

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 tor activity.

BSL	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	Not known to consistently cause diseases in immunocompetent adult humans	Standard microbiological practices	None required	Open bench top, sink required
2	Associated with human disease. Hazard: percutaneous injury, mucous membrane exposure, ingestion	BSL-1 practices plus: • limited access • biohazard warning signs • sharps precautions • biosafety manual defining waste decontamination or medical surveillance policies	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	BSL-1plus: • non-fabric chairs and other furniture easily cleanable • autoclave available • eyewash readily available
3	Indigenous or exotic agents with potential for aerosol transmission; disease may have serious or lethal consequences	BSL-2 practices plus: • controlled access • decontamination of all wastes • decontamination of lab clothing before laundering • baseline serum	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	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
4	Dangerous/exotic agents which pose high risk of life-threatening disease, aerosol-transmitted lab infections; or related agents with unknown risk of transmission	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 biosafety cabinets or Class I or II biosafety cabinets in combination with full-body, air supplied positive pressure suit	BSL-3 plus: • separate building or isolated zone • dedicated supply/exhaust, vacuum and decon system

Summarized from **Biosafety in Microbiological and Biomedical Laboratories**, 5th Edition, 2007.

<http://www.cdc.gov/od/ohs/biosfty/bmbI5/bmbI5toc.htm>

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*, *Escherichia coli* -K12, *Naegleria gruberi*, etc.

Biosafety Level 2

Viral Agents:

Adenovirus	HTLV types I and II
Creutzfeld-Jacob agent	Human Blood & Blood Products
Cytomegalovirus	Kuru
Eastern equine encephalitis	Monkeypox virus
Epstein-Barr virus	SIV
Hepatitis A, B, C, D, E	Spongiform encephalopathies
Herpes simplex viruses	Vaccinia virus
HIV	VSV (lab adapted strains)

Bacterial/Rickettsial Agents:

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

Fungal Agents:

Blastomyces dermatitidis	Fonsecaea pedrosoi
Cryptococcus neoformans	Sporothrix schenkii
Microsporum spp	Trichophyton spp
Exophiala dermatitidis (wangiella)	

Parasitic Agents:

Entamoeba histolytica
Cryptosporidium spp
Giardia spp
Naegleria fowleri
Plasmodium spp

Strongyloides spp
Taenia 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 tuberculosis

Mycobacterium bovis
Rickettsia rickettsii
Yersenia pestis (resistant strains)

Fungal Agents:

Coccidioides immitis

Histoplasma capsulatum

Biosafety Level 4

Viral Agents:

Hemorrhagic Fevers:
(Congo-Crimean, Junin, Machupo)
Ebola

Herpes simiae (B virus)
Lassa
Marburg