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REVIEW ARTICLE

When the Unthinkable Happens: Universal Work Precautions and Postexposure Prophylaxis in HIV

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ABSTRACT

Postexposure prophylaxis (PEP) with antiretrovirals is now widely used worldwide after either occupational contact (with blood or another blood-containing fluid), or nonoccupational contact (mainly sexual or injection-drug use). It is assumed to reduce the risk of HIV transmission by at least 80%, although its efficacy has not been completely proven. Several countries have issued guidelines to help the clinician in their decision to offer PEP and to improve its cost-effectiveness. This article reviews the different antiretroviral combinations used, their safety profile, the recommendations and indications of PEP.

Keywords: HIV, Postexposure prophylaxis, Antiretroviral drugs, Healthcare workers.

INTRODUCTION

Healthcare settings are constantly exposed to occupational hazards. However, there is one hazard that people in the healthcare field fear most, the needle stick injury. It has been reported that nearly 1 million healthcare workers suffer needle stick injuries each year. Of these, hundreds are infected with diseases, such as hepatitis B, hepatitis C and HIV.[1]

At the end of 1999, there were 34 million people living with HIV, including 30 millions in Africa and South-East Asia. Whereas in adult HIV transmission is predominantly via sexual and parenteral routes, infants are most frequently infected through perinatal transmission and as a result of breastfeeding. Many developing countries with a high prevalence of HIV have limited resources for education, antiretroviral drugs, infection control, or for monitoring and reporting transmission of HIV in healthcare and other settings.[2]

Viruses can be transmitted in healthcare 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 healthcare professionals (HCPs) have seroconverted because of occupational exposure to HIV,[3,4] but the risk of transmission is low, with a seroconversion rate of 0.1% after percutaneous exposure and 0.63% after mucous membrane contamination.[5] 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.[6]

The center for disease control now recommends what it calls postexposure prophylaxis (PEP) for those workers with needle stick injuries thought to be at risk of carrying the HIV virus.[1] This article briefly describes universal work precautions and postexposure prophylaxis in HIV.

Pathogenesis of HIV Infection

The exact mechanism of pathogenesis of initial infection has not been firmly established, but the dendritic cells in skin or mucous membrane appear to be the first cell to interact with HIV. Dendritic cells can trap HIV through surface ligands and then transfer virus to susceptible CD4+ T lymphocytes.[7]

Theoretically any intervention that can block transfer of HIV from dendritic cells to susceptible CD4+ T lymphocytes, can possibly prevent acute infection. Thus, based on our understanding of the early events of pathogenesis, the initiation of antiretroviral chemoprophylaxis soon after exposure and body´s cellular immune response may prevent or inhibit systemic HIV infection. The fundamental principle of PEP is actually to limit the proliferation of virus in early stages of infection during a 'window of opportunity' during which virus remain localized.[8]

Who needs? In Whom PEP is indicated?

Healthcare worker is defined as any person (e.g. an employee, student, attending clinician, public-safety worker, or volunteer) whose activities involve contact with patients or with blood or other body fluids from patients in a healthcare or laboratory

setting. An 'exposure' that may place an healthcare worker at risk for HIV infection and therefore requires consideration of PEP is defined as a percutaneous injury (e.g. a needle stick or cut with a sharp object), contact of mucous membrane or non intact skin (e.g. when the exposed skin is abraded, or afflicted with dermatitis), or contact with intact skin when the duration of contact is prolonged (i.e. several minutes or more) or involves an extensive area, with blood, tissue, or other body fluids. Body fluids include: (a) semen, vaginal secretions, or other body fluids contaminated with visible blood and (b) cerebrospinal, synovial, pleural, peritoneal, pericardial, and amniotic fluids. In the absence of visible blood in the saliva, exposure to saliva from a person infected with HIV is not considered risk for transmission; also, exposure to tears, sweat, or nonbloody urine or feces does not require postexposure follow-up. Human breast milk has been implicated in perinatal transmission of HIV. However, occupational exposure to human breast milk has not been implicated in HIV transmission to healthcare workers.[9]

Universal Precautions

Percutaneous or permucosal exposures to blood or body fluids represent a potential source of HIV infection. These include skin-piercing procedures with contaminated objects and exposures of broken skin, open wounds, cuts and mucosal membranes (mouth or eyes) to the blood or body fluid of an infected person.

Although they account for a minority of HIV infections, healthcare procedures represent a highly preventable source of HIV infection. Among healthcare associated sources of infection, unsafe injections are of particular concern, accounting for an estimated 3.9 to 7.0% of new infections worldwide.

Healthcare worker protection is an essential component of any strategy to prevent discrimination against HIV infected patients by healthcare workers. If healthcare workers feel they can protect themselves from HIV infection, they can provide better care.[10]

Protective Barriers

Whenever, exposure to blood/other potentially infected fluids is anticipated, protective barriers must be used.

Latex gloves must be worn while carrying out any procedure and be decontaminated after each use. Gloves with holes/tears should not be used. Double gloves are not preferred as these are not more protective than single glove and this may be clumsier also. Heavy-duty rubber gloves should be used for cleaning instruments, handling soiled linen or spills of blood/body fluids. These can be washed and reused.

Gowns and aprons protect one from splashes of blood or body fluids, e.g. during surgery/delivery. One may wear a waterproof gown or a sterile cloth with a plastic apron underneath. Protective eyewear (swimming goggles) may be used to prevent transmission by splash of fluids to the mucous membrane.

Safe Handling of Sharps

- Careful handling of hollow bore needle is very essential as it may lead to deep injuries
- The needles should never be recapped. In situations where recapping is essential, single hand method should be used
- Needles should never be bent or broken by hand
- Needles should not be left on trolleys and beds and must be disposed off immediately
- Never pass used sharps from one person to another directly
- Use forceps instead of fingers for guiding sutures
- The sharps should be disposed off in a puncture resistant container containing bleach
- Single use disposable injection equipment for all injections is highly recommended. Document the quality of the sterilization for all medical equipment used for percutaneous procedures
- Disinfect instruments and other contaminated equipment
- Handle properly soiled linen. Soiled linen should be handled as little as possible. Gloves and leakproof bags should be used if necessary. Cleaning should occur outside patient areas, using detergent and hot water.

Ensuring Universal Precautions

Understanding of Universal Precautions by Healthcare Workers

Healthcare workers should be educated about occupational risks and should understand the need to use universal precautions with all patients, at all times, regardless of diagnosis. Regular in-service training should be provided for all medical and non-medical personnel in healthcare settings.

Reduce Unnecessary Procedures

Reduce the supply of unnecessary procedures: Healthcare workers need to be trained to avoid unnecessary blood transfusions (e.g. using volume replacement solutions), injections (e.g. prescribing oral equivalents), suturing (e.g. episiotomies) and other invasive procedures. Standard treatment guidelines should include the use of oral medications whenever possible.

Make Adequate Supplies Available

Adequate supplies should be made available to comply with basic infection control standards, even in resource constrained settings. Provision of single use, disposable injection equipment matching deliveries of injectable substances, disinfectants and 'sharps' containers should be the norm in all healthcare settings. Attention should also be paid to protective equipment and water supplies. Use of sterilizable injection equipment should be discouraged, as evidence shows that the adequacy of the sterilization is difficult to ensure. Institutional guidelines for universal precautions should be in place. The necessary supplies (e.g. oral medications, needles and syringes, sharps containers, disinfectant, antiretrovirals) must be made available. Healthcare

waste management may require the construction of adapted waste treatment options (e.g. incinerators and alternatives to incineration).

Ensure Adherence to Universal Precautions

Although most of the healthcare workers are aware about universal precautions but they are not followed in usual day to day practice, may be due to inadequate facilities. Sometimes even when the facilities are available, there is a certain degree of inertia and complacency among doctors and other healthcare workers towards universal precautions. So, concept of universal precautions has to be put to actual use once again, in this era of emerging and reemerging infections.[10]

Prevention is the mainstay of strategy to avoid occupational exposure to HIV. Universal precautions must be practiced by all the healthcare workers at all the places, all the time.

Postexposure Prophylaxis

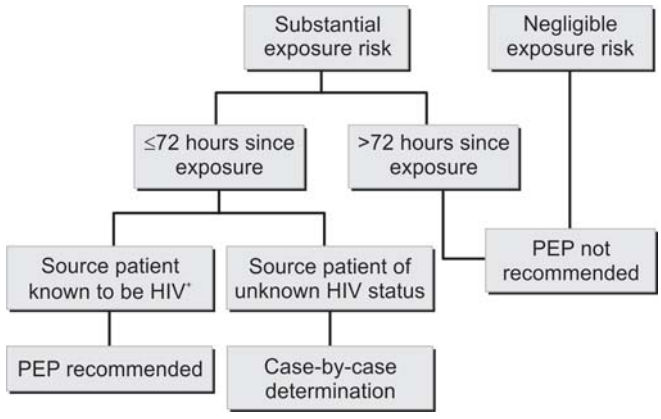
First step in managing exposure is to ensure reporting. It should be accurate and prompt. Usually there is under reporting of exposure to blood by healthcare workers. After reporting of exposure arrangement should be made for follow-up care of exposed. Confidentiality of exposed worker must be protected. Proper pretest and posttest counseling should be offered to healthcare worker.

Treatment of Exposure Site

This should be treated as medical emergency and treatment should begin at the earliest possibly, preferably within 2 hours.[7] Exposure site should be decontaminated as soon as possible. Puncture and other cutaneous injuries should be washed with soap and water. Do not try to squeeze the blood out because it can push the blood and inoculum towards systemic circulation. Mucosal exposures involving mouth and nose should be flushed with water. Following an ocular exposure, eyes should be irrigated with clean water, saline or sterile irrigants designed for this purpose.

Evaluation and Follow-up

Healthcare workers with occupational exposures to HIV should receive an immediate risk assessment and counseling related to risk of infection, the potential benefits and toxicity of PEP and prevention of further transmission of HIV. Postexposure testing and medical evaluation are also required—even when PEP is not received. Postexposure testing for HIV antibody is recommended at baseline, 6, 12 weeks and 6 months postexposure. Follow-up includes reporting any sudden or severe flu-like symptoms, any adverse events associated with PEP, if this is administered as well as signs and symptoms of possible retroviral illness (e.g. fever, enlargement or tenderness of lymph nodes, rash). If the source status is unknown, decisions should be based on the exposure risk and the chance that the source may be HIV positive. If the source consents to HIV testing, PEP can be given as soon as possible after exposure and discontinued, if the result is negative[11] (Flow chart 1).



Flow chart 1: Algorithm for evaluation and treatment for PEP[11]

Selecting a Chemoprophylaxis Regimen

A number of antiretroviral agents have been used for post-exposure prophylaxis. CDC guidelines recommend a 'basic' two drug regimes, the preferred regimen are as follows:

1. Zidovudine and lamivudine
2. Tenofovir and lamivudine.

Other alternative 'basic' two drug regimens recommended are as follows:

1. Stavudine and lamivudine
2. Didanosine and lamivudine.

For exposure ascertained with an increased risk for exposure, i.e. from large bore hollow needle exposure, deep puncture wounds, exposure to needle that had been in artery or vein and exposure to blood from source patients who have symptomatic HIV infection, AIDS, the primary HIV infection or known high viral loads CDC recommends a three drug 'expanded' regimen.[12]

The recommended three drug 'expanded' regimen consists of a two drug 'basic' regimen plus one of the following agents:

1. Lopinavir and ritonavir (preferred)
2. Indinavir and/or ritonavir (avoid in late pregnancy)
3. Atazanavir and/or ritonavir (must be boosted, if tenofovir used in basic regimen)
4. Saquinavir and ritonavir
5. Nelfinavir
6. Efavirenz (teratogenic; avoid in pregnancy).

A variety of other regimens have been used, particularly in settings in which the source patient for an exposure has extensive antiretroviral experience and in instances in which antiretroviral resistance is known or highly suspected.[13] In those cases, prophylaxis should be initiated under expert consultation. There are certain drugs which are not generally recommended for PEP. These are: Nevirapine, abacavir, delavirdine and zalcitabine.[14] Recommended HIV PEP for percutaneous injuries and for mucous membrane exposure and nonintact skin exposure (CDC)[12] are shown in Tables 1 and 2.

Table 1: Recommended HIV postexposure prophylaxis (PEP) for percutaneous injuries

	Infection status of source				
Exposure type	*HIV-positive, class 1**	*HIV-positive, class 2**	*Source of unknown HIV status*[†]	*Unknown source*[§]	*HIV-negative*
Less severe[¶]	Recommend basic 2-drug PEP	Recommend generally, no PEP expanded >3-drug	Generally, no PEP warranted; however, consider basic 2-drug PEP** for source with HIV-risk factors[††]	Generally, no PEP warranted; however, consider basic 2-drug PEP** in which exposure to HIV-infected person is likely	No PEP warranted
More severe[§§]	Recommend expanded 3-drug PEP	Recommend expanded >3-drug PEP	Generally, no PEP warranted: however, consider basic 2-drug PEP** for source with HIV-risk factors[††]	Generally, no PEP warranted; however, consider basic 2-drug PEP** in setting in which exposure to HIV-infected persons is likely	No PEP warranted

*HIV-positive, class 1—asymptomatic HIV infection or known low viral load (e.g. <1,500 ribonucleic acid copies/ml), HIV-positive, class 2—symptomatic HIV infection, acquired immunodeficiency syndrome, acute seroconversion, or known high viral load. If drug resistance is a concern, obtain expert consultation. Initiation of PEP should not be delayed pending expert consultation and, because expert consultation alone cannot substitute for face-to-face counseling, resources should be available to provide immediate evaluation and follow-up care for all exposures.

[†]For example, deceased source person with no samples available for HIV testing

[§]For example, a needle from a sharps disposal container

[¶]For example, solid needle or superficial injury

**The recommendation 'consider PEP' indicates that PEP is optional; a decision to initiate PEP should be based on a discussion between the exposed person and the treating clinician regarding the risks *vs* benefits of PEP.

[††]If PEP is offered and administered and the source is later determined to be HIV-negative, PEP should be discontinued

[§§]For example, large-bore hollow needle, deep puncture, visible blood and device or needle used in patient's artery or vein.

Table 2: Recommended HIV postexposure prophylaxis (PEP) for mucous membrane exposures and nonintact skin* exposures

	Infection status of source				
Exposure type	*HIV-positive, class 1*[†]	*HIV-positive, class 2*[†]	*Source of unknown HIV status*[§]	*Unknown source*[¶]	*HIV-negative*
Small volume**	Consider basic 2-drug PEP	Recommend basic 2-drug PEP	Generally, no PEP warranted	Generally, no PEP	No PEP warranted
Large volume[¶¶]	Recommend basic 2-drug PEP	Recommend expanded >3-drug PEP	Generally, no PEP warranted; however, consider basic 2-drug PEP[††] for source with risk factors[§§]	Generally, no PEP warranted; however, consider basic 2-drug PEP[††] in setting in which exposure to HIV-infected persons is likely	No PEP warranted

*For skin exposures, follow-up is indicated only, if evidence exists of compromised skin integrity (e.g. dermatitis, abrasion or open wound)

[†]HIV-positive, class 1—asymptomatic HIV infection or known low viral load (e.g. <1,500 ribonucleic acid copies/ml), HIV-positive, class 2—symptomatic HIV infection, AIDS, acute seroconversion, or known high viral load. If drug resistance is a concern, obtain expert consultation. Initiation of PEP should not be delayed pending expert consultation, and because expert consultation alone cannot substitute for face-to face counseling, resources should be available to provide immediate evaluation and follow-up care for all exposures

[§]For example, deceased source person with no samples available for HIV testing

[¶]For example, splash from inappropriately disposed blood

**For example, a few drops

[††]The recommendation 'consider PEP' indicates that PEP is optional; a decision to initiate PEP should be based on a discussion between the exposed person and the treating clinician regarding the risks *vs* benefits of PEP

[§§]If PEP is offered and administered and the source is later determined to be HIV-negative, PEP should be discontinued

[¶¶]For example, a major blood splash

Duration of Postexposure Prophylaxis Regimen

The optimal course of treatment is unknown. Since it has been observed in clinical and animal studies that 4 weeks of post-exposure treatment appears to provide protection against HIV infection, treatment should probably be taken for 4 weeks.[7]

Follow-up

Serological tests for HIV for exposed person should be done at base line (6 weeks, 3 and 6 months) with proper pretest and posttest counseling. Although viral load or polymerase chain reaction testing is not recommended routinely but they may be considered in special situations (i.e. diagnosis of acute retroviral illness). Person receiving prophylaxis should follow-up with the clinician at least once in a week and more frequently, if side effects are encountered. He should be advised to refrain from donating blood, semen or organs/tissues and abstain from sexual intercourse. In case, sexual intercourse is undertaken by exposed person, a latex condom should be used consistently. In addition, women healthcare personnel should not breastfeed their infants during the follow-up period.

Side Effects/Toxicity

Generally, it is presumed since PEP is a short-term (4 weeks) course of ARVs, side effects might be less of a problem than long-term therapy of HIV infection. Unfortunately this assumption is incorrect. As many as three-fourths of health worker who take postexposure prophylaxis, experience substantive treatment associated side effects. In almost all reported studies, at least 50% of individual taking PEP experience side effects.[14] Antiretroviral drugs have a potential to produce substantial toxicity.

Common side effects of nucleoside/nucleotide analogs used for postexposure prophylaxis, include bone marrow suppression, nausea, vomiting, diarrhea, abdominal pain, headache, myalgias, lassitude, malaise and insomnia.

Addition of protease inhibitors to the postexposure prophylaxis regimen is associated with increased in side effects noted for the nucleoside analogs, e.g. nausea, vomiting, diarrhea, headache, abdominal pain) as well as anorexia, hyperlipidemia, hyperglycemia and worsening of preexisting diabetes.

As many of common side effects associated with PEP can be anticipated, the clinician who provides postexposure prophylaxis can counsel person taking prophylaxis about these side effects and can manage these toxicities accordingly to ensure completion of desired treatment course.

Tolerability of HIV PEP in Healthcare Workers[14] (Fig. 1)

Preexposure Prophylaxis (PrEP)

Studies to evaluate the safety and/or efficacy of preexposure prophylaxis in various risk population in sub-Saharan, Southeast Asia and United States are currently being planned or are going on. Trials are going on for use of tenofovir and other drugs in

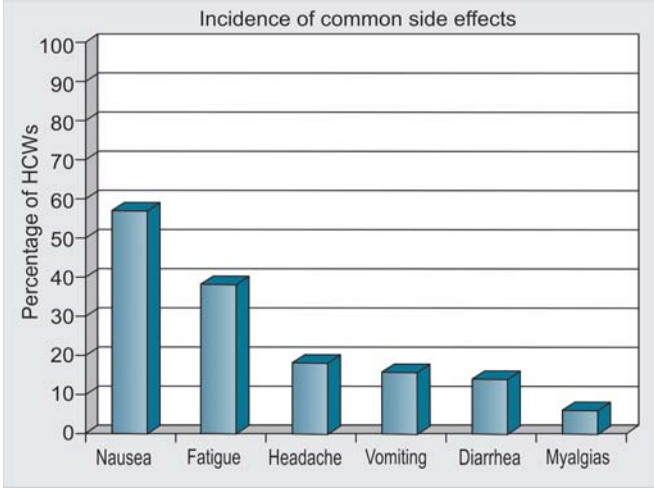


Fig. 1: Tolerability of HIV PEP in healthcare workers
(*Source*: Wang SA. Infect Control Hosp Epidemiol 2000; 231:780-85)

Preexposure prophylaxis regimes and results are encouraging. PrEP is also evaluated for its application in healthcare settings.

Whether or not HIV PrEP will come to play a significant role in HIV prevention, it will largely depend on the outcome of current and future studies evaluating the safety and effectiveness of PrEP as a HIV prevention strategy. It will also rest on how acceptable such strategy if effective, is to program planners, care providers and the public. As with all interventions, a careful risk benefit analysis would be required to determine in which context such an approach is warranted.[15]

CONCLUSION

The risk of occupationally related HIV infection from patient to dentist or vice versa is exceptionally low. The introduction of universal precautions by the dental profession has done much to reduce the risks of such occupational infections. The implications of new antiviral treatments and diagnostic techniques continue to unfold. It is important to keep abreast of these changes since they may impact on dental practice. However, despite this a situation may arise where a considerable degree of doubt exists about the most appropriate action to take, especially in the setting of general dental practice where expert advice may be particularly difficult to obtain. Written protocols should therefore be readily accessible within the practice to deal with such an eventuality. Finally, few other situations exist where the maxim that 'prevention is better than cure' applies more pertinently than that of needle stick injuries. Regular staff training will do much to reduce the physical and psychological consequences of such an incident.

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