هيئة أبوظبي للزراعة والسلامة الغذائية
ABU DHABI AGRICULTURE AND FOOD SAFETY AUTHORITY

**Guideline**
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# BIOSAFETY AND BIOSECURITY IN VETERINARY LABORATORIES VOLUME 2

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# GUIDLINES OF BIOSECURITY

## I. INTRODUCTION

Global events in the past decades have highlighted the need to protect laboratories and the materials they contain from being intentionally compromised in ways that may harm people, livestock, agriculture or the environment. It is important to understand the distinction between "laboratory biosafety" and "laboratory biosecurity". Laboratory biosafety is the term used to describe the containment principles, technologies and practices that are implemented to prevent unintentional exposure to pathogens and toxins, or their accidental release. On the other hand, laboratory biosecurity refers to institutional and personal security measures designed to prevent the loss, theft, misuse, diversion or intentional release of pathogens and toxins. A simple formulation to assist in differentiating between biosafety and biosecurity issues is that biosafety protects people from germs while biosecurity protects germs from people.

Effective biosafety practices are the foundation of laboratory biosecurity activities. Through risk assessments, performed as an integral part of an institution's biosafety programme, information is gathered regarding the type of organisms available, their physical location, identification of the personnel who need access to these organisms, and those responsible for them. This information can be used to assess whether an institution that possesses biological materials that might be attractive to those who wish to use them inappropriately. Therefore, set of standards should be developed to address the responsibilities of institutions to protect specimens, pathogens, and toxins from misuse. A specific laboratory biosecurity programme must be designed and implemented in each facility.

## II. Background

Abu Dhabi Agriculture and Food Safety Authority (ADAFSA) mandate is to implement biosecurity to ensure plant and animal Health in the Emirate of Abu Dhabi. Human, animal and plant health in addition to the protection of the environment are inextricably linked and this is the fundamental rationale for the development of an integrated approach for biosecurity. ADAFSA issued Guide No 5 for the year 2014 Guidelines of Biosecurity – Volume 1, which covers the general aspects of Biosecurity. Biosecurity Guidelines- Volume 2 includes an important discipline addressing the security of microbiological agents and toxins and the threats posed to human and animal health, the environment, and the economy by deliberate misuse or release

The safety, in particular, biological safety and biosecurity concepts, are important international issues. The World Organization for Animal Health (OIE) issues guidelines that encourages veterinary laboratory and animal facilities to implement measures for effective identification and management of biosafety and biosecurity risks applied for individual facility based on their unique setting, infrastructure, and the surrounding environment the biological agent or toxin is to be handled. The World Health Organization (WHO) encouraged countries to accept and implement basic concepts in biological safety and to develop national codes of practice for the safe handling of pathogenic microorganisms in laboratories within their geographical borders. The overall goal is to address biological safety and security issues facing us in the current millennium by, stressing on the importance of personal responsibility, application of risk assessment approach, tackling new threats to public health, such as deliberate misuse and release of microbiological agents and toxins, while ensuring the availability of these agents for diagnostic, research and epidemiological purposes.

## III. SCOPE

This guide lists the most essential laboratory practices and procedures that are basic to Good Microbiological Techniques (GMT), which are fundamental to laboratory safety. Each laboratory should adopt a safety or operations manual that identifies known and potential hazards, and specifies practices and procedures to eliminate or minimize such hazards. Specialized laboratory equipment is a supplement to but can never replace appropriate procedures. The guide advocates for the security precautions that should become a routine part of laboratory work similar to aseptic techniques and other safe microbiological handling practices. A careful review of these biosecurity concepts and guidelines introduced is essential for all laboratory workers.

## IV. Purpose

The aim of this guide is to provide details of specific laboratory biosecurity program requirements that must be developed and implemented for each facility based on, the type of laboratory work conducted, access assigned to working personnel, and local conditions. Consequently, laboratory biosecurity activities should be representative of the institution's various needs and should include input from scientific directors, principal investigators, biosafety officers, laboratory scientific staff, maintenance staff, administrators, information technology staff, and law enforcement agencies and security staff if appropriate.

Laboratory biosecurity measures should be based on a comprehensive program of accountability for pathogens and toxins. These include an updated inventory with storage location, identification of personnel with access, description of use, documentation of internal and external transfers within and between facilities, and any inactivation and/or disposal of the materials. Likewise, an institutional laboratory biosecurity protocol should be established for identifying, reporting, investigating and remediating breaches in laboratory biosecurity, including discrepancies in inventory results. The involvement, roles, and responsibilities of public health and security authorities in the events of a security infraction must be clearly defined.

## V. Definitions

**Laboratory Biosafety:** Laboratory biosafety describes the containment principles, technologies and practices implemented to prevent the unintentional exposure to pathogens and toxins, or their accidental Release.

**Laboratory biosecurity:** Laboratory biosecurity describes the protection, control and accountability for valuable biological materials within laboratories, in order to prevent their unauthorized access, loss, theft, misuse, diversion or intentional release.

**Biological Safety Cabinet /Biosafety Cabinet: It is an enclosed, ventilated** laboratory workspace for safely working with materials contaminated with (or potentially contaminated with) pathogens requiring a defined biosafety level.

**Good Microbiological Techniques (GMT):** Are necessary aseptic practices used to prevent contamination of laboratory and environment with the agents being handled and therefore, avoid compromise of results.

**HEPA Filter:** Type of air filter that meets High Efficiency Particulate Absorption (HEPA) standards, used in medical facilities and remove 99.97% of particles that have a size of 0.3 µm or larger.

**Personal Protection Equipment (PPE):** Specialized clothing or equipment such as gloves, gowns, aprons, masks, respirators, goggles, and face shields worn by employees for protection against infectious materials.

**Decontamination:** Any process for removing and/or killing microorganisms. The term is used to indicate for removal or neutralization of hazardous chemicals and radioactive materials.

## VI. Related Documents

Guide No 5 for the year 2014 Guidelines of Biosecurity - General Aspects of Biosecurity Volume 1

## 1. Biosafety Foreword

The backbone of the practice of biosafety is risk assessment. While there are many tools available to assist in the assessment of risk for a given procedure or experiment, the most important component is professional judgement. Risk assessments should be performed by the individuals most familiar with the specific characteristics of the organisms being considered for use, the equipment and procedures to be employed, animal models that may be used, and the containment equipment and facilities available. The laboratory director or principal investigator has the prime responsibility to ensure that, adequate and timely risk assessments are performed, and to work closely with the institution's safety committee and biosafety personnel to ensure that appropriate equipment and facilities are available to support the work being considered. Once performed, risk assessments should be reviewed routinely and revised when necessary. The revision must take into consideration the acquisition of new data having a bearing on the degree of risk and other relevant new information from the scientific literature.

## 2. Risk Groups

One of the most helpful tools available for performing a microbiological risk assessment is the listing of risk groups for microbiological agents. Most of the countries follow the World Health Organization (WHO) approach that classify risk groups into four levels, level 1, 2, 3 and 4 according to the relative hazards of infective microorganisms. The classification is based mainly on the pathogenicity of the organism, mode of transmission and host range, the availability of effective preventive measures (e.g., vaccines) or effective treatment (e.g., antibiotics) as well as many other factors. This risk group classification, which is used for laboratory work only, has been adopted and used throughout this guidance. In general terms, microbiological agents that fall within risk groups 2,3 and 4 are considered biohazardous and should be treated as such while microbiological agents that fall within risk group 1 are considered as bio-waste and do not fall under the biohazardous waste although certain precautions still need to be followed. Table 1 lists and describes these risk groups.

## Table 1. Classification of infective microorganisms by risk group

| Risk Group 1 | Risk Group 2 | Risk Group 3 | Risk Group 4 |
|---|---|---|---|
| no or low individual) (and community risk<br>A microorganism that is unlikely to cause human or animal .disease | (moderate individual risk, low community risk)<br>A pathogen that can cause human or animal disease but is unlikely to be a serious hazard to laboratory workers, the community, livestock or the environment. Laboratory exposures may cause serious infection, but effective treatment and preventive measures are available and the risk of spread of infection is limited.<br>**Pathogens**<br>1. No need for vectors or intermediate hosts.<br>2. Limited or no transmission between animal species.<br>3. Limited geographical spread if released.<br>4. Relatively limited direct animal-to-animal transmission.<br>5. Transmitted by ingestion, inoculation or mucus membrane route.<br>6. Infected animals do not need confinement.<br>7. The disease is of limited economic and/or clinical significance.<br>8. Short-term survival in the environment<br>9. Effective treatment or prevention is available.<br>10. Have a low risk of spread from the laboratory<br>**Viruses:** Influenza viruses types A, B, C: Newcastle disease virus; Orf virus<br>**Bacteria:** Campylobacter spp:,Clostridium tetani; Clostridium botulinum; Corynebacterium spp.; Escherichia coli.; Listeria monocytogenes; Pseudomonas spp.; Salmonella spp.; Staphylococcus spp.; Yersinia enterocolitica;<br>**Fungi:** Aspergillus fumigatus; Microsporum spp.; Trichophyton spp. | (high individual risk, low community risk)<br>A pathogen that usually causes serious human or animal disease but does not ordinarily spread from one infected individual to another. Effective treatment and preventive measures are available.<br>**Pathogens**<br>1. Transmission dependent on vectors or intermediate hosts, readily occur between different animal species.<br>2. Moderate geographical spread.<br>3. Animal to animal transmission occurs relatively easily.<br>4. The statutory confinement of diseased, infected and in-contact animals is necessary.<br>5. The disease is of severe economic and/or clinical significance.<br>6. Mode of transmission may be through the airborne route or direct contact.<br>7. Are either exotic or enzootic but are subject to official control and that have a moderate risk of spread from the laboratory.<br>**Viruses:** Rabies virus; Equine encephalomyelitis virus (Eastern, Western and Venezuelan); Japanese B encephalitis virus; Louping ill virus<br>**Bacteria:** Bacillus anthracis; Burkholderia mallei (Pseudomonas mallei); Brucella spp.; Chlamydia psittaci (avian strains only); Coxiella burnetti; Mycobacterium bovis; Brucella spp.; Chlamydia psittaci (avian strains only); Coxiella burnetti; Mycobacterium bovis | (high individual and community risk)<br>A pathogen that usually causes serious human or animal disease and that can be readily transmitted from one individual to another, directly or indirectly. Effective treatment and preventive measures are not usually available<br>**Pathogens**<br>1. They may depend on vectors or intermediate hosts for transmission.<br>2. Transmission between different species may occur very readily<br>3. Geographical spread if released from the laboratory is widespread Direct animal-to-animal transmission occurs very easily.<br>4. Can be transmitted through casual contact or indirectly.<br>5. Necessary Statutory confinement of diseased, infected and in-contact animals.<br>6. Necessary Statutory control of animal movements over a wide area.<br>7. Of extremely severe economic and/or clinical significance.<br>Have a high risk of spread from the laboratory into the environment and the national animal population.<br>**Viruses:** Ebola virus; Crimean–Congo hemorrhagic fever (CCHF) |

One of the most helpful tools available for performing a microbiological risk assessment is the listing of risk groups for microbiological agents. However, simple reference to the risk grouping for a particular agent is insufficient in the conduct of a risk assessment.

Additional factors that should be considered, as appropriate, to include:

1. Pathogenicity of the agent and infectious dose.
2. Potential outcome of exposure.
3. Natural route of infection and other routes of infection, resulting from laboratory manipulations (parenteral, airborne, ingestion).
4. Stability of the agent in the environment.
5. Concentration of the agent and volume of concentrated material to be manipulated.
6. Presence of a suitable host (human or animal).
7. Information available from animal studies and reports of laboratory-acquired infections or clinical reports.
8. Laboratory activity planned (sonication, aerosolization, centrifugation, etc.).
9. Any genetic manipulation of the organism that may extend the host range of the agent or alter the agent's sensitivity to known, effective treatment regimens.
10. Local availability of effective prophylaxis or therapeutic interventions.

Based on the information ascertained during the risk assessment, a biosafety level can be assigned to the planned work, appropriate personal protective equipment selected, and Standard Operating Procedures (SOPs) incorporating other safety interventions developed to ensure the safest possible conduct of the work.

## 3. Biosafety Levels in Relation to Risk Groups

Laboratory facilities are designated as, basic – Biosafety Level 1, basic – Biosafety Level 2, containment – Biosafety Level 3, and maximum containment – Biosafety Level 4. Biosafety level designations are based on a composite of the design features, construction, containment facilities, equipment, practices and operational procedures required for working with agents from the various risk groups. Table 2 relates but does not "equate" risk groups to the biosafety level of laboratories designed to work with organisms in each risk group. The classification of microorganisms, by risk group, should consider:

1. Pathogenicity of the organism.

2. Mode of transmission and host range of the organism. These may be influenced by existing levels of immunity in the local population, density and movement of the host population, presence of appropriate vectors, and standards of environmental hygiene.

3. Local availability of effective preventive measures. These may include prophylaxis by immunization or administration of antisera (passive immunization); sanitary measures, e.g. food and water hygiene; control of animal reservoirs or arthropod vectors.

4. Local availability of effective treatment. This may include passive immunization, post exposure vaccination, and the use of antimicrobials, antivirals, and chemotherapeutic agents. Consideration should be given to the possibility of emerging drug-resistant strains.

The assignment of an agent to a biosafety level for laboratory work must be based on an accurate risk assessment. Such an assessment will take the risk group as well as other factors into consideration in establishing the appropriate biosafety level. For example, an agent that is assigned to Risk Group 2 may generally require Biosafety Level 2 facilities, equipment, practices and procedures for safe conduct of work. However, if particular experiments require the generation of high-concentration aerosols, then Biosafety Level 3 may be more appropriate to provide the necessary degree of safety, since it ensures superior containment of aerosols in the laboratory workplace. The biosafety level assigned for the specific work to be done is therefore driven by professional judgement based on a risk assessment, rather than by automatic assignment of a laboratory biosafety level according to the particular risk group designation of the pathogenic agent to be used.

**Table 2. Relation of risk groups to biosafety levels, practices and equipment**

| Risk Group | Biosafety Level | Lab. Type | Lab. Practices | Safety Equipment |
|---|---|---|---|---|
| 1 | Basic Biosafety Level 1 | Basic teaching, research | Good Microbiological Techniques (GMT) | Open bench work (None) |
| 2 | Basic Biosafety Level 2 | Primary health services; diagnostic services, research | GMT plus protective clothing, biohazard sign | Open bench plus Biological Safety Cabinet (BSC) for potential aerosols |
| 3 | Containment Biosafety Level 3 | Special diagnostic services, research | As Level 2 plus special clothing, controlled access, directional airflow | BSC and /or other primary devices for all activities |
| 4 | Maximum Containment Biosafety Level 4 | Dangerous pathogen units | As Level 3 plus airlock entry, shower exit, special waste disposal | Class III BSC, or positive pressure suits in conjunction with Class II BSCs, double ended autoclave (through the wall), filtered air |

BSC, biological safety cabinet; GMT, good microbiological techniques Source: WHO Laboratory biosafety manual-Third edition

Designation of biosafety levels for proper handling of biohazardous materials consists of combinations of laboratory practices and techniques, safety equipment, and laboratory facilities. Each combination is specifically

appropriate for the operations performed the documented or suspected routes of transmission of the infectious agents, and for the laboratory function or activity. Thus, the assignment of a biosafety level takes into consideration the organism (pathogenic agent) used, the facilities available, and the equipment practices and procedures required conducting work safely in the laboratory. The risk assessment procedure described previously works well when there is adequate information available. However, there are situations when the information is insufficient to perform an appropriate risk assessment, for example, with clinical specimens or epidemiological samples collected in the field. In these cases, it is prudent to take a cautious approach to specimen manipulation.

1. Standard precautions should always be followed, and barrier protections applied (gloves, gowns, eye protection), whenever samples are obtained from patients/sick animals.

2. Basic containment – Biosafety Level 2 practices and procedures should be the minimum requirement for handling specimens.

3. Transport of specimens should follow national and/or international rules and regulations.

The facility requirements at four biosafety levels are summarized in Table 3

**Table 3. Summary of biosafety level requirements**

| Requirement | Biosafety Level | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Isolation a of laboratory | No | No | Yes | Yes |
| Room sealable for decontamination | No | No | Yes | Yes |
| Ventilation: | | | | |
| - inward airflow | No | Desirable | Yes | Yes |
| - controlled ventilating system | No | Desirable | Yes | Yes |
| - HEPA-filtered air exhaust | No | No | Yes/No b | Yes |
| Double-door entry | No | No | Yes | Yes |
| Airlock | No | No | No | Yes |

| | | | | |
|---|---|---|---|---|
| Airlock with shower | No | No | No | Yes |
| Anteroom | No | No | Yes | - |
| Anteroom with shower | No | No | Yes/No c | No |
| Effluent treatment | No | No | Yes/Noc | Yes |
| Autoclave: | | | | |
| - on site | No | Desirable | Yes | Yes |
| - in laboratory room | No | No | Desirable | Yes |
| - double-ended | No | No | Desirable | Yes |
| Biological safety cabinets | No | Desirable | Yes | Yes |
| Personnel safety monitoring capability d | No | No | Desirable | Yes |

**Source**: WHO Laboratory biosafety manual-Third edition

a Environmental and functional isolation from general traffic.

b Dependent on location of exhaust.

c Dependent on agent(s) used in the laboratory.

d For example, window, closed-circuit television, two-way communication

### Handling Specimens with limited information

Use available information to assist in determining the risk of handling these specimens:

1. Medical data on the sick case or patient or sick animal.
2. Epidemiological data (morbidity and mortality data, suspected route of transmission, other outbreak investigation data)
3. Information on the geographical origin of the specimen.

In the case of outbreaks of disease of unknown etiology, appropriate ad hoc guidelines may be generated, and posted by national competent authorities and/or WHO, as was the case during the 2003 emergence of the severe acute respiratory syndrome-SARS. The guidelines should indicate how specimens should be consigned for shipment, and identify the biosafety level at which they should be handled and analyzed.

**Basic and Containment Laboratories**

The guidelines for basic laboratories–Biosafety Levels 1 and 2 presented here are comprehensive and detailed, as they are fundamental to laboratories of all biosafety levels. The guidelines for containment laboratories–Biosafety Level 3 and maximum containment laboratories – Biosafety Level 4 that follow are modifications of and additions to these guidelines, designed for work with the more dangerous (hazardous) pathogens. This guidance and recommendations given as minimum requirements pertaining to laboratories of all biosafety levels are directed at microorganisms in Risk Groups 1–4. Although some of the precautions may appear to be unnecessary for some organisms in Risk Group 1, they are desirable for training purposes to promote good (i.e. safe) microbiological techniques (GMT).

### 3.1. Biosafety Level 1 and 2

BSL-1 is appropriate for most work using risk group 1 agents and other low risk work. The lab displayed here is an example of a basic vet lab at biosafety level 1(BSL-1). BSL-1 genetically modified organisms and waste generated during such research must be handled as biohazardous. Diagnostic and health-care laboratories are designed for Biosafety Level 2 or above. GMT are required, and a safety or operations manual must be prepared and adopted.

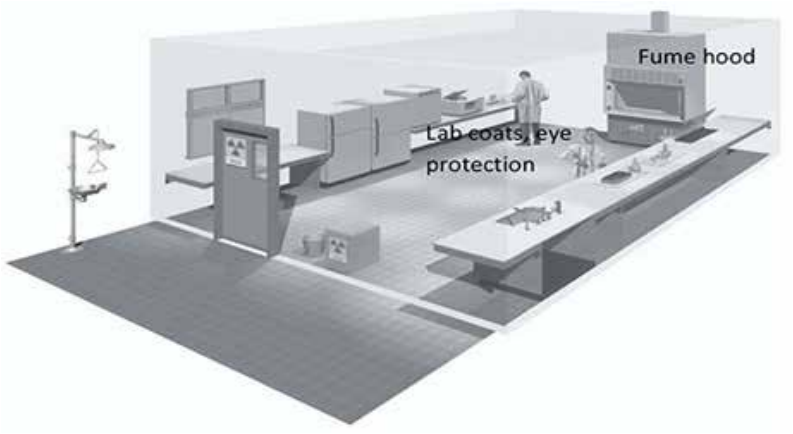
Diagnostic and health-care laboratories (public health, clinical or hospital-based) must all be designed for Biosafety Level 2 or above. As no laboratory has complete control over the specimens it receives, laboratory workers may be exposed to organisms in higher risk groups than anticipated. This possibility must be recognized in the development of safety plans and policies. In some countries, accreditation of clinical laboratories is required. Globally, standard precautions should always be adopted and practiced

A sign incorporating safety information must be posted at the entrance to the areas of microbiological laboratories where infectious materials are handled. The sign must include the biosafety level, general occupational health requirements, PPE requirements, the supervisor's name (or other responsible personnel), telephone number, and required procedures for entering and exiting the animal areas. Identification of specific infectious agents is recommended when more than one agent is being used within laboratory. The international biohazard-warning symbol and sign (Figure 1) must be displayed on the doors of the rooms where microorganisms of Risk Group 2 or higher risk groups are handled.

**Figure 1" Biohazard Warning Sign on Laboratory Entrance**

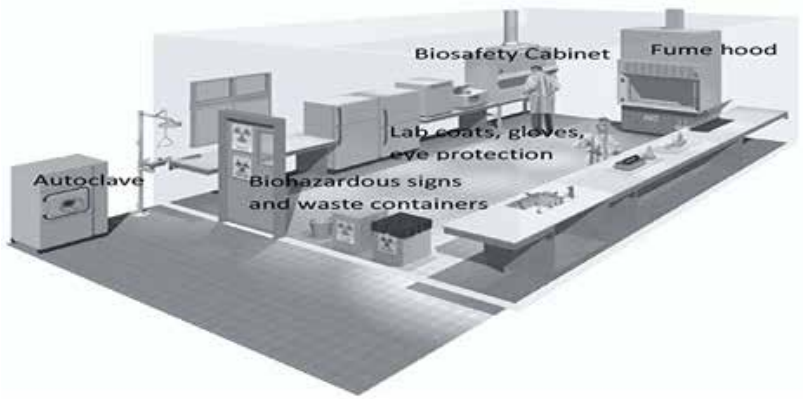

**Source:** WHO Laboratory biosafety manual-Third editionv

**Figure 2: Laboratory Layout Biosafety Level 1**




Graphics kindly provided by CUH2A, Princeton, NJ, USA
Source: WHO Biosafety Manual 3rd ed., 2004

**Figure 3: Laboratory Layout Biosafety Level 2**




Graphics kindly provided by CUH2A, Princeton, NJ, USA WHO Biosafety Manual 3rd ed., 2004 Source: WHO Biosafety Manual 3rd ed., 2004

BSL-2: Animals housed under ABSL-2 biocontainment conditions include cage signage identifying the infectious agent and are isolated from untreated ABSL-1 animals. Cage changes are performed by lab personnel, with cage and bedding treated as hazardous. Some work with viral vectors requires ABSL-2 biocontainment for at least 72 hours post infection. Approval for lowering biocontainment from ABSL-2 to ABSL-1 must be specified in the IBC approval letter

### 3.1.1 Personal protection in BSL1 and BSL2

1. Laboratory coveralls, gowns or uniforms must be worn at all times for work in the laboratory.
2. Appropriate gloves must be worn for all procedures that may involve direct or accidental contact with blood, body fluids and other potentially infectious materials or infected animals. After use, gloves should be removed aseptically and hands must then be washed.
3. Personnel must wash their hands after handling infectious materials and animals, and before they leave the laboratory working areas.
4. Safety glasses, face shields (visors) or other protective devices must be worn when it is necessary to protect the eyes and face from splashes, impacting objects and sources of artificial ultraviolet radiation.
5. It is prohibited to wear protective laboratory clothing outside the laboratory, e.g. in canteens, coffee rooms, offices, libraries, staff rooms and toilets.
6. Open-toed footwear must not be worn in laboratories.

7. Eating, drinking, smoking, applying cosmetics and handling contact lenses is prohibited in the laboratory working areas.
8. Storing human foods or drinks anywhere in the laboratory working areas is prohibited.
9. Protective laboratory clothing that has been used in the laboratory must not be stored in the same lockers or cupboards as street clothing.

### 3.1.2 Procedures in BSL1 and BSL2

1. Pipetting by mouth must be strictly forbidden.
2. Materials must not be placed in the mouth. Labels must not be licked.
3. All technical procedures should be performed in a way that minimizes the formation of aerosols and droplets.
4. The use of hypodermic needles and syringes should be limited. They must not be used as substitutes for pipetting devices or for any purpose other than parenteral injection or aspiration of fluids from laboratory animals.
5. All spills, accidents and overt or potential exposures to infectious materials must be reported to the laboratory supervisor. A written record of such accidents should be maintained.
6. A written procedure for the cleanup of all spills must be developed and followed.
7. Contaminated liquids must be decontaminated (chemically or physically) before discharge to the sanitary sewer. An effluent treatment system may be required, depending on the risk assessment for the agent(s) being handled.
8. Written documents that are expected to be removed from the laboratory need to be protected from contamination while in the laboratory.

### 3.1.3 Laboratory working areas in BSL1 and BSL2

1. Work surfaces must be decontaminated after any spill of potentially dangerous material and at the end of the working day.
2. All contaminated materials, specimens and cultures must be decontaminated before disposal or cleaning for reuse.
3. Packing and transportation must follow applicable national and/or international regulations
4. When windows can be opened, they should be fitted with arthropod-proof screens.
5. The laboratory should be kept neat, clean, and free of materials not pertinent to the work.

### 3.1.4 Biosafety management in BSL1 and BSL2

1. It is the responsibility of the laboratory director (the person who has immediate responsibility for the laboratory) to ensure the development and adoption of a biosafety management plan and a safety or operations manual.
2. The laboratory supervisor (reporting to the laboratory director) should ensure that regular training in laboratory safety is provided.
3. Personnel should be advised of special hazards, and required to read the safety or operations manual and follow standard practices and procedures. The laboratory supervisor should make sure that all personnel understand these. A copy of the safety or operations manual should be available in the laboratory.
4. There should be an arthropod and rodent control programme.
5. Appropriate medical evaluation, surveillance and treatment should be provided for all personnel in case of need, and adequate medical records should be maintained.

### 3.1.5 Laboratory design and facilities in BSL1 and BSL2

In designing a laboratory and assigning certain types of work to it, special attention should be paid to conditions that are known to pose safety problems. These include:

1. Formation of aerosols
2. Work with large volumes and/or high concentrations of microorganisms
3. Overcrowding and too much equipment
4. Infestation with rodents and arthropods
5. Unauthorized entrance
6. Workflow: use of specific samples and reagents.

### 3.1.6 Design features of BSL1 and BSL2

1. Ample space must be provided for the safe conduct of laboratory work and for cleaning and maintenance.
2. Walls, ceilings and floors should be smooth, easy to clean, impermeable to liquids and resistant to the chemicals and disinfectants normally used in the laboratory. Floors should be slip-resistant.
3. Bench tops should be impervious to water and resistant to disinfectants, acids, alkalis, organic solvents and moderate heat.
4. Illumination should be adequate for all activities. Undesirable reflections and glare should be avoided.

5. Laboratory furniture should be sturdy. Open spaces between and under benches, cabinets and equipment should be accessible for cleaning.
6. Storage space must be adequate to hold supplies for immediate use and thus prevent clutter on bench tops and in aisles. Additional long-term storage space, conveniently located outside the laboratory working areas, should also be provided.
7. Space and facilities should be provided for the safe handling and storage of solvents, radioactive materials, and compressed and liquefied gases.
8. Facilities for storing outer garments and personal items should be provided outside the laboratory working areas.
9. Facilities for eating and drinking and for rest should be provided outside the laboratory working areas.
10. Hand-washing basins, with running water if possible, should be provided in each laboratory room, preferably near the exit door.
11. Doors should have vision panels, appropriate fire ratings, and preferably be self- closing.
12. At Biosafety Level 2, an autoclave or other means of decontamination should be available in appropriate proximity to the laboratory.
13. Safety systems should cover fire, electrical emergencies, emergency shower, and eyewash facilities.
14. First-aid areas or rooms suitably equipped and readily accessible should be available
15. In the planning of new facilities, consideration should be given to the provision of mechanical ventilation systems that provide an inward flow of air without recirculation. If there is no mechanical ventilation, windows should be able to be opened and should be fitted with arthropod-proof screens.
16. A dependable supply of good quality water is essential. There should be no cross connections between sources of laboratory and drinking water supplies. An antibackflow device should be fitted to protect the public water system.
17. There should be a reliable and adequate electricity supply and emergency lighting to permit safe exit. A stand-by generator is desirable for the support of essential equipment, such as incubators, biological safety cabinets, freezers, etc., and for the ventilation of animal cages.
18. There should be a reliable and adequate supply of gas. Good maintenance of the installation is mandatory.
19. Laboratories and animal houses are occasionally the targets of vandals. Physical and fire security must be considered. Strong doors, screened windows and restricted issue of keys are compulsory. Other measures should be considered and applied, as appropriate, to augment security.

### 3.1.7. Laboratory Equipment

Together with good procedures and practices, the use of safety equipment will help to reduce risks when dealing with biosafety hazards. This section deals with basic principles related to equipment suitable for laboratories of all biosafety levels. Requirements for laboratory equipment pertinent to higher biosafety levels are dealt within the relevant chapters. The laboratory director should, after consultation with the biosafety officer and safety committee (if designated), ensure that adequate equipment is provided and that it is used properly. Equipment should be selected to take account of certain general principles, i.e. it should be:

1. Designed to prevent or limit contact between the operator and the infectious material.
2. Constructed of materials that are impermeable to liquids, resistant to corrosion and meet structural requirements.
3. Fabricated to be free of burrs, sharp edges and unguarded moving parts.
4. Designed, constructed and installed to facilitate simple operation and provide for ease of maintenance, cleaning, decontamination and certification testing; glassware and other breakable materials should be avoided, whenever possible.

Detailed performance and construction specifications may need to be consulted to ensure that the equipment possesses the necessary safety features.

### 3.1.8 Essential Biosafety Equipment

1. Pipetting aids – to avoid mouth pipetting. Many different designs are available.
2. Biological safety cabinets, to be used whenever:

    i. Infectious materials are handled; such materials may be centrifuged in the open laboratory if sealed centrifuge safety cups are used and if they are loaded and unloaded in a biological safety cabinet
    ii. There is an increased risk of airborne infection
    iii. Procedures with a high potential for producing aerosols are used; these may include centrifugation, grinding, blending, vigorous shaking or mixing, sonic disruption, opening of containers of infectious materials whose internal pressure may be different from the ambient pressure, intranasal inoculation of laboratory animals/Experimental animals, and harvesting of infectious tissues from animals and eggs.

3. Plastic disposable transfer loops. Alternatively, electric transfer loop incinerators may be used inside the biological safety cabinet to reduce aerosol production.
4. Screw-capped tubes and bottles.
5. Autoclaves or other appropriate means to decontaminate infectious materials.
6. Plastic disposable Pasteur pipettes, whenever available, to avoid glass.
7. Equipment such as autoclaves and biological safety cabinets must be validated with appropriate methods before being taken into use. Recertification should take place at regular intervals, according to the manufacturer's instructions

### 3.1.9 Health and medical surveillance

The employing authority, through the laboratory director, is responsible for ensuring that there is adequate surveillance of the health of laboratory personnel. The objective of such surveillance is to monitor for occupationally acquired diseases. Appropriate activities to achieve these objectives are:

1. Abide with all relevant UAE National Occupational Health and Safety Laws and Regulations, together with the Labor Law
2. Provision of active or passive immunization where indicated.
3. Facilitation of the early detection of laboratory-acquired infections.
4. Exclusion of highly susceptible individuals (e.g. pregnant women or immunocompromised individuals) from highly hazardous laboratory work.
5. Provision of effective personal protective equipment and procedures.

### 3.1.10 Surveillance of laboratory workers handling microorganisms at BSL 2

1. A pre-employment or preplacement health check is necessary.
2. The person's medical history should be recorded and a targeted occupational health assessment performed.
3. Records of illness and absence should be kept by the laboratory management.
4. Women of childbearing age should be made aware of the risk to an unborn child of occupational exposure to certain microorganisms, e.g. rubella virus.
5. The precise steps taken to protect the fetus will vary, depending on the microorganisms to which the women may be exposed.

### 3.1.11 Training

Human error and poor technique can compromise the best of safeguards to protect the laboratory worker. Thus, a safety-conscious staff, well informed about the recognition and control of laboratory hazards, is key to the prevention of laboratory-acquired infections, incidents and accidents. For this reason, continuous in-service training in safety measures is essential. An effective safety programme begins with the laboratory managers, who should ensure that safe laboratory practices and procedures are integrated into the basic training of employees. Training in safety measures should be an integral part of new employees' introduction to the laboratory. Employees should be introduced to the code of practice and to local guidelines, including the safety or operations manual. Measures to assure that employees have read and understood the guidelines, such as signature pages, should be adopted. Laboratory supervisors play the key role in training their immediate staff in good laboratory techniques. The biosafety officer can assist in training and with the development of training aids and documentation.

The Staff training should always include information on safe methods for performing highly hazardous procedures that are commonly encountered by all laboratory personnel and involve:

1. Inhalation risks (i.e. aerosol production) when using loops, streaking agar plates, pipetting, making smears, opening cultures, taking blood/serum samples, centrifuging, etc.
2. Ingestion risks when handling specimens, smears and cultures.
3. Risks of percutaneous exposures when using syringes and needles.
4. Bites and scratches when handling animals.
5. Handling of blood and other potentially hazardous pathological materials.
6. Decontamination and disposal of infectious material.

### 3.1.12 Waste Handling

Waste is anything that is to be discarded. In laboratories, decontamination of wastes and their ultimate disposal are closely interrelated. In terms of daily use, few if any contaminated materials will require actual removal from the laboratory or destruction. Most glassware, instruments and laboratory clothing will be reused or recycled. The overriding principle is that all infectious materials should be decontaminated, autoclaved or incinerated within the laboratory.

The principal questions to be asked before discharge of any objects or materials from laboratories that deal with potentially infectious microorganisms or animal tissues are:

i. Have the objects or materials been effectively decontaminated or disinfected by an approved procedure?
ii. If not, have they been packaged in an approved manner for immediate on-site incineration or transfer to another facility with incineration capacity?
iii. Does the disposal of the decontaminated objects or materials involve any additional potential hazards, biological or otherwise, to those who carry out the immediate disposal procedures or who might come into contact with discarded items outside the facility?

#### 3.1.12.1 Decontamination

Steam autoclaving is the preferred method for all decontamination processes. Materials for decontamination and disposal should be placed in containers, e.g. autoclavable plastic bags that are colour-coded according to whether the contents are to be autoclaved and/or incinerated. Alternative methods may be envisaged only if they remove and/or kill microorganisms.

#### 3.1.12.2 Handling and disposal procedures for contaminated materials and wastes

An identification and separation system for infectious materials and their containers should be adopted. National and international regulations must be followed. Categories should include:

i. Non-contaminated (non-infectious) waste that can be reused or recycled or disposed of as general, "household" waste
ii. Contaminated (infectious) "sharps" – hypodermic needles, scalpels, knives and broken glass; these should always be collected in puncture-proof containers fitted with covers and treated as infectious
iii. Contaminated material for decontamination by autoclaving and thereafter washing and reuse or recycling
iv. Contaminated material for autoclaving and disposal
v. Contaminated material for direct incineration.

#### 3.1.12.3 Sharps

After use, hypodermic needles should not be recapped, clipped or removed from disposable syringes. The complete assembly should be placed in a sharps disposal container. Disposable syringes, used alone or with needles, should be placed in sharps disposal containers and incinerated, with prior autoclaving

if required. Sharps disposal containers must be puncture-proof/-resistant and must not be filled to capacity. When they are three-quarters full they should be placed in "infectious waste" containers and incinerated, with prior autoclaving if laboratory practice requires it. Sharps disposal containers must not be discarded in landfills contaminated (potentially infectious) materials for autoclaving and reuse. No precleaning should be attempted of any contaminated (potentially infectious) materials to be autoclaved and reused. Any necessary cleaning or repair must be done only after autoclaving or disinfection.

### 3.1.12.4 Contaminated (potentially infectious) materials for disposal

Apart from sharps, which are dealt with above, all contaminated (potentially infectious) materials should be autoclaved in leak-proof containers, e.g. autoclavable, colour-coded plastic bags, before disposal. After autoclaving, the material may be placed in transfer containers for transport to the incinerator. If possible, materials deriving from healthcare activities should not be discarded in landfills even after decontamination. If an incinerator is available on the site of laboratory, autoclaving may be omitted: the contaminated waste should be placed in designated containers (e.g. colour-coded bags) and transported directly to the incinerator. Reusable transfer containers should be leak-proof and have tight-fitting covers. They should be disinfected and cleaned before they are returned to the laboratory for further use.

Discard containers, pans or jars, preferably unbreakable (e.g. plastic), should be placed at every workstation. When disinfectants are used, waste materials should remain in intimate contact with the disinfectant (i.e. not protected by air bubbles) for the appropriate time, according to the disinfectant used. The discard containers should be decontaminated and washed before reuse. Incineration of contaminated waste must meet with the approval of the public health and air pollution authorities, as well as that of the laboratory biosafety officer.

### 3.1.13 Chemical, fire, electrical, radiation and equipment safety

A breakdown in the containment of pathogenic organisms may be the indirect result of chemical, fire, electrical or radiation accidents. It is therefore essential to maintain high standards of safety in these fields in any microbiological laboratory. Statutory rules and regulations for each of these hazards, are usually be laid down by the competent national or local authority whose assistance should be sought when necessary. Chemical, fire, electrical and radiation hazards are considered as great concern.

### 3.2 The Containment Laboratory – Biosafety Level 3

The containment laboratory – Biosafety Level 3 is designed and provided for work with Risk Group 3 microorganisms and with large volumes or high concentrations of Risk Group 2 microorganisms that pose an increased risk of aerosol spread. Biosafety Level 3 containment requires the strengthening of the operational and safety programmes over and above those for basic laboratories – Biosafety Levels 1 and 2 .The guidelines given are presented in the form of additions to those for basic laboratories – Biosafety Levels 1 and 2, which must therefore be applied before those specific for the containment laboratory – Biosafety Level 3. The major additions and changes are in:

i. Code of practice
ii. Laboratory design and facilities
iii. Health and medical surveillance.

Laboratories in this category should be registered or listed with the appropriate authorities.

#### 3.2.1 Code of practice of BSL 3

The code of practice for basic laboratories – Biosafety Levels 1 and 2 applies except where modified as follows.

1. The international biohazard warning symbol and sign (see Figure 1) displayed on laboratory access doors must identify the biosafety level and the name of the laboratory supervisor who controls access, and indicate any special conditions for entry into the area, e.g. immunization.
2. Laboratory protective clothing must be of the type with solid-front or wrap-around gowns, scrub suits, coveralls, head covering and, where appropriate, shoe covers or dedicated shoes. Front-buttoned standard laboratory coats are unsuitable, as are sleeves that do not fully cover the forearms. Laboratory protective clothing must not be worn outside the laboratory, and it must be decontaminated before it is laundered. The removal of street clothing and change into dedicated laboratory clothing may be warranted when working with certain agents (e.g. zoonotic agents).
3. Open manipulations of all potentially infectious material must be conducted within a biological safety cabinet or other primary containment device.
4. Respiratory protective equipment may be necessary for some laboratory procedures or working with animals infected with certain pathogens.

### 3.2.2 Laboratory design and facilities of BSL 3

The laboratory design and facilities for basic laboratories – Biosafety Levels 1 and 2 apply except where modified as follows:

1. The laboratory must be separated from the areas that are open to unrestricted traffic flow within the building. Additional separation may be achieved by placing the laboratory at the blind end of a corridor, or constructing a partition and door or access through an anteroom (e.g. a double-door entry or basic laboratory – Biosafety Level 2), describing a specific area designed to maintain the pressure differential between the laboratory and its adjacent space. The anteroom should have facilities for separating clean and dirty clothing and a shower may be necessary.
2. Anteroom doors may be self-closing and interlocking so that only one door is open at a time. A break-through panel may be provided for emergency exit use.
3. Surfaces of walls, floors and ceilings should be water-resistant and easy to clean. Openings through these surfaces (e.g. for service pipes) should be sealed to facilitate decontamination of the room(s).
4. The laboratory room must be sealable for decontamination. Air-ducting systems must be constructed to permit gaseous decontamination.
5. Windows must be closed, sealed and break-resistant.
6. A hand-washing station with hands-free controls should be provided near each exit door.
7. There must be a controlled ventilation system that maintains a directional airflow into the laboratory room. A visual monitoring device with or without alarm(s) should be installed so that staff can, at all times, ensure that proper directional airflow into the laboratory is maintained.
8. The building ventilation system must be so constructed that air from the containment laboratory – Biosafety Level 3 is not recirculated to other areas within the building. Air may be high-efficiency particulate air (HEPA) filtered, reconditioned and recirculated within that laboratory. When exhaust air from the laboratory (other than from biological safety cabinets) is discharged to the outside of the building, it must be dispersed away from occupied buildings and air intakes. Depending on the agents in use, this air may be discharged through HEPA filters. A heating, ventilation and air-conditioning (HVAC) control system may be installed to prevent sustained positive pressurization of the laboratory. Consideration should be given to the installation of audible or clearly visible alarms to notify personnel of HVAC system failure.

9. HEPA filters must be installed in a way that permits gaseous decontamination and testing.
10. Biological safety cabinets should be sited away from walking areas and out of crosscurrents from doors and ventilation systems.
11. The exhaust air from Class I or Class II biological safety cabinets, which will have been passed through HEPA filters, must be discharged in such a way as to avoid interference with the air balance of the cabinet or the building exhaust system.
12. An autoclave for the decontamination of contaminated waste material should be available in the containment laboratory. If infectious waste has to be removed from the containment laboratory for decontamination and disposal, it must be transported in sealed, unbreakable and leak proof containers according to national or international regulations, as appropriate.
13. Backflow-precaution devices must be fitted to the water supply. Vacuum lines should be protected with liquid disinfectant traps and HEPA filters, or their equivalent. Alternative vacuum pumps should also be properly protected with traps and filters.
14. The containment laboratory – Biosafety Level 3 facility design and operational procedures should be documented.

### 3.2.3 Laboratory Equipment of BSL 3

The principles for the selection of laboratory equipment, including biological safety Cabinets are the same as for the basic laboratory – Biosafety Level 2. However, at Biosafety Level 3, manipulation of all potentially infectious material must be conducted within a biological safety cabinet or other primary containment device. Consideration should be given to equipment such as centrifuges, which will need additional containment accessories, for example, safety buckets or containment rotors. Some centrifuges and other equipment, such as cell-sorting instruments for use with infected cells, may need additional local exhaust ventilation with HEPA filtration for efficient containment.

### 3.2.4 Health and medical surveillance of BSL 3

The objectives of health and medical surveillance programmes for basic laboratories–Biosafety Levels 1 and 2 also apply to containment laboratories–Biosafety Level 3, except where modified as follows:

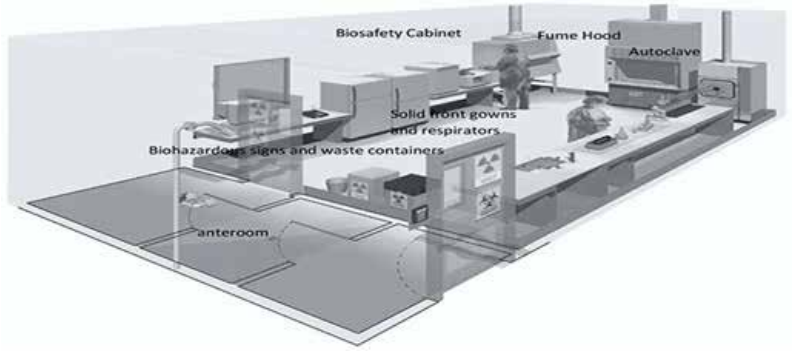
1. Medical examination of all laboratory personnel who work in containment laboratories –Biosafety Level 3 is mandatory. This should include recording

of a detailed medical history and an occupationally targeted physical examination.

2. After a satisfactory clinical assessment, the examinee may be provided with a medical contact card stating that he or she is employed in a facility with a containment laboratory – Biosafety Level 3. This card should include a picture of the cardholder, be wallet-sized, and always be carried by the holder. The name(s) of the contact persons to be entered will neeto be agreed locally but might include the laboratory director, medical adviser and/or biosafety officer.

The laboratory is separated from general traffic flow and accessed through an anteroom (double door entry or basic laboratory – Biosafety Level 2) or an airlock. An autoclave is available within the facility for decontamination of wastes prior to disposal. A sink with hands-free operation is available. Inward directional airflow is established and all work with infectious materials is conducted within a biological safety cabinet.

**Figure 4: Laboratory Layout Biosafety Level 3**




Source: WHO Biosafety Manual 3rd ed., 2004

ABSL-3 housing conditions include housing animals in the BSL-3 biocontainment laboratory in HEPA filtered cages. Rodent cages may be required to be housed in the biosafety cabinet. All animal work, cage changes are performed in the biosafety cabinet by lab personnel trained and qualified for access to the BSL-3 laboratory. All cages and bedding must be autoclaved prior to removal from

the BSL-3 lab. Animals and tissue from animals must be autoclaved or the infectious material inactivated prior to removal from the BSL-3 lab. BSL-3/ PPEB: Basic personal protective equipment includes a solid front gown lab coat or other protective outer layer, gloves and eye protection such as safety glasses or face shield and additional PPE such as a respirator and lab clothing dedicated to the BSL-3 lab may be recommended or required.

### 3.3 The Maximum Containment Laboratory – Biosafety Level 4

The maximum containment laboratory – Biosafety Level 4 is designed for work with Risk Group 4 microorganisms. Before such a laboratory is constructed and put into operation, intensive consultations should be held with institutions that have had experience of operating a similar facility. Operational maximum containment laboratories – Biosafety Level 4 should be under the control of national or other appropriate health authorities. The following information is intended only as introductory material. Entities working to pursue development of a Biosafety Level 4 laboratory should contact the WHO Biosafety programme for additional information.

#### 3.3.1 Code of Practice of BSL 4

The code of practice for Biosafety Level 3 applies except where modified as follows:

1. The two-person rule should apply, whereby no individual ever works alone. This is particularly important if working in a Biosafety Level 4 suit facility.
2. A complete change of clothing and shoes is required prior to entering, and upon exiting the laboratory.
3. Personnel must be trained in emergency extraction procedures in the event of personnel injury or illness.
4. A method of communication for routine and emergency contacts must be established between personnel working within the maximum containment laboratory – Biosafety Level 4 and support personnel outside the laboratory.

#### 3.3.2 Laboratory design and facilities of BSL 4

The features of a containment laboratory – Biosafety Level 3 also apply to a maximum containment laboratory – Biosafety Level 4 with the addition of the following:

### 3.3.2.1 Primary containment

An efficient primary containment system must be in place, consisting of one or a combination of the following.

i. Class III cabinet laboratory. Passage through a minimum of two doors prior to entering the rooms containing the Class III biological safety cabinet(s) (cabinet room) is required. In this laboratory configuration, the Class III biological safety cabinet provides the primary containment. A personnel shower with inner and outer changing rooms is necessary. Supplies and materials that are not brought into the cabinet room through the changing area are introduced through a double-door autoclave or fumigation chamber. Once the outer door is securely closed, staff inside the laboratory can open the inner door to retrieve the materials. The doors of the autoclave or fumigation chamber are interlocked in such a way that the outer door cannot open unless the autoclave has been operated through a sterilization cycle or the fumigation chamber has been decontaminated.
ii. Suit laboratory. A protective suit laboratory with self-contained breathing apparatus differs significantly in design and facility requirements from a Biosafety Level 4 laboratory with Class III biological safety cabinets. The rooms in the protective suit laboratory are arranged to direct personnel through the changing and decontamination areas prior to entering areas where infectious materials are manipulated. A suit decontamination shower must be provided and used by personnel leaving the containment laboratory area. A separate personnel shower with inner and outer changing rooms is also provided.

Personnel who enter the suit area are required to don a one - piece, positively pressurized, HEPA-filtered, supplied-air suit. Air to the suit must be provided by a system that has a 100% redundant capability with an independent source of air, for use in the event of an emergency. Entry into the suit laboratory is through an airlock fitted with airtight doors. An appropriate warning system for personnel working in the suit laboratory must be provided for use in the event of mechanical system or air failure.

### 3.3.2.2 Controlled Access

The maximum containment laboratory – Biosafety Level 4 must be located in a separate building or in a clearly delineated zone within a secure building. Entry and exit of personnel and supplies must be through an airlock or pass-through system. On entering, personnel must put on a complete set of clothing, before leaving; they should shower before putting on street clothing.

#### 3.3.2.3 Controlled Air System

Negative pressure must be maintained in the facility. Both supply and exhaust air must be HEPA-filtered. There are significant differences in the ventilating systems of the Class III cabinet laboratory and suit laboratory:

i. Class III cabinet laboratory. The supply air to the Class III biological safety cabinet(s) may be drawn from within the room through a HEPA filter mounted on the cabinet or supplied directly through the supply air system. Exhaust air from the Class III biological safety cabinet must pass through two HEPA filters prior to release outdoors. The cabinet must be operated at negative pressure to the surrounding laboratory at all times. A dedicated non-recirculating ventilating system for the cabinet laboratory is required.
ii. Suit laboratory. Dedicated room air supply and exhaust systems are required. The supply and exhaust components of the ventilating system are balanced to provide directional airflow within the suit area from the area of least hazard to the area(s) of greatest potential hazard. Redundant exhaust fans are required to ensure that the facility remains under negative pressure at all times. The differential pressures within the suit laboratory and between the suit laboratory and adjacent areas must be monitored.

Airflow in the supply and exhaust components of the ventilating system must be monitored, and an appropriate system of controls must be used to prevent pressurization of the suit laboratory. HEPA-filtered supply air must be provided to the suit area, decontamination shower and decontamination airlocks or chambers. Exhaust air from the suit laboratory must be passed through a series of two HEPA filters prior to release outdoors. Alternatively, after double HEPA filtration, exhaust air may be recirculated, but only within the suit laboratory. Under no circumstances shall the exhaust air from the Biosafety Level 4 suit laboratory be recirculated to other areas. Extreme caution must be exercised if recirculation of air within the suit laboratory is elected. Consideration must be given to the types of research conducted, equipment, chemicals and other materials used in the suit laboratory, as well as animal species that may be involved in the research. All HEPA filters need to be tested and certified annually. The HEPA filter housings are designed to allow for in situ decontamination of the filter prior to removal. Alternatively, the filter can be removed in a sealed, gas-tight primary container for subsequent decontamination and/or destruction by incineration.

### 3.3.3 Decontamination of effluents

All effluents from the suit area, decontamination chamber, decontamination shower, or Class III biological safety cabinet must be decontaminated before final discharge. Heat treatment is the preferred method. Effluents may require correction to a neutral pH prior to discharge. Water from personnel shower and toilet may be discharged to the sanitary sewer without treatment.

#### 3.3.3.1 Sterilization of waste and materials

A double-door, pass-through autoclave must be available in the laboratory area. Other methods of decontamination must be available for items that cannot withstand steam sterilization.

#### 3.3.3.2 Airlock Entry Ports

Airlock entry ports for specimens, materials and animals must be provided. Emergency power and dedicated power supply line(s) must be provided. Containment drain(s) must be installed.

Because of the great complexity of the engineering, design and construction of Biosafety Level 4 facilities, in either cabinet or suit configuration, schematic representations of such facilities have not been included. The work in the Biosafety Level 4 laboratory requires the development of a separate detailed work manual and testing in training exercises. In addition, an emergency programme must be devised. In the preparation of this programme, active cooperation with national and local health authorities should be established. Other emergency services, e.g. fire, police and designated receiving hospitals, should also be involved.

## 4. Laboratory animal facilities

Those who use animals for experimental and diagnostic purposes have a moral obligation to take every care to avoid causing them unnecessary pain or suffering. The animals must be provided with comfortable, hygienic housing and adequate wholesome food and water. At the end of the experiment, animals must be dealt with in a humane manner.

For security reasons, the animal house should be an independent, detached unit. If it adjoins a laboratory, the design should provide for its isolation from the public parts of the laboratory should such need arise, and for its decontamination and disinfestation.
Table 4. Animal facility containment levels: summary of practices and safety equipment

| RISK GROUP | CONTAINMENT LEVEL | LABORATORY PRACTICES AND SAFETY EQUIPMENT |
|---|---|---|
| 1 | ABSL-1 | Limited access, protective clothing and gloves. |
| 2 | ABSL-2 | ABSL-1 practices plus: hazard warning signs. Class I or II BSCs for activities that produce aerosols. Decontamination of waste and cages before washing. |
| 3 | ABSL-3 | ABSL-2 practices plus: controlled access. BSCs and special protective clothing for all activities. |
| 4 | ABSL-4 | ABSL-3 plus: strictly limited access. Clothing change before entering. Class III BSCs or positive pressure suits. Shower on exit. Decontamination of all wastes before removal from facility. |

ABSL, animal facility Biosafety Level; BSCs, biological safety cabinets

Animal facilities, like laboratories, may be designated according to a risk assessment and the risk group of the microorganisms under investigation, as Animal facility Biosafety Level 1, 2, 3 or 4. With respect to agents to be used in the animal laboratory, factors for consideration include:

1. The normal route of transmission
2. The volumes and concentrations to be used
3. The route of inoculation
4. Whether and by what route these agents may be excreted.

With respect to animals to be used in the animal laboratory, factors for consideration include:

1. The nature of the animals, i.e. their aggressiveness and tendency to bite and scratch
2. Their natural ecto- and endoparasites
3. The zoonotic diseases to which they are susceptible
4. The possible dissemination of allergens.

### 4.1 Animal facility – Biosafety Level 1

This is suitable for the maintenance of most stock animals after quarantine (except nonhuman primates, regarding which national authorities should be consulted), and for animals that are deliberately inoculated with agents in Risk Group 1. GMT are required. The animal facility director must establish policies, procedures and protocols for all operations, and for access to the vivarium. An appropriate medical surveillance programme for the staff must be instituted. A safety or operations manual must be prepared and adopted.

### 4.2 Animal facility – Biosafety Level 2

This is suitable for work with animals that are deliberately inoculated with microorganisms in Risk Group 2. The following safety precautions apply:

1. All the requirements for animal facilities – Biosafety Level 1 must be met.
2. Biohazard warning signs should be posted on doors and other appropriate places.
3. The facility must be designed for easy cleaning and housekeeping.
4. Doors must open inwards and be self-closing.
5. Heating, ventilation and lighting must be adequate.
6. If mechanical ventilation is provided, the airflow must be inwards. Exhaust air is discharged to the outside and should not be recirculated to any part of the building.
7. Access must be restricted to authorized persons.
8. No animals should be admitted other than those for experimental use.
9. There should be an arthropod and rodent control programme.
10. Windows, if present, must be secure, resistant to breakage and, if able to be opened, must be fitted with arthropod-proof screens.
11. After use, work surfaces must be decontaminated with effective disinfectants

12. Biological safety cabinets (Classes I or II) or isolator cages with dedicated air supplies and HEPA-filtered exhaust air must be provided for work that may involve the generation of aerosols.
13. An autoclave must be available on site or in appropriate proximity to the animal facility.
14. Animal bedding materials must be removed in a manner that minimizes the generation of aerosols and dust.
15. All waste materials and bedding must be decontaminated before disposal.
16. Use of sharp instruments should be restricted whenever possible. Sharps should always be collected in puncture-proof/-resistant containers fitted with covers and treated as infectious.
17. Material for autoclaving or incineration must be transported safely, in closed containers.
18. Animal cages must be decontaminated after use.
19. Animal carcasses should be incinerated.
20. Protective clothing and equipment must be worn in the facility, and removed on leaving.
21. Hand-washing facilities must be provided. Staff must wash their hands before leaving the animal facility.
22. All injuries, however minor, must be treated appropriately, reported and recorded.
23. Eating, drinking, smoking and application of cosmetics must be forbidden in the facility.
24. All personnel must receive appropriate training.

**4.3 Animal facility – Biosafety Level 3**

This is suitable for work with animals that are deliberately inoculated with agents in Risk Group 3, or when otherwise indicated by a risk assessment. All systems, practices and procedures need to be reviewed and recertified annually.

The following safety precautions apply:

1. All the requirements for animal facilities – Biosafety Levels 1 and 2 must be met.
2. Access must be strictly controlled.
3. The facility must be separated from other laboratory and animal house areas by a room with a double door entrance forming an anteroom.

4. Hand-washing facilities must be provided in the anteroom.
5. Showers should be provided in the anteroom.
6. There must be mechanical ventilation to ensure a continuous airflow through all the rooms. Exhaust air must pass through HEPA filters before being discharged to the atmosphere without recirculation. The system must be designed to prevent accidental reverse flow and positive pressurization in any part of the animal house.
7. An autoclave must be available at a location convenient for the animal house where the biohazard is contained. Infectious waste should be autoclaved before it is moved to other areas of the facility.
8. An incinerator should be readily available on site or alternative arrangements should be made with the authorities concerned.
9. Animals infected with Risk Group 3 microorganisms must be housed in cages in isolators or rooms with ventilation exhausts placed behind the cages.
10. Bedding should be as dust-free as possible.
11. All protective clothing must be decontaminated before it is laundered.
12. Windows must be closed and sealed, and resistant to breakage.
13. Immunization of staff, as appropriate, should be offered.

### 4.4 Animal facility – Biosafety Level 4

Work in this facility will normally be linked with that in the maximum containment laboratory – Biosafety Level 4, and national and local rules and regulations must be harmonized to apply to both. If work is to be done in a suit laboratory, additional practices and procedures must be used over and above those described here.

1. All the requirements for animal facilities – Biosafety Levels 1, 2 and 3 must be met.
2. Access must be strictly controlled; only staff designated by the director of the establishment should have authority to enter.
3. Individuals must not work alone: the two-person rule must apply.
4. Personnel must have received the highest possible level of training as microbiologists and be familiar with the hazards involved in their work and with the necessary precautions.
5. Housing areas for animals infected with Risk Group 4 agents must maintain the criteria for containment described and applied for maximum containment laboratories – Biosafety Level 4.

6. The facility must be entered by an airlock anteroom, the clean side of which must be separated from the restricted side by changing and showering facilities.
7. Staff must remove street clothing when entering and put on special, protective clothing. After work, they must remove the protective clothing for autoclaving, and shower before leaving.
8. The facility must be ventilated by a HEPA-filtered exhaust system designed to ensure a negative pressure (inward directional airflow).
9. The ventilation system must be designed to prevent reverse flow and positive pressurization.
10. A double-ended autoclave with the clean end in a room outside the containment rooms must be provided for exchange of materials.
11. A pass-through airlock with the clean end in a room outside the containment rooms must be provided for exchange of non-autoclavable materials.
12. All manipulations with animals infected with Risk Group 4 agents must take place under maximum containment – Biosafety Level 4 conditions.
13. All animals must be housed in isolators.
14. All animal bedding and waste must be autoclaved before removal from the facility.
15. There must be medical supervision of staff.

**4.5 Invertebrates**

As with vertebrates, the animal facility biosafety level will be determined by the risk groups of the agents under investigation, or when otherwise indicated by a risk assessment. The following additional precautions are necessary with certain arthropods, particularly with flying insects:

1. Separate rooms should be provided for infected and non-infected invertebrates.
2. The rooms should be capable of being sealed for fumigation.
3. Insecticide sprays should be readily available.
4. "Chilling" facilities should be provided to reduce, where necessary, the activity of invertebrates.
5. Access should be through an anteroom containing insect traps and with arthropod proof screens on the doors.
6. All exhaust ventilation ducts and openable windows should be fitted with arthropod-proof screens.

7. Waste traps on sinks and sluices should not be allowed to dry out.
8. All waste should be decontaminated by autoclaving, as some invertebrates are not killed by all disinfectants.
9. A check should be kept on the numbers of larval and adult forms of flying, crawling and jumping arthropods.
10. Containers for ticks and mites should stand in trays of oil.
11. Infected or potentially infected flying insects must be contained in double-netted cages.
12. Infected or potentially infected arthropods must be handled in biological safety cabinets or isolators.
13. Infected or potentially infected arthropods may be manipulated on cooling trays.

## 5. Laboratory biosecurity concepts

Effective biosafety practices are the very foundation of laboratory biosecurity activities. Through risk assessments, performed as an integral part of an institution's biosafety programme, information is gathered regarding the type of organisms available, their physical location, the personnel who require access to them, and the identification of those responsible for them. This information can be used to assess whether an institution possesses biological materials that are attractive to those who may wish to use them improperly. National standards should be developed that recognize and address the ongoing responsibility of countries and institutions to protect specimens, pathogens and toxins from misuse.

A specific laboratory biosecurity programme must be prepared and implemented for each facility according to the requirements of the facility, the type of laboratory work conducted, and the local conditions. Consequently, laboratory biosecurity activities should be representative of the institution's various needs and should include input from scientific directors, principal investigators, biosafety officers, laboratory scientific staff, maintenance staff, administrators, information technology staff, and law enforcement agencies and security staff if appropriate.

Laboratory biosecurity measures should be based on a comprehensive programme of accountability for pathogens and toxins that includes an

updated inventory with storage location, identification of personnel with access, description of use, documentation of internal and external transfers within and between facilities, and any inactivation and/or disposal of the materials. Likewise, an institutional laboratory biosecurity protocol should be established for identifying, reporting, investigating and remediating breaches in laboratory biosecurity, including discrepancies in inventory results. The involvement and roles, and responsibilities of public health and security authorities in the event of a security infraction must be clearly defined.

Laboratory biosecurity training, distinct from laboratory biosafety training, should be provided to all personnel. Such training should help personnel understand the need for protection of such materials and the rationale for the specific biosecurity measures, and should include a review of relevant national standards and institution specific procedures. Procedures describing the security roles and responsibilities of personnel in the event of a security infraction should also be presented during training. The professional and ethical suitability for working with dangerous pathogens of all personnel who have regular authorized access to sensitive materials is also central to effective laboratory biosecurity activities.

In summary, security precautions should become a routine part of laboratory work, just as have aseptic techniques and other safe microbiological practices. Laboratory biosecurity measures should not hinder the efficient sharing of reference materials, clinical and epidemiological specimens and related information necessary for clinical or public health investigations. Competent security management should not unduly interfere with the day-to-day activities of scientific personnel or be an impediment to conducting research. Legitimate access to important research and clinical materials must be preserved. Assessment of the suitability of personnel, security-specific training and rigorous adherence to pathogen protection procedures are reasonable means of enhancing laboratory biosecurity. All such efforts must be established and maintained through regular risk and threat assessments, and regular review and updating of procedures. Checks for compliance with these procedures, with clear instructions on roles, responsibilities and remedial actions, should be integral to laboratory biosecurity programmes and national standards for laboratory biosecurity.

### 5.1 The biosafety officer and biosafety committee

It is essential that, each laboratory organization has a comprehensive safety policy, a safety manual, and supporting programmes for their implementation. The responsibility for this normally rests with the director or head of the institute or laboratory, who may delegate certain duties to a biosafety officer or other appropriate personnel.

Laboratory safety is also the responsibility of all supervisors and laboratory employees, and individual workers are responsible for their own safety and that of their colleagues. Employees are expected to perform their work safely and should report any unsafe acts, conditions or incidents to their supervisor. Periodic safety audits by internal or external personnel are desirable.

#### 5.1.1 Biosafety officer

Wherever possible a biosafety officer should be appointed to ensure that biosafety policies and programmes are followed consistently throughout the laboratory. The biosafety officer executes these duties on behalf of the head of the institute or laboratory. The biosafety officer should apply relevant national and international rules, regulations and guidelines, as well as assist the laboratory in developing standard operating procedures. The person appointed must have a technical background in microbiology, biochemistry and basic physical and biological sciences. Knowledge of laboratory and clinical practices and safety, including containment equipment, and engineering principles relevant to the design, operation and maintenance of facilities is highly desirable. The activities of the biosafety officer should include the following:

1. Biosafety, biosecurity and technical compliance consultations.
2. Periodic internal biosafety audits on technical methods, procedures and protocols, biological agents, materials and equipment.
3. Discussions of violation of biosafety protocols or procedures with the appropriate persons.
4. Verification that all staff have received appropriate biosafety training.
5. Provision of continuing education in biosafety.
6. Investigation of incidents involving the possible escape of potentially infectious or toxic material, and reporting of findings and recommendations to the laboratory director and biosafety committee/officer.
7. Coordination with medical staff regarding possible laboratory-acquired infections.
8. Ensuring appropriate decontamination following spills or other incidents

involving infectious material(s).
9. Ensuring proper waste management.
10. Ensuring appropriate decontamination of any apparatus prior to repair or servicing.
11. Maintaining awareness of community attitudes regarding health and environmental considerations.
12. Establishment of appropriate procedures for import/export of pathogenic material to/from the laboratory, according to national regulations.
13. Reviewing the biosafety aspects of all plans, protocols and operating procedures for research work involving infectious agents prior to the implementation of these activities.
14. Institution of a system to deal with emergencies.

### 5.1.2 Biosafety committee/Biosafety Officer

A biosafety committee should be constituted, and a biosafety officer may be appointed to ensure proper implementation of biosafety measures. The biosafety committee should review research protocols for work involving infectious agents, animal use, recombinant DNA and genetically modified materials.

## 6. Training programmes

Continuous, on-the-job safety training programme is essential to maintain safety awareness among laboratory and support staff. Laboratory supervisors, with the assistance of the biosafety officer and other resource persons, play the key role in staff training. The effectiveness of biosafety training, indeed all safety and health training, depends on management commitment, motivational factors, adequate initial job training, good communications, and ultimately the organization's goals and objective.

The following are critical elements for an effective biosafety training programme:

1. Needs assessment: This process includes defining the tasks involved, the order of importance (in terms of frequency, criticality, and complexity) and details of the steps necessary to accomplish them.

2. Establishing training objectives: These are observable behaviours that the trainee is expected to demonstrate, on the job, after the training. Objectives may acknowledge the conditions under which certain activities or behaviours are performed and the required level of proficiency.
3. Specifying training content and media: Content is the knowledge or skill that the trainee must master to be able to meet the behavioural objectives. Those individuals who know the job and its demands best usually define the content of the biosafety training programme. Other approaches used may focus on the products of problem-solving exercises or the design of learning measures to correct mistakes people have made in using a skill. It is not clear that one teaching method (lectures, televised instruction, computer-aided instruction, interactive video, etc.) is superior to another. Much depends on specific training needs, the make-up of the trainee group, etc.
4. Accounting for individual learning differences: Effective training must take into account the characteristics or attributes of the trainees. Individuals and groups may differ in aptitude, literacy, culture, spoken language and pre-training skill levels. How the training programme is viewed by trainees in terms of improving their job performance or personal safety may dictate the approach used. Some individuals are more visual or "hands-on" learners; others learn well from written materials. Any special needs of employees must also be addressed, such as course adaptation for those with hearing impairments. In addition to taking account of these elements, it is recommended that the developers of any safety training programme become acquainted with the principles of adult learning.
5. Specifying learning conditions: The instructional event (e.g. training course, videotape, written materials, etc.) should not conflict with, inhibit or be unrelated to mastery of the skill or topic being taught. For example, if the intent of the instruction is to develop capabilities in problem-solving techniques, the instructional approach should stress thinking/reasoning approaches rather than rote memorization. The instruction provided should require productive behaviour and/or appropriate feedback (positive/accurate/credible). In addition, instructional events that provide opportunities for practice under conditions similar to that of the job will enhance the transfer of the skill to the actual job.
6. Training evaluation: This provides information that helps to determine whether the instruction has had the intended effect. Training evaluations generally take four forms:

- measuring the trainees' reaction to the instruction provided
- measuring the trainees' recollection and/or performance
- assessing behavioural change on the job
- measuring tangible results in terms of the organization's objectives or goals.

The most complete evaluation of a training effort involves assessments for each of the four areas. The least efficient method of evaluation is to consider only the trainees' reactions to the instruction as this may bear little relationship to the extent of actual learning. It should not be used as the sole measurement of training effectiveness.

7. Training revision: Training evaluations rarely indicate that a training programme is a complete success or failure because multiple criteria are used to measure results. Usually the data indicate a better understanding, retention or application of some parts of the course material as compared with others. Variation or gaps in knowledge or the desired competencies resulting from the training effort may reflect the need to consider more training.

## 7. Laboratory Biorisk Management

A laboratory biorisk management system includes the policies, responsibilities, and operational procedures used to support biorisk analysis and the resulting biosafety and laboratory biosecurity measures implemented to manage laboratory biorisk. Over the past two decades, bioscience facilities worldwide have experienced multiple safety and security incidents. This demonstrates that a system based solely on biosafety levels and security regulations may not be sufficient. This set the stage for a substantively different approach for managing the risks of working with biological agents in laboratories, Laboratory Biorisk Management, Biosafety and Biosecurity introduces the concept of biorisk management as a new paradigm that encompasses both laboratory biosafety and biosecurity.

Veterinary laboratories and animal facilities routinely handle biological materials that may constitute or contain infectious agents and toxins. These may cause adverse health and economic effects due to uncontrolled release within, or to the outside of the laboratory. The managers of laboratory and animal facilities are responsible for providing a management system that

ensures safe and secure handling, storage, and transport of these biological materials (a biorisk management system). This is needed not only to protect laboratory workers from inadvertent exposures and infection, but also to protect the local and regional animal populations, human populations, and environment from accidental or intentional release and spread of biological agents and toxins from laboratories. These considerations should also apply to animals and potential arthropod vectors that are handled in veterinary laboratories and animal facilities. The term "biological material" includes all potential sources of biological risk for which laboratory management may be responsible. To classify the potential biological risk posed by the presence and handling of a particular biological material, laboratory managers should apply a systematic and evidence-based approach termed biorisk analysis.

Biorisk analysis is the process of identifying and characterizing health, safety, and security risks, followed by implementing, measuring the effectiveness of, and communicating the control measures used to reduce those risks to acceptable levels. Individuals in, engineering, energy, and health industries to characterize and control inherent risks associated with routine practices have used risk analysis effectively. This analysis focuses on biological-related risks, recognizing that additional health and safety concerns exist, and should be controlled within the laboratory environment. The biorisk analysis approach typically used by health professionals, assess, manage, and communicate risks associated with dealing with animals and animal products as further described in Chapter 2.1 of the OIE Terrestrial Animal Health Code.

### 7.1 Reporting Procedures

All incidents involving exposure must be reported to the supervisor before the end of the work shift. The circumstances surrounding the incident are required including date, time, and exposure determination.

### 7.2 Post-Exposure Evaluation and Follow

An exposure incident is a specific eye, mouth, other mucous membrane, non-intact skin, or potential contact with blood or other potentially infectious materials that results from the performance of an employee's duties should immediately report it to their supervisor before the end of the work shift. A post-exposure incident should be completed immediately. Circumstances surrounding the incident e.g. date, time, and exposure determination should be clearly indicated and reported. The employee should be offered a confidential medical evaluation and follow-up,

### 7.3 Emergency Provision

1. Properly maintained first-aid equipment should be readily available stored in an appropriate location for immediate emergency use by trained first aid personnel
2. Containment Level 4 Facilities shall have advanced first aid competence.
3. There must be suitable procedures and equipment for dealing with spillages and decontamination.
4. A record must be kept of all incidents, which should be reported to the enforcing authority.
5. There must be written procedures for dealing with emergency failure of all safety and containment systems e.g. Biosafety cabinets or bio containment rooms.
6. Fire alarms shall be fitted, and tested regularly.
7. Procedures for natural disasters, such as hurricanes and earthquakes, should be in place where they present a risk.

All these procedures should be written down and periodically reviewed. Each of (ADAFSA) institutes or laboratories designate a warden (marshal) to control and communicate in emergency situations as per the applied integrated management system (IMS) , and conduct periodic drills to make staff aware of what to do and where to assemble in the event of an emergency.

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# VII. Annex Forms

## 1.Form of BSL 1 Laboratory Safety Survey

| Location | | | Date | |
|---|---|---|---|---|
| Person in charge of laboratory | | | | |
| | | | | |
| | | | | |
| (CHECKED ITEM (ENTER DATE OF CHECK | YES | NO | N/A | COMMENTS |
| **Laboratory** | | | | |
| Proper signage: ultraviolet light, laser, radioactive material, etc. | | | | |
| Appropriate biosafety guidelines available and followed | | | | |
| Laboratory equipment properly (Biohazardous, radioactive, toxic, etc.) labelled | | | | |
| **Laboratory design** | | | | |
| Designed for easy cleaning | | | | |
| Room ultraviolet lights on interlock switch | | | | |
| All shelves secured | | | | |
| Bench-tops waterproof and resistant to acids, alkali, organic solvents and heat | | | | |
| Adequate illumination provided | | | | |
| Adequate storage space available and appropriately used | | | | |
| **Gas cylinders** | | | | |
| All cylinders secured | | | | |
| Caps on reserve cylinders | | | | |
| Asphyxiating and hazardous gases only in ventilated rooms | | | | |
| Excess or empty cylinders present | | | | |
| **Chemicals** | | | | |
| Flammables stored in flammable storage cabinet | | | | |
| (Peroxide formers double-dated (received and opened | | | | |
| Chemicals properly segregated | | | | |
| Hazardous chemicals stored above eye level | | | | |
| Chemicals stored on the floor | | | | |
| Chemical containers left open | | | | |
| All solutions properly labelled | | | | |
| Mercury thermometers in use | | | | |
| **Refrigerators/freezers/cold rooms** | | | | |
| Food for human consumption present | | | | |
| Flammables in explosion-proof/-safe units | | | | |
| Labelled externally if containing | | | | |
| carcinogens, radioactivity and/or | | | | |
| biohazards | | | | |
| Cold-room has emergency release | | | | |
| **Electrical equipment** | | | | |
| Extension cords present | | | | |
| Outlets earthed/grounded and with proper polarity | | | | |
| Connections by sinks, under showers, etc. | | | | |
| Equipment with frayed or damaged wiring | | | | |
| Overloaded outlets or electrical strips | | | | |
| Power strips mounted off the floor | | | | |
| Proper fuses in conduits | | | | |
| Electrical outlets near water sources meet local codes | | | | |
| Earths/grounds present on electrical cords | | | | |
| Portable space heaters | | | | |
| **Personal protective equipment** | | | | |
| Eyewash available in laboratory | | | | |
| Safety shower available | | | | |
| Personal protective equipment available (gloves, gowns, goggles, etc.) | | | | |
| Occupants properly attired | | | | |
| Laboratory coats, gowns, smocks, gloves and other personal protective clothing not worn outside the laboratory | | | | |
| Personal protective equipment available for cryogenic storage | | | | |

| | | | |
|---|---|---|---|
| **Waste management** | | | |
| Evidence of improper waste disposal | | | |
| Wastes segregated in proper containers | | | |
| Chemical waste containers tagged, labelled, dated and kept closed | | | |
| Chemical waste containers appropriately handled and stored | | | |
| Sharps containers used and disposed of properly | | | |
| No trash on floor | | | |
| Waste disposal procedures posted in | | | |
| laboratory | | | |
| **Occupational health and safety programmes available** | | | |
| Hazard communication | | | |
| Respiratory protection | | | |
| Hearing conservation | | | |
| Formaldehyde monitoring | | | |
| Ethylene oxide monitoring | | | |
| Anaesthetic gas monitoring | | | |
| General engineering controls | | | |
| Laboratory airflow is negative to general occupancy, corridor and office areas | | | |
| Cup sinks or drains acting as vents | | | |
| Sink available for hand-washing | | | |
| Exposed machine parts (pulleys, gears) | | | |
| Vacuum line has filters and traps on laboratory benches | | | |
| Backflow hazards to water supply | | | |
| Distilled water systems in good condition | | | |
| Active and effective arthropod and rodent control programme | | | |
| **General practices and procedures** | | | |
| Food for human consumption stored outside the laboratory | | | |
| Microwave oven(s) clearly labelled "No | | | |
| Food Preparation, Laboratory Use Only" | | | |
| Eating, drinking, smoking and/or applying of cosmetics occurring in the laboratory | | | |
| Pressurized glass containers taped or shielded (i.e. vacuum traps) | | | |
| Mouth pipetting prohibited | | | |
| Mechanical pipetting devices available and used | | | |
| Protective laboratory clothing stored separately from street clothing | | | |
| **General laboratory housekeeping** | | | |
| Glass containers stored on the floor | | | |
| Trip hazards evident | | | |
| Clean absorbent pads on work surfaces | | | |
| Broken glassware handled by mechanical means (brush and dustpan, tongs, etc.) | | | |
| **Fire protection** | | | |
| Sprinkler heads free and unobstructed | | | |
| Open penetrations in walls, ceiling, floor, etc. | | | |
| Wiring or tubing through door openings | | | |
| Minimum passage width of 1 m in laboratory | | | |
| Storage observed on ductwork or light fixtures | | | |
| Excess combustibles stored in laboratory | | | |
| **Heated constant temperature baths** | | | |
| Equipped with low water level and overheat shutoff | | | |
| | | | |
| Constructed of noncombustible materials | | | |
| | | | |
| Safety surveyor's signature: | | | Date survey completed |

## 2. Form of BSL 2 Laboratory Safety Survey

This is to be used in conjunction with the Biosafety Level 1 laboratory safety survey form

| Location | | | Date | |
|---|---|---|---|---|
| Person in charge of laboratory | | | | |
| | | | | |
| (CHECKED ITEM (ENTER DATE OF CHECK | YES | NO | N/A | COMMENTS |
| **Biological safety cabinet (BSC)** | | | | |
| Certification within last year | | | | |
| BSC surface wiped down with appropriate disinfectant at beginning and end of each procedure | | | | |
| Front grill and exhaust filter unobstructed | | | | |
| Open flames used inside cabinet | | | | |
| Vacuum lines have in-line filters and disinfectant traps in use | | | | |
| BSC compromised by room air or location | | | | |
| BSC used when there is potential for creating aerosols | | | | |
| **Laboratory** | | | | |
| Access limited and restricted to authorized personnel | | | | |
| Entry limited to personnel advised of all potential hazards | | | | |
| Biohazard sign posted on laboratory door as appropriate | | | | |
| Information on sign accurate and current | | | | |
| Sign legible and not defaced | | | | |
| All doors closed | | | | |
| **Decontamination** | | | | |
| Decontaminant specific to the organism(s) in use | | | | |
| All spills and accidents involving infectious materials reported to the laboratory supervisor | | | | |
| Appropriate decontaminant used during spill clean-ups | | | | |
| Work surfaces decontaminated before and after each procedure, daily and after spills | | | | |
| **Handling of contaminated waste** | | | | |
| Infectious waste containers properly used | | | | |
| Containers not overfilled | | | | |
| Containers properly labelled and closed | | | | |
| Culture stocks and other regulated waste properly decontaminated before disposal | | | | |
| Materials decontaminated outside the laboratory transported in closed, durable, leak-proof containers according to local rules and regulations | | | | |
| Mixed waste biologically decontaminated prior to disposal as chemical or radiological waste | | | | |
| **Personal protection** | | | | |
| Laboratory personnel reminded of appropriate immunizations/ tests for agents handled | | | | |
| Appropriate medical services contacted for medical evaluations, surveillance and treatment of occupational exposures | | | | |
| Gloves worn when handling infectious material or contaminated equipment | | | | |
| Face protection provided when working outside the BSC with infectious material | | | | |
| Hands washed after removing gloves, after working with infectious agents, before leaving the laboratory | | | | |
| Antimicrobial agent available for immediate first aid | | | | |
| **Practices** | | | | |
| BSC used when potential for creating infectious aerosols/ splashes exists | | | | |
| Biosafety manual prepared and adopted | | | | |
| Personnel read, review and follow the instructions on practices and procedures, including safety or operations manual ((required for all personnel annually | | | | |
| Procedures performed so as to minimize aerosols/splashes | | | | |
| Needle-locking syringes/single-use needle syringe units used with infectious agents | | | | |
| Centrifuge cups and rotors opened only in a BSC | | | | |
| Infectious specimens transported outside a BSC in approved containers following approved transport regulations | | | | |
| | | | | |
| **Facility** | | | | |
| Hand-washing sink available near laboratory exit | | | | |
| | | | | |
| Safety surveyor's signature: | | | | Date survey completed: |

## 3. Form of BSL 3 Laboratory Safety Survey

This is to be used in conjunction with the Biosafety Level 1 and Biosafety Level 2 laboratory safety survey forms

| Location | | | Date | |
|---|---|---|---|---|
| Person in charge of laboratory | | | | |
| | | | | |
| (CHECKED ITEM (ENTER DATE OF CHECK | YES | NO | N/A | COMMENTS |
| **Facility** | | | | |
| Laboratory separated from unrestricted traffic flow in building | | | | |
| Access to laboratory through an anteroom with self-closing doors | | | | |
| All penetrations in laboratory sealed or sealable for decontamination | | | | |
| Room exhaust air single-pass and exhausted away from occupied areas | | | | |
| Controlled ventilation system to monitor directional airflow available | | | | |
| **Personal protection** | | | | |
| Closed-front gowns worn in laboratory | | | | |
| Protective laboratory clothing worn only in laboratory areas | | | | |
| Hand-washing sink foot, elbow or automatically controlled | | | | |
| **Hand protection** | | | | |
| Double gloves worn when handling infectious material, potentially contaminated equipment and work surfaces | | | | |
| **Respiratory protection** | | | | |
| Respiratory protection worn by all personnel in the laboratory when aerosols are not safely contained in a BSC | | | | |
| **Practices** | | | | |
| Mucous membrane protection provided when working with infectious material outside a BSC | | | | |
| Personnel advised of special hazards associated with the agent(s) | | | | |
| Personnel required to read and follow all instructions on practices and procedures, including safety or operations manual | | | | |
| Personnel receive annual updates/additional training for procedural changes | | | | |
| All contaminated waste autoclaved prior to disposal | | | | |
| | | | | |
| Safety surveyor's signature: | | | | Date survey completed: |

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