

2.6 TRAINING OF TECHNICIANS FOR MEDICAL EQUIPMENT MAINTENANCE

2.6.1 A practical strategy in training maintenance technicians

The maintenance of medical equipment requires a wide range of technical abilities, and the costs and time required to train a technician increase markedly with the level of skill that has to be attained (see Paragraph 2.6.3). Experience in many developing countries has revealed that training technicians to a high level of skills is very expensive. Furthermore, upon completion of their training, staff are often lured away by companies paying higher salaries.

Therefore, the approach recommended in Paragraph 2.4.2 calls for the training of technicians to do front-line maintenance for medical equipment in district health facilities. This strategy requires less time, costs less, and delivers benefits to a larger population by supporting primary health care. Because of less stringent prerequisites for selection, a large number of candidates can be recruited for training, enabling a relatively rapid multiplication of technical human resources to serve the large volume of essential medical equipment in widely distributed district health facilities in the country.

The selection of candidates should emphasize technical aptitude and motivation rather than academic qualifications. Practising electricians and plumbers already working in the health facilities are good candidates. If possible, candidates should pay at least a portion of their training fees to show motivation. To utilize the scarce technical human resources in the districts optimally, multi-skills training should be encouraged. For example, frontline medical equipment maintenance can be combined with electrician training.

The content of training should emphasize more on practice (70%) and less on theory (30%). A simple course, which can be offered at local technical colleges, should be worked out. A sample curriculum for such a course is given below. Teachers should periodically visit practising maintenance workers at their jobs, so that teachers are updated with current maintenance problems.

A PRACTICAL STRATEGY

- Set priorities on essential equipment.
- Initially, train a large number of technicians to do front-line maintenance.
- Emphasize practical training in local hospitals and workshops.
- Use experienced technicians as local trainers. Use the apprentice approach.
- As part of the training programme, take students to district health facilities to do preventive maintenance under supervision
- Encourage multi-skills training.

Concentrate on equipment that is currently used in the district (see Paragraph 2.6.2 for possible sources of equipment for training). Take one type of equipment at a time. Each theoretical teaching session should be followed by practical training in the workshops or health facilities. It may be possible to carry out apprentice training on the job so that the trainees can provide actual services to health facilities. For example, trainees can help experienced technicians in repair jobs and learn at the same time; trainees can also do preventive maintenance under supervision. Encourage multi-skill training and services including electrical power distribution, plumbing, refrigeration and air conditioning in addition to medical equipment.

Users of equipment should be trained to do routine simple maintenance on equipment. This will increase user care of equipment and cooperation with maintenance technicians. An in-service can be worked out with collaboration among experienced equipment users, maintenance technicians and the trainers.

SAMPLE CURRICULUM COURSE FOR GENERAL TECHNICIANS

Medical Equipment Management: including all aspects of an equipment life cycle. Use material in this guide. Emphasize equipment inventory lists and equipment service history record keeping. The basic concepts of quality management can also be included: goal setting, incremental steps but persistent and continuing improvements.

English: includes oral and reading skills, grammar, vocabulary, technical English, letter and report writing

Mathematics: includes computation, logarithms, trigonometry, basic algebraic equations, graphical representation.

Technical drawing: includes use of technical drawing instruments, elementary construction, pictorial projection, sections, electrical drawing, visualization.

Workshop: includes electrical installations, theory and practice of domestic and industrial wiring, selection of cables, lighting circuits, earthing systems, types of lamps, principles and practice of arc welding, gas welding, sheet-metal welding, plumbing, bench fitting, use of files, hacksaws, chisels, drills and drilling, threads, piping systems, workshop maintenance.

Electronics and electrotechnics: includes electrical instruments, DC and AC circuitry, electrical components, transformers, AC and DC motors, semi-conductors, power supplies, amplifiers, applications of thyristors, DIACs and TRIACs

Mechanical services (hospital plant): includes heating and hot-water services, refrigeration, ventilation and air-conditioning, lubricants, stand-by generators, test vehicle repair and servicing.

Medical equipment: includes principles, operation and simple repairs and maintenance of: blood pressure meters, stethoscopes, water baths, microscopes, autoclaves, sterilizers, trolleys, basic mechanical equipment, suction machines, centrifuges, theatre lights and lamps

Hospital field work: work in hospital workshops under supervision, involving simple repair and maintenance.

2.6.2 Some opportunities for further training

- During the purchase of new equipment, suppliers can be requested to train in-house technicians in maintenance, often at no cost. This condition should be included in the call for tender or purchase order. Because equipment suppliers are obliged to provide comprehensive warranty and maintenance services, it may be quite expensive for them to establish a local service staff. They may be quite willing to train in-house technicians.
- Major health development projects frequently include large volumes of equipment procurement. This provides excellent opportunities for maintenance training and for obtaining current equipment for training. Planning officials should be approached to include such requirements in the procurement agreements: (1) comprehensive operation and maintenance training to in-house staff or local trainers; (2) an extra set of major equipment should be purchased for the training workshops. This way, the most relevant training can be given.

In bilateral aid programmes, donor countries often provide modern health facilities and sophisticated equipment to developing countries. This is an excellent opportunity to request advanced technical and medical equipment management training for in-house staff.

District workshops can request teaching from technicians in national hospitals that frequently have higher skill levels. However, training must focus on existing equipment in the districts.

In-house technicians can also learn from external companies while monitoring their services.

2.6.3 Cost and time of medical equipment maintenance training

To visualize the cost and time it takes to train maintenance technicians to different levels of technical abilities, it is helpful to consider the model Cheng M. 1994, 1995.

Figure 80 represents a country's inventory of medical equipment; height indicates complexity (approximate order), and width indicates quantity. The pyramid shape reflects that items of simple equipment greatly outnumber complex items. For example: there are clearly more weight scales, stethoscopes and sterilizers than ultrasounds, lasers and CT scanners.

The maintenance of the wide range of equipment identified in Figure 80 requires a correspondingly wide range of technician skill levels, and the cost or time required to train a technician increases dramatically with the level of skills required. This situation is illustrated by the curve (*oc*) in Figure 81.

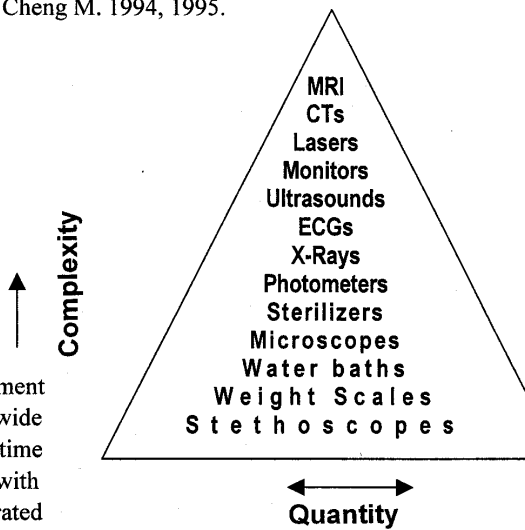


Fig. 80. Medical Equipment inventory pyramid

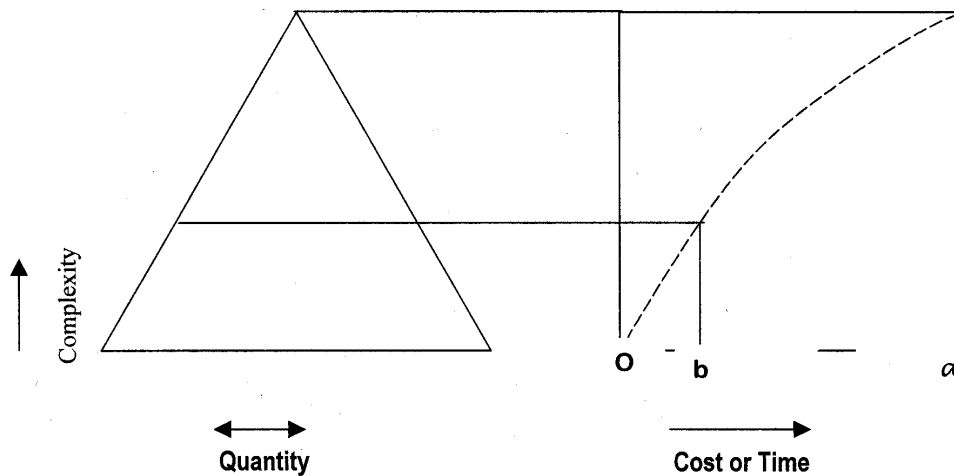


Fig. 81. Training curve based on the complexity of equipment to be maintained

In Figure 81, the inventory of equipment is divided into complexity categories A and B; line *ob* represents the cost or time to train a basic technician to maintain the simple category B; line *ha* represents the cost or time required to train a mid-level technician to maintain category A. This graphical comparison suggests that at a much smaller cost, or in a shorter time period (*ob* compared with *ba*), technicians can be trained to maintain a larger quantity of basic essential medical equipment (B compared with A).

Given the current situation in many developing countries, the pyramid model suggests an appropriate strategy to attack the problem of medical equipment maintenance. This strategy calls for a priority in the training of technicians to maintain the relatively simple but large quantity of essential medical equipment commonly found in district health facilities. This strategy requires less time, costs less, and delivers benefits to a larger population.

The concept illustrated in Fig. 81 can also be applied generally to any single piece of medical equipment. A large percentage of use and maintenance problems can be managed by the in-house staff.