

Laboratory safety

Classification of Viral Pathogens into Hazard Groups

The ACDP (Advisory Committee on Dangerous Pathogens) classified microorganisms into four hazard groups based on their pathogenicity to humans, risk to laboratory workers, transmissibility to the community, and availability of effective prophylaxis.

Group 1. - An organism that is most unlikely to cause human disease

Group 2. - An organism that may cause human disease and which may be a hazard to laboratory workers but is unlikely to spread to the community. Laboratory exposure rarely produces infection and effective prophylaxis or treatment is usually available. Examples include herpesviruses, ortho and paramyxoviruses, picornaviruses, adenoviruses, unconventional slow viruses.

Group 3 - An organism that may cause severe human disease and presents a serious hazard to laboratory workers. It may present a risk of spread to the community but there is usually effective prophylaxis or treatment available. Examples include HIV, HBV, Hantaviruses, Japanese B encephalitis, Rift Valley fever, Yellow Fever, rabies.

Group 4 - An organism that causes severe human disease and is a serious hazard to laboratory workers. It may present a high risk of spread to the community and there is usually not treated. Examples include Lassa fever, filoviruses, smallpox, Crimean-Congo haemorrhagic fever, Russian spring-summer encephalitis, Kyasanur forest.

The Safe Working Environment

Basic Levels 1 and 2 laboratories

Although laboratories with Containment Levels 1 and 2 are considered adequate for microorganisms that pose minimal risk to workers. Workers should be given a 3 m run of benching and a 24 m free air space (ACDP). People who do not work in laboratories should be restricted from entering

them. The general public should only go as far as the reception areas or waiting rooms.

Floors should be slip resistant, seamless, impermeable to liquids, and resistant to most substances in the interest of safety. Wall and partition surfaces should be smooth, impervious, and easily cleaned. Windows should be able to be sealed and have blinds installed. Doors should be fireproof and equipped with vision panels.

It is important that adequate lighting is provided. It is not usually necessary to fit microbiological safety cabinets into Levels 1 and 2 laboratories.

Level 3 laboratories

The goal of level 3 laboratories is to confine or contain organisms in order to expose only a small number of people to them. As a result, designating an entire microbiology department as a level 3 laboratory is illogical. **A true** level 3 laboratory can only house one or two people. Separate Level 3 laboratories should be provided if the amount of work warrants it. The level of containment. Level 3 laboratories should have strictly limited and controlled access, and the doors should be locked when not in use. Microbiological safety cabinets are essential features of these laboratories. Care is needed in siting those in relation to airflows and staff movements. An incubator room could open directly from a Level 3 laboratory and there should be enough storage space e.g. refrigerators and deep-freezers so that Hazard Group 3 organisms need not be kept elsewhere

Level 4 laboratories

Work with Hazard Group 4 agents is usually severely restricted by government decree in most countries. As a result, extensive consultation and supervision are required in the design and construction of these laboratories. The laboratory should be physically separated from other

parts of the same building, making access difficult. It should be airtight, with airlocks providing access. The ventilation system should be completely controlled so that air enters the laboratory through air locks. Class III safety cabinets should be kept at a lower pressure than the surrounding environment. Before being discharged into the atmosphere, all effluent air is filtered through two banks of HEPA filters. A dual-ended autoclave is required to ensure that nothing leaves the room unsterilized.

Laboratory Procedures for suspected Hazard Group 4 Pathogens -

Specimens for Hazard Group 4 virus serology or isolation must be sent, by arrangement to the Virus Reference Laboratory, where work will be carried out at Containment Level 4. Specimens for the diagnosis of other viral infections may be sent to other laboratories that comply with the requirements for Containment Level 4, but only with their consent. Material for transport to a Containment Level 4 laboratory must be packed according to instruction given by the receiving laboratory.



Class I



Class II



Class III

Collection, Transport and Receipt of Infectious Materials

Collection of Specimens

Blood: Blood is traditionally collected using hypodermic syringes and needles and then expelled into plastic containers. Many of these containers have problems with their stoppers, resulting in external contamination. Vacuum collection tubes eliminate several hazards and problems associated with drawing blood and safely disposing of syringes and needles. These containers are tough, leakproof, and cannot be contaminated from the outside.

Faeces: Other than blood, feces are likely the most dangerous material. Patients should be instructed to defecate on a pile of toilet paper in the lavatory pan, remove a pea-sized portion with the provided spoon, carefully insert it into the container, and then tighten the cap.

Other Specimens: Because tuberculosis is becoming less common in developed countries, sputum specimens are probably less dangerous to handle. Apart from a few viruses, the organisms found in sputum are rarely infectious. Nonetheless, contamination of the container's exterior remains a problem. Urine poses few risks.

External contamination is an issue, so urine from females should be collected in sterile large jars before being transferred to a laboratory container. Other specimens, such as pus and aspirated fluids, are collected by professional staff, reducing the risk of external contamination.

Labelling specimens and containers

For obvious reasons, labels and stickers should be self-adhesive. The labels "Danger of Infection" and "High Risk" are highly debated. These are frequently used for specimens containing a special risk, such as HBV or HIV. The problem is that these labels may give staff a false sense of security if any specimens are identified as potentially infectious with

dangerous pathogens. Specimens labeled "Danger of Infection" should be sealed in plastic bags.

Transport of specimens

Transport within hospitals: Staff carrying the specimens should wear overalls and encouraged to hand wash frequently. The taking of specimens into canteens and kitchens should be forbidden.

Transport between hospitals - the HSAC (1991) requires that "special" secure transport boxes with secure lids. These must be capable of withstanding autoclaving and prolonged exposure to disinfectants. These boxes should be inspected daily for leakages and decontaminated and washed out at least weekly.

Receipt of infectious material

The risks posed by packages sent to a specialist or reference laboratory clearly differ from those posed by packages sent to a routine diagnostic laboratory. The former are likely to contain infectious agent cultures or concentrates, whereas the majority of the latter is not infectious. It is recommended that cultures and other specialized materials be unpacked in the laboratory by trained personnel. There is some concern about using clerical staff to receive and document specimens. It is not uncommon to see clerical staff eating and drinking near the specimens. Clerical and reception staff are undoubtedly among the untrained workers who become infected in the laboratory. As a result, it is critical that clerical staff who handle specimens receive some sort of training in specimen handling safety. Any specimen placed in a plastic bag with a Danger of Infection label should not be removed. The accession number should be written on the outside of the bag. Leaking or broken specimens, as well as others in the same box or tray, should not be handled. A member of the professional staff should be assigned to deal with them. These specimens should not be allowed to wander around the room.