RESEARCH LABORATORY SAFETY

Topics covered

- Biosafety
- Hazard control measures
- Chemical safety
- Fire safety
- Gas cylinder safety





Topics covered

- Routes of entry for biological agents
- Biosafety levels
- Good microbiological techniques
- Blood borne pathogens
- Sharps
- First aid measures
- Hazards related to animal research work
- Segregation of biohazard waste



The risks associated with bio research activities arise from the biological agent used and the procedural requirements.

Adherence to standard microbiological techniques and using facilities suitable to the risk level of the pathogen helps to protect the researcher from laboratory-acquired infections.



Routes of entry for biological agents

The probable routes of entry are

- Inhalation of infectious aerosols.
- Contact of the agent with mucous membrane.
- Injuries caused by contaminated sharps.
- Ingestion of infectious agent through mouth pipetting or contaminated hands.



Laboratory acquired infection

University of Pittsburg – May 2016

Researcher infected with Zika Virus following needle stick injury during research work.





Physical containment helps to confine the pathogenic organisms being handled and prevent exposure to personnel.

Physical containment is achieved by

- Laboratory practices
- Containment equipment
- Special laboratory design

Primary containment

} Secondary containment



Primary containment

Laboratory practices

Consists of adhering to standard microbiological practices and awareness about potential hazards.





Primary containment

Containment equipment

Examples are biological safety cabinets and enclosed containers.





It consists of a combination of laboratory practices, equipment and facilities suitable to the procedures being performed and hazards of the pathogen.

The four biosafety levels are:

BSL Level 1 BSL Level 2 BSL Level 3 BSL Level 4



Suitable for teaching laboratories and for facilities in which work is done with defined and characterised strains of agents not known to cause any disease.

Good microbiological techniques(GMT) to be followed.





- Specimen containers must be correctly labelled for easy identification.
- Use secondary containers while transporting specimens to contain spill.



• Use mechanical pipettes.





 Always use disposable gloves. Do not touch mouth, eyes and face with contaminated hands.





 Food and drinks must not be stored or consumed in the laboratory.





• Glassware must be replaced with plasticware wherever possible.





Refer to manufacturer's instructions before operating equipments.



 Work area must be decontaminated with a suitable disinfectant at the end of the work.



 Thoroughly wash hands after completion of the work and before leaving the laboratory.





BSL II is appropriate when work is done with agents of moderate potential hazard.

BSL II requires

- Following good microbiological techniques
- Use of personal protective equipment
- Use of biosafety cabinets
- Use of autoclaves

Human/animal blood, body fluids, tissues, cell lines must be handled inside a biosafety cabinet.



Biosafety level II

Biosafety cabinets





Applicable to facilities in which work is done with indigenous or exotic agents. Exposure to aerosols can cause serious or lethal diseases.

BSL III requires the following in addition to that of BSL II requirements

- Special clothing
- Double door entry
- Controlled access
- Supervision



Biosafety level III

• Double door entry





Biosafety level III

Biosafety cabinets with exhaust





Applicable to work with dangerous and exotic agents which pose a high individual risk of life-threatening disease.

BSL IV requires in addition to BSL III requirements

- Positive pressure personnel suits
- Strictly limited access
- Double ended autoclave
- Class III Biosafety cabinet
- Airlock with shower
- Supervision



The risk from the pathogen handled depends on the following factors.

- Capability to cause infection in the host and the severity of the same.
- Availability of preventive measures and treatment.
- Routes of entry.
- Infective dose level.



Risk group I

A pathogen that is unlikely to cause any disease in humans or animals.

All bacterial, fungal and parasitic agents not included in higher groups.



Risk group II

A pathogen that can cause disease in humans or animals but is unlikely to be a serious hazard.

Effective treatment and preventive measures are available and the risk of spread of infection is limited.

- Bacterial- Vibrio cholerae
- Fungal- Aspergillus fumigatus, Actinomycetes
- Parasitic- P.falciparum, Plasmodium thcilera
- Viral and Rickettssial Vole rickettsia, Mumps virus



Risk group III

A pathogen that can cause serious human or animal disease, but does not ordinarily spread from one infected person to another.

- Bacterial Clostridium botulium, Francisella tularensis
- Fungal Coccidioides immitis, Histoplasma capsulatum
- Parasitic- Schisistosoma mansomi
- Viral and Rickettssial Foot-and-Mouth disease virus



Risk group IV

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.

- Korean hemorrhagic fever
- Omsk hemorrhagic fever
- Central European Encephalitis viruses



Aerosols

Examples of activities that generate aerosols are

- Pipetting
- Blending
- Centrifugation
- Use of sonicators and vortex mixers





To prevent exposure to aerosols

- Always conduct the work inside a biosafety cabinet.
- Use sealed containers during centrifuging.
- Equipment that generate aerosols can be placed inside a biosafety cabinet wherever possible.
- Use respiratory protection equipment.



Personal protective equipment

 Personal protective equipment act as a barrier to minimise the risk of exposure to splashes and other injuries.





Personal protective equipment

Toe covered footwear





Biological safety cabinets provide containment of infectious aerosols generated during the laboratory procedures.

Three types of BSCs are used in microbiological laboratories

These are Class I Class II Class III





Class I BSC

Protects laboratory personnel and laboratory environment. It doesn't protect the samples from external contamination.

Class II BSC

Provides protection to the samples in the cabinet from external contamination in addition to personnel and laboratory environment protection.

Class III BSC

Provides the maximum attainable level of protection to personnel and the environment.


Biosafety cabinets

Class II BSC





Handling of sharps

 Sharps(e.g., needle sticks, glass) must be avoided wherever possible as it can transmit blood borne pathogens in case of injury.







Examples of blood borne pathogens are

- Hepatitis B Virus
- Hepatitis C Virus
- Human Immunodeficiency Virus



- Contaminated sharps must be handled using tongs or tweezers to prevent injury.
- Hepatitis B vaccination for personnel working with human blood, body fluids and tissues.
- Needles must not be recapped, to prevent needle stick injury.



Handling of sharps

Puncture-proof containers must be used for disposing sharps.



Credit: University of Minnesota



In case of injury during bio research work

- Remove the contaminated clothing.
- Wash the skin thoroughly with soap and water.
- In case of eye contact flush the eyes with water.
- Report the exposure to the Lab in charge.
- Get medical attention immediately.



Hazards associated with animal facilities

- Allergic reactions
- Bites and scratches
- Zoonotic agents



Biohazard waste generated in laboratories must be segregated into the following:

- Non-contaminated general waste
- Non contaminated sharps
- Contaminated sharps
- Biohazard waste for autoclaving



- Elimination
- Substitution
- Engineering controls
- Administrative controls
- Personal protective equipment



Elimination/Substitution

e.g., Eliminating the use of a hazardous chemical/gas or substituting it with a less hazardous one.



Engineering controls – e.g., equipment guard.





Engineering controls – e.g., chemical hood





Signages





Administrative controls

- Standard operating procedure
- Training
- Supervision







- Elimination
- Substitution
- Engineering controls
- Administrative controls
- Personal protective equipment



Chemical Safety

Topics covered

- Storage and handling of chemicals
- Chemical hoods
- Emergency measures
- Personal protective equipment



Peroxide forming chemicals

- Isopropyl ether
- Butadiene
- Tetrafluoroethylene
- Sodium amide
- Divinyl acetylene
- Vinylidene chloride

- Acetal
- Cumene
- Cyclohexene
- Diethyl ether
- Dioxane
- Tetrahydrofuran



Peroxide forming chemicals

- Write the date of receipt and opening on the bottle.
- Do not store beyond the expiry date.
- Test for peroxides/remove peroxides using appropriate method before use.



Corrosive chemicals

- Can cause severe burns.
- Use apron/coverall and gloves with long sleeves while handling.



Labeling of chemicals





Labeling of chemicals





Emergency eyewash/shower

Emergency shower must be used for flushing the chemicals from the body in case of contact.





Eyes must be flushed for at least 15 minutes in case of contact.























Open flames





Electrically powered equipment- Loose connections, overloading of circuits.





Hot surfaces





Smoking





Welding





Use of lifts

Lifts can trap personnel in case of fire.




Poor housekeeping can cause quick spread of fire





Emergency equipment must not be blocked





• Display emergency contact numbers near the telephone.

• Save numbers on you mobile phone.



Gas Cylinder Safety

Gas cylinder usage

Breakage of valve can turn the gas cylinder into a lethal projectile.





Receiving gas cylinders







Storage of gas cylinders

Cylinders must always be kept chained or in a manner to prevent fall.







Transportation of gas cylinders

Before moving gas cylinder

- Valve must be closed.
- Regulator must be removed.
- Cylinder valve must be capped.
- Secure the cylinder in a cylinder cart (with chain).



Proactive prevention

- Plan in advance
- Know the hazards
- Look for possible deviations
- Adopt appropriate hazard control measures



Thank You