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Current Concepts of Medical Microbiology Laboratory

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Abstract

A ‘good’ laboratory is a fundamental need in providing a ‘good’ diagnostic service to the population. Proper designing of the laboratory with technical guidance is one of the basic requirements of a ‘good’ or standard laboratory. Lack of awareness and knowledge about laboratory designing creates many problems in building new facilities or refurbishing the buildings converting them into laboratories. Non availability of a national guideline is partly responsible for this. The critical role of the microbiology laboratory in infectious disease diagnosis calls for a close, positive working relationship between the physician and the microbiologists who provide enormous value to the health care team. Good design and good

equipment can be valuable in containing and controlling infectious materials, indifferent or inconsistent arrangements can complicate or limit efforts to minimize the risk of accidents and infections.\

Keywords **:** Microbiology Laboratory, Design, Safety Measures, Waste handling

Introduction

The magnitude of the annual national investment in new biomedical laboratory facilities, coupled with the problems arising out of unsafe designs in these facilities, justifies increased attention to engineering design criteria to maximize microbiological safety [1]. The facilities provided in microbiological laboratories have an important relationship to the safe-being of personnel working therein and, in some circumstances, to the validity of the experiments. Good design and good equipment can be valuable in containing and controlling infectious materials, indifferent or inconsistent arrangements can complicate or limit efforts to minimize the risk of accidents and infections [2]. Incorporation of microbiological safety measures in the design of biomedical laboratory facilities is needed for one or more of the following reasons: (i) to prevent the uncontrolled escape of infectious materials from the building to safe-guard the health of the surrounding community, (ii) to assist in the prevention of accidentally acquired infections among building personnel, (iii) to prevent the unintentional spread of disease and (iv) to prevent false laboratory results due to cross-contamination of microbiological cultures [3].

General Requirements for Laboratory

Unlike other areas of the diagnostic laboratory, clinical microbiology is a science of interpretive judgment that is becoming more complex, not less. The general requirements for the laboratory as under **:**

- **Walls/Doors/Windows**

The laboratory must be completely separated from outside areas (i.e. must be bound by four walls). Each door into a laboratory room must have a view panel. On the next to each door entry into the laboratory an 8.5 x 11 inch space must be provided for a standardized clear frame with

the room number and hazard warning sheet insert. Inside the laboratory, on the wall adjacent to the door latch, provide 2 feet of clear space for light switches, telephone, thermostat and fire extinguisher. If the laboratory has windows that open they must be fitted with insect screens [4].

- **Flooring**

The floor must be a one piece non-pervious and with covings to the wall. This can be achieved by use of glue, heat welded vinyl flooring, epoxy coated concrete slab, etc. Floors should be coved up walls and cabinets to ensure spills cannot penetrate underneath floors/cabinets. Tiles and wooden planks are not appropriate because liquids can seep through the small gaps between them. Floors in storage areas for corrosive liquids shall be of liquid tight construction[4].

- **Sinks**

Each laboratory must contain a sink for hand washing. Elbow or electronic sensing faucet controls are recommended particularly for biological agents and/or highly toxic chemicals. Sink faucets and hose bibs that are intended for use with attached hoses must be equipped with back siphon prevention devices. Laboratory sinks shall have lips that protect sink drains from spills. Sink lips or berms should be >= 0.25 inches and designed to completely separate the lab bench or fume hood work area from the sink drain [4].

- **Chemical Storage**

Chemical storage shelves shall not be placed above laboratory sinks. Chemical storage shelves shall be flush to a back wall and shall have a ½ inch lip along the front edge. Sufficient space or facilities (e.g., storage cabinets with partitions) shall be provided so that incompatible chemicals can be physically separated. Materials, which in combination with other substances may cause a fire or explosion, or may liberate a flammable or poisonous gas, must be kept separate. Recommend that solvent storage not be located under the

laboratory fume hood, as this is a location where fires are most likely to occur in laboratories[4].

- **Furniture Design**

All furniture must be sturdy. All work surfaces (e.g., bench tops and counters) must be impervious to the chemicals used. For example, many microbiological manipulations involve concurrent use of chemical solvents such as formaldehyde, phenol, and ethanol as well as corrosives. The lab bench must be resistant to the chemical actions of these substances and disinfectants. Wooden bench tops are not appropriate because an unfinished wood surface can absorb liquids. Also, wood burns rapidly in the event of a fire. Fiberglass is inappropriate since it can degrade when strong disinfectants are applied. Fiberglass also releases toxic smoke when burned [4].

- **Cleanability**

The laboratory must be designed so that it can be easily cleaned. Walls should be painted with washable, hard non-porous paints. Spaces between benches, cabinets, and equipment must be accessible for cleaning. Laboratory furniture must have smooth, non-porous surfaces so as to resist the absorption of liquids and the harsh effects of disinfectants. Furniture must not be positioned in such a manner that makes it difficult to clean spilled liquids or conduct routine maintenance [4].

Microbiology Laboratory design layout

1. **Specimen reception area**

The specimen reception area should be near the laboratory entrance, easily accessible to the patients and away from the public traffic and from the staff entrance. Ample bench top space to keep the samples and counter to receive samples – height- preferably 3ft. There should be Separate benches/tables for specimens and documentation.

2. Report issuing counter

The report issuing counter should be adjacent to the reception area and easily accessible to the patients.

2. General laboratory bench space

The laboratory work areas should be linear / U shape modules (usually 10 ft x 10 ft) and work bench – width 24 inches, height 30 inches. This area should have large doors to accommodate equipment.

- Bench top should be covered with non-absorbable easily cleanable washable, stain and acid resistant material with continuous surface. Avoid tiling.
- Sinks should be near the door . Sinks for staining purposes can be incorporated depending on the requirement.
- Power supply for the necessary equipment should be placed at the correct position.

4. Special laboratory bench space

Special laboratory bench space need to be determined and designed depending on the service needs. eg: Anaerobic bacteriology, Mycology, Serology etc.

5. Media preparation room

There should be a separate room with enough space to accommodate equipment is necessary. Work benches and sinks need to be adequate. Power supply for the necessary equipment should be placed at the correct positions. eg - for autoclaves.

6. Washing room

There should be a separate washing room with enough space and liberal water supply. Water supply – ideally the washing room should have hot water supply. Bench tops should have enough space to accommodate equipment. Laboratory sinks need careful designing. They should be large deep acid resistant sinks. Storage facilities for washed materials until they are

transferred to the work areas should be included in designing. A closed drainage system should be in place and should have large, wide–bore non corrosive piping without U bends. There should be an exhaust fan in place.

7. Safety and security

Special attention need to be paid on the following:

- Limited access
- Use of a Bio Safety Cabinet (BSC)
- Adequate space and ventilation with fresh air

8. Waste handling

There should be adequate designated space for waste handling in the laboratory. A storage facility for bio-hazardous waste (after rendering it non-infectious), infectious waste and general waste need to be provided near the laboratory and outside it till the waste is disposed [5,6,7].

Rules and Safety Measures in Microbiological Laboratory

It is very important to follows rules of microbiological laboratory in safety point of view. If these important rules are not followed a student,teacher, or a laboratory worker can face Bioharzards, Chemical hazards as well as Physical hazards. Safety rules are as follows :

- Whenever a person enters a laboratory he/she should remove the footware out of the laboratory.
- Dyes and chemicals are used in the laboratory due to which our skin can get harmed as well as it can damage our clothes so laboratory gown or apron should be used compulsory.
- Instruction given by the instruction should be noted and followed carefully.
- Eating and drinking is not allowed in laboratory.
- Do not put anything in your mouth like pen, pencils,and fingers etc
- Hair should be packed with hair cap to avoid falling of hair on face,working place as well

as burning Bunsen burner.

- Laboratory doors and windows should be kept closed during experiments are going on.
- Extra material like bags,clothes,purses and books should be kept at proper places like drawers or shelf's.
- The working area should be kept free from all these extra material.
- Before starting your work on your work bench the bench top should be disinfected by ethanol, phenol, Lysol or cetylpyridinium chloride before and after each laboratory work.
- Hands should be washed properly before and after each task.
- These above precaution may lessen chances of infection or contamination due to cultures.
- Smoking is completely prohibited in microbial laboratory.
- Microbial cultures should be handled properly and should not be taken out of laboratory.
- Mouth pipetting should be avoided and mechanical pipetting devices should be used.
- All laboratory work should be carried out carefully to avoid aerosol formation.
- Talking , laughing should be avoided because it can result into contamination.
- All contaminated material should placed into a proper container.
- Culture plates, tubes should be discarded in basket.
- All microbial cultures should be either incubated or refrigerated,Cultures should not be kept in drawers,cupboard or desk.
- Pipettes,glass rods should be properly disinfected or sterilized after each use.
- Before and after each use nichrome wireloop should be sterilized and then used or kept.
- All laboratory instruments should be operated as per standard operating procedure.
- Bunsen burner are very dangerous so the should be handled with care and should be turned of when not in use.
- All electrical appliances such as oven, autoclave,centrifuge and other such devices should be immediately turned off after each use.
- All accidents, injuries or broken glassware should be reported immediately.
- Alcohol should be kept away from flame.
- Waste paper, threads, broken glassware or used pH strips should be discarded safely.

- The experiments that are permitted should only carried out.
- Keep the laboratory clean.
- Follow all the instruction above and you will be safe and get good results.

Conclusion

Changing the physical plant of today's laboratories is necessitated by advancements in laboratory technologies. To survive in a competitive market place, labs must flexibly adapt to the inclusion of the new equipment and robotics, promote maximum production and efficiency, and provide the atmosphere and convenience demanded by an outpatient oriented marketplace. By following a systematic approach to planning, the design of the new lab can satisfy today's needs and be prepared for tomorrow.

References

[1] Dolowy, WC (1961) Medical research laboratory of the University of Illinois. Proc. Animal Care Panel. 11,267-280.

[2] Snow, DL (1902) Principles of space planning for biomedical research laboratories, National Institutes of health. Division of Research Services, Bethesda. Md.

[3] Kirchheimer, WF, Jemski, JV and Phillips, GB (1961) Cross-infection among experimental animals by organisms infectious for man. Proc. Animal Care Panel. 11, 83-92.

[4] Department of Facilities Services Laboratory Design Guidelines.UNC Laboratory design guidelines (2013). 1-38.

[5] The management , design and operation of microbiological containment pathogens , laboratories :Advisory committee on Dangerous pathogens ,HSE books (2001) ISBN 0 7176 2034 4.

[6] Health services advisory committee ,Safety in Health service laboratories, Safe working & the prevention of infection in clinical laboratories HSE (1991).

[7] Michael,LW and Barth, R (2003)Laboratory Design. In Manual of Clinical Microbiology 8th ed., (eds Patrick R.M, Ellen J.B., James H.J. et al) 22 – 30, ASM Press, Washington.

Authors Column

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