

## 4. PRINCIPLES OF BIOSAFETY

### 4.1 Containment

The basic and only purpose of containment in a laboratory setting is to confine and reduce the exposure of research personnel, other university staff and students, and the surrounding community to potentially biohazardous agents. The risk assessment of the work to be done with a specific agent will determine the appropriate combination of practices and techniques, safety equipment, and facility design. For purposes of this manual the term "containment" is used to denote methods for controlling infectious agents in the laboratory areas where they are being used.

#### 4.1.1 Primary Containment (Safety equipment)

An important element in primary containment is the employment of **good microbiological techniques and practices** by the laboratory worker. Included in the practices are the wearing of personal protective devices such as face masks and gloves and the use of mechanical safety equipment such as biological safety cabinets.

#### 4.1.2 Secondary Containment (Facility design)

This containment is concerned with the protection of the environment external to the laboratory from exposure to infectious materials through building design, proper air-movement systems, and operational practices.

### 4.2 Basic Laboratory Safety

All laboratory personnel are expected to be familiar with the following rules and to conduct their work in accordance with them:

- 4.2.1 Storage of food in refrigerators or freezers used for infectious materials, radioactive materials, and chemical carcinogens is not permitted. In addition, there shall be no eating, drinking, smoking, chewing of tobacco, application of cosmetics, shaving, brushing of teeth, or storage of food in areas where these biohazardous materials are used.
- 4.2.2 Outer street clothing (coats, hats, etc.) should not be kept in an area where accidental contamination with potentially hazardous material can occur.
- 4.2.3 Mechanical pipetting aids must be used when pipetting any biohazardous material. **Mouth pipetting is not permitted at any containment level.**
- 4.2.4 Hands should be washed immediately after completion of any procedure in which biohazardous material is used. Persons working with infectious material should be especially careful not to inadvertently touch the face or eyes with unwashed hands.
- 4.2.5 Long hair, beards, and loose-flapping clothing are potentially dangerous when working near open flames or moving (operating) laboratory equipment. Tying back hair or employment of hairnets should be encouraged in all laboratories.
- 4.2.6 Gloves are the most widely used form of personal protective equipment. They serve as a primary barrier between the hands and hazardous materials. **Gloves must be worn when one anticipates hand contact with blood, infectious and potentially infectious material.** Rubber (latex) or plastic (vinyl) gloves should be worn when working with an etiologic agent that may cause infection by

entry through minute skin abrasions. Vinyl and nylon single use disposable gloves should be replaced as soon as possible if contaminated, torn, punctured or damaged in any way. Never wash or attempt to decontaminate such gloves for reuse.

- 4.2.7** Avoid the use of hand lotions immediately before donning [latex gloves](#). Some lotions may break down the protective action of the gloves and increase permeability.
- 4.2.8** Protection to the eyes is a matter that should be given high priority in every laboratory. Signs bearing the legend "**EYE PROTECTION REQUIRED**" should be prominently displayed in every area where there is risk of eye exposure. Infection can occur through the conjunctiva if a pathogenic microorganism is splattered into the eye. Safety glasses or goggles must be available in every laboratory where spills or splashes of potentially infectious materials may occur and worn when necessary. The increased impact resistance of modern lens glass and plastic lenses provides wearers of corrective glasses a reasonable level of protection. Contact lenses provide little or no practical protection to the eyes. In fact, foreign material present on the surface of the eye often becomes trapped beneath the contact lens, and similarly entrapped caustic chemicals, irritating vapors, and infectious agents cannot be readily washed from the eye without removal of the lenses. **No person shall wear contact lenses while working in any BSL-3 containment level laboratory located on UAB premises.** Laboratory supervisors shall be responsible for the strict enforcement of rules regarding the wearing of safety glasses and use of protective glass or plastic shields.
- 4.2.9** Laboratories where infectious agents are used must have an emergency eye wash facility installed at a strategic location. The Speakman SE400 Model or equivalent is acceptable (see UAB General Safety Manual). Building Maintenance should be contacted for eyewash procurement and installation.
- 4.2.10** Avoid working alone in a building; do not work alone in a laboratory if procedures are hazardous or potentially hazardous (4.1.13 UAB Chemical Safety Manual).
- 4.2.11** Procedures or activities likely to produce aerosols of infectious material **must** be conducted in an annually certified biological safety cabinet. Centrifuges, sonicators, household type blenders, and shaking (aerating) equipment require special attention because they can disperse aerosols if not operated with proper precaution. Internal aerosols invariably are created in a closed centrifuge, sonicator tubes and in so-called leak-proof blenders during operation. At the end of the operating period, it is recommended that the containers be opened in a biological safety cabinet.
- 4.2.12** Disposable and reusable laboratory clothing (coats, gowns, etc.) overtly contaminated with infectious materials, or worn in **BSL-3** containment facilities or laboratories in which **Risk Group 3** etiologic agents are employed, **must** be decontaminated by steam sterilization (autoclaving) or other proven effective means before discarding or releasing to the laundry. In certain circumstances, the Institutional Biosafety Committee may recommend routine "decontamination" of laboratory clothing worn in certain **BSL-2** containment facilities or in laboratories where certain **Risk Group 2** etiologic agents are used. The PI or department/division is responsible for arranging and providing laundry services to clean reusable laboratory clothing.

- 4.2.13** All biohazardous materials **must** be placed in rigid, leak-proof, closed containers labeled with a "**BIOHAZARD**" symbol for intra-campus transport between buildings or from one laboratory to another located in the same building when public elevators or passageways are used (See Section 12).
- 4.2.14** Vacuum lines in laboratories must be protected from contamination with infectious materials by inserting a filter and overflow flask between the vacuum line and the infectious material (Table 2).
- 4.2.15** The use of water aspirators as a source of vacuum is strictly prohibited unless the water line is equipped with a recently inspected and functioning anti back-flow valve and the requirement given in Section 10 is followed.

### **4.3 Biosafety Levels – in brief**

Four biosafety levels (BSLs) are described below which consist of combinations of laboratory practices and procedures, safety equipment, and laboratory facilities. The recommended biosafety level(s) for the organisms in Section 7 represent those conditions under which the agent ordinarily can be safely handled. (See Section 6 for specific recommendations for the levels of containment.)

- 4.3.1** Biosafety Level 1 (BSL-1) practices, safety equipment, and facility design and construction are appropriate for work done with defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy adult humans. BSL-1 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 handwashing.
- 4.3.2** Biosafety Level 2 (BSL-2) practices, safety equipment, and facility design and construction are appropriate for work done with moderate-risk agents that are present in the community and associated with human disease of varying severity. With good microbiological techniques, these agents can be used safely in activities conducted on the open bench, provided splashes or aerosol productions are unlikely. All BSL-2 laboratories must prepare a safety plan and register projects/grants with UAB OH&S.
- 4.3.3** Biosafety Level 3 (BSL-3) practices, safety equipment, and facility design and construction are appropriate for work done with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection. BSL-3 places more emphasis on primary and secondary barriers to protect personnel in surrounding labs, the community and the environment from exposure to potentially infectious aerosols. All BSL-3 laboratories must prepare a laboratory specific safety plan and register projects/grants with UAB OH&S. The Institutional Biosafety Committee/OH&S may require monthly activity reports for all work conducted in BSL-3 facilities.
- 4.3.4** Biosafety Level 4 (BSL-4) practices, safety equipment and facility design is appropriate for work with dangerous and exotic agents that pose a high individual risk or life-threatening disease, which may be transmitted via the aerosol route and for which there is no available vaccine or therapy. **NO BSL-4 work is permitted at UAB.**

**Animal Biosafety Levels** – four biosafety levels are also recommended for activities involving infectious disease work with experimental animals. These four combinations of practices, safety equipment, and facilities are designed ABSL-1, 2, 3, and 4, and provide

increasing levels of protection to personnel and the environment. **NO ABSL-4 work is permitted at UAB.**

- 4.3.4** Animal Biosafety Level 1 (ABSL-1) practices, safety equipment, and facility design and construction are appropriate for work done with defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy adult humans. ABSL-1 represents a basic level of containment that relies on standard practices and procedures approved by the Animal Resources Program and Institutional Animal Care and Use Committee in conjunction with the Institutional Biosafety Committee.
- 4.3.5** Animal Biosafety Level 2 (ABSL-2) involves practices for work with agents associated with human disease. ABSL-2 builds upon the practices, procedures, containment equipment, and facility requirements of ABSL-1. All PIs must prepare a specific animal room safety plan and register projects/grants with UAB OH&S.
- 4.3.6** Animal Biosafety Level 3 (ABSL-3) involves practices for work with indigenous or exotic agents that present the potential of aerosol transmission and of causing serious or potentially lethal disease. ABSL-3 builds upon the practices, procedures, containment equipment, and facility requirements of ABSL-1 and ABSL-2. All PIs must prepare a specific animal room safety plan and register projects/grants with UAB OH&S.
- 4.3.7** Animal Biosafety Level 4 (BSL-4) practices, safety equipment and facility design is appropriate for work with dangerous and exotic agents that pose a high individual risk or life-threatening disease, which may be transmitted via the aerosol route and for which there is no available vaccine or therapy. **NO BSL-4 work is permitted at UAB.**