Welcome to week 11, entitled “Bloodborne Pathogens and Needlestick Injury Surveillance”. This is part 1 of 2.

There are several different blood borne pathogens but in terms of needlestick injury and risk to health care workers in a health care setting, the three that are of the greatest concern are hepatitis B (HBV), hepatitis C (HCV), and Human Immunodeficiency Virus (HIV). Here is the outline for what will be covered in these two lectures. In part 1, the 3 major bloodborne pathogens: hepatitis B (HBV), hepatitis C (HCV) and HIV in relation to epidemiology, transmission, risk of acquisition post-needlestick injury (NSI) and blood exposure, will be discussed. What surveillance data indicates regarding healthcare workers will be examined. The focus of part II will be on needlestick injuries and blood exposures, reporting of exposures, epidemiology & surveillance of NSI and safer needle devices.

You may wonder why are we talking about these 3 bloodborne pathogens when also discussing surveillance for needlestick injuries. It is because, if you look in this diagram, much of what we know about seroconversion risks for HBV, HCV & HIV are from the surveillance conducted for those diseases, NOT from needle stick injury surveillance. So that is a very important point to recognize, and the reason for that, is because we haven't had requirements to have needle stick surveillance until the last 15 years. So we will spend the first part of the lecture for this week on what surveillance for these 3 bloodborne pathogens has taught us.
Let’s start with hepatitis B. You should now, if you have not already done so, look at Required Reading #1. In 2013, the estimated number of acute new cases of hepatitis B virus was 3,050. The estimated number of actual new cases of HBV in 2013 was 19,764 (after adjusting for asymptomatic infections and under-reporting). The number of reported cases of acute hepatitis B decreased 62%, from 8,036 in 2000 to 3,050 in 2013. The overall incidence rate for 2013 was 1.0 cases per 100,000 population. (Note: 2013 is the latest year for which CDC data are available as surveillance data usually lag by 1-2 years.)

It is estimated that up to 1.4 million people are chronically infected with hepatitis B in the U.S. and 240 million worldwide. In the United States, chronic HBV infection results in an estimated 2,000-4,000 deaths per year and 786,000 worldwide. Approximately 25% of those who become chronically infected during childhood and 15% of those who become chronically infected after childhood die prematurely from cirrhosis or liver cancer. The presence of signs and symptoms varies by age. Most children under age 5 years and newly infected immunosuppressed adults are asymptomatic, whereas 30%-50% of persons aged ≥5 years have initial signs and symptoms. The highest rate of disease in 2013 was in men 25-44 years of age. The risk for chronic infection varies according to the age at infection and is greatest among young children. Approximately 90% of infants and 25%-50% of children aged 1–5 years will remain chronically infected with HBV. By contrast, approximately 95% of adults recover completely from HBV infection and do not become chronically infected. Disease is more severe among adults aged >60 years.

The good news is that the rate of new HBV infections has declined by approximately 82% since 1991, when a national strategy to eliminate HBV infection was implemented in the United States.

Source:
http://www.cdc.gov/hepatitis/HBV/HBVfaq.htm#overview
Transmission of HBV

- **Sexual** (hetero-, MSM)
- **Parenteral** (injection drug use, needlestick injury)
- **Perinatal** (mother to infant)
- **Other** (open sore contact, sharing razors/toothbrushes)

HBV is transmitted through activities that involve percutaneous (i.e., puncture through the skin) or mucosal contact with infectious blood or body fluids (e.g., semen, saliva). The main routes are listed on this slide. Hepatitis B can be acquired by sexual transmission from an infected partner, through heterosexual sex, or sex between men; by injection drug use that involves sharing needles, syringes or drug preparation equipment; by birth from an infected mother to infant; from needlestick or other sharp instrument exposures; by contact with blood or open sores of an infected person, or sharing items such as razors or toothbrushes with an infected person.

On slide #3, we talked about how conducting surveillance on viral hepatitis helps estimates healthcare workers and needlestick injuries. Let’s apply that to hepatitis B surveillance.

From the 2013 report on hepatitis B surveillance, Figure 3.6b presents patient engagement in selected risk behaviors and exposures during the incubation period, 6 weeks to 6 months prior to onset of symptoms. Of the 1,577 case reports that contained information about occupational exposures, 0.1% (n=1) indicated employment in a medical, dental, or other field involving contact with human blood. Of the 1,493 case reports that included information about receipt of blood transfusion, 0.7% (n=11) noted receipt of a blood transfusion. Of the 1,482 case reports that had information about surgery, 9.9% (n=147) reported surgery. Of the 1,358 case reports that had information about needle sticks, 4.5% (n=61) reported an accidental needle stick/puncture. So 2/5 risk exposure categories involved healthcare workers.

**Source:**
From the same 2013 report on hepatitis surveillance on the previous slide, Figure 3.6a presents reported risk exposures/behaviors for hepatitis B during the incubation period, 6 weeks to 6 months prior to onset of symptoms. Of the 1,428 case reports that had information about injection-drug use, 23.2% (n=332) noted use of these drugs. Of the 965 case reports that had information about sexual contact, 5.0% (n=48) indicated sexual contact with a person with confirmed or suspected hepatitis B infection. Of the 167 case reports from males that included information about sexual preference/practices, 26.9% (n=45) indicated sex with another man. Of the 665 case reports that had information about number of sex partners, 26.2% (n=174) were among persons with ≥2 sex partners. Of the 965 case reports that had information about household contact, 0.7% (n=7) indicated household contact with someone with confirmed or suspected hepatitis B infection.

Source:

For acute infection, treatment is supportive. For chronic infection, the currently licensed antiviral drugs for HBV treatment are listed on this slide. The trade name for each medication is in italics next to the generic name. Persons with chronic HBV infection require medical evaluation and regular monitoring to determine whether disease is progressing and to identify liver damage or hepatocellular carcinoma.

Source:
http://www.fda.gov/forpatients/illness/hepatitisbc/ucm408658.htm
More than 350 patients have become infected with hepatitis B following procedures by hepatitis B-infected health care workers. Transmissions have taken place during dental procedures prior to widespread use of examining gloves, and during vaginal hysterectomies, major pelvic surgeries, and cardiac surgeries, and nearly all transmissions were linked to hepatitis B e-antigen-positive healthcare providers. Between 1990-2009, there were 18 hepatitis B infection outbreaks related to improper use of blood glucose monitoring equipment. The predominant unsafe practices were the use of spring-loaded finger-stick devices on multiple persons and the sharing of blood glucose testing meters without cleaning and disinfection between uses.


See more at: http://www.acoem.org/HIV_AIDS_Workplace.aspx#sthash.ubF4IRCb.dpuf

Lets talk about the risk of acquiring hepatitis B (or seroconversion risk) after a needle stick or blood exposure. It is pretty dramatic, 6 to 30%, if the patient, the source patient or client or whomever you have got exposed to, is HBsAg positive, which is hepatitis B surface antigen positive, and the health care worker is not vaccinated. This is a significant risk, of up to almost 1 in 3 chance. If that source individual is also positive for anti-HBe which is hepatitis B antigen, there is a higher risk. Hepatitis B e antigen is a marker for increased infectivity for hepatitis B. To combat that risk, there is a vaccine available, that can be administered both pre and post exposure, as well as (HBIG) or hepatitis B immune globulin post exposure. For preventing hepatitis B post-exposure, with hepatitis B immune globulin post exposure it is 75% effective, and if you use the vaccine and hep B immune globulin, it is 85 to 90% effective. So this disease is highly preventable. This is in stark contrast to hepatitis C.
Epidemiology of HCV

- 3.2 million with chronic infection in U.S.
- In 2013, estimated:
  - # of reported acute cases: 2,138
  - estimated # new cases: 29,718
  - 151.5% increase in cases from 2010-2013


It is estimated that approximately 3.2 million people in the U.S. have chronic HCV infection. In 2013, the estimates for hepatitis C are as follows: # reported acute cases: 2,138; and estimated # new cases after adjusting for asymptomatic infections and underreporting: 29,718.

There was a significant increase of 151.5% in reported cases of acute HCV infection from 2010-2013. Note this in contrast to the decrease in HBV infections. The increase from 2010-2013 is thought to reflect both true increases in incidence and improved case ascertainment.


Morbidity & Mortality of HCV

- 70-80% have no signs or symptoms
- 75-85% develop chronic infection
- 60-70% evidence of active liver disease
- 1-5% mortality
- 5-20% will develop cirrhosis in 20-30 yrs.
- #1 indication for liver transplant in U.S.
- Can go decades from chronic infection to liver disease

Source: [http://www.cdc.gov/hepatitis/HCV/HCVfaq.htm](http://www.cdc.gov/hepatitis/HCV/HCVfaq.htm)

For every 100 persons infected with HCV, 70-80% of cases have no signs or symptoms, and 75- 85% will develop chronic infections. Between 60-70% of chronically infected persons have evidence of active liver disease. There is a one (1) -5% mortality rate from the consequences, e.g., liver cancer or cirrhosis. Five (5)-20% will develop cirrhosis in the next 20-30 years. Consequently, hepatitis C is the number one indication for liver transplantation in the U.S. Most persons with chronic HCV infection are asymptomatic. However, many have chronic liver disease, which can range from mild to severe, including cirrhosis and liver cancer. Chronic liver disease in HCV-infected persons is usually insidious, progressing slowly without any signs or symptoms for several decades. In such cases, persons may be unknowingly transmitting hepatitis C. In fact, HCV infection is often not recognized until asymptomatic persons are identified as HCV-positive when screened for blood donation or when elevated alanine aminotransferase (ALT, a liver enzyme) levels are detected during routine examinations.

Source: [http://www.cdc.gov/hepatitis/HCV/HCVfaq.htm](http://www.cdc.gov/hepatitis/HCV/HCVfaq.htm)
How is HCV transmitted? HCV is transmitted primarily through large or repeated percutaneous (i.e., passage through the skin) exposures to infectious blood, such as by:

- **Injection drug use** (currently the most common means of HCV transmission in the United States)
- Receipt of donated blood, blood products, and organs (once a common means of transmission but now rare in the United States since blood screening became available in 1992)
- Needlestick injuries (NSI) in healthcare settings
- Birth to an HCV-infected mother

HCV can also be spread infrequently through:

- Sex with an HCV-infected person (an inefficient means of transmission)
- Sharing personal items contaminated with infectious blood, such as razors or toothbrushes (also inefficient vectors of transmission)
- Other healthcare procedures that involve invasive procedures, such as injections (usually recognized in the context of outbreaks)

The role of sexual activity in the transmission of HCV has been controversial. Case-control studies have reported an association between acquiring HCV infection and exposure to a sex contact with HCV infection or exposure to multiple sex partners. Surveillance data also indicate that 15%–20% of persons reported with acute HCV infection have a history of sexual exposure in the absence of other risk factors. Case reports of acute HCV infection among HIV-positive MSM who deny injecting-drug use have indicated that this occurrence is frequently associated with other STDs (e.g., syphilis). In contrast, a low prevalence (1.5% on average) of HCV infection has been demonstrated in studies of long-term spouses of patients with chronic HCV infection who had no other risk factors for infection. Multiple published studies have demonstrated that the prevalence of HCV infection among MSM who have not reported a history of injecting-drug use is no higher than that of heterosexuals. Because sexual transmission of other bloodborne viruses, such as HIV, is more efficient among homosexual men than in heterosexual men and women, the reason that HCV infection rates are not substantially higher among MSM is unclear. Overall, these findings indicate that sexual transmission of HCV is possible but inefficient.

### Slide 16

On this slide are different pictures as examples of how HCV can be transmitted.

Sources of images (clockwise from top left):  
- IDU: [Link to image](http://www.avert.org/sites/default/files/image/5422/5422-injecting-drug-use-paraphernalia-russia-150x150.jpg),  
- mother to infant: [Link to image](http://t3.gstatic.com/images?q=tbn:ANd9GcR3FZK_8NB0J7jcPi5tvzhitBRbUA2IUnwt_AsOTpf5xoE0WmSp8hnbZgG),  
- occupational NSI: [Link to image](http://www.uic.edu/depts/envh/Images/fingerNeedlestick.jpg),  
- transfusion: [Link to image](http://z.about.com/f/p/440/graphics/images/en/19449.jpg) and sexual contact (https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQqqgAMci5laO9BBejKhD05zHQj1aSZ912cfhFq6zP9IHc9qt8y1pMabwe).

### Slide 17

Figure 4.6b from the same source as the hepatitis B data, presents reported risk exposures/behaviors for hepatitis C during the incubation period, 2 weeks to 6 months prior to onset of symptoms. Of the 887 case reports that contained information about occupational exposures, 1.0% (n=9) involved persons employed in a medical, dental, or other field involving contact with human blood. Of the 811 case reports that had information about receipt of dialysis or a kidney transplant, 0.2% (n=2) indicated patient receipt of dialysis or a kidney transplant. Of the 729 case reports that had information about surgery, 12.2% (n=89) were among persons who had undergone surgery. Of the 679 case reports that included information about needle sticks, 7.7% (n=52) indicated accidental needle stick/puncture. As with hepatitis B, two of the five risk exposures for hepatitis C involved healthcare occupations.

**Source:** [Link to CDC site](http://www.cdc.gov/hepatitis/Statistics/2013Surveillance/Slide4.6b.htm)
Figure 4.6a from the same source as the hepatitis B data, presents reported risk exposures/behaviors for hepatitis C during the incubation period, 2 weeks to 6 months prior to onset of symptoms. Of the 955 case reports that had information about injection-drug use, 61.6% (n=588) noted use of these drugs. Of the 183 case reports from males that included information about sexual preferences/practices, 16.4% (n=30) indicated sex with another man. Of the 76 case reports that had information about sexual contact, 18.4% (n=14) involved persons reporting sexual contact with a person with confirmed or suspected hepatitis C infection. Of the 616 case reports that had information about number of sex partners, 31.3% (n=193) involved persons with ≥2 sex partners.

Source:

In the literature we can also find evidence that hepatitis C can be transmitted in health care settings through chronic hemodialysis, or hemodialysis machines. With hemodialysis, a patient’s blood is sent through a filter via the dialysis machine. HBV and HCV have been shown to survive on inanimate objects for quite a long period. If they are inadequately cleaned, shared between patients, that could be a risk factor for hemodialysis transmission. The inpatient setting of a hospital, private practice healthcare, and home therapy can also be recognized outbreak sources for hepatitis C. The other area that we can see transmission is unsafe injection practices, as mentioned in the slide about HBV transmission. Some underdeveloped and developing countries will reuse syringes without adequate sterilization between patient uses, and that can result in transmission of infection. In the U.S., contaminated multi-dose medication vials have been the source of hepatitis C and B as well. As an example, an HCV outbreak occurred at an endoscopy center in Nevada in 2008. Unsafe injection practices involved reusing syringes and sharing single-use medication vials between patients. At least 63,000 patients were identified as being at potential risk for acquiring hepatitis, and at the time this particular article was written in 2010, 12,000 has been tested and 115 were found to be infected with HCV.
On the right there in this slide are some examples of multi-dose vials. If you take a syringe that has been used on a patient and enter that vial for another patient, there can be contamination. The left shows an attempt to sterilize a needle before injection drug use.

At least six distinct HCV genotypes (genotypes 1–6) and more than 50 subtypes have been identified. Genotype 1 is the most common HCV genotype found in the United States. Genotype information is helpful in defining the epidemiology of Hepatitis C and in making recommendations regarding treatment. Knowing the genotype can help predict the likelihood of treatment response and, in many cases, determine the duration of treatment. Once the genotype is identified, it need not be tested again; genotypes do not change during the course of infection.

It is not important that you know the specific treatments, just know that there are treatments for HCV. Until recently, the mainstay of treatment for chronic hepatitis C virus (HCV) infection has been pegylated interferon and ribavirin, with the possible addition of 2 protease inhibitors for HCV genotype 1 infection. In late 2013, the Food and Drug Administration approved two new direct acting antiviral drugs to treat chronic HCV infection. For more details on the specific treatments for HCV, go to the following link from the Food and Drug Administration:

Source: [http://www.cdc.gov/hepatitis/HCV/HCVfaq.htm#d4](http://www.cdc.gov/hepatitis/HCV/HCVfaq.htm#d4)

In comparison to HBV, the HCV seroconversion risk post NSI ranges between 0-10% with an average of 1.8%. There is one report showing the risk to be 22.2%. If a healthcare worker gets stuck by a patient who is positive for HCV, those are the NSI risks. That is in contrast to 6% -30% with hep B. One study showed that transmission only occurred from a hollow-bore needle. A hollow bore needle is one that has a lumen inside where blood can be, as opposed to a solid needle, like a suture needle. A suture needle, if familiar with that, does not have an inside for blood to be trapped. The bad news about HCV, is there is no current post exposure prophylaxis, and there is no vaccine, so you can't take something before, and there is nothing to take afterwards to prevent HCV infection. Studies have
shown that there may be some benefit from treating early acute infections, that is, if a HCW acquires HCV infection in an acute stage.

What about other blood exposures? The risk of mucous membrane exposure, so exposure to an eye, nose, mouth, is low, but it has been reported. There was one case where hepatitis C and another case where hepatitis C and HIV were transmitted to someone via a splash to their eye. To date, for hepatitis C there has not been transmission to a health care worker through intact or non-intact skin. But there is a probable case where hepatitis C and HIV were transmitted in a nursing home care situation between a patient to a health care worker through non-intact skin. In a few minutes you will see what the difference is between possibly vs. confirmed occupational acquisition.

Because of the high burden of chronic HCV infection in the United States and because no vaccine is available for preventing infection, national recommendations emphasize other primary prevention activities, including screening and testing blood donors, inactivating HCV in plasma-derived products, testing persons at risk for HCV infection and providing them with risk-reduction counseling, and consistently implementing and practicing infection control in health-care settings. In 2010, the FDA approved point-of-care tests for HCV infection, which meant that patients could receive HCV test results within the same visit and faster referral to care. In 2012, CDC augmented existing risk-based recommendations for HCV testing by recommending one-time screening for HCV infection among all those born during 1945-1965. It is estimated that persons born during these years have a 3% prevalence of HCV antibodies, which is five times higher than the prevalence seen in adults born in other years. Of all persons living with HCV infection, about 75% were born during 1945-1965; a similar percentage of HCV-associated deaths can be attributed to this birth
The goal of the new birth-cohort approach to HCV testing is to identify unrecognized infections among the segment of the population with the largest risk of HCV associated morbidity and mortality, thereby increasing opportunities for persons infected with HCV to benefit from appropriate care and treatment. Implementation of the birth cohort screening recommendation and point of care testing for HCV infection will facilitate testing, notification of results, post-test counseling and referral to care.

Only certain fluids—blood, semen, pre-seminal fluid, rectal fluids, vaginal fluids, and breast milk—from an HIV-infected person, can transmit HIV. These fluids must come in contact with a mucous membrane or damaged tissue or be directly injected into the bloodstream (from a needle or syringe) for transmission to possibly occur. Mucous membranes can be found inside the rectum, the vagina, the opening of the penis, and the mouth. HIV is mainly spread by having contact with someone who has HIV (either men having sex with men [MSM], or heterosexual sex); sharing needles, syringes, rinse water or other equipment involved with injection drug use (IDU); perinatally from mother to infant during pregnancy, birth or breast-feeding; being stuck with a contaminated needle or other sharp object; and receiving blood transfusions, blood products or organ/tissue transplants contaminated with HIV. This risk is extremely small because of rigorous testing of the US blood supply and donated organs and tissues.) Additional routes of transmission have been reported as follows, but range from a very small number of documented cases to being extremely rare.:

- Eating food that has been pre-chewed by an HIV-infected person. The contamination occurs when infected blood from a caregiver’s mouth mixes with food while chewing, and is very rare.
- Being bitten by a person with HIV. Each of the very small number of documented cases has involved severe trauma with extensive tissue damage and the presence of blood. There is no risk of transmission if the skin is not broken.
- Oral sex
- Contact between broken skin, wounds, or mucous membranes and HIV-infected blood or blood-contaminated body fluids. These reports have also been extremely rare.
Deep, open-mouth kissing if the person with HIV has sores or bleeding gums and blood is exchanged. HIV is not spread through saliva. Transmission through kissing alone is extremely rare.

There has been no evidence of spread from other sources. HIV is not spread by day-to-day contact in the workplace, schools, or social settings, through shaking hands, hugging, or a casual kiss. One cannot become infected from a toilet seat, a drinking fountain, a door knob, dishes, drinking glasses, cigarettes, or pets. There is no evidence of HIV transmission from mosquitoes or any other insects—even in areas where there are many cases of HIV and large populations of mosquitoes. Unlike organisms that are transmitted by insect bites, HIV does not reproduce (and does not survive) in insects. HIV cannot be spread through saliva, and there is no documented case of transmission from an HIV-infected person spitting on another person. There is no risk of transmission from scratching because there is no transfer of body fluids between people.

There have not been any additional routes of transmission identified, and surveillance of HIV has been conducted on a global scale, on a national scale, on a state scale, and on a county level. HIV is not spread through the air, and it does not live long outside the body. Finally, there has not been one report of an environmental source of transmission.

This slide was provided by the CDC in the HIV Surveillance – Epidemiology of HIV infection (through 2013) slide set. This slide set can be accessed at: http://www.cdc.gov/hiv/library/slideSets/index.html - specifically, http://www.cdc.gov/hiv/pdf/g-l/cdc-hiv-genepislideseries-2013.pdf.

In 2013, among adults and adolescents diagnosed with HIV infection in the United States and 6 U.S. Dependent areas with long-term confidential name-based HIV infection reporting, an estimated 65% of all diagnosed infections were attributed to male-to-male sexual contact. An estimated 17% of all diagnosed infections were attributed to heterosexual contact for females and 8% for males. An estimated 4% of all diagnosed infections were attributed to injection drug use for males and 2% for females. Approximately 3% of diagnosed infections were attributed to male-to-male sexual contact and injection drug use.
*Heterosexual contact is with a person known to have, or to be at high risk for, HIV infection.

What about the issue of healthcare worker transmission to a patient? There was an initial report, about 20 years ago now, where 6 patients were, suspected to be infected from one dentist. The most noticeable person in that group was Kimberly Bergalis, who was a 23 year old who died from HIV. Kimberly Bergalis had claimed up until she died that she was a virgin and had never injected any drugs. So while these patients may have been infected by the dentist, the way they were infected is still not known. Other investigations have been completed looking at up to 22,000 patients who were cared for by a total of 63 health care workers who were either dentists, surgeons, or physicians and these did not show any other cases of transmission. CDC has documented rare cases of patients contracting HIV in healthcare settings from infected donor tissue.

How about in other countries? There have been 3 reports of provider to patient transmission of HIV infection in other countries.

- In 1992 a French orthopedic surgeon, who was likely originally occupationally infected, transmitted HIV to one of the patients after performing a 10-hour procedure in 1992. The surgeon himself appeared to have been infected by a patient during an operation in 1983. Neither patient nor surgeon had any other known risk factors for HIV, and genetic sequences from the viruses of the surgeon and the patient were almost identical. Investigation of the surgeon’s work practices revealed that he was in the habit of several practices that could have caused injuries such as palpating the needle tip when sewing up operation incisions and twisting sharp suture wires with his fingers. When they looked at the other 982 patients who underwent procedures with that same surgeon, they did not have any other evidence of transmission.

- The second episode also was detected in France in 1996. In this unusual case, transmission of HIV is suggested to have occurred from an infected nurse to
a patient, although no clear mechanism for transmission could be identified. The investigators conducted a look-back study focusing on 7,580 patients for whom the infected nurse had provided care. They were able to locate 5,308 patients, and they serologically tested 2,293. No additional infections were identified.

- The third case occurred in Spain in 2004. A woman was infected with HIV by her obstetrician/gynecologist during cesarean delivery. The surgeon did not know he had HIV and had never been tested. After it was realized he might have infected his patient, he said he recalled pricking his finger on a needle during the operation. Spanish officials conducted a look-back evaluation of the physician’s patients. Of 275 patients on whom the practitioner had performed procedures, 250 could be tested, and none were found to be infected.


Next let’s discuss occupational transmission of HIV infection. **Documented** or confirmed cases of occupationally acquired HIV/AIDS require documentation that seroconversion in the exposed healthcare worker is temporally related to a specific exposure to a known HIV-positive source. **Possible cases** of occupationally acquired HIV/AIDS are defined as infections in a healthcare worker whose job duties might have exposed the HCW to HIV but who lacks a documented workplace exposure. If the HIV status of the source patient is unknown or the HCW’s seroconversion was not documented as temporally related, occupational acquisition is possible but cannot be confirmed.

Of those healthcare personnel for whom case investigations were completed from 1985-2013, **58 had documented seroconversion** to HIV following occupational exposures. The routes of exposure resulting in infection were: 49 percutaneous (puncture/cut injury); 5 mucocutaneous (mucous membrane and/or skin); 2 both percutaneous and mucocutaneous; and 2 unknown. Forty-nine (49) healthcare personnel were exposed to HIV-infected blood; 4 to concentrated virus in a laboratory; 1 to visibly bloody fluid; and 4 to unspecified body fluids. In addition, **150 possible cases** of HIV infection have been reported among healthcare personnel. Since 1999, only one confirmed case (a laboratory technician sustaining a
needle puncture while working with a live HIV culture in 2008) has been reported.

It is important to mention that this surveillance system is voluntary and thus passive in nature. Because of the voluntary nature of the reporting system, there is likely underreporting of cases, and the relatively low numbers of documented and possible cases may not reflect the true numbers of cases in the U.S.  *(See Required Reading #2)*

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| Occupations Acquiring HIV/AIDS | \*Nurses (24; 37) \*Clinical lab (16; 21) \*Physicians, non-surgical (6;13) \*Lab tech, non-clinical (4; 8) \*Housekeeper/maintenance worker (2; 14) \*Technician, surgical (2;2) \*Entomologist/morgue tech (1;2) \*Hospice caregiver/attendant (2;16) | \*Respiratory therapist (1;2) \*Technician, dialysis (1;3) \*Dental worker including dentist (0; 6) \*EMT/paramedic (0; 12) \*Physician, surgical (0; 6) \*Other technician, therapist (0; 9) \*Other healthcare occupation (0; 6) |

On this slide is a breakdown of healthcare personnel with **documented** (number listed first) and **possibly occupationally acquired** (number listed second) HIV/AIDS between 1985-2013. The most recent possible new case of occupationally acquired HIV reported to CDC occurred in 2009; no new documented cases have been reported since then, although several cases are currently in various stages of investigation. There are usually delays between the exposure and the reporting of the case to CDC. The number of possible cases may decrease if individuals are reclassified when a non-occupational risk is identified or may increase if new cases are reported. More than 90% of healthcare personnel infected with HIV have non-occupational risk factors reported for acquiring their infection.

*You do not need to know exact numbers, but should be able to recognize which occupations have higher numbers of documented transmission.*

**Source:**
http://www.cdc.gov/hiv/workplace/occupational.html
Let’s break down HIV seroconversion risks post-exposure. In prospective studies of healthcare personnel, the average risk of HIV transmission after a percutaneous exposure (NSI) is estimated to be approximately 0.3%. The average risk for occupational HIV transmission after a mucous membrane exposure (e.g., a blood splash to nose, mouth, eyes), is between 0.09 to 0.1%. The estimated risk from a blood exposure to skin, is less than 0.1% but this has not been precisely quantified. Remember, these estimates are based on the reported voluntary surveillance data.

On the CDC website entitled “Occupational HIV Transmission and Prevention Among Health Care Workers”, updated last on June 22, 2015, they state the following: “Health care workers who are exposed to a needlestick involving HIV-infected blood at work have a 0.23% risk of becoming infected. In other words, 2.3 of every 1,000 such injuries, if untreated, will result in infection. Risk of exposure due to splashes with body fluids is thought to be near zero even if the fluids are overtly bloody. Fluid splashes to intact skin or mucous membranes are considered to be extremely low risk of HIV transmission, whether or not blood is involved.”

Source: http://www.cdc.gov/hiv/workplace/occupational.html

As many resources are before June 2015, please use the 0.3% for the answer to the question of the risk of acquiring HIV from a needlestick injury, until notified otherwise.

There are risk factors that have been identified for seroconversion for HIV post-exposure. These include deep injury from the contaminated sharp object, exposure from a visibly bloody device, the device that caused the exposure was in an artery or vein, and the stick occurred from a terminally ill source patient. So what does it mean when it says the odds ratio for deep injury is 15? If you are stuck from a HIV positive individual, and the injury is deep, there is a 15 times greater chance of seroconversion than if the injury is not deep. If it is a visibly bloody device, the seroconversion risk is 6.2 times higher, if the device is in an artery or a vein, 4.3 times higher and if the source patient, is terminally ill, then it is 5.6 times higher. Note what happens if a HCW gets post exposure prophylaxis: there is a 0.19 odds ratio. This means that someone who receives AZT, for example, after an exposure is about 1/5 less likely to seroconvert than someone who does not receive AZT. This is the good news about HIV.
exposures- there is effective post exposure-prophylaxis available.

**Slide 33**

Other Likely Risk Factors
- Viral load
- Glove use
  - 50% decrease in volume of blood transmitted
  - Hollow bore vs solid bore
    - Large diameter needles weakly associated with increased risk (p = 0.08)
- Drying conditions
  - Tenfold drop in infectivity every 9 hours

Other factors that were found to be likely risk factors in 2 other studies are viral load, glove use, use of a hollow bore vs. a solid bore needle, and environmental conditions from drying. Viral load is one of the greatest risk factors—the higher the load, the higher the seroconversion risk post-exposure. Regarding glove use, if you use one pair of gloves, and that needle goes through the glove, there is a 50% decrease in the volume of blood that is transmitted. If you wear 2 pairs of gloves, it is even more. A large diameter needle (e.g., hollow bore) is weakly associated with an increased risk. As the virus dries, there is a tenfold drop in infectivity every nine hours, and that is why environmental transmission is so unlikely. So for HIV, there is no working vaccine, no pre-exposure treatment, but there are several different combinations of anti-virals available post-exposure.

**Slide 34**

Summary
- Epidemiology of HBV, HCV, HIV
- Surveillance & relevance to healthcare workers
- Seroconversion risks post-exposure

In part 1, we have discussed the epidemiology of HBV, HCV and HIV, surveillance and its relevance to healthcare workers, and seroconversion risks post-exposure.

*This concludes Week 11, part 1.*