Decontamination

SERVICE ★ INTEGRITY
PROFESSIONALISM

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Welcome to the Introductory Training about Decontamination

University Health & Safety

University of Minnesota
Driven to Discover®

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
  - 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

	Microbe	Examples
More Resistant		
	Bacterial Spores	*Bacillus subtilus*
	Mycobacteria	Mycobaterium tuberculosis
	Hydrophilic Viruses (non lipid, non enveloped)	Rhinovirus
	Fungi	Candida
	Vegetative bacteria	Streptococcus pneumonia
	Lipophilic Viruses (lipid containing enveloped)	Herpes Simplex
Least Resistant		

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:

Biocide	Concn (mg/liter)	
	Sporistatic	Sporicidal
Benzalkonium chloride	5	—[b]
Chlorhexidine	1	—
Ethanol	700	—
Sodium hypochlorite	1	100
Phenol	500	—
Hydrogen peroxide	500	50,000
Peracetic acid	10	100
Glutaraldehyde	50	10,000
Formaldehyde	500	20,000

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

- 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

621-626-6002

uhs@umn.edu

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