Biosafety Principles

SNL Biosecurity Team

National Workshop on Biosecurity

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NNSA National Nuclear Security Administration

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Why Biosafety?

- Microbiology labs can be environments with infectious disease risks to persons in or near them
- History of lab-acquired infections
  - Often attributed to carelessness or poor technique
  - Relatively few cases can be attributed to direct accident
    - Mouth pipetting and sharps injuries
  - Exposure to airborne pathogens generally presumed to be most plausible cause
  - Brucellosis is most common
- Sporadic infections in community as a result
  - Examples:
    - 1973 and 1978 – England had 3 secondary cases of smallpox
    - 1950 – 2 cases of Q fever in household of scientist
    - 1990 – 1 documented case of Monkey B virus from animal handler to wife
    - SARS

Elements of Biosafety

- Laboratory practice and technique
  - Standard practices
  - Special practices
- Safety equipment (primary barriers)
- Laboratory facilities (secondary barriers)
- Building (tertiary barriers)

- Biosafety measures determined by risk assessment

Laboratory Practice and Technique for Basic Laboratories (BSL 1 and BSL 2)

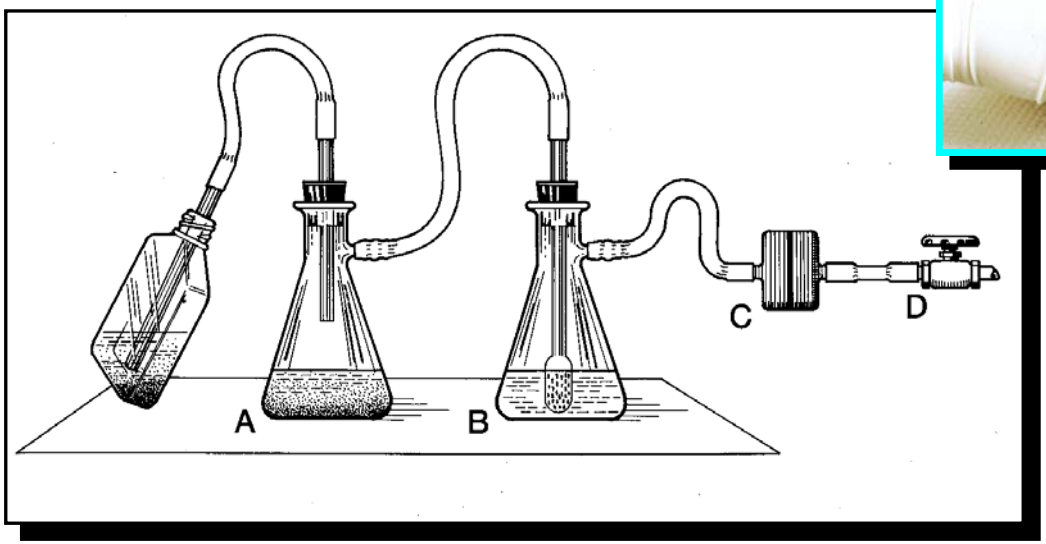
- **WHO Laboratory Biosafety Manual (LBM) 3rd edition:**
  - **Access, including**
    - **Biohazard sign displayed for RG2 organisms or higher**
    - **Only authorized persons in working areas**
  - **Personal protection, including**
    - **Lab coats worn for work**
    - **Appropriate gloves worn if may have contact with potentially infectious materials**
  - **Procedures, including**
    - **No mouth pipetting**
    - **Minimize formation of aerosols and droplets**
    - **Limit use of needles and syringes**
  - **Laboratory working areas, including**
    - **Work surfaces decontaminated after spills and at end of day**
    - **Open windows should have screens**

Laboratory Practice and Technique for Basic Laboratories (BSL 1 and BSL 2)

- **WHO Laboratory Biosafety Manual (LBM) 3rd edition:**
  - **Biosafety management, including**
    - **Regular training**
    - **Biosafety plan and SOPs**
  - **Design features, including**
    - **Bench tops should be impervious to water and resistant to chemicals**
    - **At BSL2, an autoclave or other means of decontamination should be available**
    - **Facilities for safe handling and storage of chemicals**
  - **Laboratory equipment, including**
    - **Pipetting aids**
    - **Biosafety cabinets for procedures with risk of aerosol generation**
    - **Plastic, whenever available, to avoid glass**
  - **Waste handling**
  - **Chemical, fire, electrical, radiation, and equipment safety**

Special Practices and Procedures

- **Examples:**
  - **Access limitations for immunocompromised**
  - **Use of bioaerosol-containing equipment**
  - **Protection of vacuum lines**
  - **Medical surveillance program**



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Animal Facilities

- Separate from other areas
- Access controls with appropriate locking mechanism
- Cage washing

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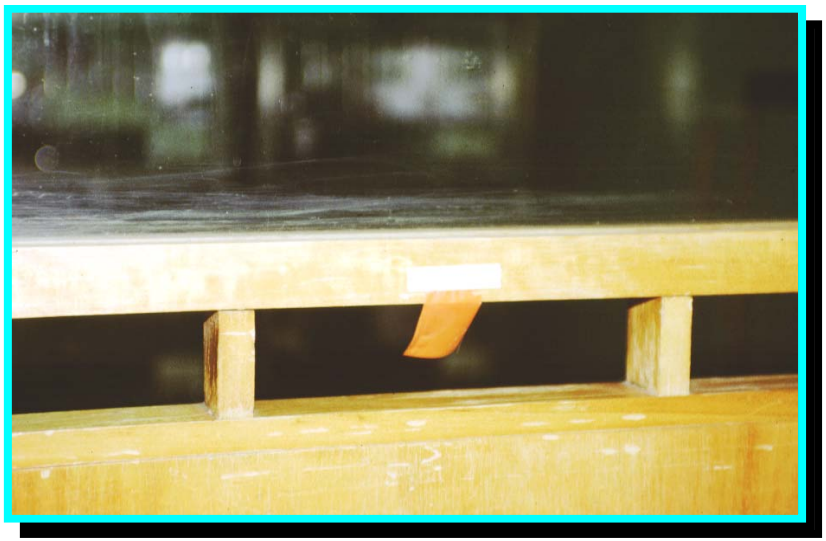
Animal Facility Design Considerations

- Designed and constructed to facilitate cleaning
- Inward airflow into animal rooms
- Insect and rodent control program



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Biosafety Levels, Practices, and Equipment

Table 2. ***Relation of risk groups to biosafety levels, practices and equipment***

RISK GROUP	BIOSAFETY LEVEL	LABORATORY TYPE	LABORATORY PRACTICES	SAFETY EQUIPMENT
1	Basic – Biosafety Level 1	Basic teaching, research	GMT	None; open bench work
2	Basic – Biosafety Level 2	Primary health services; diagnostic services, research	GMT plus protective clothing, biohazard sign	Open bench plus BSC for potential aerosols
3	Containment – Biosafety Level 3	Special diagnostic services, research	As Level 2 plus special clothing, controlled access, directional airflow	BSC and/or other primary devices for all activities
4	Maximum containment – Biosafety Level 4	Dangerous pathogen units	As Level 3 plus airlock entry, shower exit, special waste disposal	Class III BSC, or positive pressure suits in conjunction with Class II BSCs, double-ended autoclave (through the wall), filtered air

BSC, biological safety cabinet; GMT, good microbiological techniques (see Part IV of this manual)

From: WHO LBM 3rd edition