**BIOSAFETY LEVELS** Four biosafety levels (BSLs) are summarized in the table below for proper handling of biohazardous materials. BSLs consist of combinations of laboratory practices and techniques, safety equipment, and laboratory facilities. Each combination is specifically appropriate for the operations performed the documented or suspected routes of transmission of the infectious agents, and for the laboratory function or activity.

<table>
<thead>
<tr>
<th>BSL</th>
<th>Agents</th>
<th>Practices</th>
<th>Safety Equipment (Primary Barriers)</th>
<th>Facilities (Secondary Barriers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not known to consistently cause diseases in immunocompetent adult humans</td>
<td>Standard microbiological practices</td>
<td>None required</td>
<td>Open bench top, sink required</td>
</tr>
<tr>
<td>2</td>
<td>Associated with human disease. Hazard: percutaneous injury, mucous membrane exposure, ingestion</td>
<td>BSL-1 practices plus: • limited access • biohazard warning signs • sharps precautions • biosafety manual defining waste decontamination or medical surveillance policies</td>
<td>Primary barriers: Class I or II biosafety cabinets or other physical containment devices used for all manipulations of agents that cause splashes or aerosols of infectious materials; PPE: laboratory coats, gloves, face protection as needed</td>
<td>BSL-1plus: • non-fabric chairs and other furniture easily cleanable • autoclave available • eyewash readily available</td>
</tr>
<tr>
<td>3</td>
<td>Indigenous or exotic agents with potential for aerosol transmission; disease may have serious or lethal consequences</td>
<td>BSL-2 practices plus: • controlled access • decontamination of all wastes • decontamination of lab clothing before laundering • baseline serum</td>
<td>Primary barriers: Class I or II biosafety cabinets or other physical containment devices used for all manipulations of agents; PPE: laboratory coats, gloves, respiratory protection as needed</td>
<td>BSL-2 plus: • physical separation from access corridors • hands-free handwashing- sink • self-closing double door access • exhaust air not recirculated • negative airflow into laboratory • eyewash readily available in lab</td>
</tr>
<tr>
<td>4</td>
<td>Dangerous/exotic agents which pose high risk of life-threatening disease, aerosol-transmitted lab infections; or related agents with unknown risk of transmission</td>
<td>BSL-3 practices plus: • clothing change before entering • shower on exit • all material decontaminated on exit from facility</td>
<td>Primary barriers: All procedures conducted in Class III biosafety cabinets or Class I or II biosafety cabinets in combination with full-body, air supplied positive pressure suit</td>
<td>BSL-3 plus: • separate building or isolated zone • dedicated supply/exhaust, vacuum and decon system</td>
</tr>
</tbody>
</table>


**Classification of Agents According to Risk**

Biological agents are assigned to biosafety levels (BSL) based on the risk they pose to human health and the environment. Such factors as severity of disease caused by the agent routes of exposure, and virulence are used when determining the most appropriate BSL. The partial list below is provided to assist laboratories in making preliminary decisions on the appropriate
biosafety level for particular agents. Ultimately, the Occupational and Environmental Safety Office (OESO) will make the final BSL assignment. If a particular agent is not listed below, or if further assistance is needed in interpreting BSL requirements, contact the OESO-Biological Safety Division at 684-8822.

**Biosafety Level 1 (BSL-1)**
BSL-1 is suitable for work involving well-characterized agents not known to consistently cause disease in immunocompetent adult humans, and present minimal potential hazard to laboratory personnel and the environment. All bacterial, parasitic, fungal, viral, rickettsial, and chlamydial agents which have been assessed for risk but do not belong to a higher risk group can be safely handled at BSL-1. Be aware that many agents not ordinarily associated with disease are opportunistic pathogens and may cause infection in the young, the aged and immunocompromised individuals. Examples of BSL-1 agents include: Bacillus subtilis, Eschericia coli-K12, Naegleria gruberi, etc.

**Biosafety Level 2**

**Viral Agents:**
- Adenovirus
- Creutzfeld-Jacob agent
- Cytomegalovirus
- Eastern equine encephalitis
- Epstein-Barr virus
- Hepatitis A, B, C, D, E
- Herpes simplex viruses
- HIV

**Bacterial/Rickettsial Agents:**
- Campylocacter fetus, coli, jejuni
- Chlamydia psittaci, trachomatis
- Clostridium botulinum, tetani
- Corynebacterium diphtheriae
- Legionella spp
- Neisseria gonorrhoeae
- Neisseria meningitidis
- Pseudomonas pseudomallei
- Salmonella spp
- Shigella boydii, dysenteriae, flexneri, sonnei
- Treponema pallidum
- Vibrio cholera
  (including El Tor)
- Vibrio parahemolyticus
- Vibrio vulnificus
- Yersinia pestis

**Fungal Agents:**
- Blastomyces dermatitidis
- Cryptococcus neoformans
- Microsporum spp
- Exophiala dermatitidis (wangiella)
- Fonsecaea pedrosoi
- Sporothrix schenckii
- Trichophyton spp
**Parasitic Agents:**

- Entomoeoba histolyta
- Crytosporidium spp
- Giardia spp
- Naegleria fowleri
- Plasmodium spp
- Strongyloides spp
- Tania solium
- Toxoplasma spp
- Trypanosoma spp

**Biosafety Level 3**

**Viral Agents:**

- Valley
- Rift Valley Fever (Zinga)
- VSV exotic strains (Piry)
- Yellow fever (wild type)

**Bacterial/Rickettsial Agents:**

- Bacillus anthracis
- Francisella tularensis
- Mycobacterium bovis
- Mycobacterium tuberculosis
- Rickettsia rickettsii
- Yersenia pestis (resistant strains)

**Fungal Agents:**

- Coccidioides immitis
- Histoplasma capsulatum

**Biosafety Level 4**

**Viral Agents:**

- Hemorrhagic Fevers: Herpes simiae (B virus)
- (Congo-Crimean, Junin, Machupo) Lassa
- Ebola Marburg