



**FIGURE 226-6 Global geographic distribution of HIV-1 subtypes and recombinant forms.** Distributions derived from relative frequency of subtypes among >500,000 HIV genomic sequences in the Los Alamos National Laboratory HIV Sequence Database. (Additional information available at [www.hiv.lanl.gov/components/sequence/HIV/geo/geo.comp](http://www.hiv.lanl.gov/components/sequence/HIV/geo/geo.comp).)

subtype C, with smaller proportions of infections caused by subtype A, subtype G, CRF02\_AG, and other subtypes and recombinants. In South Africa, the country with the largest number of prevalent infections (6.3 million in 2013), >97% of the HIV-1 isolates sequenced are of subtype C. In Asia, HIV-1 isolates of the CRF01\_AE lineage and subtypes C and B predominate. CRF01\_AE accounts for most infections in south and southeast Asia, while >95% of infections in India, home to an estimated 2.1 million HIV-infected individuals, are of subtype C (see “HIV Infection and AIDS Worldwide,” below). Subtype B viruses are the overwhelmingly predominant viruses seen in the United States, Canada, certain countries in South America, western Europe, and Australia. It is thought that, purely by chance, subtype B was seeded into the United States and Europe in the late 1970s, thereby establishing an overwhelming founder effect. Many countries have co-circulating viral subtypes that are giving rise to new CRFs. Sequence analyses of HIV-1 isolates from infected individuals indicate that recombination among viruses of different clades likely occurs as a result of infection of an individual with viruses of more than one subtype, particularly in geographic areas where subtypes overlap, and more often in sub-epidemics driven by IV drug use than in those driven by sexual transmission.

The extraordinary diversity of HIV, reflected by the presence of multiple subtypes, circulating recombinant forms, and continuous viral evolution, has implications for possible differential rates of transmission, rates of disease progression, responses to therapy, and the development of resistance to antiretroviral drugs. This diversity is also a formidable obstacle to HIV vaccine development, as a broadly useful vaccine would need to induce protective responses against a wide range of viral strains.

## TRANSMISSION

HIV is transmitted primarily by sexual contact (both heterosexual and male to male); by blood and blood products; and by infected mothers to infants intrapartum, perinatally, or via breast milk. After more than 30 years of experience and observations regarding other potential modalities of transmission, there is no evidence that HIV is transmitted by casual contact or that the virus can be spread by insects, such as by a mosquito bite. **Table 226-3** lists the estimated risk of HIV transmission for various types of exposures.

## SEXUAL TRANSMISSION

HIV infection is predominantly a sexually transmitted infection (STI) worldwide. By far the most common mode of infection, particularly in

developing countries, is heterosexual transmission, although in many western countries a resurgence of male-to-male sexual transmission has occurred. Although a wide variety of factors including viral load and the presence of ulcerative genital diseases influence the efficiency of heterosexual transmission of HIV, such transmission is generally inefficient. A recent systemic review found a low per-act risk of heterosexual transmission in the absence of antiretrovirals: 0.04% for female-to-male transmission and 0.08% for male-to-female transmission during vaginal intercourse in the absence of antiretroviral therapy or condom use (Table 226-3).

HIV has been demonstrated in seminal fluid both within infected mononuclear cells and in cell-free material. The virus appears to concentrate in the seminal fluid, particularly in situations where there are increased numbers of lymphocytes and monocytes in the fluid,

**TABLE 226-3 ESTIMATED PER-ACT PROBABILITY OF ACQUIRING HIV FROM AN INFECTED SOURCE, BY EXPOSURE ACT**

Type of Exposure	Risk per 10,000 Exposures
<b>Parenteral</b>	
Blood transfusion	9250
Needle-sharing during injection drug use	63
Percutaneous (needle-stick)	23
<b>Sexual</b>	
Receptive anal intercourse	138
Insertive anal intercourse	11
Receptive penile-vaginal intercourse	8
Insertive penile-vaginal intercourse	4
Receptive oral intercourse	Low
Insertive oral intercourse	Low
<b>Other<sup>a</sup></b>	
Biting	Negligible
Spitting	Negligible
Throwing body fluids (including semen or saliva)	Negligible
Sharing sex toys	Negligible

<sup>a</sup>HIV transmission through these exposure routes is technically possible but unlikely and not well documented.

Sources: CDC, [www.cdc.gov/hiv/policies/law/risk.html](http://www.cdc.gov/hiv/policies/law/risk.html); P Patel: AIDS 28:1509, 2014.