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Shivaji K Jadhav*

Head of Laboratory Operations, Mapmygenome India Limited, Royal Demeure, Madhapur, Hyderabad, India

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***Corresponding author:** Shivaji K Jadhav, Head of Laboratory Operations, Mapmygenome India Limited, Royal Demeure, Madhapur, Hyderabad, India; Tel: 8884493021; Email: scientistshivaji@gmail.com

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Review Article

An Overview: Laboratory Safety and work Practices in Infectious Disease Research

Review

Occupational exposure and risk of acquiring the infections is a very serious issue and it plays an important role concerned to personnel safety in the laboratory. It is very much essential to emphasis on safety aspects for each personnel working in infectious laboratories. This review article provides an insight on bio safety practices to be followed for safe and effective functioning of the laboratory to prevent the occupational exposure.

Bio safety practice is designed as per international standards to help a safe and healthy environment that adequately supports good work practices. This review is mainly focused on bio safety practices which will provide sufficient information and SOPs should be used in conjunction with other resources to work safely with biohazard or any infectious agents in the laboratory. It will also commit to provide knowledge for safe laboratory environment for laboratory staff, trainees and also healthcare workers. In laboratories, there are many tasks that involve numerous risks factors to the laboratory staff [1]. Thus, any incident associated with a given microbiological hazard is probably most likely to happen in infectious laboratory. However, incidents are not only associated to a single factor [2]. Further these practices shall be practiced routinely to achieve the highest ethical and professional standards possible to protect the health of staff, the public, and the working environment, There are biological risks in health sector in biotechnology by bacteria, viruses, rickettsiae, fungi, and parasites [3,4].

Safety in laboratory work place can be achieved maximum by using equipments which includes biological safety cabinets (BSCs). The biological safety cabinet is the principal device used to provide containment of aerosols generated by many infectious procedures. Regarding bio safety and bio security in biomedical laboratories, there is great concern about vaccines, diagnostic tools, or therapeutic agents, some of which are made by genetic engineering methods [5].

Safety equipment may include items for personal protection such as gloves, coats, gowns, shoe covers, face shields, and safety glasses. The personal protective devices are always used in combination with biological safety cabinets to ensure safety for lab personnel. In some situations it is impractical to work in biological safety cabinets hence personal protective devices are useful which may form primary barrier between personnel and infectious materials. Examples of such activities which may include some animal studies, animal necropsy additional activities to support laboratory involving infectious organisms. Currently there is a concern of bio safety is due to the emergence of new diseases or the re-emergence of diseases that were already under control [6,7].

Biological safety cabinets mainly used are of two types (Class II, III) in infectious laboratories. Open fronted Class II biological safety cabinets are partial containment cabinets that can provide significant levels of protection to laboratory personnel and to the environment when used with good safety standard operating procedures. The gas-tight Class III biological safety cabinet will also provide the highest attainable level of protection to personnel and the environment.

Bio safety Level requirements for Infectious research laboratories

As per the WHO guidelines Bio safety level 2 plus and BSL3 is applicable to clinical, diagnostic, research, where the work is executed with any infectious agents that may cause serious or potentially lethal disease through inhalation route exposure like (HIV, Mycobacterium tuberculosis).The laboratory personnel must receive specific training in handling infectious and pathogenic agents before initiating any research activities and the person should be aware of risk factors that potentially caused by infectious agents and must be supervised

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by scientists competent in handling infectious agents. All procedures involving infectious materials must be conducted within the bio safety cabinets by wearing appropriate personal protective equipment by the laboratory personnel. The following standard and special safety practices, equipment, and facility requirements apply to BSL2 plus laboratory for Infectious disease.

Standard Practices should be practiced in Infectious disease laboratories: The standard practices should be followed includes the laboratory supervisor or scientist must enforce the institutional policies that control access to the laboratory. Always make sure all the policies for the safe handling of sharps, such as needles, scalpels, pipettes, and broken glassware must be implemented. The primary importance is careful management of needles and other sharps, it is necessary to ensure needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal. Some of the non-disposable sharps must be placed in a hard walled container for decontamination preferably by autoclaving. It is essential to handle broken glassware with extract precautions, health care worker must not be handled directly the broken glassware's Instead, it must be removed using a brush and dustpan, tongs, or forceps. It is advisable to substitute plastic ware instead of glass whenever possible.

It is important to assign biohazard symbol on laboratory workplace and environment which includes extraction, isolation and storage, A universal biohazard symbol must be posted with relevant information including laboratory's bio safety level, the supervisor's name (or other responsible personnel), telephone number, and required procedures for entering and exiting the laboratory. The laboratory supervisor must ensure that laboratory personnel receive appropriate training and exposure or experience regarding their duties, the necessary precautions to prevent exposures, and exposure evaluation procedures.

It is essential for healthcare workers or laboratory staff to receive annual updates or additional training when procedural or policy changes occur at any point of time. It is also essential to understand personal health status which may impact an individual's susceptibility to infection, ability to receive immunizations or prophylactic interventions. Therefore, it is recommended that all laboratory personnel and especially women of child-bearing age should be provided with information regarding immune competence and conditions related conditions that may predispose them easily to infection. It is important to have an effective integrated pest management program as per the SOPs and recommended guidelines from Bio safety officer.

Special Practices implemented in Infectious disease laboratories: All the special practices should be followed in bio safety level 2 laboratory will includes all the persons who are entering the laboratory must be advised of the potential hazards and they should meet specific entry/exit requirements and must take prior approval from the head of the laboratory operations, It is essential to provide laboratory personnel medical surveillance and offered appropriate immunizations for infectious agents handled or potentially present in the laboratory. It is always necessary to perform sample collection and storage of samples as per SOPs to prevent risk from infectious agents to personnel. The SOPs must include decontamination protocol for any spills involving infectious materials and cleaning procedures should be implemented by staff with proper trained and equipped to work with infectious material in bio safety laboratory, all the procedure must include equipment must be decontaminated before repair, maintenance, or removal from the laboratory. It is essential decontaminate all cultures, stocks, and other potentially infectious materials before disposal using standard operating protocols. A proper method for decontaminating for all laboratory wastes should be available in the laboratory facility with validated decontamination protocols as per SOPs. After decontamination the material must be packed in appropriate color coding bags accordance with applicable local, state, regulations or bio waste disposal from recognized bio waste management systems.

A laboratory-specific bio safety manual must be prepared as per the policy and guidelines from WHO. These manuals should be periodically updated with new versions if any changes are made and approved by bio safety officer. Manual must be available and accessible for all the laboratory personnel and staffs , the laboratory scientist must ensure that laboratory personnel demonstrate proficiency in working and practicing bio safety practices before working with infectious agents.

Any kind of Incidents that may result in exposure to infectious materials must be immediately reported to lab supervisor and further evaluated for the risk factors and treated according to standard operating procedures described in the laboratory bio safety manual. It is important to perform all safety procedures to minimize the creation of splashes or aerosols.

It is also essential to understand before potentially infectious materials risk factors and health hazards and must be placed in a durable, leak proof container during collection, handling, processing, storage, or transport within a facility. All the staff must wash their hands after working infectious materials and before leaving the laboratory. It is strictly prohibited for mouth pipetting and always uses mechanical pipettes while working in bio safety cabinets, any kind of eating, drinking and storing food for human consumption must not be permitted in laboratory areas.

Safety Equipment (Personal Protective Equipment or Primary Barriers): It is essential to conduct any procedures involving the infectious materials within a BSC preferably Class II/ Class III) cabinets. Laboratory workers should always worn protective laboratory clothing with wraparound gowns. It is recommended to decontaminate Reusable clothing's with appropriate disinfectant before being laundered. Clothing is changed when contaminated with infectious materials or substances. To prevent any infection by splashes or sprays of infectious samples or aerosols it is mandatory to use eye and face protection (goggles, mask, face shield or other splatter guard) Eye and face protection must be disposed of with other contaminated laboratory waste or decontaminated before

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reuse. It is always must to wear eye protection for persons who wear contact lenses in laboratories. Always wear gloves to protect hands from exposure to infectious materials. The selection of the gloves is based on appropriate risk assessment for the working environment and always avoids wearing gloves outside the laboratory.

Additionally the laboratory staff working in BSL-3 laboratory should change gloves immediately when contaminated and it is recommended to wear two pairs of gloves when appropriate risk of infectious agents is known, it is mandatory to remove gloves and wash hands when work with infectious materials has been completed and before leaving the laboratory. Always dispose of used gloves with other contaminated laboratory waste and placed in specific color coding bags for appropriate disposal it is mandatory to practice hand washing protocols after the lab activities

Laboratory Facilities (Secondary Barriers): The secondary barriers includes laboratory facilities, it is important that laboratory doors must be self-closing and have locks in accordance with the institutional policies and recommendations. The laboratory must be separated from the crowded traffic flow within the building. Access to the laboratory is restricted to entry by self-closing doors is mandatory. In laboratory design a clothing change room (anteroom) should be included in the passageway between the two self-closing doors. Laboratory design of the must be done so that it can be cleaned and decontaminated easily. The BSL laboratories must have a sink for hand washing. The sink must automatically operate and it is recommended to locate near to the exit door. If the laboratory is segregated and compartmentalized in to different sections each sections must have a sink available for hand washing.

The use of carpets and rugs are not permitted. Seams, floors, walls, and ceiling surfaces should be sealed properly and floors should be slip resistant, impervious to liquids and also resistant to chemicals. The ceilings should be constructed, sealed, and finished in the same general manner as walls. The laboratory furniture should be capable of supporting anticipated loads. Spaces between benches, cabinets and equipment must be accessible for cleaning. The use of bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals. The chairs used in laboratory work should non porous that can be easily cleaned with appropriate disinfectant as per the standard operating procedures. All the windows in the laboratory must be sealed and the BSCs must be installed so that fluctuations of the room air supply and exhaust do not interfere with proper operations. BSCs should be always located away from doors, heavily traveled laboratory areas, and other possible airflow disruptions.

An eyewash station must be readily available in the laboratory for any spillage or emergency. An appropriate ducted air ventilation system is very much essential and it should provide sustained directional airflow by drawing air into the laboratory. The laboratory should be designed such that the airflow will not be reverse under failure conditions. Laboratory Staff personnel must be able to verify directional air flow and monitor the flow rate required for the proper functioning of the bio safety cabinet. It is necessary to have a visual monitoring device which confirms directional air flow must be provided at the laboratory entry. Audible alarms should be considered to notify personnel of air flow disruption immediately to take necessary actions.

The laboratory exhaust air must not re circulate to any other area of the building to prevent related risk hazards. The laboratory building exhaust air should be dispersed away from occupied areas by passing in burnt out unit @ 121°c and the air released to the environment should be sterile and free from contaminations. The HEPA filtered exhaust air from a Class II BSC can be safely re circulated into the laboratory working environment, if the cabinet is tested and certified at least annually and operated according to manufacturer's recommendations. The provisions to assure proper safety cabinet performance and air system operation must be verified by bio safety officer or supervisors. BSCs should be certified at least annually to assure appropriate and accurate performance. These HEPA filters must be tested or replaced at least annually at the time of validation of the instruments. The enhanced environmental and personal protection may be required by the agent summary statement, risk assessment as per the WHO guidelines. Advanced access control devices such as biometrics should be installed to avoid for unauthorized entry in the laboratory.

Risk assessment and routes of exposure in infectious research laboratories

Risk assessment is an important process used to identify the level of risk to the laboratory worker, other personnel working in the laboratory and the environment. The exposure and subsequent infection with an infectious agent to an individual can occur by several routes. The degree of risk takes into consideration for the virulence, pathogenicity, stability and communicability of the infectious organisms as well as the route of transmission. It is essential to avoid mouth and strictly prohibited the indirect oral exposures can be avoided through the use of the personal hygienic practice of regularly washing hands, not to eat or drinking in the work area and to avoid putting fingers, into the mouth. The wearing of N-95 mask or face shield will protect against the splashing of bio hazardous material into the mouth. A variety of organisms used in the laboratory carry the prime risk of infection by ingestion.

Some of the laboratory operations which release a substantial number of aerosol droplets while working with infectious organisms. The major source of such infections is by aerosolization of biohazards or infectious agents handling in the laboratory. The infectious agents who cause respiratory infections are those which withstand drying such as Mycobacterium tuberculosis. To protect from occupational exposure with sharps and needles it is essential to handles needles and syringes carefully, it has greatest risk of exposure because of the imminent hazard of self-inoculation and the procedure with sharps and needles should be always performed with the greatest care. The wearing of a face shield, safety glasses, or goggles will protect workers against splashing bio hazardous material into the eyes.

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Personal protective equipments

The Personal Protective Equipment (PPE) policy implements the requirements of OSHA regulations 29 CFR 1910.132 thru 29 CFR 1910.140. The policy applies to the use of PPE in all laboratories practices. It is responsibility of the supervisor to asses each work if hazards are present or likely to be present and requirement of the use of personal protective equipment. The supervisor should provide adequate training to each employee who is required to use PPE as per the standard operating procedures. It is recommended to wear the PPE as described by supervisor. It is always necessary to wear fresh lab coats along with lab designated slippers or shoes with a closed toe and heel (no sandals) in the lab at all times. It is always advisable that legs and arms are fully covered and a buttoned up lab coat with long sleeves with cuffs. A back closing gown should be preferable to a front-closing lab coat or it may be required for some work, such as that in a BSC or in cleaning up a spill. It is essential to wear safety glasses for all bench work involving infectious materials or fluids. Always wear face protection for bench procedures that are likely to generate droplets with infectious organisms.

It is recommended to wear gloves (e.g., latex, vinyl, co-polymer and nitrile) for all procedures that might involve direct skin contact with potentially infectious material. Always keep a stock of gloves available in varying sizes required by lab personnel. Always inspect gloves for tears and punctures before and after putting them on. It is not advisable to touch contaminated surfaces with bare hands when removing your gloves. Wash your hands immediately after removing gloves. The use of nitrile gloves are always preferable due to the lower frequency of allergic responses by people wearing nitrile compared to latex gloves.

Good laboratory practices and waste disposal and decontamination

Always follow good lab practices it includes technical proficiency of lab personnel, Hazard Awareness training of lab personnel should include knowledge and implementation of prohibited Activities, Personal Protective Equipment, biohazard warning signs, minimization of aerosols during work process, hand washing, pest control measures, Biohazard waste management. All bio hazardous or infectious materials should be sterilized before being washed and stored or discarded. The infectious solid waste generated in infectious laboratory should be segregated and placed in red colored bag for proper disposal. The liquid waste should be decontaminated with proper decontamination protocol as per SOPs. Autoclaving is the preferred method of sterilization of the infectious materials, every personnel working with bio hazardous material should be responsible for its sterilization before disposal. To minimize hazard to emergency response personnel, all bio hazardous materials should be placed in an appropriately marked refrigerator or incubator and sterilized and it should not be placed in autoclaves overnight in anticipation of autoclaving the next day or decontamination will be followed by other personnel in the laboratory. Special precautions should be taken to remove material from an autoclave for any hazards. All laboratory rooms containing bio hazardous materials should designate two separate areas or containers labeled biohazardous to be autoclaved or non-infectious to be cleaned, the containers should be labeled dated and should identify the owner of the infectious agent.

It is essential to maintain stock solutions of suitable disinfectants for disinfection purposes. The sterilization is important in the entire infectious laboratory to follow appropriate procedure it is always advisable to review the type of materials being handled and to establish standard conditions for sterilization. The general autoclave procedure should be followed as per SOPs involves 1210C for 15lb pressure for 15 mins it always recommended to choose the type of disinfectant for decontamination , In general in infectious laboratory 1% Hypochlorite solution and leave for 10 min is recommended for liquid disinfection.

Biohazard spill and cleanup procedures and Injury policy and accident reporting

The spill is very important route of risk factor for transmission, it is important to move carefully during spill clean up to avoid splashes and/or self-contamination. If a known exposure occurs to any clothing, treat that item as contaminated. It must be decontaminated before laundering or treating a spill with bleach. It is essential to report any spills accidents or exposures immediately to the bio safety in charge / supervisor. Always maintain a written record of such incidents and the results of incident investigations should be further used for continuing education. It is recommended to have an emergency preparedness for first Aid treatment. If a known or suspected exposure occurs then immediately wash the area completely immediately and seek medical assistance within two hours. If eyes are exposed wash the eyes thoroughly according to directions to thoroughly flush the area. Any small intact areas of skin are exposed initiate first aid by washing skin surfaces thoroughly and seek medical advice immediately.

Biosafety Training for Infectious disease laboratory

Before the initiation of work in infectious laboratory a new lab personnel must read bio safety manual and sign acknowledgment of having done so. As well, the concerned divisional heads /Supervisors are responsible for training their workers in all laboratory specific procedures as defined in the Standard Operating Procedures (SOP's). All new staff is required to undergo bio safety training. The staff must take refresher training every one year. Topics that may be covered in any Biosafety training session might include Access/ security controls, Use of safety equipment in laboratory, Risk factors, health hazards, safe work procedures with emergency procedures.

Conclusion

In the near future, advances in microbiology associated with biotechnology will increase the knowledge of infectious agents that carry novel genetic material, which has been

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modified or constructed through genetic engineering. Thus, new concerns in bio security and environmental health will emerge, it is very much essential to work with infectious agents as these may also turn to be reemerging viruses in future. The research will involve the manipulation of pathogenic microorganisms that could have harmful effects on public health and the environment. Research with highly pathogenic microorganisms, like H5N1 influenza, anthrax among others, could derive into a serious biological threat to a population or even terrorism [8,9]. Epidemics of pandemic proportions or improved previous research to develop bio weapons could be an uncontrollable risk for a population.

Although research in biotechnology is necessary, nowadays there is a dilemma about the freedom or limitation of these investigations. Thus, gain-of-function (GOF) research or dual use research (DUR) have arisen as an important concern, not only among the scientific community but also among the population [10].

To guarantee the bio safety of laboratory staff and the bio security measures of the facilities, the intrinsic and potentially harmful characteristics of all infectious agents and microorganisms needs to be identified and proper precautions to be followed working with deadlier infectious organisms to prevent risk of acquiring infections with occupational exposure and to protect the scientific community in modern science.

Summary

Key Points to be remember working in Infectious disease laboratory

- Entry restricted to personnel working in the Laboratory.
- Keep the laboratory neat, clean and free from extraneous material or equipments.
- Always wear lab coat while handling infectious material and remove the lab coat place in specific place before leaving the lab.
- Avoid eating, drinking and mouth pipetting in the lab
- Wash hands thoroughly before wearing and after removing gloves.
- Consider every sample as infectious.
- Use Bio safety cabinets for handling infectious material.
- Wear gloves before handling infectious material (Double gloves while handling live virus stocks)
- Check your hands for cuts, scratches and breaks in the skin. Cover open skin lesions with waterproof band-aid before wearing gloves.
- Avoid use of sharp instruments. If essential, use with utmost care. Needle sticks, cuts, wounds contaminated by infected material should be washed thoroughly with water. Encourage bleeding from wound.
- Keep all the required material and instruments ready before beginning the work.
- Use biohazard bag for discarding infected material.
- Use separate container for discarding non-infectious material such as papers, plastic bags etc.
- Ensure that the work place, multi channels and micropipettes are cleaned properly using 70% alcohol before and after the work
- Use a plastic beaker containing 10% sodium Hypochlorite filled to 1/4th of its capacity to discard liquid waste and pipettes in the bio-safety cabinet.
- Always carry infected material on a trolley.
- Make sure that all infected material is autoclaved before discard or incinerated.
- Report any spills, accidents or exposure to infected material to the lab supervisors. Follow the precautionary measures as described below.
- Cover the spills of infected materials with paper towel soaked in 1% Hypochlorite solution and leave for 10 min. clean up the area and discard towel in the biohazard bag. Wipe the area with disinfectant again.
- Avoid overcrowding, unnecessary talks and phone calls in the laboratory.
- Be alert about the proper routine maintenance of the equipments in the lab
- Clean incubator once in 15 days with 70% alcohol.
- Defrost refrigerator once in two months.
- Clean bio-safety cabinet with 70% alcohol every day before and after handling infectious material.
- Fumigate bio safety cabinet at least once a month.
- Always follow Standard Operating Procedures and Good laboratory practices

References

1. Sewell DL (1995) Laboratory-associated infections and biosafety. Clin Microbiol Rev 8: 389–405. Link: https://goo.gl/6dZfgM
2. Kozajda A, Szadkowska-Stanczyk I (2010) Protection of medical diagnostic laboratory workers against biohazards. Med Pr 62: 291–295. Link: https://goo.gl/5TcNH8
3. Liberman DF, Israeli E, Fink R (1990) Risk assessment of biological hazards in the biotechnology industry. Occup Med 6: 285–299. Link: https://goo.gl/wNZhN1
4. (2004) World Health Organization (WHO) Laboratory Biosafety Manual, 3th Edn Geneva: WHO. Link: https://goo.gl/ycWWjz
5. Doblhoff-Dier O, Collins CH (2001) Biosafety: future priorities for research in health care. J Biotechnol 85: 227–239. Link: https://goo.gl/Mq88Gd

Citation: Jadhav SK (2018) An Overview: Laboratory Safety and work Practices in Infectious Disease Research. J HIV Clin Sci Res 5(1): 001-006.
DOI: http://doi.org/10.17352/2455-3786.000126

6. Brown C (2004) Emerging zoonoses and pathogens of public health significance – an overview. Rev Sci Tech 23: 435–442. Link: https://goo.gl/XPGCPs

7. Jones KE, Patel NG, Levy MA, Storeygard A, Balk D, et al. (2008) Global trends in emerging infectious diseases. Nature 451: 990–993. Link: https://goo.gl/TDstwy

8. Resnik DB (2010) Can scientists regulate the publication of dual use research? Stud Ethics Law Technol 4. Link: https://goo.gl/8iWaBR

9. Lipkin WI (2012) Biocontainment in gain-of-function infectious disease research. MBio 3: e00290–e00312.10.1128/mBio.00290-12. Link: https://goo.gl/vfS7kA

10. Casadevall A, Imperiale MJ (2014) Risks and benefits of gain-of-function experiments with pathogens of pandemic potential, such as influenza virus: a call for a science-based discussion. MBio 5: e1730–e171410. Link: https://goo.gl/p2nugw

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