

Overview of Biosafety and Biosafety levels

2020

©INSTITUTE OF HUMAN VIROLOGY NIGERIA

Objectives



- 1. Understand the concept of Biosafety
- 2. Describe the main elements in biocontainment
- 3. Understand the criteria for determining the appropriate biosafety level
- 4. Identify the differences between biosafety levels 1-4

What is Biosafety?



- Biosafety: describes the containment principles, technologies and practices that are implemented to prevent the unintentional exposure to pathogens and toxins, or there accidental release
- Containment principles, technologies, and practices include:
 - Laboratory Facilities (facility design and construction)
 - Safety Equipment (laboratory equipment and Personal Protective Equipment (PPE)
 - Work practices and policies (microbiological practices and established SOPs)

What is Bio-containment?



Describes safe methods for managing infectious agents in the laboratory

 Purpose is to reduce or eliminate exposure of laboratory workers and outside environment to potentially hazardous agents

Elements of Bio-containment



The proper mix of the three elements is assessed by the needs and specific hazards of the facility

Plus Occupational Health

Practices and Procedures

Safety Equipment

Facility Design

©INSTITUTE OF HUMAN VIROLOGY NIGERIA

Containment Barriers



- Primary barriers (safety equipment)
 - BSCs- all procedures
 - Personal Protective Equipment (PPE) Full-body, air-supplied, positive pressure personal suit
 - Isolators and Ventilated Racks
- Secondary barriers (facilities)
 - Design parameters to protect people surrounding the laboratory and the community
 - Separate building or isolated zone
 - Special HVAC systems and controls

Achieving Containment

Strategies Using

- Inward directional airflow
- Isolation dampers
- Sealing service penetrations
- Backflow prevention
- Filtration
- Standard Operating Procedures



Standard Operating Procedures (Some Common Elements)

- Roles and responsibilities
- Conditions of access
- Medical surveillance and employee health
- Immunization
- Entry/ exit/Access
- Personal protective equipment (PPE)
- Decontamination and disinfection
- Hazardous waste management
- Housekeeping
- Animal care and safety
- Emergency response
- Incident reporting, Training

Typical Standard Microbiological Practices

- Hand washing
- Strict adherence to Aseptic Technique
- No eating or drinking in the lab
- Use of mechanical pipetting devices
- Signage



Aerosol Characteristics



- Particles in the air
- Large droplets settle quickly, <u>contaminate</u> <u>surfaces</u>
- Smaller droplets evaporate rapidly, microorganisms are in dried state "droplet nuclei"
- <u>Smaller droplets travel further by air currents</u>, HVAC system
- Proteins (serum, sputum) slower evaporation, settle more rapidly

Aerosol Hazards (Common Activities)

- Opening tubes
- Inoculating loop
- Pipetting
- Centrifugation
- Mixing and homogenizing
- Needles and syringes
- Pouring infectious material
- Opening ampoules of lyophilized cultures



Minimizing Aerosol Hazards



 Falling drop on hard surface creates aerosols





Minimizing Aerosol Hazards



• Withdrawing syringe



Minimizing Aerosol Hazards Centrifugation



- Use sealed safety cups and rotors
- Open cups in BSC



Minimizing Aerosol Hazards Breakage



 Avoid glassware and use plastic tubes, flasks, bottles



Laboratory Equipment

- Biological Safety Cabinet (BSC)
- Autoclaves
- Bio-waste System
- Isolators
- Ventilated Cages
- Transfer Chambers
- Dunk Tanks
- Sinks

Safety Equipment







Personal Protective Equipment





©INSTITUTE OF HUMAN VIROLOGY NIGERIA

Powered Air-Purifying Respirator (PAPR)

- Disposable hood
- Breathing tube
- Motor/blower unit
- Cartridges
- Rechargeable battery pack



Engineering Controls for Centrifuges





Sealed Centrifuge Rotors





Safety Equipment **Types of Biological Safety Cabinets**



Establishing Biosafety Levels



Performing a Risk Assessment

The Foundation of Biosafety and the Basis for BSLs

- Perform a comprehensive hazard evaluation of the hazard posed by the infectious agent
- Determine additional safety enhancements based on the laboratory functions

BSL-1



Agents not known to cause disease

(Bacillus subtilis, infectious canine hepatitis)

- Utilize Standard Microbiological Procedures
- No Special Practices required
- Areas not separated from other areas

BSL-1 Laboratory





- Hand washing sink
- Windows with fly screens
- Fume hoods
- Signage

BSL2 Laboratories



- Designed for Risk Group 2 micro organisms
 - Moderate individual risk
 - Low community risk
 - Pathogens that can cause humane disease
 - Disease unlikely to be a serious hazard to lab workers or the environment

BSL-2



Agents associated with human disease

(Hepatitis B virus, Salmonella spp.)

Work involving agents that pose moderate hazards to personnel and the environment

- Personnel are trained to handle pathogens
- Restricted access while in operation
- Aerosol or splash-producing procedures are conducted in containment equipment



BSL 2



In addition to BSL-1 requirements:

- "Site-Specific" Biosafety manual with Standard Operating Procedures (include spill response and emergency procedures)
- Autoclave available
- Minimize procedures that cause splashes/aerosol formation
- Transport of materials in "special" containers



BSL-2 Laboratory



BSL 2 Physical Laboratory Design





- Work surfaces/bench tops easily cleaned and decontaminated
- Slip-resistant floor
- Windows fitted with flyscreens
- Emergency showers/eyewash

BSL 2 Physical Laboratory Design



• Handwashing sink



BSL 2 Physical Laboratory Design





• Autoclave available

©INSTITUTE OF HUMAN VIROLOGY NIGERIA