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CRITICAL REVIEWS IN ORAL BIOLOGY & MEDICINE

Human Immunodeficiency Virus (HIV) Transmission in Dentistry

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ABSTRACT

HIV transmission in the health-care setting is of concern. To assess the current position in dentistry, we have reviewed the evidence to November 1, 2005. Transmission is evidently rare in the industrialized nations and can be significantly reduced or prevented by the use of standard infection control measures, appropriate clinical and instrument-handling procedures, and the use of safety equipment and safety needles. We hope that breaches in standard infection control will become vanishingly small. When occupational exposure to HIV is suspected, the application of post-exposure protocols for investigating the incident and protecting those involved from possible HIV infection further reduces the likelihood of HIV disease, and also stress and anxiety.

KEY WORDS: HIV, AIDS, mouth, dental, transmission, occupational.

INTRODUCTION

Viruses can be transmitted in health-care settings including dentistry, albeit rarely, notably where standard infection control measures are not implemented. The epidemic of Acquired Immune Deficiency Syndrome (AIDS) has been recognized for about 25 years, and concern about the transmission of human immunodeficiency viruses (HIV) is therefore not new. In the case of HIV, transmission is evident from cases where health-care professionals (HCPs) have seroconverted because of occupational exposure to HIV (Marcus, 1988; Tokars *et al.*, 1993; Centers for Disease Control and Prevention, 1995), but the risk of transmission is low, with a seroconversion rate of 0.1% after percutaneous exposure and 0.63% after mucous-membrane contamination (Ippolito *et al.*, 1993). Review of data reported to December, 2001, in the HIV/AIDS Reporting System and the National Surveillance for Occupationally Acquired HIV Infection revealed 57 HCPs with documented occupationally acquired HIV infection; most (86%) had been exposed to blood, and most (88%) had percutaneous injuries (Do *et al.*, 2003). However, to assess the current position in dentistry, we have reviewed the evidence to November 1, 2005. We have focused on HIV and do not discuss other blood-borne pathogens, such as hepatitis viruses, herpesviruses, prions, bacteria, fungi, or parasites. Definitions relevant to this paper are outlined in Table 1.

HEALTH-CARE WORKERS WITH POSSIBLE OCCUPATIONALLY CONTRACTED HIV INFECTION

In the USA until December, 2001, the Centers for Disease Control and Prevention (CDC) reported that there had been 57 occupational HIV infections in HCPs (Centers for Disease Control, 2002), mainly from percutaneous (sharps; needlestick) injuries. Of these, none was reported to be in dental HCPs (Table 2). In addition, 139 other cases of HIV infection or AIDS have been recorded among HCPs who have not reported other risk factors for HIV infection, but who report a history of occupational exposure to HIV-infected blood, body fluids, or laboratory material, but where seroconversion after exposure was not documented. Six have been dental HCPs; each had a history of percutaneous or mucous membrane exposure to HIV-infected body fluids, but seroconversion could not be linked to specific occupational exposure (Centers for Disease Control, 2001). The occupations of these HCPs are presented in Table 2.

In the UK, until May, 2005, the Health Protection Agency (HPA) reported that there had been 5 documented HIV seroconversions through occupational exposure in the health-care setting, and 12 possible/probable occupational seroconversions—but none was in dental HCPs. A further 14 probable cases of occupational acquisition of HIV in HCPs have been diagnosed in the UK. The majority of these HCPs had worked in countries of high HIV prevalence, and are presumed to have been infected outside of the UK (Heptonstall *et al.*, 1993).

According to McCarthy, there are, worldwide, > 300 reports

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Table 1. Terminology Relevant to HIV Transmission

Term	Definition
Infection control	Infection control refers to policies and procedures used to minimize the risk of spreading infections, especially in hospitals and health-care facilities.
Standard infection control precautions	Preventive practices used to reduce blood exposures, particularly percutaneous exposures, include: careful handling of sharp instruments; the use of rubber dams to minimize blood spattering; handwashing; and the use of protective barriers (*e.g.*, gloves, masks, protective eyewear, and gowns), based on the premise that all blood and body fluids, excretions, and secretions should be treated as infectious. http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5217a1.htm
Sterilization	Sterilization is defined as the complete destruction of all organisms, including a large number of highly resistant bacterial endospores.
Disinfection	Disinfection is defined as the removal of all vegetative bacteria and nearly all recognized pathogenic organisms except bacterial endospores.
Decontamination	Decontamination is any process or treatment that makes a machine, component, instrument, medical device, or environmental surface incapable of transmitting infectious particles.
Occupational exposure	Reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that can result from the performance of an employee's duties. Exposure is not synonymous with transmission of an infectious agent.
Possible occupational transmission	The term implies that a HCP has been found to be HIV-infected, and that subsequent investigations have revealed no other identified risk for infection other than occupational exposure. There is variation between and among countries on what constitutes a "possible occupational transmission".
Documented occupational transmission	An exposure for which there is documented evidence of HIV seroconversion (a recorded negative result of a test for anti-HIV, followed by a subsequent positive result) associated in time with a specific *occupational* exposure to a source of HIV. There is little variation between and among countries on what constitutes a "documented occupational transmission".
Exposure-prone procedure	Procedures during which there is a recognized risk for percutaneous injury to the health-care professional (HCP), and if such an injury occurs, the HCP's blood is likely to come into contact with the patient's body cavity, subcutaneous tissues, and/or mucous membranes. Exposure-prone procedures are those invasive procedures where there is a risk that injury to the HCP may result in the exposure of the patient's open tissues to the blood of the HCP. These include procedures where the HCP's gloved hands may be in contact with sharp instruments, needle tips, or sharp tissues (*e.g.*, spicules of bone or teeth) inside a patient's open body cavity, wound, or confined anatomical space, where the hands or fingertips may not be completely visible at all times. However, other situations, such as pre-hospital trauma care and care of patients where the risk of biting is regular and predictable, should be avoided by health-care workers restricted from performing exposure-prone procedures.

(102 confirmed) of occupational transmission to HCPs, including up to nine dental HCPs (unconfirmed) (McCarthy *et al.*, 2002). Exposure to HIV has been reported by 0.5% dentists/year (McCarthy *et al.*, 2002). There are few data from resource-poor countries or regions where the prevalence of HIV is, and risk of infection must be, higher.

HEALTH-CARE PROFESSIONALS WITH HIV INFECTION OF UNKNOWN ORIGIN

Many HCPs do have HIV infection or AIDS, but the infection has often been contracted non-occupationally. Of about 23,000 HCPs with AIDS reported to the CDC, fewer than 500 are dental HCPs, but there is no reported evidence of any of them having acquired HIV occupationally in the dental health-care setting (ADA, 2003) (Table 3).

DENTAL STAFF WITH POSSIBLE OCCUPATIONALLY CONTRACTED HIV INFECTION

Reports of those dental HCPs who do appear to have contracted HIV infection occupationally are as follows:

Dentist 1

The first case of a dental HCP reported with apparently occupationally contracted HIV was a male dentist in the USA (Klein *et al.*, 1988). He lived among and treated New York City "Greenwich Village" patients—a high HIV/AIDS risk population—and he used protective equipment only intermittently, denied other high-risk behavior, and tested HIV-positive in a survey of 1309 dental HCPs (Klein *et al.*, 1988). His HIV exposure could not be documented, and the CDC concluded that if the dentist did contract HIV occupationally, then standard infection control precautions would have prevented transmission to his patients.

Dentists 2 & 3

There is a reference to two HIV-seroconverted dental HCPs, among a group of 69 HCPs with no identifiable risk for infection (Neiburger, 2004). These dentists evidently worked in a correctional facility (treating high-risk patients), experienced needlesticks from equipment used on unidentified patients, and died before HIV-DNA studies and in-depth interviews could be done (Centers for Disease Control, 1992a).

Table 2. Documented and Possible Occupational Transmissions of HIV to Health-care Professionals

Health-care Occupations	Documented Occupational Transmissions	Possible Occupational Transmissions
Dental health-care worker	0	6
Embalmer/morgue technician	1	2
Emergency medical technician/paramedic	0	12
Health aide/attendant	1	15
Housekeeper/maintenance worker	2	13
Laboratory, Worker, clinical	16	17
Technician, non-clinical	3	0
Nurse	24	35
Physician, Non-surgical	6	12
Surgical	0	6
Respiratory therapist	1	2
Technician, Dialysis	1	3
Surgical	2	2
Other	0	9
Other	0	5
Total	57	139

Adapted from the Centers for Disease Control and Prevention (CDC), 1999 and 2001.

Table 3. Adults Reported with AIDS and a History of Employment in US Healthcare, where Job is Known, by Occupation, as of December, 2002

Occupation	Number with AIDS
Nurses	5,378
Health aides	5,638
Technicians	3,182
Physicians	1,792
Therapists	1,082
Dental workers	492
Paramedics	476
Surgeons	122
Other	5,050
Total	23,212

From CDC, 2001.

There was little other information on these two dentists or any potential high-risk behavior.

Dentists 4, 5, & 6

The CDC, in several years of HIV/AIDS Surveillance Reports, indicated that there were seven dental HCPs who were possible cases of occupational HIV transmission, but this was later revised to six possible cases (Centers for Disease Control, 1993, 1997, 1999). Of these seven (or six) dental HCPs, three were general dental practitioners, two were dental students, one was a pedodontist, and one a periodontist. Dental HCPs in the UK have not been reported to have contracted HIV from HIV-infected patients (Public Health Laboratory Service, 2005).

HIV TRANSMISSION FROM HCP TO PATIENT

Available information indicates that the risk of HIV transmission in the dental office is very low (Centers for Disease Control, 1990). There is general agreement that there can be some risk of HIV transmission from an HIV-infected HCP to a patient, but it is small, and may be minimized by the use of standard infection-control measures.

In attempting to assess the risk, one must consider not only statistical data, but also the nature of the procedure being performed. Should the HIV-infected HCP incur a surgical accident or percutaneous injury in an exposure-prone procedure (EPP), there may be the potential for exchange of blood or other potentially infected fluid, such as saliva, but the susceptibility of oropharyngeal and other mucous membranes to transmission of HIV is unknown.

In only three reported instances (discussed below)—the Florida dentist (Ciesielski *et al.*, 1992), the French orthopedic surgeon (Lot *et al.*, 1999), and the nurse (Goujon *et al.*, 2000)—have there been possible transmissions from an HIV-infected HCP to patients, but although genetic relatedness was demonstrated, only in the orthopedic case was the route of transmission clear.

Worldwide, all other retrospective studies of patients exposed to the potential risk of transmission of HIV during EPP have failed to identify any patients who have become infected by this route. Analysis of the data available from patient notification exercises also supports the conclusion that the overall risk of transmission of HIV from infected HCPs to patients is very low. Between 1988 and 2001 in the UK, there were 22 patient notification exercises, but no detectable transmission of HIV from an infected HCP to a patient, despite about 7000 patients having been tested (Public Health Laboratory Service, 2005).

THE FLORIDA DENTIST CASE

Although AIDS has been recognized in the USA since 1981, the cases described related to the Florida dentist remain the only ones in which HIV transmission has been convincingly documented in any way in dental practice (Centers for Disease Control, 1991), and even this is controversial. Possible transmission of HIV infection during an invasive dental procedure was first reported in a young woman (patient A) with AIDS in Florida, USA. She had no identified risk factors for HIV infection and was infected with a strain of HIV apparently closely related to that of her male dentist, as determined by viral DNA sequencing. Because the dentist had known behavioral risk factors for HIV, his infection was probably not occupationally acquired.

The dentist then wrote to his former patients, which prompted 591 persons to be tested for HIV, when two patients (B and C) were found to be HIV-seropositive. Another patient (patient D) was identified as HIV-infected when the list of available names of the dentist's former patients was matched with Florida's state AIDS surveillance records, and one more patient (E) contacted the CDC to report that she was HIV-infected and had been a former patient of the dentist. Of these four additional HIV-infected patients of the dentist, only two were infected with HIV strains closely related to those of the dentist and patient A, but not to strains from other persons residing in the same geographic area as the dental practice. Another 1100 persons who may have been patients of the dentist were contacted for counseling and HIV-antibody testing; of

these persons, 141 were tested, but all were HIV-seronegative.

This investigation strongly suggests that at least three (possibly six) patients of the Florida dentist with AIDS were infected with HIV during their dental care, since they had no other confirmed exposures to HIV, all had had invasive procedures performed by the HIV-infected dentist, and DNA sequence analyses of the HIV strains indicated a high degree of similarity of these strains to each other and to the strain that had infected the dentist. These HIV strains were also distinct from strains from patient D (who had known behavioral risks for HIV infection), from strains of the eight HIV-infected patients residing in the same geographical area, and from the 21 other North American HIV isolates. The precise mode of HIV transmission to patients A, B, and C remains uncertain, though all three had invasive dental procedures at times when the dentist was known to be HIV-infected and would have had high blood viral titers, and patients B and C had multiple invasive procedures.

Although barrier precautions were reportedly used in the Florida dental office, they were neither consistent nor in compliance with recommendations. Transmission might also have occurred by the use of instruments or other dental equipment that had been previously contaminated with blood from either the dentist or an infected patient.

There have been continued controversy and speculation over this case, and the truth will probably never be established, since the dentist has died.

OTHER REPORTS FROM THE USA ON PATIENTS TREATED BY HIV-POSITIVE HCPs

The CDC have reported HIV test results for 15,795 patients who were treated by 32 HIV-infected HCPs, including some dental HCPs (Centers for Disease Control, 1992b). The total number of patients treated by these HCPs and the number of patients who underwent invasive procedures are unknown. However, 23 of these HCPs (11 were dentists/dental students) had 10,270 of their patients tested, and no seropositive persons were reported. For the remaining nine HCPs (five were dentists), 5525 of their patients were tested, and 84 HIV-infected patients were identified. Follow-up was completed for 47 of these 84 HIV-seropositive patients: Seven patients had established HIV risk factors identified (*e.g.*, male-to-male sexual contact, injecting-drug use, receipt of a blood transfusion from a retrospectively identified HIV-infected donor); five were documented to be infected before receiving care from the HIV-infected HCP; and the remaining 35 were male inmates in a state correctional facility. These 35 inmates were among a total of 962 male inmates who received treatment from two HIV-infected dentists, and for whom HIV-antibody test results were known. The prevalence of HIV infection for male inmates tested (3.6%) was less than that documented among male inmates upon entrance into the state correctional system (8.6%). Established risk factors were identified for 33 of the 35 HIV-infected inmates. Because both dentists died, specimens for HIV genetic sequence analysis were not available.

The 37 HIV-infected persons in the same study (Centers for Disease Control, 1992a), for whom investigations were in progress, were patients treated by three HCPs, two of whom were dentists. Dentist 1 practiced in an area with high background prevalence of HIV infection, and, of 1162 patients tested, 29 were HIV-infected. Established risk factors could not be identified for 17 of these 29 patients, but epidemiologic investigations determined that many may have had opportunities for exposure to HIV (*e.g.*, multiple sex partners and/or exchange of sex for drugs or money). HIV genetic sequence analysis results do not appear to have been published. More than 800 patients of Dentist 2 were tested, and five proved to be HIV-positive. Three of these patients had established risk factors identified. Eighteen months after the last visit to the dentist, a fourth patient was documented to be seronegative but was seropositive when re-tested 2 years later. No risk factors were identified for the remaining patient, who had visited the dentist only once, for an examination.

As of 1 January 1995, information about investigations of 64 HCPs infected with HIV had been reported to the CDC, with HIV test results available for 22,171 patients of 51 of these HIV-infected HCPs (Robert *et al.*, 1995). For 37 of the 51 HCPs, no HIV-seropositive patients were reported among 13,063 patients tested. For the remaining 14 HIV-infected HCPs, 113 seropositive patients were reported among 9108 patients. However, epidemiologic and laboratory follow-up did not show any HCPs to have been a source of HIV for any of the patients tested (Robert *et al.*, 1995).

Data from the above investigations, as well as risk estimates from modeling techniques, continue to indicate that the risk for HIV transmission from an HIV-infected HCP, whether dental or other, to a patient during an invasive procedure is very small.

THE FRENCH ORTHOPEDIC SURGEON

This HIV-infected orthopedic surgeon practiced in Paris, France, for 12 years after his HIV diagnosis was known, and 983 of 3004 of his patients treated during that period were HIV-tested. Only one HIV-positive woman, negative before hip prosthesis and without other risk factors, was identified as HIV-positive, and the strain of HIV from both surgeon and patient was similar (Lot *et al.*, 1999).

This seems to confirm transmission of HIV from the HCP.

THE FRENCH NURSE

The first known case of HIV transmission from a nurse practicing near Paris, France, to a 61-year-old female surgical patient has been reported, without evidence of blood exposure (Goujon *et al.*, 2000). Phylogenetic analyses strongly suggested that the HIV-seropositive 51-year-old female night nurse, who was also infected with hepatitis C virus (HCV), appears to have infected the patient with HIV but not HCV, despite not having performed invasive procedures (Goujon *et al.*, 2000). Interestingly, another HIV-infected nurse attending the patient appears not to have been involved in the transmission.

TRANSMISSION OF OTHER VIRAL INFECTIONS IN DENTAL PRACTICE

There is no doubt that blood-borne viral infections such as hepatitis B and other pathogens have been transmitted from dental HCPs to patients and *vice versa*, especially when the dental HCPs were those practicing surgical procedures, and in the era before standard infection control measures were widely adopted.

The current level of risk of transmission, however, is debatable. Dental HCPs do not now seem to be particularly at risk for occupational acquisition of blood-borne hepatitis

viruses transmissible by percutaneous injuries or blood products, such as either hepatitis C virus or transfusion-transmitted virus.

UNIVERSAL AND STANDARD INFECTION CONTROL PROCEDURES

Universal infection control precautions were based on the concept that all blood and body fluids might be contaminated with blood and should be treated as infectious, because patients with blood-borne infections can be asymptomatic or unaware that they are infected. Standard infection control precautions integrate and expand the elements of these universal precautions into a standard of care designed to protect both HCPs and patients from pathogens that can be spread by blood or any other body fluid, excretion, or secretion. The latest detailed guidelines are available elsewhere (Kohn *et al.*, 2003) and will not be described here.

COMPLIANCE WITH INFECTION CONTROL PROCEDURES IN DENTAL PRACTICE

Despite improvements in infection control over the period of the HIV pandemic (Scully *et al.*, 1992), there have been substantial improvements with compliance in some areas of infection control in dentistry—for example, glove-wearing. However, other aspects, such as the effective management of needlestick injuries, remain problematic (Gordon *et al.*, 2001), and there remain widespread shortcomings in facilities, equipment, operational procedures, management, and staff training in some health services (Glennie Report, 2004), and the available evidence suggests that compliance in dental practice is sometimes lacking, even in developed areas such as North America and Europe (McCarthy *et al.*, 1999a; Bagg *et al.*, 2001).

PERCUTANEOUS INJURIES IN DENTAL HEALTH-CARE PROFESSIONALS

The circumstances varied among 51 percutaneous injuries in one US study of HCPs, with the largest proportion (41%) occurring after a procedure, 35% occurring during a procedure, and 20% occurring during disposal of sharp objects (Do *et al.*, 2003). Factors that increase the risk of contracting HIV infection from a percutaneous injury in a HCP include the volume of blood involved and, probably, a higher HIV titer in the source patient's blood (Cardo and Bell, 1997; Cardo *et al.*, 1997). Other factors include:

- terminal HIV-related illness in the source patient (Saag *et al.*, 1991),
- a deep injury,
- visible blood on the device that caused the injury, and
- injury with a needle that had been placed in a source patient's artery or vein.

Blood is effectively removed from many hollow needles or suture needles when the needle passes through one or more layers of latex or vinyl gloves before coming into contact with the skin (Mast *et al.*, 1993).

Dental HCPs are also at risk, but tend to under-report percutaneous injuries, particularly when there is potential HIV contamination (Ramos-Gomez *et al.*, 1997). The CDC, from June, 1995, through August, 2001, reported 208 exposures—199 percutaneous injuries, six mucous membrane exposures, and three skin exposures—in dental HCPs (Cleveland *et al.*, 2002). One-third of these injuries were caused by small-bore hollow syringe needles, and most were moderately deep. Nearly half the devices involved were visibly bloody at the time of injury. Twenty-four (13%) of the known source patients were HIV-positive; 14 had symptomatic HIV infection or a high viral load. In this study, three of four dental HCPs exposed to an HIV-positive source warranted a three-drug post-exposure protocol (PEP) regimen. Twenty-nine (24%) dental HCPs exposed to a source patient, who subsequently was found to be HIV-negative, took PEP; six took PEP for 5 to 29 days. No exposures resulted in HIV infection (Cleveland *et al.*, 2002).

Most dental HCPs appear to be careful to try to avoid injury during intra-oral procedures, but it is during extra-oral procedures—such as laboratory work, operatory clean-up, and instrument preparation for sterilization—that most percutaneous injuries occur (Porter *et al.*, 1990; Cleveland *et al.*, 1995; Gooch *et al.*, 1995; McCarthy *et al.*, 1999b).

Fortunately, the rate of occupational injuries among dental HCPs appears to have decreased over the last decade (Bednarsh and Klein, 2003). Post-exposure prophylaxis after percutaneous injuries reduced transmission by over 80% (Cardo *et al.*, 1997), but prevention of injuries is much more important.

PREVENTION OF OCCUPATIONAL TRANSMISSION OF PATHOGENS

Strategies for preventing occupational HIV transmission to HCPs have been summarized by the CDC (Centers for Disease Control, 2002). In the USA, in 1991, the US Department of Labor's Occupational Safety & Health Administration (OSHA) issued the Bloodborne Pathogens Standard to protect workers from the risk of exposure to blood-borne pathogens such as Hepatitis B, Hepatitis C, and HIV/AIDS. In 2002, in response to the Needlestick Safety and Prevention Act, OSHA revised the Bloodborne Pathogens Standard 29 CFR 1910.1030. The revised standard clarifies the need for employers to select safer needle devices and to involve employees in identifying and choosing these devices. The updated standard also requires employers to maintain a log of injuries from contaminated sharps (OSHA, 2002).

Engineering controls to eliminate or isolate the hazard (*e.g.*, puncture-resistant sharps containers or needle-retraction devices) are the primary strategies for protecting dental HCPs and patients. Where these are not appropriate or available, work-practice controls that result in safer behaviors, coupled with the use of personal protective equipment (PPE) (*e.g.*, protective eyewear, gloves, and masks), can prevent or minimize exposure.

An effective sharps injury prevention program is also required. This includes two main components: organizational steps for developing and implementing a sharps injury program, and operational processes. A culture of safety, reporting injuries, analyzing data, and selecting and evaluating devices must be engendered. Instruments, rather than fingers, should be used to grasp needles, retract tissue, and load/unload needles and scalpels. Safer local anesthetic syringes and retractable scalpels are available. It is important that HCPs not pass any needles unsheathed, or recap needles using two hands. Use of a mechanical recapping device or a scoop technique is recommended. Sharps disposal containers and needles and other sharps devices with an integrated engineered sharps injury prevention feature are essential (Centers for Disease Control, 2004).

PROTOCOLS FOR DEALING WITH PERCUTANEOUS INJURIES AND OTHER POSSIBLE OCCUPATIONAL EXPOSURES TO HIV INFECTION

Occupational exposures should be considered urgent to ensure timely post-exposure management and administration of hepatitis B immune globulin, hepatitis B vaccine, and/or HIV post-exposure prophylaxis (PEP) (Smith *et al.*, 2001). Post-exposure prophylaxis with zidovudine appears to be protective against HIV infection (Cardo *et al.*, 1997). Current protocols employ nucleoside reverse-transcriptase inhibitors (NRTIs) and/or nucleotide reverse-transcriptase inhibitors (NtRTIs).

CDC recommendations for PEP (Centers for Disease Control, 2005) for most HIV exposures include beginning, within hours, a basic four-week regimen of 2 anti-retroviral drugs, using 2 NRTIs, or one NRTI and one NtRTI. Regimens include zidovudine [ZDV] and lamivudine [3TC] or emtricitabine [FTC]; d4T and 3TC or FTC; and tenofovir [TDF] and 3TC or FTC. Where there is an increased risk for HIV transmission, an expanded drug regimen is recommended, which includes the addition of a third protease inhibitor [PI]-based drug, usually lopinavir/ritonavir [LPV/RTV]. When the source person's HIV is known or suspected to be resistant to one or more of the PEP drugs, then drugs to which the source person's virus is unlikely to be resistant are recommended. In addition, the CDC outlines several special circumstances (*e.g.*, delayed exposure report, unknown source person, pregnancy in the exposed person, resistance of the source virus to antiretroviral agents, or toxicity of the PEP regimen) when consultation with local experts and/or the National Clinicians' Post-Exposure Prophylaxis Hotline ([PEPline] 1-888-448-4911) is advised (Centers for Disease Control, 2005).

European guidelines suggest that PEP should be started as soon as possible with any triple combination of antiretroviral drugs approved for the treatment of HIV-infected patients; initiation of PEP is discouraged after 72 hours. Rapid HIV testing of the source could reduce inappropriate PEP. HIV testing should be performed at baseline, 4, 12, and 24 weeks, with additional clinical and laboratory monitoring of adverse reactions and potential toxicity at weeks 1 and 2. HIV resistance tests in the source and direct virus assays in the exposed HCP are not recommended routinely (Puro *et al.*, 2004). Specific UK recommendations are also available (Department of Health, 2004, http://www.dh.gov.uk/PublicationsAndStatistics/Publications/PublicationsPolicyAndGuidance/PublicationsPolicyAndGuidanceArticle/fs/en?CONTENT_ID=4083638&chk=qtPweH). The UK Department of Health recommends zidovudine as first choice, with lamivudine and nelfinavir, and recommends that PEP be considered whenever there is significant exposure to high-risk body fluids. In an ideal situation, PEP should be commenced immediately, preferably within 1 hour, but starting PEP up to 2 weeks after exposure may still be beneficial.

CONCLUSIONS

HIV transmission in the dental care setting continues to be of concern, but is rare in the industrialized nations and can be significantly reduced or prevented by the use of standard infection control measures, appropriate and careful clinical and instrument-handling procedures, and the use of safety equipment and safety needles. We hope that breaches in standard infection control will become vanishingly small and that percutaneous injuries will reduce even further.

When percutaneous exposure to HIV is suspected, the application of post-exposure protocols for investigating the incident and protecting those involved from possible HIV infection further reduces the likelihood of HIV disease, as well as the associated stress and anxiety.

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