



Biosafety Basics

Module 1:

Biosafety Fundamentals

Topics Covered

- Hazard Classification of Microbial Agents (Risk Groups)
- Risk Assessment
- Biosafety Containment Levels
- Biosafety Best Practices
- Personal Protective Equipment

Biological Safety (Biosafety)

The field of biosafety promotes:

- safe laboratory practices
- safe procedures
- proper use of containment equipment and appropriate facilities
- provides advice on laboratory design

Biosafety

The discipline of biosafety addresses the safe handling & containment of infectious microorganisms & hazardous biological materials

- application of knowledge & the use of appropriate techniques & equipment
- prevent personal, laboratory & environmental exposure to potentially infectious agents or biohazards

Source: BMBL, 6th Edition

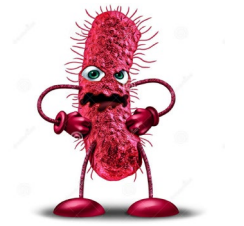


Hazard Classifications of Microbial Agents

Microbial agents or materials containing infectious material are classified by **Risk Group** based on several factors:

Agent

- Pathogenicity and Virulence
- Routes of exposure
- Concentration being used compared to Infectious Dose
- Stability in the environment
- Treatment options and vaccine availability
- Considering reproductive risks to workers
- Considering risks to animals, plants, and the environment
- Endemic nature



Risk Group	Agent Risk Description	Examples
RG-1	Agents not associated with disease in healthy adult humans (no or low individual risk).	<i>Bacillus subtilis</i> , <i>Escherichia coli</i> K12, adeno-associated virus
RG-2	Agents associated with human disease which is rarely serious & for which preventive or therapeutic interventions are <i>often</i> available (moderate individual risk).	<i>Staphylococcus aureus</i> , <i>Salmonella</i> sp., Herpes simplex virus (HSV), Adenovirus
RG-3	Agents associated with serious or lethal human disease for which preventive or therapeutic interventions <i>may be</i> available (high individual risk).	<i>Mycobacterium tuberculosis</i> , <i>Bacillus anthracis</i> , HIV
RG-4	Agents likely to cause serious or lethal human disease for which preventive or therapeutic interventions are <i>not usually</i> available (high individual & community risk).	Ebola virus, Marburg virus, Lassa virus

Hazard Classifications of Microbial Agents

Risk Group Resources (Data Sheets)



ABSA database

<https://my.absa.org/RiskGroups>

(also a free downloadable app)

NIH rDNA Guidelines

https://osp.od.nih.gov/wp-content/uploads/NIH_Guidelines.pdf

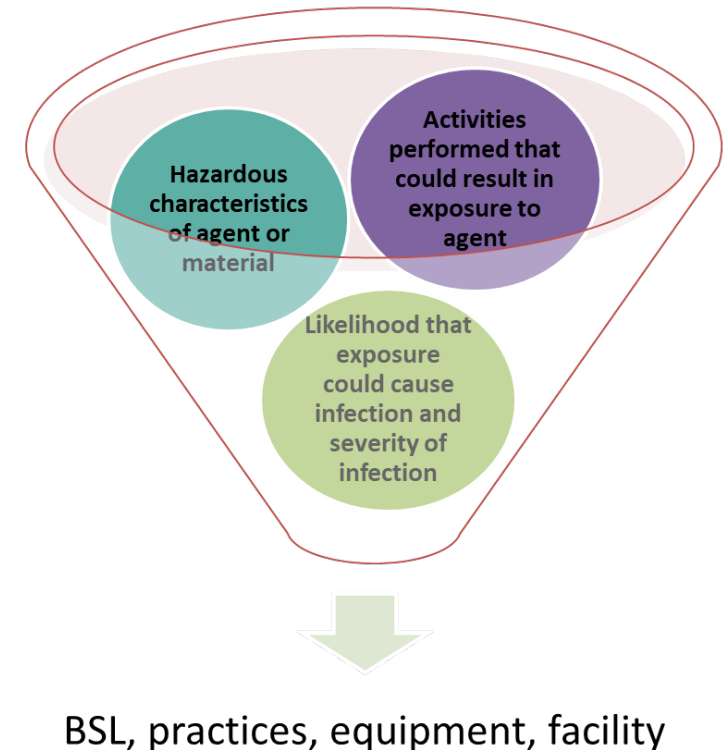
Others: Public Health Agency of Canada

<http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/index-eng.php>

Biological Risk Assessment

Process used to identify:

- Hazardous characteristics of a known infectious or potentially infectious agent or material (Risk Group)
- Activities that can result in a person's exposure to an agent (lab procedure hazards & capability to control hazards)
- Likelihood that such exposure will cause a laboratory-associated infection (LAI)
- Probable consequences of such an infection



Biological Risk Assessment

Process used to identify:

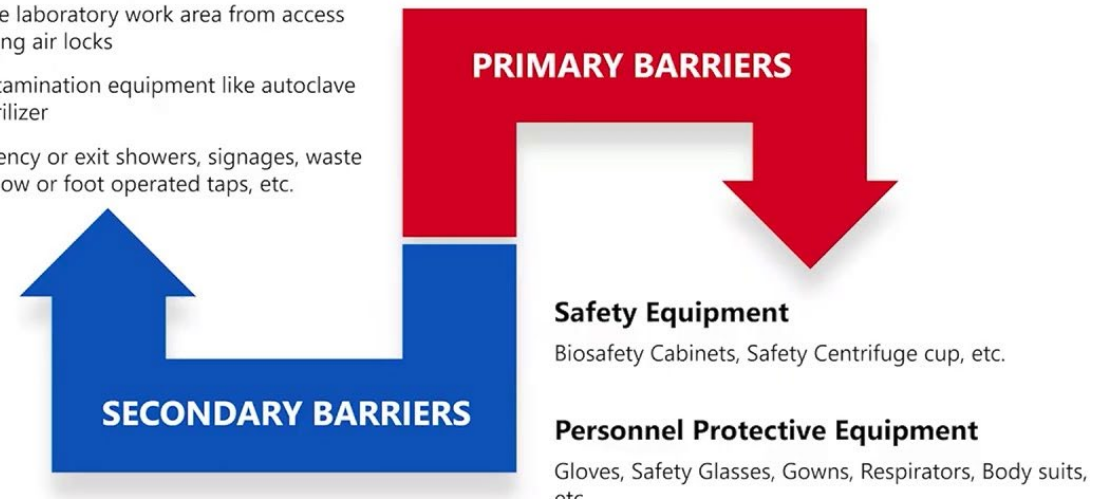
- Containment equipment necessary
- Personal Protective Equipment
- Appropriate Facility
- Training proficiency
- Training requirements

Facility Construction & Design

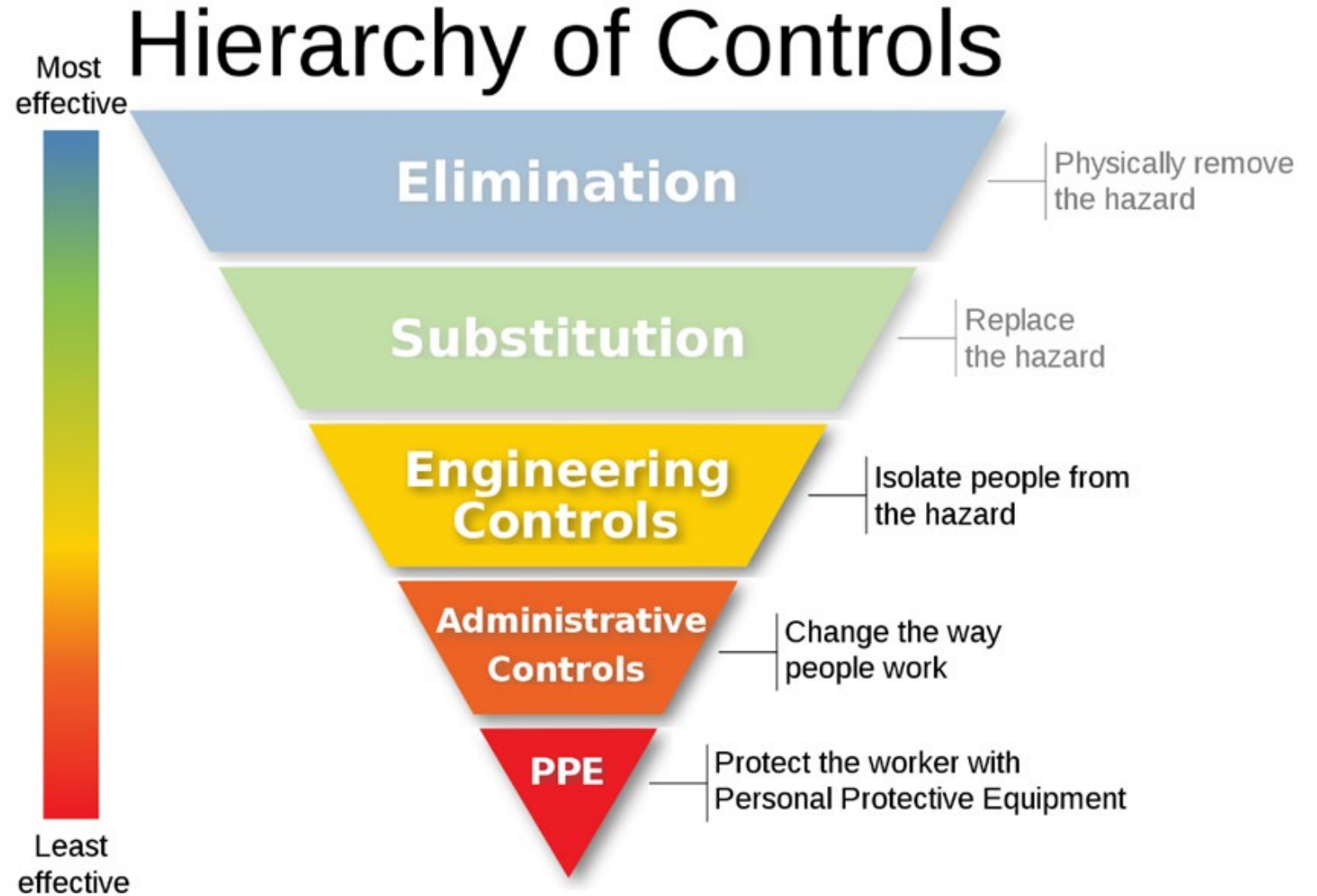
Separation of the laboratory work area from access area by introducing air locks

Providing decontamination equipment like autoclave and dry heat sterilizer

Providing emergency or exit showers, signages, waste disposal bins, elbow or foot operated taps, etc.



During the biological risk assessment, the “Hierarchy of Controls” is used to reduce risk of occupational exposure and to select the appropriate Biosafety Level (BSL) based on the risk assessment





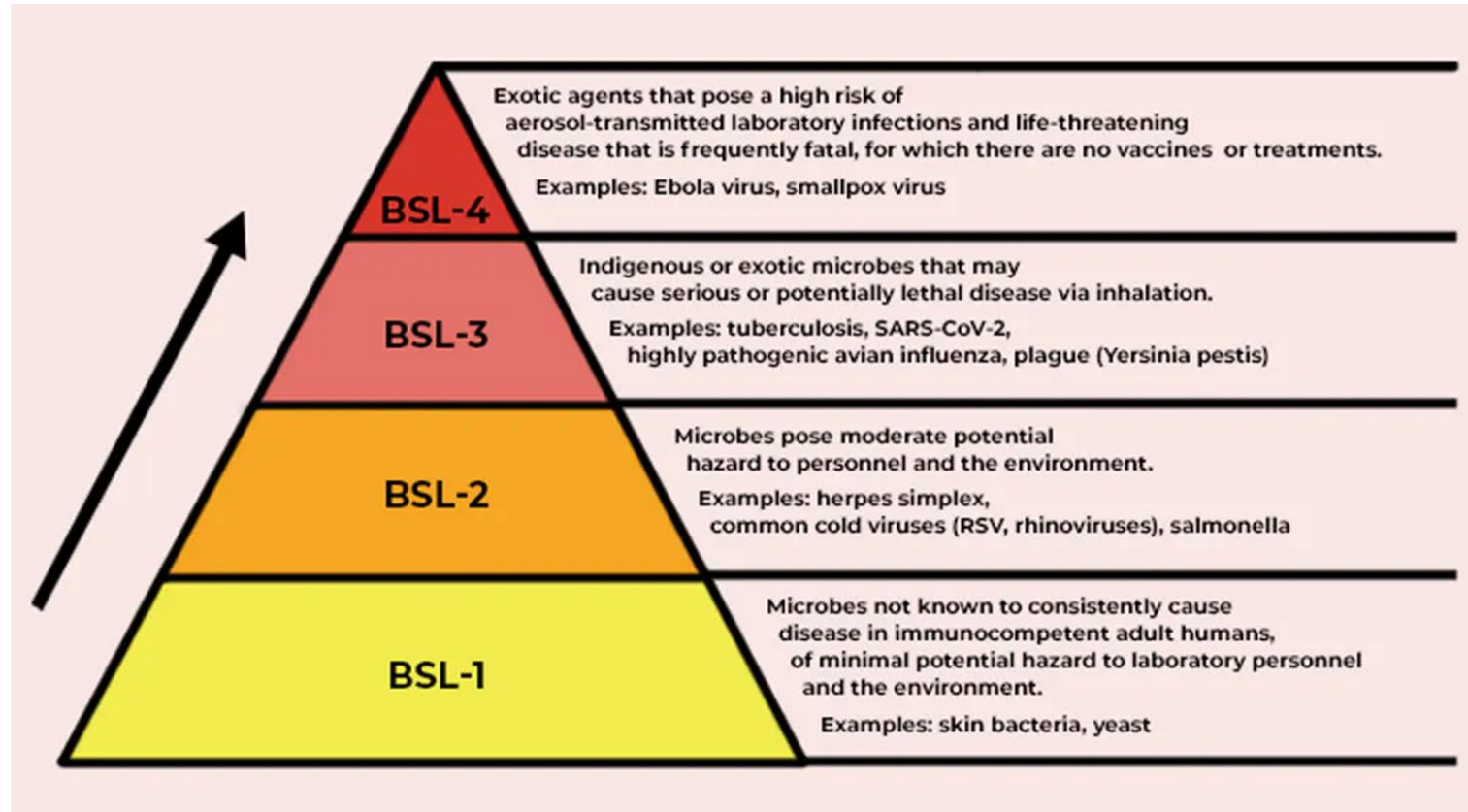
Biosafety Levels (BSL)

Biosafety levels are combinations of lab practices, safety equipment, and lab facilities

BSL-1 through 4

- Ascending degree of protection provided to personnel, the environment, & the community
- Increasing levels of containment

Biosafety Levels (BSL)



Human and other primate cells, fluids and tissue should be handled using Biosafety Level 2 practices and containment.

Biosafety Levels (BSL)

Each biosafety level has

- Standard microbiological practices
- Special Practices
- Safety Equipment and PPE
- Laboratory Facilities

Each biosafety level builds upon the previous

- All practices, equipment, PPE and facilities used at BSL-1 must be followed in BSL-2, with the additional requirements of BSL-2



Biosafety Level -1 (BSL-1)

Microbial Agents not known to consistently cause disease in immunocompetent adult humans; low hazard to laboratory personnel and the environment

Standard microbiological practices:

- PPE includes lab coat or gown, gloves and eye protection at minimum with long pants and close toed shoes
- Contaminated PPE should be removed and replaced
- PPE should not be worn outside of the laboratory
- Wash hands after working with hazardous material and before leaving the laboratory
- Eating, drinking, smoking, handling contact lenses, applying cosmetics and storing food or drinks for human consumption is not allowed in the laboratory
- Long hair should be restrained as to not contact the work surface
- Mouth pipetting is prohibited
- Animals and plants not associated with the research are not allowed in the laboratory.

Biosafety Level -1 (BSL-1)

Microbial Agents not known to consistently cause disease in immunocompetent adult humans; low hazard to laboratory personnel and the environment

Standard microbiological practices:

- Sharps should be handled safely and dispose of in a sharps container
- Sharps containers should be closed when $\frac{3}{4}$ full
- Avoid recapping needles or use a single hand technique
- Minimize the creation of aerosols and droplets/splashes
- Decontaminate work surfaces after completion of work or if there is a spill

Biosafety Level -1 (BSL-1)

Microbial Agents not known to consistently cause disease in immunocompetent adult humans; low hazard to laboratory personnel and the environment

Safety Equipment:

- Biological Safety Cabinets are not required for BSL-1 work

Laboratory Facilities:

- Door signs must indicate hazards present
- Sink must be available for hand washing
- No carpet/rugs
- Benchtops must be impervious to water and resistant to heat, organic solvents, acids, other chemicals
- Chairs in the laboratory should be covered with non-porous material that can be easily cleaned
- Lighting should be sufficient

Biosafety Level -2 (BSL-2)

Microbial Agents pose a moderate hazard to laboratory personnel and the environment

BSL-1 Standard microbiological practices PLUS....

Special practices:

- Laboratory doors should be closed when work is conducted
- Biological Safety Cabinets (BSCs) used when
 - Procedures have potential to create infectious aerosols or splashes (pipetting, blending, shaking, mixing, sonicating, opening materials of infectious materials, inoculating animals, harvesting tissues from animals)
 - High concentrations or large volumes of infectious materials are used
 - If a BSC is not able to be used, PPE may be increased based on the risk assessment
- Decontaminate laboratory equipment routinely, after spills or potential contamination
- Durable, leak proof containers during collection, handling, processing, storage & transport of infectious materials
- Biological waste method defined by risk assessment
- Recommend a list of infectious agents in possession by location
- Written Standard Operation Procedures should be available to personnel

Biosafety Level -2 (BSL-2)

Microbial Agents pose a moderate hazard to laboratory personnel and the environment

BSL-1 Standard microbiological practices PLUS....

Safety Equipment:

- PPE may include face protection due to risk of splashes
- PPE may include respiratory protection based on risk assessment
- Biological Safety Cabinets (BSCs) are installed at an appropriate location within the laboratory
- Biological Safety Cabinets (BSCs) are certified annually
- Centrifuges should have sealed rotors or used sealed centrifuge cups for use with infectious materials
- Vacuum lines in use are protected with liquid disinfectant traps and in-line HEPA filters

Laboratory Facilities:

- Inward flow of air from hallway
- Equipment used with or to store infectious materials should have a biohazard sign
- Biological waste method defined by risk assessment

Biosafety Level -3 (BSL-3)

Microbial Agents that are indigenous or exotic that may cause serious or potential lethal disease via inhalation

** Specialized training is required for BSL-3 work at UTHealth Houston **

Biosafety Level -4 (BSL-4)

Exotic Agents that pose a high risk of aerosol-transmitted laboratory infectious and life-threatening disease, that is frequently fatal, for which there is no vaccines or treatment

** UTHealth Houston has no BSL-4 facilities **

Questions

If you have any questions or concerns, please contact the UTHealth Houston [Biological Safety Program](#) at 713-500-8170

