

Safeguards are essential to protect the health of laboratory workers and the public from risks associated with the use of hazardous agents in laboratories. The term “containment” is used in describing safe methods, facilities and equipment for managing infectious materials in the laboratory environment where they are being handled or maintained. The purpose of containment is to reduce or eliminate exposure of laboratory workers, other persons, and the outside environment to potentially hazardous agents. Four levels of containment are defined in the publication *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*, published by the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH). The Biosafety Levels (BSLs), designated in ascending order consist of combinations of laboratory practices and techniques, safety equipment, and laboratory facilities.

Biosafety Level 1

Biosafety Level 1 (BSL1) is appropriate for undergraduate and secondary educational training and teaching laboratories, and for other facilities in which work is done with well-characterized agents not known to cause disease in healthy adult humans. Many agents not ordinarily associated with disease processes in humans are, however, opportunistic pathogens and may cause infection in the young, the aged, and immunodeficient or immunosuppressed individuals. BSL1 represents a basic level of containment that relies on standard microbiological practices with no special primary or secondary barriers recommended, other than a sink for hand washing. The Standard Microbiological Practices apply to all Biosafety Levels. Additional practices are recommended for BSL2, BSL3 and BSL4. There are no BSL4 laboratories at Meharry Medical College.

The following standard practices, safety equipment, and facility requirements apply to BSL1.

Standard Microbiological Practices

- Access to the laboratory is limited or restricted at the discretion of the laboratory director when experiments or work with cultures and specimens are in progress.
- Persons wash their hands after working with potentially hazardous materials, after removing gloves, and before leaving the laboratory.
- Eating, drinking, smoking, handling contact lenses, and applying cosmetics are not permitted in the work areas where there is reasonable likelihood of exposure to potentially infectious materials. Persons who wear contact lenses in the laboratories should also wear goggles or a face shield. Food is stored outside the work area in cabinets or refrigerators designated and used for this purpose only.
- Mouth pipetting is prohibited; mechanical pipetting devices are acceptable.
- Minimize the use of sharps. Use needles and scalpels according to appropriate guidelines and precautions.
- All procedures are performed carefully to minimize the creation of splashes or aerosols.
- Work surfaces are decontaminated at least once a day and after any spill of potentially infectious material with appropriate disinfectant.
- All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method, such as autoclaving, chemical disinfection, or other validated decontamination method. Materials to be decontaminated outside of the immediate laboratory are to be placed in a durable, leak-proof container and closed for transport from the laboratory.

- Protective laboratory coats or gowns are recommended to prevent contamination of personal clothing.
- Wear protective eyewear when conducting procedures that have the potential to create splashes of microorganisms or other hazardous materials. Persons who wear contact lenses in laboratories should also wear eye protection.
- Gloves must be worn to protect hands from exposure to hazardous materials. Change gloves when contaminated, glove integrity is compromised, or when otherwise necessary. Remove gloves and wash hands when work with hazardous materials has been completed and before leaving the laboratory.
- Be familiar with written instructions for laboratory procedures and proper responses to emergencies.
- Report spills, exposures, illnesses, and injuries immediately.

Biosafety Level 2

Biosafety Level 2 (BSL2) builds upon BSL1. BSL2 is suitable for work involving agents that pose moderate hazards to personnel and the environment. It differs from BSL1 in that: 1) laboratory personnel have specific training in handling pathogenic agents and are supervised by scientists competent in handling infectious agents and associated procedures; 2) access to the laboratory is restricted when work is being conducted; and 3) all procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment. With good microbiological techniques, work at BSL2 can be conducted safely on the open bench, provided the potential for producing splashes or aerosols is low. Primary hazards to personnel working with BSL2 agents relate to accidental percutaneous or mucous membrane exposures, or ingestion of infectious materials. BSL2 is appropriate when work is done with any human-derived blood, body fluids, tissues or primary human cell lines where the presence of an infection agent may be unknown.

The following standard and special practices, safety equipment, and facility requirements apply to BSL2.

- Standard Microbiological Practices and additional practices recommended for BSL2.
- Access to the laboratory is limited or restricted by the laboratory director when work with infectious agents is in progress. Persons who are at increased risk of acquiring infection or for whom infection may be unusually hazardous are not allowed in the laboratory. The laboratory director has the final responsibility for assessing each circumstance and determining who may enter or work in the laboratory.
- A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present. Posted information must include: the biosafety level of the laboratory, the investigator's name, telephone number, and required procedures for entering and exiting the laboratory, the agents in use, the required immunizations and personal protective equipment that must be worn in the laboratory.
- Biohazard warning signs must be posted on equipment containing or contaminated by potentially infectious materials.
- All procedures involving the manipulation of infectious materials that may generate an aerosol should be conducted within a biological safety cabinet. These may include pipetting, centrifuging, grinding, blending, shaking, mixing sonicating, opening containers

of infectious materials, inoculating animals intranasally, and harvesting infected tissues from animals or eggs.

- Spills involving infectious materials must be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material.
- Waste materials must be decontaminated before disposal.

Biosafety Level 3

Biosafety Level 3 is suitable for work involving indigenous or exotic agents that may cause serious or potentially lethal disease through the inhalation route of exposure. Laboratory personnel must receive specific training in handling pathogenic and potentially lethal agents, and must be supervised by scientists competent in handling infectious agents and associated procedures. All procedures involving the manipulation of infectious materials must be conducted within biological safety cabinets or other physical containment devices. A BSL3 laboratory has special engineering and design features.

The following standard and special safety practices, equipment and facility requirements apply to BSL3 laboratory.

- Biological Level 2 practices and additional practices recommended for BSL3.
- Restriction of access to the laboratory is enforced by the laboratory director. The laboratory director establishes policies and procedures whereby only persons who have been advised of the potential biohazard, who meet any specific entry requirements (e.g. immunization), and who comply with all entry and exit procedures, enter the laboratory.
- Laboratory doors must be self-closing and have locks in accordance with the institutional policies. The laboratory must be separated from areas that are open to unrestricted traffic flow within the building. Laboratory access is restricted. Access to the laboratory is through two self-closing doors. A clothing change room (anteroom) may be included in the passageway between the two self-closing doors.
- A ducted exhaust air ventilation system is provided. This system creates directional airflow that draws air from “clean” areas into the laboratory toward “contaminated” areas. The exhaust air is not recirculated to any other area of the building, and is discharged to the outside with filtration and other treatment options. The outside exhaust must be dispersed away from occupied areas and air intakes. Laboratory personnel must verify that the direction of the airflow (into the laboratory) is proper.
- Laboratory personnel receive the appropriate immunizations or tests for the agents handled or potentially present in the laboratory (e.g. hepatitis B vaccine) and periodic testing as recommended for the agent being handled.
- Baseline serum samples are collected and stored for all laboratory and other at-risk personnel. Additional serum specimens may be collected periodically, depending on the agents handled or the function of the laboratory.
- All manipulations involving infectious materials are conducted in a Class II or III biological safety cabinets or other physical containment devices within the containment module. No work in open vessels is conducted on the open bench.
- Protective laboratory clothing such as solid-front or wrap-around gowns, scrubs suits, or coveralls are worn by workers when in the laboratory.

- All potentially contaminated lab clothing from the laboratory are decontaminated before disposal or reuse. All laboratory waste are decontaminated (e.g. autoclave, chemical disinfection, or other validated decontamination method) before removal from laboratory.
- Vacuum lines are protected with liquid disinfectant traps and HEPA filters, or their equivalent, which are routinely maintained and replaced as needed.