



**RECOMMENDED BIOSAFETY LEVELS FOR INFECTIOUS AGENTS AND INFECTED ANIMALS**

Please consult CDC/NIH's Publication: "Biosafety in Microbiological and Biomedical Laboratories," (BMBL) for more information.

1. The selection of an appropriate biosafety level or work with a particular agent or animal study is dependent upon a number of factors.

The most important of these include the:

- a. Virulence, pathogenicity, biological stability, route of spread and communicability of the agent.
  - b. Nature or function of the laboratory.
  - c. Procedures and manipulations involving the agent.
  - d. Quantity or concentration of the agent.
  - e. Endemicity of the agent.
  - f. Availability of effective vaccines or therapeutic measures.
  - g. Documented or suspected route of transmission of the agent.
2. In general, the biosafety level used for activities involving infectious agents or infected animals must be commensurate with that required for the agent of highest virulence known, or likely to be encountered in the course of the contemplated work. For example, all material of human origin, including cell lines, tissue, and blood, must be considered potentially infectious for hepatitis and HIV and handled under Universal Precautions, which reasonably preclude cutaneous, oral, and parenteral exposure to personnel.
  3. If, in the course of diagnostic or other laboratory examination, there is evidence that the materials being studied contain an agent of higher or lower risk than expected, the biosafety level can be raised or lowered accordingly.
  4. Occasions will arise when it will be necessary to assign a biosafety level higher than that recommended in these guidelines. For example, a higher biosafety level may be indicated by the unique nature of the proposed activity. (e.g., the need for special containment for experimentally generated aerosols).

**TABLE I - Summary of Recommended Biosafety Levels for Infectious Agents**

Biosafety Level	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	Not known to cause disease in healthy adults.	Standard Microbiological Practices.	None Required.	Open bench top sink required.
2	Associated with human disease, hazard =	BSL - 1 practice plus: * Limited access;	Primary barriers = Class I or II BSCs or other physical containment	BSL - 1 plus: Autoclave available.

	auto-inoculation, ingestion, mucous membrane exposure.	<ul style="list-style-type: none"> <li>* Biohazard warning signs;</li> <li>* "Sharps" precautions;</li> <li>* Biosafety manual defining any needed waste decontamination or medical surveillance policies.</li> </ul>	devices used for all manipulations of agents that cause splashes or aerosols of infectious materials; PPEs: laboratory coats; gloves; face protection as needed.	
3	Indigenous or exotic agents with potential for aerosol transmission; disease may have serious or lethal consequences.	<p>BSL - 2 practice plus:</p> <ul style="list-style-type: none"> <li>* Controlled access;</li> <li>* Decontamination of all waste;</li> <li>* Decontamination of all clothing before laundering;</li> <li>* Baseline serum.</li> </ul>	Primary barriers = Class I or II BSC's or other physical containment devices used for all manipulations of agents; PPE's: protective lab clothing; gloves; respiratory protection as needed.	<p>BSL - 2 plus:</p> <ul style="list-style-type: none"> <li>* Physical separation from access corridors;</li> <li>* Self-closing, double-door access;</li> <li>* Exhausted air not recirculated;</li> <li>* Negative airflow into laboratory.</li> </ul>
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>BSL - 3 practices plus:</p> <ul style="list-style-type: none"> <li>* Clothing change before entering;</li> <li>* Shower on exit;</li> <li>* All material decontaminated on exit from facility.</li> </ul>	Primary barriers = All procedures conducted in Class III BSC's or Class I or II BSCs in combination with full-body, air-supplied, positive pressure personnel suit.	<p>BSL - 3 plus:</p> <ul style="list-style-type: none"> <li>* Separate building or isolated zone;</li> <li>* Dedicated supply/exhaust, vacuum, and decon systems;</li> <li>* Other requirements outlined in the text.(BMBL)</li> </ul>

**TABLE 2- Summary of Recommended Biosafety Levels for Activities in which experimentally or naturally infected vertebrate animals are used.**

Biosafety Level	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	Not known to 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: <ul style="list-style-type: none"> <li>* non recirculation of exhaust air;</li> <li>* directional air flow recommended.</li> </ul>
2	Associated with human disease. Hazard: percutaneous exposure, ingestion, mucous membrane exposure.	<p>ABSL - 1 practices plus:</p> <ul style="list-style-type: none"> <li>* limited access;</li> <li>* biohazard warning signs;</li> <li>* sharps precautions;</li> <li>* biosafety manual;</li> <li>* decontamination of all infectious wastes and of animal cages prior to washing.</li> </ul>	<p>ABSL - 1 equipment plus primary barriers:</p> <p>containment equipment appropriate for animal species; PPEs: laboratory coats, gloves, face and respiratory protection as needed.</p>	<p>ABSL - 1 facility plus:</p> <ul style="list-style-type: none"> <li>* autoclave available;</li> <li>* handwashing sink available in the animal room.</li> </ul>

3	Indigenous or exotic agents with potential for aerosol transmission; disease may have serious health effects.	<p>ABSI -2 practices plus:</p> <ul style="list-style-type: none"> <li>* controlled access;</li> <li>* decontamination of clothing before laundering;</li> <li>* cages decontaminated before bedding removed;</li> <li>* disinfectant foot bath as needed.</li> </ul>	<p>ABSL -2, equipment plus:</p> <ul style="list-style-type: none"> <li>* containment equipment for housing animals and cage dumping activities;</li> <li>* Class I or II BSCs available for manipulative procedures (inoculation, necropsy) that may create infectious aerosols. PPEs: appropriate respiratory protection.</li> </ul>	<p>ABSL -2, facility plus:</p> <ul style="list-style-type: none"> <li>* physical separation from access corridors;</li> <li>* self-closing, double-door access;</li> <li>* sealed penetrations;</li> <li>* sealed windows</li> <li>* autoclave available in facility.</li> </ul>
4	Dangerous/exotic agents which pose high risk of life threatening disease; aerosol transmission, or related agents with unknown risk of transmission.	<p>ABSL - 3 practices plus:</p> <ul style="list-style-type: none"> <li>* entrance through change room where personal clothing is removed and laboratory clothing is put on; shower on exiting;</li> <li>* all wastes are decontaminated before removal from the facility.</li> </ul>	<p>ABSL - 3 equipment plus:</p> <ul style="list-style-type: none"> <li>* 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.</li> </ul>	<p>ABSL -3 facility plus:</p> <ul style="list-style-type: none"> <li>* separate building or isolated zone;</li> <li>* dedicated supply/exhaust, vacuum and decontamination systems.</li> <li>* other requirements outlined in the text.</li> </ul>

University of the Sciences in Philadelphia • 600 South Forty-third Street • Philadelphia, PA 19104-4495 • phone: 215-596-8800 • email: [safety@usip.edu](mailto:safety@usip.edu)