Microbiology

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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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