Practical
Medical Bacteriology

Lab 1
Biosafety in Microbiological Laboratory

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Biosafety

Biosafety: preventing lab-acquired infections

Biosafety is the application of safety precautions that:

1. Reduce exposure to a potentially infectious material.
2. Limit contamination of the work environment and ultimately the community.

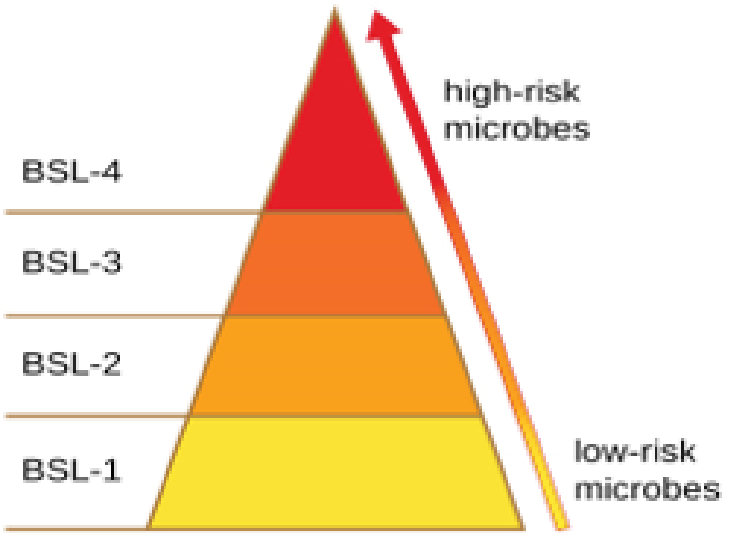
Biosafety is important because dealing with infectious agents that are risky or hazardous so follow the general safety guidelines in order to protect yourself and other.

Standard Microbiological Practices

NOT permitted in laboratories:

- Eating
- Drinking
- Smoking
- Handling contact lenses
- Pipetting by mouth
- Storing food and drink

Biosafety Levels

Biosafety Levels			
Biological Safety Levels	**Description**	**Examples**	**CDC Classification**
BSL-4	Microbes are dangerous and exotic, posing a high risk of aerosol-transmitted infections, which are frequently fatal without treatment or vaccines. Few labs are at this level.	Ebola and Marburg viruses	
BSL-3	Microbes are indigenous or exotic and cause serious or potentially lethal diseases through respiratory transmission.	*Mycobacterium tuberculosis*	
BSL-2	Microbes are typically indigenous and are associated with diseases of varying severity. They pose moderate risk to workers and the environment.	*Staphylococcus aureus*	
BSL-1	Microbes are not known to cause disease in healthy hosts and pose minimal risk to workers and the environment.	Nonpathogenic strains of *Escherichia coli*	

Biosafety Level 1 (BSL-1)

- Agents not known to cause disease in healthy adults.
- Some organisms may cause disease in immunocompromized individuals.
- Agents include *Bacillus subtilis*, *Naegleria gruberi*, infectious canine hepatitis virus, non-pathogenic strains of *E. coli*.

Standard practices required

- Frequent hand washing
- Door that can be kept closed when working;
- Limits on access to the lab space when working;
- No smoking, eating, drinking, storage of food in laboratory;
- Care to minimize splashes and actions that may create aerosols (tiny droplets);
- Decontamination of work surfaces after every use after any spills;
- Decontamination of laboratory wastes;
- Use of mechanical pipettes only (no mouth pipetting);
- "Sharps" precautions, including special containers for disposing of needles and other sharp objects;
- Maintenance of insect/rodent control program;
- Use of personal protective equipment (lab coats, latex gloves, eye protection or face shields).

Biosafety Level 2 (BSL-2)

- Agents associated with human disease
- Generally required for any human-derived blood, bodily fluids, tissues in which infectious agent may be unknown.
- Agents include measles virus, *Salmonella* species, pathogenic *Toxoplasma*, *Clostridium botulinum*, hepatitis B virus.

Standard practices

Standard practices include BSL-1 plus:

- Policies to restrict access to lab;
- Biohazard warning signs posted outside lab;
- Surveillance of laboratory personnel with appropriate immunizations offered;
- Biosafety manual with definitions of needed waste decontamination;
- Supervisory staff who have experience working with infectious agents and specific training for laboratory personnel in handling these agents.
- Primary barriers:
  - biosafety cabinets
  - Personal protective equipment: lab coats, gloves, face protection as needed
  - Protective clothing removed when personnel leave laboratory area
  - Cabinets thoroughly decontaminated daily and monitored for radiation for personal protection.
- Secondary barriers: autoclave for glassware

Biosafety Level 3 (BSL-3)

- Agents with potential for respiratory transmission, may cause serious and potentially lethal infection
- Agents include *Mycobacterium tuberculosis*, St. Louis encephalitis virus, *Francisella tularensis*, *Coxiella burnetii*.

Standard practices

Standard practices include BSL-2 plus:

- Strictly controlled access to the lab;
- Specific training for lab personnel in handling potentially lethal agents;
- Decontaminating all wastes;
- Changing contaminated protective lab clothing, decontaminating lab clothing before laundering;
- Institutional policies regarding specimen collection and storage from workers to establish exposure.
- Primary barriers:
  - Similar to BSL-2 personal protective equipment
  - Respiratory equipment if risk of infection through inhalation.
- Secondary barriers:
  - Corridors separated from direct access to lab.
  - Access through self-closing double doors.
  - Air pumped into lab not re-circulated in building.

Biosafety Level 4 (BSL-4)

- Microorganisms that cause lethal disease, with no known treatment or vaccine
- Agents include Ebola virus, Marburg virus

Standard practices

Standard practices include BSL-3 plus:

- Immunocompromized persons are never allowed to enter the lab
- Changing clothing before entering and exiting lab (showering upon exiting recommended);
- Decontaminating all material exiting facility
- Primary barriers:
  - Biosafety cabinets used at other biosafety levels
  - Full-body, air-supplied, Positive Pressure Personnel Suit (PPPS) (Moon suits)
- Secondary barriers:
  - All physical barriers at BSL-3
  - Isolated zone or a separate building;
  - Dedicated supply and exhaust, vacuum, decontamination systems;
  - A recommended absence of windows (or sealed and resistant to breakage).

Biosafety Level 4 (BSL-4)

Maximum containment lab; positive pressure ventilated suits (moon suits)