Precautions for Prevention of Transmission of HIV, Blood-borne Pathogens and Nosocomial Infections

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(2) As healthcare workers, we are at risk for occupational exposure to blood, bloodborne pathogens and nosocomial infections, including hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV). Exposures occur through needlesticks or cuts from other sharp instruments contaminated with an infected patient’s blood or through contact of the eye, nose, mouth, or skin with a patient’s blood. (3) Important factors that may determine the overall risk for occupational transmission of a bloodborne pathogen include the number of infected individuals in the patient population, the chance of becoming infected after a single blood contact for an infected patient, and the type and number of blood contacts. Most exposures do not result in infection. (4) Following a specific exposure, the risk of infection may vary with factors such as these (FDRA Quick Drill, January 2004):

- the pathogen involved
- the type of exposure
- the amount of blood involved in the exposure
- the amount of virus in the patient’s blood at the time of exposure
- the length of exposure

(5) All employers should have a system for reporting exposures in order to quickly evaluate the risk of infection, to make treatments available, to monitor for side effects of treatments, and to determine if infections actually occur.

(6) What is the risk of infection after an occupational exposure?

If a healthcare worker has received a hepatitis B vaccine and has developed immunity to the virus, he or she is at virtually no risk for infection to HBV. For an unvaccinated person, the risk from a single needlestick or a cut exposure to HBV-infected blood ranges from 6 - 30%. For HCV, the risk of infection is approximately 1.8%. The risk of HIV infection is 0.3% (CDC National Prevention Information Network, 2004).

While the risks seem relatively small, there are still over 800 documented cases of healthcare workers becoming infected by bloodborne pathogens every year following an occupational exposure. It is imperative that healthcare workers use all possible precautions to keep from becoming infected themselves or spreading the infections to others.

While intact skin provides some protection from exposure to potentially infectious material, when providing health care it is recommended that health professionals use blood and body fluid precautions for further protection. These precautions also help protect workers from exposure to an infection from another healthcare worker.
Body and fluid precautions (called universal precautions) are recommendations designed to prevent the transmission of HIV, bloodborne pathogens, and other diseases while administering first aid or other health care. These precautions treat all blood and body fluids as potential infections transmitted in the blood (i.e., bloodborne pathogen).

In the workplace, universal precautions should be followed when workers are exposed to blood and certain other body fluids, including:
- Semen
- Vaginal secretions
- Synovial fluid
- Cerebrospinal fluid
- Pleural fluid
- Peritoneal fluid
- Pericardial fluid
- Amniotic fluid

Although it is recommended that blood and body fluid precautions be used whenever contact is made with saliva, nasal secretions, breast milk, feces, sputum, sweat, tears, urine, or vomit, it is not absolutely necessary unless these fluids contain visible traces of blood. However barriers and isolation precautions are necessary in preventing the spread of other infections such as influenza (droplet), tuberculosis (airborne), and methicillin-resistant *Staphylococcus aureus* (MRSA) even if blood is not present.

Universal precautions involve the use of protective barriers such as gloves, gowns, aprons, masks, or protective eyewear, which can reduce the risk of exposure of the health care worker’s skin or mucous membranes to potentially infective materials.

Recommendations for the use of gloves are presented in detail in the Morbidity and Mortality Weekly Report dated June 24, 1988 and is available by calling the National AIDS Information Hotline at 1-800-342-2437.

Gloves should be worn:
- For touching blood and body fluids that are possibly infectious
- For handling items or surfaces soiled with blood or body fluids that are possibly infectious.

Gloves should be changed after contact with each patient. Hands and other skin surfaces should be washed immediately or as soon as patient safety permits, usually immediately after gloves are removed. Gloves should reduce incidence of contamination, but cannot prevent contamination from penetration injuries caused by needles, scalpels, and other sharp instruments or devices during procedures; when cleaning used instruments; during disposal of used needles; and when handling sharp instruments after procedures. Additional care must be taken.
Masks and protective eyewear or face shields should be worn by health care workers to prevent exposure of mucous membranes of the mouth, nose, and eyes during certain procedures. Gowns or aprons should be worn if blood splashes are anticipated.

(12) Five to six percent of hospitalized patients in the United States develop nosocomial infections (Specific Risks, Schiff Consulting, 2004). A nosocomial infection is one that occurs after a patient has been in hospital or admitted to a health care facility or after a routine visit to a doctor’s office.

(13) The major routes for pathogenic bacteria are:
1. Direct contact – a person touches another person with an infection.
2. Indirect contact – a person touches improperly disinfected or sterilized medical instruments, patient care equipment or hands of a health care worker.
3. Airborne transmission – coughing or sneezing produces fine aerosol sized droplet which are often projected 1-2 meters away from the source and can remain airborne for an extended period of time. Pathogenic bacteria can be present on surface and become attached to dust particles where they can float for hours and travel long distances.

(14) The major causes of nosocomial infections are either due to ineffective cleaning of environmental surfaces or inadequate disinfection of medical devices.

(15) The types of surfaces which require cleaning and disinfection are: (a) environmental surfaces, i.e., floors, walls, table tops. Most detergents are adequate, but each should have sufficient cleaning power to dissolve and emulsify oil-based and proteinaceous soils; (b) medical equipment surfaces, i.e., switches on equipment. Because biological fluids often contain high levels of calcium, magnesium and iron which can interfere with over all detergency, hospital grade cleaners should contain sequestrants such as sodium EDTA in order to tie up these ions. The end result is an increase in the efficiency of the cleaning process, and the elimination of stains or streaks which would otherwise result. After cleaning medical equipment, surfaces should be disinfected with an intermediate-level-disinfectant. (c) medical device surfaces, BP cuff, endoscopes, catheters, scalpels, etc. Regardless of the device being disinfected or the level of disinfection required, cleaning with a detergent must precede before effective disinfection can occur. The devices are then allowed to soak in a disinfectant solution for 20 minutes to several hours. Following disinfection, the surfaces are usually rinsed with sterile or high quality water containing very low levels of inherent microorganisms.
The methods of controlling microbes are:

- Sterilization
- Autoclaving
- Ethylene oxide gas
- Disinfection
  - Low-level disinfectants (LLD)
  - Intermediate-level disinfectants (ILD)
  - High-level disinfectants (HLD)

A disinfectant must completely eliminate all the organisms listed on its label. Sanitizers need not eliminate 100% of all organisms to be effective. Neither fungi nor viruses are ever included in sanitizing claim. A sanitizer must reduce the bacterial count by 99.999% (Lonza, 2004). Disinfectants are always applied after cleaning a surface and rinsing it with potable water. The disinfectant solution is generally applied to the surface for a period of at least 10 minutes and the surface is allowed to remain wet during the interval. Following disinfection, the surface is usually rinsed with sterile water in order not to re-contaminate the equipment.

While sterilization whether through autoclaving or ethylene oxide gas provide the most common ways of destroying microbial life, including spores, and the highest level of disinfection, both processes take time and specialized conditions. Autoclaving requires very high temperatures and a pressure of about 15 psi. The process itself can damage the items being sterilized. Ethylene oxide gas takes about 2 to 3 hours and a pressure between 12-15 psi. However the gas itself is dangerous and items sterilized in this way must be ventilated for several hours after exposure. Nevertheless, all heat stable reusable medical devices which enter the bloodstream or enter normally sterile tissue should ALWAYS be sterilized using heat-based methods.

Chemical disinfectants provide alternate methods and levels of killing pathogenic microorganisms. Remember there are three levels of disinfection. High-level disinfection kills all organisms, except high levels of bacterial spores and works using a chemical germicide cleared for marketing as a sterilant by the Food and Drug Administration.. Intermediate-level disinfection kills mycobacteria, most viruses, and bacteria with a chemical germicide registered as a “tuberculocide” by the Environmental Protection Agency (EPA). Low-level disinfection kills some viruses and bacterial with a chemical germicide registered as a hospital disinfectant by the EPA.

Here are some of the most common chemical disinfectants: alcohol, chlorohexidine gloconate, quaternary ammonium compounds (Quats), peroxyacetic acid (PPA), hypochlorites, glutaraldehyde (2%), phenolics, idophors, and germicidal hand cleaners.
Alcohol and chlorohexidine gluconates are considered Low-level disinfectants. These disinfectants are used on items which do not ordinarily touch the patient or touch only intact skin and are not normally involved in disease transmission. These items include crutches, bed and backboards, blood pressure cuffs, and most items on an ambulance or in a hospital room. Washing with detergent and using a low-level disinfectant are sufficient when decontamination is needed.

(19) Alcohol, used in a 70% ethanol, 30% water solution is effective in killing some viruses. However it is the drying action that kills. Alcohol must remain on the surface until that surface is completely dry. Isopropanol purchased at the pharmacy usually comes in the correct concentration.

(20) Chlorohexidine gluconates are effective against most bacteria and yeast, but not many viruses or bacterial spores. The advantages of chlorohexidine gluconates are that they are rapid acting, there is a residual build-up with repeated use, and they are less susceptible to organic inactivation than providone/iodine. However they also cause skin irritations.

(21) Quaternary Ammonium Compounds (Quats) are effective against a broad spectrum of microorganisms. Quats can be used directly as disinfectants or can be combined with synthetic detergents, which allows them to be used also as disinfectant-cleaners. These types of disinfectants are mainly used in routine cleaning or in one-step cleaning and disinfection procedures. The typical quat disinfectant is not used on high traffic floor areas because rinsing the excess away is difficult and would pose a risk if the floor remained slippery.

(22) Peroxyacetic acid (PAA) functions as a high-level disinfectant and sterilant when applied at appropriate concentrations. Some advantages include: rapid biocidal activity, continued effectiveness in the present of some organic matter, and sporicidal activity even at ambient and low temperatures. PAA exerts optimal biocidal activity in the pH range of 3.5-5.5. But PAA should not be used in the presence of alkaline soils or on unsealed porous surfaces, since doing so will neutralize the PAA.

(23) Hypochlorites, or bleach, is an inexpensive way to disinfect at a low-level. Intermediate-level disinfection can also be achieved. However, the activity of hypochlorites is greatly affected by water hardness and pH. At high pH, a prolonged time is necessary for disinfection. Additionally, hypochlorites degrade with age.

(24) Glutaraldehyde (2%) is a high-level disinfectant and is used for critical items that require a high-level of disinfection. Items disinfected by glutaraldehyde require minimal time and can be done in cold temperatures.
(25) Phenolics are considered to be an intermediate-level disinfectant and their main value, is in their capability of destroying TB causing bacteria. They act by disrupting cell walls and precipitating cellular proteins. Phenolics also can tolerate moderate loads of organic contamination without a loss in their germicidal activity. However, phenolics have disadvantages. They have a tendency to be absorbed by rubber and by some plastics and therefore cannot be used on all surfaces. And phenolics are toxic and must be used and disposed of properly.

(26) & (27) Iodophores attach themselves to vital bacterial proteins and inactivate them. In hospitals, iodophores are used because they have bactericidal, viricidal, and fungicidal properties. Iodophores stain almost all surfaces; they are inactivated by organic debris, and work well only within the acidic pH range. They also have little residual activity, except for antimicrobial activity, and poor sporicidal activity. The main application in a health care facility is in their use in topical applications and as germicidal hand cleansers.

(28) Hand washing generally considered to be the single most important procedure for preventing nosocomial infections. Germicidal hand cleansers are designed for the rapid removal and elimination of transient skin microorganisms. The trend is a cleanser that is low irritating using mild surfactants, emollients and moisturizers. They are designed for frequent use and may provide residual or persistent germicidal activity.

(29) Table 1 (Schiff Consulting, 2004) summarized the types of chemical disinfectants and the degree of disinfection for which they are recommended.
**METHODS AND TIME REQUIREMENTS COMPARISONS FOR THE DIFFERENT DISINFECTION CATEGORIES**

<table>
<thead>
<tr>
<th>Method of Disinfection</th>
<th>Dosage Required (ppm)</th>
<th>Sterilization</th>
<th>High Level</th>
<th>Intermediate Level</th>
<th>Low Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Autoclaving</td>
<td>...</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>...</td>
</tr>
<tr>
<td>Ethylene Oxide Gas</td>
<td>...</td>
<td>120 - 180</td>
<td>120 - 180</td>
<td>120 - 180</td>
<td>...</td>
</tr>
<tr>
<td>Glutaraldehyde</td>
<td>20,000 (2%)</td>
<td>180 - 600</td>
<td>20</td>
<td>10</td>
<td>On Contact</td>
</tr>
<tr>
<td>Peroxy Acetic Acid (PAA)</td>
<td>250 - 300</td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>Less than 1 min.</td>
</tr>
<tr>
<td>Hypochlorites (Available Chlorine)</td>
<td>500</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>10</td>
</tr>
<tr>
<td>Hypochlorites (Available Chlorine)</td>
<td>1,000</td>
<td>...</td>
<td>...</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Iodophors</td>
<td>75</td>
<td>...</td>
<td>...</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Phenolics</td>
<td>500</td>
<td>...</td>
<td>...</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Quats</td>
<td>500 - 750</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>10</td>
</tr>
<tr>
<td>Isopropyl Alcohol (70%)</td>
<td>neat</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>20</td>
</tr>
<tr>
<td>Chlorhexidine Gluconate</td>
<td>40,000 (4%)</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>20</td>
</tr>
</tbody>
</table>

(30) One company, Lonza is currently producing a quaternary biocide that is combined with either a phenolic or solvent like ethanol increasing its effectiveness against TB, recognizing that TB is primarily airborne. They also carry formulas that are effective against both HBV and HBC.

(31) An important postscript… while wearing gloves is the most significant protective device that can be used, it is estimated that 8 -12% of health care workers are latex sensitive. Curiously, 50% of sensitive individuals show cross-reactivity to bananas, chestnuts, kiwi fruit, avocado and tomato perhaps because of resemblance to a latex protein component. These reactions can progress to anaphylactic reactions. Also, figs, apples, celery, melons, potatoes, papayas, pitted fruits cause progressive symptoms beginning with oral itching.

(32) Many persons who are constantly exposed to powdered gloves, the most sensitizing latex product, are likely to become sensitized. Direct skin contact with latex may cause in immediate hypersensitivity or may cause a delayed reaction. There are three levels of allergic reaction to latex: Irritant contact dermatitis, allergic contact dermatitis, and immediate hypersensitivity. Any person may develop a reaction or progress to another level of reaction with each contact to latex. Irritant contact dermatitis has a gradual onset and is usually caused by hand washing, occlusion, antiseptics and glove chemicals. Symptoms include redness, cracks, fissures, and scaling. Allergic contact dermatitis has an onset between 6
and 48 hours after contact. It is caused by chemicals. Symptoms include erythema, vesicles, papules, pruritus, blisters, and crusting. Immediate hypersensitivity has an onset of minutes. Symptoms include local and generalized urticaria, feeling of faintness, feeling of impending doom, angioedema, nausea, vomiting, abdominal cramps, rhinocojunctivitis, bronchospasm, and anaphylactic shock. Between 1988 and 1992, the Federal Drug Administration (FDA) received more than 1000 reports of adverse health effects from exposure to latex, including 15 deaths due to such exposure. We must provide alternative ways of protecting health care workers who may be at risk themselves.

A final personal note. I must remind you that I am not a medical doctor, nor a microbiologist. I am a paramedic, working to care for patients in immediate danger or with life-threatening illnesses. What I have learned about disease and what I do to prevent the spread of disease is for the care and safety of myself, my patients, and my co-workers.
References


