus. J Infect Dis 1978;138:668–71.

11. Bond WW, Petersen NF, Gravelle CR, Favero MS. Hepatitis B virus in peritoneal dialysis fluid: A potential hazard. Dialysis and Transplantation 1982; 11:592–600.

12. Oskenhendler E, Harzic M, Le Roux J-M, Rabian C, Clauvel JP. HIV infection with seroconversion after a superficial needlestick injury to the finger [Letter]. N Engl J Med 1986; 315:582.

13. Lifson AR. Do alternate modes for transmission of human immunodeficiency virus exist? A review. JAMA 1988; 259:1353–6.

14. Friedland GH, Saltzman BR, Rogers MF, et al. Lack of transmission of HTLV-III/LAV infection to household contacts of patients with AIDS or AIDS-related complex with oral candidiasis. N Engl J Med 1986; 314:344–9.

15. Jenison SA, Lemon SM, Baker LN, Newbold JE. Quantitative analysis of hepatitis B virus DNA in saliva and semen of chronically infected homosexual men. J Infect Dis 1987; 156:299–306.

16. Cancio-Bello TP, de Medina M, Shorey J, Valledor MD, Schiff ER. An institutional outbreak of hepatitis B related to a human biting carrier. J Infect Dis 1982; 146:652–6.

17. MacQuarrie MB, Forghani B, Wolochow DA. Hepatitis B transmitted by a human bite. JAMA 1974; 230:723–4.

18. Scott RM, Snitbhan R, Bancroft WH, Alter HJ, Tingpalapong M. Experimental transmission of hepatitis B virus by semen and saliva. J Infect Dis 1980; 142:67–71.

19. Glaser JB, Nadler JP. Hepatitis B virus in a cardiopulmonary resuscitation training course: Risk of transmission from a surface antigen-positive participant. Arch Intern Med 1985; 145:1653–5.

20. Osterholm MT, Bravo ER, Crosson JT, et al. Lack of transmission of viral hepatitis type B after oral exposure to HBsAg-positive saliva. Br Med J 1979; 2:1263–4.

21. Curran JW, Jaffe HW, Hardy AM, et al. Epidemiology of HIV infection and AIDS in the United States. Science 1988; 239:610–6.

22. Jason JM, McDougal JS, Dixon G, et al. HTLV-III/LAV antibody and immune status of household contacts and sexual partners of persons with hemophilia. JAMA 1986; 255:212–5.

23. Wahn V, Kramer HH, Voit T, Brüster HT, Scrampical B, Scheid A. Horizontal transmission of HIV infection between two siblings [Letter]. Lancet 1986; 2:694.

24. Salahuddin SZ, Groopman JE, Markham PD, et al. HTLV-III in symptom-free seronegative persons. Lancet 1984; 2:1418–20.

25. Simmons BP, Wong ES. Guideline for prevention of nosocomial pneumonia. Atlanta: US Department of Health and Human Services, Public Health Service, Centers for Disease Control, 1982.

26. Klein RS, Phelan JA, Freeman K, et al. Low occupational risk of human immunodeficiency virus infection among dental professionals. N Engl J Med 1988; 318:86–90.

27. Garner JS, Favero MS. Guideline for handwashing and hospital environmental control, 1985. Atlanta: US Department of Health and Human Services, Public Health Service, Centers for Disease Control, 1985; HHS publication no. 99-1117.

28. Centers for Disease Control. 1988 Agent summary statement for human immunodeficiency virus and report on laboratory-acquired infection with human immunodeficiency virus. MMWR 1988; 37(suppl no. S-4:1S–22S).

Appendix B. Recommendations for Prevention of HIV Transmission in Health-Care Settings (Reprinted from Morbidity and Mortality Weekly Report 1987; 36 [no. 2S].)

Introduction

Human immunodeficiency virus (HIV), the virus that causes acquired immunodeficiency syndrome (AIDS), is transmitted through sexual contact and exposure to infected blood or blood components and perinatally from mother to neonate. HIV has been isolated from blood, semen, vaginal secretions, saliva, tears, breast milk, cerebrospinal fluid, amniotic fluid, and urine and is likely to be isolated from other body fluids, secretions, and excretions. However, epidemiologic evidence has implicated only blood, semen, vaginal secretions, and possibly breast milk in transmission.

The increasing prevalence of HIV increases the risk that health-care workers will be exposed to blood from patients infected with HIV, especially when blood and body-fluid precautions are not followed for all patients. Thus, this document emphasizes the need for health-care workers to consider **all** patients as potentially infected with HIV and/or other blood-borne pathogens and to adhere rigorously to infection-control precautions for minimizing the risk of exposure to blood and body fluids of all patients.

The recommendations contained in this document consolidate and update CDC recommendations published earlier for preventing HIV transmission in health-care settings: precautions for clinical and laboratory staffs (*1*) and precautions for health-care workers and allied professionals (*2*); recommendations for preventing HIV transmission in the workplace (*3*) and during invasive procedures (*4*); recommendations for preventing possible transmission of HIV from tears (*5*); and recommendations for providing dialysis treatment for HIV-infected patients (*6*). These recommendations also update portions of the "Guideline for Isolation Precautions in Hospitals" (*7*) and reemphasize some of the recommendations contained in "Infection Control Practices for Dentistry" (*8*). The recommendations contained in this document have been developed for use in health-care settings and emphasize the need to treat blood and other body fluids from **all** patients as potentially infective. These same prudent precautions also should be taken in other settings in which persons may be exposed to blood or other body fluids.

Definition of Health-Care Workers

Health-care workers are defined as persons, including students and trainees, whose activities involve contact with patients or with blood or other body fluids from patients in a health-care setting.

Health-Care Workers with AIDS

As of July 10, 1987, a total of 1,875 (5.8%) of 32,395 adults with AIDS, who had been reported to the CDC national surveillance system and for whom occupational information was available, reported being employed in a health-care or clinical laboratory setting. In comparison, 6.8 million persons—representing 5.6% of the U.S. labor force—were employed in health services. Of the health-care workers with AIDS, 95% have been reported to exhibit high-risk behavior; for the remaining 5%, the means of HIV acquisition was undetermined. Health-care workers with AIDS were significantly more likely than other workers to have an undetermined risk (5% versus 3%, respectively). For both health-care and non-health-care workers with AIDS, the proportion with an undetermined risk has not increased since 1982.

AIDS patients initially reported as not belonging to recognized risk groups are investigated by state and local health departments to determine whether possible risk factors exist. Of all health-care workers with AIDS reported to CDC who were initially characterized as not having an identified risk and for whom follow-up information was available, 66% have been reclassified because risk factors were identified or because the patient was found not to meet the surveillance case definition for AIDS. Of the 87 health-care workers currently categorized as having no identifiable risk, information is incomplete on 16 (18%) because of death or refusal to be interviewed; 38 (44%) are still being investigated. The remaining 33 (38%) health-care workers were interviewed or had other follow-up information available. The occupations of these 33 were as follows: five physicians (15%), three of whom were surgeons; one dentist (3%); three nurses (9%); nine nursing assistants (27%); seven housekeeping or maintenance workers (21%); three clinical laboratory technicians (9%); one therapist (3%); and four others who did not have contact with patients (12%). Although 15 of these 33 health-care workers reported parenteral and/or other non-needlestick exposure to blood or body fluids from patients in the 10 years preceding their diagnosis of AIDS, none of these exposures involved a patient with AIDS or known HIV infection.

Risk to Health-Care Workers of Acquiring HIV in Health-Care Settings

Health-care workers with documented percutaneous or mucous-membrane exposures to blood or body fluids of HIV-infected patients have been prospectively evaluated to determine the risk of infection after such exposures. As of June 30, 1987, 883 health-care workers have been tested for antibody to HIV in an ongoing surveillance project conducted by CDC (*9*). Of these, 708 (80%) had percutaneous exposures to blood, and 175 (20%) had a mucous membrane or an open wound contaminated by blood or body fluid. Of 396 health-

care workers, each of whom had only a convalescent-phase serum sample obtained and tested ≥90 days postexposure, one—for whom heterosexual transmission could not be ruled out—was seropositive for HIV antibody. For 425 additional health-care workers, both acute- and convalescent-phase serum samples were obtained and tested; none of 74 health-care workers with nonpercutaneous exposures seroconverted, and three (0.9%) of 351 with percutaneous exposures seroconverted. None of these three health-care workers had other documented risk factors for infection.

Two other prospective studies to assess the risk of nosocomial acquisition of HIV infection for health-care workers are ongoing in the United States. As of April 30, 1987, 332 health-care workers with a total of 453 needlestick or mucous-membrane exposures to the blood or other body fluids of HIV-infected patients were tested for HIV antibody at the National Institutes of Health (*10*). These exposed workers included 103 with needlestick injuries and 229 with mucous-membrane exposures; none had seroconverted. A similar study at the University of California of 129 health-care workers with documented needlestick injuries or mucous-membrane exposures to blood or other body fluids from patients with HIV infection has not identified any seroconversions (*11*). Results of a prospective study in the United Kingdom identified no evidence of transmission among 150 health-care workers with parenteral or mucous-membrane exposures to blood or other body fluids, secretions, or excretions from patients with HIV infection (*12*).

In addition to health-care workers enrolled in prospective studies, eight persons who provided care to infected patients and denied other risk factors have been reported to have acquired HIV infection. Three of these health-care workers had needlestick exposures to blood from infected patients (*13–15*). Two were persons who provided nursing care to infected persons; although neither sustained a needlestick, both had extensive contact with blood or other body fluids, and neither observed recommended barrier precautions (*16,17*). The other three were health-care workers with non-needlestick exposures to blood from infected patients (*18*). Although the exact route of transmission for these last three infections is not known, all three persons had direct contact of their skin with blood from infected patients, all had skin lesions that may have been contaminated by blood, and one also had a mucous-membrane exposure.

A total of 1,231 dentists and hygienists, many of whom practiced in areas with many AIDS cases, participated in a study to determine the prevalence of antibody to HIV; one dentist (0.1%) had HIV antibody. Although no exposure to a known HIV-infected person could be documented, epidemiologic investigation did not identify any other risk factor for infection. The infected dentist, who also had a history of sustaining needlestick injuries and trauma to his hands, did not routinely wear gloves when providing dental care (*19*).

Precautions To Prevent Transmission of HIV

Universal Precautions

Since medical history and examination cannot reliably identify all patients infected with HIV or other blood-borne pathogens, blood and body-fluid precautions should be consistently used for **all** patients. This approach, previously recommended by CDC (*3,4*), and referred to as "universal blood and body-fluid precautions" or "universal precautions," should be used in the care of **all** patients, especially including those in emergency-care settings in which the risk of blood exposure is increased and the infection status of the patient is usually unknown (*20*).

1. All health-care workers should routinely use appropriate barrier precautions to prevent skin and mucous-membrane exposure when contact with blood or other body fluids of any patient is anticipated. Gloves should be worn for touching blood and body fluids, mucous membranes, or non-intact skin of all patients, for handling items or surfaces soiled with blood or body fluids, and for performing venipuncture and other vascular access procedures. Gloves should be changed after contact with each patient. Masks and protective eyewear or face shields should be worn during procedures that are likely to generate droplets of blood or other body fluids to prevent exposure of mucous membranes of the mouth, nose, and eyes. Gowns or aprons should be worn during procedures that are likely to generate splashes of blood or other body fluids.

2. Hands and other skin surfaces should be washed immediately and thoroughly if contaminated with blood or other body fluids. Hands should be washed immediately after gloves are removed.

3. All health-care workers should take precautions to prevent injuries caused by needles, scalpels, and other sharp instruments or devices during procedures; when cleaning used instruments; during disposal of used needles; and when handling sharp instruments after procedures. To prevent needlestick injuries, needles should not be recapped, purposely bent or broken by hand, removed from disposable syringes, or otherwise manipulated by hand. After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in puncture-resistant containers for disposal; the puncture-resistant containers should be located as close as practical to the use area. Large-bore reusable needles should be placed in a puncture-resistant container for transport to the reprocessing area.

4. Although saliva has not been implicated in HIV transmission, to minimize the need for emergency mouth-to-mouth resuscitation, mouthpieces, resuscitation bags, or other ventilation devices should be available for use in areas in which the need for resuscitation is predictable.

5. Health-care workers who have exudative lesions or weeping dermatitis should refrain from all direct patient care and from handling patient-care equipment until the condition resolves.

6. Pregnant health-care workers are not known to be at greater risk of contracting HIV infection than health-care workers who are not pregnant; however, if a health-care worker develops HIV infection during pregnancy, the infant is at risk of infection resulting from perinatal transmission. Because of this risk, pregnant health-care workers should be especially familiar with and strictly adhere to precautions to minimize the risk of HIV transmission.

Implementation of universal blood and body-fluid precautions for **all** patients eliminates the need for use of the isolation category of "Blood and Body Fluid Precautions" previously recommended by CDC (*7*) for patients known or suspected to be infected with blood-borne pathogens. Isolation precautions (e.g., enteric, "AFB" [7]) should be used as necessary if associated conditions, such as infectious diarrhea or tuberculosis, are diagnosed or suspected.

Precautions for Invasive Procedures

In this document, an invasive procedure is defined as surgical entry into tissues, cavities, or organs or repair of major traumatic injuries 1) in an operating or delivery room, emergency department, or outpatient setting, including both physicians' and dentists' offices; 2) cardiac catheterization and angiographic procedures; 3) a vaginal or cesarean delivery or other invasive obstetric procedure during which bleeding may occur; or 4) the manipulation, cutting, or removal of any oral or perioral tissues, including tooth structure, during which bleeding occurs or the potential for bleeding exists. The universal blood and body-fluid precautions listed above, combined with the precautions listed below, should be the minimum precautions for **all** such invasive procedures.

1. All health-care workers who participate in invasive procedures must routinely use appropriate barrier precautions to prevent skin and mucous-membrane contact with blood and other body fluids of all patients. Gloves and surgical masks must be worn for all invasive procedures. Protective eyewear or face shields should be worn for procedures that commonly result in the generation of droplets, splashing of blood or other body fluids, or the generation of bone chips. Gowns or aprons made of materials that provide an effective barrier should be worn during invasive procedures that are likely to result in the splashing of blood or other body fluids. All health-care workers who perform or assist in vaginal or cesarean deliveries should wear gloves and gowns when handling the placenta or the infant until blood and amniotic fluid have been removed from the infant's skin and should wear gloves during post-delivery care of the umbilical cord.

2. If a glove is torn or a needlestick or other injury occurs, the glove should be removed and a new glove used as promptly as patient safety permits; the needle or instrument involved in the incident should also be removed from the sterile field.

Precautions for Dentistry*

Blood, saliva, and gingival fluid from **all** dental patients should be considered infective. Special emphasis should be placed on the following precautions for preventing transmission of blood-borne pathogens in dental practice in both institutional and non-institutional settings.

1. In addition to wearing gloves for contact with oral mucous membranes of all patients, all dental workers should wear surgical masks and protective eyewear or chin-length plastic face shields during dental procedures in which splashing or spattering of blood, saliva, or gingival fluids is likely. Rubber dams, high-speed evacuation, and proper patient positioning, when appropriate, should be utilized to minimize generation of droplets and spatter.

2. Handpieces should be sterilized after use with each patient, since blood, saliva, or gingival fluid of patients may be aspirated into the handpiece or waterline. Handpieces that cannot be sterilized should at least be flushed, the outside surface cleaned and wiped with a suitable chemical germicide, and then rinsed. Handpieces should be flushed at the beginning of the day and after use with each patient. Manufacturers' recommendations should be followed for use and maintenance of waterlines and check valves and for flushing of handpieces. The same precautions should be used for ultrasonic scalers and air/water syringes.

3. Blood and saliva should be thoroughly and carefully cleaned from material that has been used in the mouth (e.g., impression materials, bite registration), especially before polishing and grinding intra-oral devices. Contaminated materials, impressions, and intra-oral devices should also be cleaned and disinfected before being handled in the dental laboratory and before they are placed

*General infection-control precautions are more specifically addressed in previous recommendations for infection-control practices for dentistry (*8*).

in the patient's mouth. Because of the increasing variety of dental materials used intra-orally, dental workers should consult with manufacturers as to the stability of specific materials when using disinfection procedures.

4. Dental equipment and surfaces that are difficult to disinfect (e.g., light handles or X-ray-unit heads) and that may become contaminated should be wrapped with impervious-backed paper, aluminum foil, or clear plastic wrap. The coverings should be removed and discarded, and clean coverings should be put in place after use with each patient.

Precautions for Autopsies or Morticians' Services

In addition to the universal blood and body-fluid precautions listed above, the following precautions should be used by persons performing postmortem procedures:

1. All persons performing or assisting in postmortem procedures should wear gloves, masks, protective eyewear, gowns, and waterproof aprons.

2. Instruments and surfaces contaminated during postmortem procedures should be decontaminated with an appropriate chemical germicide.

Precautions for Dialysis

Patients with end-stage renal disease who are undergoing maintenance dialysis and who have HIV infection can be dialyzed in hospital-based or free-standing dialysis units using conventional infection-control precautions (*21*). Universal blood and body-fluid precautions should be used when dialyzing <u>all</u> patients.

Strategies for disinfecting the dialysis fluid pathways of the hemodialysis machine are targeted to control bacterial contamination and generally consist of using 500–750 parts per million (ppm) of sodium hypochlorite (household bleach) for 30–40 minutes or 1.5%–2.0% formaldehyde overnight. In addition, several chemical germicides formulated to disinfect dialysis machines are commercially available. None of these protocols or procedures need to be changed for dialyzing patients infected with HIV.

Patients infected with HIV can be dialyzed by either hemodialysis or peritoneal dialysis and do not need to be isolated from other patients. The type of dialysis treatment (i.e., hemodialysis or peritoneal dialysis) should be based on the needs of the patient. The dialyzer may be discarded after each use. Alternatively, centers that reuse dialyzers—i.e., a specific single-use dialyzer is issued to a specific patient, removed, cleaned, disinfected, and reused several times on the same patient only—may include HIV-infected patients in the dialyzer-reuse program. An individual dialyzer must never be used on more than one patient.

Precautions for Laboratories*

Blood and other body fluids from <u>all</u> patients should be considered infective. To supplement the universal blood and body-fluid precautions listed above, the following precautions are recommended for health-care workers in clinical laboratories.

1. All specimens of blood and body fluids should be put in a well-constructed container with a secure lid to prevent leaking during transport. Care should be taken when collecting each specimen to avoid contaminating the outside of the container and of the laboratory form accompanying the specimen.

2. All persons processing blood and body-fluid specimens (e.g., removing tops from vacuum tubes) should wear gloves. Masks and protective eyewear should be worn if mucous-membrane contact with blood or body fluids is anticipated. Gloves should be changed and hands washed after completion of specimen processing.

3. For routine procedures, such as histologic and pathologic studies or microbiologic culturing, a biological safety cabinet is not necessary. However, biological safety cabinets (Class I or II) should be used whenever procedures are conducted that have a high potential for generating droplets. These include activities such as blending, sonicating, and vigorous mixing.

4. Mechanical pipetting devices should be used for manipulating all liquids in the laboratory. Mouth pipetting must not be done.

5. Use of needles and syringes should be limited to situations in which there is no alternative, and the recommendations for preventing injuries with needles outlined under universal precautions should be followed.

---

*Additional precautions for research and industrial laboratories are addressed elsewhere (*22,23*).

6. Laboratory work surfaces should be decontaminated with an appropriate chemical germicide after a spill of blood or other body fluids and when work activities are completed.

7. Contaminated materials used in laboratory tests should be decontaminated before reprocessing or be placed in bags and disposed of in accordance with institutional policies for disposal of infective waste (*24*).

8. Scientific equipment that has been contaminated with blood or other body fluids should be decontaminated and cleaned before being repaired in the laboratory or transported to the manufacturer.

9. All persons should wash their hands after completing laboratory activities and should remove protective clothing before leaving the laboratory.

Implementation of universal blood and body-fluid precautions for **all** patients eliminates the need for warning labels on specimens since blood and other body fluids from all patients should be considered infective.

Environmental Considerations for HIV Transmission

No environmentally mediated mode of HIV transmission has been documented. Nevertheless, the precautions described below should be taken routinely in the care of **all** patients.

Sterilization and Disinfection

Standard sterilization and disinfection procedures for patient-care equipment currently recommended for use (*25,26*) in a variety of health-care settings—including hospitals, medical and dental clinics and offices, hemodialysis centers, emergency-care facilities, and long-term nursing-care facilities—are adequate to sterilize or disinfect instruments, devices, or other items contaminated with blood or other body fluids from persons infected with blood-borne pathogens including HIV (*21,23*).

Instruments or devices that enter sterile tissue or the vascular system of any patient or through which blood flows should be sterilized before reuse. Devices or items that contact intact mucous membranes should be sterilized or receive high-level disinfection, a procedure that kills vegetative organisms and viruses but not necessarily large numbers of bacterial spores. Chemical germicides that are registered with the U.S. Environmental Protection Agency (EPA) as "sterilants" may be used either for sterilization or for high-level disinfection depending on contact time.

Contact lenses used in trial fittings should be disinfected after each fitting by using a hydrogen peroxide contact lens disinfecting system or, if compatible, with heat (78 C–80 C [172.4 F–176.0 F]) for 10 minutes.

Medical devices or instruments that require sterilization or disinfection should be thoroughly cleaned before being exposed to the germicide, and the manufacturer's instructions for the use of the germicide should be followed. Further, it is important that the manufacturer's specifications for compatibility of the medical device with chemical germicides be closely followed. Information on specific label claims of commercial germicides can be obtained by writing to the Disinfectants Branch, Office of Pesticides, Environmental Protection Agency, 401 M Street, SW, Washington, D.C. 20460.

Studies have shown that HIV is inactivated rapidly after being exposed to commonly used chemical germicides at concentrations that are much lower than used in practice (*27–30*). Embalming fluids are similar to the types of chemical germicides that have been tested and found to completely inactivate HIV. In addition to commercially available chemical germicides, a solution of sodium hypochlorite (household bleach) prepared daily is an inexpensive and effective germicide. Concentrations ranging from approximately 500 ppm (1:100 dilution of household bleach) sodium hypochlorite to 5000 ppm (1:10 dilution of household bleach) are effective depending on the amount of organic material (e.g., blood, mucus) present on the surface to be cleaned and disinfected. Commercially available chemical germicides may be more compatible with certain medical devices that might be corroded by repeated exposure to sodium hypochlorite, especially to the 1:10 dilution.

Survival of HIV in the Environment

The most extensive study on the survival of HIV after drying involved greatly concentrated HIV samples, i.e., 10 million tissue-culture infectious doses per milliliter (*31*). This concentration is at least 100,000 times greater than that typically found in the blood or serum of patients with HIV infection. HIV was detectable by tissue-culture techniques 1–3 days after drying, but the rate of inactivation was rapid. Studies performed at CDC have also shown that drying HIV causes a rapid (within several hours) 1–2 log (90%–99%) reduction in HIV concentration. In tissue-culture fluid, cell-free HIV could be detected up to 15 days at room temperature, up to 11 days at 37 C (98.6 F), and up to 1 day if the HIV was cell-associated.

When considered in the context of environmental conditions in health-care facilities, these results do not require any changes in currently recommended sterilization, disinfection, or housekeeping strategies. When medical devices are contaminated with blood or other body fluids, existing recommendations include the cleaning of these instruments, followed by disinfection or sterilization, depending on the type of medical device. These protocols assume "worst-case" conditions of extreme virologic and microbiological contamination, and whether viruses have been inactivated after drying plays no role in formulating these strategies. Consequently, no changes in published procedures for cleaning, disinfecting, or sterilizing need to be made.

Housekeeping

Environmental surfaces such as walls, floors, and other surfaces are not associated with transmission of infections to patients or health-care workers. Therefore, extraordinary attempts to disinfect or sterilize these environmental surfaces are not necessary. However, cleaning and removal of soil should be done routinely.

Cleaning schedules and methods vary according to the area of the hospital or institution, type of surface to be cleaned, and the amount and type of soil present. Horizontal surfaces (e.g., bedside tables and hard-surfaced flooring) in patient-care areas are usually cleaned on a regular basis, when soiling or spills occur, and when a patient is discharged. Cleaning of walls, blinds, and curtains is recommended only if they are visibly soiled. Disinfectant fogging is an unsatisfactory method of decontaminating air and surfaces and is not recommended.

Disinfectant-detergent formulations registered by EPA can be used for cleaning environmental surfaces, but the actual physical removal of microorganisms by scrubbing is probably at least as important as any antimicrobial effect of the cleaning agent used. Therefore, cost, safety, and acceptability by housekeepers can be the main criteria for selecting any such registered agent. The manufacturers' instructions for appropriate use should be followed.

Cleaning and Decontaminating Spills of Blood or Other Body Fluids

Chemical germicides that are approved for use as "hospital disinfectants" and are tuberculocidal when used at recommended dilutions can be used to decontaminate spills of blood and other body fluids. Strategies for decontaminating spills of blood and other body fluids in a patient-care setting are different than for spills of cultures or other materials in clinical, public health, or research laboratories. In patient-care areas, visible material should first be removed and then the area should be decontaminated. With large spills of cultured or concentrated infectious agents in the laboratory, the contaminated area should be flooded with a liquid germicide before cleaning, then decontaminated with fresh germicidal chemical. In both settings, gloves should be worn during the cleaning and decontaminating procedures.

Laundry

Although soiled linen has been identified as a source of large numbers of certain pathogenic microorganisms, the risk of actual disease transmission is negligible. Rather than rigid procedures and specifications, hygienic and common-sense storage and processing of clean and soiled lined are recommended (*26*). Soiled linen should be handled as little as possible and with minimum agitation to prevent gross microbial contamination of the air and of persons handling the linen. All soiled linen should be bagged at the location where it was used; it should not be sorted or rinsed in patient-care areas. Linen soiled with blood or body fluids should be placed and transported in bags that prevent leakage. If hot water is used, linen should be washed with detergent in water at least 71 C (160 F) for 25 minutes. If low-temperature ($\leq$70 C [158 F]) laundry cycles are used, chemicals suitable for low-temperature washing at proper use concentration should be used.

Infective Waste

There is no epidemiologic evidence to suggest that most hospital waste is any more infective than residential waste. Moreover, there is no epidemiologic evidence that hospital waste has caused disease in the community as a result of improper disposal. Therefore, identifying wastes for which special precautions are indicated is largely a matter of judgment about the relative risk of disease transmission. The most practical approach to the management of infective waste is to identify those wastes with the potential for causing infection during handling and disposal and for which some special precautions appear prudent. Hospital wastes for which special precautions appear prudent include microbiology laboratory waste, pathology waste, and blood specimens or blood products. While any item that has had contact with blood, exudates, or secretions may be potentially infective, it is not usually considered practical or necessary to treat all such waste as infective (*23,26*). Infective waste, in general, should either be incinerated or should be autoclaved before disposal in a sanitary landfill. Bulk blood, suctioned fluids, excretions, and secretions may be carefully poured down a drain connected to a sanitary sewer. Sanitary sewers may also be used to dispose of other infectious wastes capable of being ground and flushed into the sewer.

Implementation of Recommended Precautions

Employers of health-care workers should ensure that policies exist for:

1. Initial orientation and continuing education and training of all health-care workers—including students and trainees—on the epidemiology, modes or transmission, and prevention of HIV and other blood-borne infections and the need for routine use of universal blood and body-fluid precautions for all patients.

2. Provision of equipment and supplies necessary to minimize the risk of infection with HIV and other blood-borne pathogens.

3. Monitoring adherence to recommended protective measures. When monitoring reveals a failure to follow recommended precautions, counseling, education, and/or re-training should be provided, and, if necessary, appropriate disciplinary action should be considered.

Professional associations and labor organizations, through continuing education efforts, should emphasize the need for health-care workers to follow recommended precautions.

Serologic Testing for HIV Infection

Background

A person is identified as infected with HIV when a sequence of tests, starting with repeated enzyme immunoassays (EIA) and including a Western blot or similar, more specific assay, are repeatedly reactive. Persons infected with HIV usually develop antibody against the virus within 6–12 weeks after infection.

The sensitivity of the currently licensed EIA tests is at least 99% when they are performed under optimal laboratory conditions on serum specimens from persons infected for $\geq$12 weeks. Optimal laboratory conditions include the use of reliable reagents, provision of continuing education of personnel, quality control of procedures, and participation in performance-evaluation programs. Given this performance, the probability of a false-negative test is remote except during the first several weeks after infection, before detectable antibody is present. The proportion of infected persons with a false-negative test attributed to absence of antibody in the early stages of infection is dependent on both the incidence and prevalence of HIV infection in a population (Table 1).

Table 1. Estimated annual number of patients infected with HIV not detected by HIV-antibody testing in a hypothetical hospital with 10,000 admissions/year*

Beginning prevalence of HIV infection	Annual incidence of HIV infection	Approximate number of HIV-infected patients	Approximate number of HIV-infected patients not detected
5.0%	1.0%	550	17–18
5.0%	0.5%	525	11–12
1.0%	0.2%	110	3–4
1.0%	0.1%	105	2–3
0.1%	0.02%	11	0–1
0.1%	0.01%	11	0–1

*The estimates are based on the following assumptions: 1) the sensitivity of the screening test is 99% (i.e., 99% of HIV-infected persons with antibody will be detected); 2) persons infected with HIV will not develop detectable antibody (seroconvert) until 6 weeks (1.5 months) after infection; 3) new infections occur at an equal rate throughout the year; 4) calculations of the number of HIV-infected persons in the patient population are based on the mid-year prevalence, which is the beginning prevalence plus half the annual incidence of infections.

The specificity of the currently licensed EIA tests is approximately 99% when repeatedly reactive tests are considered. Repeat testing of initially reactive specimens by EIA is required to reduce the likelihood of laboratory error. To increase further the specificity of serologic tests, laboratories must use a supplemental test, most often the Western blot, to validate repeatedly reactive EIA results. Under

optimal laboratory conditions, the sensitivity of the Western blot test is comparable to or greater than that of a repeatedly reactive EIA, and the Western blot is highly specific when strict criteria are used to interpret the test results. The testing sequence of a repeatedly reactive EIA and a positive Western blot test is highly predictive of HIV infection, even in a population with a low prevalence of infection (Table 2). If the Western blot test result is indeterminant, the testing is considered equivocal for HIV infection. When this occurs, the Western blot test should be repeated on the same serum sample, and, if still indeterminant, the testing sequence should be repeated on a sample collected 3–6 months later. Use of other supplemental tests may aid in interpreting of results on samples that are persistently indeterminant by Western blot.

TABLE 2. Predictive value of positive HIV-antibody tests in hypothetical populations with different prevalences of infection

	Prevalence of infection	Predictive value of positive test*
Repeatedly reactive enzyme immunoassay (EIA)†	0.2%	28.41%
	2.0%	80.16%
	20.0%	98.02%
Repeatedly reactive EIA followed by positive Western blot (WB)‡	0.2%	99.75%
	2.0%	99.97%
	20.0%	99.99%

*Proportion of persons with positive test results who are actually infected with HIV.
†Assumes EIA sensitivity of 99.0% and specificity of 99.5%.
‡Assumes WB sensitivity of 99.0% and specificity of 99.9%.

Testing of Patients

Previous CDC recommendations have emphasized the value of HIV serologic testing of patients for: 1) management of parenteral or mucous-membrane exposures of health-care workers, 2) patient diagnosis and management, and 3) counseling and serologic testing to prevent and control HIV transmission in the community. In addition, more recent recommendations have stated that hospitals, in conjunction with state and local health departments, should periodically determine the prevalence of HIV infection among patients from age groups at highest risk of infection (*32*).

Adherence to universal blood and body-fluid precautions recommended for the care of all patients will minimize the risk of transmission of HIV and other blood-borne pathogens from patients to health-care workers. The utility of routine HIV serologic testing of patients as an adjunct to universal precautions is unknown. Results of such testing may not be available in emergency or outpatient settings. In addition, some recently infected patients will not have detectable antibody to HIV (Table 1).

Personnel in some hospitals have advocated serologic testing of patients in settings in which exposure of health-care workers to large amounts of patients' blood may be anticipated. Specific patients for whom serologic testing has been advocated include those undergoing major operative procedures and those undergoing treatment in critical-care units, especially if they have conditions involving uncontrolled bleeding. Decisions regarding the need to establish testing programs for patients should be made by physicians or individual institutions. In addition, when deemed appropriate, testing of individual patients may be performed on agreement between the patient and the physician providing care.

In addition to the universal precautions recommended for all patients, certain additional precautions for the care of HIV-infected patients undergoing major surgical operations have been proposed by personnel in some hospitals. For example, surgical procedures on an HIV-infected patient might be altered so that hand-to-hand passing of sharp instruments would be eliminated; stapling instruments rather than hand-suturing equipment might be used to perform tissue approximation; electrocautery devices rather than scalpels might be used as cutting instruments; and, even though uncomfortable, gowns that totally prevent seepage of blood onto the skin of members of the operative team might be worn. While such modifications might further minimize the risk of HIV infection for members of the operative team, some of these techniques could result in prolongation of operative time and could potentially have an adverse effect on the patient.

Testing programs, if developed, should include the following principles:

- Obtaining consent for testing.

- Informing patients of test results, and providing counseling for seropositive patients by properly trained persons.
- Assuring that confidentiality safeguards are in place to limit knowledge of test results to those directly involved in the care of infected patients or as required by law.
- Assuring that identification of infected patients will not result in denial of needed care or provision of suboptimal care.
- Evaluating prospectively 1) the efficacy of the program in reducing the incidence of parenteral, mucous-membrane, or significant cutaneous exposures of health-care workers to the blood or other body fluids of HIV-infected patients and 2) the effect of modified procedures on patients.

Testing of Health-Care Workers

Although transmission of HIV from infected health-care workers to patients has not been reported, transmission during invasive procedures remains a possibility. Transmission of hepatitis B (HBV)—a blood-borne agent with a considerably greater potential for nosocomial spread—from health-care workers to patients has been documented. Such transmission has occurred in situations (e.g., oral and gynecologic surgery) in which health-care workers, when tested, had very high concentrations of HBV in their blood (at least 100 million infectious virus particles per milliliter, a concentration much higher than occurs with HIV infection), and the health-care workers sustained a puncture wound while performing invasive procedures or had exudative or weeping lesions or microlacerations that allowed virus to contaminate instruments or open wounds of patients (*33,34*).

The hepatitis B experience indicates that only those health-care workers who perform certain types of invasive procedures have transmitted HBV to patients. Adherence to recommendations in this document will minimize the risk of transmission of HIV and other blood-borne pathogens from health-care workers to patients during invasive procedures. Since transmission of HIV from infected health-care workers performing invasive procedures to their patients has not been reported and would be expected to occur only very rarely, if at all, the utility of routine resting of such health-care workers to prevent transmission of HIV cannot be assessed. If consideration is given to developing a serologic testing program for health-care workers who perform invasive procedures, the frequency of testing, as well as the issues of consent, confidentiality, and consequences of test results—as previously outlined for testing programs for patients—must be addressed.

Management of Infected Health-Care Workers

Health-care workers with impaired immune systems resulting from HIV infection or other causes are at increased risk of acquiring or experiencing serious complications of infectious disease. Of particular concern is the risk of severe infection following exposure to patients with infectious diseases that are easily transmitted if appropriate precautions are not taken (e.g., measles, varicella). Any health-care worker with an impaired immune system should be counseled about the potential risk associated with taking care of patients with any transmissible infection and should continue to follow existing recommendations for infection control to minimize risk of exposure to other infectious agents (*7,35*). Recommendations of the Immunization Practices Advisory Committee (ACIP) and institutional policies concerning requirements for vaccinating health-care workers with live-virus vaccines (e.g., measles, rubella) should also be considered.

The question of whether workers infected with HIV—especially those who perform invasive procedures—can adequately and safely be allowed to perform patient-care duties or whether their work assignments should be changed must be determined on an individual basis. These decisions should be made by the health-care worker's personal physician(s) in conjunction with the medical directors and personnel health service staff of the employing institution or hospital.

Management of Exposures

If a health-care worker has a parenteral (e.g., needlestick or cut) or a mucous-membrane (e.g., splash to the eye or mouth) exposure to blood or other body fluids or has a cutaneous exposure involving large amounts of blood or prolonged contact with blood—especially when the exposed skin is chapped, abraded, or afflicted with dermatitis—the source patient should be informed of the incident and tested for serologic evidence of HIV infection after consent is obtained. Policies should be developed for testing source patients in situations in which consent cannot be obtained (e.g., an unconscious patient).

If the source patient has AIDS, is positive for HIV antibody, or refuses the test, the health-care worker should be counseled regarding the risk of infection and evaluated clinically and serologically for evidence of HIV infection as soon as possible after the exposure. The health-care worker should be advised to report and seek medical evaluation for any acute febrile illness that occurs within 12 weeks after the exposure. Such an illness—particularly one characterized by fever, rash, or lymphadenopathy—may be indicative of recent HIV infection. Seronegative health-care workers should be retested 6 weeks post-exposure and on a periodic basis thereafter (e.g., 12 weeks and 6 months after exposure) to determine whether transmission has occurred. During this follow-up period—especially the first 6–12

weeks after exposure, when most infected persons are expected to seroconvert—exposed health-care workers should follow U.S. Public Health Service (PHS) recommendations for preventing transmission of HIV (*36,37*).

No further follow-up of a health-care worker exposed to infection as described above is necessary if the source patient is seronegative unless the source patient is at high risk of HIV infection. In the latter case, a subsequent specimen (e.g., 12 weeks following exposure) may be obtained from the health-care worker for antibody testing. If the source patient cannot be identified, decisions regarding appropriate follow-up should be individualized. Serologic testing should be available to all health-care workers who are concerned that they may have been infected with HIV.

If a patient has a parenteral or mucous-membrane exposure to blood or other body fluid of a health-care worker, the patient should be informed of the incident, and the same procedure outlined above for management of exposures should be followed for both the source health-care worker and the exposed patient.

References

1. Centers for Disease Control. Acquired immunodeficiency syndrome (AIDS): Precautions for clinical and laboratory staffs. MMWR 1982; 31:577–80.

2. Centers for Disease Control. Acquired immunodeficiency syndrome (AIDS): Precautions for health-care workers and allied professionals. MMWR 1983; 32:450–1.

3. Centers for Disease Control. Recommendations for preventing transmission of infection with human T-lymphotropic virus type III/lymphadenopathy-associated virus in the workplace. MMWR 1985; 34:681–6, 691–5.

4. Centers for Disease Control. Recommendations for preventing transmission of infection with human T-lymphotropic virus type III/lymphadenopathy-associated virus during invasive procedures. MMWR 1986; 35:221–3.

5. Centers for Disease Control. Recommendations for preventing possible transmission of human T-lymphotropic virus type III/lymphadenopathy-associated virus from tears. MMWR 1985; 34:533–4.

6. Centers for Disease Control. Recommendations for providing dialysis treatment to patients infected with human T-lymphotropic virus type III/lymphadenopathy-associated virus infection. MMWR 1986; 35:376–8, 383.

7. Garner JS, Simmons BP. Guideline for isolation precautions in hospitals. Infect Control 1983; 4 (suppl):245–325.

8. Centers for Disease Control. Recommended infection control practices for dentistry. MMWR 1986; 35:237–42.

9. McCray E, The Cooperative Needlestick Surveillance Group. Occupational risk of the acquired immunodeficiency syndrome among health care workers. N Engl J Med 1986; 314:1127–32.

10. Henderson DK, Saah AJ, Zak BJ, et al. Risk of nosocomial infection with human T-cell lymphotropic virus type III/lymphadenopathy-associated virus in a large cohort of intensively exposed health care workers. Ann Intern Med 1986;104:644–7.

11. Gerberding JL, Bryant-LeBlanc CE, Nelson K, et al. Risk of transmitting the human immunodeficiency virus, cytomegalovirus, and hepatitis B virus to health care workers exposed to patients with AIDS and AIDS-related conditions. J Infect Dis 1987; 156:1–8.

12. McEvoy M, Porter K, Mortimer P, Simmons N, Shanson D. Prospective study of clinical, laboratory, and ancillary staff with accidental exposures to blood or body fluids from patients infected with HIV. Br Med J 1987; 294:1595–7.

13. Anonymous. Needlestick transmission of HTLV-III from a patient infected in Africa. Lancet 1984; 2:1376–7.

14. Oskenhendler E, Harzic M, Le Roux JM, Rabian C, Clauvel JP. HIV infection with seroconversion after a superficial needlestick injury to the finger [Letter]. N Engl J Med 1986; 315:582.

15. Neisson-Vernant C, Arfi S, Mathez D, Leibowitch J, Monplaisir N. Needlestick HIV seroconversion in a nurse [Letter]. Lancet 1986; 2:814.

16. Grint P, McEvoy M. Two associated cases of the acquired immune deficiency syndrome (AIDS). PHLS Commun Dis Rep 1985; 42:4.

17. Centers for Disease Control. Apparent transmission of human T-lymphotropic virus type III/lymphadenopathy-associated virus from a child to a mother providing health care. MMWR 1986; 35:76–9.

18. Centers for Disease Control. Update: Human immunodeficiency virus infections in health-care workers exposed to blood of infected patients. MMWR 1987; 36:285–9.

19. Kline RS, Phelan J, Friedland GH, et al. Low occupational risk for HIV infection for dental professionals [Abstract]. In: Abstracts from the III International Conference on AIDS, 1–5 June 1985. Washington, DC: 155.

20. Baker JL, Kelen GD, Sivertson KT, Quinn TC. Unsuspected human immunodeficiency virus in critically ill emergency patients. JAMA 1987; 257:2609–11.

21. Favero MS. Dialysis-associated diseases and their control. In: Bennett JV, Brachman PS, eds. Hospital infections. Boston: Little, Brown and Company, 1985:267–84.

22. Richardson JH, Barkley WE, eds. Biosafety in microbiological and biomedical laboratories, 1984. Washington, DC: US Department of Health and Human Services, Public Health Service, HHS publication no. (CDC) 84-8395.

23. Centers for Disease Control. Human T-lymphotropic virus type III/lymphadenopathy-associated virus: Agent summary statement. MMWR 1986; 35:540-2, 547–9.

24. Environmental Protection Agency. EPA guide for infectious waste management. Washington, DC: U.S. Environmental Protection Agency, May 1986 (publication no. EPA/530-SW-86-014).

25. Favero MS. Sterilization, disinfection, and antisepsis in the hospital. In: Manual of clinical microbiology. 4th ed. Washington, DC: American Society for Microbiology, 1985; 129–37.

26. Garner JS, Favero MS. Guideline for handwashing and hospital environmental control, 1985. Atlanta: Public Health Service, Centers for Disease Control, 1985. HHS publication no. 99-1117.

27. Spire B, Montagnier L, Barré-Sinoussi F, Chermann JC. Inactivation of lymphadenopathy associated virus by chemical disinfectants. Lancet 1984; 2:899–901.

28. Martin LS, McDougal JS, Loskoski SL. Disinfection and inactivation of the human T lymphotropic virus type III/lymphadenopathy-associated virus. J Infect Dis 1985; 152:400–3.

29. McDougal JS, Martin LS, Cort SP, et al. Thermal inactivation of the acquired immunodeficiency syndrome virus-III/lymphadenopathy-associated virus, with special reference to antihemophilic factor. J Clin Invest 1985; 76:875–7.

30. Spire B, Barré-Sinoussi F, Dormont D, Montagnier L, Chermann JC. Inactivation of lymphadenopathy-associated virus by heat, gamma rays, and ultraviolet light. Lancet 1985; 1:188–9.

31. Resnik L, Veren K, Salahuddin SZ, Tondreau S, Markham PD. Stability and inactivation of HTLV-III/LAV under clinical and laboratory environments. JAMA 1986; 255:1887–91.

32. Centers for Disease Control. Public Health Service (PHS) guidelines for counseling and antibody testing to prevent HIV infection and AIDS. MMWR 1987; 36:509–515.

33. Kane MA, Lettau LA. Transmission of HBV from dental personnel to patients. J Am Dent Assoc 1985; 110:634–6.

34. Lettau LA, Smith JD, Williams D, et al. Transmission of hepatitis B virus with resultant restriction of surgical practice. JAMA 1986; 255:934–7.

35. Williams WW. Guideline for infection control in hospital personnel. Infect Control 1983; 4(suppl):326–49.

36. Centers for Disease Control. Prevention of acquired immune deficiency syndrome (AIDS): Report of inter-agency recommendations. MMWR 1983; 32:101–3.

37. Centers for Disease Control. Provisional Public Health Service inter-agency recommendations for screening donated blood and plasma for antibody to the virus causing acquired immunodeficiency syndrome. MMWR 1985; 34:1–5.

☆U.S. GOVERNMENT PRINTING OFFICE: 1989