1

Organization and staffing of district laboratory services

1.1 Importance of laboratory practice in district health care

District laboratory services have an essential role in the surveillance, prevention, control, diagnosis and management of diseases of greatest public health importance. In discussing the role of laboratories at district level, the World Health Organization comments that with the scaling up of interventions against HIV/AIDS, tuberculosis and malaria, the need for diagnostic and laboratory services has never been greater.[1]

Meaning of district as used in this manual
The district is designated by the World Health Organization as the key level for the management, growth and consolidation of primary health care (PHC). It is the most peripheral unit of local government and administration that has comprehensive powers and responsibilities.

A typical rural district health system consists of:

- A network of PHC facilities, including village health clinics, maternity centres, health centres and small urban clinics. Mobile health units may also provide some outreach PHC services and support for home-based health care.
- A system for the referral of seriously ill patients needing specialist care.
- The district hospital (first referral hospital).
- Other government health related departments, including social and rehabilitative services, environmental health, nutrition, agriculture, water supply and sanitation.
- Non-government health sector organizations working in the district.

A district health system is usually administered by a district health management team or health council, consisting of representatives from the community, PHC and hospital services, and health related departments such as water and sanitation.

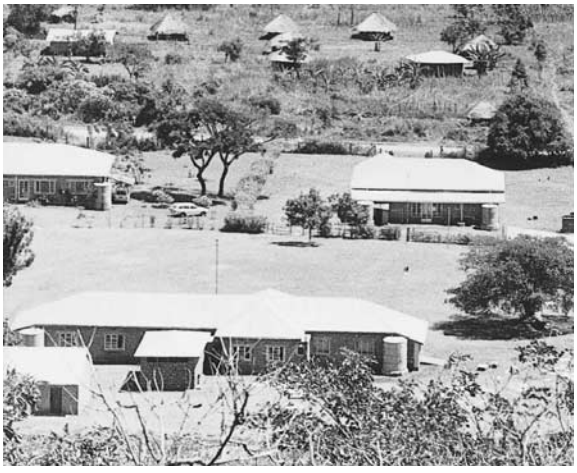


Plate 1.1 Typical community-based district hospital in Kenya.

The growth of district health systems has led to:

- essential health services and health decisions being brought closer to where people live and work.
- communities becoming more aware of health issues and demanding health services that are relevant, accessible, reliable, affordable, and accountable.
- district health councils being formed to identify and assess community health care needs, develop and manage local health services, and ensure district health resources are used effectively, efficiently and equitably.

Plate 1.2 Health centre in Vietnam.
Courtesy: RP Marchand, MCNV.

WHY THE LABORATORY IS NEEDED IN DISTRICT HEALTH CARE

The laboratory has an important role in improving the:

- quality,
- efficiency,
- cost-effectiveness,
- planning and management of district health care.

What difference can the laboratory make to the quality of district health care?

■ *Laboratory investigations increase the accuracy of disease diagnosis*

Many infectious diseases and serious illnesses can only be diagnosed reliably by using the laboratory. For example, errors in the diagnosis of malaria have been shown to be particularly high when diagnosis is based on clinical symptoms alone.

Misdiagnosis or late diagnosis can lead to:

– incorrect treatment with misuse and waste of drugs.
– increased morbidity and mortality.
– hospitalization and need for specialist care.
– patient dissatisfaction leading to negative responses to future health interventions.
– underutilization of health facilities.
– lack of confidence and motivation of health personnel.
– increased risk to the community from inappropriate disease management and untreated infectious disease.

■ *The laboratory has an essential role in screening for ill health and assessing response to treatment*

At district level the laboratory is needed to:

– assess a patient's response to drug therapy.
– assist in monitoring the condition of a patient and help to decide when it may be necessary to refer for specialist care.
– screen pregnant women for anaemia, proteinuria, and infections which if not treated may cause disease in the newborn, premature birth, low birth weight, or significant maternal illness.
– screen the contacts of persons with infectious diseases such as tuberculosis and sexually transmitted diseases.
– detect inherited abnormalities such as haemoglobin S as part of district family planning health services.
– screen whole blood and blood products for transfusion transmitted pathogens.

■ *The laboratory is needed to work with others in reducing infection in the community and investigating epidemics rapidly*

The public health functions of a district health laboratory service include:

– detecting the source(s) of infection, identifying carriers, and contact tracing.
– participating in epidemiological surveys.
– assisting in disease surveillance and in the selection, application, and evaluation of control methods.
– helping to control hospital acquired infections.
– participating in health education.
– examining designated community water supplies for indicators of faecal and chemical pollution.
– responding rapidly when an epidemic occurs, including appropriate on-site testing and the collection and despatch of specimens to the Regional or Central Microbiology Laboratory for pathogen identification.

In what ways can the laboratory contribute to achieving efficiency and cost effectiveness in district health care?

■ *The laboratory can help to reduce expenditure on drugs*

When the laboratory is used to improve the accuracy of diagnosis, perform appropriate antimicrobial susceptibility testing, and monitor a patient's response to treatment:

– drugs can be used more selectively and only when needed.
– patterns of emerging drug resistance can be identified more rapidly and monitored.

■ *The laboratory can lower health care costs by identifying disease at an early stage*

Early successful treatment following early correct laboratory diagnosis can help to:

– reduce the number of times a patient may need to seek medical care for the same illness.
– prevent complications arising from advanced untreated disease.
– avoid hospitalization and further costly investigations.

■ *Significant savings can be made when the laboratory participates in local disease surveillance and control*

This is because:

– the spread of infectious disease can be contained more rapidly.
– disease control measures can be selected and targeted more effectively.
– sources of infection and disease carriers can be identified.

What information can the laboratory provide to achieve rational health planning and good health management?

■ *Reliable laboratory test results with relevant patient data, provide information on the health status of a community, health patterns, and disease trends*

This information is needed to establish health care priorities and plan:

– health care programmes and location of health facilities.
– training of district health personnel and delivery of health services.
– treatment schedules and changes in drug usage.
– financing of district health care programmes.

■ *Public health laboratory activities provide accurate epidemiological information for health planning*

This information can help to determine:

– causes of ill health in the community and risk factors contributing to the presence and spread of diseases.
– prevalence and incidence rates of important infectious diseases.
– effectiveness of health care programmes, drug treatments, and immunization programmes.
– which methods have appropriate sensitivity and specificity to be useful.

Further information: Readers are referred to the paper of Mundy *et al*: The operation, quality and costs of a district laboratory service in Malawi.[2]

SUMMARY

Laboratory practice in district health care

- District laboratories form an integral part of good health care planning and delivery.
- Reliable, integrated, and well managed district laboratory services are essential if:
  – an acceptable quality of community health care and district health management are to be achieved and sustained.
  – illness and premature death are to be reduced.
  – the community is to have confidence in its health services.
- Unless the importance of the laboratory in generating valid and objective health data is recognized:
  – district health programmes will be unable to respond adequately to local health care needs and priorities.
  – scarce health resources are likely to be wasted on other less effective interventions.
  – national health planning will lack a scientific foundation on which to develop and evaluate its health strategies.
- For district laboratories to operate effectively, district health authorities must allocate the correct proportion of available resources to:
  – district laboratory practice.
  – training and continuing education of district laboratory personnel.
  – instructing district medical officers and community health workers in the correct and optimum use of laboratory services.

1.2 Structuring of a district laboratory network

A district laboratory service must be integrated in the health system which exists within its district if it is to function as a network, be accessible, and provide a service that is needed by the community and those managing health care in the district.

An example of a laboratory service that has been integrated in a rural district health system is shown in Fig. 1.1. The district laboratory service network consists of:

■ Outreach community-based laboratory facilities located in:
  – comprehensive health centres, staffed by laboratory personnel and able to perform a range of microscopical investigations and other basic tests to assist in the diagnosis, assessment, treatment and prevention of common diseases.
  – maternity health units, with nursing staff

screening for anaemia and proteinuria and collecting blood for appropriate antibody screening in the district hospital laboratory.

- District hospital laboratory with facilities to service the clinical, epidemiological, and training requirements of a first referral hospital.
- Specimen collection and transport system to enable:
  - patients attending health centres to benefit from the facilities of the district hospital laboratory.
  - epidemics to be investigated rapidly.
- Mobile laboratory work as required by district health needs.

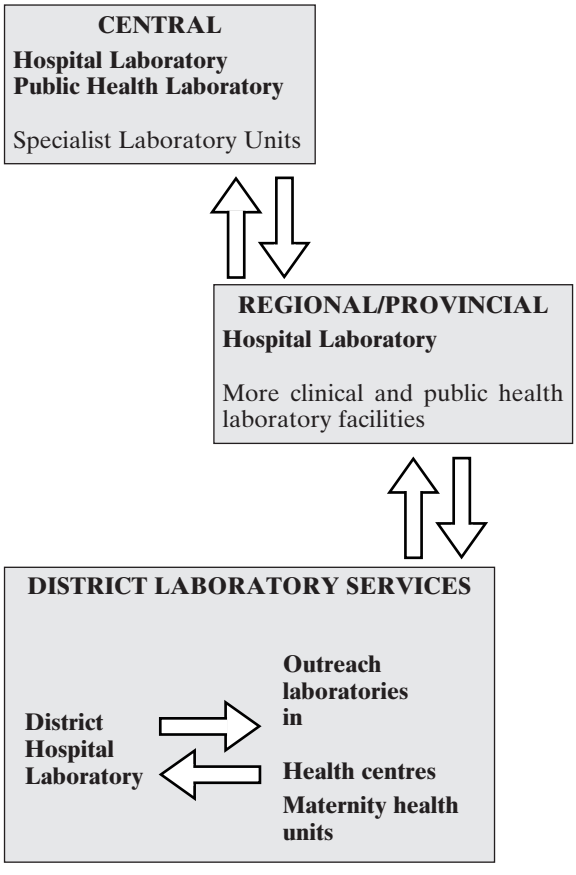


Fig. 1.1 Laboratory service network

COMMUNITY-BASED LABORATORY FACILITIES

A reliable community-based laboratory service is one of the most important ways of improving the quality of PHC and avoiding patients and pregnant women having to travel to the district hospital for essential laboratory tests. To be effective in PHC, community-based laboratory practice must:

- meet the health needs of individuals and the community.
- operate in an acceptable way.
- be accessible to the community and affordable.
- be reliable and sustainable.

Health centres with laboratory facilities are generally better attended and more highly valued by the community because laboratory testing can often be seen to establish the true cause of an illness, enabling correct treatment to be prescribed at a patient's first attendance.

Establishing a health centre laboratory

When deciding whether to site a laboratory in a health centre the following are important considerations:

- What is likely to be the affect on morbidity and mortality in the area if essential laboratory facilities were to be made available. How will the results of tests be used?
- Is the health centre sufficiently well attended and what is likely to be the demand for laboratory tests?
- Is it possible to train local community health workers to use laboratory facilities correctly, particularly in early diagnoses, follow-up, care, and local disease surveillance?

  Note: Written *Guidelines on the Use of the Laboratory in PHC* must be provided for community health workers by the district medical officer. Included in the *Guidelines* should be when to order particular tests, type of specimen required, interpretation of test results and appropriate follow-up. Health workers should know the relative costs of tests and average time it takes to perform individual tests.

- Is there a person trained or can be trained to perform the required tests competently and manage safely and efficiently a health centre laboratory?
- Can the necessary measures be taken to ensure the safe collection, transport and disposal of specimens?
- Is it possible for the health centre laboratory to be visited regularly by the district laboratory coordinator or a senior person from the district hospital laboratory?

  Important: At no time should a laboratory be established in a health centre unless it can be visited regularly and the work controlled adequately.

- Is it possible to organize a reliable system for supplying the laboratory with reagents and other essential supplies?
- Is the cost of running the laboratory affordable, including the cost of supplies, maintaining equip-

ment, and staff salaries? How will laboratory expenditures be met?

- Can the health centre provide adequate facilities for a laboratory to operate effectively and safely, i.e. can a room be provided that is:
  - structurally sound with secure door(s), and burglar proof, insect screened windows that provide adequate light and ventilation.
  - sufficiently large to be sub-divided into areas for working, reception of patients and specimens, keeping records, decontamination of infected material and cleaning of laboratory-ware.
  - provided with running water.
  - provided with separate sinks for cleaning laboratory-ware and hand-washing.
  - fitted with facilities for the safe disposal of specimens.
  - wired for mains electricity or if unavailable, supplied with an alternative source of power, e.g. battery, rechargeable from a solar panel.
  - fitted with appropriate washable working surfaces, seating for patients and staff, secure storage cupboards, and shelving.

Staffing a health centre laboratory

A laboratory in a community health centre will usually be staffed by a laboratory worker or a local community health worker trained to examine specimens microscopically, perform appropriate diagnostic and screening tests, collect and refer specimens for specialist tests, and participate in community health education and disease surveillance. Depending on the workload of the health centre, one or two laboratory aides may also be required.

Activities of a health centre laboratory

- To investigate by referral or testing on site, important diseases and health problems affecting the local community. Depending on geographical area such investigations will usually include:

  Bacterial and viral infections: Tuberculosis, leprosy, meningitis, cholera, gonorrhoea, syphilis, vaginitis, urinary tract infections, respiratory tract infections, bacillary dysentery, and relapsing fever. In the more comprehensive health centres staffed by a laboratory technical officer, it may also be possible to investigate HIV disease and associated infections.

  Parasitic diseases: Malaria, schistosomiasis, lymphatic filariasis, loiasis, onchocerciasis, African trypanosomiasis, Chagas' disease, leishmaniasis, amoebic dysentery, giardiasis, strongyloidiasis, trichuriasis, hookworm disease, and any other locally important parasitic diseases.

  Other causes of ill health: Including anaemia, diabetes, renal disease, and skin mycoses.
- To assist the health worker in deciding the severity of a patient's condition and prognosis.
- To collect and refer specimens for testing to the district laboratory, including:
  - drinking water samples from sources used by the community.
  - faecal specimens for the microbiological investigation of major enteric pathogens.
  - serum for antibody tests to investigate important communicable diseases.
  - specimens for biochemical testing to investigate disorders of the liver and kidney, metabolic and deficiency diseases.
  - specimens for culture and antimicrobial sensitivity testing to diagnose important bacterial infections and monitor drug resistance.
- To notify the district hospital laboratory at an early stage of any result of public health importance and send specimens for confirmatory tests.
- To screen pregnant women for anaemia, proteinuria and malaria, and refer serum to the district hospital laboratory for antibody screening of sexually transmitted diseases such as syphilis.
- To promote health care and assist in community health education, e.g. by demonstrating microscopically parasites of public health importance.
- To keep careful records which can be used by health authorities in health planning.
- To keep an inventory of stock and order reagents and other supplies in good time..
- To send an informative monthly report to the district hospital laboratory of the work carried out and results obtained.

Screening for proteinuria and anaemia in maternity health centres

All health units providing antenatal care should be able to test for proteinuria and anaemia. Laboratory staff from the district hospital should train health workers how to collect specimens correctly and how to perform and control the required tests. Maternity centres should be provided with standardized reagents and specimen containers.

A reliable system is also needed for transporting venous blood collected from antenatal women to the district hospital laboratory for appropriate testing.

DISTRICT HOSPITAL LABORATORY

The important functions of a district health system can be found in the 3rd edition, *Principles of Medicine in Africa*.[3]

Depending on the area served by the district hospital, number of hospital beds, and workload of the laboratory, the district hospital laboratory may consist of a number of connecting laboratory units or a subdivided laboratory room.[4,5]

Staff

A district hospital laboratory is usually staffed by at least one experienced laboratory officer and depending on workload, by two to four assistants and several aides. Ideally the district laboratory coordinator and tutor in charge of training should be based at the district hospital.

Note: The training of district laboratory personnel is described in subunit 1.3. The responsibilities of the district laboratory coordinator and involvement of the medical staff in district laboratory services are discussed in subunit 2.1.

Activities of a district hospital laboratory

- In consultation with the district health management team, public health officers, and clinical staff, to decide which laboratory tests are needed and can be performed at district level (see subunit 2.2).
- With the district laboratory coordinator, to manage effectively the district laboratory network as explained in subunit 2.1.
- To prepare and implement standard operating procedures for all district laboratory activities (see subunit 2.4).
- To support the work of the outreach laboratories by:
  - testing specimens referred from community health centres and maternity health units and returning test results speedily.
  - confirming a test result that indicates serious illness or is of major public health importance.
  - supplying standardized reagents, controls, stains, specimen containers, stationery and other essential laboratory supplies.
  - checking the performance of equipment.
  - implementing and monitoring safe working practices.
  - visiting each outreach laboratory every three months (role of the district laboratory coordinator) to assist staff and monitor work performance and quality of laboratory reports.
  - training health centre laboratory personnel and arranging supervision and continuing training in the work place.
  - organizing a district external quality assessment scheme as described in subunit 2.4.
- To refer specimens to the regional laboratory that cannot be tested locally or are more economically batch-tested at regional level. Also, to notify the regional Public Health Laboratory of any result of public health importance and to send specimens for confirmatory testing.
- To participate in external quality assurance programmes organized by the regional or central laboratory.
- To keep accurate records and send a report every three months to the district management team and director of the regional laboratory, detailing the activities of the district laboratory network, together with suggestions for managing problems and improving the laboratory service to the community.

DISTRICT SPECIMEN COLLECTION AND TRANSPORT SERVICE

An efficient laboratory specimen collection and transport service from the community health centres with a reliable and prompt return of test results, is an important way of extending laboratory facilities throughout the district with the following benefits:

- improved treatment and follow-up care of patients in the community and better health care of pregnant women.
- confirmation and further investigation of patients with important abnormal test results.
- more reliable information on health trends and the causes of disease in the district.
- more rapid investigation and control of epidemics.
- opportunities for detecting the emergence of drug resistance and monitoring its spread in the community.

Requirements of a specimen referral system

A specimen referral system will function reliably providing:

- There is close communication between staff of

the community-based health facilities and the district hospital laboratory.

- Outreach laboratories are supplied with specimen containers and laboratory request forms.
- Community health workers and district laboratory personnel are trained in the correct collection, preservation, and despatch of specimens.
- Correctly completed documentation accompanies all specimens, and careful records are kept of referred specimens and test reports.
- There is a reliable and secure means of transporting specimens throughout the year and returning test results with the minimum of delay.

MOBILE DISTRICT LABORATORY WORK

Basic mobile laboratory services may be required in district health care for the following reasons:

- to support mobile community health programmes usually in areas where communities are nomadic or sparsely distributed.
- to investigate outbreaks of serious disease and identify high risk factors.
- to work with specialist teams to assess the effectiveness of disease control interventions, check the efficacy of immunization programmes, and obtain epidemiological data.
- to assist medical teams in emergencies and disaster situations.
- to provide back-up for health education and the promotion of health activities in the district.
- to monitor community water supplies for pollution.

Mobile laboratory work must be well planned and organized. Most of the difficulties and poor performance associated with mobile laboratory work are due to:

- using inappropriate technologies,
- equipment that is not sufficiently rugged or designed for field use,
- reagents that have deteriorated due to heat, high relative humidity or incorrect storage,
- bypassing quality control procedures because they are too time-consuming or difficult to apply under field situations.

Problems of safety arise when specimens are collected and transported in unsuitable and leaky containers, handled without due care, or disposed of unsafely. Accidents tend to occur more frequently under field conditions due to cramped, unfamiliar or noisy working conditions, unsafe pipetting, limited facilities for handwashing, tiredness, pressure to work rapidly, and lack of supervision.

The cost of mobile laboratory work can be high because in addition to transport costs, heat-sensitive reagents deteriorate more rapidly, equipment needs to be repaired more often, and extra controls are needed in field work. The travelling time of staff needs also to be considered.

Recommendations for mobile district laboratory work

- Establish the reasons and objectives for undertaking mobile laboratory work and the anticipated extent of it. Discuss the data required and how it should be obtained and recorded.
- Assess whether full field-testing is necessary or whether specimens can be collected, stabilized, and brought back to the district hospital laboratory for testing under more controlled conditions.
- Obtain in advance as much information as possible about travelling time and conditions, the community and its customs, location of the work, electricity supplies, water availability and quality.
- Select technologies and instrumentation of proven reliability and acceptability in the field. If this cannot be established, pretest the techniques and equipment under simulated field conditions.
- Decide how to check the performance of instruments and test for reagent deterioration under field conditions.
- Make a detailed check list of every item needed and quantity of each required. Prepare rugged containers for transporting the mobile laboratory, including insulated containers for storing heat sensitive reagents, controls, and specimens.
- Discuss in advance the tasks that each member of the mobile laboratory team will perform and measures to be taken to ensure quality and safety.
- Monitor the cost, information provided, benefits to the community and performance characteristics of any on-going mobile laboratory work.

Note: Further information on mobile laboratory work can be found in the WHO publication *Health laboratory facilities in emergency and disaster situations.*[6]

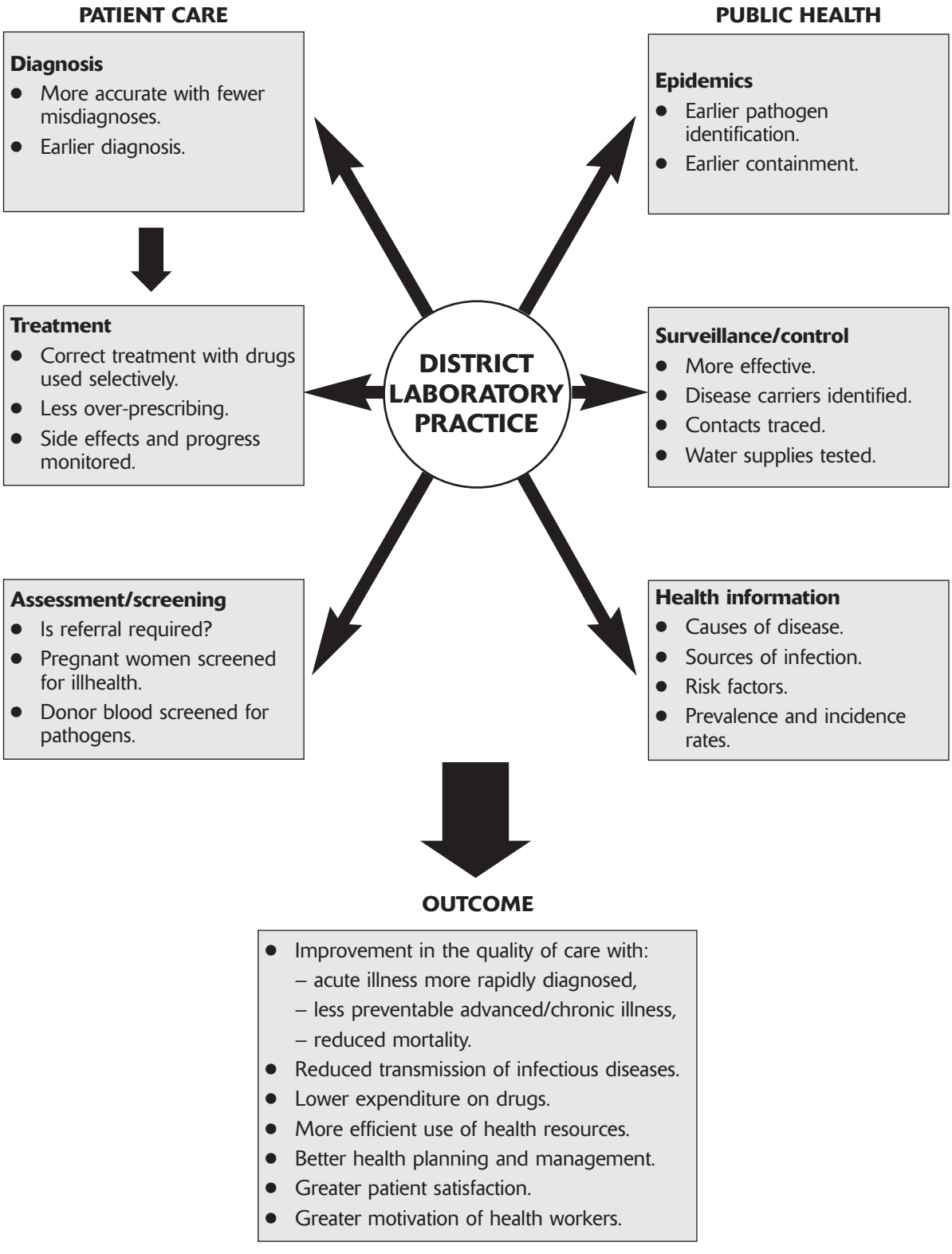
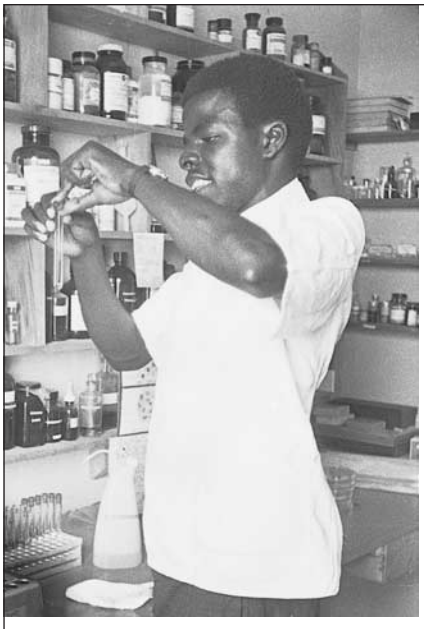
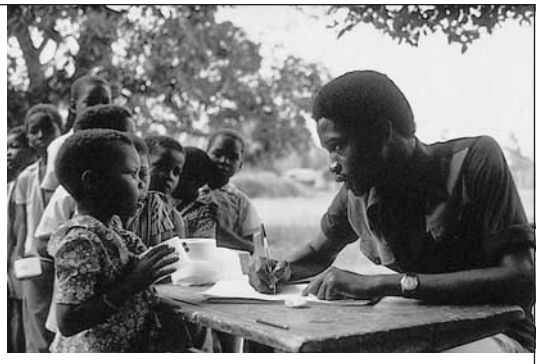


Fig. 1.2 Role of the laboratory in district health care.



1 District hospital laboratory officer.



2 Urinary schistosomiasis survey.

3 Examining malaria smears in a health centre.

4 Staining for AFB in refugee camp.

5 Screening for anaemia in refugee camp.

6 Mobile laboratory work in Peru.

Acknowledgements: Plate 2: Courtesy TALC, Plates 4, 5, 6: Courtesy Warren L Johns, Plate 3: Courtesy Graham Mortimer.

1.3 Training and continuing education of district laboratory personnel

In most developing countries the training of medical laboratory personnel is changing in response to:

- The need for more appropriately trained district laboratory staff to support community-based health care.
- The need for improved quality, safety, efficiency and management in district laboratory practice to optimize the use of health resources.
- The need for relevant, better planned, indigenous training programmes with educational objectives that define clearly what trainees need to learn to become competent district laboratory officers.
- The need for continuing on-site training and education to retain competency and motivation.

A job related approach to the training and continuing education of laboratory personnel is *essential* if district laboratories are to provide a service that is reliable, cost-effective, efficient, and relevant. Inappropriate or inadequate training of laboratory personnel is not only wasteful but also potentially dangerous.

The following are some of the indicators of poor training of laboratory personnel:[8]

- increase in the number of wrong test results.
- delays in issuing reports or loss of reports.
- frequent and serious complaints from those requesting laboratory tests and an increase in requests for repeat tests as confidence decreases.
- increase in the damage to equipment.
- increase in the contamination of reagents and materials and in the amounts of reagents used.
- greater incidence of laboratory-acquired infections and other laboratory-related accidents.
- poorly motivated staff and job dissatisfaction.
- more time needed to supervize new staff.
- increase in laboratory operating costs.

A good learner-centred training programme will help students to learn the right facts, skills, and attitudes in an efficient and integrated way. It will assess whether students have learned the right things and help students to put into practice what they have learned.

The training programme should allow sufficient time both for learning and assessment. Students and tutors need to be assured of progress during training. Becoming aware of learning problems or teaching inadequacies at the end of training is too late.

Teaching students[7]

- The purpose of a training programme is to teach students to do a job.
- Teachers should concentrate on essential facts, skills, and attitudes. It is neither possible nor desirable to teach everything.
- Teachers should base their teaching on the health problems of the community and on the work their students will be expected to do.
- Teachers should plan courses and lessons using situation analysis and task analysis (see Supplement, *Training curriculum for district laboratory personnel*, pages 430–435.

Important: If students can do their job competently at the end of their training, the course has been successful. If students cannot do the work they have been trained for, then the course has failed.

JOB RELATED TRAINING CURRICULUM FOR DISTRICT LABORATORY PERSONNEL

A job related training programme is usually referred to as competency-based or task-orientated and is recommended for the basic training of medical laboratory personnel. It is ideally suited to the training of district laboratory officers in developing countries because it ensures the training is indigenous and relevant to the working situation. It fits a person to do the job that is needed, where it is needed, and to take on the responsibilities that go with the job.
The better a person can do their job the greater will be their effectiveness and satisfaction. Competency and job satisfaction are major factors in achieving and retaining quality of service.

How to design a curriculum for district laboratory personnel

Information on how to design and implement a job-related, i.e. competency-based, training programme can be found in a SUPPLEMENT at the back of this book, see pages 430–435.