

## Biological Safety Levels - Summary

Two tables that were developed by the Centers for Disease Control and Prevention are presented below for your reference. Under *Agents* on the CDC Tables, the corresponding agent description can be matched to the NIH's Risk Group definitions listed below:

### NIH's Basis for the Classification of Biohazardous Agents by Risk Group (RG)

Risk Group 1 (RG1)	Agents that are not associated with disease in healthy adult humans
Risk Group 2 (RG2)	Agents that are associated with human disease which is rarely serious and for which preventive or therapeutic interventions are <i>often</i> available
Risk Group 3 (RG3)	Agents that are associated with serious or lethal human disease for which preventive or therapeutic interventions <i>may be</i> available (high individual risk but low community risk)
Risk Group 4 (RG4)	Agents that are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are <i>not usually</i> available (high individual risk and high community risk)

Sections highlighted in red are equivalent expressions between the respective definitions.

It will be noticed immediately that there is some difference in the two Agencies' definitions, making a quick answer to what is the correct BioSafety Level for a given Risk Group problematic and simplistic at best. *All risks and hazards* must be taken into account, and in most cases a careful combination of both definitions will aid in selecting the right match.

It should also be remembered that a BioSafety Level is *not* an all encompassing set of practices – it really should be regarded as a *minimum* set of practices, to be added to if additional hazards or risks are known about a given organism. There are greater hazards associated with *Escherichia coli* O157:H7, a Verotoxin producer strain, in comparison to *E. coli* X1776, which is a standard molecular biology tool, and therefore greater need to use higher protective practices when working with the former bacteria.

Each successive BioSafety Level builds on the former level, including all of the practices and equipment listed in the previous level, unless a more protective practice or device is required. At all levels, good microbiological technique is required-there is no substitute for sound practice when handling microbiological agents.

## Summary of Recommended Biosafety Levels for Infectious Agents <sup>\*</sup>

BSL	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	Not known to consistently cause disease in healthy adults	Standard Microbiological Practices	None required	Open bench top sink required
2	Associated with human disease, hazard = percutaneous injury, ingestion, mucous membrane exposure	<p><b>BSL-1 practice plus:</b></p> <p>Limited access</p> <p>Biohazard warning signs</p> <p>"Sharps" precautions</p> <p>Biosafety manual defining any needed waste decontamination or medical surveillance policies</p>	Primary barriers = Class I or II BioSafety Cabinets (BSCs) or other physical containment devices used for all manipulations of agents that cause splashes or aerosols of infectious materials; Personal Protective Equipments (PPEs): laboratory coats; gloves; face protection as needed	<p><b>BSL-1 plus:</b></p> <p>Autoclave available</p>
3	Indigenous or exotic agents with potential for aerosol transmission; disease may have serious or lethal consequences	<p><b>BSL-2 practice plus:</b></p> <p>Controlled access</p> <p>Decontamination of all waste</p> <p>Decontamination of lab clothing before laundering</p> <p>Baseline serum</p>	Primary barriers = Class I or II BSCs or other physical containment devices used for all open manipulations of agents; PPEs: protective lab clothing; gloves; respiratory protection as needed	<p><b>BSL-2 plus:</b></p> <p>Physical separation from access corridors</p> <p>Self-closing, double-door access</p> <p>Exhausted air not recirculated</p> <p>Negative airflow into laboratory</p>
4	Dangerous/exotic agents which pose high risk of life-threatening disease, aerosol-transmitted lab infections; or related agents with unknown risk of transmission	<p><b>BSL-3 practices plus:</b></p> <p>Clothing change before entering</p> <p>Shower on exit</p> <p>All material decontaminated on exit from facility</p>	Primary barriers = All procedures conducted in Class III BSCs or Class I or II BSCs <u>in combination with</u> full-body, air-supplied, positive pressure personnel suit	<p><b>BSL-3 plus:</b></p> <p>Separate building or isolated zone</p> <p>Dedicated supply and exhaust, vacuum, and decontamination systems</p> <p>Other requirements outlined in the text</p>

*\*Source: CDC: "Biosafety in Microbiological and Biomedical Laboratories", 4th Edition*

## Summary of Recommended Biosafety Levels for Activities in Which Experimentally or Naturally Infected Vertebrate Animals Are Used

BSL	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	Not known to consistently cause disease in healthy human adults.	Standard animal care and management practices, including appropriate medical surveillance programs	As required for normal care of each species.	Standard animal facility  No recirculation of exhaust air  Directional air flow recommended  Handwashing sink recommended
2	Associated with human disease. Hazard: percutaneous exposure, ingestion, mucous membrane exposure.	<b>ABSL-1 practices plus:</b>  Limited access  Biohazard warning signs  Sharps precautions  Biosafety manual  Decontamination of all infectious wastes and of animal cages prior to washing	<b>ABSL-1 equipment plus primary barriers:</b>  containment equipment appropriate for animal species; PPEs: laboratory coats, gloves, face and respiratory protection as needed.	<b>ABSL-1 facility plus:</b>  Autoclave available  Handwashing sink available in the animal room.  Mechanical cage washer used
3	Indigenous or exotic agents with potential for aerosol transmission; disease may have serious health effects .	<b>ABSL-2 practices plus:</b>  Controlled access  Decontamination of clothing before laundering  Cages decontaminated before bedding removed  Disinfectant foot bath as needed	<b>ABSL-2 equipment plus:</b>  Containment equipment for housing animals and cage dumping activities  Class I or II BSCs available for manipulative procedures (inoculation, necropsy) that may create infectious aerosols. PPEs: appropriate respiratory protection	<b>ABSL-2 facility plus:</b>  Physical separation from access corridors  Self-closing, double-door access  Sealed penetrations  Sealed windows  Autoclave available in facility
4	Dangerous/exotic agents that pose high risk of life threatening disease; aerosol transmission, or related agents with unknown risk of transmission.	<b>ABSL-3 practices plus:</b>  Entrance through change room where personal clothing is removed and laboratory clothing is put on; shower on exiting  All wastes are decontaminated before removal from the facility	<b>ABSL-3 equipment plus:</b>  Maximum containment equipment (i.e., Class III BSC or partial containment equipment in combination with full body, air-supplied positive-pressure personnel suit) used for all procedures and activities	<b>ABSL-3 facility plus:</b>  Separate building or isolated zone  Dedicated supply and exhaust, vacuum and decontamination systems  Other requirements outlined in the text

Source: CDC: "Biosafety in Microbiological and Biomedical Laboratories", 4<sup>th</sup> Edition