Decontamination

November 2022
Welcome to the Introductory Training about Decontamination
• 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.
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
  • Incineration
  • Alkaline hydrolysis
Decontamination Categories

• Space decontamination:
  • Large areas with inaccessible surfaces
  • BSL-3 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.

• Find helpful templates here: Fact Sheets and Templates
Decontamination Prep Work

- 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>Microbe</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>More Resistant</strong></td>
<td></td>
</tr>
<tr>
<td>Bacterial Spores</td>
<td><em>Bacillus subtilus</em></td>
</tr>
<tr>
<td>Mycobacteria</td>
<td><em>Mycobacterium tuberculosis</em></td>
</tr>
<tr>
<td>Hydrophilic Viruses (non lipid, non enveloped)</td>
<td><em>Rhinovirus</em></td>
</tr>
<tr>
<td>Fungi</td>
<td><em>Candida</em></td>
</tr>
<tr>
<td>Vegetative bacteria</td>
<td><em>Streptococcus pneumonia</em></td>
</tr>
<tr>
<td>Lipophilic Viruses (lipid containing enveloped)</td>
<td><em>Herpes Simplex</em></td>
</tr>
<tr>
<td><strong>Least Resistant</strong></td>
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</table>
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!
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>
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<tbody>
<tr>
<td>Benzalkonium chloride</td>
<td>5</td>
<td>—</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.
  • 2<sup>nd</sup> 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

- Decontamination and Disinfection
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!
Thank you!

Questions:
Contact Biosafety
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uhs@umn.edu