

OR: Safety in the Operating Room and Other Areas Where Invasive
Procedures Are Done

3 Contact Hours

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PURPOSE OF THE COURSE:

The purpose of this course is to provide the learner with the knowledge and skills necessary to effectively provide perioperative care and services that ensure the safety of the patient as well as the healthcare workers in the team. Sharps injuries, surgical smoke, medical waste management and disposal as well as unsafe work practices place patients and healthcare professionals at high risk. These risks can lead to prolonged lengths of stay, increased healthcare costs, pain, death and a decreased quality of life for those affected by them.

This content of this course contains the current principles of OR safety, OSHA regulations and how to integrate these principles into practice, personal protective equipment, sharps and sharps injuries, surgical smoke and the proper disposal of biohazardous liquid waste.

Objectives:

- 1) Detail the Occupational Safety and Health Act (OSHA) requirements as related to the OR, the delivery room and other areas where invasive procedures are done.
- 2) Discuss various types of personal protective equipment and their indications for use.
- 3) Identify the risks associated with and some procedures and pieces of equipment that can prevent sharps injuries.
- 4) Relate the dangers of and ways to avoid surgical smoke risks.
- 5) Describe the proper way to dispose of biohazardous liquid waste in the OR and delivery rooms.

OSHA Regulations: Bloodborne Pathogens

All pathogenic microorganisms that are found in human blood and other bodily fluids which can cause disease in humans are referred to as *bloodborne pathogens*. Bloodborne pathogens include viruses, such as the hepatitis virus and the human immunodeficiency virus (HIV), bacteria, parasites and other microorganisms.

Although hepatitis and HIV are the most commonly encountered bloodborne diseases in healthcare today, malaria, a parasitic bloodborne disease carried and transmitted by mosquitoes and syphilis, caused by *Treponema pallidum*, a spirochete, are also bloodborne pathogens.

Since the 1980s, our government's Occupational Safety and Health Administration (OSHA) has been actively involved in efforts to protect the safety of healthcare workers in respect to bloodborne pathogens. In 1992, their prior calls for voluntary compliance became law. Since then all healthcare facilities are compelled to follow all elements of their Final Standard that includes requirements relating to:

- Exposure Determination and Documentation
- Exposure Control Plans
- Engineering Controls
- Work Practice Controls
- Handwashing
- Standard Precautions
- Personal Protective Equipment
- Sharps and Sharps Disposal
- Hepatitis B Vaccine
- Post-Exposure Prophylaxis
- Employee Education and Training

Exposure Determination and Documentation

OSHA regulations require that healthcare facilities identify and analyze all job classifications and all tasks within the scope of each job classification, or job title, which potentially place healthcare workers at risk for occupational exposure, without consideration for the use of personal protective equipment and the protection that such items offer. Some or all incumbent employees for each job title may be at risk for occupational exposure to bloodborne pathogens.

For example, a person whose job classification requires that they clean contaminated medical equipment and supplies is at risk for an

occupational exposure to a bloodborne pathogen. Although this person significantly reduces their risk for occupational exposure when they wash their hands properly and they use personal protective equipment, such as gloves, the task itself, i.e., cleaning contaminated medical equipment does place a person at significant risk when the use of personal protective equipment, such as gloves, is NOT considered.

Exposure Control Plans

Once the healthcare facility identifies and analyzes all of these job classifications and the tasks within each, the facility must then establish methods and procedures that can decrease or eliminate the risk of exposure. These established methods and procedures must be documented in the healthcare facility's *exposure control plan*.

OSHA requires that this plan be generated and documented in order to minimize or eliminate the risk of occupational exposures to bloodborne pathogens when healthcare workers perform their role. For example, the healthcare facility's exposure control plan may establish that handwashing and the use of gloves are indicated for phlebotomy and that the use of gowns and gloves, in addition to handwashing, is necessary to protect workers who clean reusable contaminated medical supplies that not intended for single use.

This Plan must:

- be readily available and accessible to the employees of the healthcare facility;
- reflect the "input from non-managerial employees responsible for direct patient care who are potentially exposed to injuries from contaminated sharps in the identification, evaluation, and selection of effective engineering and work practice controls and shall document the solicitation in the Exposure Control Plan." (OSHA, 1992);
- revised and updated at least annually and as often as necessary to incorporate new job roles, technological advances and new research findings relating to potential exposures;
- be enforced and reflective of "appropriate commercially available and effective safer medical devices designed to eliminate or minimize occupational exposure" (OSHA, 1992).

Clearly, the successful prevention of occupational exposures against bloodborne pathogens must be a continuous, collective and collaborative effort of those front line employees who are at risk as well as representatives from the agency's management and administration staff.

Product selection committees, infection control offices and other personnel, who participate in or coordinate the selection and/or "pilot testing" of safer medical devices, must encourage and facilitate sound, knowledgeable decision making using valid data over a sufficient period of time. Pilot testing and selection should be viewed as research driven processes, not arbitrary ones based on opinions and esthetics, rather than data. Unfortunately, this is often not the case. Product pilot testing and selection should be a planned process that also includes the incorporation of inservice education aimed at training the employees about the new product and its proper use.



In terms of invasive procedure products in the OR and other areas, product selection begins by identifying and understanding the specific causes of occupational exposures. For example, in the OR, sharps injuries and occupational risk occur during one of these four crucial and commonly occurring actions:

- 1) *During the assembly and disassembly of sharps.* Examples include the repositioning of a needle in a needle holder and mounting a scalpel blade on its handle.
- 2) *Transferring sharps between and among healthcare workers.* This risky action occurs, for example, when a nurse directly hands a scalpel to the surgeon hand to hand.
- 3) *While actually using the sharp.* Some examples of risky practices while using sharps include using fingers as backstops while

suturing, holding tissue during the suturing, sewing toward oneself or an assistant, protecting adjacent structures and tissue using one's hand, manual tissue retraction, tying the suture while the needle remains attached, and leaving needles on the surgical field.

- 4) *Disposing of sharps*. Recapping, bending and breaking needles, as well as overfilled and/or inaccessible sharps disposal containers, are examples of risky practices associated with the disposal of sharps.

Engineering and Work Practice Controls

OSHA requires that *engineering controls* and *work practice controls* be identified, documented, implemented and communicated to all staff, in order to prevent occupational risks, including those related to the transmission of bloodborne pathogens in the workplace.

Engineering controls are those preventive measures in the environment of care including all items, equipment and supplies that isolate or remove the bloodborne pathogens. Some examples of engineering controls, known to decrease risk, include specially made disposal containers for sharps in readily accessible areas, single use suction canisters, ample handwashing facilities, labels for biomedical waste, self-sheathing needles and other safer medical devices, such as sharps with injury protections and needleless systems.

Other examples of *engineering controls* include:

- the solidification of potentially infectious medically regulated liquid and semi-liquid wastes such as blood, secretions and other bodily fluids, in suction containers, rather than pouring these medically hazardous wastes into the facility's sewer system which places healthcare workers at risk for splashes, sprays and spills of this waste during handling and disposal of these biohazardous wastes;
- specially designed scalpels with retractable blades and/or rounded tips;
- blunt tipped suture needles;
- surgical staple systems that permit the closing of surgical wounds without the need for sutures and suture needles;

- disposable, single use supplies, such as disposable scalpels, that eliminate the need for decontamination, cleaning and returning instruments to central supply;
- puncture proof sharps containers;
- sharps transfer devices that enable the safe transfer of sharps;
- safely engineered needle capping devices;
- scalpel blade removal systems;
- strainers that facilitate the removal of sharps without placing one's hands in contaminated fluids; and
- effective personal protective equipment that protects healthcare workers from bloodborne pathogens.



Work practice controls, on the other hand, include work performance modifications and alterations that decrease the risk of exposure to bloodborne pathogens. Some work control practices include prohibitions against the recapping of needles, frequent handwashing, the implementation of *standard precautions*, formerly referred to as universal precautions, and the use of a “neutral zone”, rather than hand to hand passing of sharps in the operating room.

In addition to *standard precautions* and scrupulous, routine *handwashing*, other *work practice controls* that minimize and reduce the risk of an occupational exposure to pathogenic bloodborne microorganisms include:

- NOT recapping needles “unless the employer can demonstrate that no alternative is feasible or that such action is required by a

specific medical or dental procedure” (OSHA, 1992) and a specially engineered “mechanical device or a one-handed technique is used”(OSHA, 1992);

- the proper use and disposal of personal protective equipment;
- labeling and disposing of biomedical wastes in the correct manner; and
- the employment of a neutral safe zone for the passing of sharps during invasive procedures and surgery.

Handwashing



Handwashing, the single most effective way of preventing the spread of infection, is emphasized in the OSHA regulations as part of both engineering and work practice control requirements. Healthcare facilities are required to provide ample and readily accessible handwashing facilities for healthcare workers as part of their *engineering control* efforts. When running water is not feasible, they are required to provide antiseptic hand cleansers and clean towels or antiseptic towelettes.

Additionally, healthcare facilities are also expected to have procedures in place that require handwashing before and after each patient contact as well as before and after using of gloves and other personal protective equipment. The use of gloves is not a substitute for proper handwashing. These established, documented and communicated handwashing procedures are examples of *work practice controls*.

Standard Precautions

Standard precautions have replaced previously used universal precautions. *Standard precautions* are grounded on the premise that all bodily secretions are hazardous and protective actions must be,

therefore, used in order to prevent an occupational exposure to blood and other bodily fluids.

Personal Protective Equipment:

Gloves, Masks, Face Wear, Protective Eyewear, Gowns, Aprons, Surgical Caps or Hoods and Shoe Covers or Boots

OSHA requires that, "When there is occupational exposure, the employer shall provide, at no cost to the employee, appropriate personal protective equipment such as, but not limited to, gloves, gowns, laboratory coats, face shields or masks and eye protection, and mouthpieces, resuscitation bags, pocket masks, or other ventilation devices. Personal protective equipment will be considered "appropriate" only if it does not permit blood or other potentially infectious materials to pass through to or reach the employee's work clothes, street clothes, undergarments, skin, eyes, mouth, or other mucous membranes under normal conditions of use and for the duration of time which the protective equipment will be used." (OSHA, 1992)

It is required that *gloves*, hypoallergenic when needed, be readily accessible and used when it is anticipated that a healthcare worker may come into contact with blood and other bodily fluids. Single use gloves, discarded immediately after use, are much preferred over reusable gloves.

OSHA requires that *masks*, in combination with eye protection devices such as *goggles* or glasses with solid *side shields* or chin-length *face shields*, must be worn whenever splashes, splatters, sprays, or droplets of potentially infectious bodily fluids, airborne and/or bloodborne, may enter the eyes, nose, and/or mouth of the healthcare worker.

Your eyes, nose and mouth are the entry way for bacteria and viruses. Many infectious diseases are transmitted when pathogens come in contact with one's face either by direct contact or by airborne proximity. Furthermore, "most infections can be spread before symptoms are present. Exposure to any patient's blood or other bodily fluid through... splashes into eyes and mouth (mucus membranes) increase the risk of exposure" (Tietjen, 1997). Furthermore, "In patients with acute or chronic hepatitis, 1 milliliter of blood may contain 1 million to 1 billion viral particles. A single droplet of blood, especially in the eye, could represent a significant exposure" (Davis, 1999).

As you know from your experience on the frontline where invasive procedures are done, liquids, tissue and other bodily substances spill, splash and spray as a result of and independent of treatments and other manipulation of the human body. The Exposure Prevention Information Network of the University of Virginia Medical School, which collected and analyzed blood and bodily fluid exposure data from 77 hospitals over 2 years, found some very interesting trends that we can all benefit from. These 77 hospitals had 2,833 blood and bodily fluid exposures over this 2 year period of time. These exposures occurred in all areas of the hospital with many types of bodily fluids. Blood was involved in 62% of these exposures. What healthcare provider parts were most affected? Most cases (68%) involved the face of the healthcare provider. The eyes were subjected to the risky exposure in 52% of the cases. The nose and mouth were affected 5% and 11%, respectively. Goggles, eyeglasses, face shields and face masks were not used as they should have been. (University of Virginia, 2002).

Many facilities are wisely incorporating the eyewear standards of the American National Standards Institute (ANSI) into their eyewear selection efforts. ANSI is a nonprofit agency founded in 1918 that has established eyewear related performance standards that address the design, construction and testing of protective eyewear and the safety of the person using it, particularly in areas where solid waste, such as bone chips in the orthopedic operating room, can possibly penetrate some available eyewear products, thus placing the wearer at additional risk.

Protective facial and eyewear products fall into one of five distinct categories:

1. Reusable Protective Glasses

Protective glasses, specifically manufactured for healthcare use, come in a number of different styles and colors. Some have a wrap around design that offers complete protection at the top and on both sides. Other available plastic glasses have side ventilation and are sized so that the wearer is able to use them over their own prescription eyeglasses. Ideally, these personal protective equipment products should:

- Be light weight
- Be easy to use and easy to put on and take off
- Allow for maximum fluid protection by fitting completely against the forehead to protect from above

- Have side protection to protect the eyes from the sides
- Be comfortable, particularly on the bridge of the nose and the ear areas
- Permit clarity of vision without fogging or glare
- Be anti-static
- Have UV protection of 99.9%
- Meet OSHA and ANSI standards

2. Reusable Goggles

Protective goggles should wrap around to completely and closely fit the face and eyes from above, below and on all sides. They can be vented or non vented. Vented goggles protect from impact only. They are generally more comfortable than non-vented goggles. Non-vented goggles have no holes for fumes or fluids to seep through. They, therefore, must have an anti-fog coating to prevent fogging and impaired vision. Ideally, these goggles should:

- Be sturdy and snug-fitting
- Comfortable, easy to use, and easy to put on and take off
- Have high quality, easily adjustable straps to keep the goggles in place
- Have UV protection of 99.9%
- Be anti-static, anti-glare and anti-fogging

3. Solid Side Shields

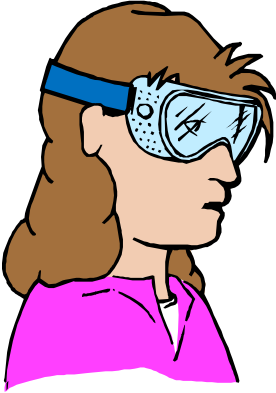
According to OSHA, personal corrective eyeglasses are NOT a substitute for personal protective face shields. Side shields are protective eyewear that can be attached to prescription eyeglasses. They protect the eyes and allow the user to be also able to use their corrective vision eyeglasses. These shields should:

- Be solid and without perforations or vents (with a two piece design containing interior holes for the glasses under the solid outer exterior)
- Be capable of quick application to virtually all kinds of eyeglass frames
- Extend beyond the eyeglasses themselves
- Have an anti-fog coating
- Be anti-static and anti-glare
- Have a snug slide on or clip on application feature

4. *Face Shields*

Face shields are a highly effective and cost efficient way to meet OSHA standards when the contamination of the eyes, nose or mouth is reasonably anticipated. They should:

- Be light weight
- Have a forehead fitting device, such as a foam barrier, that prohibits fluids from entering from above
- Be comfortable and easy to put on or take off.
- Have straps made of Velcro or elastic that permits the user to place the shield securely, snugly and comfortable against the face without leakage
- Be anti-fog, anti-static and anti-glare on all surfaces
- Permit the user to wear corrective eyeglasses and/or a face mask underneath it
- Come in affordable quantities and easy to access packaging that allows convenient and speedy access to them. Some manufacturers distribute these products in a dispenser box that can be placed in areas where procedures that place employees at risk occur most often, for example, in the operating room, emergency room, endoscopy areas, the delivery room and the special care, or intensive care, areas.



5. Face Masks With Eye Shields

Face masks with eye shields creatively marry necessary protective eye shields with face masks. The face mask is integrated into the eye shield with either ties or ear loops, thus allowing the user to have their nose and mouth covered at the same time that the clear splash shield covers the eye area to protect it from splashes coming from below.

This combination product should ideally:

- Have a pleated surgical mask that is fiberglass free
- Have a filtration of at least 90% to 95% at 0.1 micron particles
- Have an anti-static, anti-glare and anti-fog shield that securely wraps around the sides of the face to protect the eyes and face from all sides. (Talikwa, 2002)

Gowns, aprons, and other personal protective clothing, such as plastic, impervious aprons to protect the worker from contamination of their cloth work clothes, surgical caps or hoods and/or shoe covers or boots shall be worn in instances when gross contamination can reasonably be anticipated.

How well are we complying with the necessary and prudent use of personal protective equipment? Sadly, the research, advice and regulations associated with the use of personal protective equipment are not always heeded in the healthcare environment. In one study, it was found that a sample of 104 healthcare providers, including nurses and doctors, were poorly compliant with following the indications for personal protective equipment while they were actively and directly

involved in resuscitation efforts, a medical emergency very often associated with actual and potential splashes, sprays, splatters and droplets, all of which place healthcare workers at great risk for an occupational exposure to a bloodborne and/or airborne pathogen. (Maden, Rentz, Whale, and Flint, 2001).

These researchers reported the following resuscitation compliance rates for the indicated use of personal protective equipment:

- Gloves- 98%, the highest rate of prudent compliance;
- Eyewear of any type- 52%
- Eyewear with side protectors- 9%
- Gowns- 38%
- Masks- 10% (Maden, Rentz, Whale, and Flint, 2001)

In summary, why, with such clear and convincing evidence about the benefits of personal protective equipment and the risk of exposure to infectious microorganisms with nonuse, do so many healthcare workers not use what is available to them? The answer to this question, according to some, is:

- Lack of comfort
- A poor fit
- Fogging
- The cumbersome combination of prescription glasses and eye and/or face protection
- Functionality issues
- Lack of style

Things that help to overcome the barriers relating to the consistent and proper use of personal protective equipment include:

- *Education.* OSHA and prudent logic requires that all healthcare workers who are at risk for occupational exposures to bloodborne pathogens are thoroughly educated about the risks and ways that risk can be minimized or eliminated.
- *Comfort and Ease of Use.* The introduction of products into the workplace that are comfortable and easy to use is probably one of the best ways that employers can facilitate an increased use

of personal protective equipment, when indicated. The best products are ones that the user can don and remove quickly, easily and safely and ones that are comfortable to wear.

- *Effectiveness.* Personal protective equipment should allow the person to effectively and efficiently perform their role with the least disruption. Glasses that fog up and that have no accommodation for prescription eyeglasses are not suitably effective personal protective equipment for obvious reasons.
- *Low cost.* The ideal product is one that is comfortable, easy to use, easy to remove, effective in terms of protection and in terms of allowing the healthcare worker to effectively and efficiently perform their role. It should also be of low cost. The challenge before product selection teams is to select the product or products that best meet these criteria.

Sharps and Sharps Disposal

Sharps injuries are a very costly problem to healthcare facilities. The direct costs of the initial follow-up on an exposure incident can range anywhere from \$250 to \$ 1,500. These costs result from laboratory diagnostic testing, medications, supplies and staff time. When looking at the direct costs of exposures on a national scale, of the 26 million surgeries performed in one year, approximately 7 to 15% of these were associated with needlesticks and other sharps injuries, as observed by an objective observer and data collected. (Davis, 1999)

It is believed that such injuries are not always reported when they occur, so facilities with superlative records of "zero" injuries may want to more closely observe actual practice in order to determine whether these data are reflective of under-reporting and non-reporting, rather than errorless human performance. The same phenomena of under-reporting is a long standing problem in terms of medication errors. Nonetheless, if one uses an average of 10%, this adds up to 2.6 million sharps injuries annually, some of which are reported and some of which are not reported. (Davis, 1999)

If the estimated 800,000 reported injuries involving contaminated sharps is multiplied by a conservative \$500 figure to represent direct costs, it can then be calculated that \$400,000,000 is spent annually for initial follow-up on reported occupational exposures as the result of sharps injuries. Again, this figure does NOT represent indirect costs, such as those associated with lost time from working, the time involved with reporting and investigating incidents, workers compensation payments, follow up pharmacological treatment,

psychological counseling and the recruitment of replacement personnel should an injury lead to work absence or resignation. Significant as well are the immeasurable costs associated with the injured person's emotional distress after a sharps injury. (Davis, 1999)

Of the 600,000 to 800,000 sharps injuries that happen to healthcare workers each year, 21% of them occur in the operating room, an area of very great risk, and second only to individual patients' rooms. The vast majority of these injuries (46%) affect nurses, while 12% happen to physicians. All of these injuries place these healthcare workers at risk for the hepatitis B and C viruses, as well as HIV, potentially life-threatening diseases. Fortunately, these injuries and subsequent infections can be prevented. (Davis, 1999)

Sharps wounds can range anywhere from pin pricks to deep cuts and lacerations. The thumb and index finger of the non-dominant hand are the usual sites of a sharps injury. The next most common sites are the middle finger, other fingers, palm and the back of the hand. The non-dominant hand is the usual target because this hand is most often used to reposition or reach for needles or to hold the tissue while it is being cut or sutured in the operating room and other areas where invasive procedures occur. Scalpels and sutures cause the majority of these sharps injuries. Nurses and scrub personnel are more likely to be injured by scalpels, while suture needles most often injure surgeons. Suture needles account for 75% of OR sharps injuries. (Davis, 1999)

OSHA has issued clear compliance directives outlining the steps that facilities must take to prevent sharps injuries. These directives provide guidance for our healthcare facilities and they also give inspectors guidance on how to cite and penalize employers for failing to evaluate, purchase and implement safer needle devices. OSHA has a long history of citing and fining healthcare employers who fail to implement new and safer technology, as well as safer work practices that prevent sharps injuries.

Further guidance is provided in the Needlestick Safety and Prevention Act (H.R. 5178). This law mandates that employers consider and implement "safer medical devices", such as medical instruments that have built-in safety mechanisms that reduce or eliminate exposure to needles and other sharps objects. This law also requires that healthcare facilities:

- maintain and analyze an accurate log of sharp injuries and

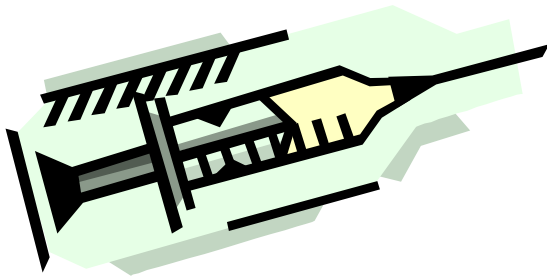
- actively involve front-line healthcare workers who actually use these sharps on a regular, recurring basis, in the selection of safer sharps within the facility.

Preventing injuries is clearly a multidisciplinary effort that involves the active involvement of the healthcare worker closest to the risky task, and not just management. Further details of the Needlestick Safety and Prevention Act are described below.

The first step in achieving surgical sharps safety involves the recognition and identification of which procedures, surgical activities and devices make sharps injuries more likely to occur, thereby increasing the risk of an bloodborne exposure incident. Sharps injuries are most likely to occur when a procedure is:

- *lengthy* in terms of its duration;
- accompanied with *high volumes of blood loss*; and/or
- attended to by *large numbers of personnel* working in close, confined space.

The riskiest surgical procedure is one that is lengthy, with a lot of blood loss and performed with the maximum number of people in attendance. The least risky surgical, or invasive procedure, is one that is brief in terms of duration, and has little or no blood loss and performed by only one person.



Many relatively routine and seemingly innocuous actions and activities that often lead to a sharps injury include:

- *Transfers* of instruments or sharps, such as scalpels, suture needles, etc. between personnel during an invasive procedure. 25% of suturing injuries occur during a transfer.
- *Assembly and disassembly of sharps*. Mounting or repositioning of the needle in the needle holder or placing the scalpel blade in

the handle are examples of assembly and disassembly, risky yet routine procedures. An assistant inflicts 61% of surgical scalpel injuries. 39% are self inflicted.

- *Using a sharp.* Injuries that occur while a healthcare provider is using a sharp include injuries incurred while using a scalpel and simultaneously using the fingers as a backstop or guide and/or when tissue is held during suturing.
- *Disposing of sharps.* Many injuries occur when needles are recapped, when proper sharps disposal containers are not accessible or they filled to the point where they are not safely usable as well as when sharps are being contained and/or transported for cleaning and decontamination.
- *Other risky routines.* Other routine and actions that can lead to a sharps injury include those that involve wire sutures, needles used for injections and intravascular lines, guide wires, trocars, stylets, orthopedic drill bits, pointed scissors, penetrating towel clamps, broken glass and almost anything with a sharp or pointed tip or edge.

Surgical Sharps Safety

Needles, scalpels and other sharps must be handled in a manner that avoids injury. Operating room (OR) personnel, and others who work in areas that perform invasive procedures, should take all the necessary precautions to prevent sharps injuries. Fortunately, there are many devices and procedures that can help us do this. Some of these preventive measures include:

- Handling needles and suturing devices in a safer manner
- Using a *hands-free, neutral zone*
- Substituting safer sharps as alternatives to sharps of greater risk
- The proper handing, removal and disposal of contaminated sharps

Handling Needles and Sutures With Safety

Needles should never be recapped unless absolutely necessary. When a needle must be recapped, it should NOT be done using any technique that directs the point of the needle toward any body part. It should be done, when necessary, using a mechanical device or a one-handed scoop technique.

Needles should also never be bent, unless this bending is a necessary part of a medical procedure. Additionally, used needles should not be removed from disposable syringes nor should they be broken, or otherwise manipulated by hand.

Suture accidents are preventable with the use of:

- devices that safely and securely “park” the needle during repositioning using the non-dominant hand;
- passing trays to facilitate the safe transfer of suture needles among personnel; and
- blunt-tipped, or curved suturing supplies.

The Hands-Free Neutral Zone of Safety

The employment of *hands-free* techniques should be used whenever possible, rather than passing or transferring needles, scalpels and other sharp items from the hand of one person to the hand of another in the OR and other areas. One such *hands free* technique, described by Dr. Mark S. Davis (1999), is called using the “neutral zone”.

About 25% of suture needle injuries and more than 50% of scalpel injuries occur when sharps are being handed to, or passed to, another purpose. (Davis, 1999). The purpose of the *neutral zone* is to eliminate the risks associated with the hand to hand transfers of sharps. Various devices, such as mats, trays, basins and a designated area on the sterile field are used as a neutral zone. The ideal device to serve as a neutral zone should be one:

- of sufficient size to adequately contain all used sharps;
- that is stable and not easily tipped over accidentally;
- easy to be moved safely.

Safer Sharps

The wise selection of alternatives to surgical sharps may significantly lower the sharps injury severity and rates. This selection decision must be carefully thought out and planned prior to each surgical procedure.

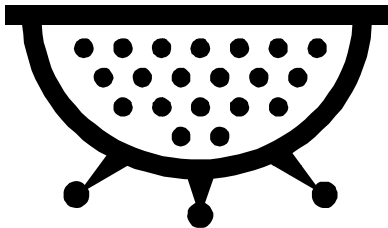
Some of the alternative options that can minimize the risk of injury include:

- *Disposable scalpels*. These products eliminate the need for assembly, disassembly, decontamination and sterilization.

- *Safety scalpels.* Safety scalpels are available with both retractable blades and protective shields. Those that have fully retractable blades, using one hand, can be passed, placed on a tray or neutral free zone and picked up with minimal risk.
- *Scalpels and other items with blunt, rather than sharp, aspects.* Some blunt alternatives to sharps include scissors with rounded rather than pointed tips, scalpels with rounded tips, synthetic rather than wire sutures, blunt tipped suture needles, hemostatic clips, staplers, electrosurgery and lasers as safer alternatives to sutures, and nonpenetrating towel clips.

The Proper Handling, Removal and Disposal of Contaminated Sharps

Contaminated *disposable sharps* should be placed in a puncture resistant container located as close as possible to the point-of-sharps use. *Re-usable sharps* that are contaminated should be contained in a puncture-resistant container that can be used to safely transport these items to an area where they will be decontaminated and prepared for future use. *Needle counter devices* are an excellent way to safely secure these sharps during invasive procedures and closure.



The Needlestick Safety and Prevention Act

5.6 million Americans handle sharps in the healthcare environment. In March of 2001, after the unanimous passage of the Needlestick Safety and Prevention Act in November of 2000, OSHA revised and perfected their bloodborne pathogens standards. These standards were originally put forth in 1991, later updated in 1999 and then again, most recently with this new law. (Fleming, 2001).

This law further defined and clarified engineering controls. Engineering controls now include “safer medical devices, such as sharps with engineered sharps injury protection and needleless systems” (Fleming, 2001, p.13).

It also:

- “calls for employers to solicit input from frontline employees in choosing safer devices to ensure that workers who use the equipment have the opportunity to provide input into purchasing devices;

- requires employers to establish a log to track needlesticks and help both employers and employees identify problem areas or operations. Employers must maintain the privacy of employees who have suffered these injuries.
- Clarifies and emphasizes the importance of employers yearly reexamination of their exposure control plan, as mandated in the original bloodborne pathogens standard. As part of this review, employers must adopt, where feasible and commercially available, safer needle devices- those with engineering controls to protect against accidental needlesticks." (Fleming, 2001, p.12)

According to R. Davis Layne of OSHA, "Safe needles protect workers from deadly injuries. All of us want our nation's health-care system to be as safe as possible." (Fleming, 2001, p.13). According to the Centers for Disease Control and Prevention (CDC), we can prevent "62 to 88 percent of sharps injuries in hospital settings". (Fleming, 2001, p.12).

Hepatitis B and the Hepatitis B Vaccine

OSHA also address and mandates the hepatitis B vaccine in order to protect healthcare workers at risk for an occupational exposure to this commonly occurring bloodborne pathogen. This national regulatory body mandates that this vaccination be offered, free of cost, to all employees, who by the nature of their role within the healthcare facility, are at risk for an occupational exposure. If an employee, for one reason or another, chooses to forgo this vaccine, they must sign a declination statement that is retained by the healthcare facility. If, in the future, a person who had declined the vaccine chooses to get it, the healthcare facility must then provide it to them at no cost.

Post-Exposure Prophylaxis

OSHA has several requirements that must be met when a person within the healthcare agency has been exposed to a bloodborne pathogen. They are mandated to:

- provide the affected individual with a confidential "medical evaluation and follow-up" that includes documentation of the circumstances surrounding the incident, the route or routes of exposure, and the identification of the source individual when feasible and permissible, according to local and state laws;
- test the affected person's blood for HBV and HIV status, pending their consent;

- test the source individual's blood for hepatitis and AIDS/HIV status, with their consent, whenever consent can be obtained. OSHA states that "If consent is not obtained, the employer shall establish that legally required consent cannot be obtained. When law does not require the source individual's consent, the source individual's blood, if available, shall be tested and the results documented. When the source individual is already known to be infected with HBV or HIV, testing for the source individual's known HBV or HIV status need not be repeated" (OSHA, 1992);
- reveal the results of the source individual's HBV and HIV status to the exposed employee;
- provide the employee with post-exposure prophylaxis, as indicated and as recommended by the U.S. Public Health Service; and
- make counseling and other psychological support available to the exposed individual.

Employee Education and Training

Finally, OSHA requires that healthcare agencies provide their employees with education and training at the time a person is assigned to a task that has the potential for occupational exposure and annually thereafter, at a minimum, unless more frequent updates are needed because the healthcare facility has changed a policy, procedure or piece of equipment.

This education and training must be understandable to the participants, with consideration for their level of understanding, literacy and any language barriers. It must include content about:

- Bloodborne diseases, how they are transmitted and the symptoms of them;
- The facility's *exposure control plan* and how employees can obtain a copy of this written plan;
- How to recognize and identify tasks and activities that can potentially place a healthcare worker at risk for an occupational exposure to blood and other body fluids;
- The benefits and limitations of current engineering controls, work practice controls and personal protective equipment;

- The location, proper use and selection, removal, handling, decontamination and proper disposal of personal protective equipment;
- Hepatitis B and the hepatitis B vaccine in terms of its safety and efficacy as well as the route of administration and the fact that it is given to all "at risk" employees for no fee by their healthcare employer;
- What must be done when someone has had an exposure, including reporting;
- The post exposure prophylaxis and medical follow up routine used by the specific facility; and
- Hazardous waste handling and an explanation of associated signs, labels and color coding. (OSHA, 1992)

Surgical Smoke

In the past, smoke or plume was thought only to be a hazard that was associated with laser use, however, smoke is also generated by the thermal destruction of tissue with electrosurgery. This smoke is now recognized as noxious, hazardous and of serious concern to patients and OR staff members alike. Since an electrosurgery unit is used in at least 85% of all surgical procedures, this device is most often responsible for the generation of surgical smoke.

The heat produced by electrosurgery units causes tissue disruption and the formation of biological aerosol products. These aerosols, found in both gas and particulate forms, in addition to blood and tissue fragment result from this process. The visible components of smoke include water, carbonized particles and intact cells. The smoke also contains living and dead cellular material, including viral DNA particles and bacteria. These particles vary in size from 0.1 to 5 microns. Because of their tiny size, they can be inhaled through standard surgical masks, thus causing potential respiratory damage.

The gaseous component of surgical smoke produces not only a noxious odor but also chemical by-products and toxic gases such as:

- formaldehyde,
- hydrogen cyanide,
- carbon monoxide, and
- methane.

These chemical by-products are known to have mutagenic and carcinogenic potential. Some of these surgical smoke contents are identical to those found in cigarette smoke, a universally accepted health hazard.

It is estimated that 500,000 healthcare workers every year are exposed to electrosurgical smoke. In 1998, the National Institute for Occupational Safety and Health (NIOSH) released a study that details some of the immediate effects of surgical smoke that OR personnel are subjected to as a result of their close proximity to the surgical field. These effects on human beings include:

- nausea,
- eye irritation,
- eye infections among contact lens users,
- headache,
- upper respiratory irritation,
- exacerbations of asthma, and
- reactions, physical and psychological, to the noxious odor itself.

Additional concerns regarding surgical smoke have also been identified in animal research studies. Animals have revealed evidence that surgical smoke can lead to the development of significant upper respiratory conditions, such as chronic obstructive pulmonary disorders (COPD), emphysema, bronchiolitis and interstitial pneumonia.

In addition to the actual and potential physiological effects of surgical smoke, surgical smoke in high concentrations obscures and impairs the visualization of the surgical field. This impaired visualization can impede the safe performance of the surgeon and other members of the surgical team, thus indirectly affecting the patient and their outcome.

The toxic nature of surgical smoke may also directly affect the patient who is undergoing an invasive procedure. Carbon monoxide has been identified inside of the abdomen of patients undergoing minimally invasive procedures within five minutes after the beginning of electrosurgery unit use. These concentrations increased as the procedure continued. As smoke is produced and contained within the abdomen, a patient will experience an increase in methemoglobin

concentration. Methemoglobin decreases the oxygen carrying capacity of the red blood cells. Consequently, the presence of methemoglobin can:

- jeopardize tissue perfusion and oxygenation;
- lengthen the postoperative recovery period; and
- lead to a poor, or less than optimal, patient outcome.

The hazards of surgical smoke are now recognized and identified as an area of concern for those working in the OR and other areas of the healthcare facility where invasive procedures take place. The American National Standards Institute (ANSI), OSHA, NIOSH and the Association of periOperative Registered Nurses (AORN, formerly known as the Association of Operative Registered Nurses) all advocate for the reduction of surgical smoke. They all recommend that some type of smoke evacuation system be employed to reduce the amount of smoke that patients and healthcare personnel are exposed to.

There are three primary methods to reduce exposures to surgical smoke. They are:

- high filtration surgical masks,
- ventilation systems and
- smoke evacuation systems.

The best way to minimize surgical smoke is by combining these three methods, that is, combining the use of high filtration surgical masks with ventilation and smoke evacuation systems.

High Filtration Surgical Masks

The use of high filtration surgical masks, although an effective, simple and relatively inexpensive way to reduce the inhalation of smoke, is not fail proof. Particulate matter that is smaller than 0.5 microns can permeate a surgical mask regardless of its thickness and rating. Additionally, surgical masks gather moisture during the users' normal ventilatory process. This moisture compromises the effectiveness of the mask. Additional measures, therefore, are necessary to reduce the amount of surgical smoke in the environment.

Ventilation Systems: General Room and Local Exhaust Ventilation

A combination of *general room* and *local exhaust ventilation* systems is recommended. General room ventilation is not sufficient enough to

capture debris generated at the source. Local exhaust ventilation methods include *room suction systems* and *portable smoke evacuators*.

Room suction systems vacuum at a low rate. These systems are primarily designed to capture liquids, rather than smoke and particulate matter found in surgical smoke. These systems, therefore, must be equipped with special and properly installed additional filters. They are not as effective as portable smoke evacuation systems.

Smoke evacuation systems, available on the market today, consist of high volume vacuums that capture smoke at the point where it originates. The smoke is evacuated through a nozzle or hose setup, thereby preventing it from escaping into the ambient air surrounding the patient and the healthcare team. These types of systems are advantageous for both open and laparoscopic procedures.

Smoke in the operating room, and other areas where invasive procedures are conducted, remains a major safety issue today. It is not just an issue of patient comfort, it is now known that smoke is a significant safety concern for all OR patients and staff. A proactive approach to smoke evacuation that uses the latest and most effective technological advances is the best way to reduce potential risks.

Solidification and Handling of Surgical Fluid Wastes

Hospitals generate approximately two million tons of waste annually. This tonnage accounts for about 1% of all the solid waste generated for our entire nation. All of this waste eventually ends up in incinerators and landfills, and is known to have serious environmental impacts and implications. It is important to clarify what types of waste are classified as infectious, that is, those that require special and costly handling and disposal.

The Environmental Protection Agency (EPA) and the Centers for Disease Control (CDC) define infectious waste as medical waste that has a potential for producing a disease in humans, as based on the following criteria:

- The pathogen present has sufficient virulence
- The dose is of sufficient quantity
- There is an available portal of entry into a host, and
- The host is susceptible to the pathogen.

In other words, medical waste is, or possibly is, contaminated with a pathogen of sufficient virulence and quantity, and can lead to an exposure to the waste by a susceptible host that can result in an infectious disease.

Concerns about medical waste were headline news as early as 1988. Prior to this, medical waste was of little concern. All medical waste, including grossly and visibly contaminated equipment and supplies, such as bed linens saturated with blood and other bodily fluids, was handled in a very different manner than they are now. No sharps containers or other labeled disposal containers were to be found. Also, there were no medical waste tracking, transport and disposal systems such as there are today.

Since 1988, however, the year when the horrors of used needles, syringes and other medical waste washing up on our beaches threatened our public health and the AIDS/HIV epidemic was well underway, medical waste and medical waste disposal became very different than it was in the past. It was the United States Congress that, in 1988, passed the Medical Waste Tracking Act that mandated the EPA to take the following actions, as necessary to protect the environment and the health of its inhabitants. This law mandated that the EPA:

- establish a two year medical waste demonstration program on the east coast and the Great Lakes states;
- gain experience and expertise in the management and tracking of infectious medical waste;
- determine what waste should be regulated by federal laws;
- develop tracking systems that will follow medical waste from the point that it is generated to the point of disposal; and
- detail and implement a program for medical waste that can and will be followed on a nationwide basis, as determined at the conclusion of the two year demonstration project.

As previously mentioned, OSHA mandates the safe handling of infectious waste and that "All procedures involving blood and other potentially infectious materials shall be performed in such a manner as to minimize splashing, spraying, splattering and the generation of droplets" (OSHA, 1992), based on the knowledge that bloodborne pathogens are transmitted in many ways and during all procedures where blood and bodily fluids are present.

Bulk blood and suctioned material pose great risks in the OR and other areas where invasive procedures are done. Upon the completion of a surgical procedure, bulk blood and/or suction fluid used to be primarily poured down a drain that was connected to the facility's sanitary sewer in the past. During the transportation and pouring of these liquid wastes, healthcare providers also used personal protective attire, such as gloves and plastic aprons. Now, there are much better and safer alternatives to the pouring of liquid medical wastes.

Depending on local and state regulations, solidifiers are the preferred alternative. Powder treatments of liquid bodily fluids, with or without a sanitizing compound, are now available on the market to solidify liquid material prior to its transport and disposal. Some of these solidifiers minimize the virulence, that is, the ability of microbes in this waste to cause diseases, such as tuberculosis, however, few solidifiers are approved as complete sanitizers that enable the waste to be completely uncontaminated, according to many states and local authorities. Nonetheless, these products do significantly reduce the risk of exposure to bodily spills, splashes and sprays.

Medical waste is synonymous to a "biohazardous waste", "biomedical waste", "potentially infectious waste" and "biological waste" in the laws and regulations of local and state authorities. State and local regulations governing infectious medical waste are typically congruent with the guidelines and recommendations of the EPA, OSHA and CDC, however, they may be more restrictive and prescriptive about what constitutes medical waste and how it must be handled and disposed of. It is, therefore, recommended that you refer to your own state and local regulations to insure that your practices relating to medical waste are compliant with all related requirements.

Glossary of Terms

Blood - human blood, human blood components, and products made from human blood.

Bloodborne Pathogens - pathogenic microorganisms that are present in human blood and other bodily fluids and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Contaminated - the presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

Contaminated Sharps - any contaminated object that can penetrate the skin including, but not limited to, needles, scalpels, broken glass, broken capillary tubes, and exposed ends of dental wires.

Decontamination - the use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal.

Engineering Controls - controls (e.g., sharps disposal containers, self-sheathing needles, safer medical devices, such as sharps with engineered sharps injury protections and needleless systems) that isolate or remove the bloodborne pathogens hazard from the workplace.

Exposure Control Plan - a documented plan that the employer is required to do and implement that identifies ways to decrease the risk of occupational exposure. This plan must be reviewed and revised at least annually, according to new regulations, technology, and research. It must also be accessible to employees.

Exposure Incident - a specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that results from the performance of an employee's duties.

Infectious Materials - includes (1) The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; (2) Any unfixed tissue or organ (other than intact skin) from a human (living or dead); and (3) HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV. All body fluids are considered potentially infectious materials.

Needleless Systems - a device that does not use needles for (1) the collection of bodily fluids or withdrawal of body fluids after initial venous or arterial access is established; (2) the administration of medication or fluids; or (3) any other procedure involving the potential for occupational exposure to bloodborne pathogens due to percutaneous injuries from contaminated sharps.

Needlestick Safety and Prevention Act – law that further expands upon OSHA’s bloodborne pathogen regulations in respect to engineering controls and the active participation of front line workers in the selection of safer medical devices.

Occupational Exposure - reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties.

Parenteral - piercing mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions.

Personal Protective Equipment - specialized clothing or equipment worn by an employee for protection against a hazard. Personal protective equipment must be used when engineering and/or work practice controls have not completely eliminated possible occupational exposure. Typically used work clothing, such as uniforms, scrubs, pants, shirts and blouses, not intended to function as protection against a hazard are not considered to be personal protective equipment. Examples of personal protective equipment include gloves, gowns, masks and face shields.

Regulated Waste- liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; items that are caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials.

Sharps with Engineered Sharps Injury Protections - 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.

Source Individual - any individual, living or dead, whose blood or other potentially infectious materials may be a source of occupational exposure to the employee. Examples include, but are not limited to, hospital and clinic patients; clients in institutions for the developmentally disabled; trauma victims; clients of drug and alcohol treatment facilities; residents of hospices and nursing homes; human remains; and individuals who donate or sell blood or blood components.

Sterilize - the use of a physical or chemical procedure to destroy all microbial life including highly resistant bacterial endospores.

Work Practice Controls - controls that reduce the likelihood of exposure by altering the manner in which a task is performed (e.g., prohibiting recapping of needles by a two-handed technique).

Summary

Work in the operating room is indeed satisfying, however, it is laden with risks. The multidisciplinary team must work collectively and in a continuous manner to decrease the risks associated with some of the most common hazards in this area. Together it can be done.

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