Laboratory safety

Classification of Viral Pathogens into Hazard Groups

Micro-organisms have been classified into 4 hazard groups by the ACDP (Advisory Committee on Dangerous Pathogens) on the basis of pathogenicity to humans, risk to laboratory workers, transmissibility to the community, and whether effective prophylaxis is available.

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 herpesvirses, 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.

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, CPHL, 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. When there is a likelihood of many hours delay before a patient is transferred to a unit designated for the management of VHF cases, specimens for non-virological tests which are essential for the management of the patient may be carried out in Containment Level 3 laboratory in a Class III microbiological safety cabinet. Potentially infectious material to be removed from a Class III safety

cabinet for incubation or storage must first be placed in hermetically sealable containers which are disinfected with 2% glutaraldehyde or Hypochlorite before removal. Such hermetically sealed containers must not be reopened unless they have been transferred back into a Class III microbiological safety cabinet. Sealed units must be used for centrifugation, and they must be opened only in a Class III safety cabinet. All waste materials and discarded clothing must be rendered safe to handle before they are removed from the laboratory and autoclaved before disposal or recycling. Water used for hand washing must be rendered safe by either chemical or hear disinfection. A high security isolation unit for the management of VHF would have appropriate Containment Level 4 laboratory facilities on-site.

The Safe Working Environment

Basic Levels 1 and 2 laboratories

Although Containment Levels 1 and 2 laboratories are considered to be adequate with microorganisms which offer minimal risk to the worker. worker be given 3 m run of benching and 24 m of free air space (ACDP). Access to laboratory areas by people who do not work in them should be strictly limited. Members of the general public should get no further than the reception areas or waiting rooms.

In the interest of safety, floors should be slip resistant, seamless, be impermeable to liquids and resistant to most. The surfaces of walls and partitions should be smooth, impervious and easily cleaned. Windows should be sealable and fitted with blinds. Doors should be fire resistant and fitted 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 object of level 3 laboratories is to confine, or contain the organisms so that only a minimum number of people are exposed to them. Hence the policy of designating a whole microbiology department as a level 3 laboratory is fatuous. A true level 3 laboratory is suitable for one or two persons only. If the amount of work merits more staff, than separate Level 3 laboratories should be provided. Containment Level. Access to Level 3 laboratories should be strictly limited and controlled and the doors should be locked when the rooms are 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 in most countries by government decree. Therefore a great deal of consultation and supervision is necessary in the planning and building of these laboratories. The laboratory should be isolated or physically separated from other parts of the same building so that access is difficult. It should be airtight and access is through airlocks. The ventilation system should be completely controlled so that air flows via air locks into the laboratory. Class III safety cabinets should be maintained at a lower pressure than the room. All effluent air is passed through double banks of HEPA filters before discharge to the atmosphere. A double-ended autoclave is essential to ensure that nothing passes outside the room without being sterilized.

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Class III Microbiological Safety Cabinet

Collection, Transport and Receipt of Infectious Materials

Collection of Specimens

Containers –

Blood - traditionally blood is collected with hypodermic syringes and needles and then expelled into plastic containers. There are problems with the stoppers of a lot of these containers which result in external contamination. Vacuum collection tubes minimize several of the hazards and problems of taking blood and disposing safely of syringes and needles. These containers are robust, leakproof, and cannot be contaminated externally.

Faeces - faeces are probably the most hazardous material other than blood. Patients should be told to defaecate on a pile of toilet paper in the lavatory pan and to remove a pea-sized portion with the spoon provided, to insert it carefully into the container and then to screw the cap on tightly.

Other Specimens - sputum specimens are probably less hazardous to handle because of the decreasing incidence of tuberculosis in developed countries. Apart from some viruses, the organisms present in sputum are rarely infectious. Nevertheless, the contamination of the outside of the container remains a problem. The risks from urine are minimal .

External contamination is a problem and there is a strong case for collecting urine from females in sterile large jars before transferring to a laboratory container. Other specimens such as pus and aspirated fluids are collected by professional staff which minimizes the risk of external contamination.

Labelling specimens and containers

Labels and stickers used should be self-adhesive for obvious reasons. There is much controversy about "Danger of Infection" and "High Risk" labels. These are often used for specimens where there is a special risk such as HBV or HIV. The problem is that these labels may give a false sense of security to the staff who should any specimens as potentially infectious with dangerous pathogens. Specimens labelled "Danger of Infection" should be placed in self-sealing plastic bags

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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

There is clearly a difference between the hazards posed by packages sent to a specialist or reference laboratory and those to a routine diagnostic laboratory. The former are likely to contain cultures or concentrates of infectious agents whereas the bulk of the latter is not particularly infectious. It is advisable that cultures and such specialized materials are unpacked in the laboratory by professional staff. There is concern over the use of clerical staff for receiving and documenting specimens. It is not unusual to see food and drink being consumed by clerical staff near the specimens. The disturbing large number of untrained staff who acquire infection in the laboratory undoubtedly include clerical and reception staff. Therefore it is essential that clerical staff handling specimens should be given some form of training in the safe handling of specimens. Any specimen in a plastic bag which carries a Danger of Infection label should not be removed from that bag. The accession number can be put on the outside of that bag. Leaking or broken specimens should not be touched, nor should any others in the same box or tray. Provision should be made for a member of the professional staff to deal with them. These specimens should not be allowed to stray to other parts of the room.