Time to Teach, Learn and Practice Science Safely

The Laboratory Safety Institute

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TRAINING
PROGRAM DEVELOPMENT
AUDITS & INSPECTIONS
REGULATORY COMPLIANCE
AV LENDING LIBRARY
REFERENCE LIBRARY
INTERNET DISCUSSION LIST
MINI-GRANTS
Sources of Infection

- Oral aspiration
- Pipetting
- Inoculating loops
- Accidental syringe injections
- Animal bites or contact
- Spray from syringes
- Centrifuge accidents
- Broken containers

www.labsafety.org
Other Potential Hazards

- Bloodborne Pathogens
- Careless culturing
- Autoclaves
- Allergic reactions
- Ether and other chemicals
- Eating in the laboratory
- Sonication
- Electroporation
- Popping tube caps
- Vortexing
- Flow cytometry
- Centrifugation

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"What the? ... This is lemonade! Where's my culture of amoebic dysentery?"
Field Work Precautions

- Visit site before
- List of workers
- Plans for emergencies
- First Aid Equipment
- Communication devices

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### Fieldwork Safety Plan

**Risk Assessment:**
Identify risks associated with fieldwork activities or the environment surrounding fieldwork activities (e.g. violence, water, extreme heat or cold, wild animals, endemic disease, firearms, explosives, high altitudes, climbing, etc). Also list appropriate measures to be taken to reduce the risks.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Preventative Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Environmental conditions</td>
<td>Wear appropriate clothing for activities/weather. Wear appropriate footwear.</td>
</tr>
<tr>
<td>2 Getting hit by a vehicle on the side of a road</td>
<td>All fieldwork members shall wear reflective vest. Work as far away from the road as</td>
</tr>
<tr>
<td></td>
<td>possible. Park vehicle well off the side of the road.</td>
</tr>
<tr>
<td>3 Snakes</td>
<td>Wear snake guards to protect against snake bites.</td>
</tr>
<tr>
<td>4 Car accident</td>
<td>Only workers with a valid drivers license shall be able to drive. Obey all traffic</td>
</tr>
<tr>
<td></td>
<td>laws. Do not drive if over tired.</td>
</tr>
<tr>
<td>5 Domestic animals</td>
<td>Ask permission to enter a landowner's property.</td>
</tr>
<tr>
<td>6 Falling rocks</td>
<td>Minimize work spent at the base of a rock cliff, especially in rainy conditions. All</td>
</tr>
<tr>
<td></td>
<td>team members must wear hard hats near rocky areas.</td>
</tr>
<tr>
<td>7 Theft</td>
<td>Keep wallet in front pocket. Do not carry expensive belongings with you. Carry</td>
</tr>
<tr>
<td></td>
<td>shoulder bags diagonally across body.</td>
</tr>
<tr>
<td>8 International Disease</td>
<td>Consult with a physician prior to trip. Obtain a vaccine if available.</td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
Biological Wastes

- Cultures/stocks or infectious agents or biologicals
- Blood and blood products
- Sharps
- Contaminated liquids
- Contaminated equipments
- Fermentation broths
- Tissue cultures
State-by-State Regulations for Medical Waste

www.envcap.org
## Accidents Associated with Laboratory – Acquired Infections

<table>
<thead>
<tr>
<th>Accident</th>
<th>Number (%) Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splash/spray</td>
<td>188 (26.7%)</td>
</tr>
<tr>
<td>Needlestick</td>
<td>177 (25.2%)</td>
</tr>
<tr>
<td>Sharps</td>
<td>112 (15.9%)</td>
</tr>
<tr>
<td>Pipetting</td>
<td>92 (13.1%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>39 (5.5%)</td>
</tr>
</tbody>
</table>
Nearly 50 students in Franklin, MA sick with salmonella
University of Chicago researcher dies after exposure to plague bacteria
Safety Issues Continue

April 28, 2011 – CDC Investigation Announcement: Multistate Outbreak of Human Salmonella Typhimurium Infections Associated with Exposure to Clinical and Teaching Microbiology Laboratories
Advice from CDC to prevent future outbreaks

- Develop biosafety guidelines for work with pathogens.
- Use non-pathogenic or attenuated bacterial strains.
- Personnel must be aware of potential hazards and trained and proficient in the practices and techniques.
- Watch for symptoms, call health care provider if you or a family member have any of these symptoms.
- Require students and employees to wash their hands before leaving the laboratory.
- Lab coats only leave lab to be cleaned by the institution.
- No food, drinks or personal items like car keys, cell phones and mp3 players used while in the lab.
- Provide students with dedicated writing utensils, paper, and other supplies at each laboratory station.
BREAK the “chain of infection”

**INFECTIONOUS AGENT**
(Germ that causes the disease) =

**SUSCEPTIBLE PERSON**
(How likely a person is to get sick after being exposed to the germ) =

**RESERVOIR**
(Where the germ normally lives) =

**MEANS OF TRANSMISSION**
(How the germ travels from the reservoir to a person) =

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Chain of Infection

- Reservoir of pathogen
- Portal of escape
- Transmission
- Route of entry / infectious dose
- Susceptible host
- Incubation period

Risk Assessment

Facilities
- Practices / Equipment
- PPE
- Access control / Immunization
- Surveillance
What is Biosafety?

Biosafety describes the

- containment principles,
- technologies
- and practices that are implemented to prevent the unintentional exposure to biological agents and toxins, or their accidental release.
### TABLE 1
SUMMARY OF RECOMMENDED BIOSAFETY LEVELS FOR INFECTIOUS AGENTS

<table>
<thead>
<tr>
<th>BSL</th>
<th>AGENTS</th>
<th>PRACTICES</th>
<th>PRIMARY BARRIERS AND SAFETY EQUIPMENT</th>
<th>FACILITIES (SECONDARY BARRIERS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Not known to consistently cause diseases in healthy adults</strong></td>
<td>Standard Microbiological Practices</td>
<td>None required</td>
<td>Open bench and sink required</td>
</tr>
</tbody>
</table>
| 2   | **Agents associated with human disease**                               | BSL-1 practice plus:  
  - Limited access  
  - Biohazard warning signs  
  - “Sharps” precautions  
  - Biosafety manual defining any needed waste decontamination or medical surveillance policies  | Primary barriers:  
  - Class I or II BSCs or other physical containment devices used for all manipulations of agents that cause splashes or aerosols of infectious materials  
  - PPEs:  
    - Laboratory coats; gloves; face protection as needed  | BSL-1 plus:  
  - Autoclave available                                                                                                                   |
| 3   | **Indigenous or exotic agents with potential for aerosol transmission** | BSL-2 practice plus:  
  - Controlled access  
  - Decontamination of all waste  
  - Decontamination of laboratory clothing before laundering  
  - Baseline serum  | Primary barriers:  
  - Class I or II BSCs or other physical containment devices used for all open manipulation of agents  
  - PPEs:  
    - Protective laboratory clothing; gloves; respiratory protection as needed  | BSL-2 plus:  
  - Physical separation from access corridors  
  - Self-closing, double-door access  
  - Exhaust air not recirculated  
  - Negative airflow into laboratory                                                                                                     |
| 4   | **Dangerous/exotic agents which pose high risk of life-threatening disease** | BSL-3 practices plus:  
  - Clothing change before entering  
  - Shower on exit  
  - All material decontaminated on exit from facility  | Primary barriers:  
  - All procedures conducted in Class III BSCs or Class I or II BSCs in combination with full-body, air-supplied, positive pressure personnel suit  | BSL-3 plus:  
  - Separate building or isolated zone  
  - Dedicated supply and exhaust, vacuum, and decontamination systems  
  - Other requirements outlined in the text                                                                                               |

*PPE – Personal Protective Equipment*
Biohazard Risk Assessment

1. What is the biohazard or procedure involving a potential biohazard?

2. What is the worst thing that can happen? (Consequences! to personnel & community)

3. How common are adverse incidents? (LAI’s -- Rare, Moderate, Frequent)

4. Are you prepared? (Emergency Planning, Treatment options, Medical Surveillance)

5. What are the Control Measures? (elimination, substitution, engineering, administrative, PPE, altered work practices, training)
Biosafety Program Components

- **Engineering**
  - Autoclaves, HVAC systems, physical security, directional airflow, BSCs, lab design

- **Administrative**
  - Training, immunization, medical surveillance, SOP compliance programmes

- **Personal Protective Equipment**
  - Gloves, gowns, respirators

- **Standard Operating Procedures**
  - Validated, edited and updated SOPs ensuring clear, concise and consistent processes
Engineering Controls/Equipment

Biological Safety Cabinets (Class II)

- Ventilated cabinet
- Provides personnel, product, and environmental protection
- Open front with inward airflow for personnel protection
- Downward HEPA filtered laminar airflow for product protection
- HEPA filtered exhaust air for environmental protection
Class II Cabinets Type A
Laminar Flow Hood – No Personnel Protection
Key Resources

- **Biosafety in Microbiological and Biomedical Laboratories (BMBL), 5th U.S. Department of Health and Human Services**
  

- **National Institutes of Health Guidelines for Research Involving Recombinant DNA Molecules (NIH Guidelines) October 2011**
  
Key Resources

- Laboratory Biosafety Manual, 3rd Ed.
  World Health Organization, 2004

- Centers for Disease Control and Prevention
  Office of Health and Safety (website)
  [http://www.cdc.gov/od/ohs/](http://www.cdc.gov/od/ohs/)
Key Resources

- ABSA Risk Group Classification for Infectious Agents

- Public Health Agency of Canada - Material Safety Data Sheets for Infectious Substances