PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Postexposure Prophylaxis in Children and Adolescents for Nonoccupational Exposure to Human Immunodeficiency Virus

Peter L. Havens and Committee on Pediatric AIDS

Pediatrics 2003;111;1475

AMERICAN ACADEMY OF PEDIATRICS

CLINICAL REPORT

Guidance for the Clinician in Rendering Pediatric Care

Peter L. Havens, MD, and the Committee on Pediatric AIDS

Postexposure Prophylaxis in Children and Adolescents for Nonoccupational Exposure to Human Immunodeficiency Virus

ABSTRACT. Exposure to human immunodeficiency virus (HIV) can occur in a number of situations unique to, or more common among, children and adolescents. Guidelines for postexposure prophylaxis (PEP) for occupational and nonoccupational (eg, sexual, needle-sharing) exposures to HIV have been published by the US Public Health Service, but they do not directly address nonoccupational HIV exposures unique to children (such as accidental exposure to human milk from a woman infected with HIV or a puncture wound from a discarded needle on a playground), and they do not provide antiretroviral drug information relevant to PEP in children.

This clinical report reviews issues of potential exposure of children and adolescents to HIV and gives recommendations for PEP in those situations. The risk of HIV transmission from nonoccupational, nonperinatal exposure is generally low. Transmission risk is modified by factors related to the source and extent of exposure. Determination of the HIV infection status of the exposure source may not be possible, and data on transmission risk by exposure type may not exist. Except in the setting of perinatal transmission, no studies have demonstrated the safety and efficacy of postexposure use of antiretroviral drugs for the prevention of HIV transmission in nonoccupational settings. Antiretroviral therapy used for PEP is associated with significant toxicity. The decision to initiate prophylaxis needs to be made in consultation with the patient, the family, and a clinician with experience in treatment of persons with HIV infection. If instituted, therapy should be started as soon as possible after an exposure—no later than 72 hours—and continued for 28 days. Many clinicians would use 3 drugs for PEP regimens, although 2 drugs may be considered in certain circumstances. Instruction for avoiding secondary transmission should be given. Careful follow-up is needed for psychologic support, encouragement of medication adherence, toxicity monitoring, and serial HIV antibody testing.

ABBREVIATIONS. HIV, human immunodeficiency virus; USPHS, US Public Health Service; PEP, postexposure prophylaxis; CDC, Centers for Disease Control and Prevention; CI, confidence interval; AIDS, acquired immunodeficiency syndrome; PI, protease inhibitor; NRTI, nucleoside analog reverse transcriptase inhibitor; PCR, polymerase chain reaction; ZDV, zidovudine.

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

INTRODUCTION

Exposure to human immunodeficiency virus (HIV) can occur in a number of situations unique to or more common among children and adolescents. Guidelines for prophylaxis after exposure to HIV in occupational and nonoccupational (eg, sexual, needle-sharing) settings have been published by the US Public Health Service (USPHS),[1–3] but they do not directly address nonoccupational HIV exposures unique to children (such as accidental exposure to human milk from a woman infected with HIV or a puncture wound from a discarded needle on a playground), and they do not provide antiretroviral drug information relevant to postexposure prophylaxis (PEP) in children.

This clinical report provides a review of the literature focused on issues of HIV exposure uniquely related to children and adolescents and gives recommendations for PEP in the following situations: injury from discarded needles, bite wounds, sexual exposure, and inadvertent exposure to human milk from an HIV-infected woman. In each setting, the risk of HIV transmission is directly related to the probability that the exposure source has HIV infection and that transmission of a sufficient amount of infectious virus occurred in a manner that could result in infection in the recipient. Because no studies have directly measured the effectiveness of PEP in decreasing the risk of HIV transmission in nonoccupational settings or after mucosal exposure, the potential benefit of PEP in modifying transmission risk is extrapolated from data regarding HIV pathogenesis in animals, from information about PEP for needlestick injuries in occupational settings, and from studies of vertical transmission of HIV.

Type of Source Material

Not all body fluids from persons with HIV infection are equally infectious (Table 1). Blood and fluids contaminated with blood from persons with HIV infection should be assumed to contain HIV and are associated with the highest risk of HIV transmission. Semen or vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, human milk, and unfixed tissue from persons with HIV infection also may contain HIV and should be considered infectious.

TABLE 1. Materials That May Contain HIV From Persons With HIV Infection[1]

Usually Infectious Materials*	Usually Infectious Materials†	Usually Noninfectious Materials
Concentrated HIV in a laboratory specimen	Semen	Saliva
Blood[1]	Vaginal secretions	Urine
Fluid contaminated with blood	Cerebrospinal fluid	Feces
	Synovial fluid	Tears
	Pleural fluid	Sweat
	Peritoneal fluid	Vomitus
	Pericardial fluid	Nasal secretions
	Amniotic fluid	Sputum
	Human milk	
	Unfixed body tissue	

* Most likely to be associated with a risk of HIV transmission.
† May contain HIV, but less likely to be associated with risk of HIV transmission.

However, exposure to these "other potentially infectious materials"[1] is associated with a lower risk of HIV transmission. Blood-free saliva, urine, feces (including diarrhea), and vomitus are highly unlikely to transmit HIV.

Volume of Source Material

Exposure to a large volume of infectious material carries a greater risk of HIV transmission than does exposure to a smaller volume. For example, in studies of health care professionals with percutaneous exposure to blood from persons with HIV infection (Table 2),[4] injuries with large-gauge, hollow-bore needles were 14 times as likely to result in HIV transmission as were injuries with smaller-gauge, hollow needles; solid suture needles; or solid objects (such as a scalpel; Table 2).[4] Risk is also greater after exposure to a needle on which blood is visible, compared with that after exposure to a needle on which blood is not visible.[4]

Concentration of Virus in Source Material

In addition to the volume of source material, the concentration of virus in the source material is an important factor in determining the risk of transmission after an exposure. The concentration of virus in blood is highest during early (primary) HIV infection, before the infected person has fully developed an immune response, and late in infection, when immunity wanes. Some persons with HIV infection have persistently high viral load. Percutaneous exposure to blood from a person with late-stage HIV infection increases transmission risk by more than fivefold (Table 2).[4] For persons 15 to 24 years of age, for each act of heterosexual intercourse, risk of HIV transmission varies from 0.01% at viral loads less than 1700 copies/mL to 0.3% at viral loads more than 38 500 copies/mL.[5] Risk of perinatal transmission is higher for mothers with late-stage HIV disease. Prenatal maternal HIV viral load is a critical factor in determining the risk of perinatal HIV transmission.[6,7] Treatment with antiretroviral drugs can decrease the concentration of virus in blood and body fluids, even in persons with primary or late-stage infection. Therefore, antiretroviral treatment of the HIV infected individual may be associated with decreased risk of sexual and perinatal HIV transmission. However, although antiretroviral therapy for an HIV-infected source patient may decrease viral load, transmission has occurred after exposure to blood or infectious body fluids from HIV-infected persons with plasma viral loads below the level of detection, perhaps from cell-associated virus. Although there is a correlation between plasma and genital viral load, HIV may be present in genital secretions even when undetectable in plasma.[8]

TABLE 2. Percutaneous Exposure to Blood Infected With HIV: Risk Factors for HIV Transmission[4]

Risk Factor	Adjusted Odds Ratio*	95% CI
Deep injury	15	6.0–41
Visible blood on device	6.2	2.2–21
Procedure involving needle in artery or vein	4.3	1.7–12
Terminal illness in source patient	5.6	2.0–16
Postexposure use of ZDV	0.19	0.06–0.52

* Based on logistic regression analysis of 33 case patients and 665 controls reported by national surveillance systems in France, Italy, the United Kingdom, and the United States.

Viability of Virus in Source Material

The viability of virus in the source material also is an important consideration when evaluating the significance of a potential exposure to HIV, especially in the setting of a puncture wound from a needle found in the community setting.[9] In most reports of HIV transmission by percutaneous injury, needlestick injury occurred shortly after needle withdrawal from the vein or artery of the source patient with HIV infection. HIV RNA was detected in only 3 (3.8%) of 80 discarded disposable syringes that had been used by health care professionals for intramuscular or subcutaneous injection of patients with HIV infection,[10] indicating that most syringes will not contain HIV even after being used to draw blood from a person with HIV infection. HIV is susceptible to drying, and when HIV is placed on a surface exposed to air, the 50% tissue culture infective dose decreases by ~6 logs in 72 hours (1 log every 9 hours).[11] The concentration of viable virus on a discarded needle will be related to the initial virus concentration and the time that contaminated material has been drying.[12] Such drying may not occur uniformly; if there are cells, tissue, or a blood clot inside the needle, drying and virus inactivation may be slower than for a thin uniform layer of fluid on the outside of a

needle, and in the laboratory setting, HIV has been shown to survive for up to 28 days in syringes containing as little as 20 μL of blood.[13] HIV survival may be less likely outside the laboratory, and HIV proviral DNA could not be found in 28 syringes discarded in public places and 10 syringes from a needle exchange program for injection drug users.[14] Two small studies have found no evidence of HIV transmission after injuries from needles of discarded syringes.[15,16] There have been no confirmed reports of HIV acquisition from percutaneous injury by a needle found in the community (M.G. Fowler, Epidemiology Branch, Division of HIV/AIDS, Centers for Disease Control and Prevention [CDC], personal communication, June 15, 2002).

Type of Contact

The type of contact between the infectious fluid and a susceptible person is an important determinant of the risk of HIV transmission (Table 3). Blood transfusion from an HIV-infected donor carries a 95% risk of HIV transmission.[17] The risk of perinatal HIV transmission is between 13% and 45% in the absence of prophylaxis with antiretroviral medications.[18,19]

The risk of HIV transmission from breastfeeding is associated with maternal stage of infection and duration of breastfeeding. For women who acquire HIV infection after giving birth, the transmission risk from breastfeeding is estimated to be 29% (95% confidence interval [CI], 16%–42%).[20] For women with chronic HIV infection, transmission risk from breastfeeding is estimated to be 10% to 16%.[20–23] The cumulative risk of transmission if breastfeeding for 5, 11, 17, and 23 months was 3.5%, 7.0%, 8.9%, and 10.3%.[21] Using these estimates of cumulative risk and assuming that a mother breastfeeds 6 to 10 times per day, the per-episode risk of HIV transmission from a single exposure to human milk is estimated at ~0.001% to 0.004% (Table 3). There are no reports of HIV transmission from a single episode of exposure to HIV-infected human milk in an individual handling human milk in a nursery or in an infant with a single enteral exposure to milk from a woman with HIV infection.[24]

Sharp percutaneous exposure (needlestick, scalpel) to blood infected with HIV is associated with a much lower risk of transmission than that for perinatal or blood transfusion exposure. Prospective evaluation of 6202 health care professionals after percutaneous exposure to HIV-infected blood identified seroconversion in 20 persons, with an overall risk estimate of 0.32% (95% CI, 0.20%–0.50%).[4,25,26] Needle sharing in the context of injection drug use is estimated to have a transmission probability of 0.67% per injection (Table 3).[27]

The risk of HIV transmission from sexual exposure is highest with unprotected receptive anal intercourse (0.5%–3.2%), intermediate with receptive vaginal intercourse (0.05%–0.15%), and lowest for insertive vaginal intercourse (0.03%–0.09%; Table 3).[28–33] The per-act risk of HIV transmission from oral sex is not known, although HIV rarely has been transmitted from orogenital sexual exposure.[34–39] The risk of sexual transmission of HIV is potentially modified by a variety of factors related to the type of sexual act and to biological variables in each partner (Table 4).[29,40] These factors may be important for younger children in the context of a single episode of sexual abuse and for adolescents who may have repeated sexual encounters that may put them at risk of HIV infection.

Transmission of HIV by human bites has been described,[41–44] although such transmission seems to be extremely rare, even when saliva is contaminated with the biter's blood,[24] on the basis of the following observations:[45]

- Saliva inhibits HIV infectivity.[46]
- HIV is rarely isolated from saliva.[47]
- Concentrations of HIV are low in the saliva of HIV-infected persons, even in the presence of periodontal disease.[48]
- None of the approximately 500 000 cases of acquired immunodeficiency syndrome (AIDS) reported to the CDC by 1997 have been attributed to exposure to saliva.
- Transmission of HIV has not been documented in studies of nonsexual household exposure,[49] although unconfirmed transmission has been reported.[50]

Risk of HIV transmission after mucous membrane exposure is low, probably near 0.1% or less.[51,52] Transmission has occurred after contact between

TABLE 3. Type of Exposure and Risk of HIV Transmission per Exposure Event When the Source is HIV Infected

Type of HIV Exposure	Risk of Transmission per Exposure Event
Blood transfusion[17]	0.95
Perinatal exposure[18,19]	0.13 to 0.45
Needle sharing (injection drug use)[27]	0.0067
Unprotected receptive anal intercourse†[5,29,31–33]	0.005 to 0.032
Needlestick (health care professional)[4,25,26]	0.0032
Unprotected receptive vaginal intercourse†[29,30]	0.0001 to 0.003
Unprotected insertive vaginal intercourse‡[29,30]	0.0003 to 0.0009
Ingestion of human milk[20–23]*	0.00001 to 0.00004

* See text for derivation of per-event risk calculation.
† Receptive anal intercourse and receptive vaginal intercourse refer to the risk of HIV acquisition for the person whose anus or vagina was entered by the penis of the exposure source.
‡ Insertive vaginal intercourse refers to the risk of HIV acquisition for the person whose penis was inserted into the vagina of the exposure source.

TABLE 4. Sexual Exposure to HIV: Factors Affecting Risk of Sexual Transmission of HIV.[40]

Biologic Factor	Effect on Risk of HIV Transmission*	Effect on Risk of HIV Acquisition†
Late stage of HIV infection	↑ ↑ ↑	Not applicable
Primary HIV infection	↑ ↑	Not applicable
Antiretroviral therapy	↓ ↓	↓ ↓
Local infection at exposure site	↑ ↑	↑ ↑
Presence of cervical ectopy	↑ ↑	↑ ↑
Presence of foreskin	↑ ↑	↑ ↑
Condoms	↓ ↓ ↓	↓ ↓ ↓
Intrauterine device contraception	↑	↑ ↑
Menstruation	↑ ↑	↑
Genital tract trauma	↑ ↑	↑ ↑

Arrows represent risk relative to baseline values in Table 3 (the more arrows pointing upward, the higher the risk; the more arrows pointing downward, the lower the risk).
* Risk of transmission: the likelihood that HIV will be passed (transmitted) from donor to recipient.
† Risk of acquisition: the likelihood that recipient, once exposed, will become infected with HIV.

blood and nonintact skin (eczema, abrasions, etc), but infectious blood in contact with intact skin has not been reported to result in HIV transmission and is not considered an exposure with risk of transmission.[1]

RATIONALE FOR PEP TO PREVENT TRANSMISSION

During acute HIV infection, the viral doubling time is approximately 10 hours, and approximately 19 newly infected cells will develop from each HIV-infected cell.[53] Therefore, within 48 hours of infection, there will be more than 1.3×10^6 HIV-infected cells. For HIV injected directly into blood, early administration of potent antiretroviral drugs may be particularly important for successful PEP.[54] For skin and mucosal exposures, dendritic cells of skin, mucosa, and submucosa may be the first sites of virus capture and containment.[55,56] Thus, rapid drug penetration to those tissues may be an important consideration in regimen efficacy. HIV is rapidly incorporated into the DNA of resting lymphocytes, where it exists in a nonduplicating state that will not be affected by antiretroviral treatment. Host genetic and immune factors may affect the susceptibility of the exposed patient to infection.

Animal Models of PEP

Animal models of PEP suggest that antiretroviral therapy initiated after virus inoculation can prevent or ameliorate infection when drugs of adequate potency are administered immediately[57] or within a few hours of exposure[58–60] and continued for a few days[61] to weeks.[62,63] PEP was most effective if begun immediately or within 24 hours[64] to 36 hours[65] and was less[65] or not[66] beneficial if begun after 72 hours. Animals developing HIV infection despite receiving PEP may have evidence of infection delayed for up to 16 weeks after virus inoculation.[65] However, even potent therapy may not be able to prevent transmission if the virus inoculum is high.[63,67,68]

In animal models of PEP, antiretroviral drugs are most efficacious when continued for 28 days, compared with shorter durations.[64] This suggests that "prophylactic" therapy is not always truly preventing transmission but rather may be modifying the course of primary infection,[69,70] allowing the host to eliminate HIV early in infection. The development of a cellular immune response in HIV-exposed but ultimately uninfected animals[71–73] and humans[74–76] lends further support to this concept. If these regimens for prophylaxis are truly acting to abort early mucosal, submucosal, or subcutaneous infection, then antiretroviral regimens chosen for prophylaxis should be similar to those that have been shown to be effective for treatment of established HIV infection.

Prevention of Perinatal HIV Transmission as a Model of PEP

Single-drug preexposure plus postexposure antiretroviral therapy can decrease perinatal HIV transmission. In a randomized, placebo-controlled trial in 477 nonbreastfeeding women in the United States and Europe, zidovudine (ZDV [formerly called azidothymidine or AZT]) was administered to women during pregnancy and labor and to their infants for 6 weeks after birth. The rate of perinatal transmission of HIV was decreased by 67%, from 25.5% in the placebo group to 8.3% in the treatment group.[77] In a placebo-controlled trial in 626 breastfeeding women in Uganda, a single dose of nevirapine given to pregnant women at labor onset followed by a single dose to the infant after birth was compared with a very short course of ZDV. At 14 to 16 weeks of age, HIV infection was present in 25.1% of the nevirapine group, compared with 13.1% of the ZDV group, a 47% decrease in the rate of perinatal HIV transmission.[78]

Prenatal use of combinations of antiretroviral agents may further decrease perinatal HIV transmission, compared with use of single-agent therapy. In a randomized, placebo-controlled trial in 1797 pregnant women with HIV infection in southern Africa, the rate of perinatal HIV transmission was decreased by 63%, from 15.3% in placebo-treated patients to 5.7% in women treated with the combination of ZDV plus lamivudine during pregnancy and labor and continued through 7 days after birth in women and their infants.[79] In an observational cohort study of 1542 pregnant women with HIV infection in the United States who delivered infants from 1990 to 2000, the rate of perinatal HIV transmission was 20.0% for women who received no antiretroviral therapy during pregnancy, 10.4% for those who received ZDV alone, 3.8% for women treated with 2-drug combination therapy, and 1.2% for women who received combination therapy that included protease inhibitors (PIs [highly active antiretroviral therapy]) during pregnancy.[80]

Treating infants of HIV-infected women with ZDV exclusively, starting within 12 to 24 hours after birth and continued for 6 weeks, was associated with a decrease in the rate of perinatal HIV transmission in an observational study in New York.[81,82] However, observational data from North Carolina did not confirm the effectiveness of only postexposure treatment

in preventing perinatal HIV transmission.[83,84] This suggests that combined pre- and postexposure therapy may more effectively prevent perinatal HIV transmission, at least when a single agent is used.

PEP: Potential for Failure

Although postexposure ZDV treatment of HIV-exposed health care professionals was associated with an 81% lower risk of HIV transmission in an analysis of observational data (Table 2),[4] failures have occurred.[85] Such failures may result from large inoculum size,[86] late institution of therapy or failure to take prescribed therapy,[87] transmission of ZDV-resistant virus,[88,89] or other as yet unidentified factors.[2]

Although the feasibility of prophylaxis after nonoccupational exposure to HIV has been demonstrated,[90] there are no data measuring the efficacy or effectiveness of PEP in the nonoccupational setting, although this therapy is being offered in various communities.[91] Failures of such prophylaxis have been reported,[92] as have apparent successes.[54] The theoretic concern that offering PEP to sexually active persons would increase risk-taking behavior has not been identified in practice.[93] However, the cost of prophylaxis after nonoccupational exposures is high,[94] and adverse effects are relatively common[95] and can rarely be fatal.[2,96]

General Considerations Regarding Recommendations for Prophylaxis

In evaluating the need for PEP, the following factors should be considered: the duration of time that has passed since the potential exposure, the likelihood of HIV infection in the exposure source, the risk of transmission given the source material and type of exposure, the effectiveness of therapy at modifying that risk, the toxicity of the therapy, and the burden of adherence to antiretroviral therapy.

Because PEP is only recommended for exposures to material from persons with HIV infection, efforts should be made to learn the infection status of the exposure source. If the HIV infection status of the exposure source is unknown, HIV testing should be requested of the person who is the source of the exposure, with consent as required by local laws or regulations. Although awaiting results of testing of the exposure source, PEP may be started for the potentially exposed person and stopped if the exposure source is found not to be infected with HIV.

According to USPHS recommendations for PEP in the nonoccupational setting,[3] PEP should not be used for persons with HIV exposures that have a low risk of HIV transmission (eg, potentially infected body fluid on intact skin) or for persons who seek care too late for the anticipated interruption of transmission (more than 72 hours after reported exposure). Clinicians considering use of PEP after a nonoccupational HIV exposure should recognize that benefits likely would be restricted to situations in which the risk of transmission is high, the intervention can be initiated promptly, and adherence to the regimen is likely. If PEP is used, physicians experienced in the management of children and adolescents with HIV infection should be consulted.[97] Because PEP needs to be started within 72 hours of exposure, often the most feasible approach is to start PEP with a 3-day supply of medications and refer the patient to be evaluated by a consultant within 72 hours.

Recommendations for PEP in children and adolescents vary and include: 1) no PEP; 2) consider PEP; and 3) recommend PEP. Because of the absence of data documenting safety and efficacy of PEP, clinicians may make different, reasonable decisions in similar clinical circumstances. In individual cases of potential exposure, the perceived risks of HIV acquisition may be great enough to justify the burden and potential toxicity of PEP. The final decision to undertake PEP in a specific patient depends on the clinician's recommendation and the exposed person's and/or parent's evaluation of the risk of transmission versus the toxicity of therapy.

If an exposure is serious enough to warrant PEP, 2-drug or 3-drug therapy can be chosen, balancing the theoretically improved efficacy of 3 drugs with the potentially lower toxicity of 2-drug regimens. The USPHS identifies the strength of their recommendations for PEP in the occupational setting by the number of drugs in the regimen.[1,97] The recommendations in this clinical report separate the decision to start PEP from the decision about the number of drugs to include in the regimen. CDC guidelines suggest that determining which agents and how many agents to use is largely empiric.[1] Complete recommendations from the CDC[97] are available online (www.hivpepregistry.org/pdf/pedipep.pdf). American Academy of Pediatrics recommendations follow.

Prophylaxis with ZDV alone or in combination with other drugs was associated with at least 1 adverse effect in 49% of 674 health care professionals treated after occupational exposure to HIV, and 20% stopped prophylaxis prematurely because of adverse effects.[98] Adverse effects can be severe, including potentially fatal lactic acidosis and hepatitis from mitochondrial toxicity of nucleoside analog reverse transcriptase inhibitors (NRTIs)[99] and fatal hypersensitivity reactions from nevirapine.[96] Concern about adverse effects may contribute to low initiation rates for PEP,[100] and difficulty in adhering to complex drug regimens may lead to premature cessation of PEP.[101]

HIV antibody testing of the exposed person is recommended at baseline and at 6 weeks, 12 weeks, and 6 months after exposure. Such diagnostic testing will identify most persons who develop HIV infection after an exposure, although a small fraction of infected persons may not develop detectable antibody until more than 6 months after exposure.[102,103] Delay in HIV seroconversion may be more common if hepatitis C virus transmission occurs at the same time as HIV transmission.

Recommendation for Prophylaxis After Nonoccupational Exposure to HIV in Children and Adolescents

The risk of HIV transmission after an exposure varies by the type and severity of exposure (Tables

1–4) and by the likelihood that the source is infected with HIV (Table 5). Evaluation of both factors allows for estimation of the risk of HIV transmission after a potential exposure (Table 6). For an exposure to a person known to be infected with HIV, the baseline risk of transmission will be modified by the viral load in the exposure fluid.[5] For an exposure to a person of unknown HIV infection status, the baseline risk of HIV transmission will be modified by the probability that the exposure source is infected with HIV (Table 5).

Once the risk of HIV transmission has been estimated, a decision whether to recommend PEP needs to be made. In the absence of specific data on efficacy of PEP outside of the health care setting, this decision is best made by experienced clinicians in collaboration with the exposed person and/or parents after a careful discussion of the risks of transmission and the burden and potential complications of antiretroviral therapy. The risk of transmission and potential benefits of PEP vary for different clinical situations, as outlined in Tables 6 through 8 and Fig 1.

Although PEP may be considered in many circumstances, it is only recommended for high-risk exposures to persons known to be infected with HIV (Table 8). No PEP is given if the exposure occurred more than72 hours previously, if the exposed person refuses PEP, or if the exposed person is unwilling or unable to commit to 28 days of therapy and appropriate follow-up (Table 7).

A careful discussion of the risks and benefits of therapy guides the decision-making regarding PEP and allows appropriate postexposure care (Table 9). If PEP is begun, it should be started as soon as possible after the exposure (within hours, and definitely within 72 hours), and therapy should be continued for 28 days. If consultation with a clinician experienced in the care of children and adolescents with HIV is not immediately possible, a supply of medications sufficient to last until consultation occurs could be dispensed to the patient.

Sexual Exposure

Sexual exposure can result in HIV infection (Tables 3 and 4), and sexual abuse has resulted in HIV transmission to children. Of 9136 children with HIV infection or AIDS reported to the CDC from 1981 through 1997, 26 were sexually abused, with confirmed HIV exposure in 17 and suspected HIV exposure in 9.[104] Of the 17 children with confirmed HIV exposure, 14 had no other risk of HIV infection, and 3 had multiple risk factors. Sexual abuse may be more likely to result in HIV transmission in girls than in women because of thin vaginal epithelium in children and cervical ectopy in adolescents and because children may be repeatedly abused by the same person over a long period.[24] In proven cases of sexual assault by a person known or suspected to have HIV infection, PEP may be considered up to 72 hours after the exposure but is likely to be most effective if given sooner, preferably within a few hours after exposure.[105–107] If the exposure source has genital ulcer disease or another sexually transmitted disease or if the exposure included tissue damage, the risk of HIV transmission is greater (Tables 3 and 4), increasing the potential benefit of PEP relative to the burden of therapy and risks of drug toxicity. Such modifying factors might strengthen the force of the recommendation in a given clinical setting.

For adolescents with a history of a single sexual exposure, PEP can be considered, and if given should be started as soon as possible after the exposure but certainly within 72 hours.[108,109] Such exposure might occur from sexual abuse or by accidental exposure in a consensual relationship (eg, a broken condom). For persons with ongoing consensual sexual exposure to HIV, PEP is not indicated, and behavioral interven-

TABLE 5. Characteristics of the Exposure Source and Risk of Human Immunodeficiency Virus (HIV) Transmission

HIV Infection Status of Exposure Source	Risk of HIV Transmission
Not HIV infected Known not to be infected with HIV*	No risk
HIV status unknown/unknown source HIV infection status unknown, HIV risk status unknown	Unquantified
HIV status unknown: low risk HIV infection status unknown, but known not to have risk factors†	Low
HIV status unknown: high risk HIV infection status unknown but known to have 1 or more risk factors†	Intermediate
HIV infected Known to be infected with HIV‡	High

* HIV infection is documented by presence of specific antibody to HIV in persons older than 18 months and by positive plasma HIV RNA polymerase chain reaction (PCR) assay results, positive cell-associated HIV DNA PCR assay results, or detection of plasma HIV p24 antigen in persons of any age.

† Risk factors for HIV infection include male homosexual activity, injection drug use, blood transfusion or blood product infusion before 1985, or sexual activity with a member of a high-risk group. Some persons who have sex with members of a high-risk group do not identify themselves as at risk, because they are unaware of the risk history of their sexual partner. Their risk of HIV infection is related to the prevalence of HIV infection in their immediate community.

‡ Absence of HIV infection is identified by laboratory documentation of negative HIV antibody or negative HIV DNA PCR assay results from a specimen collected close to the time of the exposure and in the absence of interval high-risk behavior or symptoms compatible with acute retroviral infection syndrome.

TABLE 6. Exposure Type and Exposure Risk Category for HIV

Exposure Type	Exposure Risk Category
Cutaneous exposure	
Fluid on intact skin	No risk identified
Bite without break in skin	
Skin with compromised integrity (eczema, chapped skin, dermatitis, abrasion, laceration, open wound)	Low to intermediate
Traumatic skin wound with bleeding in donor and recipient*	High
Mucous membrane exposure	
Kissing	No risk identified
Oral sex	Low
Human milk: single ingestion	
Splash to eye or mouth	
Receptive vaginal sex without trauma	Intermediate
Receptive anal intercourse	High
Traumatic sex with blood (sexual assault)	
Percutaneous exposure†	
Superficial scratch with sharp object, including a needle found in the community	No risk identified
Puncture wound with solid needle	Low
Puncture wound with hollow needle without visible blood	
Body piercing	
Bite with break in skin	
Puncture wound with hollow needle with visible blood	Intermediate
Puncture wound with large-bore hollow needle with visible blood on needle, or needle recently used in source patient artery or vein	High

* For example, in a fight, a blow to the mouth might break a tooth that bleeds and lacerate the first that also bleeds. If there was mixing of blood, both persons may be at risk.
† See text for considerations used in assigning the appropriate risk category for a percutaneous exposure.

TABLE 7. Suggested Approach to HIV (PEP) on the Basis of Characteristics of the Exposed Patient*

Characteristics of Exposed Patient	Suggested Approach
Exposure >72 h ago; or Exposed person refuses PEP; or Exposed person unwilling or unable to commit to 28 d of therapy and appropriate follow-up.	No PEP
Exposure ≤72 h ago; or Exposed person voluntarily accepts PEP; or Exposed person commits to 28 d of therapy and appropriate follow-up.	Consider PEP in appropriate exposure setting (Tables 6 and 8)

* Animal data suggest PEP started later than 72 hours after exposure is less effective in preventing infection.[64–66]

tions to decrease repeated exposure probably are more appropriate.[110,111]

Percutaneous Exposures

Risk of HIV transmission from a puncture wound from a needle found in the community is significantly lower than the 0.3% HIV transmission risk after needlestick injury in a health care professional from a person with HIV infection. Although it is unlikely that a true estimate of risk can be established, transmission will be related to:

- The probability that the person who used the needle has HIV infection (Table 5);
- The time interval since the needle was in contact with blood of the source;
- The initial concentration of HIV on the needle, presence of blood or tissue that might delay drying (and, therefore, killing of the virus), or the presence of fresh blood or material that might contain viable virus; and
- The severity of the injury (skin contact without skin breakage, abrasion without bleeding, deeper skin penetration) in the exposed individual.

In evaluating a puncture wound, the following factors are considered in assessing potential for HIV transmission (presented as lower risk category followed by higher risk category for each attribute): the depth of the wound (superficial scratch or deep puncture); the presence of blood on the needle (no visible blood or visible blood); the characteristics of the blood on the needle (dried or fresh); the type of needle (solid or hollow bore); and the location the needle was used in the source patient's body (not in artery or vein; or in artery or vein).

The risk of HIV transmission from a discarded needle in public places (often referred to as a "found" needle) seems to be low. Because data are not available on the efficacy of PEP in this circumstance for adults or children, the USPHS is unable to recommend for or against PEP in this circumstance.

TABLE 8. Suggested Approach* to PEP on the Basis of Exposure Risk Category and HIV Infection Status of the Source

Exposure Risk Category†	HIV Infection Status of Source‡	Suggested Approach
No risk identified	Any	No PEP
Any	Not HIV infected	No PEP
Low, intermediate, or high	Unknown	Consider PEP
Low or intermediate risk	HIV infected	Consider PEP
High risk	HIV infected	Recommend PEP

* PEP is not recommended if the exposure occurred >72 hours ago, the exposed person refuses PEP, or if the exposed person is unwilling or unable to commit to 28 days of therapy and appropriate follow-up (Table 7). When considering PEP, the approach is suggested on the basis of type and severity of exposure, fluid involved, and HIV infection status of the exposure source, as outlined in Tables 1 through 6. Characteristics of the exposed patient are also considered, as described here and in the text. Given the absence of compelling data on effectiveness of PEP, clinicians may make different, reasonable decisions in similar clinical circumstances.
† See Table 6.
‡ See Table 5.

Furthermore, PEP is not without risk and often is associated with significant adverse effects. Therefore, PEP is not routinely recommended in this situation. However, if the needle and/or syringe are found to have visible blood and the source is known to be HIV infected, some experts recommend that PEP be considered. Testing the syringe for HIV is not practical or reliable and is not recommended.

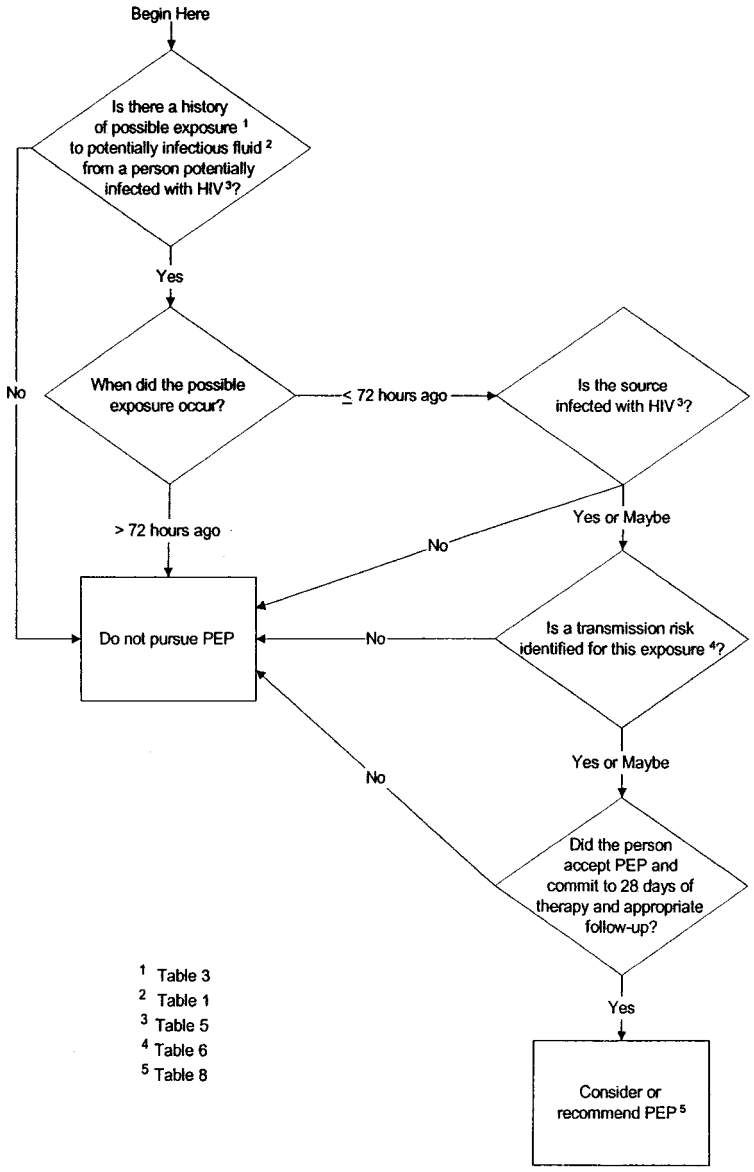

Fig 1. Possible exposure to HIV in children and adolescents: algorithm for decision-making for use of PEP.

TABLE 9. Management of Patients With Possible Exposure to HIV

Exposure Management Issue	Implementation Comment
Treat exposure site	—Wash wounds with soap and water; flush mucous membranes with water. Give tetanus booster if appropriate.
Evaluate exposure source if possible	—Determine the HIV infection status of the exposure source. If unknown, testing with appropriate consent should be offered if possible.
Evaluate exposed person	—Perform HIV serologic testing to identify current HIV infection and hepatitis B and hepatitis C serologic testing as appropriate[122] —Provide or refer for counseling to address stress and anxiety —Discuss prevention of potential secondary HIV transmission —Discuss prevention of repeat exposure, if appropriate —Report incident to legal or administrative authorities as appropriate to the setting of the exposure and the severity of the incident
Consider PEP	—Explain potential benefits and risks —Discuss issues of drug toxicity and medication compliance —Measure complete blood cell count, creatinine, and alanine transaminase concentration as baseline for possible drug toxicity —Begin prophylaxis as soon as possible after exposure, preferably within 1 to 4 h; prophylaxis begun more than 72 h after exposure is unlikely to be effective —Arrange for follow-up with HIV specialist and psychologist, if appropriate —Educate about prevention of secondary transmission (sexually active adolescent should avoid sex, or use condoms, until all follow-up test results are negative) —Report to PEP registry at CDC
Choose therapy	—Consider drug potency and toxicity, regimen complexity and effects on compliance, and possibility of drug resistance in the exposure source —Supply 3–5 d of medication immediately, instructing patients to obtain remainder of medication at follow-up visit
Follow-up	—Perform initial follow-up within 2–3 d to review drug regimen and adherence, evaluate for symptoms of drug toxicity, assess psychosocial status, and arrange appropriate referrals, if needed —Continue therapy for 28 d —Monitor for drug adverse effects at 4 wk with complete blood cell count and alanine transaminase concentration —Evaluate for psychologic stress and medication compliance with weekly office visits or telephone calls —Consider referral for counseling if needed —Repeat HIV serologic testing at 6 wk, 12 wk, and 6 mo after exposure

Bite wounds are another percutaneous body fluid exposure that may occur in children, but the risk of HIV transmission after exposure to saliva is very low. In the absence of blood in saliva and blood in the bite wound, PEP is not indicated. However, if there is blood exchange from a bite, both the person bitten and the person biting should be considered at risk of transmission of HIV and considered for PEP. Use in this setting would be extremely unusual and is potentially indicated only when there is significant exposure to deep, bloody wounds in persons with HIV infection.

Adolescents may be percutaneously exposed to potentially infectious fluids by needle sharing for injection drug use (including anabolic steroids) or for body piercing. The per-contact probabilities of HIV transmission in Table 3 apply in this setting, and for a single percutaneous exposure to blood of a person at risk for or known to have HIV infection, PEP can be considered. For adolescents with ongoing needle sharing and potential exposure to HIV, PEP is not routinely recommended, and behavioral interventions to decrease repeated exposures are more appropriate than is postexposure drug therapy after a single episode.[110,111]

Human Milk Exposures

Because HIV can be transmitted via human milk, even a single exposure to human milk should be considered to confer a potential (albeit very low) risk of HIV transmission (Table 3). Such exposure is possible in a hospital if stored, unpasteurized human milk is given to the wrong infant or if an infant is accidentally breastfed by a woman with HIV infection who is not the child's mother. Exposure also could occur if a mother developed HIV infection while breastfeeding or if a breastfeeding mother with established HIV infection was not tested for HIV in the prenatal period. However, in most areas of the United States, the prevalence of HIV infection in pregnant women is less than 2 per 1000.[112] Most breastfeeding women will have been tested for HIV during pregnancy,[113,114] and women known to be HIV infected will have been counseled not to breastfeed.[115] Therefore, the actual likelihood that exposure to HIV would occur by this route is extremely low.

For women with known HIV infection, the best approach to preventing transmission is to avoid breastfeeding. For a woman who continues to breastfeed, potent antiretroviral therapy for herself may decrease viral load and decrease risk of transmission, but prolonged therapy for the mother or the infant so exposed is of unknown benefit. For an infant with a single exposure to human milk from a woman with HIV infection, the magnitude of risk is estimated to be approximately 100 times lower than that for other mucous membrane exposures (Table 3), and PEP is likely not warranted (Tables 6–8).

TABLE 10. Dosage and Administration of Selected Antiretroviral Drugs That Might Be Used for Prophylaxis After Exposure to HIV in Children or Adolescents[121]

Drug Generic Name (Abbreviation), Trade Name	Recommended Dosage*	How Supplied
NRTIs		
ZDV, Retrovir	Preterm infants (investigational)	Syrup: 10 mg/mL
	0–2 wk of age: 1.5 mg/kg/dose, twice daily, orally (1.0 mg/kg/dose, every 12 h, IV)	Capsules: 100 mg
	>2 wk of age: 2.0 mg/kg/dose, 3 times/day, orally (1.5 mg/kg/dose, every 8 h, IV)	Tablets: 300 mg
	Term infants	Combination (Combivir): ZDV, 300 mg, plus lamivudine, 150 mg, in a single tablet
	0–6 wk of age: 4 mg/kg/dose, twice daily, orally (3.0 mg/kg/dose, every 12 h, IV)	Injection: 10 mg/mL in 20-mL vials
	4 wk–12 y of age: 160 mg/m^2/dose, 3 times/day, orally, or 180–240 mg/m^2/dose, twice daily, orally (maximum 200 mg/dose, 3 times/day or 300 mg/dose, twice daily)	
	≥13 years of age: 200 mg/dose, 3 times/day, orally or 300 mg/dose, twice daily, orally	
ddI, Videx	<3 mo of age: 50 mg/m^2/dose, twice daily, orally (investigational)	Chewable tablets*: 25 mg, 50 mg, 100 mg, 150 mg (2 tablets/dose)
	3 mo–12 y of age: 90–135 mg/m^2/dose, twice daily, orally or 240 mg/m^2/dose once daily, orally (investigational)	Buffered powder packets: mix with water: 100 mg, 167 mg, 250 mg
	≥13 y of age:	
	<60 kg in body weight: Tablets, 125 mg, twice daily, orally Powder, 167 mg, twice daily, orally	Coated tablets (Videx EC): 125 mg, 200 mg, 250 mg, 400 mg
	≥60 kg in body weight: Tablets, 200 mg, twice daily, orally, or 400 mg, once daily, orally Powder, 250 mg, twice daily, orally, or 500 mg, once daily, orally	Pediatric powder for oral solution mixed to final concentration of 20 mg/mL or 10 mg/mL
d4T, Zerit	<30 kg in body weight: 1 mg/kg/dose, twice daily, orally	Solution: 1 mg/mL
	30–60 kg: 30 mg, twice daily, orally	Capsules: 15, 20, 30, 40 mg. Mix with applesauce.
	>60 kg: 40 mg, twice daily, orally	
3TC, Epivir	<1 mo of age: 2 mg/kg/dose, twice daily, orally	Oral solution: 10 mg/mL
	<37.5 kg in body weight: 4 mg/kg/dose, twice daily, orally	Tablets: 150 mg
	≥37.5 kg in body weight: 150 mg/dose, twice daily, orally	Combination (Combivir): ZDV, 300 mg, plus 3TC, 150 mg, in a single tablet.
PIs		
RTV, Norvir	3 mo–12 y of age: 400–450 mg/m^2/dose, twice daily, orally	Oral solution: 80 mg/mL
	≥13 y of age: 600 mg/dose, twice daily, orally	Gelcaps: 100 mg
IDV, Crixivan	3–12 y of age: 450 to 500 mg/m^2/dose, 3 times/day, orally	Capsules: 200 and 400 mg. Must be stored in original bottle.
	≥13 y of age: 800 mg, 3 times/day, orally	
NFV, Viracept	1 mo–12 y of age: 30–50 mg/kg/dose, 3 times/day, orally, or 55 mg/kg/dose, twice daily, orally (maximum 2000 mg/dose)	Powder for oral suspension: 50 mg/"level scoop"
	≥13 y of age: 750 to 1250 mg/dose, 3 times/day, orally, or 1250 mg/dose, twice daily, orally	Tablet: 250 mg
LPV/r, Kaletra	Children: LPV, 300 mg/m^2/dose, plus RTV, 75 mg/m^2/dose, twice daily, orally	Oral solution: 400 mg of LPV/100 mg of RTV per 5 mL (80 mg of LPV/20 mg of RTV per mL). Can store at room temperature for 2 mo.
	Adults: LPV, 400 mg/dose, plus RTV, 100 mg/dose, twice daily, orally, or LPV, 533 mg/dose, plus RTV, 133 mg/dose, twice daily, orally if given with nevirapine	Capsules: 133.3 mg of LPV/33.3 mg of RTV per capsule.

IV indicates intravenous. ddI, didanosine; d4T, stavudine; 3TC, lamivudine; RTV, ritonavir; IDV, indinavir sulfate; NFV, nelfinavir mesylate; LPV/r, lopinavir/ritonavir.

* Although the doses listed for adults are usually the Food and Drug Administration-licensed doses, the doses listed for children may be higher than the Food and Drug Administration-licensed doses. Before prescribing, see package insert for complete prescribing information, including drug toxicities, potential drug interactions, and contraindications for use.

Choice of Antiretroviral Medications for PEP

No clinical studies are available to determine the best antiretroviral regimen for PEP. The most extensive data in terms of potential efficacy and safety are for ZDV monotherapy.[4,81] A clinician with experience in treatment of persons with HIV infection should be consulted before starting PEP.

Many clinicians would use the 3-drug combination of ZDV, lamivudine, and nelfinavir for PEP in children and adolescents (doses in Table 10).[116] If the efficacy of PEP is in aborting early mucosal, submucosal, subcutaneous, or lymphatic HIV infection, then potent suppressive therapies, such as 2 NRTIs plus a PI, should be chosen, because such regimens have been shown to be more likely to suppress HIV replication than have monotherapy or dual therapy.

Taking the multiple medications required for PEP is a daunting task, and problems with drug toxicity (Table 11), patient adherence, and other factors severely limit the proportion of patients who finish PEP once they have started it.[107,117–119] Completing 28 days of a 2-drug regimen is easier than completing

TABLE 11. Major Toxicities of Selected Antiretroviral Drugs for Use as Prophylaxis After Exposure to HIV in Children or Adolescents[121]

Drug Generic Name (Abbreviation), Trade Name	Major Adverse Effects
Zidovudine (ZDV), Retrovir	Anemia, neutropenia, nausea, headache, insomnia, muscle pain, weakness, lactic acidosis, hepatic steatosis
Didanosine (ddI), Videx	Pancreatitis, neuropathy, diarrhea, abdominal pain, nausea, lactic acidosis, hepatic steatosis
Stavudine (d4T), Zerit	Peripheral neuropathy, headache, diarrhea, nausea, insomnia, anorexia, pancreatitis, hepatitis, anemia, neutropenia, lactic acidosis, hepatic steatosis
Lamivudine (3TC), Epivir	Abdominal pain, nausea, diarrhea, rash, pancreatitis, lactic acidosis, hepatic steatosis
Ritonavir (RTV), Norvir	Abdominal pain, nausea, diarrhea, circumoral paresthesias, taste alteration, increased cholesterol and triglyceride concentrations
Indinavir sulfate (IDV), Crixivan	Nephrolithiasis, hyperbilirubinemia, nausea, abdominal pain, increased cholesterol and triglyceride concentrations
Nelfinavir mesylate (NFV), Viracept	Diarrhea, nausea, abdominal pain, weakness, rash, increased cholesterol and triglyceride concentrations
Lopinavir/ritonavir (LPV/r), Kaletra	Abdominal pain, nausea, diarrhea, circumoral paresthesias, taste alteration, increased cholesterol and triglyceride concentrations

a 3-drug regimen and may be associated with fewer medication adverse effects. Although the burden and toxicity of a 3-drug regimen may be warranted for treatment of persons with established HIV infection, the risk-benefit ratio for PEP may favor a 2-drug regimen for some patients. Therefore, some clinicians recommend 2-drug combinations of ZDV and lamivudine for PEP, hoping that the improved ease of use and potential decrease in toxicity will balance out the theoretic decrease in efficacy. It may be reasonable to consider a 2-drug regimen for treatment of some patients. The effectiveness of a drug regimen in practice will be related to the efficacy of the drugs and the probability of completion of the course of therapy.

ZDV and lamivudine are each available as syrups and are available together in a single tablet (Combivir [GlaxoSmithKline, London, United Kingdom]), enhancing ease of use for adolescents (doses in Table 10). If current and/or previous therapy used by the source patient is known and drug resistance is a concern, alternatives to the standard regimen might be considered in consultation with a specialist in HIV care in children and adolescents. Stavudine or didanosine are reasonable alternative NRTIs for use if resistance to ZDV or lamivudine is suspected. ZDV and stavudine should never be used in combination with one another because of intracellular antagonism. Because of the potential for a severe hypersensitivity reaction, the NRTI abacavir sulfate should be avoided in PEP regimens.

Nelfinavir is available as a powder for children who are unable to take pills, although some children prefer the crushed tablets to the powder. Indinavir is only available in capsule form, is associated with crystalluria and nephrolithiasis, and requires extra hydration and for these reasons is usually avoided for PEP in children and adolescents. Other PIs available in a liquid formulation appropriate for children include ritonavir, lopinavir/ritonavir (Kaletra [Abbott Laboratories, North Chicago, IL]), and amprenavir. However, gastrointestinal intolerance may be a problem with ritonavir and lopinavir/ritonavir. The liquid formulation of amprenavir has high levels of vitamin E, contains propylene glycol in a concentration that exceeds World Health Organization standards for use in infants, and should not be used in children under 4 years; therefore, it is not recommended for routine use in PEP regimens. PIs have multiple potential interactions with other drugs, and the package insert should always be consulted before prescribing any of these medications.

Nevirapine is a non-NRTI that has been shown to decrease mother-to-child transmission in a single-dose intrapartum and infant regimen.[78] The single-dose regimen has been shown to be safe for mothers and infants.[120] However, severe life-threatening cases of hepatotoxicity, including liver failure and death, have been reported in patients receiving nevirapine as part of a PEP regimen or as treatment of HIV infection. Therefore, nevirapine should not be used as part of a PEP regimen in children.[96,121]

All antiretroviral agents have potential adverse effects (Table 11). It is critical to review the drug regimen, assess adherence, and evaluate the child for any symptoms of drug toxicity at all follow-up visits.

Implementation and Follow-up

The HIV infection status of the exposure source should be sought. If the source person is known but HIV status unknown, then HIV testing with appropriate counseling and consent should be requested.

Wounds should be washed completely with soap and water. Mucous membranes should be flushed with water or saline solution. Tetanus booster and other wound care should be provided as needed (Table 9).

A discussion of risks and benefits of PEP with the family of an exposed toddler will differ from the discussion with a potentially exposed adolescent, whose family may be specifically excluded from knowledge of the whole event. Treating adolescents in this setting should follow state and local laws regarding confidentiality of medical care. Because of the need to begin prophylaxis as quickly as possible after an exposure, office or clinic staff should be instructed to act immediately on telephone calls concerning possible HIV exposure, and the clinician should not wait until the end of the clinic day to return a call. Such staff education might be incorpo-

rated into OSHA-mandated bloodborne pathogen training.

Emergency departments should have protocols concerning possible need for postexposure HIV prophylaxis, and a "starter kit" of 3 days of antiretroviral medicines should be available at all times to ensure immediate institution of PEP therapy. Careful follow-up is crucial to ensure that the rest of the medications can be obtained easily and that consultation with a specialist in pediatric and adolescent HIV care occurs, to monitor toxicity, and to provide support for medication adherence and psychologic stress.

Initial follow-up of the exposed child is recommended within 2 to 3 days to review drug regimen, assess adherence, evaluate for any symptoms of toxicity, assess psychosocial status of the child and family, and arrange appropriate referrals if needed. To support patient adherence to medications, visits to the clinician's office or clinic or patient-clinician telephone calls should occur at weekly intervals.

Laboratory testing for drug toxicity should be performed at baseline and 2 weeks (optional) and 4 weeks after starting therapy, and at a minimum should include complete blood cell count and alanine transaminase concentration. Persons treated with indinavir should be monitored for hematuria because of the risk of nephrolithiasis. Careful attention needs to be paid to complaints of abdominal pain, which might prompt evaluation for pancreatitis.

Monitoring for seroconversion to HIV includes testing for HIV by enzyme immunoassay, indicated at baseline and 6 weeks, 12 weeks, and 6 months after exposure. For patients coinfected with hepatitis C virus, HIV enzyme immunoassay should also be performed 12 months after the potential exposure. Testing for hepatitis B and hepatitis C should be performed as appropriate, following standard guidelines.[122]

In a significant exposure, the person at risk of HIV acquisition also becomes a potential source of HIV transmission to others. This needs to be discussed, and methods of preventing possible secondary transmission of HIV should be outlined, including abstinence or use of condoms for sexually active adolescents.

The potential for acquisition of HIV infection can lead to psychologic stress, which may require intensive counseling during the immediate postexposure period and until follow-up testing is negative 6 months after the exposure.

If local experts in the use of antiretroviral agents in children are unavailable for consultation, the University of California-San Francisco has a hot line (1–888-HIV-4911) that is supported by the CDC and the Health Resources and Services Administration and is staffed 24 hours a day to help clinicians through the decision pathways and to provide information on choice of therapy.

In selected instances of possible HIV exposure, legal or administrative issues may be raised, and careful documentation is important. For exposures in the hospital setting, hospital administrative policies should be consulted. For adolescents, support from family or friends might be encouraged, but the adolescent's right to privacy should be respected.

Reporting of Exposures and Therapy

Exposures that are considered for PEP should be reported to the nonoccupational HIV PEP registry, which is run by the John Snow Institute under the auspices of the CDC. The registry can be accessed online (www.hivpepregistry.org), by telephone (1–877-HIV-1PEP), or by fax (1–877-HIV-7PEP).

SUMMARY

The risk of HIV transmission from nonoccupational, nonperinatal exposure is generally low. Transmission risk is modified by factors related to the exposure source and extent. Determination of the HIV infection status of the exposure source may not be possible, and data on transmission risk by exposure type may not exist. Except in the setting of perinatal transmission, no studies have demonstrated the safety and efficacy of postexposure use of antiretroviral drugs for the prevention of HIV transmission in the nonoccupational setting. Antiretroviral therapy used for PEP is associated with significant toxicity. The decision to initiate prophylaxis needs to be made in consultation with the patient, family, and a clinician with experience in treatment of persons with HIV infection. If instituted, therapy should be started as soon as possible after an exposure—no later than 72 hours—and continued for 28 days. Many clinicians would use 3 drugs for prophylaxis regimens, although 2 drugs may be considered in certain circumstances. Instruction for avoiding secondary transmission should be given. Careful follow-up is needed for psychologic support, encouragement of medication adherence, toxicity monitoring, and serial HIV antibody testing.

REFERENCES

1. Centers for Disease Control and Prevention. Public Health Service guidelines for the management of health-care worker exposures to HIV and recommendations for postexposure prophylaxis. *MMWR Recomm Rep.* 1998;47(RR-7):1–33
2. Centers for Disease Control and Prevention. Updated US Public

Health Service guidelines for the management of occupational exposures to HBV, HCV, and HIV and recommendations for postexposure prophylaxis. *MMWR Recomm Rep*. 2001;50(RR-11):1–52
3. Centers for Disease Control and Prevention. Management of possible sexual, injecting-drug-use, or other nonoccupational exposure to HIV, including considerations related to antiretroviral therapy. Public Health Service statement. *MMWR Recomm Rep*. 1998;47(RR-17):1–14
4. Cardo DM, Culver DH, Ciesielski CA, et al. A case-control study of HIV seroconversion in health care workers after percutaneous exposure. CDC Needlestick Surveillance Group. *N Engl J Med*. 1997;337:1485–1490
5. Gray RH, Wawer MJ, Brookmeyer R, et al. Probability of HIV-1 transmission per coital act in monogamous, heterosexual, HIV-1-discordant couples in Rakai, Uganda. *Lancet*. 2001;357:1149–1153
6. Mofenson LM, Lambert JS, Stiehm ER, et al. Risk factors for perinatal transmission of human immunodeficiency virus type 1 in women treated with zidovudine. Pediatric AIDS Clinical Trials Group Study 185 Team. *N Engl J Med*. 1999;341:385–393
7. Garcia PM, Kalish LA, Pitt J, et al. Maternal levels of plasma human immunodeficiency virus type 1 RNA and the risk of perinatal transmission. Women and Infants Transmission Study Group. *N Engl J Med*. 1999;341:394–402
8. Hart CE, Lennox JL, Pratt-Palmore M, et al. Correlation of human immunodeficiency virus type 1 RNA levels in blood and the female genital tract. *J Infect Dis*. 1999;179:871–882
9. Nourse CB, Charles CA, McKay M, Keenan P, Butler KM. Childhood needlestick injuries in the Dublin metropolitan area. *Ir Med J*. 1997;90:66–69
10. Rich JD, Dickinson BP, Carney JM, Fisher A, Heimer R. Detection of HIV-1 nucleic acid and HIV-1 antibodies in needles and syringes used for non-intravenous injection. *AIDS*. 1998;12:2345–2350
11. Resnick L, Veren K, Salahuddin SZ, Tondreau S, Markham PD. Stability and inactivation of HTLV-III/LAV under clinical and laboratory environments. *JAMA*. 1986;255:1887–1891
12. Raffanti S, Svenningsson A, Resnick L. Determination of HIV-1 status of discarded sharps: polymerase chain reaction using minute quantities of blood. *JAMA*. 1990;264:2501
13. Abdala N, Stephens PC, Griffith BP, Heimer R. Survival of HIV-1 in syringes. *J Acquir Immune Defic Syndr Hum Retrovirol*. 1999;20:73–80
14. Zamora AB, Rivera MO, Garcia-Algar O, Cayla Buqueras J, Vall Combelles O, Garcia-Saiz A. Detection of infectious human immunodeficiency type 1 virus in discarded syringes of intravenous drug users. *Pediatr Infect Dis J*. 1998;17:655–657
15. Walsh SS, Pierce AM, Hart CA. Drug abuse: a new problem. *Br Med J (Clin Res Ed)*. 1987;295:526–527
16. Montella F, DiSora F, Recchia O. Can HIV-1 infection be transmitted by a "discarded" syringe? *J Acquir Immune Defic Syndr*. 1992;5;1274–1275
17. Donegan E, Stuart M, Niland JC, et al. Infection with human immunodeficiency virus type 1 (HIV-1) among recipients of antibody-positive blood donations. *Ann Intern Med*. 1990;113:733–739
18. European Collaborative Study. Children born to women with HIV-1 infection: natural history and risk of transmission. *Lancet*. 1991;337:253–260
19. The Working Group on Mother-to-Child Transmission of HIV. Rates of mother-to-child transmission of HIV-1 in Africa, America, and Europe: results from 13 perinatal studies. The Working Group on Mother-to-Child Transmission of HIV. *J Acquir Immune Defic Syndr Hum Retrovirol*. 1995;8:506–510
20. Dunn DT, Newell ML, Ades AE, Peckham CS. Risk of human immunodeficiency virus type 1 transmission through breastfeeding. *Lancet*. 1992;340:585–588
21. Miotti PG, Taha TE, Kumwenda NI, et al. HIV transmission through breastfeeding: a study in Malawi. *JAMA*. 1999;282:744–749
22. Bertolli J, St Louis ME, Simonds RJ, et al. Estimating the timing of mother-to-child transmission of human immunodeficiency virus in a breast-feeding population in Kinshasa, Zaire. *J Infect Dis*. 1996;174:722–726
23. Nduati R, John G, Mbori-Ngacha D, et al. Effect of breastfeeding and formula feeding on transmission of HIV-1: a randomized clinical trial. *JAMA*. 2000;283:1167–1174
24. Dominguez KL. Management of HIV-infected children in the home and institutional settings. Care of children and infections control in schools, day care, hospital settings, home, foster care, and adoption. *Pediatr Clin North Am*. 2000;47:203–239
25. Tokars JI, Marcus R, Culver DH, et al. Surveillance of HIV infection and zidovudine use among health care workers after occupational exposure to HIV-infected blood. The CDC Needlestick Surveillance Group. *Ann Intern Med*. 1993;118:913–919
26. Bell DM. Occupational risk of human immunodeficiency virus infection in healthcare workers: an overview. *Am J Med*. 1997;102:9–15
27. Kaplan EH, Heimer R. A model-based estimate of HIV infectivity via needle sharing. *J Acquir Immune Defic Syndr*. 1992;5:1116–1118
28. Katz MH, Gerberding JL. The care of persons with recent sexual exposure to HIV. *Ann Intern Med*. 1998;128:306–312
29. Mastro TD, de Vincenzi I. Probabilities of sexual HIV-1 transmission. *AIDS*. 1996;10:S75–S82
30. DeGruttola V, Seage GR III, Mayer KH, Horsburgh CR Jr. Infectiousness of HIV between male homosexual partners. *J Clin Epidemiol*. 1989;42:849–856
31. Wiley JA, Herschkorn SJ, Padian NS. Heterogeneity in the probability of HIV transmission per sexual contact: the case of male-to-female transmission in penile-vaginal intercourse. *Stat Med*. 1989;8:93–102
32. Peterman TA, Stoneburner RL, Allen JR, Jaffe HW, Curran JW. Risk of human immunodeficiency virus transmission from heterosexual adults with transfusion-associated infections. *JAMA*. 1988;259:55–58
33. Downs AM, DeVincenzi I. Probability of heterosexual transmission of HIV: relationship to the number of unprotected sexual contacts. *J Acquir Immune Defic Syndr Hum Retrovirol*. 1996;11:388–395
34. Lane HC, Holmberg SD, Jaffe HW. HIV seroconversion and oral intercourse. *Am J Public Health*. 1991;81:658
35. Keet IP, Albrecht van Lent N, Sandfort TG, Coutinho RA, van Griensven GJ. Orogenital sex and the transmission of HIV among homosexual men. *AIDS*. 1992;6:223–226
36. Goldberg DJ, Green ST, Kennedy DH, Emslie JA, Black JD. HIV and orogenital transmission [lett]. *Lancet*. 1988;2:1363
37. Berrey MM, Shea T. Oral sex and HIV transmission [lett]. *J Acquir Immune Defic Syndr Hum Retrovirol*. 1997;14:475
38. Lifson AR, O'Malley PM, Hessol NA, Buchbinder SP, Cannon L, Rutherford GW. HIV seroconversion in two homosexual men after receptive oral intercourse with ejaculation: implications for counseling concerning safe sexual practices. *Am J Public Health*. 1990;80:1509–1511
39. DeGruttola V, Mayer KH. Human immunodeficiency virus and oral intercourse [lett]. *Ann Intern Med*. 1987;107:428–429
40. Royce RA, Sena A, Cates W Jr, Cohen MS. Sexual transmission of HIV. *N Engl J Med*. 1997;336:1072–1078
41. Transmission of HIV by human bite. *Lancet*. 1987;2:522
42. Vidmar L, Poljak M, Tomazic J, Seme K, Klavs I. Transmission of HIV-1 by human bite [lett]. *Lancet*. 1996;347:1762
43. Richman KM, Rickman LS. The potential for transmission of human immunodeficiency virus through human bites. *J Acquir Immune Defic Syndr*. 1993;6:402–406
44. Abel S, Cesaire R, Cales-Quist D, Bera O, Sobesky G, Cabie A. Occupational transmission of human immunodeficiency virus and hepatitis C virus after a punch. *Clin Infect Dis*. 2000;31:1494–1495
45. Centers for Disease Control and Prevention. Transmission of HIV possibly associated with exposure of mucous membrane to contaminated blood. *MMWR Morb Mortal Wkly Rep*. 1997;46:620–623
46. Yeh CK, Handelman B, Fox PC, Baum BJ. Further studies of salivary inhibition of HIV-1 infectivity. *J Acquir Immune Defic Syndr*. 1992;5:898–903
47. Ho DD, Byington RE, Schooley RT, Flynn T, Rota TR, Hirsch MS. Infrequency of isolation of HTLV-III virus from saliva in AIDS [lett]. *N Engl J Med*. 1985;313:1606
48. Yeung SC, Kazazi F, Randle CG, et al. Patients infected with human immunodeficiency virus type 1 have low levels of virus in saliva even in the presence of periodontal disease. *J Infect Dis*. 1993;167:803–809
49. Rogers MF, White CR, Sanders R, et al. Lack of transmission of human immunodeficiency virus from infected children to their household contacts. *Pediatrics*. 1990;85:210–214
50. Fitzgibbon JE, Gaur S, Frenkel LD, Laraque F, Edlin BR, Dubin DT. Transmission from one child to another of human immunodeficiency virus type 1 with a zidovudine-resistance mutation. *N Engl J Med*. 1993;329:1835–1841
51. Henderson DK, Fahey BJ, Willy M, et al. Risk for occupational transmission of human immunodeficiency virus type 1 (HIV-1) associated with clinical exposures. A prospective evaluation. *Ann Intern Med*. 1990;113:740–746
52. Ippolito G, Puro V, De Carli G. The risk of occupational human immunodeficiency virus infection in health care workers. The Italian Study Group on Occupational Risk of HIV Infection. *Arch Intern Med*. 1993;153:1451–1458
53. Little SJ, McLean AR, Spina CA, Richman DD, Havlir DV. Viral dynamics of acute HIV-1 infection. *J Exp Med*. 1999;190:841–850
54. Katzenstein TL, Dickmeiss E, Aladdin H, et al. Failure to develop HIV infection after receipt of HIV-contaminated blood and postexposure prophylaxis. *Ann Intern Med*. 2000;133:31–34

55. Blauvelt A. The role of skin dendritic cells in the initiation of human immunodeficiency virus infection. *Am J Med*. 1997;102:16–20
56. Spira AI, Marx PA, Patterson BK, et al. Cellular targets of infection and route of viral dissemination after an intravaginal inoculation of simian immunodeficiency virus into rhesus macaques. *J Exp Med*. 1996;183: 215–225
57. Van Rompay KK, Marthas ML, Lifson JD, et al. Administration of 9-[2-(phosphonomethoxy)propyl]adenine (PMPA) for prevention of perinatal simian immunodeficiency virus infection in rhesus macaques. *AIDS Res Hum Retroviruses*. 1998;14:761–773
58. Tavares L, Roneker C, Johnston K, Lehrman SN, de Noronha F. 3′-Azido-3′deoxythymidine in feline leukemia virus-infected cats: a model for therapy and prophylaxis of AIDS. *Cancer Res*. 1987;47: 3190–3194
59. Shih CC, Kaneshima H, Rabin L, et al. Postexposure prophylaxis with zidovudine suppresses human immunodeficiency virus type 1 infection in SCID-hu mice in a time-dependent manner. *J Infect Dis*. 1991; 163:625–627
60. Van Rompay KK, Otsyula MG, Marthas ML, Miller CJ, McChesney MB, Pedersen NC. Immediate zidovudine treatment protects simian immunodeficiency virus-infected newborn macaques against rapid onset of AIDS. *Antimicrob Agents Chemother*. 1995;39:125–131
61. Bottiger D, Johansson NG, Samuelsson B, et al. Prevention of simian immunodeficiency virus, SIV_{sm}, or HIV-2 infection in cynomolgus monkeys by pre- and postexposure administration of BEA-005. *AIDS*. 1997;11:157–162
62. Black RJ. Animal studies of prophylaxis. *Am J Med*. 1997;102:39–44
63. Sinet M, Desforges B, Launay O, Colin JN, Pocidalo JJ. Factors influencing zidovudine efficacy when administered at early stages of Friend virus infection in mice. *Antiviral Res*. 1991;16:163–171
64. Tsai CC, Emau P, Follis KE, et al. Effectiveness of postinoculation (R)-9-(2-phosphonylmethoxypropyl) adenine treatment for prevention of persistent simian immunodeficiency virus SIV_{mne} infection depends critically on timing of initiation and duration of treatment. *J Virol*. 1998;72:4265–4273
65. Otten RA, Smith DK, Adams DR, et al. Efficacy of postexposure prophylaxis after intravaginal exposure of pig-tailed macaques to a human-derived retrovirus (human immunodeficiency virus type 2). *J Virol*. 2000;74:9771–9775
66. Martin LN, Murphey-Corb M, Soike KF, Davison-Fairburn B, Baskin GB. Effects of initiation of 3′-azido, 3′-deoxythymidine (zidovudine) treatment at different times after infection of rhesus monkeys with simian immunodeficiency virus. *J Infect Dis*. 1993;168:825–835
67. Fazely F, Haseltine WA, Rodger RF, Ruprecht RM. Postexposure chemoprophylaxis with ZDV or ZDV combined with interferon-α: failure after inoculating rhesus monkeys with a high dose of SIV. *J Acquir Immune Defic Syndr*. 1991;4:1093–1097
68. Ruprecht RM, Bronson R. Chemoprevention of retroviral infection: success is determined by virus inoculum strength and cellular immunity. *DNA Cell Biol*. 1994;13:59–66
69. Niu MT, Stein DS, Schnittman SM. Primary human immunodeficiency virus type 1 infection: review of pathogenesis and early treatment intervention in humans and animal retrovirus infections. *J Infect Dis*. 1993;168:1490–1501
70. Schacker T, Collier AC, Hughes J, Shea T, Corey L. Clinical and epidemiologic features of primary HIV infection. *Ann Intern Med*. 1996;125:257–264
71. Ruprecht RM, Chou TC, Chipty F, et al. Interferon-α and 3′-azido-3′-deoxythymidine are highly synergistic in mice and prevent viremia after acute retrovirus exposure. *J Acquir Immune Defic Syndr*. 1990;3: 591–600
72. Mathes LE, Polas PJ, Hayes KA, Swenson CL, Johnson S, Kociba GJ. Pre- and postexposure chemoprophylaxis: evidence that 3′-azido-3′-dideoxythymidine inhibits feline leukemia virus disease by a drug-induced vaccine response. *Antimicrob Agents Chemother*. 1992;36: 2715–2721
73. Grob PM, Cao Y, Muchmore E, et al. Prophylaxis against HIV-1 infection in chimpanzees by nevirapine, a nonnucleoside inhibitor of reverse transcriptase. *Nat Med*. 1997;3:665–670
74. Clerici M, Giorgi JV, Chou CC, et al. Cell-mediated immune response to human immunodeficiency virus (HIV) type 1 in seronegative homosexual men with recent sexual exposure to HIV-1. *J Infect Dis*. 1992;165:1012–1019
75. Pinto LA, Sullivan J, Berzofsky JA, et al. ENV-specific cytotoxic T lymphocyte response in HIV seronegative health care workers occupationally exposed to HIV-contaminated body fluids. *J Clin Invest*. 1995;96:867–876
76. D'Amico R, Pinto LA, Meyer P, et al. Effect of zidovudine postexposure prophylaxis on the development of HIV-specific cytotoxic T-lymphocyte responses in HIV-exposed healthcare workers. *Infect Control Hosp Epidemiol*. 1999;20:428–430
77. Connor EM, Sperling RS, Gelber R, et al. Reduction of maternal-infant transmission of human immunodeficiency virus type 1 with zidovudine treatment. Pediatric AIDS Clinical Trials Group Protocol 076 Study Group. *N Engl J Med*. 1994;331:1173–1180
78. Guay LA, Musoke P, Fleming T, et al. Intrapartum and neonatal single-dose nevirapine compared with zidovudine for prevention of mother-to-child transmission of HIV-1 in Kampala, Uganda: HIVNET 012 randomised trial. *Lancet*. 1999;354:795–802
79. The Petra Study Team. Efficacy of three short-course regimens of zidovudine and lamivudine in preventing early and late transmission of HIV-1 from mother to child in Tanzania, South Africa, and Uganda (Petra study): a randomised, double-blind, placebo-controlled trial. *Lancet*. 2002;359:1178–1186
80. Cooper ER, Charurat M, Mofenson L, et al. Combination antiretroviral strategies for the treatment of pregnant HIV-1-infected women and prevention of perinatal HIV-1 transmission. *J Acquir Immune Defic Syndr*. 2002;29:484–494
81. Wade NA, Birkhead GS, Warren BL, et al. Abbreviated regimens of zidovudine prophylaxis and perinatal transmission of the human immunodeficiency virus. *N Engl J Med*. 1998;339:1409–1414
82. McIntosh K. Short (and shorter) courses of zidovudine. *N Engl J Med*. 1998;339:1467–1468
83. Fiscus SA, Schoenbach VJ, Wilfert C. Short courses of zidovudine and perinatal transmission of HIV. *N Engl J Med*. 1999;340:1040–1043
84. Fiscus SA, Adimora AA, Schoenbach VJ, et al. Trends in human immunodeficiency virus (HIV) counseling, testing, and antiretroviral treatment of HIV-infected women and perinatal transmission in North Carolina. *J Infect Dis*. 1999;180;99–105
85. Ippolito G, Puro V, Heptonstall J, Jagger J, De Carli G, Petrosillo N. Occupational human immunodeficiency virus infection in health care workers: worldwide cases through September 1997. *Clin Infect Dis*. 1999;28:365–383
86. Lange JM, Boucher CA, Hollak CE, et al. Failure of zidovudine prophylaxis after accidental exposure to HIV-1. *N Engl J Med*. 1990;322: 1375–1377
87. Jochimsen EM, Luo CC, Beltrami JF, Respess RA, Schable CA, Cardo DM. Investigations of possible failures of postexposure prophylaxis following occupational exposures to human immunodeficiency virus. *Arch Intern Med*. 1999;159:2361–2363
88. Erice A, Mayers DL, Strike DG, et al. Brief report: primary infection with zidovudine-resistant human immunodeficiency virus type 1. *N Engl J Med*. 1993;328:1163–1165
89. Jochimsen EM. Failures of zidovudine postexposure prophylaxis. *Am J Med*. 1997;102:52–57
90. Kahn JO, Martin JN, Roland ME, et al. Feasibility of postexposure prophylaxis (PEP) against human immunodeficiency virus infection after sexual or injection drug use exposure: the San Francisco PEP Study. *J Infect Dis*. 2001;183:707–714
91. Kunches LM, Meehan TM, Boutwell RC, McGuire JF. Survey of nonoccupational HIV postexposure prophylaxis in hospital emergency departments. *J Acquir Immune Defic Syndr*. 2001;26:263–265
92. Fournier S, Maillard A, Molina JM. Failure of postexposure prophylaxis after sexual exposure to HIV. *AIDS*. 2001;15:430
93. Waldo CR, Stall RD, Coates TJ. Is offering post-exposure prevention for sexual exposures to HIV related to sexual risk behavior in gay men? *AIDS*. 2000;14:1035–1039
94. Braitstein P, Chan K, Beardsell A, et al. How much is it worth? Actual versus expected costs of a population-based post-exposure prophylaxis program [Abstr 270P]. *Can J Infect Dis*. 2001;12(Suppl B):45B–46B
95. Braitstein P, Chan K, Beardsell A, et al. Side effects associated with post-exposure prophylaxis in a population-based setting [Abstr 271P]. *Can J Infect Dis*. 2001;12(Suppl B):46B
96. Centers for Disease Control and Prevention. Serious adverse events attributed to nevirapine regimens for postexposure prophylaxis after HIV exposures—worldwide, 1997–2000. *MMWR Morb Mortal Wkly Rep*. 2001;49:1153–1156
97. Dominguez KL, Simonds RJ. Postexposure prophylaxis. In: Zeichner SL, Read JS. *Handbook of Pediatric HIV Care*. Philadelphia, PA: Lippincott Williams and Wilkins; 1999:294–318. Available at: http://www.hivpepregistry.org/pdf/pedipep.pdf. Accessed December 16, 2002
98. Ippolito G, Puro V. Zidovudine toxicity in uninfected healthcare workers. Italian Registry of Antiretroviral Prophylaxis. *Am J Med*. 1997;102: 58–62
99. Henry K, Acosta EP, Jochimsen E. Hepatotoxicity and rash associated

with zidovudine and zalcitabine chemoprophylaxis [lett]. *Ann Intern Med*. 1996;124:855
100. Forseter G, Joline C, Wormser GP. Tolerability, safety, and acceptability of zidovudine prophylaxis in health care workers. *Arch Intern Med*. 1994;154:2745–2749
101. Sepkowitz KA, Rivera P, Louther J, Lim S, Pryor B. Postexposure prophylaxis for human immunodeficiency virus: frequency of initiation and completion of newly recommended regimen. *Infect Control Hosp Epidemiol*. 1998;19:506–508
102. Busch MP, Satten GA. Time course of viremia and antibody seroconversion following human immunodeficiency virus exposure. *Am J Med*. 1997;102:117–126
103. Ciesielski CA, Metler RP. Duration of time between exposure and seroconversion in healthcare workers with occupationally acquired infection with human immunodeficiency virus. *Am J Med*. 1997;102: 115–116
104. Lindegren ML, Hanson IC, Hammett TA, Beil J, Fleming PL, Ward JW. Sexual abuse of children: intersection with the HIV epidemic. *Pediatrics*. 1998;102(4). Available at: http://www.pediatrics.org/cgi/content/full/102/4/e46
105. Foster I, Bartlett JG. Rape and subsequent seroconversion to HIV [lett]. *BMJ*. 1989;299:1282
106. Gostin LO, Lazzarini Z, Alexander D, Brandt AM, Mayer KH, Silverman DC. HIV testing, counseling, and prophylaxis after sexual assault. *JAMA*. 1994;271:1436–1444
107. Bamberger JD, Waldo CR, Gerberding JL, Katz MH. Postexposure prophylaxis for human immunodeficiency virus (HIV) infection following sexual assault. *Am J Med*. 1999;106:323–326
108. Katz MH, Gerberding JL. Postexposure treatment of people exposed to the human immunodeficiency virus through sexual contact or injection-drug use. *N Engl J Med*. 1997;336:1097–1100
109. Evans B, Darbyshire J, Cartledge J. Should preventive antiretroviral treatment be offered following sexual exposure to HIV? Not yet! *Sex Transm Infect*. 1998;74:146–148
110. Lurie P, Miller S, Hecht F, Chesney M, Lo B. Postexposure prophylaxis after nonoccupational HIV exposure: clinical, ethical, and policy considerations. *JAMA*. 1998;280:1769–1773
111. Pinkerton SD, Holtgrave DR, Bloom FR. Cost-effectiveness of post-exposure prophylaxis following sexual exposure to HIV. *AIDS*. 1998; 12:1067–1078
112. Gwinn M, Wortley PM. Epidemiology of HIV infection in women and newborns. *Clin Obstet Gynecol*. 1996;39:292–304
113. Centers for Disease Control and Prevention. US Public Health Service recommendations for human immunodeficiency virus counseling and voluntary testing for pregnant women. *MMWR Recomm Rep*. 1995; 44(RR-7):1–15
114. Centers for Disease Control and Prevention. Revised recommendations for HIV screening of pregnant women. *MMWR Recomm Rep*. 2001;50(RR-19):63–85
115. Centers for Disease Control and Prevention. Recommendations of the US Public Health Service Task Force on the use of zidovudine to reduce perinatal transmission of human immunodeficiency virus. *MMWR Recomm Rep*. 1994;43(RR-11):1–20
116. Havens PL, Waters DA, Cuene BE, McIntosh K, Yogev R. *Caring for Infants, Children, Adolescents, and Families with HIV Infection*. Madison, WI: Wisconsin Department of Health and Social Services, Division of Health. Publication POH 4498 (Rev. 01/01). Available at: http://www.mcw.edu/peds/infectdis
117. Babl FE, Cooper ER, Damon B, Louie T, Kharasch S, Harris JA. HIV postexposure prophylaxis for children and adolescents. *Am J Emerg Med*. 2000;18:282–287
118. Wiebe ER, Comay SE, McGregor M, Ducceschi S. Offering HIV prophylaxis to people who have been sexually assaulted: 16 months' experience in a sexual assault service. *CMAJ*. 2000;162:641–645
119. Myles JE, Hirozawa A, Katz MH, Kimmerling R, Bamberger JD. Post-exposure prophylaxis for HIV after sexual assault. *JAMA*. 2000;284: 1516–1518
120. Mofenson LM, Munderi P. Safety of antiretroviral prophylaxis of perinatal transmission for HIV-infected pregnant women and their infants. *J Acquir Immune Defic Syndr*. 2002;30:200–215
121. Benn PD, Mercey DE, Brink N, Scott G, Williams IG. Prophylaxis with a nevirapine-containing triple regimen after exposure to HIV-1. *Lancet*. 2001;357:687–688
122. American Academy of Pediatrics. *Red Book 2003: Report of the Committee on Infections Diseases*. Elk Grove Village, IL: American Academy of Pediatrics; 2003

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

Postexposure Prophylaxis in Children and Adolescents for Nonoccupational Exposure to Human Immunodeficiency Virus

Peter L. Havens and Committee on Pediatric AIDS

Pediatrics 2003;111;1475