**Containment**

Containment is one of the cornerstones of biosafety. Containment includes the use of safe methods, facilities and equipment to handle infectious material such that exposure to the lab worker, the environment, and other persons is reduced or eliminated. The risk assessment that is performed will determine the combination of the above when working with a particular agent.

The three elements of containment are:

1. Laboratory practice and technique
2. Safety equipment [primary barriers and personal protective equipment (PPE)]
3. Facility design and construction (secondary barriers)

**Laboratory Practice and Technique**

The most important practice of containment is strict adherence to standard microbiological practices and techniques. The PI is responsible for ensuring that each worker is not only trained in the standard microbiological practices but also in any special practices required for work with the specific material. Personnel are also required to be informed of the potential hazards of the material.

Each lab should have its own biosafety or operations manual that details the hazards and practices necessary to work with the hazard.

So what are the standard microbiological practices? There are 11.

1. Access to the laboratory is controlled (enforced by the PI).
2. Wash hands after working with the material and before leaving laboratory.
3. Eating, drinking, smoking, handling contacts, application of cosmetics and storing food is not permitted in lab areas. Food for human consumption must be stored outside of the lab in cabinets or refrigerators designated for this purpose.
4. Mouth pipetting is prohibited. Use a mechanical device instead.
5. Policies for the handling of sharps (needles, scalpels, broken glass) must be in place.
6. Minimize the creation of aerosols. Aerosols can be caused by: pipetting, centrifuging, grinding, blending, shaking, mixing, sonicating, opening containers of infectious materials, inoculating animals intranasally, and harvesting infected tissues from animals or eggs.
7. Decontaminate all work surfaces after completion of work and after any spill or splash of material. Always use a disinfectant effective against the agent being used.
8. Decontaminate all cultures, stocks, and other potentially infectious materials before disposal using an effective method such as autoclaving.
9. A sign containing the universal biohazard symbol must be placed on the entrance door when hazardous materials are present. At the minimum, the sign should contain the name of the agent in use and the name and phone number of the person in charge.

![Biohazard Symbol]

10. Have an effective pest management program in place.
11. The PI must ensure that all personnel have appropriate training and are made aware of the risks associated with the agent.

**Safety Equipment**

Safety equipment includes biological safety cabinets (BSCs), enclosed containers, and other engineering controls (centrifuge safety cups, mechanical recapping of needles etc.) designed to remove or minimize exposures to hazardous biological materials. In addition to equipment, PPE can be used. Items such as gloves, face shields, lab coats, shoe covers, safety glasses, and respirators all provide another primary barrier to the infectious material.

**Facility Design and Construction**

Facility design and construction can provide a barrier for protection of other workers, the community and environment. The best facility design depends upon the risk of transmission and the specific agents. When work involves an increased risk of aerosol exposure to an infectious organism, higher levels of containment may be necessary. In addition to separation of the lab from public access areas, specialized ventilation systems and air treatment systems as well as other design features may be necessary for containment of accidental release of aerosols.

Out of risk assessment and the types of containment available, arise the 4 biosafety levels described in the BMBL. Each one consists of a combination of laboratory practices, safety equipment and facility design appropriate for work with different potentially infectious agents.

**Risk Group vs. Biosafety Level**

Please note that Risk Groups (*NIH Guidelines, WHO Biosafety manual*) and Biosafety Levels (CDC-BMBL) are not the same thing. Risk groups are a classification of microbiological agents based their ability to cause disease in humans. The determination of the biosafety level of an organism is based not only on its risk group, but also the mode of its transmission, the procedures and kinds manipulations planned for the agent, the experience of the staff and other factors (e.g. the availability of vaccines or other treatment, antibiotic resistance).

Sections 4 and 5 of the BMBL describe the Biosafety level criteria. Section 8 contains the agent summary sheets with recommended Biosafety levels. This is not comprehensive so if the institution is working with an organism not listed, a comprehensive risk assessment must be performed using available information. Consultation with the BSO, IBC and other SMEs can facilitate this.