Decontamination

April 2018
Welcome to the Introductory Training about Decontamination
Outline

• Decontamination
  • Definitions
  • Categories
  • Prep Work
  • Methods
    • Physical
    • Chemical
    • Gases
  • Questions?
Decontamination Definitions

“A procedure or process that renders an area safe for occupancy or material or equipment safe to handle or use.”
Decontamination Definitions

• Antisepsis:
  • Is the disinfection of living tissues; achieved through the use of antiseptics.
  • The objective is to prevent sepsis, either by destroying potentially infectious organisms or by inhibiting their growth and multiplication.
  • No sporicidal activity is implied
Decontamination Definitions

• Sanitization:
  • Reduces a microbial population to levels considered safe by public health standards
  • Objects usually cleaned as well as partially disinfected

*e.g. sanitizers are used to clean restaurant utensils and these do not have to be sterilized before use*
Decontamination Definitions

• Disinfection:
  • killing, inhibition or removal of microorganisms that may cause disease or compromise the integrity of equipment
  • Usually accomplished with chemical agents
  • Does not necessarily sterilize objects (some spores & microorganisms remain)
Decontamination Definitions

• Sterilization:
  • Use of a physical or chemical procedure to destroy *all* microbial life, including algae, bacteria, fungi, protozoa, viruses, dormant endospores, prions and poorly characterized agents such as viroids.
  • Sterilization requires verification of the process before sterility is assumed.
Decontamination Categories

- Categories of decontamination in the microbiology lab:
  - Surface decontamination
  - Waste decontamination
  - Space decontamination
Decontamination Categories

• *Surface decontamination: Why*
  • Daily clean-up of work area
  • Decontamination of any spills

• *Common Methods*
  • Liquid disinfectants most commonly used
Decontamination Categories

• Waste decontamination:
  • Why
    • To protect workers who handle lab waste away from the lab
    • To protect the environment
  • Common Methods
    • Autoclaving
    • Liquid disinfectants
Decontamination Categories

• Space decontamination: Where: Biological Safety Cabinets (BSC)
  • Large areas with inaccessible surfaces
  • BSL3 labs

• Common Methods
  • Requires use of fumigants such as formaldehyde
  • Vaporous hydrogen peroxide (VHP)
  • Chlorine dioxide
Decontamination Prep Work

• Written procedures are required to ensure best management practices.
  • Establish procedures based on current needs, equipment and disinfectants.
  • Research laboratories all use some form of disinfecting.
• Often cleaning procedures are not in place.
  • When unwritten, cleaning procedures are passed on verbally or guessed at based on experience with other cleaning chemicals and potentially mistaken assumptions.
  • Write, review, update and refer to SOP’s (Standard Operating Procedures) regularly.
• Risk Assessment:
  • Risk assessment needs to include what products and tools should be used, when to use them and how to use them.
  • Consider the following information when writing a disinfection procedure.
    • Product Label and efficacy data
    • Organism(s)
    • Resistance profile
    • Contact time required for efficacy
    • Training requirements to use chosen method safely
# Examples of Relative Resistance of Microorganisms

<table>
<thead>
<tr>
<th>More Resistant</th>
<th>Microbe</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial Spores</td>
<td>Bacillus subtilis</td>
<td></td>
</tr>
<tr>
<td>Mycobacteria</td>
<td>Mycobacterium tuberculosis</td>
<td></td>
</tr>
<tr>
<td>Hydrophilic Viruses (non lipid, non enveloped)</td>
<td>Rhinovirus</td>
<td></td>
</tr>
<tr>
<td>Fungi</td>
<td>Candida</td>
<td></td>
</tr>
<tr>
<td>Vegetative bacteria</td>
<td>Streptococcus pneumonia</td>
<td></td>
</tr>
<tr>
<td>Lipophilic Viruses (lipid containing enveloped)</td>
<td>Herpes Simplex</td>
<td></td>
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</tbody>
</table>

| Least Resistant                                      |                                 |                            |

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*University Health & Safety*
Decontamination Methods

• Decontamination can be achieved by:
  • Physical methods (heat, filtration, radiation)
  • Chemical disinfectants
  • Gases
Decontamination Methods

• Read the Label:
  • Review the labels of your current disinfectants.
  • Do these solutions match the profile of the microbes you need to kill?
  • The labels of concentrated disinfectants state the proper level of dilution for maximum effectiveness.
Decontamination Methods

• Selection of decontamination method:
  • type of organism/number
  • Amount of organic material present
  • Its risk group or containment level classification
  • The reason for the decontamination
  • Degree of microbial killing required
Decontamination Methods

- Selection of decontamination method (cont’d):
  - The nature of item/surface to be treated
  - Type & concentration of disinfectant
  - Time/temperature of exposure
  - Safety
Decontamination Methods

• Physical agents:
  • Heat
  • Filtration
  • Radiation (UV & gamma)
Decontamination Methods

• Heat:
  • Moist – steam (autoclaves, renderer)
  • Dry – convection oven
  • Incineration
Decontamination Methods

• Heat: Steam sterilization (autoclaves) (cont’d)—
  • Ensure proper functioning of autoclave
  • Load test to be carried out to determine standard load times/temps.
  • Vessels should be loosely capped or plugged

• Verification
  • Biological indicators
  • Thermocouples
  • Chemical integrators
Example of an autoclave
This really should not happen, but it does!
Autoclave “Do’s

• Do test autoclaves monthly
• Do use autoclave bags
• Do loosely close the bag
• All autoclave users must be trained before they use an autoclave!!!
Autoclave “Don’ts”

• Do not tightly close the autoclave bag
• Do not use foil caps on bottles use vented caps or loosely capped bottles
• Do not overfill the bag (less than 3/4 full)
• Do not use an autoclave without training
Autoclaving Resources

- Biological Waste Disposal Table
- Autoclaves
- Biohazardous and Infectious Waste
- And LOTS more on the [Biosafety and Occupational Health website](http://www.biosafety.umn.edu)!
Decontamination Methods

• Heat: Steam sterilization (renderer/ biowaste cooker) –
  • used for solid waste or liquid effluent
  • secondary waste treatment method for BSL3 and ABSL3
Decontamination Methods

• *Heat*: Dry heat sterilization (oven) –
  • Used for glassware*, metal instruments etc.
  • Denaturation of proteins: 160 - 170ºC/2-4h

*Do not use plastic coated racks, plastic test tubes, Nalgene ware etc.*
Decontamination Methods

• **Filtration:**
  • Used for heat-sensitive material, e.g. pharmaceuticals, culture media, antibiotics, HEPES buffer, etc.
  • Synthetic membrane filters – 0.2µm diameter pores
  • HEPA filters remove 99.99% of 0.3µm particles from the air
Decontamination Methods

• Radiation:
  • UV lamps—do not penetrate glass, dirt, films, water & other substances very effectively; effectiveness drops off quickly as number of lamp hours increases
  • Gamma radiation used for cold sterilization of antibiotics, sutures, pathogens coming out of containment labs, etc.
Decontamination Methods

- Chemical: Used for:
  - Decontamination of surfaces & equipment that cannot be autoclaved
  - Clean-up of infectious spills, rooms & animal cubicles
Decontamination Methods

- Factors influencing the effectiveness of chemical disinfection:
  - Number of microorganisms present
  - Type of population of microorganisms
  - Concentration & nature of disinfectant
  - Length of treatment
  - Environmental factors
Decontamination Methods

- Microorganisms differ in their resistance to chemical disinfection:
  - **High Resistance**: spore forming organisms
  - **Moderate Resistance**: protozoan cysts, Hepatitis B, poliovirus, *M. tuberculosis, S. aureus*, Pseudomonas
  - **Least Resistance**: most bacteria, yeasts
Decontamination Methods

• Chemical disinfectants should be:
  • Effective against a wide variety of infectious agents at high dilution & in presence of organic matter
  • Toxic for the infectious agent but not toxic to people
  • Non-corrosive for common materials
Decontamination Methods

• Chemical disinfectants should be (cont’d):
  • Stable upon storage
  • Odorless or ideally with a pleasant odor
  • Soluble in water & fats for penetration into pathogens
  • Inexpensive
Decontamination Methods

• Types of chemical disinfectants:
  • Phenolics
  • Alcohols
  • Halogens
  • Quaternary ammonium compounds
  • Aldehydes
  • Gases
Decontamination Methods

• Phenolics:
  • First widely used disinfectant – used today
  • Active against tuberculosis; effective in presence of organic material
  • Remains active on surfaces long after application
  • Disagreeable odor & can cause skin irritation & allergies
  • e.g. Lysol
Decontamination Methods

• Alcohols:
  • Kill bacteria, fungi & some lipid-containing viruses but not spores
  • Ethanol & isopropanol (70% concentration)
Decontamination Methods

• Halogens:
  • **Iodine** can be used as a skin disinfectant & in lab (e.g. Wescodyne, Betadine)
  • **Bromine** used instead of chlorine in hot tubs
  • **Chlorine** (sodium hypochlorite) kills live bacteria & fungi, moderately effective against spores
  • Inactivated by organic material

*Use 1/9 (v/v) dilution of household bleach (100 ml household bleach/900 ml water)
Decontamination Methods

• Quaternary Ammonium Compounds:
  • Actual detergents, not soaps
  • Cationic detergents kill most bacteria but not M. tuberculosis or spores
  • Stable, non-toxic but inactivated by hard water
Decontamination Methods

• Aldehydes:
  • Active against spores; used as a chemical sterilant
  • Formaldehyde widely used to sterilize lab spaces & BSCs
  • 2% glutaraldehyde (e.g. Cidex); much less irritating than formaldehyde
  • Used to disinfect hospital & lab equipment
Decontamination Methods

- Types of chemical disinfectants:

<table>
<thead>
<tr>
<th>Biocide</th>
<th>Sporistatic</th>
<th>Sporicidal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzalkonium chloride</td>
<td>5</td>
<td>b</td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Ethanol</td>
<td>700</td>
<td>—</td>
</tr>
<tr>
<td>Sodium hypochlorite</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Phenol</td>
<td>500</td>
<td>—</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>500</td>
<td>50,000</td>
</tr>
<tr>
<td>Peracetic acid</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Glutaraldehyde</td>
<td>50</td>
<td>10,000</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>500</td>
<td>20,000</td>
</tr>
</tbody>
</table>
Decontamination Methods

• Gases:
  • Ethylene oxide kills both living bacteria & spores
  • Penetrates packing material
  • Vaporous hydrogen peroxide (VHP) used to decontaminate BSCs & sealed containment labs
  • Chlorine dioxide gas
Decontamination Methods

• Write your Standard Operating Procedure (SOP)
  • Once the work of selecting a method and procedure is done, write it up, train staff on it and keep it up to date
Decontamination Emergency

• **Small spill:**
  • Put on gloves
  • Cover the spill with paper towels
  • Soak the towels with 1:9 (v/v) household bleach solution
  • Wait 30 min.
  • Clean up towels and discard.
  • 2nd Treatment with 1:9 (v/v) bleach
  • Remove gloves, wash hands.

• **Large Spill:**
  • Call Biosafety and Occupational Health (BOHD) 612-626-5008.
  • Request assistance.
Resources for Choosing a Disinfectant

• Biological Decontamination Fact Sheet
  • https://bohd.umn.edu/decontamination-and-disinfection

• Biological Waste Disposal Table
  • https://bohd.umn.edu/sites/bohd.umn.edu/files/biological_waste_disposal_table.pdf

• Decontamination template
  • https://bohd.umn.edu/sites/bohd.umn.edu/files/decontaminationtemplate.doc

• Fact Sheet: Equipment Decontamination
  • https://bohd.umn.edu/sites/bohd.umn.edu/files/equipment_decontamination_fact_sheet.doc
Resources

• Antimicrobial Spectrum of Disinfectants
  • http://www.cfsph.iastate.edu/pdf/antimicrobial-spectrum-of-disinfectants

• Characteristics of Selected Disinfectants
  • http://www.cfsph.iastate.edu/Disinfection/Assets/CharacteristicsSelectedDisinfectants.pdf
Decontamination Management Best Practices

• Management of microbial contaminants:

• Use best practices to protect patients, employees and the environment.
  • Because disinfectants are designed to kill cellular organisms, they are toxic and it is important to follow the instructions on the label.
  • Most chemicals used as disinfectants are corrosive, irritants and potentially carcinogenic.
  • Use only the amount of disinfectant necessary to effectively decontaminate.
Decontamination

• Be Safe
• Use good microbiological practices and good hygiene!
• Disinfectants DO NOT replace good microbiological practices or good hygiene!
Questions

• The UHS web site has lots of information on
  • Autoclaving
  • Decontamination
  • Disinfection
  • Spill cleanup
  • Waste management
  • www.uhs.umn.edu
  • www.bohd.umn.edu
Thank you!

Questions:
Contact Biosafety 621-626-5008
uhs@umn.edu