University of Medicine and Dentistry of New Jersey
EOHSS FACTSHEET

Decontamination and Disinfection

Terminology

***sterilization*-** the destruction of all microbial life, including bacterial endospores.
disinfection-the elimination of virtually all pathogenic microorganisms on inanimate objects with the exception of large numbers of bacterial endospores, reducing the level of microbial contamination to an acceptably safe level.
antisepsis-the application of a chemical to living tissue to prevent infection.
decontamination-all of the above. Decontamination is any activity that reduces the microbial lode to prevent inadvertent contamination or infection. The appropriateness of a decontamination procedure is situational-dependent. For example, surgical instruments must be sterile but this level of microbial killing is unnecessary for environmental surfaces such as floors and walls.

Sterilization Methods

Autoclaves-Autoclaves provide the most efficient and reliable method of sterilization for most laboratory applications. Decontamination is accomplished by steam heat sterilization in an autoclave. Steam sterilization generally denotes heating in an autoclave employing saturated steam under pressure of approximately 15 psi to achieve a chamber temperature of at least 121 C. The time is measured after the temperature of the material being sterilized reaches 121 C. The critical process factors are temperature, exposure time, and ensuring that materials are packaged to allow the steam to penetrate throughout the load. Sterilization time will vary in relation to the size of the load and the packing density of the chamber. Typical laboratory autoclaves operate at 121 degrees C. All users should review the operating manual periodically; it's probably inside the machine's door. Instructions should be prominently posted.

Always use heat resistant gloves and face protection, particularly when removing processed material. When removing items, crack the door slowly and wait a few minutes before fully opening the door.

For dry loads, add 250-500ml. of water to the bag to aid in steam generation. Do not attempt to make autoclave bags air tight; they should be closed loosely to allow steam to penetrate; bottles and test tubes should not be tightly capped.

Autoclave tape is not a fail-safe indicator of sterilization it blackens after only brief exposure to a temperature of 121 C. When used for the decontamination of infectious waste, autoclave performance must be periodically validated by using B. stearothermophilus spore strips. Place a strip in a hard-to-reach area of a mock load and attach a string to the strip to facilitate removal from after autoclaving. Then, incubate the strip as directed; a lack of turbidity indicates that the autoclave is operating effectively. (These strips are closed systems; there is no exposure risk in the validation procedure.)

Dry heat is used for materials (some glassware, instruments, anhydrous materials) that are sensitive to moisture or the corrosion it may cause. Consult the manufacturers of such items for recommendations for appropriate sterilization procedures. Dry heat is less effective than steam autoclaving and this method requires higher temperatures and a longer exposure time. For example, the recommended exposure time for dry heat sterilization is 2-4 hours at a temperature of 160 degrees C, compared to 30 minutes at 121 C in an autoclave. This method may also be validated by using spore strips as discussed in the section on autoclaves.

Chemical sterilization is chiefly used for heat-sensitive patient care instruments that enter body cavities or normally sterile areas. This process requires prolonged contact times with high concentrations of chemical decontaminating solutions. Chemical sterilants, e.g., 2% glutaraldehyde, are frequently used at a relatively high concentration posing a toxicity hazard. Carefully follow manufacturers' directions regarding dilution, contact time, personal protective equipment. Some sterilants require that specific ventilation systems be in place to remove hazardous gases and vapors.

Disinfection

Disinfection encompasses a continuum of outcomes in terms of the types of microorganisms destroyed. Microorganisms can be grouped as following in terms of decreasing resistance to disinfectants: bacterial endospores (*B. subtilis, clostridium spp*); Mycobacteria; nonlipid or small viruses (poliovirus, rhinovirus); fungi ; vegetative bacteria; and, lipid or medium sized virus (herpes simplex, HIV, HBV).
The table at the end of this section provides a framework for the selection of the appropriate disinfectant. The label on commercial products will note the types of 'cidal' action of the disinfectant, (e.g., 'tuberculocidal', 'sterilant'). These claims may not appear on the label unless the manufacturer has submitted data to the EPA supporting such claims. The lists of EPA registered disinfectants can be obtained from your campus EOHSS office or found at http://ace.orst.edu/info/nain/lists.htm.

(The EPA does not independently audit such results and research indicates that in real life situations some products do not perform as claimed. This result from manufacturers testing their products in best-case situations, e.g., on a smooth surface, at an optimal pH, in a buffer solution instead of a solution containing organic material which partially inactivates some disinfectants. For high risk pathogens, investigators may devise their own test to confirm a product's claim.)

* Follow label instructions regarding dilution and contact time necessary to achieve the desired level of disinfection .
* Disinfectants that require pre-use dilution should be treated as hazardous chemicals during mixing. Wear a lab coat and goggles, not glasses.
* Select a glove that provides protection against permeation by the disinfectant (glutaraldehyde rapidly penetrates some latex gloves).
* Clean contaminated surfaces as soon as possible and any surface that may have become contaminated at the end of the task.

Considerations for selecting and using disinfectants

- **A 1/10 dilution of household bleach, prepared fresh daily, will suit most disinfectant needs.** These solutions lose potency over time and should be prepared fresh daily.
- Nature of surface-rough surfaces will require a longer contact time for effective treatment.
- Surface compatibility-bleach will corrode many metals, rinse with water after use; instruments vary in their ability to withstand disinfectants based on their composition
- Organic matter will inactivate some disinfectants; a second application may be necessary once visible contamination (and hence, most organic debris) has been removed. **The removal of visible 'soil' may be the single most critical factor in assuring effective decontamination.**
- Resistance of microorganisms, e.g. bacterial endospore vs. vegetative bacteria.
- Contact time necessary for desired level of decontamination.
- Select the disinfectant with the lowest toxicity possible.
- Number of microorganisms present, overnight culture vs. a recently inoculated one.

Summary of Disinfectant Activities

Disinfectant	Disinfec-tion Level	Bacteria	Lipophil. Viruses	Hydro-Philic Viruses	*M. tuber-culosis*	Fungi	Comments
Alcohols (ethyl and isopropyl) 60-85%	inter-mediate	+	+	-	+/-	+	Not sporicidal; evaporates quickly so that adequate contact time may not be achieved, high concentrations of organic matter diminish effectiveness; flammable.
Phenolics (0.4%-5%)	inter-mediate	+	+	+/-	+	+	Not sporicidal; phenol penetrates latex gloves; eye/skin irritant; remains active upon contact with organic soil; may leave residue.
Glutaraldehyde (2-5%)	high	+	+	+	+	+	Used to sterilize surgical instruments that can not be autoclaved; strong odor; use with adequate ventilation. Not for use on environmental surfaces. Because it is a sensitizer and causes asthma it is not recommended for laboratory use.
Quaternary Ammonium (0.5-1.5%)	low	+	+	-	-	+/-	May be ineffective against Psuedomonas and other gram – bacteria; recommendation limited to environmental sanitation (floors, walls). Low odor, irritation.
Iodophors (30-1,000 ppm iodine)	inter-mediate	+	+	+	+/-	+/-	Inactivated by organic matter.
Chlorine (100-1,000 ppm)	inter-mediate	+	+	+	+/-	+	Not sporicidal; inactivated by organic matter; fresh solutions of hypochlorite (chlorox) should be prepared weekly; corrosive; irritating to eyes and skin.