



# Microbiology 1

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# Biorisk Management

- **Biorisk management** involves the use of measures designed to *reduce potential exposure* of laboratory personnel, the community and the environment to hazards present in the laboratory
- **Biorisk management principles**
  - **Biosafety**: containment principles, technologies and practices that are implemented to **prevent the unintentional exposure** to the biological agents and toxins, or their accidental release
  - **Biosecurity**: protection, control and accountability for biological agents and toxins within laboratories, in order to **prevent their loss, theft, misuse, diversion of, unauthorized access or intentional unauthorized release** (sometimes stressing protection of assets)
  - **Biorisk** is combination of:
    - 1) The **probability** of occurrence of harm
    - 2) The **severity** of harm where the source of harm is a biological agent or toxin
- **Biorisk Management Model**
  - Key Components:
    - 1) **Biorisk Assessment**: Identifying hazards, assessing risks, and prioritizing actions.
    - 2) **Biorisk Mitigation**: Measures to reduce risks, including safe practices and protective equipment.
    - 3) **Biorisk Performance**: Refining and evaluating measures to ensure biosafety and biosecurity.
- **Biosafety**
  - Barrier that Protects workers from biological risks with:
    - ✓ **Primary barriers**: Equipment like biosafety cabinets and PPE (gloves, lab coats, respirators).
    - ✓ **Secondary barriers**: Infrastructure design (facility layout, air filtration, and secure access).
    - ✓ **Personnel & Procedural**: Worker training, general/specific work practices, and procedural standards.
  - Laboratory Biosafety Levels (**BSL**): Levels 1-4, each with increasing containment and control standards.
  - **Barriers** that protect worker from Biorisk:
    - ✓ **Safe** handling of waste
    - ✓ **Proper** use of engineering controls
      - pipettors, biosafety cabinets, centrifuges, shakers, sonicators
      - no mouth pipetting
    - ✓ **Proper** use of Personal Protective Equipment (PPE) – safe glove removal technique, no glove reuse
    - ✓ **Careful** handling/storage of biologicals
    - ✓ **Following** standard operating procedure (SOP) when available
    - ✓ **Procedural** Working in a neat and organized manner
- **Sterilization and Disinfection:**
  - **Sterilization**: Completely inactivates **all** microbes (e.g., autoclaves).
  - **Disinfection**: **Reduces** harmful microbes using chemicals (effectiveness depends on type, concentration, and contact time).

- **Biological Safety Equipment**

- *Specialized equipment* helps reduce risk when working with biomaterials which is **barriers** that protect worker from Biorisk (Primary – equipment)
- *Include:*
  - ✓ Personal Protective Equipment (PPE): Gloves ,Lab coats, Respirators (e.g. N95, not surgical masks) – protect respiratory tract from aerosols
  - ✓ Liquid pipetting devices
  - ✓ Instruments
  - ✓ Sharps containers
  - ✓ Biosafety cabinets

- **Biorisk Assessment in Labs:**

- Objective assessment of conditions and the level of risk they present to biosafety and biosecurity
  - ✓ Identify hazards and methods to control them
  - ✓ Evaluate risks
  - ✓ Secondary – design of the infrastructure/building
- Consideration of *factors* important for containment
  - ✓ Locking doors, security
  - ✓ Laboratory layout and workflow
  - ✓ Air handling and filtration
  - ✓ High Efficiency Particular Air (HEPA) filters
  - ✓ Handwashing access
  - ✓ Biosafety cabinet accessibility and maintenance
  - ✓ Sterilization (e.g. autoclave) access
  - ✓ Proper signage – post biosafety/biosecurity warnings
  - ✓ Containment suits
- Assessment for *animal lab*
  - ✓ Animal biosafety levels (*ABLS1-4*)
  - ✓ *Small* animal housing :
    - Disposable cages
    - HEPA filtered racks
  - ✓ *Large* animals requires:
    - Special facilities, equipment
    - Knowledge of their behavior

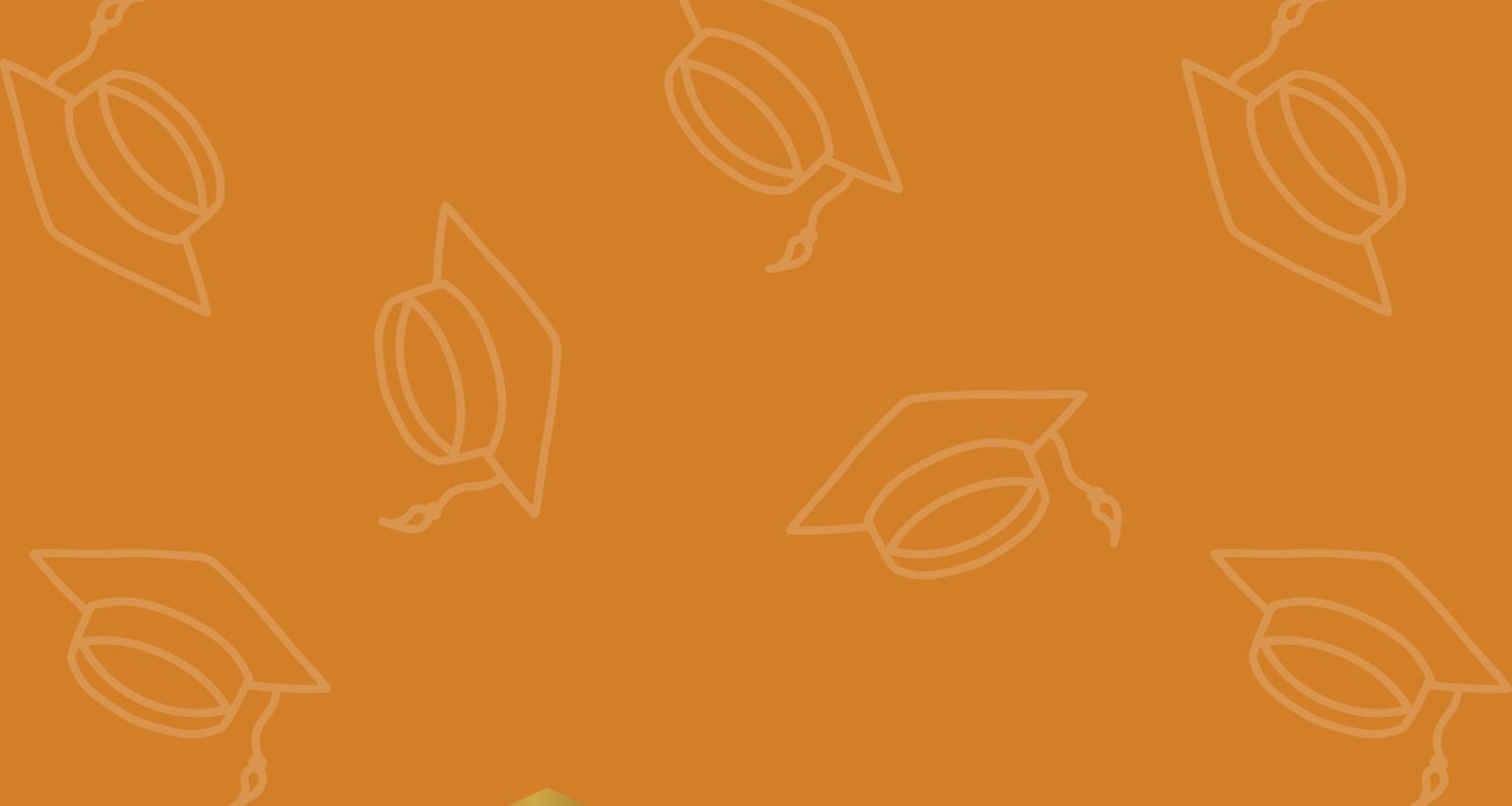
- **Biorisk Mitigation:**

- *Reduces* risk with work practices, specialized equipment, PPE, and facility design.
- Includes workplace immunizations to protect staff when working with specific pathogens.

- **Transport of Biological Materials:**

- *Requires* secure packaging, labeling, and compliance with local and international regulations.
- Only *certified individuals* may transport hazardous materials, ensuring safety for public health and the environment.

- **Recombinant and Synthetic Nucleic Acid Molecules:**
  - *Synthetic nucleic acids* are chemically created or modified molecules that can pair with natural nucleic acids, potentially changing an organism's traits or functions.
  - Recombinant and synthetic nucleic acids require careful management due to *potential risks*, especially when their biological effects or ability to cause disease are not fully understood.
  - *This involves:*
    - ✓ **Approvals**, handling, storage, and tracking of these molecules.
    - ✓ Oversight by Institutional Biosafety Committees (**IBCs**), which review research and ensure compliance with regulations.
  
- **Emerging Infectious Diseases (EID):**
  - EIDs are *diseases* that are either new or rapidly spreading.
  - The *factors* effect :
    - ✓ Global travel
    - ✓ Zoonosis (diseases affecting both animals and humans),
    - ✓ Microbial evolution contribute to their spread.
  - The impact of EIDs varies based on health, economic, and social factors,
  - The *transmission modes* including:
    - ✓ **General transmission** (e.g., through animal vectors or environmental factors).
    - ✓ **Human-to-human transmission** (direct contact, airborne, fecal-oral, etc.).
  
- **Bioterrorism:**
  - The intentional *release* of biological agents to cause harm or terror.
  - Understanding the threats and Biorisk management helps mitigate potential bioterrorism risks.
  
- **Biorisk Management and Ethical Responsibility:**
  - Biorisk management is essential to prevent accidents or intentional misuse of biological agents. Labs must assess risks and apply standards tailored to specific situations.
  - International standards from organizations like *OSHA, NIH, ISO, OIE, FAO, and WHO* guide the safe handling of biohazardous materials.



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