Welcome to part 2 of 2 for Week 11’s, “Bloodborne Pathogens and Needlestick Injury Surveillance”.

Let’s start with some definitions. Needlestick injuries or NSI are a break in the skin by a sharp object or a needle, which is contaminated with blood or body fluids. If someone sticks themselves with a needle that has been used to draw up a sterile medication but has not yet been used on a patient that is not a contaminated needlestick injury. There are several other terms for NSI including percutaneous exposure, or PE; percutaneous or puncture injuries, PI; and sharps injuries, or SI.

A blood exposure refers to a splash to the mucous membranes or non-intact skin by a patient's blood or body fluids when personal protective equipment is either breached or not worn.

Sharps devices designed for safety have been called “safety devices” or “safer needle devices”. However, the formal term designated by the Occupational Safety and Health Administration or OSHA for these are devices with engineered sharps injury protection or ESIP.

Now we are going to discuss needlestick exposures in the healthcare setting that can result in bloodborne pathogen infection.

There are numerous consequences of NSI. First is the chance or even the fear of the chance of acquiring an infection or disease as a result. Side effects of post-exposure prophylaxis (PEP) medications can be a problematic consequences of an NSI, particularly for HIV exposures. There are exposures to other entities than bloodborne pathogens, depending on what was in that needle, and we will talk about that in a few more slides. Although occupational transmission of HIV or hepatitis is relatively rare, the risks and costs associated with blood exposure are high. The cost varies depending on the status of the source patient and the exposed HCW. Some of the direct costs of sharps injuries are those associated with the initial and follow-up laboratory testing and treatment of exposed healthcare personnel. Costs that are harder to quantify include direct and indirect costs associated with potential side effects of antiretroviral therapies and lost time from work, time lost to completion of paperwork and follow-up (including obtaining informed consent for source patient testing). The emotional distress that not only the injured person, but their family members and friends have to go through does not have a numerical dollar value. The societal cost refers to possible loss of a worker's services in patient care, the economic burden of medical care, any worker’s compensation claims due to injury and exposure, and the cost of any associated litigation. There are also liability issues. Did the institution provide a safety device, were devices readily available, did the device malfunction, did the employee fail to use the device or use it incorrectly.

All of these infections on this slide have been documented to be transmitted via a sharps injury during patient care and/or a laboratory accident or during autopsy.

As mentioned previously, there is concern with an NSI based on what was in the needle or on the sharp device. Perhaps someone gets a needlestick while administering a chemotherapy agent to a cancer patient. The patient obviously needs that chemo, but the health care worker does not. So if they get stuck and some of that material gets injected
into them that is a hazard. The same goes for a radioactive agent. There are many chemicals used in a healthcare setting.

**Slide 6**

In order to conduct surveillance on needlestick injuries, we must rely upon these incidents to be reported by the healthcare worker. On this slide is a picture of an iceberg with reported injuries in the top or “tip” of the iceberg and those not reported making up a large base. There are a certain number that are reported, and then a large percentage that are not. Estimates in the literature range between 40% to 70% of needlestick injuries overall not being reported, with different rates found between categories of healthcare workers.

**Slide 7**

When I was at Santa Clara Valley Medical Center in San Jose, California, I wanted to look at how much reporting was done in our hospital. This was **before** I went into the doctoral program.

The objectives of this project were to determine if health care workers were reporting all of their exposures, both needlestick and blood exposures. Not only that, we wanted to use the data to design appropriate interventions to improve reporting. If you remember, when conducting surveillance, the data need to be used to improve practices. In any opportunity where there was teaching of health care workers, I handed out a survey and they were not asked to put their name, only their job classification, on it. I handed those out between 1992 and 1995, and I received 549 surveys back. What I did not record was how many I handed out, so I do not know what the return rate was. (*That is important to know for validity purposes.*)

**Slide 8**

The questions on the survey were: How many needlestick injuries or mucocutaneous exposures have you had in the last 5 years; of those, how many did you report; and if you did not report, please explain why?

**Slide 9**

Here is a summary of the results. Of those 549 returned surveys, 45% reported **no injuries**, 30% reported that they **did** report all of their injuries, and 26% **did not** report all their injuries. Because the job category was listed on the survey, we were able to determine an overall underreporting rate at this hospital to be 46%, in nursing it was 45%, and in physicians, 80% did not report. When I wrote this up for publication, I conducted a literature review on reporting of needlestick injuries in physicians and it fit the same pattern. Between 60 and 80, sometimes up to 90% of physicians underreported their exposures.
When you examine the reasons for not reporting these exposures, 55 (39%) said it was a sterile/clean needlestick. When we asked employees what is a clean needlestick, the answer was it was in an IV tubing, and/or and I did not see any blood on the device or the device was not used to enter blood. That is not a clean or sterile needlestick. There can be microscopic blood in IV tubing or in tissue or there could be other pathogens. That showed us that people did not even realize what the definition was for a contaminated percutaneous exposure and this also related to risk. Thirty-seven (26%) said there was no risk to them, or there was very little, so they did not report it, 12 (9%) said they were too busy, 11(8%) said they did not like what they had to go through to report exposures (e.g., going to employee health or to the emergency room when employee health was not open), and 18% had no response to why they did not report exposures. We were concerned with this information, and if you think back to the objectives of this survey, the second one was to formulate interventions to improve the reporting.

We realized that one of the reasons that HCWs did not report indicated that they needed more education. They needed more information on what are the risks for seroconversion for those three pathogens, and what was a sterile needlestick vs. a contaminated one. If they were dissatisfied with the follow up procedures, we needed to address that because that might make people report more in the future. The results illustrated to us, the importance of targeting prevention efforts to specific groups that are NOT identified by routine reporting, such as physicians, because we could be missing valuable information. Finally, we found that if we applied 3 interventions: education, decreasing the wait time for reporting report exposures, and standardizing the protocol for how exposures were managed, then this might decrease the reasons of being too busy, not understanding the risk and dissatisfaction for not reporting exposures.


Some employees may ask, why should I report an exposure? There are compelling reasons why. First of all, if it is a bloodborne pathogen that there is post exposure prophylaxis for, you can receive it. If you do not report it, you will not receive it. If you don’t receive it, there is more of a risk of seroconversion (for HBV & HIV). Let’s say in the unfortunate event that you do acquire a bloodborne pathogen, if you did not report it you will not be able to receive Workers Compensation for the condition or paid treatment at the healthcare facility where the exposure occurred. On the statistics and surveillance sides, the more people that report, a more accurate the assessment of the risk of seroconversion can be estimated. Think for a moment, about the 60-90% of physicians that do not report exposures. There may be some valuable information that is being missed, that could perhaps be used to prevent future NSI in that group. So those are reasons to report NSI and blood exposures.
Who conducts NSI surveillance? Many hospitals conduct their own surveillance.

Two acronyms you should be familiar with when talking about NSI surveillance are EPINet & NaSH. EPINet, or Exposure Prevention Intervention Network, is a system developed by Dr. Janine Jagger from the University of Virginia health care system. If hospitals volunteer their data in this system, then they will be included in the surveillance. Every year the number of hospitals that are in that system varies. EPINet uses standardized forms to describe the exposure, where it occurred, and what category of sharps device was being used. *(You saw these forms in Week 6).*

CDC developed a surveillance system, the National Surveillance System for Health Care Workers (NaSH) that focused on surveillance of exposures and infections among healthcare personnel. This was operational from 1995 through 2007. Many of the graphs used in this lecture are from the CDC Sharps Injury Workbook and contain NaSH data.

NaSH has been replaced by the Healthcare Personnel Safety (HPS) Component of the National Healthcare Safety Network (NHSN). The Healthcare Personnel Safety (HPS) Component of the National Healthcare Safety Network (NHSN) was launched in 2009. The component consists of two modules: 1) Healthcare Personnel Exposure; and (2) Healthcare Personnel Vaccination. The Healthcare Personnel Exposure module includes: Blood/Body Fluid Exposure Only; Blood/Body Fluid Exposure with Exposure Management; and Influenza Exposure Management. The Healthcare Personnel Vaccination module includes: Influenza Vaccination Summary. *(This was also mentioned in Week 6.)* *(There are no publicly available national reports from NHSN on healthcare personnel exposure surveillance data to date.)*

The Needlestick Safety & Prevention Act of 2000 has required that hospitals collect these data. If you remember back to weeks 2-3, we talked about mandatory reporting. There may be laws that require reporting, but unfortunately that does not mean that reporting will occur. So that is a potential issue when trying to standardize sharps injury surveillance.

Next let’s cover the epidemiology of needlestick injuries. When we do that we are talking about the who, what, where, how many, reasons, and consequences (we have already covered the consequences). *It is very important to mention here that one can go into numerous websites and publications and find charts with data that differ from those presented in this lecture.* This is one of the challenges in making general statements about surveillance for sharps injuries and blood exposures.

It is estimated that there are between 600,000 to 800,000 blood exposures per year in health care settings. CDC estimates 384,325 per year in hospitals and when you combine hospitals and other health care settings, the estimate goes up to 600,000. As of 2007, 15 NaSH and 29 EPINet hospitals (teaching & non-teaching) were conducting surveillance with voluntary systems and they factored in a 57% underreporting rate. An underreporting rate refers to that percentage of exposures that are estimated to NOT be reported.

Who sustains NSI? Data from NaSH between 1995-2007 show that nurses sustain the highest percentage of percutaneous injuries. However other patient-care providers (such as physicians and specialized technicians), laboratory staff and support personnel (such as housekeeping and maintenance staff) are also at risk.
What types of exposures are occurring? This pie chart shows the types of exposures to blood and body fluids reported to NaSH between June 1995 and December 2007. There were 30,945 exposures reported, with percutaneous exposures accounting for 82% followed by exposures to mucous membrane exposures (14%), non-intact skin (3%), and bites (1%). Contacts with intact skin and clean needlesticks are excluded, because they are not considered exposures.

Where do percutaneous & mucocutaneous exposures occur in healthcare settings? From the same time period of the previous slide, of 30,881 exposures, the breakdown of location was as follows: in-patient (36%), operating room (29%), procedure rooms (9%), outpatient (8%), Emergency Room (8%), labs (4%), other (5%), waste/laundry/central supply (1%). (In the hospital that I worked at for 15 years, the area with the highest needlesticks every month was the OR). The breakdown of inpatient areas is: medical/surgical ward (19%), intensive care unit (12%), pediatrics ward (2%), 1% each obstetrics & gynecology, psychiatry, and nursery. Exposures in the jail units are under 1%.

Continuing with the epidemiology of needlesticks, what are the determinants, what activities contribute to those needlesticks? NaSH data of NSI with hollow-bore needles from 1995 to 2007 show that 52% of NSI occur during use; 19% occur after use, but before disposal; and 22% occur during or after disposal. 27% of these NSI occurred while the needle was inserted, moved or removed from the patient. Work practices contributing to NSI were needle recapping (5%), transferring or processing specimens (5%), and improper disposal (8%).

What devices are causing the exposures? This chart shows the distribution of devices involved in the percutaneous injuries reported to NaSH. Out of 25,324, 55% were hollow bore needles, and 41% were solid sharps (which include suture needles, scalpels, and other). Of the 55% due to hollow bore needles, that category could be further subdivided as follows: hypodermic needle (30%), winged steel needle (12%), IV stylet (4%), vacuum tube needle (3%), and other hollow bore needle (6%). Although many types of sharps injure healthcare personnel, aggregate data from NaSH indicates that the 6 devices...
responsible for nearly 80% of all injuries are: Disposable syringes, suture needles, winged steel needles, scalpel blades, intravenous (IV) catheter stylets and phlebotomy needles.

**Slide 22**
The Needlestick Safety and Prevention Act of 2000 resulted in a revision of the OSHA Bloodborne Pathogens Standard. There are some important requirements of this standard that the employer must meet. The first is to evaluate available engineering controls (devices with ESDIP). (We learned about engineering controls in Week 10’s occupational health for healthcare workers lecture). Next, they have to train employees on how to use such devices. Third, every year, new devices have to be reviewed. It does not say what that review consists of, how to do it, or how long it has to take. Finally, it requires employers to implement new device use as appropriate and available.

**Slide 23**
The Needlestick Safety and Prevention Act provided a surveillance requirement that also was incorporated into the revised OSHA BBPS. (*This is important to know*). It requires the facility to keep a sharps injury log which contains at a minimum: 1) type and brand of device. Was it a syringe, a suture needle, a recapping device? What is the brand of that device? (e.g., retractable syringe from Becton Dickinson or a safety butterfly needle by Terumo) 2) department or area where incident occurred (e.g., in surgery, patient care room, the trash, the laundry)? 3) A description of the incident. When this first came out, we conducted a small study to see how well this information was being recorded in our hospital. I was in California and their law came out one year before it did nationally, so we had a little head start. We found that the type and brand of device was infrequently being reported. Particularly the brand of device because most HCWs do not know the brand. Or, if it was a housekeeping/maintenance/facilities management employee stuck by a device left around or improperly disposed of in the trash, they would not ever know this information. Because it was manageable at that time, what we did to improve this problem was to place samples of the devices being used in the hospital on a big display board. Then, when employees got stuck, and reported to Employee Health, we would have them point to which object they got stuck with. There are too many available devices now for this to be a feasible strategy however.

**Slide 24**
Sharps devices can be divided into 6 categories. Phlebotomy devices are ones that you use to draw blood. (Intravascular devices) (Intravenous catheters or intra-arterial devices stay in the vein or artery and deliver some kind of medication, or are used for pressure monitoring in intensive care units). Pre-filled medications are usually on a crash cart, so in a code if you need epinephrine or sodium bicarbonate, it is already drawn up and packaged for quick delivery of the desired medication. Syringes (numerous gauges sizes for needles, lengths of needles and capacity sizes of barrel of syringe) are available. I.V. access systems are lines and tubings that get attached to an intravenous catheters to deliver medication or draw blood. The last category is the miscellaneous category which includes sharps containers, devices to recap needles in a one handed motion, and other devices that do not fit into the first 5 categories.
Slide 25 | There are numerous different designs of safer needle devices. A few of them are shown here. The one on the top left is a syringe with a sliding sheath, after you use the needle, the sheath slides over the needle. Some of them lock, so you can not pull it back open. When we got this particular type of design in California, we looked at two, one that locked and one that did not lock. The nurses wanted the one that did not lock because they wanted to draw up the medicine, pull it back, walk to the patient, give it, then lock it. The design on the right has retractable technology, after you use the needle and press on the top of the device, the needle goes back up into the casing. The bottom left is a winged safety steel needle, also known as a “butterfly” (because of the wings on each side of the needle). With this particular safety butterfly, one can slide the device forward over the needle after use. There are numerous different butterfly devices with differing safety mechanisms currently available on the market.

Slide 26 | The device on the left is a syringe with a protective shield that slides over the needle when the injection is completed. That design is less expensive than the one in the middle. The one in the middle has springs in it, so when you press on the plunger, the needle gets retracted back into the syringe. The one on the right has an interesting design. If you look at the close up you can see that. This can be used for drawing blood or giving an injection. Instead of pulling something back, a blunt edge is pushed forward after you have gone into the vein to draw blood. Or into the muscle to inject if someone does have contact with the tip after that, it is blunt and it is not going to penetrate the skin. The CDC conducted a very large clinical trial with a steel safety butterfly and this device on the far right, as well as one other type of needle used to draw blood. Interestingly, the design with the least number of needlesticks was the one on the far right.

Slide 27 | There are several types of sharps devices with engineered sharps injury protection (ESIP). Sharps with engineered sharps injury protection (ESIP) have a non-needle sharp or a needle device used for withdrawing body fluids, accessing a vein or artery, or administering medications or other fluids, with a built-in safety feature or mechanism that effectively reduces the risk of an exposure incident. I find the categories on this slide a useful way to conceptualize the different designs. First, there are engineered vs. substitution devices. The syringe with a sheath that slides over the needle, is an engineered device. A substitution device would be one where you are not using a needle, and there are some of those for entering IV lines. So you are substituting the needle with something else to get into an IV line to either deliver the medication or to get blood samples. Another way you can categorize devices with ESIP is active vs. passive. With an active device, the HCW must do something to activate the safety mechanism, e.g., push a button, move a sheath, move a part of the device, etc. Active devices can be two-handed or one-handed. Obviously, a one-handed device would be desirable as it does not require the user to move both hands towards the needle. The most desirable of all, is a device that is passive, and one that automatically does whatever it needs to do. Many companies advertise their product as passive when they are not. They say it is passive because you only have to press a button to make it work. If you have to press a button to make it work, it is not passive. The device illustrated on the previous slide on the far right is the closest to a passive device that I have seen. The act of drawing blood or entering the vein pushes the blunt tip forward.
This is something that I put together for my dissertation. What I was looking at was when health care workers reported a needlestick injury and what their perceived risk for that was. This is a range of risk depending on the device, and it goes from low to high. On the low end, if you have a sterile needle, the risk of acquiring a bloodborne pathogen is very low. With a pre-filled medication on a crash cart, or a clean needle that you took out of the package and put it into a sterile container, you have a much lower risk of getting a bloodborne pathogen infection. In the middle, there is a needle that goes into an IV line. Well maybe that line had no visible blood in it, or maybe it was microscopic, it might have some risk so it falls in the middle risk category. If you give an injection the way you are taught to give an injection into a muscle, you withdraw first to make sure you are not in a vein and there is no blood and then you give it. If that is the case and someone pulls back and they are in a vein and they get stuck with that there is a greater risk of seroconversion. On the higher risk end, is a catheter that goes in an artery or vein, or a device that draws blood. So just to give you a little perspective, yes there are a lot of devices, but some of them have a higher risk after a needlestick than others.

In the first class on core concepts, we learned about the uses of surveillance. What are some of the uses of a facility’s own NSI surveillance data? Why I think we need to talk about facilities doing their own is because that is the reality today, facilities do their own surveillance. So the first use of NSI surveillance is to regularly monitor these data to identify trends and/or possible “hot spots” of exposures. What devices, what personnel, what areas, what procedures are being affected? Next, the surveillance data need to be used to guide or direct educational prevention efforts. Where do educational efforts need to be targeted to prevent future needlesticks? The surveillance may be used to identify “system” problems. For example, maybe the facility has certain devices but they are not readily available. They could be on different locations on different floors, so staff who float between units may not be able to consistently locate devices. Or for a given floor, they may not be easily accessible. Finally, another use of NSI surveillance data is to comply with mandates and a perfect example is the OSHA BBPS. We learned about benchmarking in the first two weeks of the course. For a facility to be able to use benchmarking with another facility or national standard, the data must have been collected using the same definitions. As many institutions use their own definitions and there are a variety of denominators used for this type of surveillance, it is difficult to use benchmarking with NSI surveillance.

Let’s discuss some problems with NSI surveillance. We already mentioned that there has not been a mandate to collect NSI data with a sharps injury log until 2001. OSHA mandates that facilities keep a sharps injury log, but OSHA does not collect these data and there have been no national reports of data presented since this standard came out. If a facility goes through an OSHA inspection, they might ask to see the log but they do not require submission of the sharps injury log. It is important to realize that one of the reasons for the sharps injury log is to determine if there are some devices that are involved in more NSI than others, to be able to identify that and to use that information to prevent future exposures. There is a lack of standardized definitions for blood exposures and a variety of ways to determine rates. Surveillance is passive; it is mandated but you cannot make someone report an injury. The underreporting problem has been well documented, contributing to incomplete surveillance information. Imagine all of the data from sharps injury logs that have been available since 2002, and not knowing what those data are. That is why it is imperative that facilities at least conduct their own surveillance,
feed the information back to those who need to know it, and design education and intervention to prevent future NSI.

Slide 31
As a result of what has been found from conducting needlestick injury surveillance, there are recommendations that have evolved. The first is to immediately or as soon as possible after use, to dispose of all sharps in the nearest sharps container. It is quite troubling when housekeeping, maintenance or other categories of personnel get stuck by a contaminated needle because the initial HCW using it did not dispose of it properly or at all. The second recommendation is NOT to recap used needles (more about that on the next slide). Paying attention to self and others while carrying sharps, particularly in an emergency situation (e.g., a crowded room with numerous HCWs trying to work on one patient), a lot of people around the bed, and you need to be careful when passing sharps. Getting help with uncooperative patients is important, as they may move or jump when you do a procedure with a needle or other sharp. In the 15 years I conducted needlestick injury surveillance, between 7-15% of needlesticks every year were in this one category, "patient moved during procedure". Whatever products your facility has evaluated and brought in for safety, should be used. A basic rule of sharps safety is to avoid moving a hand towards the sharp item.

Slide 32
Regarding recapping a used needle. Look at the very small space into which the needle has to be aimed. This is why recapping is such a dangerous procedure. My dissertation was entitled “Sharps Injuries and Needle Safety Practices among Home Care Nurses”. Please allow me to share some interesting findings in relation to this topic. When I asked home care nurses why they recap needles, many stated that they did not want people in the home to get stuck if they put a sharp down on a table or other household surface. They could not consistently count on a sharps container being in the home, for numerous reasons. Thus, some HCWs were thinking of others when they recapped needles. I also found that home care nurses who had sustained a needlestick injury from recapping did not recap any longer.

Slide 33
As long as sharp devices must be used to access blood, there will be a risk of occupational transmission of HBV, HCV, & HIV. At any one time, there are over 1,000 medical devices on the market (which includes other devices than needles). What I have learned is that just because something is labelled a “safety” or “safer” device, does not necessarily guarantee it is safe. It could be a wonderful design, but if HCWs are not trained on how to use it, or if it does not work correctly, it may not prevent needlesticks. One of the worst things for me, as a practicing infection control professional, was to see a health care worker get stuck with a "safer" needle device.

Slide 34
There are challenges for needlestick injury surveillance and devices with ESIP. The more we use these re-engineered devices, the more injuries will be caused by them. Why is that? Needles still have to be used to penetrate the skin and most still require activation after use. The HCW still has to DO something to many of the devices for the safety mechanism to be activated. There are some challenges with collecting surveillance on safer needle devices as required by the revised OSHA BBPS. The more successful we become at preventing NSI’s, the longer and more difficult it will be to demonstrate the efficacy of these devices. A needlestick, in terms of statistics, it is a rare event. (On the contrary, as a human event, for even one person who gets stuck it is catastrophic.)
injury rates from sharps decrease, a larger number of devices will need to be tested. No one facility can test all devices, there is just not enough time.

| Slide 35 | Let’s summarize the information you need to retain from these two sets of lectures regarding HBV, HCV & HIV. For HIV, there is no vaccine and no preventive therapy, but there is post-exposure prophylaxis (PEP). The HIV seroconversion risk after an NSI is 0.3%. For HCV, there is no vaccine, no preventive therapy and no PEP. The risk of seroconversion following an NSI is about 1.8% (with ranges of from 0-22% reported). For hepatitis B, there is a preventive vaccine available. After an exposure, the vaccine can be given to those who did not already receive it, as well as hepatitis B immune globulin. The HBV seroconversion risk following an NSI ranges between 6% -30%.

This ends part 2 of 2 and this week’s lecture material. |