



GBRMC

Decontamination

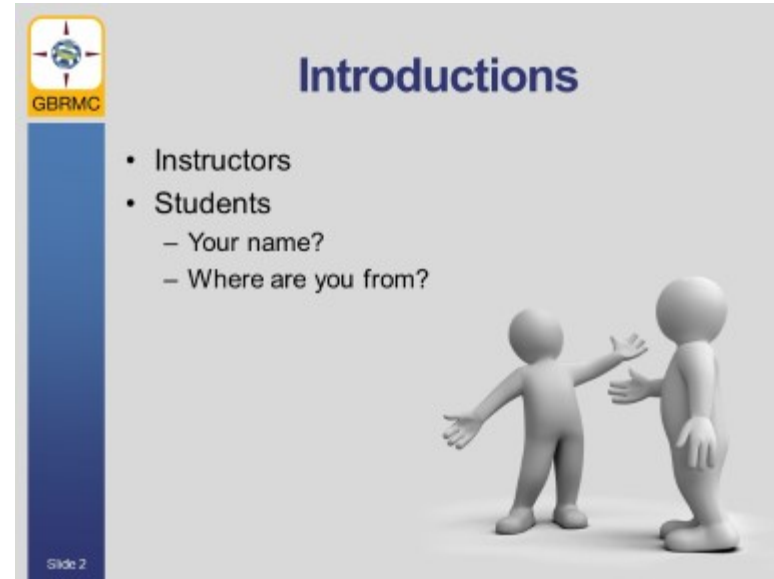
Student Guide

2012



GLOBAL BIORISK MANAGEMENT CURRICULUM





Action Plan

By the end of this lesson, I would like to:

KNOW		FEEL		BE ABLE TO DO	
<i>Your learning doesn't stop with this lesson. Use this space to think about what else you need to do or learn to put the information from this lesson into practice.</i>					
What more do I need to know or do?		How will I acquire the knowledge or skills?		How will I know that I've succeeded?	How will I use this new learning in my job?



Key Messages

- Disinfection and decontamination have similar meanings. Both are less rigorous than sterilization which is the complete removal of all life.
- No disinfectant is ideal, they all have strengths and limitations. Understanding the strengths and limitations is key to their use.
- There are a number of factors that determines how effective a particular disinfectant is.
- Micro-organisms have various innate resistance to disinfectants

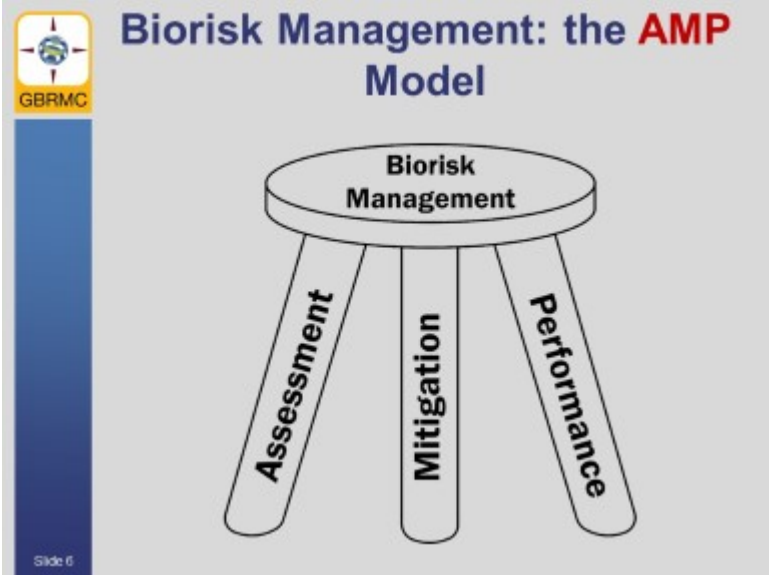
Slide 4




Key Messages – Continued

- Autoclaves can be used to sterilize things through wet heat and the application of appropriate time, pressure and temperature.
- Wet heat is much more effective than dry heat.
- Validation is a process to ensure that the decontamination, disinfection or sterilization process used was complete and achieved its requirements


Slide 5






Key Components of Biorisk Management

- **Biorisk Assessment**
 - Process of identifying the hazards and evaluating the risks associated with biological agents and toxins, taking into account the adequacy of any existing controls, and deciding whether or not the risks are acceptable




Slide 7

Define Biorisk Assessment:




Key Components of Biorisk Management

- Biorisk **Mitigation**
 - Actions and control measures that are put into place to reduce or eliminate the risks associated with biological agents and toxins




Slide 8

Define Biorisk Mitigation:



Key Components of Biorisk Management

- **Biorisk Performance**
 - Improving biorisk management by recording, measuring, and evaluating organizational actions and outcomes to reduce biorisk.



Define Performance:



Definitions

Decontamination – A process to remove contamination. Decontamination renders an area, device, item, or material safe to handle, that is, reasonably free from a risk of disease transmission.

Different Methods of Decontamination:

- **Sterilization** - act or process, physical or chemical, that destroys or eliminates all forms of life, especially microorganisms. The definition is categorical and absolute - an item either is sterile or is not.

Slide 10



Definitions, continued


Different Methods of Decontamination:

- **Disinfection** - Generally less lethal process than sterilization. It is the elimination of nearly all recognized pathogenic micro-organisms but not necessarily all microbial forms (e.g., bacterial spores, generally used on nonliving things).
- **Antiseptic** - a substance that prevents or arrests the growth or action of microbes, either by inhibiting their activity or by destroying them (e.g. used on living things).
 - “septic” – containing disease causing organism,
 - anti - remove

Slide 11




Decontamination

Definitions & Methods of Decontamination


 **Methods of Decontamination**

- Chemical (e.g., bleach)
- Thermal (e.g., autoclave)
- Radiation (e.g., UV light)
- Filtration (e.g., HEPA filter)

What are common types of decontamination methods you use in your laboratory and why?

Slide 12

 **Classes of Chemical Disinfectants**

Chemical Disinfectants

- Halogens (Chlorine, Iodophors)
- Aldehydes (Glutaraldehyde/Formaldehyde)
- Phenolics
- Alcohols
- Acids (Peracetic acid) & Alkalis (NaOH)
- Oxidizing Agents (Hydrogen peroxide)
- Quaternary Ammonium compounds
- Biguanidines (Chlorhexidine)

Slide 13



The Ideal Chemical Disinfectant

Group Scenario:

You are looking for the perfect chemical disinfectant.

In your groups, please spend **5 minutes** to list all of the **properties of the ideal chemical disinfectant**. Write one property per **sticky note** and post them on your **flip chart**.

Slide 14



Factors Affecting Disinfection

Group Scenario - Continued:

Now consider the conditions and **factors** that might affect how well a chemical disinfectant will work.

In your groups, please spend **5 minutes** to list all of the **factors**. Write one factor per **sticky note** and post them on your **flip chart**.

Slide 15



Factors Affecting Disinfection

- Number of microorganisms
- Location of microorganisms
- Innate resistance to the disinfectant
- Concentration and potency of the disinfectant
- Physical and chemical factors
- Presence of organic matter
- Appropriate contact time between disinfectant and the contaminate.
- Biofilms



Slide 16

Notes:



Environmental Factors


Environmental Factors

- **Dried spills** (from media, buffers) may limit contact between the disinfectant and the target organism.
 - Pre-cleaning usually necessary for spills
- **Dirt, grease and oils** - all can protect the organisms.
 - Grease and oils will repel water based disinfectants.




Slide 17

Notes:



Product Factors

- **Age** of the product/solution
- **Method** of application
 - spray vs. wipe
- **Rate** of application
- **Storage** conditions
 - Opaque vs. clear containers




Slide 18

How do each of these affect the effectiveness of the chemical disinfectant?

- Age:
- Method:
- Rate:
- Storage:

Decontamination



Properties of Chemical Disinfectants


How do chemical disinfectants work against an enveloped, non-enveloped, or spore former microorganism?

Individually reflect:

- What type of disinfectant would work on your organism?
- Why?


Slide 19

Properties and Selection of Chemical Disinfectants



Resistance to Disinfectants

Resistant



Prions (agents causing Creutzfeldt-Jakob Disease)
Bacterial spores (*Bacillus anthracis*)
Coccidia (*Cryptosporidium*)
Mycobacteria (*M. tuberculosis*)
Nonlipid or small viruses (polio, coxsackie)
Fungi (*Aspergillus*, *Candida*)
Vegetative bacteria (*E. coli*, *S. aureus*)
Lipid or medium-sized virus (HIV, herpes, hepatitis B)

Susceptible

Slide 20



Properties of Chemical Disinfectants

Group Scenario:

Your group will be assigned a chemical disinfectant to **research** including the following information:

- Typical concentration used
- Uses in the laboratory
- Advantages
- Limitations/Disadvantages

In your groups, please spend **10 minutes** to **review the resource material** provided. Complete the table in your **student guide** and be prepared to report to the class.

Slide 21

Properties of Chemical Disinfectants

Criteria				
Name of Chemical Disinfectant:				
Typical Concentration used				
Uses in the Laboratory				
Advantages				
Limitations/Disadvantages				



Choosing a Chemical Disinfectant

Group Scenario:

In your groups, please spend **5 minutes** to read the scenario provided. **Discuss and select** an appropriate **disinfectant**.

Using the template in your workbook, spend **15 minutes** to **write an SOP** for using the **disinfectant** in the scenario.

Slide 23



Scenario

- A researcher plans to grow various strains of *Bacillus cereus* (a potential foodborne pathogen closely related to *B. anthracis*) on petri dishes.
- Individual colonies will then be used to inoculate liquid broth cultures of up to 500 mLs. The cultures are grown in glass reusable Erlenmeyer flasks in a shaker incubator.
- Cultures will be transferred to plastic disposable tubes to be spun down in a centrifuge. The pellet will be washed, collected and analyzed for toxin production. This will involve the use of micropipettes, glass slides, and various stains and reagents.
- Sub cultures will be lyophilized for storage in small (<1ml) cryovials and stored in the freezer.
- ***How will lab surfaces and reusable materials be disinfected?***

Standard Operating Procedure for: Chemical Disinfection

Conditions

Who should use the SOP?	Everyone in the laboratory
When should it be used?	Before and after the laboratory procedure
Why should the SOP be used?	To disinfect the surfaces and reusable materials
Where should it be used?	In the laboratory


Context

Input(s):	Contaminated surfaces and reusable materials
Output:	Disinfected surfaces and reusable materials
Preparation required:	

Actions (steps required to move from the input to the output)

Step 1	
Step 2	
Step 3	
Step 4	
Step 5	

Decontamination



“Evaluating” your SOP

Group Scenario - Continued:

Give your **SOP** to another small group for evaluation.


In your groups, spend **15 minutes** to read the **SOP** you've been asked to evaluate and **answer the following questions**:

- Did you understand the SOP?
- Is it physically possible to follow the SOP?
- What questions do you have?
- What suggestions might make the SOP easier to understand and follow?

If time allows, come to a class-wide consensus on the **SOP** to be used.

Slide 26

Properties and Selection of Chemical Disinfectants



Additional Methods of Disinfection


- Thermal
 - Autoclave
 - Incinerator
- Filtration
- Radiation
 - Non-ionizing (UV light, microwave)
 - Ionizing (E-Beam, gamma and x-rays)


Slide 27

 **Autoclaves**



Slide 28

 **Heat Kills!**



- 160 °C Spores killed 2 hrs dry heat
- 134-138 °C Prions inactivated
- 121 °C Spores killed in 20 min (autoclave)
- 100 °C Only spores survive after 10 minutes
- 82 °C Bacteria killed 3 secs (pasteurization)
- 72 °C Bacteria killed 17 secs
- 63 °C Bacteria killed in 30 mins
- 56 °C HIV inactivated 30 mins
- 41 °C Protein denaturing starts
- 37 °C Body temperature
- 20 °C Room temperature

Slide 29



Principles of Autoclave Sterilization

- Direct exposure to **steam** at the required **temperature** and **pressure** for a **specific time**
 - 121 °C – 123 °C
 - 15 psi; 1.05 kg/cm²
- Time required depends on the nature of the material to be **sterilized**. (Generally 1 hr for waste)

Slide 30

For most purposes, the following cycles will ensure sterilization of correctly loaded autoclaves:

- 3 minutes holding time at 134°C
- 10 minutes holding time at 126°C
- 15 minutes holding time at 121°C
- 25 minutes holding time at 115°C




Steam Penetration

- Steam **must** directly contact **all** areas of the load (bags should be loosely gathered)
- If the steam cannot penetrate a dry container, you have **dry heat**, which takes **much longer** to achieve kill.
- Add ~ 50 - 250 ml of water to bags **prior** to autoclaving to facilitate steam saturation

Slide 31

Notes:



When to Autoclave?

Group Exercise:

In your groups, spend **10 minutes** develop a list of the **advantages** and **disadvantages** for using an autoclave to decontaminate laboratory materials.

- **Complete the template** in your workbook.
- Based on your answers:
 - When would using an autoclave be advantageous?
 - When would another method be preferable to autoclaving?

Slide 32

▪ Advantages:

▪ Disadvantages:



Autoclave Safety

- Follow manufacturers' guidelines
- Do **not** open pressurized chamber
- Avoid standing directly in front when opening
- Establish a **preventative maintenance schedule** and **annual inspection** by certified technician
- Wear appropriate PPE
- **Careful** – liquids are hot
- Open door **slowly**, allow steam to **vent** before opening fully



Slide 33



Autoclave Safety

- Do **not** place sealed containers into autoclave
- Do **not** autoclave items containing **solvents, volatiles, radioactive or corrosive chemicals**
- Use shallow metal pans for best results and heat transfer
- Check **drain and seals**



Slide 34


Decontamination

Additional Methods of Disinfection




- What do you notice about this picture?

- Are there any practices or procedures you would modify? Anything with the autoclave itself?



Incineration

- Treatment of choice for **animal bedding, carcasses** and **pathological wastes**; but **not** plastics!
- Reduces volume of waste by up to **95%**
- May allow **energy** generated to be recovered
- Operation parameters:
 - Primary chamber: 1400°F-1800 °F (760 °C-982 °C)
 - Secondary chamber: >2000 ° F (1093 °C)



Slide 36

- What is the advantage of an incinerator over an autoclave or chemical disinfectants?

 **Incineration Concerns**

- Can generate **smoke**, residues with **heavy metals**, **gases** (e.g., HCl, CO, PCBs)
- May require **pollution control devices**, e.g., wet/dry air scrubbers, electrostatic precipitators
- Loading needs to be controlled
- May require **permits**




Slide 37

- What are the disadvantages of an incinerator over an autoclave or chemical disinfectants?



- What is required to make a fire an incinerator?
- When is fire okay?
- When does fire need to be an incinerator?




Validation Methods

Group Scenario:

In your groups, spend **10 minutes** to discuss methods or ways in which you can ensure that the following procedures actually result in **decontamination**:

- Chemical disinfection – **surfaces**
- Chemical disinfection – **liquids**
- Autoclave sterilization
- Incinerator run

Slide 39



Review of Decontamination

For **10 minutes**, let's discuss what we learned about **decontamination in a biological laboratory setting**.

What did we learn? What does it mean? Where do we go from here?

Slide 40



Review Key Messages

- Disinfection and decontamination have similar meanings. Both are less rigorous than sterilization which is the complete removal of all life.
- No disinfectant is ideal, they all have strengths and limitations. Understanding the strengths and limitations is key to their use.
- There are a number of factors that determines how effective a particular disinfectant is.
- Micro-organisms have various innate resistance to disinfectants.

Slide 41



Review Key Messages – Cont.

- Autoclaves can be used to sterilize things through wet heat and the application of appropriate time, pressure and temperature.
- Wet heat is much more effective than dry heat.
- Validation is a process to ensure that the decontamination, disinfection or sterilization process used was complete and achieved its requirements.

Slide 42

Action Plan

By the end of this lesson, I would like to:

KNOW		FEEL		BE ABLE TO DO	
------	--	------	--	---------------	--

Your learning doesn't stop with this lesson. Use this space to think about what else you need to do or learn to put the information from this lesson into practice.

What more do I need to know or do?	How will I acquire the knowledge or skills?	How will I know that I've succeeded?	How will I use this new learning in my job?

Use space on back, if needed