CHAPTER 3

Laboratory Planning

A pathologist having the opportunity to design a new laboratory or make major renovation in older laboratory, should think in functional terms about the laboratory operations and their facility needs.

Traditionally laboratories have been organised without due regard to the functional requirement. The whole concept of a laboratory has changed during the last decade. Unfortunately there has been a lot of proliferation of laboratories which are sub-standard and with no knowledge of quality control. The only way to curb such practices is to start good laboratories and provide facilities at reasonable costs, by qualified pathologists. Today, a planned laboratory can be started with a budget of rupees one lakh.

The accommodation initially, should be reasonably good to start the common tests that are in demand and should be properly planned so that it will be functional and convenient.

A few samples of plan are given below which are scientifically developed. Depending upon the area available, these plans may be applied suitably (Figs 3.1–3.3).

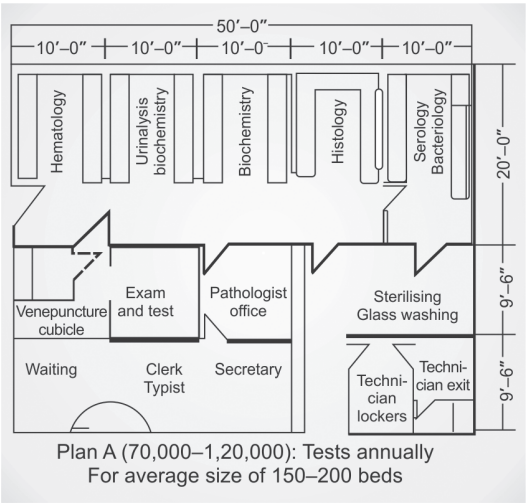

Fig. 3.1: Plan A: 150–200 beds

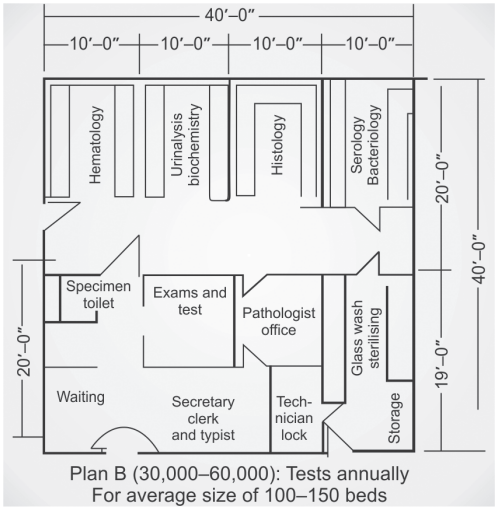

Fig. 3.2: Plan B: 100–150 beds

CHAPTER 6

Disposable Specimen Containers

These are generally made of plastic (polystyrene or polypropylene), but some may be made of aluminium, glass or waxed cardboard. Waxed cardboard cartons must not be sent through the post.

Plastic containers of similar size and dimensions to the universal container are supplied, already sterilized, by a number of manufacturers. Particular types may have, e.g. a plastic spoon attached to the inside of the cap, for collection of faeces, added anticoagulant, for collection of serous fluid, or added boric acid, for bacteriostasis of urine specimens. Shallow, wide-mouthed 2 oz (60 ml) plastic containers with screw-caps are particularly convenient for the collection of sputum.

It should be noted that not all of these containers have been authorized for sending by post, as some, particularly those with push-on caps instead of screw-caps, have been known to leak during transmission. A separate standard covering specimen containers for microbiology is being prepared. Attention is drawn to the work of cash on a special type of double plastic envelope suitable for the transport of 'high risk' specimens such as blood for examination for hepatitis virus B.

All used disposable containers should be sterilized before discard, or be incinerated by responsible staff.

Swabs

Swabs suitable for taking specimens of exudate from the throat, nostril, ear, skin, wounds and other accessible lesions may be made in the laboratory. A 6 in. length of aluminium or tinned iron wire, 15 gauge, may be used as the handle, or 'swab-stick'. One end is made rough for about ½ in. by squeezing it in a small metal vice or the cutting edge of pliers. Around this end a thin pledget of absorbent cotton-wool is tightly wrapped for about ¾ in. The wire is placed in a narrow thick-walled test-tube, 5 in. × ½ in., and the top of the tube is plugged with cotton wool. Alternatively, and where swabs have to be sent by post, the wire should be 4½ in. long and the top inserted into a bark cork which stoppers the tube. The tube with swab should be sterilized in the autoclave and not in the hot-air oven, as in the latter the wool may char and give rise to tar-like products which may be inimical to bacteria on the swab. It is important to autoclave cork-stoppered tubes with the cork loose and to press in the cork after sterilization. Tubes plugged with cotton wool should be dried after autoclaving.

Instead of wire, swabs may be prepared from thin wooden sticks 6½ in. long that are specially made for the purpose, and are known as 'Peerless' wooden applicators. A cotton wool

pledget is wrapped round one end as above, and the tube is plugged with cotton wool. They cannot be used conveniently with a bark cork, but have the advantage that the stick can be broken off short when the swab has to be placed in transport medium in a screw-capped container.

Disposable Swabs

A variety of tapes of swab, e.g. plain, serum coated, charcoal coated, are available. These come in cardboard or clear plastic tubes, or plastic envelopes already sterilized. The swab in its tube or envelope is destroyed in a furnace after use.

The swabs may also be purchased loose and unsterile, for assembly and sterilization in tubes. This type of swab is also useful in the laboratory for other purposes, e.g. seeding of media for disk sensitivity tests.

Swabs for Special Purposes

Swabs differing from those described above are required to take specimens from less accessible areas:

1. **'Baby' swabs:** When taking specimens from babies and young children, it is often necessary to employ a very fine swab so that small orifices, such as the aural meatus, may be negotiated without gross contamination from the external surfaces. These are made in the same way as the swabs described above but with fine rigid wire. To avoid damage to the tissues, the end of the wire should be fused in a Bunsen flame before fireing a tiny pledget of cotton wool to it.
2. **Pernasal swabs:** These are used for the diagnosis of whooping-cough. The swab is passed along the floor of the nasal cavity to reach and sample the secretions in the nasopharynx. A small swab and a flexible swab-stick are required to minimize the risk of damage to the nasal tissues. The swab-stick may be made from 7 in. of flexible copper wire or nichrome SWG 25 (0.51 mm diameter), the terminal ¼ in. being bent back to take the pledget of cotton wool, a very thin layer of which is wound firmly round it. Readymade pernasal swabs with a finger loop may be purchased. The swab is contained in a 6 × ½ in. test-tube plugged with cotton wool.

   Disposable pernasal swabs in plastic tubes, which may or may not contain a transport medium, are commercially available.
3. **Post-nasal swabs:** These are used to sample nasopharyngeal secretion for the diagnosis of meningococcal carriage. The terminal ¾ in. of a long stiff metal swab-stick is bent through an angle of 45 degrees, so that when introduced through the mouth, it carries the swab up behind the soft palate into the nasopharynx. The swab is contained in a stoppered test-tube of sufficient width to admit the bent end.
4. **Laryngeal swabs:** These swabs are used to obtain a sample of bronchial secretion for the diagnosis of tuberculosis in patients who cannot expectorate sputum. Their construction resembles that of post-nasal swabs, but the bent, swab-bearing end should be longer, about 2 in., and be more sharply bent, through an angle of 60 degrees to its original direction. A very wide, stoppered tube is required to contain it. The swab is moistened with sterile water just before use, passed over the dorsum of the tongue and introduced into the larynx, where it stimulates coughing and collects the expelled secretion.
5. **High vaginal and cervical swabs:** For the diagnosis of gonorrhoea and puerperal fever, a swab should be taken from the uterine cervix and its lumen, rather than from the general area of the upper vagina. A swab on a specially long, rigid swab-stick, preferably about 9 in. long, is required.

such data must be controlled. The laboratory result must be fully reliable and to attain this every effort must be made for constant checking and search for error.

The International Federation of Clinical Chemistry's Expert Panel defines quality control as "The study of those errors which are the responsibility of the laboratory and the procedures used to recognise and minimise them. This study includes all errors arising within the laboratory between the receipt of the specimen and the despatch of the report; on some occasions, the responsibility of the laboratory may extend to the collection of the specimen from the patient, and the provision of a suitable container."

A high degree of quality control is achieved through cleanliness of glasswares, carefully designed requisition slips and report forms, identification and labelling of samples and recording the data and of course, high degree of precision and accuracy.

A careful and continuous check is necessary at:

1. Cleanliness of glasswares
2. Quality of glasswares—a grade pipettes
3. Instrument—maintenance
4. Chemicals—use of AR or GR grade
5. Method of determination
6. Clinical and other errors
7. Quality of work—precision and accuracy.

The quality of work done in a laboratory is assessed or evaluated by having a close look at the precision and accuracy, when a single sample is estimated several times and when these values are close together, it refers to good precision. Secondly, when these values are close together to the standard value of the same sample, it refers to good accuracy.

BRANCHES OF LAB MEDICINE COVERED BY QC

Some branches are more suited to QC because of mainly objective interpretation and numerical expression of results like chemical pathology. Others like histopathology with predominently subjective interpretation and non-numerical result expression are rather difficult to handle. In between the two extremes are branches in which some of the tests are quantitative and others not like in haematology, microbiology, serology and some of diagnostic immunology. QC of blood banking is an entirely different approach since no 'tests' are done for the purpose of reports, a consumable product is issued instead.

Quality Control Material

Usually pooled normal serum forms the material for quality control. Pooled lyophilised serum can be got from standard companies. It can also be prepared in the laboratory as follows:

1. Pool the left over serum after the analysis is complete. Collect 1–2 litres. Exclude hymolysed jaundice and lipemic (turbid) serum.
2. Filter the pooled serum through glass-wool taken in a funnel.
3. Mix the serum thoroughly.
4. Adjust the pH to 7.4. This is done by adding concentrated sulfuric acid carefully with continuous, vigorous mixing and checking the pH with a pH meter.
5. Distribute 10 ml portions of this into several plastic vials preferably, otherwise glass vials. Store in deep freezer. This lasts for three months.
6. Each day take out one vial for use.

Method

l. Remove one control serum vial from the deep freezer. Thaw it and allow to come to room temperature.
2. Perform the test treating it the same way as sample serum.
3. Determine the value.
4. Plot the value on the quality control chart.