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Review Article

Occupational Acquisition of HIV Infection by Healthcare Workers in the United States

Introduction

Healthcare Is the fastest growing sector (5.6% increase in 2016) of the United States economy, comprising 17.8% ($3,2 trillion) of the gross domestic product. There are more than 18,000,000 American healthcare professionals (HCP) [1,2].

HCP face many noninfectious occupational hazards. This includes hazardous chemicals, latex allergies, lasers, radiation, stress, violence, strains, sprains and heat/fire. Also, HCP are commonly exposed to infectious agents, including the hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) while working.

Occupational blood and body fluid exposure to bloodborne pathogens is a serious public health concern. The Centers for Disease Control and Prevention (CDC) estimate that 5.6 million workers in the healthcare industry and related occupations are at risk for a variety of occupational hazards [1,3,4]. This often occurs because of sharp injuries (e.g., needles, blades, pointed instruments and broken glass and instruments), direct patient care (direct contact and inhalation) and a contaminated environment (indirect contact). Nonfatal occupational injuries and illnesses among HCP are the highest among any industry sector [2,5,6].

The risk of bloodborne pathogen transmission is dependent on HBV, HCV and HIV prevalence in the American population, their environmental survival ability and transmissibility via percutaneous, mucous membrane or intact skin exposure [1,7].

Seroprevalence for HBV in the general population is approximately 0.4%, for HCV it is 1.3%, while it is 0.31% for HIV [1,7]. Environmental survival of bloodborne pathogens varies. HBV is able to survive and remain infectious for more than seven days (8) Studies place HCV environmental survival between 16 hours and six weeks. The half-life for HIV is 28 hours with a potential maximum of several days (1) Efficiency of bloodborne pathogen transmission depends on viral load, the route of transmission and the immune's status of the HCP. A generalized estimate after a percutaneous injury (hollow needle, not a solid instrument) is 33% (1 in 3) for HBV, 1.8% (1 in 55) and 0.3% (1 in 333 for HIV) [1,7].

Bloodborne pathogens can also be spread by other routes, such as exposure of mucous membranes or nonintact skin and human bites. Seroconversion rates do not exist for HBV or HCV; however, they are thought to be lower than by percutaneous routes. The HIV acquisition by mucous membrane routes is 0.09% (1 in 1111) and by contact with nonintact skin is probably less than 0.1% (1 in 1000); however, this has not been completely quantified. The risk from a human bite also has not been quantified [1,7].

CDC estimates that about 385,000 sharps-related injuries (penetrating stab or puncture wounds) occur annually among HCP in hospitals. It has been estimated about half or more of sharps injuries go unreported. Most reported sharps injuries involve nursing staff, but laboratory staff, physicians, housekeepers and other HCP are also injured [7,8].

In addition to the use of sharps devices, injuries are also closely associated with certain work practices that can pose an increased risk of bloodborne pathogen exposure. Common work practices include disposal-related activities (11%), activities after use and prior to disposal, such as item disassembly (30%) and recapping a used needle (3%) [7,8].

Also, injuries are closely associated with certain devices that can pose an increased risk of bloodborne pathogen exposure. These devices include disposable syringes (31%), suture needles (24%) and winged steel needles (5%) (7,8) (Figure 1).

The greatest HIV risk follows a percutaneous injury involving a contaminated sharp, especially a hollow needle that has been in the vein or artery of an HIV positive source patient. Risk increases for patients with Stage Three HIV Infection (AIDS). This late in the disease process often involves high viral loads [1,3,9,10] (Figure 2).

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In the United States, 58 confirmed cases and 150 possible cases of occupationally acquires HIV infection were reported to the CDC between 1985 and 2013. The CDC then further investigated each and reconfirmed the original assignment. Since 1999, only one confirmed case (a laboratory technician who sustained a needle puncture while working with a live HIV culture in 2008) has been reported. Of course, underreporting is a possibility because reporting is voluntary [1,9].

A confirmed case of occupationally acquired HIV infection requires documentation that seroconversion in the exposed HCP is temporally related to a specific exposure to a known HIV-positive source. A possible case of occupationally acquired HIV infection is defined as an infection in a HCP whose job duties might have exposed them, but who lack a documented workplace exposure. If the HIV status of a source patient is unknown or the HCP's seroconversion after was not documented as temporally related. Thus, occupational acquisition of HIV infection is possible, but cannot be confirmed [9] (Table 1).

Among the 58 confirmed cases, the routes of exposure resulting in infection were percutaneous punctures or cuts (49 cases), mucocutaneous exposures (5), both percutaneous and mucocutaneous exposures (2) and unknown (2). A total of 49 HCP were exposed to HIV-infected blood, four to concentrated virus in a laboratory, one to visibly bloody fluids and four to unspecified body fluids [9].

CDC recommends the use of standard precautions to prevent exposure of HCP to potentially infectious body fluids when working with any patient, whether known to be infected

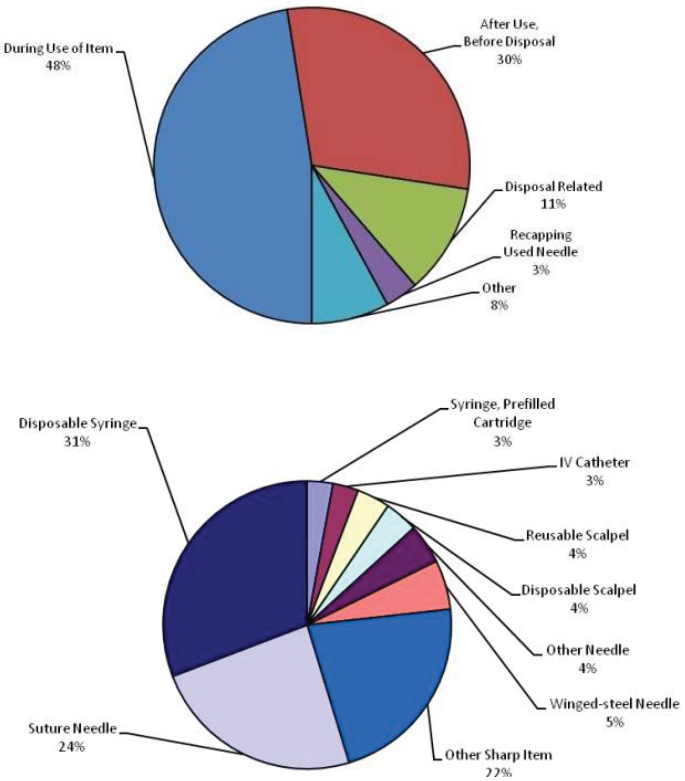

Figure 1: Injuries closely associated with certain work practices.

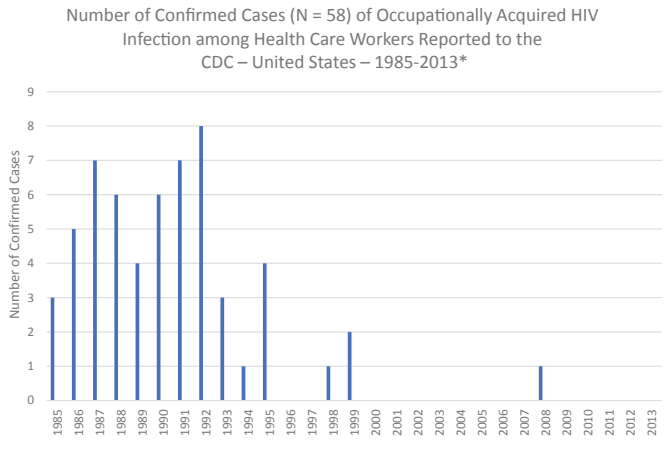

Figure 2: Injuries closely associated with the use of certain devices.

Table 1: Occupational Risk of HIV Infection for Healthcare Worker 1985-2013, United States*.

	Number of Occupationally Acquired HIV Infections	
Occupation	**Documented**	**Possible**
Nurse	24 (42%)	37 (25%)
Laboratory Worker, Clinical	16 (28%)	21 (14%)
Physician. Non-surgical	6 (11%)	13 (9%)
Laboratory Worker, Non-clinical	4 (5%)	0
Housekeeping/Maintenance	2 (4%)	14 (10%)
Technician, Surgical	2 (4%)	2 (1%)
Embalmer/Morgue Worker	1 (2%)	2 (1%)
Health Aide/Attendant	1 (2%)	16 (11%)
Respiratory Therapist	1 (2%)	2 (1%)
Technician, Dialysis	1 (2%)	2 (1%)
Dental**	0	6 (4%)
Emergency Medical/ Paramedic	0	13 (9%)
Physician. Surgical	0	6 (4%)
Technician/Therapist/Other	0	9 (7%)
Other Healthcare Occupations	0	6 (4%)
Total	58	150

*Centers for Disease Control and Prevention (2015) - https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6353a4.htm?s_cid=mm6353a4_w
**three dentists, one oral surgeon and two dental assistants.

with HIV or not. This means that HCP should assume that all patient body fluids are potentially infectious [9].

Proper implementation of standard precautions (i.e., use of safety devices and barriers such as gloves and protective eyewear to minimizes exposure risk) [9]. To prevent puncture injuries, CDC recommends a comprehensive prevention program consistent with requirement of the Occupational Safety and Health Administration's Bloodborne Pathogens Standard [10]. This includes use of medical devices engineered for sharps protection (i.e., needleless systems). Used devices such as syringes or other sharp instruments should be disposed in sharps containers without attempting to recap needles. HCP

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should immediately wash hands and other skin surfaces after contact with blood and body fluids.

1) Healthcare workers must always follow three infection control precaution. These include:Routine use of barriers, such as gloves and/or goggles when anticipating contact with blood or body fluids

2) Immediately wash hands and other skin surfaces after contact with blood or body fluids

3) Carefully handle and dispose of sharp instruments during and after use [8].

Preventing occupational exposure is the most important strategy for reducing the risk for occupational acquisition of HIV infection. However, there also must be a post-exposure prophylaxis (PEP) plan. Occupational exposure requires immediate medical management. This includes whether the exposed person should receive PEP (antiretroviral medication taken as soon as possible after exposure to reduce the chance of HIV infection) and what type of PEP regimen is needed. For most HIV exposures that warrant PEP, a four-week, two-drug regimen is recommended, starting as soon as possible after exposure (within 72 hours). If there is an increased risk of transmission (based on the viral load of the source and the type of exposure), then a three-drug regimen is recommended. There are other specific recommendations when there is a delay in exposure reporting, if the source is unknown, pregnancy of the exposed person, and resistance of source virus to antiretroviral agents and toxicity of PEP regimens [1].

Safer work practices help to reduce the chances of occupational HIV exposure and resulting lower numbers of infections. However, other factors may be in play.

In 2015, 39,513 people were diagnosed with HIV infection in the United States. The number of new HIV diagnoses fell 19% from 2005 to 2014. Because HIV testing has remained stable or increased in recent years, this decrease in diagnoses suggests a true decline in new infections. The decrease may be due to targeted HIV prevention efforts. However, progress has been uneven, and diagnoses have increased among a few groups [10].

At the end of 2014, the most recent year for which such data are available, an estimated 1,107,700 adults and adolescents were living with HIV with an estimated 166,000 (15%) remain undiagnosed. Young people were the most likely to be unaware of their infection. Among people aged 13-24, an estimated 51% (31,300) of those living with HIV at the end of 2013 did not know [10].

Worldwide, the number of newly diagnosed cases of HIV has dropped about 33% (3.4 to 2.3 million) from 2001 to 2013. Also, potent antiretroviral therapy (ART) has significantly increased longevity among HIV-infected patients. As this patient population grows older, an increased need for surgical interventions, such as coronary revascularization, will likely rise. Concerns arise about HIV-positive patients who need surgery, including morbidity and mortality, pre-operative evaluation and post-surgical management. It is estimated that 25% of these individuals will need surgical/anesthesia treatment during the course of their illness [11,12].

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