

DISTRICT HEALTH FACILITIES: Guidelines for Development & Operations

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DISTRICT HEALTH FACILITIES

Guidelines for Development & Operations



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FOREWORD

The concept of "the district" defines an administrative and geographic area. It provides an excellent organizational framework for an effective and affordable health system. A district health system based on primary health care is more or less a self-contained segment of the national health system. District health systems form the basis of overall national health structures and the role of district health facilities is crucial in the overall context. District health facilities play an important part in supporting primary health care by delivering services to their populations.

The importance of improving district health facilities needs to be emphasized, as adequate planning, design, management and maintenance of these facilities are essential if national governments are to plan the allocation of resources and to ensure that a high quality of health care is delivered to the maximum number of people at minimum cost.

Developing countries are passing through a transitional period in which technology transfer plays an important part. Developed countries, on the other hand, are increasingly sharing their experiences with developing countries through information sharing and technology transfer. The planning and design of health facilities are important aspects of technology transfer.

The WHO Regional Office for the Western Pacific has developed these new expanded guidelines from an existing publication entitled *District hospitals: guidelines for development*. They include emerging issues of the 21st century, such as the demographic and health transition and include guidelines for planning and management of peripheral health units. The emphasis is on issues such as administration and management, and communications, in particular use of telemedicine and health care of older persons.

This book is intended as a guide for national health planners, managers and team leaders at the district level as well as international agencies interested in providing aid in the field of health care. It aims to help determine the size of each facility and select the appropriate equipment for that facility, from the first contact level to the first referral level and including all intermediate facilities. It does not provide a standard model because what may be inadequate in one place may be excessive in another or adequate but unaffordable in a third. It is relevant to a wide variety of situations and as such it will help to further WHO's cooperation with Member States in this important field.



S.T. Han, MD, Ph.D.
Regional Director

INTRODUCTION

INTRODUCTION

Purpose

In 1992, in order to improve national capabilities in district hospital planning, the WHO Regional Office for the Western Pacific developed guidelines entitled *District hospitals: guidelines for development*. Recognizing that the 21st century will bring new challenges to the Region, the WHO Western Pacific Regional Office has prepared these expanded guidelines to cover all district health facilities. It also includes administration and management, as well as telemedicine and linkages, to make it more comprehensive. The new publication is intended to be used by planners, architects, engineers, aid agencies and Member States and by managers and team leaders at the district level. It should be considered as a guide only and can be adapted to local situations according to the needs of the population.

To achieve its purpose, the report:

- 1) outlines the relationship of the facilities to the district health services of which they are apart;
- 2) presents a detailed outline of the planning and design process for district health facilities, encompassing aspects of function, size, space, and staffing;
- 3) provides a detailed account of the lifecycle requirements of equipment management, together with medical and other equipment lists for different facilities and types of services;
- 4) provides an outline of how essential drugs should be selected, procured and managed;
- 5) describes the linkages required to support a district health service;
- 6) presents an overview of telemedicine and health information as important tools in enhancing linkages and addressing health transition; and
- 7) provides an outline of the features required to implement integrated health care and resource management processes necessary to support a district health service.

District health system

The term "district" is used in a generic sense to denote a clearly defined administrative area, which commonly has a population of between 50 000 and 500 000, where some form of local government or administration takes over many of the responsibilities from central government sectors or departments and where there is a general hospital for referral.

The district health system is not a new idea: decentralization has long been an important political and organizational strategy. District health systems remain the fundamental basis for

implementing health policies and delivering health care. Management of health services for defined geographic areas from regional, provincial or district centres has been a common feature of most health systems in both developed and developing countries.

The district provides an excellent organizational framework within which to introduce changes in the health system. At this level, policies, plans and practical reality can meet and feasible solutions can be developed, provided that human and other resources are made available and sufficient authority is delegated.

The following definition of the district health system was adopted by the WHO Global Programme Committee in 1986:

A district health system based on primary health care is a more or less self-contained segment of the national health system. It comprises first and foremost a well-defined population, living within a clearly delineated administrative and geographic area, whether urban or rural. It includes all institutions and individuals providing health care in the district, whether governmental, private or traditional. A district health system, therefore, consists of a large variety of interrelated elements that contribute to health in homes, schools, work places and communities, through the health and other sectors. It includes self-care and all health workers and facilities, up to and including the hospital at first referral level and appropriate laboratory, other diagnostic and logistic support services. Its component elements need to be well coordinated by an officer assigned to this function in order to draw together all these elements and institutions into a fully comprehensive range of promotive, preventive, curative and rehabilitative health activities.

Some key features of a district health system are:

- it is people-oriented;
- it is clearly defined;
- it incorporates the principles of primary health care in all its activities; and
- it has substantial autonomy, so that it can manage and implement solutions as effectively as possible in accordance with local conditions.

The actual organization of district health systems obviously depends on the specific situation in each country and each district, including the administrative structure and personnel involved. Nevertheless, the general principles for developing such systems are based on the Declaration of Alma Ata and the Global Strategy for Health for All and incorporate the following:

- equity;
- accessibility;
- emphasis on promotion and prevention;

- intersectoral action;
- community development;
- decentralization;
- integration of health programmes; and
- coordination of separate health services.

District health services

Health facilities within a district have often been put in place as needs have arisen as individual discrete units. The facilities have provided services with interrelationships evolving over time, more or less on an informal basis. This process by which facilities have developed within a district may not have resulted in the most favourable circumstances to promote an integrated health service.

A district health service is an important component of a district health system. For the purposes of these guidelines, it is not intended to explore the components that support a district health system, such as intersectoral collaboration and community participation, in any depth. Integration of district health services is seen to be a key phase in the development of a district health system.

Integrated health services

WHO encourages countries to develop a sustainable health infrastructure which will provide health care in an integrated way. The integration of health services has been defined as the process of bringing together common functions within and between organizations to solve common problems, develop a commitment to a shared vision and goals and, using common technologies and resources, achieve health goals for the community

The various elements of integrated health services are:

- **integration of service tasks**, for example, integration of certain functions previously confined to specific facilities e.g. providing primary preventive and outreach services from hospitals;
- **integration of management and support functions**, such as planning, budget and financial processes, transport, communication and information systems, training, supervisory visits, quality assurance and research; and
- **integration of organizational components**, such as making the hospital an integral part of the district health service, putting in place coordinating mechanisms such as health councils, assuming responsibility for discrete facilities linked structurally so that all resources (human, physical and financial) are part of the one organization or entity employed to achieve stated objectives for the district community.

The guidelines in this publication are based on the concept of district facilities as part of district health service that is committed to the integration of health services. The guidelines, however, recognize that there needs to be integration of service tasks, management and support functions, and organizational components for this to occur.

Implementation of integrated district health services will be advanced by decentralization, integration of district hospitals within district health services, the establishment of comprehensive patient referral systems, taking a settings approach to health promotion, community participation and setting up a district health service structure.

An integrated district health service is expected to use a primary health care approach to meet the health needs of the community. This will require intersectoral collaboration and community participation in the planning, delivery and evaluation of services.

Primary health care approach

The Declaration of Alma Ata in 1978 strongly influenced the health policies of many nations, which set out to achieve the goal of health for all by the year 2000 through primary health care. The conference defined primary health care both as a level of care and an approach. As a level of care, primary health care was defined in the Declaration as:

Essential health care based on practical, scientifically sound and socially acceptable methods and technologies made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination.

The Declaration focused attention on the gross inequalities in health status between developed and developing countries. It emphasized the idea that these inequalities could be removed with the cooperation and assistance of a number of sectors, especially the health services. Primary health care should be provided by health workers based in facilities that are simple and located close to their clients.

The primary health care approach has the following four underlying principles:

- universal accessibility and coverage on the basis of need;
- community and individual involvement and self reliance;
- intersectoral action for health; and
- appropriate technology and cost-effectiveness in relation to available resources.

Renewed effort is needed to implement primary health care as an approach. In order to succeed, primary health care must have unwavering support from the top in the form of a clear and firm national policy. However, its full realization depends critically on the people at the district level who are charged with the management and implementation of primary health care strategies. It is in the district that top and bottom meet.

The role of district hospitals in primary health care has been expanded beyond being dominantly curative and rehabilitative to include promotional, preventive and educational roles as part of a primary health care approach. The concept of a settings approach to health promotion further expands the role of the hospital in health promotion. This can be achieved by the hospital providing a healthy workplace for staff and a health-promoting physical environment for patients and their families, and being a centre for information on health development. These changes require a reorientation of the thinking of policy-makers and health planners.

Emerging needs of the 21st Century

As we approach 2000, we have witnessed numerous changes such as technological advancement, demographic epidemiological and environmental changes. The 21st century brings many new and emerging issues, the most important being the epidemiological transition from a disease profile in which communicable diseases and nutrition-related conditions predominate to one where non-communicable and lifestyle-related diseases, accidents and injuries are the major causes of morbidity and mortality. The alarming increase in populations and the deteriorating economic situation of many Member States, coupled with new emerging issues, will require health policies to be reoriented once again to be able to respond to these changes effectively. The WHO Regional office for the Western Pacific, therefore, developed a policy framework entitled *New horizons in health* in 1995. This framework provides clear directions for the future, outlining three themes: preparation for life, protection of life and quality of life in later years. Its emphasis is on people-centred and intersectoral approaches supported by sound public health policies.

Strategies to deal with emerging problems associated with the health transition, such as traffic accidents, ischaemic heart disease, stroke and cancer, require a major commitment to prevention through changes in the lifestyles of individuals. Experience shows that, while such preventive changes are difficult and long-term, they can be successful. For example, sustained anti-tobacco campaigns.

In the past, improved education has led to an increase in demand for more expensive health care. Educational programmes must transmit the message that highly sophisticated technology is only effective in very particular situations. Moreover, the application of traditional curative care is typically applied at a late stage of treatment for most chronic and degenerative diseases and the results are not very effective. It is therefore, imperative that preventable diseases to be addressed as such and not be allowed to develop into life-threatening conditions.

Health promotion has become the theme for national health development. This new emphasis has two aspects. First, health promotion must have a significant operational role throughout the entire health system rather than be topic based and limited to small health education programmes as part of a settings approach to health promotion. Second, health promotion should be targeted at different stages of life. Simple modifications of behaviour, such as eating less fat, stopping smoking or taking more exercise, will pose the biggest challenge for the health sector, at least for a decade or two. Targeting at-risk groups is becoming more accepted as one of the most significant aspects of managerial efficiency.

At the same time we should not lose sight of the fact that acute care will continue to consume the vast majority of resources and be the primary concern of health workers. Hospitals have traditionally consumed more than 50% of resources. The issue now is to ensure that appropriate technical resources remain in these centres and that these resources are used more efficiently. Hospitals should also continue to develop as the managerial centres for planning and supervision of services for specified populations.

It is well documented that health interventions with costly technologies provide very little return in terms of improved quality of life for older persons. Therefore, health systems are more concerned with the care of aging populations. Community-based facilities will increasingly be needed to provide personal care and facilitate daily living for some older people who experience significantly diminishing physical and mental capabilities.

Telecommunications technology is undergoing rapid development. The cost-effectiveness of computers has greatly improved, resulting in more investment in information technology and telemedicine in hospitals in many advanced countries. Developing countries have many competing priorities for limited health spending and so it is important to emphasize appropriate adoption of technology for the individual country or health facility. This means taking advantage of technology which can make a cost-effective contribution to achieving health outcomes. Service needs and careful planning must drive technology adoption.

Developing district health facilities

The Western Pacific Region is one of the six regions of WHO, covering 37 countries and areas. It is the most populous of the six regions, the populations ranging from more than one billion in China to 41 in Pitcairn. The socioeconomic, political, geographical and climatic conditions in the Region are highly diverse: the geography varies from mountains to plains and small islands, the climatic conditions from very cold to tropical and socioeconomic conditions from highly developed to some of the least developed in the world.

Since 1986, the WHO Regional Office for the Western Pacific has been encouraging a new, multidisciplinary team approach to facility planning to support Member States in improving national capability and expertise in facility planning and design. Such an approach should result in plans that will ensure:

- optimum utilization of space;
- easy and safe movement of people and materials;
- the best use of local skills, materials, and natural resources;
- provision for any future changes or extensions;
- the use of appropriate technology; and
- ease and cost-effectiveness of utilization and maintenance.

Above all, the construction of a new hospital or any other health facility, or changes in an existing one, must be carefully correlated with the real needs of the community, through the district health service.

Before the role of the district hospital and other facilities in the district and in the regional health system can be defined, plans necessary for developing health services must be outlined and planning objectives understood.

A health services development plan establishes the strategy for achieving the objectives of the health services. Each service is examined with regard to the need it fulfils, its characteristics, the setting in which it is provided, its functions and the objectives and priorities for change set by the overall health system plan. The plan is based on a detailed study of the implications arising from those objectives and policies, consideration of the various components of the system; and examination of the constraints of existing facilities and resources, including their influence on the timing and phasing of any proposed development of the services.

A decision to proceed with the design and construction of district health facilities cannot be taken until the health services development plan has been agreed. This plan determines the priorities for developing the various components to be provided in each region and district and the provisions for funding each facility. Development of health services must be planned within the financial constraints of the overall health system plan. Any additional expenditure required must be agreed before planning for a district hospital or any other facility is taken up.

It should be borne in mind that certain sections in this publication, such as emergencies, water and sewerage, medical equipment and engineering services, etc. covered in Part I, may also apply to other parts, perhaps to a lesser extent.

PART I

THE DISTRICT HOSPITAL

1. PLANNING AND DESIGN

1. PLANNING AND DESIGN

1.1 THE DISTRICT HOSPITAL

1.1.1 Definition

The term "district hospital" is used here to mean a hospital at the first referral level that is responsible for a district of a defined geographical area containing a defined population and governed by a politico-administrative organization such as a district health management team. It is possible that this term "district hospital" may vary from country to country but will remain distinct with its functions. In some countries, where the population is small, the role and functions of district hospital may be enlarged to suit the needs of the population.

1.1.2 Role

The WHO Expert Committee on the Role of the Hospital at the First Referral Level, which met in 1985, clarified the importance of the full involvement of hospitals in primary health care; it also crystallized the concept of the district health system as a central strategy in this approach. The report of the Committee includes a conceptual model of a comprehensive health system based on the principles of primary health care, as shown in Figure 1.

This model clarifies the place of hospitals at the first referral level as the component of district health systems that immediately supports the health activities of the district or community, and especially primary health care activities. Such hospitals can provide wide-ranging support for patient referral as well as support for various technical, administrative and educational/training activities in the district.

1.1.3 Functions

The district hospital has the following functions:

- (1) it is an important support for other health services and for health care in general in the district;
- (2) it provides wide-ranging technical and administrative support and education and training for primary health care;
- (3) it provides an effective, affordable health care service for a defined population, with their full participation, in cooperation with agencies in the district that have similar concerns.

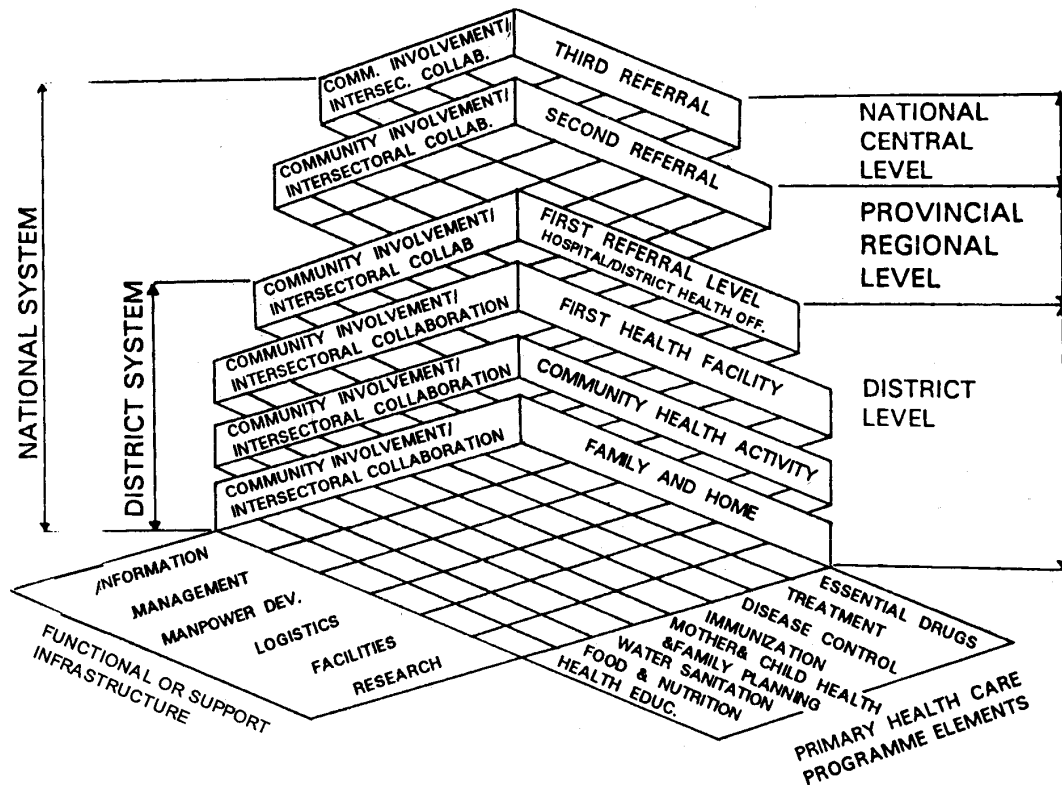


Fig. 1. Model of a health system based on primary health care.

1.1.4 Services

The range of medical services offered by the district hospital differs from one country to another owing to differences in the:

- epidemiology of cases that require complex treatment, including accidents;
- size and density of the population;
- geographic and climatic conditions;
- level of economic development;
- socio-cultural infrastructure;
- quality and quantity of health resources;
- national policy for health care; and
- availability of medical and paramedical personnel.

The Western Pacific Region is one of the six regions of WHO. It consists of 37 countries and areas including 27 Member States and one Associate Member and is the most populous of the six regions, the populations ranging from more than one billion in China to about 41 in Pitcairn. The socioeconomic, political, geographical and climatic conditions in the Region are highly diverse: the geography varies from mountains to plains and small islands, the climatic conditions from very cold to tropical, and socioeconomic conditions from highly developed to some of the least developed in the world.

As shown in Figure 1, the district health system is part of the national health system. The range of services offered by a district hospital is limited by its managerial efficiency and effectiveness. When the disease prevalence in a district varies widely in type and complexity, it may be impossible to treat all of them: some may require the intervention of highly specialized physicians and the use of sophisticated, expensive medical equipment. Patients with such diseases can be transferred to second- or third-level hospitals located in a nearby province or region. A district hospital should, however, be able to serve 85-95% of the medical needs in the district. The list of services that a district hospital can provide is described below. The extent to which the last two groups of services can be provided is flexible, depending on local financial, social and cultural conditions. The list can also be extended or modified according to local needs.

DEPARTMENT	SERVICE
Clinical	
Medicine	Essential
Surgery	Essential
Paediatrics	Essential
Obstetrics/Gynaecology	Essential
Dentistry	Essential
Orthopaedic surgery	Optional
Otorhinolaryngology	Optional
Neurology	Optional
Psychiatry	Optional
Clinical support	
Anaesthesia	Essential
Radiology	Essential
Clinical laboratory	Essential
Pathology	Optional
Rehabilitation	Optional
Non-clinical support	
Kitchen (catering)	Essential
Laundry	Essential
Warehousing (central store)	Essential
Domestic hygiene	Essential
Waste disposal	Essential
Maintenance and repair	Essential
Transport	Essential
Communications	Essential
Staff residential housing	Essential

Administrative

Finance	Essential
Medical records	Essential
Procurement	Essential
Personnel	Essential
Security	Essential

1.1.5 Size of the hospital

The size of a district hospital is a function of the hospital bed requirement, which in turn is a function of the size of the population served.

The groupings of populations around health facilities vary. A survey of the Member States of the Western Pacific Region revealed that primary health care facilities generally serve communities of 5000-10 000 people, and first-level referral hospitals generally serve communities of 50 000-500000. In some countries, an intermediate level of primary health care facility exists, serving populations of 10000-50000.

The physical scale of the hospital is established on the basis of a determination of the number of beds required and a suggestion for the minimal hospital area per bed. One method that can be used to determine the number of beds is based on the expected patient load, as shown in the following example:

Data collected:

Population of district	150 000
Average length of stay in hospital	5 days
Annual rate of admissions	1 per 20 population

Computations:

- (1) Total number of admissions per year:
 = district population x rate of admission per year
 = 150000 x 1/20 = 7500
- (2) Bed-days per year:
 = total number of admissions per year x average length of stay in hospital
 = 7500 x 5 = 37500
- (3) Total number of beds required when occupancy is 100%:
 = bed-days per year + 365 days
 = 37500 + 365 = 102.74
 Say 105 beds.
- (4) Total number of beds required when occupancy is 80%:
 = bed-days per year + (365 x 80%)
 = 37 500 + (365x80%)
 = 128.42, say 130 beds

To initially determine the total area of the hospital, the number of beds must be multiplied by a factor or a standard expressed in *area per bed*. This factor has been discussed at various meetings of the hospital planning and design in the WHO Western Pacific Region and, based on the opinion expressed by various countries, a figure of 40 sqm/bed has been found to be reasonable. However, it can be changed according to the actual situation prevailing at a particular site/location.

Computations:

- (5) Total area of hospital:
 = total number of beds x 40 square metres per bed
 = 105 beds x 40 = 4200 square metres (for 100% occupancy)
 = 130 beds x 40 = 5200 square metres (for 80% occupancy)

This method gives an initial picture of the physical size of the hospital, which in turn can be used to determine initial budgetary costs through the application of prevailing construction costs per square metre.

Using this approach, the number of "justified" admissions must be estimated on the basis of the existing level of admissions, corrected according to a population survey to determine the number of people who needed hospitalization but could not be admitted and to a hospital audit that showed how many patients had been hospitalized.

The "appropriate" average length of stay can be estimated from the prevailing one, corrected for both delayed and premature discharges when this information is available in hospital records.

The "acceptable" rate of occupancy is established by approximation. It should be high, but not so high that incoming patients must be rejected or placed two in one bed space. Special, separate consideration should be given, however, to the needs of chronic (long-term) patients and to referrals for tertiary care.

In many cases, hospital bed requirements should not be based on "international" or even national standards. Rather, an attempt should be made to approximate bed needs by district or region, taking into consideration:

- the prevalence of morbidity that must be treated in a hospital, on the basis of severity and frequency, which will differ in rural, urban, semi-urban, agricultural and industrial environments;
- the ability of the health services outside the hospital to reduce the need for beds;
- the age, structure and concentration of the population;
- communications and transport facilities; and
- other socioeconomic determinants, such as the capacity of the local area to support hospital services, including the availability and distribution of human resources and the capacity of available utilities (e.g., water and electricity supplies).

The decision to build a new district hospital to augment existing facilities depends on how adequate the existing facilities are to meet the health needs of the population.

1.2 METHODS OF PLANNING AND DESIGN

1.2.1 Objectives

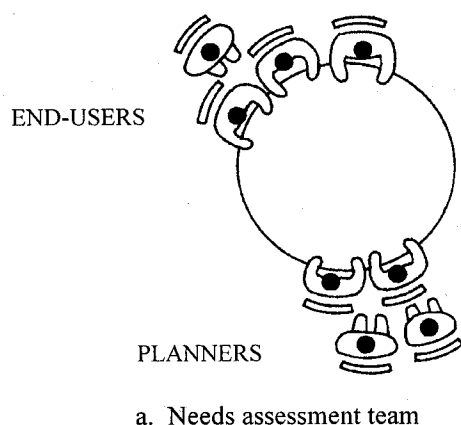
- (1) to present an overview of the planning and design process, to guide its participants, and especially those working in units and agencies for health planning and designing in different countries;
- (2) to present concisely the basic information that is important in the process of planning and designing;
- (3) to organize the overview and basic information in such a way that it can serve as checklists for planning units, planning teams and professional designers, so that they can derive the maximum benefit and organize their own planning and design; and
- (4) to help strengthen and develop planning and design capabilities at the local level.

The complex process of planning and designing a hospital requires that it be a multidisciplinary endeavour. This being so, the process must be organized and systematized so that all the stages such as: roles, activities, contribution and expected results, and their levels, standards and quality, are clear to everyone involved in the process.

In general, the people involved in this process are:

- Health planners, functional planners, financial planners and physical planners.
- Architects
- Engineers (such as civil, mechanical and sanitary)
- Quantity surveyors
- Finance managers
- Staff responsible for procurement of supplies
- Staff members such as doctors/nurses, clients/end users

1.2.2 Planning team and the process

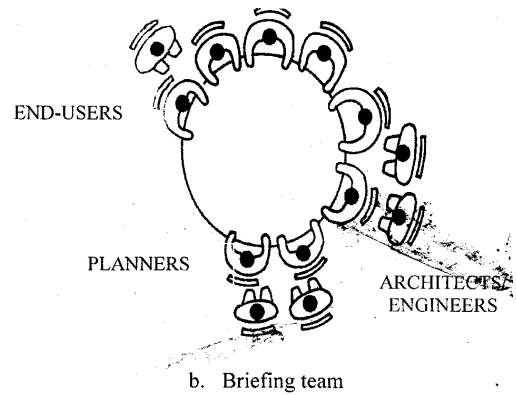


(a) Needs assessment team

The planning and design process can be envisaged with the interaction of various groups of people involved in the process. At the earliest stage, a needs assessment team involving the planners, end users such as the hospital staff and the community establishes an overall plan of the needs, range of services to be provided, the target population or catchment area, the financial feasibility of the project with cost-benefit analysis and the scale of the hospital, etc.

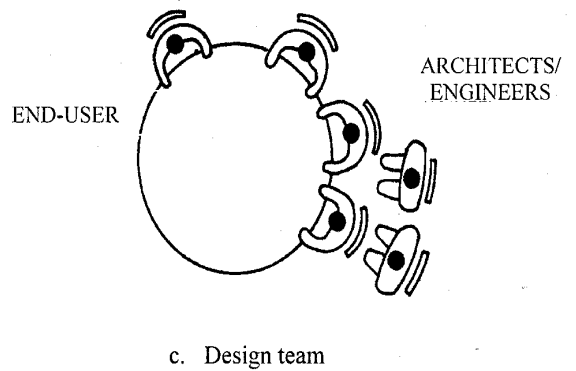
(b) Briefing team

After the needs and the size of the hospital have been determined, the briefing team involving architects, engineers, the staff and the community sit together to prepare the key document, i.e. "the design brief" which translates the requirements into functions, activities, space distribution and/or any other information necessary for the design.



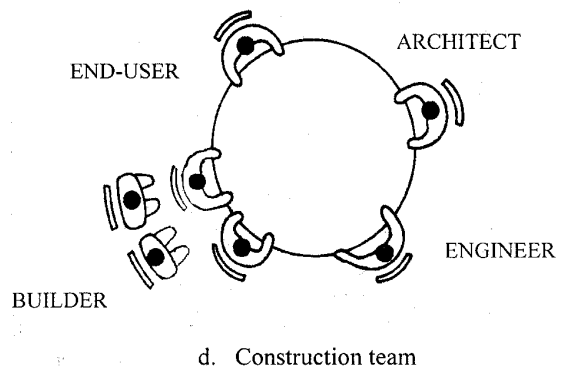
(c) Design team

This team consists of all the people involved in designing the facility(ies) and pools the expertise of its members to produce the instruments for implementing construction, starting from preliminary investigation to the final designs with technical specification, tendering documents and detailed working drawings and estimates of cost. This team mainly consists of engineers, architects, quantity surveyors, hospital staff, the community and the approving authority.



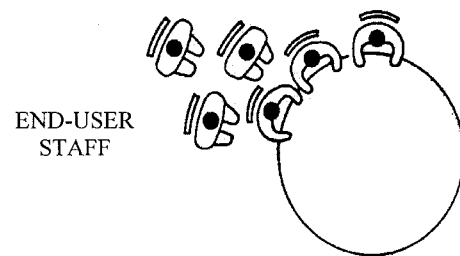
(d) Construction team

This team consists of engineers, architects and builders. The construction team implements the design from the approved drawings and technical specifications within the prescribed time and cost and produces the facility for commissioning cause serious complications when left untreated.



(e) Commissioning team

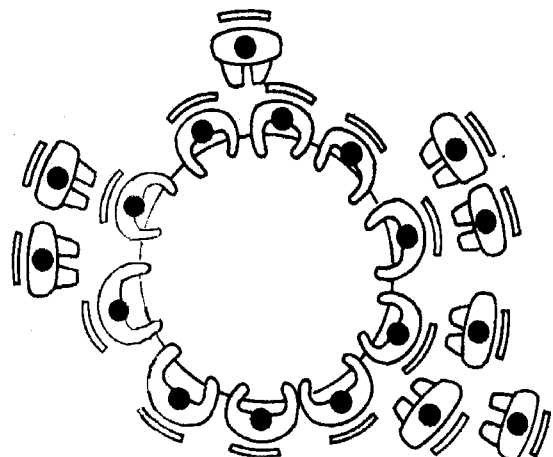
The commissioning team responsible to staff the hospital, commissions and procures the equipment, furniture and supplies and prepares it for operation.



e. Commissioning team

(f) Planning team

By the end of the project, multitude of people would have made their contribution to the project as part of a whole working team including the community.



f. Planning team

1.2.3 Roles of members of the team

In each of the stages that comprise the planning and design process, each member of the team has a role to play:

- The *health planner* establishes the need for the hospital, its role in the community and the services it will offer.
- The *functional planner* establishes the functioning of the different departments and of the hospital as a whole.
- The *financial planner* establishes the financial feasibility of the project and is responsible for identifying and earmarking the funds for the Project.
- The *physical planner* establishes the relation of the hospital to the town and the community it serves.
- The *architect* and the *engineering consultants* provide professional planning, design and supervision of construction.
- The *construction manager* manages people and resources on site to ensure that the project is completed on time within the budgeted amount.

- The *builder/contractor* produces the hospital in its physical form using materials, labour and construction equipment,
- The *procurement staff* and the *personnel staff* form part of the commissioning team which prepares the hospital for operation by procuring material and recruiting staff.
- The *client/user* is the owner and final user of the hospital.

These people assume either active or consultative roles at the planning table, depending on the task at hand, Table 1 gives a simplified version of the stages and their corresponding inputs and outputs and the role of working professionals at each stage, It is important to note that the engineering services should be planned jointly with the layout, so that the final result is the logical outcome that meets the needs of the actual users of the hospital, offering the best available health care service to the population commensurate with the cost,

Table 1. Stages in planning and designing a hospital

Stage	Task	Input	Output	Working Team	
				Active	Consultative
One	Establish demand for new hospital or for hospital expansion	Information Indicators Projections	Decision to construct, renovate, expand	User/ Client Planners	
Two	Prepare design brief	Services to be delivered Function requirements	Design brief	User/ Client	Architect/ Engineers
Three	Design	Design brief Additional data from consultants	Design of hospital Working documents	Architect/ Engineers	User Client
Four	Construction	Design of hospital Working drawings	Hospital in physical form	Architect Builder Engineer	User/ Client
Five	Commissioning	List of staff List of furniture List of equipment List of supplies	Appointment and training of staff Procurement of furniture, equipment, supplies	User/Client Procurement staff Personnel staff	

1.2.4 Preparation of the design brief

The design brief is a key document: it is the written expression of the client's needs, as expressed in consultation with various professionals, including the architect and engineers. It is important because a good design brief is the sound base for a good design. The brief should provide the following information about the hospital and its parts or units:

- (1) Functional content: size and content of departments, such as the number of operating theatres, number of beds in wards
- (2) Philosophy of service: what the departments will and will not do

- (3) Workload: the number of hours and the time that the hospital departments will work, the shifts, maintenance time, overtime, etc
- (4) Planning principles: policies and procedures of the hospital with regard to:
 - patient movement
 - staff movement
 - supply delivery
 - disposal of used goods
 - laundry service
 - food service
 - domestic services
- (5) Staffing: number and types of staff, peak periods of work
- (6) Functional relationships: between departments, between rooms within a department
- (7) Environmental factors and engineering: hospital policies with regard to:
 - fire protection
 - electrical supply (mains and stand-by)
 - sterilizing and sterile supply
 - security
 - hot- and cold-water supplies
 - heating and ventilation
 - lighting
 - medical gases and vacuum
 - emergency alarm system
 - other engineering services
 - landscaping and pollution control
- (8) Schedule of accommodations: list of all rooms and spaces in each department, type and number of occupants, sizes and activities performed in them
- (9) Financial aspects
 - (a) Costs: budget, or programmed amounts, to include:
 - construction (a major budget item)
 - professional services (architects, engineers)
 - construction/project management services
 - fixed equipment
 - furniture and movable equipment
 - extra utilities, if necessary

- professional procurement and installation of equipment
- site investigation and development, including purchase of land
- insurance, for fire and other liabilities required during construction
- legal counsel
- taxes, customs duty and other statutory charges
- contingencies, for unforeseen situations

(b) Possible sources of funds

- central government
- gifts, donations or grants
- money generated by hospital activities prior to construction
- money to be repaid from future hospital activities

The following is a sample format and checklist of the contents of a typical design brief for a district hospital:

(1) Introduction

- (a) Background, project initiative
- (b) Project funding, source
- (c) Philosophy of service development plans
- (d) Organization
- (e) Others

(2) Site information

- (a) Physical description: bearings, boundaries, topography, surface area
- (b) Land use in adjoining areas
- (c) Any limitations of the site that would affect planning
- (d) Maps of vicinity and landmarks or centres
- (e) Existing utilities
- (f) Nearest city, port, airport
- (g) Rainfall and data on weather and temperatures

(3) Policies for hospital operation: concepts on a general level, with implications at specific levels, such as:

- patient movement
- staff movement
- delivery of supplies
- disposal of used goods
- laundry services

- food services
- domestic services
- security
- engineering services
- fire protection
- emergency alarm systems

(4) Zoning: grouping of departments according to zoning principles

(5) Departmental requirements: separate consideration for each department should include:

(a) Description of functions and facilities

- procedures, operational policies
- schedule of accommodation
- list of rooms
- suggested area; critical dimensions, if any

(b) Qualitative parameters

(i) location, relationship to other rooms, services and departments

(ii) use

- function of or activities carried out in room
- space requirements for activities, when critical
- numbers of staff and/or patients using room at one time
- wheeled traffic
- goods or materials
- special uses and work flow,
- occupancy or time in use

(iii) constraints

- privacy
- supervision
- security
- separation
- fire protection

(iv) environment

- wind direction
- lighting, natural and artificial
- heat, humidity , sterility

- cold, room heating
- sound (acceptable noise levels)
- ventilation

- (v) fittings, fixtures and equipment (fixed and movable)

- (vi) loads on services
 - electrical
 - heating
 - ventilation and air-conditioning
 - hot water

- (c) Functional relationships and physical proximities
 - (i) closeness matrices¹

 - (ii) bubble diagrams²

 - (iii) activity analyses, traffic movements

- (d) Flexibility and future expansion: possibility of future growth, with schedule

- (6) Cost of project, other financial aspects (in terms of capital and recurring costs)
 - (a) financing scheme

 - (b) cost limitations for each aspect of the project (working budget)

 - (c) priorities for phasing, if necessary

 - (d) expected flow of funding with time

1.2.5 Designing from the brief

It is at this important stage that abstract ideas are translated into concrete physical facilities. In essence, the designer gains an understanding of the activities and their sequence and visualizes people performing the activities; with these in mind, the designer creates the working environment, translating invisible ideas to visible spaces formed by the process of design.

¹ Closeness matrices: graphical analyses that qualify the levels of proximity between departments, rooms or spaces, using descriptions in levels of progression, such as "physical adjacent", "easy access", "closeness not necessary", "closeness undesirable".

² Bubble diagrams: graphical analyses that show departments, rooms or spaces and the types and intensity of traffic between them, generated by people (patients, staff, visitors) and things (supplies, food).

1.3 LOCATION

1.3.1 Inventory and distribution of health facilities (the mapping exercise)

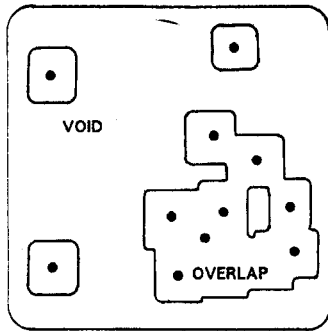


Fig. 2. Mapping exercise

One of the most effective ways of determining the location of a new facility is to use a *base map* of the district and vicinity, on which one can enter, translate and compare data, facts and information (Fig. 2). A basic mapping exercise is the first step in locating the positions of existing facilities; a graphical analysis of data on where patients come from can be used to determine the areas of influence and service of those facilities. This kind of analysis shows the overlapping of influence and any voids that need filling and therefore warrant the provision of a new facility.

1.3.2 Service catchment area

The catchment area for a health facility is determined by several factors:

- (1) Politico-administrative boundaries are usually the strongest determinant, as they set a defined area and imply an established organization which directs, manages and operates the affairs of the population within its jurisdiction. In most countries, the hierarchy of physical facilities parallels that of the politico-administrative organization, so that a particular level of facility is under the jurisdiction of an equivalent level of the politico-administrative unit throughout the country.

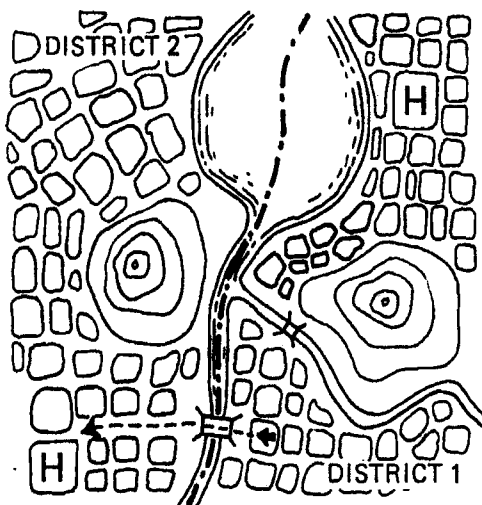


Fig. 3. Natural physical barrier as a determinant of catchment area.

- (2) Geographical boundaries are *natural physical barriers* to population movement and can therefore also be strong determinants of *catchment areas* (Fig. 3). Mountain ranges and bodies of water, for instance, deter cross-movement. People may cross politico-administrative boundaries to reach a facility, however, if they are deterred by a natural barrier within their own district.

Geographic boundaries are often formalized into politico-administrative boundaries as a natural consequence of the development of ethnic, cohesive or homogeneous cultures on either side.

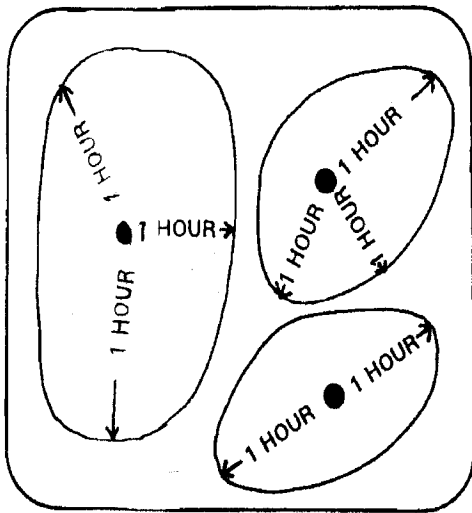


Fig. 4. Time boundaries as determinants of catchment area

(3) *Time boundaries*, although invisible, *determine catchment areas* in regions without roads and easy means of transport (Fig.4). Populations gravitate towards the facilities that are most easily accessible, that is, the facility they can get to in the shortest time. The factor of geography also contributes to this situation, as a difficult terrain takes longer to negotiate.

1.3.3 Factors to be considered in locating a district hospital

- (1) It should be within 15-30 min travelling time. In a district with good roads and adequate means of transport, this would mean a service zone with a radius of about 25 km.
- (2) It should be grouped with other institutional facilities, such as religious (church), educational (school), tribal (cultural) and commercial (market) centres.
- (3) It should be free from dangers of flooding; it must not, therefore, be sited at the lowest point of the district.
- (4) It should be in an area free of pollution of any kind, including air, noise, water and land pollution.
- (5) It must be serviced by public utilities: water, sewage and storm-water disposal, electricity, gas and telephone. In areas where such utilities are not available, substitutes must be found, such as a deep well for water, generators for electricity and radio communication for telephone.

1.3.4 Site selection criteria

A rational, step-by-step process of site selection occurs only in ideal circumstances. In some cases, the availability of a site outweighs other rational reasons for its selection, and planners and architects are confronted with the job of assessing whether a piece of land is suitable for siting a hospital. In the case of either site selection or evaluation of adaptability, the following items must be considered: size, topography, drainage, soil conditions, utilities available, natural features and limitations.

1.3.4.1 Size of the site

The site must be large enough for all the planned functional requirements to be met and for any expansion envisioned within the coming ten years (Fig. 5). Recommended standards vary from 1.25 to 4 ha per 100 beds; the following minimum requirements have been proposed:

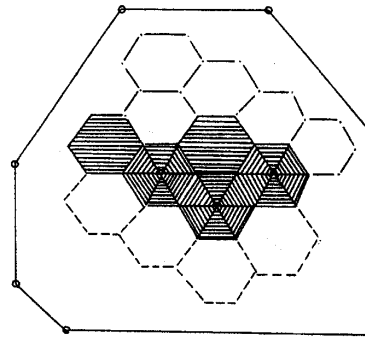


Fig. 5. Minimal size of site

- 25-bed-capacity - 2 ha (800 m² per bed)
- 100-bed capacity - 4 ha (400 m² per bed)
- 200-bed capacity - 7 ha (350 m² per bed)
- 300-bed capacity - 10 ha (333 m² per bed)

These areas are for the hospital buildings only, excluding the area needed for staff housing. For smaller hospitals, single-storey construction generally results in effective use of the building, less reliance on expensive mechanical services and lower running and maintenance costs. Thus, hospitals up to 150 beds should be single-storey constructions unless other parameters dictate that they be multistoreyed. For such a construction, the recommended minimum area of the site of a 100-bed hospital is 1.50 hectares. This area again is for the hospital building only and does not include the area for staff housing, if required.

1.3.4.2 Topography

Topography is a determinant of the distribution of form and space. A flat terrain is the easiest and least expensive to build on. A rolling or sloping terrain is more difficult and more expensive to build on, but the solutions can be interesting and innovative; by using the natural slope of the ground, the drainage and sewage disposal systems can be designed so as to result in lower construction and maintenance costs (Fig. 6).

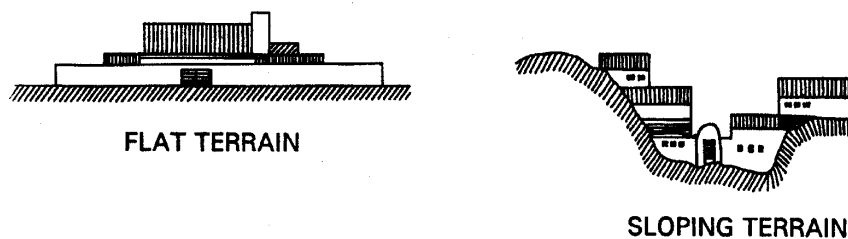


Fig. 6. Topography

1.3.4.3 Drainage

The terrain must allow for easy movement of water away from the site. A high point in the community is ideal. If this is not available and the site is at a low point or in a depression, the following must be checked:

- how the surrounding natural terrain and waterways can be used to move water away from the site;
- whether the type of soil allows rapid absorption and disposal of water;
- the use of other technical means of ensuring drainage such as the building on a podium or on stilts, or digging temporary reservoirs (Fig. 7).

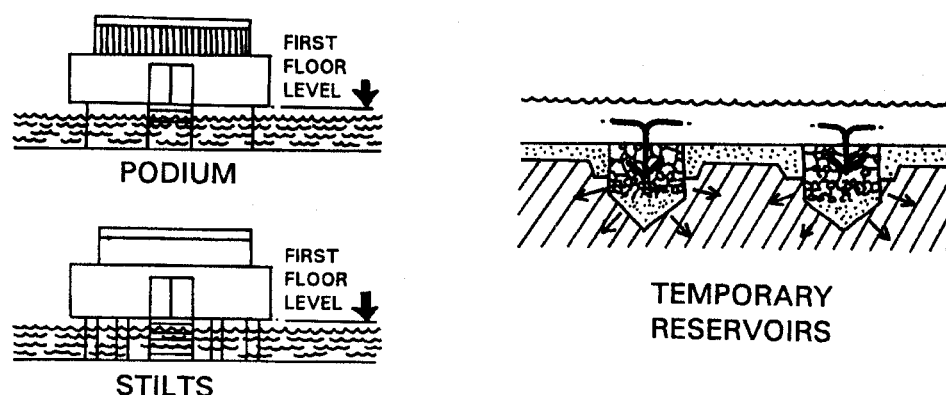


Fig. 7. Means of draining low-lying sites

It should be noted that the placing on a site of hospital buildings and paved areas greatly increases run-off of storm-water. A site with no apparent drainage problems when bare may be subject to serious flooding when developed, if adequate provision is not made for disposal of rainwater. Wherever possible, a site should be provided with surface openings to storm-water drains, drainage channels or waterways. Storm-water run-off from roads and buildings should be piped to such openings. It is also important to check that the waterways themselves are not subject to flooding and that, in flood conditions, water will not back up on the hospital site.

When deciding the ground floor level of the buildings, care should be taken to safeguard against temporary flooding of the building in a heavy downpour. In areas prone to regular flooding, a raised ground floor, which allows for expected peak floods, is essential. Local engineering advice on the possibilities of drainage from a site should be obtained before proceeding with its purchase, when such advice is available (e.g., from records of the local authority or relevant government department). It may also be necessary to perform percolation tests to determine the capacity of the soil to absorb liquids; this is particularly important when sewage must be treated and effluents disposed of on the site.

1.3.4.4 Soil conditions

The soil conditions are a determinant of foundation schemes. Ideally, the subsoil should be such that conventional, economical structural design and foundation schemes can be used.

Waterlogged areas, swamps and former ricefields should be avoided. If no other site is available, however, the following steps must be taken:

- (a) Check the bearing capacity of the soil. As foundation requirements vary greatly with the form of construction and the building materials used, the subsurface soil and water conditions must be determined. A sufficient number of test borings or pits must be made so that the engineer can best judge the true subsurface conditions. The results of this investigation must be submitted in a report that contains detailed recommendations for designing the foundation. If necessary, appropriate laboratory tests should be performed to determine the safe bearing capacity and the compressibility of the various strata of soil, including alkali content, which might affect concrete foundations in the long run.

The bearing capacity of the soil must be confirmed at key points, preferably where major foundation elements or footings would be located. In Figure 8, the starred points show the locations of boreholes or test points with respect to the locations of buildings. Some boreholes should be dug closest to the location of the basement, if any, and to the tallest structure of the building complex, including water reservoirs and the sewage treatment plant.

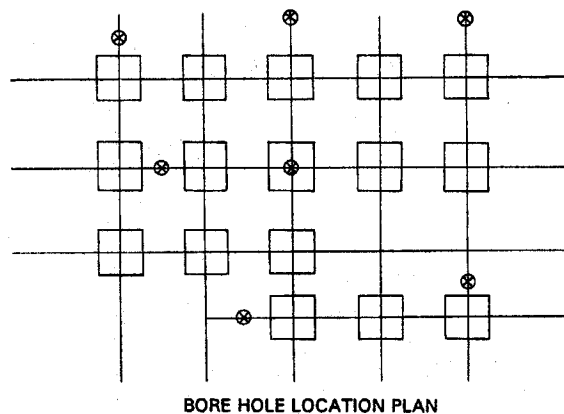


Fig. 8. Boreholes to confirm bearing capacity of soil

- (b) Scrap unstable top layers, if necessary, and fill with well compacted, suitable materials, like clean coarse sand.
- (c) Seek engineering advice before finalizing the depth and size of the foundations, which should be designed to suit the site conditions.

1.3.4.5 Utilities available

Electrical, water and communication lines should be available. If not, generators, deep wells and water pumps must be provided and radio communication lines established. Health care facilities are quite ineffective if all-weather roads, water supplies and a reliable electrical supply are not available at the site.

1.3.4.6 Natural features

Features such as natural lakes and ponds and lush vegetation are not necessarily a disadvantage and can have great potential for enhancing the building design. Building design should respond as much as possible to the site, so that the structure is in context with the environment: a waterway that bisects a site also generally bisects the building form; this might call for an innovative design solution in which the *building straddles the waterway* (Fig. 9a).

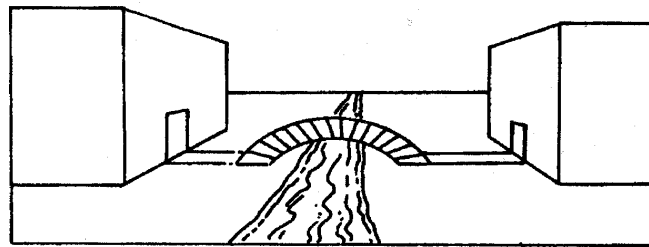


Fig. 9a. Building straddling waterway

The presence of a large pond on a site diminishes its area and coverage and might call for a multi-storey solution on a site that could otherwise adequately accommodate a sprawling building (Fig. 9b).

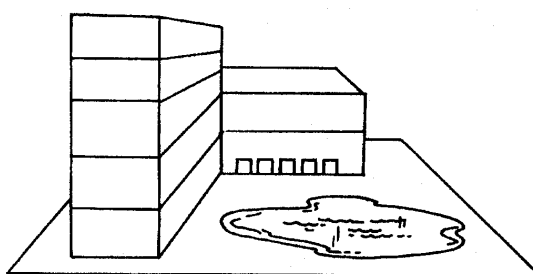


Fig. 9b. Building designed around a pond

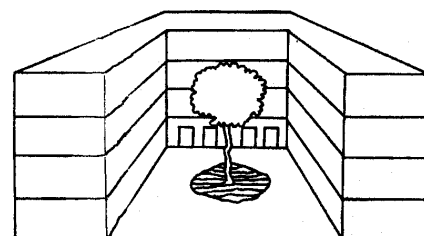


Fig. 9c. Building designed around a large tree

A large, old tree might necessitate a design that skirts around it (Fig. 9c). All attempts should be made to maintain the existing trees on the site in accordance with the profile of the building.

Solutions can be numerous, involving creativity and innovation, but they should be based on two overriding considerations: (i) that the design respects and follows the laws of nature; and (ii) that the limitations imposed by the natural features do not detract from the functional performance or cost-effectiveness of the facility.

If the constraints of a site result in a building form that is too expensive, an alternative site should be found or the restrictive feature removed. For example, a waterway that crosses a site might be diverted around the edge of the site.

1.3.4.7 Limitations

The site may be adequate in all respects, but it must be checked for possible constraints to its use:

- (a) Does it have *direct access* from the road (Fig. 10)?

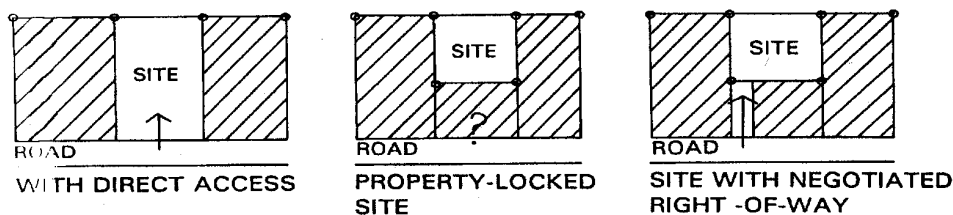


Fig. 10. Access to site

- (b) Is it a contiguous piece with proper ownership titles (Fig. 11)? Unsolved problems of ownership can constrain full utilization of a site. Sites with ownership problems should not be used (Fig. 12).

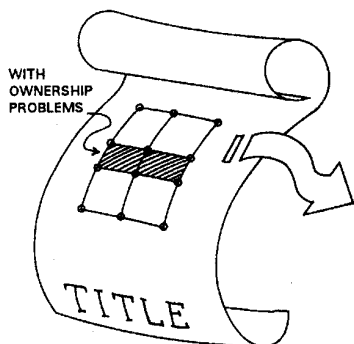


Fig. 11. Proper ownership titles

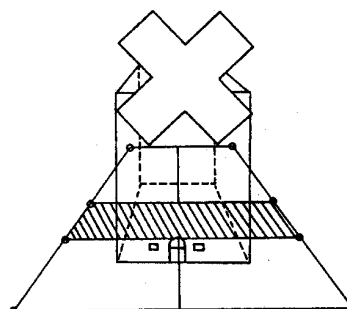


Fig. 12. Structures on site with ownership

(c) Does the site have existing structures? If so:

- Can they be incorporated into the design of the new structure and the existing parts converted into functional spaces in the new hospital?
- If the existing structures are too old to become part of the new hospital, could they be converted to a motor pool, laundry, store or workshop? Are these buildings suitably located on the site?
- Are they so old and dilapidated that they must be demolished? If so, are any of the parts, members or elements retrievable for possible re-use?

1.4 MASTER PHYSICAL DEVELOPMENT

1.4.1 Basic documents and information

(1) Documents

These consist of a written and graphic description of the site and its features, including:

- the title, which describes the property, the bearings and lengths of the enclosing property lines, surrounding, adjacent properties and roads, the area of the property and its encumbrances, if any;
- the survey plan, which translates into graphic and scaled form the data contained in the title;
- the topographic survey, which describes graphically the configuration of the site in terms of topographic lines and shows all the physical features, including trees, fences, buildings and drains;
- the slope map, for sites in which there is great variation in grade. This is seldom required since sites on steep slopes would not usually have been selected or evaluated as adaptable. When it is required, this map identifies areas on-the-site with a low percentage of slope, which is the ratio of the rise, or height (h) to the run, or length (x) (Fig. 13).

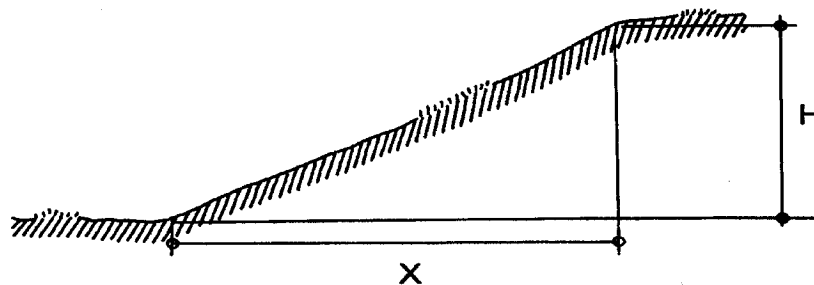


Fig. 13. Slope section

(2) Site Survey

Before the physical planning and design of a hospital is started, the proposed site must be surveyed and a plan made. The site plan indicates the following:

- the courses and distances of the property lines, including details of party walls and foundations adjacent to the plot lines;
- dimensions and locations of any buildings, structures, easements, rights-of-way or encroachments on the site;
- established curb and building lines and curb grades of streets, alleys and sidewalks at or adjacent to the site;

- all existing utility services, including their size and characteristics; the location of all piping, mains, sewers, poles, wires, hydrants, manholes, etc., upon or under the site and adjacent to the site;
- official data on which elevations are based and permanent values established on or adjacent to the site;
- information regarding the disposal of sanitary wastes and storm-water and suitability of subsoil for disposal of rainwater and sewage;
- contemplated date and description of any proposed improvements to approaches or utilities adjacent to the site;
- all trees and types of vegetation within the plot; and
- elevations on a horizontal grid system of not more than 6-m interval, indicating changes of slope, to form a basis for a contour map of 50-cm intervals.

All discrepancies between the survey and the recorded legal description should be reconciled before the physical planning for the hospital is begun.

(3) Legal documents

The legal aspect is one of the most significant considerations in planning and designing a project. Architects, engineers, planners and those in allied professions must have at least a working knowledge of the applicable laws, rules and regulations, ordinances and codes of a country before they can practise their profession. Laws are generalized acts that provide parameters, guidance, supervision, direction and control over all planning and design activities. Rules and regulations implement the provisions of the law; ordinances are local laws refined and elaborated for specific areas of application; building codes embody general policies and standards for building design and construction and the requirements of modern technology to ensure the safety and optimal use, occupancy and maintenance of buildings and other structures.

Some legal documents relevant to planning and design are:

(a) Zoning regulations

With the land-use map, this document ensures that the site selected is in the proper area for the intended use (Fig. 14). A planner who establishes a site in the overall context of the zoning restrictions of the locality paves the way to establishing the following aspects of the project:

- access and accessibility of the area,
- catchment area to be served,
- distance of other facilities and utilities required
- easements and rights of way, if any, and
- sources of materials and of local skilled and unskilled labour .

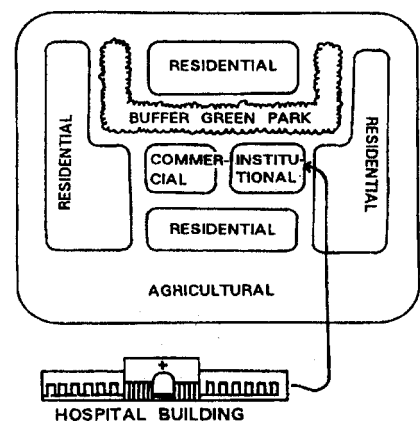


Fig. 14. Land-use map

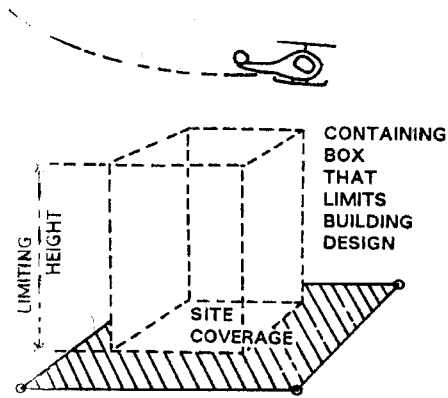


Fig. 15. Dimensional limits

The volumetric dimensional limits of the building in terms of site coverage and building height are also dependent on zoning regulations (Fig, 15).

Although such regulations constrain design, they also establish the criteria that help evolve a design that is in context with the overall plan for the community, without disturbing the local ethos and environment.

(b) *Building code*

The building code of a country is designed to achieve the maximum safety in building construction, to establish standard requirements for the construction of buildings that can withstand powerful earthquakes and other calamities or survive them without undue damage, It contains provisions for:

- general building requirements,
- site requirements,
- permits and inspection requirements,
- types of construction,
- fire zoning,
- fire-resistance requirements,
- classification and general requirements for all buildings by use or occupancy,
- light and ventilation,
- labour safety and welfare during construction,
- sanitation,
- general design and construction requirements,
- electrical and mechanical regulations,
- use of specific or special materials, such as plastics and glass,
- design and computation for earthquakes and cyclones, and
- protection from ionizing radiation from x-ray equipment.

(c) *Fire code*

A fire code is intended to minimize death, injury, loss and damage to property resulting from fire through national guidelines for the prevention and management of fire, by adopting safety standards, incorporating fire safety in design and construction and making provision for protective devices in buildings and structures.

A fire code contains provisions for:

- general precautions against fire;
- fire safety in buildings, structures and facilities;
- maintenance of fire exits;

- design of high-risk buildings, such as theatres and auditoriums;
- fire protection appliances;
- suppression control in hazardous areas;
- smoking;
- organization of fire brigades and community volunteers; and !
- management and use of combustible materials.

(d) *Other codes*

Other relevant bylaws, regulations and codes include sanitation codes, environmental protection laws and water codes; these vary in form and content from one country to another. They provide detailed provisions for design and construction. By complying with them, the planner and designer ensure that:

- the permits and licences necessary for operating the hospital will be obtained, the work is within the national standards for public health and safety, and
- the designer is protected from litigation arising from interpretation of responsibility in respect of matters covered by the codes.

1.4.2 Operational policy

No other reference can give the planner and designer a clearer picture of the functions of a hospital than the operational policy and procedures. An operational policy is a document in which answers can be found to the basic questions: "What?", "How?", "When?" and "Where?". It spells out the operational intention of the hospital at various levels; it serves as a means of communication between members of the planning team; as it is a record of all the information on which planning and design were based, it can even serve to evaluate the performance of the finished building when it is in use. The operational policy of a hospital may be developed at both the level of the whole hospital and at the departmental level. Policies at the level of the entire hospital affect all aspects and determine the disposition of the parts of the hospital on the site. They identify groupings of activities that must therefore be zoned together. Departmental-level policies affect the internal organization of particular departments within the context of the whole hospital.

Development of an operational policy can be time-consuming, but organizing the process in steps using a prepared checklist can hasten the process. The major aspects that comprise the framework of an operational policy are:

- (1) Function-both the major and minor functions of the health service system
- (2) Scale-the workload and the number of staff required to meet the workload
- (3) Organization-the procedure by which functions are to be carried out
- (4) Administration-the management structure that oversees the whole operation

(1) Operational Functions

- (a) *Major operational functions*
 - (i) Aims and objectives of the services to be provided
 - (ii) Patients and types
 - (iii) Types of illnesses to be treated
 - (iv) Activities involved (e.g., reception and documentation, diagnosis and treatment, disposal)
- (b) *Minor operational functions*
 - (i) Other functions contemplated (e.g., teaching, research)
 - (ii) People involved (e.g., patients, staff, researchers, students, outside faculty members)

(2) Scale

- (a) *Workload* (e.g., daily number of in-patients treated, of in-patient meals served, of X-rays taken)
- (b) *Manpower and staffing* needed to meet the workload

(3) Organization policy in regard to:

- (a) *Patient movement.* The manner in which patients are moved---on stretchers, their own beds or wheelchairs-affects decisions on circulation routes and spaces, corridor widths and door widths. It also affects decisions on types of vertical routes to be used, whether stairs, lifts or ramps.
- (b) *Staff and staff movement.* The routes taken by the staff from the outside to their places of work, how they arrive and their distribution within the hospital bears on the size and siting of staff areas and amenities, including areas for parking, changing, resting, conference and study.
- (c) *Supply delivery.* A hospital may adopt a centralized system for storage and delivery of supplies. In this case, corridor routes by which supplies are brought from the central store to departments must be of adequate dimensions to accommodate the delivery of equipment used such as trolleys and mechanical pullers. In hospitals that opt for decentralized systems, traffic routes are simpler but a number of sub-supply posts must be provided in different departments or units.
- (d) *Disposal of used goods.* Used goods, especially contaminated ones, very often require design solutions that involve segregation of clean and dirty streams of traffic. Segregation may also involve use of plastic bags or sealed containers, so that clean and dirty streams can use the same corridor.

- (e) *Laundry services.* When laundry is to be undertaken within the hospital, a complete facility must be provided; if it is to be contracted outside the hospital, laundry areas may be limited to a receiving counter for clean supplies and a temporary station for soiled linen to be collected by the outside agency. Provision for washing "foul" linen may still be necessary.
- (f) *Food services.* A centralized kitchen from which food is brought directly to patients will be large, and centralized food management will mean that the movement of large food trolleys must be considered in the design of the corridor system. A kitchen that is decentralized to the departments and wards will be smaller at the central point but will involve satellite kitchens for tray and plate preparation and washing and storage of utensils and equipment.
- (g) *Domestic service.* A centralized domestic service will require large storage areas for fresh linen and cleaning equipment. In a decentralized system, these areas will be smaller units in different parts of the hospital.
- (h) *Security.* The number of entrances and exits is often the concern of the security unit of the administrative office of the hospital. The decision taken on the maximum number affects circulation and circulation routes both inside and outside the hospital building.
- (i) *Engineering services.* The checklist for this aspect will include questions like:
- Should hot-water lines be provided in addition to cold-water lines? If so, in what departments?
 - Should the hospital be air-conditioned? Should the air-conditioning be centralized for the whole hospital, or should it serve only selected areas? If selected areas, which departments or units?
 - What medical gas lines should be provided? Should the lines be centralized or decentralized? At what points should the lines have outlets? Or should the provisions for gas be in the form of portable tanks on carriers with rollers?
- (j) *Fire safety.* Fire safety is not limited to the provision of fire exits and fire control; fire safety should start with the design of the building. It can be improved by good planning and recognition of the specific problems of hospitals. A minimum of two compartments should be provided per floor, with proper facilities to stop fire and smoke and fire doors of appropriate standard. The larger the continuous floor area on any storey, the more fire compartments are required; this also ensures greater opportunity for progressive evacuation. Maximum amounts of fire-resistant materials should be used in constructing the buildings, in false ceilings and in partition walls, so that they have the requisite fire-resistance and flame-spread ratings as outlined in the code.
- (k) *Communication and call systems*

The types of wired communication should be decided on, and whether all or only some of the following are required:

- internal telephones
- external telephones
- public (coin-operated) telephones

- intercoms
- patient-nurse call buttons
- emergency alarms
- public address system
- radio and television
- others

(4) Administration

- (a) Administrative arrangements
- (b) Office accommodation

1.4.3 Site utilization

The hospital is a rational organization of spaces in hierarchical level: the whole hospital consists of zones, which in turn consist of spaces (Fig. 16). The space is the smallest architectural unit in this hierarchy: here, people (patients, staff, the public, students) and goods (supplies, equipment and records) interact. Thus, the design of the hospital must proceed in the same way—from the macro to the micro level, from the general to the specific, from the whole hospital to the space. The designer must envisage the whole hospital as the sum of all the parts. Some of the items that must be analysed at the level of the whole hospital are described below. In all of these analyses, it must be remembered that socio-cultural considerations have very strong bearings on the success of planning and design for hospital spaces. In some countries, the family of the sick invariably accompany the sick to the hospital. Thus, site planning must provide for open spaces where the family may temporarily stay in makeshift tents or huts. If resources so allow, it is best to incorporate spaces for transient use of families of the sick in the overall planning and design of the hospital complex.

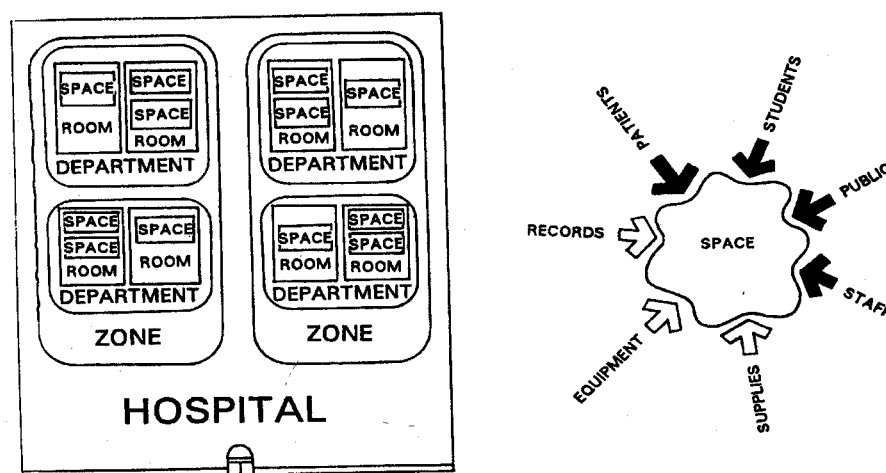


Fig. 16. Organization of zones and spaces

(1) Plot ratio

The area of the site covered by buildings can be expressed in terms of the plot ratio, using the formula:

$$\text{Plot ratio} = (\text{Total hospital area} + \text{total area of site})$$

The total hospital floor area can be obtained from the schedule of accommodations in the architect's brief, making due allowance for additional areas required for circulation.

Examples of plot ratios and subsequent possible schemes for distributing the required areas in the hospital are as follows (Fig. 17):

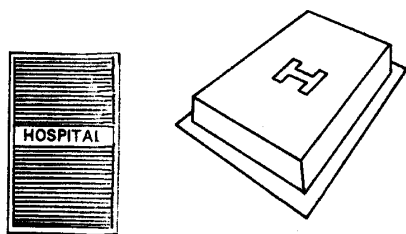


Fig. 17a

A plot ratio of 1 means that a one-storey building will cover the entire area of the site (Fig. 17a).

Since it is recommended that 50% of a site area be left open for roads, other circulation routes, parking and landscaping, a plot ratio of one would require a solution in which the area requirements are distributed in a two-storey building. (Fig. 17b)

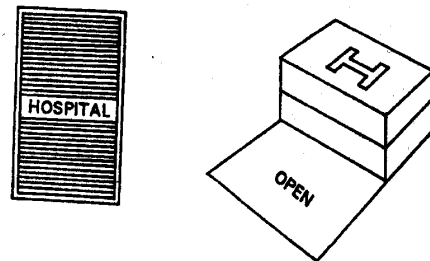


Fig. 17b

Similarly, a plot ratio of 2 would lead to a four-storey solution (Fig. 17c) and a plot ratio of 0.5 would lead to a one-storey solution (Fig. 17d).

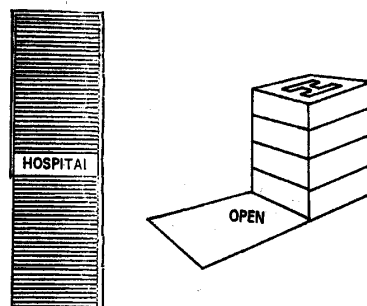


Fig. 17c

In the suburbs, where population densities are low and land can be obtained easily, a plot ratio of no more than 0.5 should be sought. In the centre of a town, no more than two should be provided.

Plot ratio, however, is a measure of desirability and is not an absolute requirement. Plot ratios of more than 2 may be justified where land is expensive and use of available properties must be maximized. In these cases, building coverage is regulated by building codes with regard to:

- the distance of the building from the property Fig. 17d boundary, and
- the maximum allowable height, which in turn is limited by structural and soil conditions and by regulations with regard to, e.g., airplane and helicopter routes.

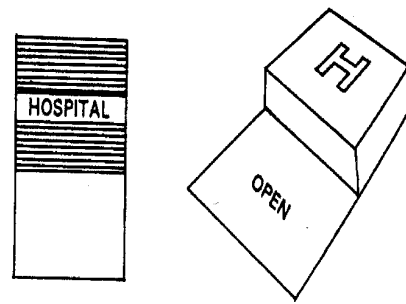


Fig. 17d

(2) Orientation

The orientation with regard to the sun and prevailing winds must be checked (Fig. 18). It has been found that orientating buildings along an east-west axis, giving the longer sides of the building northern and southern exposures, is the most desirable. In areas where the major climatic problem is humidity rather than heat, buildings should be sited at a slight angle, either towards the east or the west, depending on the direction of the prevailing wind. In the cold countries, buildings should, as far as possible, be south facing to allow the maximum exposure to the sun.

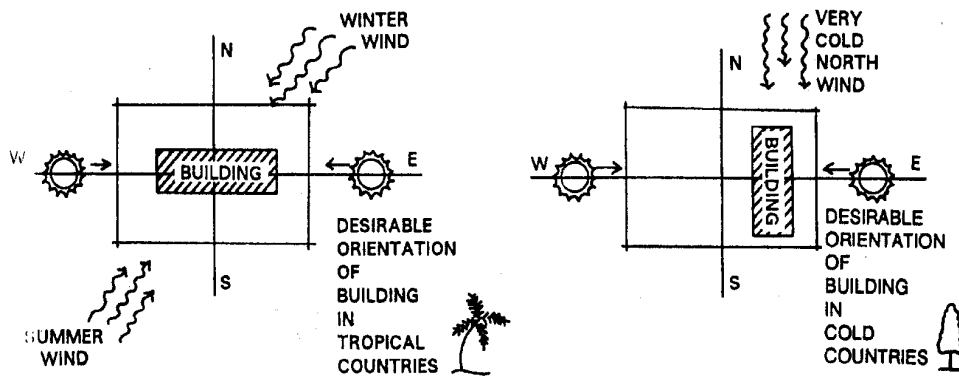


Fig. 18. Orientation of sun and wind (conditions in northern hemisphere)

In order to overcome severe aspects of the climate at the building site, a favourable microclimate should be provided through landscaping, lawns, paving and planting trees and shrubs as well as constructing ornamental bodies of water and creating sunny and shady areas.

Illumination and ventilation are major problems in hospitals, and these are further aggravated by modern trends to construct "deep" buildings using steel and reinforced concrete. Good ventilation in tropical climates ideally requires long, narrow buildings; but this is not always feasible, and a compromise must be found by separating activities and orientating buildings or wings of buildings. Incorrect orientation of buildings strongly affects the consumption of energy in the finished hospital.

In areas where there are heavy rains accompanied by wind, all openings should be protected against wind-driven rain. In hot, humid areas, the external surface should reflect as much solar radiation as possible, and the walls and roof should, as far as possible, be made of lightweight material with low thermal capacity.

(3) Slope study

On sites with steep slopes, the best areas for building must be found. As a rule, slopes of 0-10% are desirable and easy to build on (Fig. 19); slopes greater than these require either massive cuts or massive fill or a combination of the two.

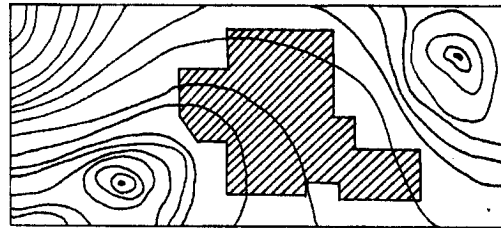


Fig. 19. Slope map

(4) Landscaping and horticulture

Advances in technology often entail a risk of lowering the quality of the environment. The setting up of a modern hospital on a new site is no exception. Even a functionally well-designed building sometimes does not fit in with the environment and does not provide the level of comfort and friendly surroundings necessary for patients. The solution may lie to a large extent in proper landscaping and horticulture arrangements, which should form part of the master plan.

The physical features of the land surrounding a building—shape, contours, whether open or dotted with large trees, location of other buildings—affect the prevailing wind. Wind lanes are thus formed, or useful breezes might be blocked. The most severe aspects of the climate and the handicaps of the building site should be observed in detail, so that they can be corrected to provide, as far as possible, a favourable microclimate by landscaping, grassing, paving, planting trees and shrubs, constructing ornamental bodies of water and creating many sunny and shady areas. Dense vegetation in arid areas controls hot, dusty winds, while transpiration from leaves increases humidity and lowers the temperature. In humid areas, bushes and trees can be planted to deflect or divert winds into the building (Fig. 20; Manahan, 1983). Similarly, waterways and water channels help to reduce temperatures, and the grassing over of large areas of ground reduces glare.

1.4.4 Circulation

Circulation routes in a hospital consist of external and internal routes.

(1) External routes

These consist of traffic lines within the site, from the access point to the entrance of the building (Fig. 21). They are generated by various kinds of exterior traffic, including:

- patients on foot,
- patients in cars or on motorcycles,
- patients in ambulances,
- visitors on foot,

- visitors in cars or on motorcycles,
- staff on foot,
- staff in cars or on motorcycles,
- supplies delivery
- rubbish collection
- removal of the dead
- special route for fire trucks.

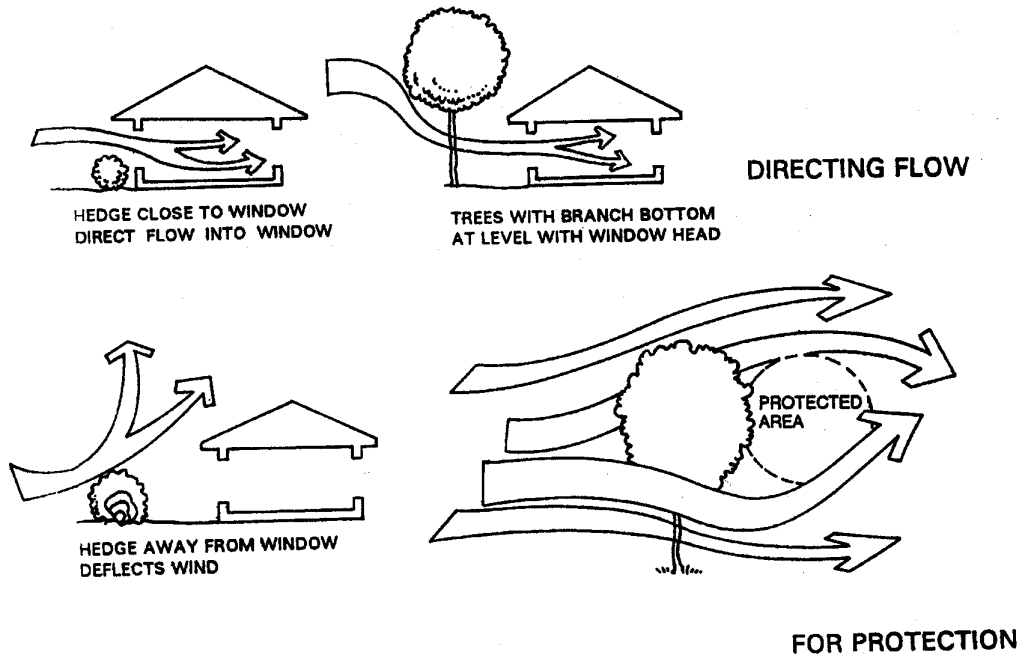


Fig. 20. Use of plants and trees to direct air flow

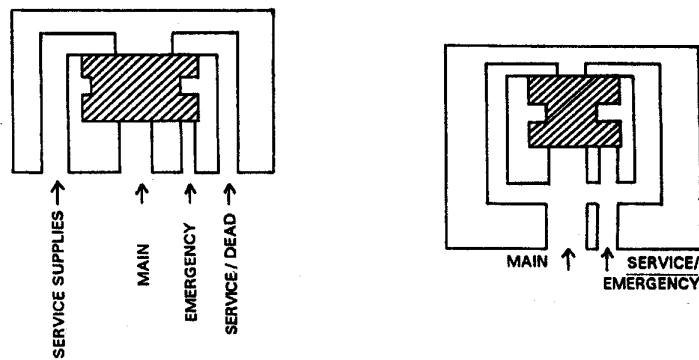


Fig. 21. Distribution of access routes

These various types of traffic should be grouped for entry into the hospital premises according to their nature. An important consideration is that traffic moving at extremely different paces (e.g., a patient on foot and an ambulance) should be separated. Some hospital guidelines recommend four access points to the site, in order to segregate traffic:

- emergency: for patients in ambulances and other vehicles for the emergency department;
- service: for delivering supplies and collecting rubbish;
- service: for removal of dead; and
- main: for all others.

This kind of decentralized distribution of access, however, poses security and control problems, and hospital administrators prefer fewer points of entry and exit. A design solution that takes this into consideration is to have one or a maximum of two entrances and to break the main access road into several branches in a hierarchy of roads within the site.

(2) Internal routes

Internal traffic streams link departments; some important guidelines are as follows:

(a) Corridor size in relation to traffic intensity

Studies have shown that traffic problems are caused by:

- inadequate pace of circulation, e.g., when there are more users than were provided for;
- different paces of circulation, e.g., when a slow-moving trolley bed with a sedated
- patient and equipment obstructs the normal flow of traffic in a busy corridor; and
- two-way traffic, e.g., when a food trolley and a bed trolley cross at a corridor intersection.

A study of traffic in hospital corridors showed however, that a corridor 2-3 m wide can accommodate daily traffic. A corridor 3 m wide in a major hospital can accommodate a walking traffic load of 4000 people per direction per hour, or 8000 people in both directions per hour, assuming a free-flowing walking speed in hospitals of 4 km/h. The same corridor can accommodate 20-60 journeys per hour of wheeled traffic, including supplies, bed and food trolleys.

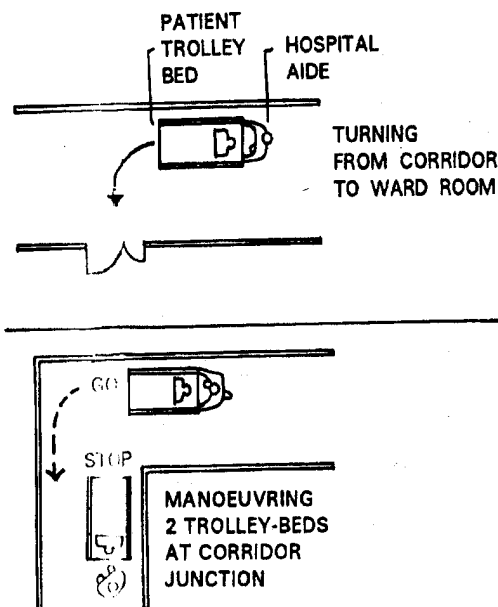


Fig. 22. Manoeuvrability of wheeled equipment

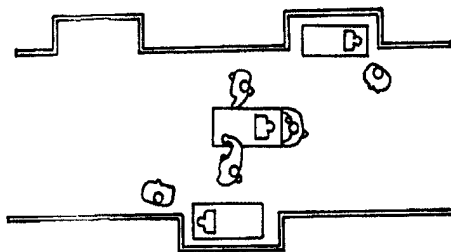


Fig. 23. Accommodation of stationary equipment

(b) *Corridor size in relation to manoeuvrability*

The intensity of the traffic in a hospital is critical factor in deciding dimensions of its corridors; rather, the overriding factors are:

- manoeuvrability of wheeled equipment at doors, junctions and routes of vertical movement, such as ramps, stairs and lifts (Fig. 22); and
- accommodation of stationary wheeled equipment in corridors as other users pass by (Fig.23). (Storage of equipment in corridors should be discouraged.)

Corridors in outpatient departments and ward blocks should not be less than 2.8 wide. A corridor must be wide enough to accommodate two passing trolleys, one of which may have a drip attached to the Fig. 23. Accommodation of stationary equipment patient.

(c) *Vertical circulation*

If site limitations and functional interrelationships lead to a multi-storey design, the following guidelines should be considered:

The *stair* is the traditional and most economical route of vertical circulation (Fig. 24); however, its use as the only means of vertical circulation is limited to four storeys for walking public and staff, beyond which it must be supplemented by mechanical equipment. The stair must also be evaluated in terms of manoeuvrability; movement of trolleys and beds requires ramps and lifts.

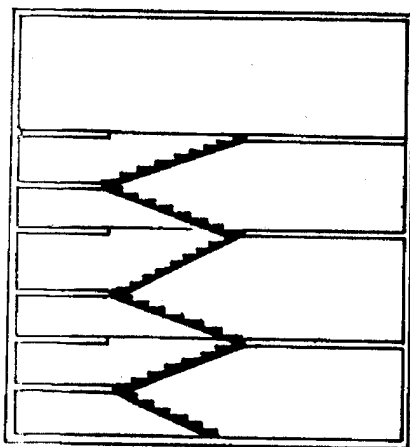


Fig. 24. Stairs

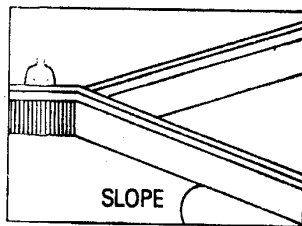


Fig. 25. Ramps

- The *ramp* is very convenient for wheeled traffic (Fig. 25), especially when there is no electricity supply. Since its slope must be 1:15 to 1:18, however, for safety, comfort and ease of movement, it requires a great deal of space. It must also be checked for manoeuvrability of beds and trolleys at any turning point.

- The *lift* is versatile for transporting all kinds of traffic vertically (Fig. 26). Owing to their cost, however, lifts cannot always be located at points where specific departments need them. A lift system must be designed with a clear picture of departmental distribution and must be coherent with the hierarchy of circulation routes in the hospital. The key point must be determined, at which the lifts will be grouped and from which traffic will circulate on each floor. It is recommended that the distance of a lift from the furthest point on a floor should be no more than 30 m.

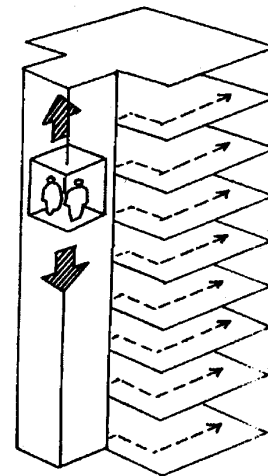


Fig. 26. Lifts

The number of cars of specific passenger load and car speed is difficult to determine using empirical formulae. Studies must be made on type of traffic, floor of origin, floor of destination, time of trip, programmes and schedules of departments, plan of supply rounds and other data. Such studies are tedious to undertake. In the absence of standards, some experience in existing multi-storey hospitals confirms the adequacy of: two lift cars large enough to accommodate one trolley bed and eight passengers or 16 passengers and travelling at 105 m/min for a 100-bed hospital; and three lift cars of the same specifications for a 200-bed hospital. (These figures have not been adopted as a standard in any official document or by any formal study and they require confirmation.) Adequacy is also affected, of course, by public use. It is desirable to encourage the public to use the stairs, unless they are elderly, frail or incapacitated.

- The *escalator* is a luxury provision: it is expensive to install and it devours much space. Its use is limited to ambulant people, and it cannot be used for wheeled, large hospital equipment. Its use is not recommended for any district hospital in the foreseeable future.

1.4.5 Growth and change

Provision for growth is often ignored or treated as an afterthought, but it should form part of the initial planning and design process. If it is left to the time when an urgency is recognized for more beds, laboratory services or X-ray services, it may be difficult to accommodate these needs. It is therefore of utmost importance that, when preparing the master plan for the hospital, imaginative foresight be used to identify the areas in which there will probably be fast growth. Growth is inevitable and is generated mainly by:

- *Growth of the community.* A community may urbanize or may change drastically as the result of an event or a catalysing situation that requires the equivalent growth of health care services.
- *Accumulated needs and requirements.* Necessary expansion may not be undertaken immediately because of lack of resources; needs are deferred and accumulate to the bursting point.
- *Physical effects on the building with time.* Buildings deteriorate and become obsolete and even irrelevant over the years.
- *Changing standards and codes.* Regulations for health and safety change to meet advances in construction techniques and materials. A building may be declared unsafe and unfit for human use if it is not updated, upgraded and properly maintained.
- *Changing methods in medicine.* Development of new equipment, miniaturization, computerization and other new technologies in the medical field translate into new requirements for architectural design to provide better and more modern clinical services.

When difficulties become apparent, the first step is to see whether there are alternative ways of overcoming the problem. Sometimes, management solutions can alleviate difficulties and make it possible to avoid or defer the need for expansion or replacement of existing facilities. When a new building with new service facilities appears to be needed for a particular department, it is sometimes possible to adopt more cost-effective procedures within the old building; the planned new service facilities may simply be the same as the old ones but in a larger space.

(1) Physical growth of hospitals

(a) Outward growth

This is the recommended form of expansion (Fig. 27). Thus, those areas in which growth is most probable should adjoin an outside wall; areas that are non- or slow-growing should be in the central part of the building complex. Outward growth requires that departments be placed where they can expand into open space without disturbing the operation of other parts of the hospital

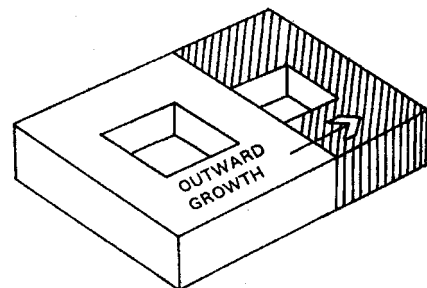


Fig. 27. Outward growth

and infrastructure, including the road network and sewer lines. Obviously, the greatest scope for independent expansion of separate components is available in single-storey complexes with separate buildings, each of which is extendable independently of the others (Fig. 28).

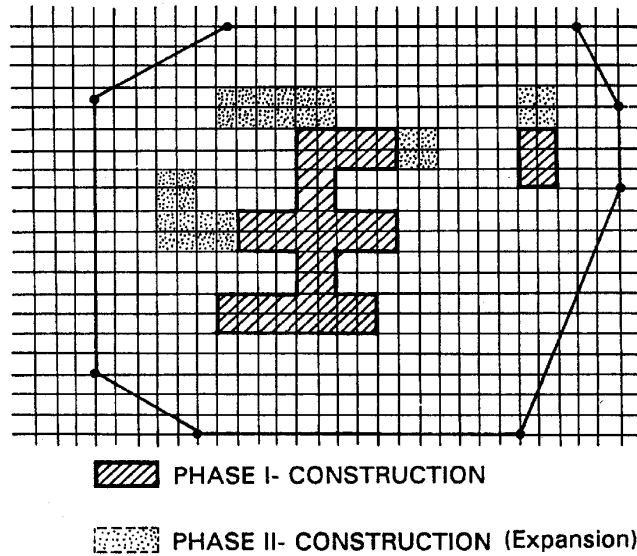


Figure 28. Independent expansion of separate components

(b) *Upward (vertical) growth*

This direction of growth is the option for block forms on very limited sites (Fig. 29). It disrupts operations, particularly on the top floor of the hospital; construction materials are difficult to transport, requiring an elaborate system of scaffoldings and hoists. Excess material, although initially expensive, must be installed ahead of time, in:

- foundations that will accommodate the future load of additional floors;
- sanitary, electrical and mechanical systems that will accommodate future requirements;

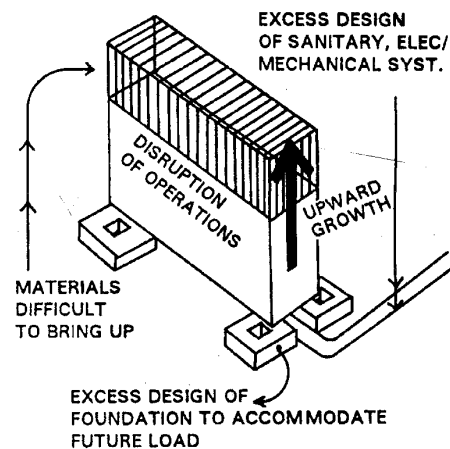


Fig. 29. Upward growth

- a strong roof slab on the top floor that can be converted to a future floor slab that will support the projected load of patients and equipment; and
- special and sometimes costly provisions to ensure that the building remains waterproof throughout the period of extension,

(c) *Downward (vertical) growth*

This direction of growth utilizes the basement volumes, when they are not part of the original design (Fig. 30). This can cause enormous problems of adequate headroom and in clearing the existing system of foundations and columns,

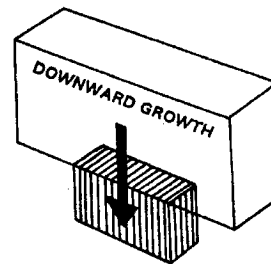
Furthermore, there are problems of waterproofing and damp-proofing the new retaining walls. As windows will be limited or impossible to install, there will be problems in providing natural ventilation and light. It is always desirable to avoid this type of growth, owing to technical and cost considerations.

(d) *Inward growth*

This direction of growth pushes adjoining departments out of their location to make way for a growing department (Fig. 31). It usually occurs in concentrated types of development. This type of growth disrupts the operation of the growing Fig. 31. Inward growth departments and the adjoining department.

(e) *Growth by fragmentation .*

This is the division of a single department into several sub-units in different locations (Fig. 32). Departments and other units that can be fragmented are: administration, dining, laboratories, storage, lockers and records. Fragmentations should be avoided, however, as they pose problems of management and control and the hospital ultimately becomes less efficient and productive owing to duplication of necessary support services.



PROBLEM:
HEADROOM ADEQUACY
WATERPROOFING/ DAMP PROOFING
VENTILATION, LIGHT
CLEARING EXISTING FOOTINGS

Fig. 30. Downward growth

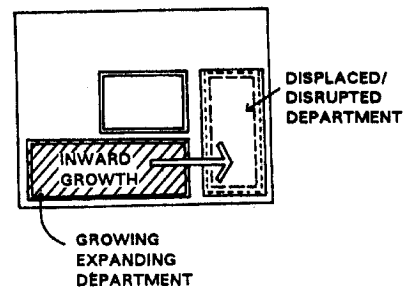


Fig. 31. Inward growth

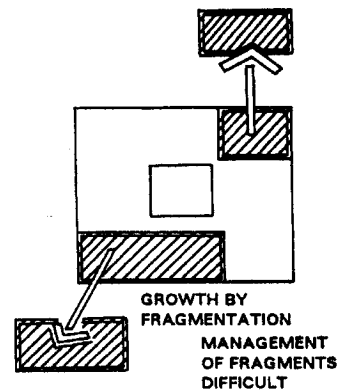


Fig. 32. Growth by fragmentation

(2) Increments of growth

It is most advisable to expand not in spurts with needs but by deliberate increments, thus:

- by number of beds, but in terms of ward units with their complementary manpower and supporting services (Fig. 33a);
- by functional units, in the case of a new hospital department (Fig. 33b);
- by specialist rooms and their supporting units and services (Fig. 33c).

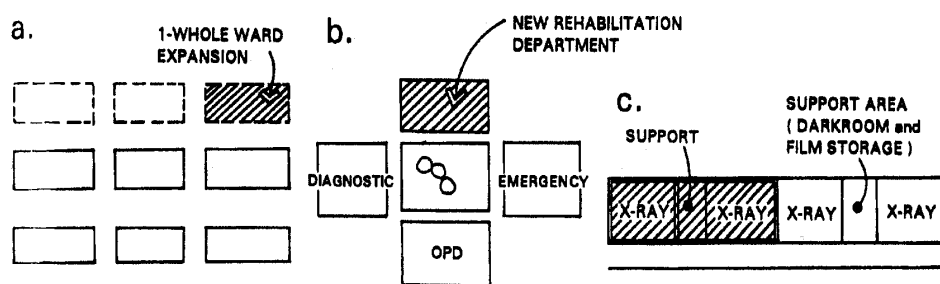


Fig. 33. Increments of growth (OPD, out-patient department)

1.4.6 Energy conservation

(1) Choice of level of technology

Energy conservation can be addressed on two levels: practical low-level technology and sophisticated high-level technology .

The choice of the level of technology depends on a number of factors: low-technology solutions are less financially demanding and easy to maintain; high-technology equipment ensures the precise control of environmental conditions necessary for some hospital procedures but demands a high level of maintenance and spare parts inventory. The designer also has the option of combining high- and low-level technology.

High- and low- technology responses are also found with regard to power sources. High technology plants (hydroelectric, thermal, nuclear and others) produce energy for the large-scale requirements of cities and countries, both domestic and industrial. By converting waste from human beings and animals into bio-gas, a useful source of energy is harnessed for minimal light requirements.

(2) Utilization of solar energy

Some departments in a hospital, such as the laundry, kitchen and wards, need a constant supply of hot water. The hot-water supply in a hospital not only requires the consumption of large amounts of conventional energy but also frequently fails, owing to lack of proper, timely maintenance and lack of availability of spare parts.

Use of simple, solar heating devices can avoid most such problems and ensure a reliable supply of hot water, particularly in tropical climates, where supplementary energy is needed only during the cold season. Aided by the orientation of the building, this almost maintenance-free system can provide hospitals with hot water (up to 60°C) at very low cost.

A number of solar water heating systems of varying capacities are now available on the market. A simple system is shown in Figure 34.

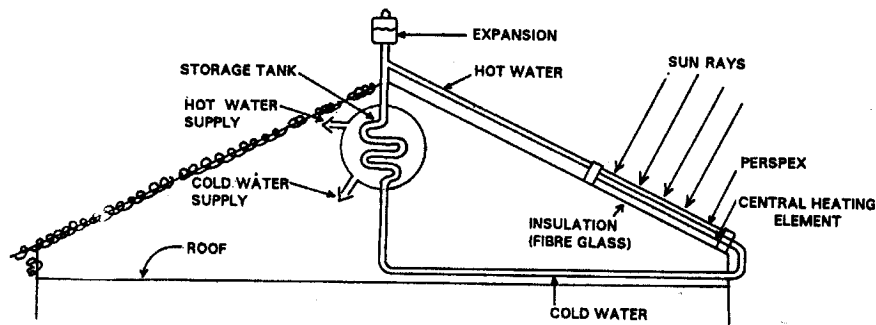


Fig. 34. A simple solar heating system

Solar energy can, of course, also be made use of for natural lighting. Windows should be as tall as possible in order to provide maximal lighting against the inner wall; the angle of incidence of light from the window to the inner working areas should be not less than 27°. Special inlets with translucent covers can be placed at various places in the roof to supply glare-free light during the day in various areas of the hospital, such as corridors, waiting halls and atria.

(3) Building design

The implications of building design on the capital and operating costs of facilities must be fully understood at the outset. Adoption of the more expensive, high energy consuming forms of building involves inherent on-going costs, and unnecessary consumption of fossil fuels should be avoided whenever possible. Factors to be considered are:

- (a) Unless the external environment is severely polluted, by smog, industrial gases or noise, windows that open are the best means of ventilating most parts of a hospital. Air-conditioning is necessary in operating theatres and in a few other areas, such as intensive care units and x-ray facilities, but not in normal nursing wards, clinics or most service departments. The deep plan form of building necessitates more widespread use of expensive air-conditioning and artificial lighting.

- (b) Buildings that require high energy result in increased capital and operating costs, and the latter usually increases with time as energy and fuel cost rise. Energy thus consumes an ever-increasing percentage of the hospital budget.
- (c) High-energy buildings require more sophisticated equipment and more maintenance. The life expectancy of air-conditioning equipment is much shorter than that of the building, so further capital must be spent on the repair and replacement of mechanical components.
- (d) Mechanical and electrical building service equipment requires regular preventive maintenance, and trained personnel must form part of the hospital staff or be on call to keep it operational. The funding of the building may be severely impaired when such equipment is out of action.
- (e) Since hospitals must remain fully operational in the event of a disaster or civil emergency, reliance on high-energy mechanical services may necessitate duplication of some items of equipment and the provision of emergency (stand-by) power. This also results in an increase in the cost of the project.

1.4.7 Financial aspects

The construction of a district hospital is part of the national health programme and, as such, is subject to long-established bureaucratic procedures. Knowledge of these procedures of requirements, flow of approval of documents and required submissions at each stage is very useful.

Sources of funds for health facilities include the following:

- (1) national sources:
 - national appropriations;
 - special funds, established and set aside for the project;
 - share of locally generated, community funds;
 - private funds, from individuals or nongovernmental and voluntary organizations; and
- (2) international and foreign sources:
 - loan from an international funding agency;
 - loan from a foreign country;
 - grant from a foreign investor;
 - grant from a private foreign institution or foundation.

The mechanisms for obtaining, releasing, repaying, monitoring and other procedures greatly affect the work of planners and designers. The extent and schedule of release of funds affects the scope of the project, and the schedule of release of increments of funds, affects phasing of the construction and planning of components of a total project. Details of the arrangements should be known before the master planning of the project is begun.

Whatever the form of funding, reliable cost estimates should be prepared and updated at every stage of the project. A cost plan should be prepared at the earliest stage; but, as initial estimates are based on limited information, they should be reviewed at each stage of the project.

1.4.8 Master planning

The master plan of a hospital is the basis for present and future decisions on the layout of buildings and services, changes in needs and phasing. It indicates the phasing and grouping of individual buildings and the means of communication between them, the scale and location of utilities necessary at various stages, and directions and limits of probable future expansion or remodelling of the hospital. Any mistake in placing buildings, access roads, sewer systems, entry points and parking facilities on the site can restrict possibilities of growth.

The architectural and engineering aspects of the project are evolved within the master plan on the basis of:

- grouping main functions, like wards, medical services, admissions and central supplies;
- establishing appropriate access routes for easy orientation of patients and visitors, with special emphasis on disabled people; and
- providing scope for future expansion (see section 1.4.5, above), to cope with an increased number of beds, supplementary functions and medical specialization, by ensuring maximum interaction between hospital units and support services.

The master plan consists of two elements: (i) determination of circulation routes and corridor systems; and (ii) location of elements on the site in relation to one another.

Circulation routes and corridor systems (discussed above in section 1.4.4) must be designed so that all users can find their way around with least difficulty. The main circulation loop must be discernible as such, and the hierarchy of secondary routes that in turn break into more minor traffic paths must correspond to the hierarchy of the hospital units they serve. Simplicity should be the target of design; this reduces the requirements for signs and improves the quality of service.

The placing of elements and departments on a site should result in an optimal interrelationship among departments and provide room for expansion (Fig. 35). Some principles and guidelines for the disposition of the units of a hospital are as follows:

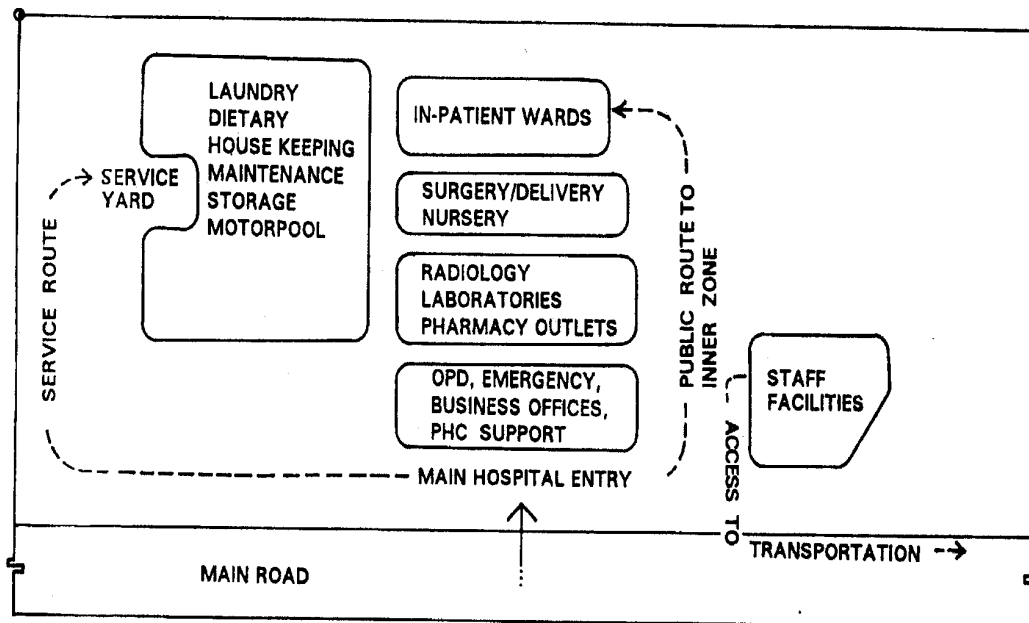


Fig. 35. Zoning of elements on a site

- (1) Departments that are most closely linked to the community should be closest to the main entrance: out-patient department, emergency, administration (especially business sections), family planning clinic and other primary health care support.
- (2) Departments that receive their workload from those described above should be next closest to the entrance: X-ray, laboratories, dispensary.
- (3) In-patient departments should be in the interior zones, or wards.
- (4) Operating theatres, the delivery department and the nursery should have (1) and (2) on one side and (3) on the other, e.g., to provide easy access from the emergency and accident departments to X-ray and operating theatres. The delivery department and nursery must be separated from the operating theatre.
- (5) Housekeeping and domestic service areas should be grouped around a service yard: laundry, kitchen, housekeeping, maintenance, storage and motor pool.
- (6) Staff facilities should be located on the periphery near roads and public transport: staff dormitories, quarters or housing.
- (7) Teaching facilities, if any, should be close to both staff facilities and teaching areas and to roads and public transport: student areas, educational and training components of primary health care.
- (8) The mortuary should be in a special service yard, with a discreet entrance; it should be away from the out-patient department, ward block and nursery.

1.4.9 Building shape

The district hospital should reflect the local architecture. Every country and every community has its own concept of form and of space and of their interrelationship, as well as having its own feeling for scale and proportion. The district hospital should reflect the rhythm of the local culture civilization and historical heritage but at the same time be flexible enough to accommodate mode.

methods of health care and facilities. The hospital should not be alien to its surroundings or stand out as an exception but should fit in with local life, expressing its spirit and character. The hospital building should not be a huge, unfriendly, structure but should be a human, welcoming part of the community.

Layouts suitable for tropical climatic conditions include: an open-plan layout for "hot-humid" areas; a compact layout for "hot-dry" areas; and a compact layout for "upland" regions. But, as stated in a publication of the American Institute of Architects:

There are no stock or standard plans for health care facilities. Each facility will be unique to the extent that site constraints, local zoning, vehicular access and neighbourhood requirements are taken into consideration in the initial project.

This also applies to the varying conditions of project sites in the countries of the Western Pacific Region. Some of the basic shapes of hospitals, and the reasons for using them, are as follows:

The *village* form (Fig. 36) is organized like a small town, in which corridors correspond to streets and departments correspond to the different land uses of a village. This design is easy to phase, which is useful when the budget is limited. It is also easy to expand, since the design is open-ended, and a wall can simply be broken down for expansion into an open space. This form requires, however, a large site; and if sufficient room is to be provided for ultimate growth, the distances between departments will be great.

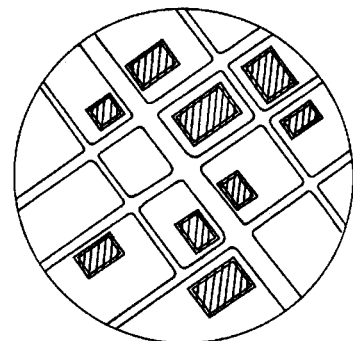


Fig. 36. Village form

The *modular village* form (Fig. 37) is similar to the village concept except that the departments must fit into a predetermined form. This form is useful when repeated modules are used. It results, however, in forced planning of departments to fit within the same shape: some will fit just right, others will be "bursting at the seams" and others will have wasted space.

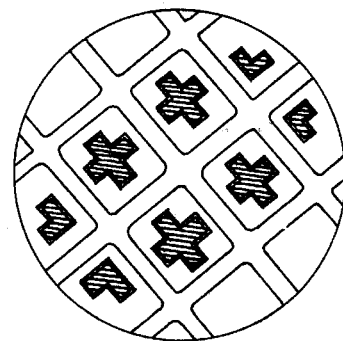


Fig. 37. Modular village form

The *finger* plan consists of central corridor and side corridors, which link various departments branching out in "fingers". It is a development of the *train corridor* form (Fig. 38), in which one must pass through one compartment to reach the next. Since the corridors in the finger plan have single functions, this form lends itself to the provision of abundant natural ventilation and lighting.



Fig. 38. Train corridor

An *open-ended finger* development plan (Fig. 39) can allow for the expansion of individual blocks at different times. It also allows for staged development, by progressive extension of the main corridor as further components are required.

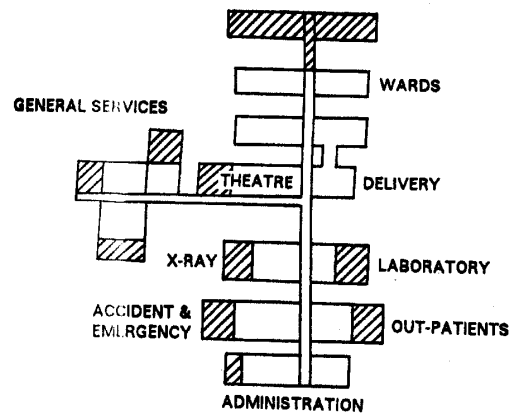


Fig. 39. Open-ended finger plan

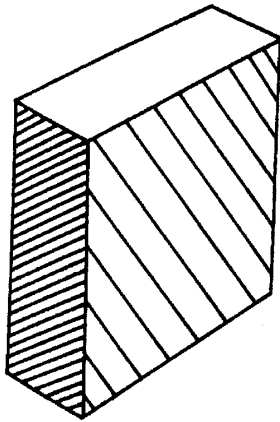


Fig. 40. Block form

The *block* (Fig. 40) is a form for sites where the ground area is limited. As the hospital is developed vertically, optimal relationships between departments may be difficult to achieve and one department may be disposed on two levels. It is also a form that is difficult to expand later. It is appropriate for designing wards, since wards have generally similar floor plans; however, structural costs are likely to be higher than those for a similar number of wards in a single-storey construction.

In the *tower and podium* design (Fig. 41 a), the fastest growing departments are located in the ground floor podium and those that are slow-growing and departments that are typical and replicable are located in the tower. This form was developed with expansion and growth as the overriding criteria. The tower, however, relies heavily on mechanical engineering services, and the structure of the tower and the location of lifts and service ducts may severely limit the central area of the podium. The roof of the podium must be constructed of fire-resistant materials so that fire will not spread from the podium via external walls and windows to the tower block.

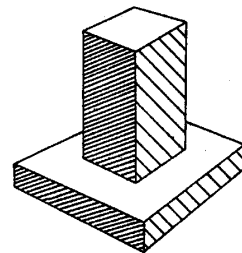


Fig. 41a. Tower and podium design

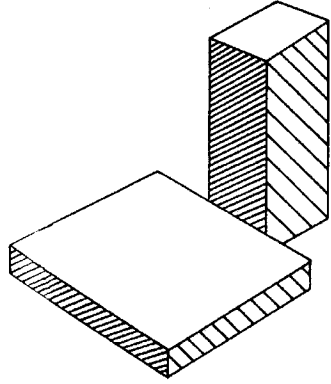


Fig. 41b. Alternative tower and podium design

If the site permits it, there are definite advantages to placing the tower block next to rather than on the podium (Fig. 41 b).

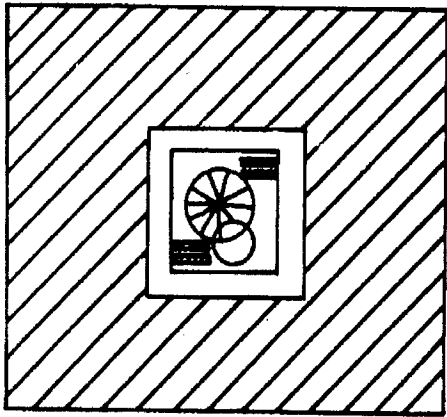


Fig. 42. Court plan

The *court* plan (Fig. 42) closes on itself. It has the same advantages of natural lighting and ventilation as the village and finger plans but is easier to secure and more comfortable in humid tropical areas. This plan does, however, impose certain limitations; rooms at the corners of the court have no external light or ventilation; facilities that face the court cannot be extended without displacing other rooms. Increased demand for space may also mean that the area occupied by the air-conditioning, and underground services (e.g., sewer and storm-water drains) that pass through the area may have to be relocated.

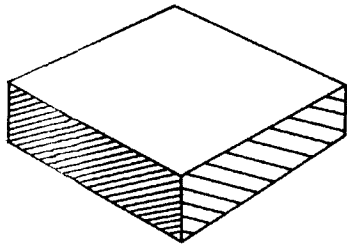


Fig. 43. Compact plan

The *compact* plan (Fig. 43) is a "deep" form and its proper functioning relies heavily on engineering services. Artificial ventilation and lighting must be provided for inner areas; heat generated by people and equipment must be removed by artificial cooling. This type of plan is therefore expensive to construct, operate and maintain. Compactness can be of advantage in terms of proximity of departments and of conservation of space, as in densely populated metropolitan areas. In such cases, however, the building usually has several floors, and the proximity of departments may be reduced by vertical separation.

1.5 DEPARTMENTAL PLANNING AND DESIGN

This section deals only with general principles of planning and design. The detailed design brief should contain a comprehensive schedule of accommodation for each department and should state the functional planning requirements for each activity to be carried out in each space.

The different departments of the hospital can be grouped according to zone, as follows:

- (1) Outermost zone, which is the most community oriented
 - primary health care support areas
 - out-patient department
 - emergency department
 - administration
 - admitting office, reception
- (2) Second zone, which receives workload from (1)
 - diagnostic X-ray
 - laboratories
 - pharmacy
- (3) Middle zone between outer and inner zones
 - operating department
 - intensive care unit
 - delivery
 - nursery
- (4) Inner zone, in the interior but with direct access for the public
 - wards and nursing units
- (5) Service zone, disposed around a service yard ~
 - dietary services
 - laundry and housekeeping
 - storage
 - maintenance and engineering
 - mortuary
 - motor pool

1.5.1 Primary health care support areas

The three ways in which a hospital supports primary health care are: education and training, technical support and administrative support. Specific areas should be designed so that the hospital can fulfill its role in primary health care in the community.

(1) Education and training support areas

About 85-90% of out-patients seek solutions to medical problems that could be dealt with at home; only 10-15% have been referred from general practitioners and peripheral health units. Of the latter, 30-35% have major medical conditions. It is clear, therefore, that the number of unnecessary trips to hospital could be reduced if people were educated about the nature of various diseases, their causes, their treatment and how to stay healthy. As long as people run to the hospital whenever they feel ill, however, the medical staff of the out-patient department can serve as agents to teach better health rather than merely dispensing medical treatment.

First-referral hospitals must therefore integrate spaces for education and training in their plans. Such spaces are convertible, flexible, multi-use spaces (such as classrooms) or corners found elsewhere (such as shelves for books and magazines). They may include (Fig. 44):

- classrooms where primary health care personnel can lecture and show films and other audio-visual materials on the promotion of health, prevention of disease, sanitation, hygiene and family planning;
- classrooms for training paramedical personnel and volunteers;
- a library or reading room, containing materials on health written and illustrated for the layman;
- a "primary health care court", "garden" or "gallery", the name being designed to create awareness of primary health care; this area can be accessible to out-patients, so that those who are waiting their turn can absorb educational material from exhibits (Fig. 44a);
- a "primary health care corner" in the consultation or examination room, with educational materials for the use of medical staff (Fig. 44b);
- use of dayrooms on wards for regular showing of films on health to patients, visitors and staff (Fig. 44c);

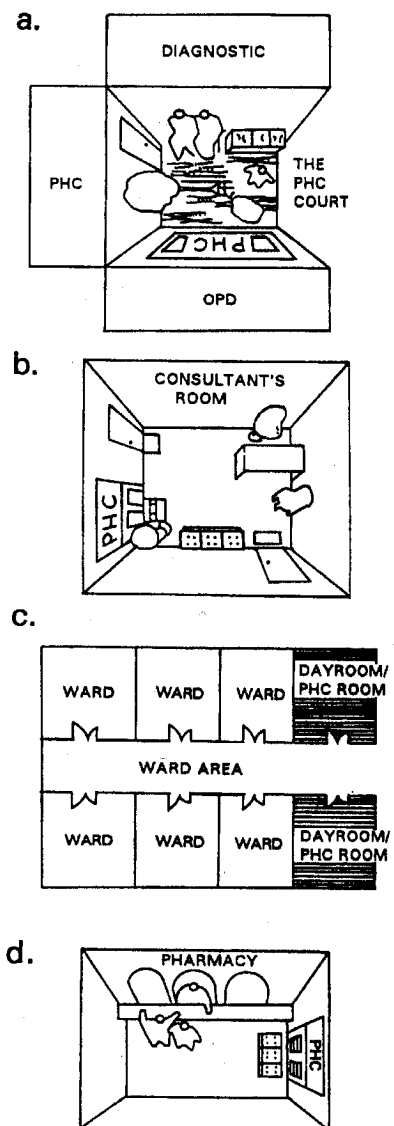


Fig. 44. Spaces for education and training in primary health care (PHC; OPD; outpatient department)

a corner in the dispensary containing information on the use of drugs and of equivalent herbal medicines (Fig. 44d).

(2) Technical support areas

The hospital can provide a laboratory service for the primary health care complex, in clinical haematology, biochemistry, histopathology and analysis of body fluids, either by expanding its laboratory facilities or by providing mobile services, or both (Fig. 45). Similarly, a central blood bank can be established at the hospital for use by the primary health care complex.

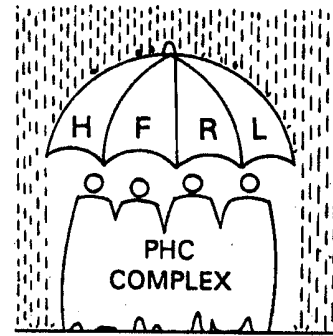


Fig. 45. Technical support for primary health care (PHC;HFRL, hospital at first referral level)

Mobile services that might be provided include (Fig. 46):

- laboratory
- X-ray
- medical shop, carrying common drugs, vaccines, serum and surgical items
- out-patient department
- intensive care unit
- emergency unit

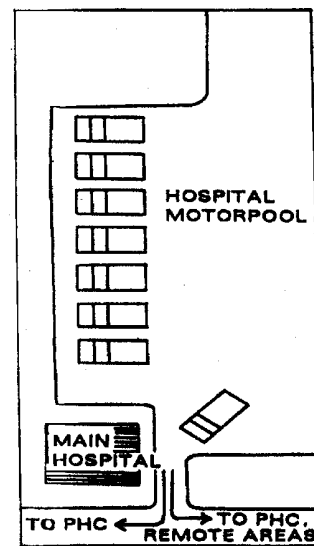
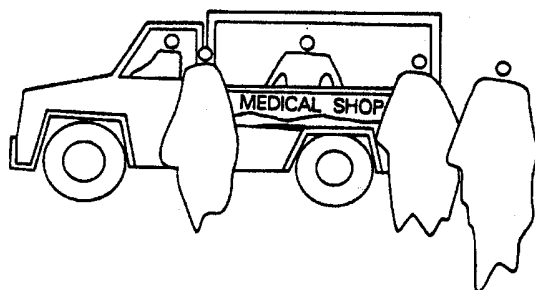


Fig. 46. Mobile services



All of these might be needed for hospitals that serve a widespread population, whereas only the ' first few types of mobile unit might be needed in a small geographic area. Each unit can involve educational activities, including lectures and material for dissemination.

The hospital should ensure documentation of referrals by a responsible medical officer (Fig. 47), so that reports on treatment and results on investigations are sent back to the peripheral unit.

An ambulance service should be available to transport patients from outlying areas of the primary health care region to the hospital.

The central sterile supply department of the hospital, especially large ones, can also be used for primary health care, with exchange and transport of soiled and sterile items. Centralization of equipment in this way can result in savings in time and money. Other services, such as laundry, can also be shared.

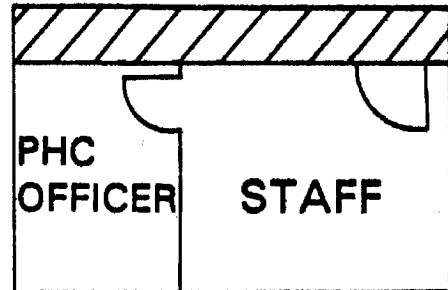


Fig. 47. Primary health care (PHC) officer at hospital

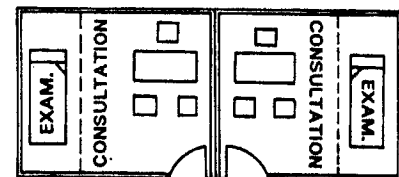
1.5.2 Outpatient department

The design of the out-patient department of the hospital depends on the scheduling of consultations, the availability of medical staff for consultations, the number of referrals from general practitioners and peripheral health units and the propensity of people in the area to go to a hospital. It may also be affected by the availability of visiting specialists from a regional base hospital, who may conduct specialist clinics intermittently before patients are referred for specialist treatment.

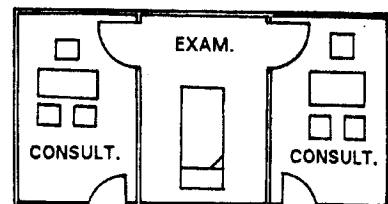
The basic requirements of an outpatient department are simple and few:

- reception and waiting areas,
- consultation rooms,
- examination rooms,
- treatment rooms, and
- staff and supply areas.

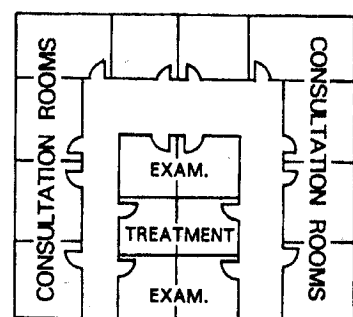
Depending on the factors described above, the planner and designer can choose from a variety of schemes for grouping the basic requirements (Fig. 48):



a. COMBINED CONSULTATION-EXAMINATION ROOMS



b. SHARED EXAMINATION ROOM



c. COMMON POOL OF SHARED ROOMS

Fig. 48. Out-patient department pla

- (1) Combined consultation-examination rooms give maximum privacy to the patient and maximum flexibility to the medical staff (Fig. 48a).
- (2) With a shared examination room, two consultants share one examination room. This requires synchronous consultation between the doctors. It is an economical arrangement, but it can slow the pace of consultations (Fig. 48b).
- (3) In a common pool of shared rooms, each consultant shares a centrally located pool of examination and treatment rooms. This is the most economical scheme from the point of view of space, but it results in criss-crossing of users and gives the patient the least privacy (Fig. 48c).

The required ratio of examination to consulting rooms varies with the type of clinic. Allowance must be made for patients to dress and undress, so, in general, medical consultations and examinations take longer than surgical examinations; but medical clinics require only one examination space per consultant, while surgical clinics may need two or three examination rooms per consultant. In practice, the most flexible arrangement is a mixture of the two types, scheduling clinics for optimal use. Requirements vary, however, depending on local conditions and whether out-patient arrivals can be limited to working hours.

1.5.3 Emergency department

This fast-paced department requires a large area that is flexible and can be converted into private areas when necessary, usually by the use of curtains on tracks around delineated spaces.

It is vital that the provisions for movement within the emergency department allow for fluidity, with rapid access to the operating, X-ray and other departments (Fig. 49).

Because of the nature of emergencies, it is recommended that if resources are available, beds be clustered and dedicated to specific types of emergency cases. Accident and trauma, fracture and orthopaedic, obstetrics and gynaecology, and paediatrics cases require different ministrations and emergency procedures.

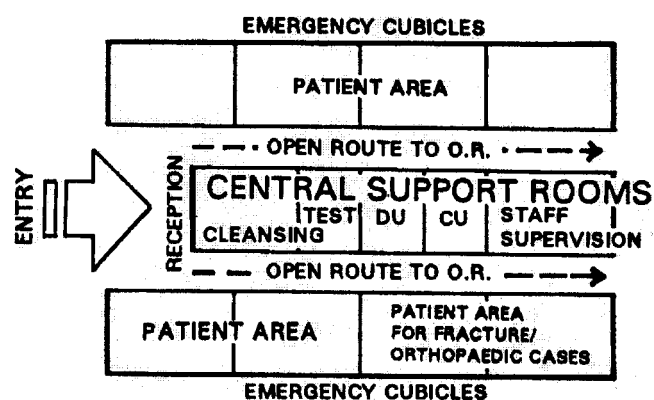


Fig. 49. Plan for emergency department (OR, operating room)

1.5.4 Administration Block

The administrative department is orientated to the public but is at the same time private. Areas for business, accounting, auditing, cashiers and records, which have a functional relationship with the public, must be located near the entrance of the hospital. Offices for hospital management, however, can be located in more private areas.

1.5.5 Medical record room

Well-kept medical records form an integral and vital part of an efficient hospital system. Each country has its own legal requirement regarding how long such records must be maintained at the hospital. If possible, a full-scale computerized data bank should be created in which all data relating to hospital patients are retained. This allows rapid access to the previous hospital records of every patient. In addition, standardization of records in a database makes the information available for statistical use in research into, e.g., community health, hospital planning and design, drug use and planning of ambulance services.

If medical records are handled manually, adequate space must be available so that they can be kept for the required time. This space should be in an area that ensures that the records remain confidential.

The best location for a Medical Record Room is immediately adjacent to the Admitting Section for ease of filing of records of new patients and for ease of retrieval of records of returning patients. Though this location is in a very public zone, controlled access to the room itself is paramount so that records are not touched by any other personnel except the ones directly assigned to be responsible for them. It is therefore recommended that it be a "room within a room" -which means that the Medical Record Room be accessed through a door inside the Admitting Section.

Being a room that very often outgrows all other administrative areas, but is devoted to inanimate and non-moving documents, prudence must be exercised in the determination of its size in relation to the other areas. In order that this size does not become so grossly large as to cause imbalance in space provision, the whole file of patient records is usually fragmented, the active records retained at the Medical Record Room in the public zone and the inactive or dead records kept in a Medical Record Storage somewhere in the inner areas of the hospital. It is important to make sure that this storage space is located with the consideration that it is a high-fire-load space and must be distant from the wards.

1.5.6 Radiology and imaging department

The term "radiology department" usually refers to the department in which diagnostic imaging is provided. It is distinct from that in which radiotherapy and radiation oncology are carried out. The latter services are not provided in district hospitals of 50-100 beds, as the radiation treatment of malignant disease requires highly trained physicists and physicians who are specialized in radiotherapy and very complex, costly equipment. This service should be available only in regional hospitals.

Diagnostic imaging (or diagnostic radiology) is provided by X-ray units, ultrasound and radionuclide (radioisotope) scanners. A radionuclide service will probably not be available in a 50-100 bed hospital, as the supply of radioactive materials and the handling and administration of radioisotopes are beyond the training of general physicians.

There are major differences between imaging with X-rays and with ultrasound. X-rays are ionizing radiation, with potential risk to personnel and patients. The images (radiographs) are recorded on X-ray film, and most examinations can be done by a non-physician technician, responding to a doctor's requests. Ultrasound carries, as far as is now known, no risk to patients or personnel, but most ultrasound examinations (scans) require the participation of a physician and may take 15-20 minutes. 'Ultrasound images are not easy to record, so accurate patients' records must be kept. Training a technician to undertake ultrasound scanning requires 8-12 months' experience in a busy ultrasound department. Less training can result in serious errors.

X-rays can image the lungs, skeleton, kidneys, gall-bladder and bowel. They should be the first choice of imaging equipment. Ultrasound cannot image the lungs or skeleton. It is of greatest importance in obstetrics and for imaging the liver, kidneys, pancreas, gall-bladder and pelvic contents. It can be very helpful in the diagnosis of early osteomyelitis of the long bones, because of the changes to soft tissues, but cannot otherwise be used to detect bone disease. Ultrasound should be the second choice of imaging equipment, except in a busy maternity hospital, where it should take priority.

- (1) Diagnostic imaging, both X-rays and ultrasound, should be available to both in-patients and out-patients. The equipment needs electrical power. There are many advantages to locating X-ray and ultrasound equipment in the same department. In small hospitals with a daily workload of 5-10 patients, the two can be in the same room. As the workload increases, separate rooms should be made available.
- (2) Ultrasound does not require any special building construction. The room should contain a patient couch, firm but comfortable, a chair and at least 1 m² for the equipment. The lighting must be dim-bright light makes it difficult to examine a patient properly-but the room must not be very dark. Hand-washing facilities should be located either in the room or close by. There must be a toilet close to the ultrasound room.
- (3) The X-ray department should consist of three rooms:
 - the X-ray room;
 - the dark-room; and
 - office and storage space.

These must be grouped, and the X-ray room and the dark-room must be adjoining. If accommodation is limited and if only 5-8 patients are to be imaged per day, the office work can be done in the X-ray room. The dark-room, however, must be separate, and no other work should be carried out there. Figures 50, 51 and 52 show three alternative layouts for an X-ray department.

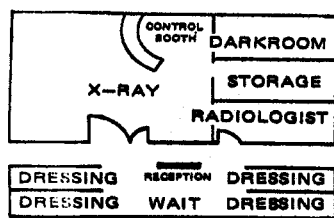


Fig. 50. Simple compact plan

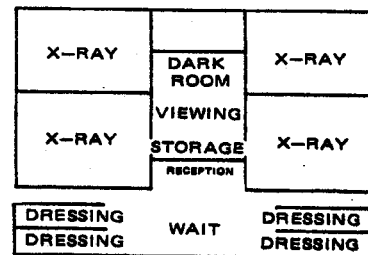


Fig. 51. Cluster plan

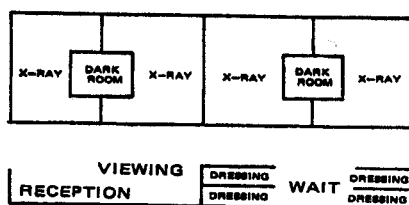


Fig. 52. Linear plan

Detailed recommendations for the location and space requirements of an X-ray department are given in Annex 6 (Guidelines for the installation of WHO Basic Radiological Systems (BRS). Various plans are attached. If ultrasound is available, the room housing it can be located anywhere close to the X-ray section, as convenient.

- (4) The diagnostic imaging area should be on the ground floor of the hospital, with easy, covered access for wheel-chairs, patient trolleys and beds. Its location close to the emergency section of the out-patient department is helpful, but easy access for all patients should be the first consideration. A separate building is not necessary.

One X-ray room and one dark-room can handle up to 40-50 patients per day. Because of the high cost of the equipment, it is better to increase the number of staff and to lengthen the working day rather than add additional rooms and more equipment. Even a 150-bed hospital is very unlikely to need more than one X-ray room. If the hospital increases in size, it is preferable to place any additional X-ray room in the same area. One dark-room is sufficient for two X-ray rooms.

Further information on equipment for X-ray, ultrasound and dark-rooms is given in Chapter 2 of these guidelines.

The pace of technology development with regard to radiology and imaging is fast. Doctors have relied on the use of the Computer Tomology Scan (CT - Scan) and the Magnetic Resonance Imaging (MRI) for diagnosis of ailments that cannot be comprehensively evaluated by the more traditional diagnostic methods. If resources are available, the quality of health care will always be enhanced by such equipment.

1.5.7 Laboratory services

Modern medicine is increasingly dependent on laboratory services for the prevention, diagnosis and control of diseases. Pathology laboratories play a central role in the hospital and in community health services, and each hospital must have an adequate laboratory service under the direction of a medically qualified pathologist.

A comprehensive laboratory should have the following sections:

- morbid anatomy
- haematology
- clinical pathology
- microbiology

with sub-sections, according to the functions of the hospital in the community.

The laboratory must be located and designed so as to:

- provide suitable, direct access for patients
- allow reception of deliveries of chemicals
- allow for disposal of laboratory materials and specimens.

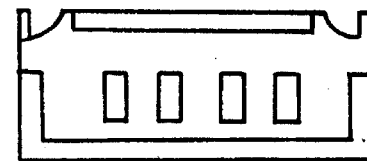
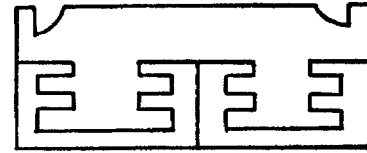


Fig. 53. Plan for laboratory

It should be noted that laboratory services come under great pressure to expand, as the workload tends to double every 5-8 years. Their growth will be even faster as the out-patient department is strengthened to integrate provisions for primary health care. The plan for laboratory work benches must therefore be flexible, perhaps comprising modules Fig. 53. Plan for laboratory (Fig. 53).

The information that the planner and designer need to plan a laboratory space includes:

- (1) deciding the range of services to be offered and thus the number of different areas;
- (2) determination of the technical units and sub-units, procedures to be adopted and any special requirements;
- (3) estimation of the volume of work in each area, unit and sub-unit;
- (4) indication of style of work-manual, mechanized, automated-in each unit and sub-unit;
- (5) determination of the number and category of personnel working in each unit and sub-unit;
- (6) indication of principal equipment and furniture, including support services;
- (7) determination of linear metres of bench space and its arrangement, including space for auxiliary areas for washing and sterilizing, preparation of reagents and culture media, storage and locker facilities;
- (8) indication of preferable locations of various units and sub-units; e.g., the bacteriology unit should be located at the farthest end of the laboratory, next to the washing and sterilizing unit, to diminish the hazard of contamination;
- (9) listing of environmental requirements and safety measures.

In order to estimate space requirements, a rule of thumb is that each member of the laboratory staff, technical or administrative, needs 6 m² of net floor space. This does not include corridors, stairs, toilets, stores or wall space, for which an additional 30-50% of space should be provided, depending on the size and type of equipment.

As mentioned above, laboratories should be planned on a modular system; i.e., the basic building unit is a laboratory module of a particular width, depth and height. This contains all of the standard features needed to support the laboratory activities, including wet and dry services, lighting, electricity and ventilation. It can be repeated as many times as necessary to make up a laboratory of the required size. Figure 54 (a, b and c) shows examples of a single-module space, a two-module suite and a three-and-a-half module suite.

The external walls of the laboratory should be of permanent, durable construction, but the partition walls should be considered to be temporary so that they can be taken out or replaced easily as the activities expand. The ceilings should be made of materials that are easily cleaned and disinfected so as to reduce airborne contamination. They should be 2.55-2.80 m in height to allow for wall-mounted distillation racks and other equipment. The floors should be made of materials that are resistant to acids, alkali and salts and can be easily cleaned and disinfected. An installation with a minimal number of joints is desirable.

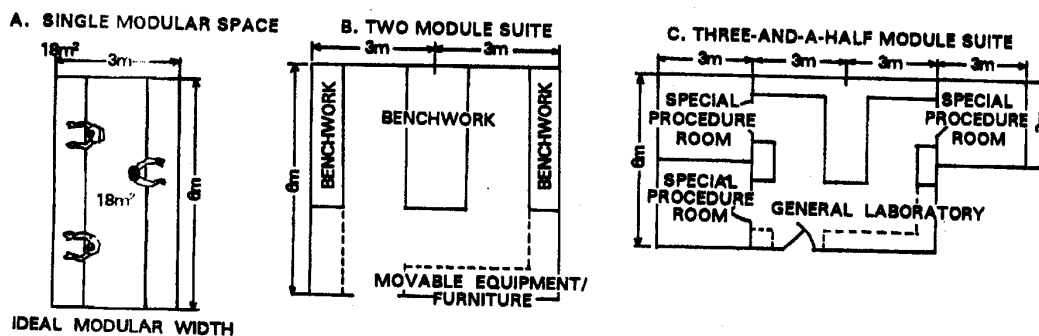


Fig. 54. Examples of laboratories of different sizes

Doors should be located in places where entry and exit is easy and does not interfere with the laboratory benches or equipment. Laboratory doors should be no less than 1 m wide to allow easy access of equipment. In some areas, double doors, 1.2 m wide, should be provided for passage of large equipment, such as deep-freezes. All doors should open towards the corridor.

The basic utilities that are to be provided in the laboratory are water supply, sanitary drains and drain vents, electricity, compressed air, distilled water, carbon dioxide, steam and gas. Others may be necessary depending on the types of tests to be performed. A method must be designed for identifying the different pipes in the laboratory; the following colour code may be used:

hot water	orange
cold water	blue
drain	brown
steam	gray
compressed air	white

vacuum	black
gas	yellow
sprinkler	red

A typical section through the work-benches of a laboratory is given in Figure 55, showing the locations of some of the utilities.

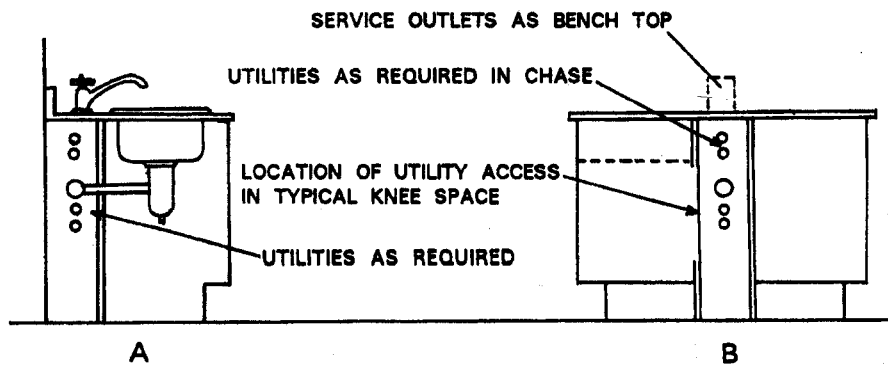


Fig. 55. Laboratory work-benches

The laboratory should have external access to a small, remotely located store for dangerous goods. The quantities of such goods (particularly inflammable ones) that are held in the department should be limited and strictly controlled.

Lifestyles of people and other factors still unknown have brought the advent of diseases like AIDS that require special consideration in their medical management and in the planning and design and operational use of facilities in the hospital. In the laboratory, blood banking procedures and, facility provision, specification of impervious materials for easy cleaning and disinfection of surfaces are paramount considerations.

1.5.8 Pharmacy

Where there are private pharmacies, patients, and in particular outpatients, may obtain drugs from them, if necessary with a physician's prescription. However, in many districts the hospital will be the main source of drugs, with the primary health centres coming next. In a first referral hospital, there should be a qualified pharmacist or dispenser in charge of the pharmacy, but the pharmacy staff will need considerable support from the head doctor. As drug costs are often high, it is necessary to restrict the number of different drugs available to comply with a nationally agreed list of essential drugs. Generally, a first referral hospital will be treating, on average, about 100-150 different diseases, for which about 80-120 different drugs from the national essential drugs list will be needed. Peripheral health units treat fewer varieties of disease, and require fewer kinds of drugs. Guidelines on the appropriate selection of drugs will be found in several WHO publications.

The pharmacy staff, with advice from a physician, will plan the selection and procurement of drugs not included in standard provisions for hospitals. The tasks of the pharmacy will include: the safe storage and distribution of vaccines and drugs; careful record-keeping; and provision of education on drugs for hospital workers and the community. The cost-effective use of drugs should be monitored.

As decided by the district health council, the staff of the pharmacy may also have to deal with supplies to peripheral health units and help supervise their use. Increasingly, drugs for such units are provided in kit form by a central authority, thus eliminating the need for local selection, though not for local storage, distribution and supervision. There should also be a feedback mechanism to advise the central authority on the appropriateness of its kits. Any variation in normal usage of the supplies should be investigated by the pharmacist with the help of the appropriate physician.

Pharmacy staff should be prepared to advise prescribing and administering staff on the proper use of drugs, especially antibiotics and any other strong or expensive drugs.

A hospital pharmacy department essentially provides a dispensing service to in-patient wards, departments and the out-patient department. The pharmacist is responsible for the purchase, storage and dispensing of all drugs and of bulk pharmaceutical preparations, disinfectants and sterile solutions.

In designing the pharmacy, the following considerations should be kept in mind:

- (1) The pharmacy must be located so that it is:
 - accessible to the out-patient department,
 - convenient for dispensing, and
 - accessible to the central delivery yard.
- (2) Traffic within the department must be economical and flexible.
- (3) Its size is determined by its organization and operational policies.
- (4) Provision for security of dangerous drugs must be ensured.
- (5) Provision for control of fire must be ensured, as many inflammable substances are stored there. Bulk quantities should not be held in the pharmacy but should be drawn from a remotely located store for dangerous goods.
- (6) Finishes must be impervious to acid and alkali and easy to clean.
- (7) The corridors must allow easy turning of wheeled vehicles.

The pharmacy will sometimes keep controlled drugs, poisons and other drugs liable to misuse.

These are subject to statutory regulations, which the designer should be aware of in planning the rooms, and provision should be made for an alarm system to guard against intrusion and theft.

The planning of the pharmacy should also include space for preparing sterile water, unless this is to be done in the central sterile supply department or elsewhere.

1.5.9 Blood bank

Every hospital at first referral level should be provided with adequate blood-bank facilities as part of organized blood transfusion services based on a system of unpaid donation by volunteers. Particular attention must be paid to the correct storage of blood.

Blood should be supplied from a blood transfusion centre (national or regional) after appropriate testing. If this is not possible, the blood-bank system may be based on blood obtained from previously screened local donors. A third approach in which donors are recruited locally when the need arises ("the working blood bank") is the least desirable alternative. The promotion of donor recruitment is a community task to be organized through the district health council.

Blood donation and transfusion are possible at the first referral level, provided that the following basic requirements are met:

- The suitability of the donor is established with the help of a health questionnaire. Blood pressure and weight must be recorded, and screening carried out for anaemia and infectious agents, including human immunodeficiency virus (HIV) type 1 (and, where necessary, type 2), the surface antigen of hepatitis B virus, syphilis, and any other conditions, as determined by national policy based on epidemiological surveys and standard exclusion criteria.
- Compatibility testing is carried out.

1.5.10 Sterilization

While major hospitals regard a central sterile-supply department as essential, it may be easy to organize a separate sterilization unit in a small hospital. However, it is essential to ensure that all instruments, dressings, and equipment that come into contact with patients' tissues are sterile. It is also necessary to ensure that, after use, contaminated utensils are rendered safe for handling. The old methods of boiling instruments in water or soaking them in disinfectant are not reliable, particularly where there is a high risk of hepatitis and HIV infection, and should be discouraged. Steam under pressure is needed for sterilizing, and this can be supplied by means of a simple pressure cooker, a table-top autoclave, or a larger machine. There are some places in the hospital (e.g., the operating theatre, the delivery suite, the emergency room) where sterilization facilities are constantly needed, and these may require their own equipment. Other sterilizing equipment could well be centralized, with staff coming to use it as the need arises. In time, such a central area might be developed into a central sterile-supply unit. Special staff should be designated and trained to maintain all the sterilization equipment in the hospital.

The district health council will decide whether the hospital should supply sterile dressings and instruments to the peripheral health units and to the community nursing service. This would mean extra staff, and transport would have to be provided.

Education on sterilization must also be given to people such as diabetics, who have to use syringes and needles at home.

1.5.11 Operating theatre

The design of operating theatres has become more and more complex. In developed countries, the latest technology has made possible bacteria-free environments in which surgery can be undertaken under almost completely aseptic conditions. As the operating department is thus now viewed as a high-technology, sophisticated provision, it is often dismissed as a luxury when financial resources are scarce. But this is the very reason why the planning and design of this department are

important: to ensure a facility with a high standard of patient safety with the most economical use of manpower and other resources. Sober, down-to earth planning and design can yield an effective facility.

A surgical operation is successful if the following conditions are met:

- The wound heals (aseptic technique)
- Blood loss is replaced (intravenous infusion)
- It is painless (anaesthesia)

The essential physical requirements for meeting these conditions (Fig. 56) are:

- a place in which to work that is comfortable and unobstructed by the movement of other staff, with a table is strong enough to hold the patient and easy to clean;
- basic services of water, light and medical gases; and
- two sets of basic instruments, comprising about 50 pieces each.

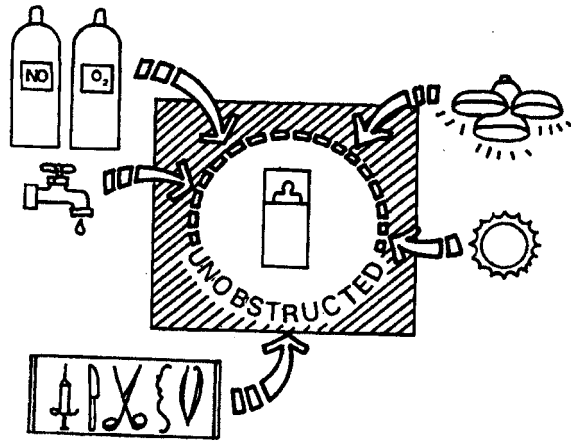


Fig. 56. Essential physical requirements

The number of operating theatres required is obviously related to the number of hospital beds.

As a general rule, one operating theatre is required for every 50 general in-patient beds and for every 25 surgical beds.

Computations can also be made on the basis of the number of surgical beds, the average length of time in the operating theatre and the expected output of the department:

Number of surgical beds x 300 days (usual number of operating days with no weekends) = number of surgical bed-days available per year

Number of surgical bed-days per year average + average length of stay in surgical ward = number of surgical patients admitted per year (expected)

Number of surgical admissions expected per year + actual number of working days = number of surgical operations per day (expected)

Number of surgical. operations expected per day x average number of hours per operation = number of operating theatre hours per day

Number of operating theatre hours per day + actual number of working hours in operating theatre = number of operating theatres needed

The average duration of operations must be determined from experience and established statistics and includes: the actual length of the operation plus about one hour for preparation and cleaning.

Provision should also be made for pre-operative space, containing 0.75 bed per operating theatre, and post-operative space, with 1.5 beds per operating theatre.

(1) Location of operating department

The preferred location is on the same floor as the surgical wards, which may be the ground floor. It should be connected to the surgical ward by the simplest possible route, It should also:

- adjoin the central sterile supply department;
- be easily accessible from the accident and emergency department;
- be easily accessible for the delivery suite;
- adjoin the intensive care unit;
- be located in a cul-de-sac, so that entry and exit can be controlled; there should be no through-traffic (Fig, 57).

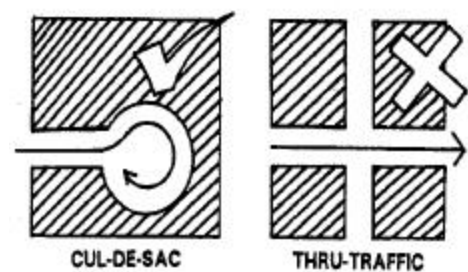


Fig. 57. Location of operating department

(2) General design principles

The overriding principle is that the centre of the theatre suite should be the cleanest area, the requirement for cleanliness decreasing towards the perimeter of the department (Fig. 58). Thus, any space for handling sterile supplies should be in the central area, and any space for transporting patients, general staff movement and removal of used material should be on the perimeter.

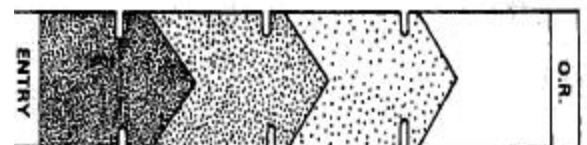


Fig. 58. Progressive sterility (OR, operating room)

To achieve maximal economy of support facilities, an operating department should be planned in pairs of operating theatres, with one main clean-up room serving all the operating theatres, In departments with more than four operating rooms, however, this might involve too great a distance to travel, and sub-clean-up spaces should be provided.

To avoid airborne contamination, operating theatres and the main clean supply area should be slightly pressurised, with most of the exhaust air removed through the outer areas (Fig. 59). The air-conditioning system should provide air that has been filtered to the stringent requirements of operating theatres, and the temperature and humidity should be controlled (see section 1.8.1).

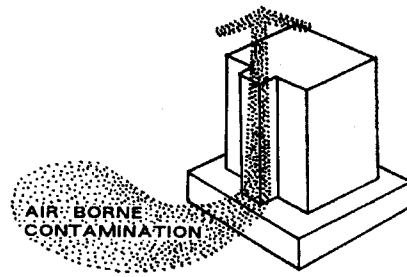


Fig. 59. Removal of airborne contamination

Instruments and equipment may be sterilized either in a theatre sterile supply unit established within the operating department or in an adjoining central sterile supply department. In either case, dressings and gowns should be sterilized in the central unit, to minimize the requirements for large, expensive autoclaves. A small "dropped instrument" sterilizer should be located within each theatre.

(3) Management

Two management systems on which policy must be decided and which affect the planning of the operating department are instrument trolley preparation and patient transport.

(a) *Instrument trolley preparation system*

The area provided at the centre of the theatre suite for storing sterile supplies and instruments can also be used as a set-up room, for laying out the sterile instruments and supplies required for an operation on the theatre trolley (central trolley preparation). Alternatively, the sterile instruments and supplies can be transported still wrapped to the operating theatre, where they are opened and laid out on the theatre trolley (local trolley preparation). Both systems are used, although central trolley preparation is generally preferred. This system requires that the central working area be large enough to park several theatre trolleys.

(b) *Patient transport system*

The entrance to the operating department must have a reception and transfer point. Control of unauthorized, unsupervised entry into the area ensures the principles of aseptic conditions. The transfer area is the point at which the patient is physically removed from the bad trolley to the theatre trolley. Three systems can be used, each of which involves different requirements for staff, space and equipment.

- the two-trolley system, involving six patient transfers;
- the theatre trolley system, involving four patient transfers; and
- the trolley-bed system, involving two patient transfers.

(4) General planning principles

(1) The internal layout should be based on the traffic flow within the department (Fig. 60).

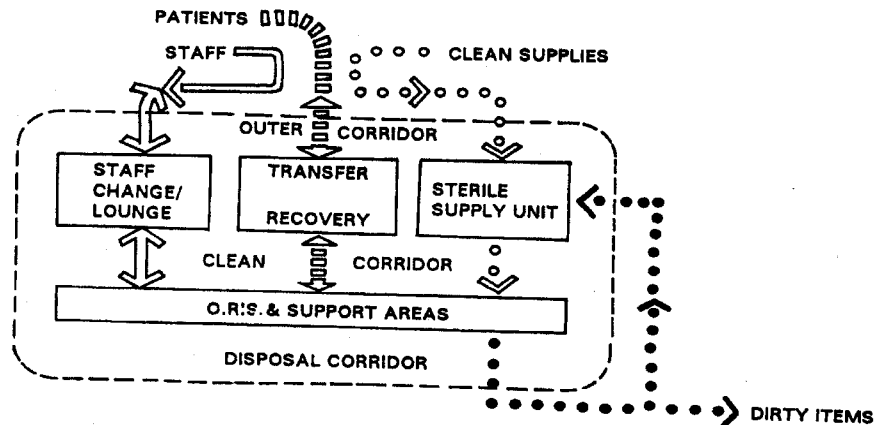


Fig. 60. Traffic flow in operating department (ORs, operating rooms)

A single corridor may be used to carry patients, staff and clean and used equipment (suitably bagged) to and from the operating theatres. This corridor should lead to each operating theatre via an anaesthetic room, a scrub-up facility and a separate theatre exit. Alternatively, clean and dirty streams of traffic can be segregated. An enclosed, traffic-restricted room close to the operating theatres must be provided for sterile theatre supplies; it should lead directly into the operating theatres.

- (2) Rooms should be arranged in continuous progression from the entrance through zones of increasing sterility, following the concept of progressive asepticism (see Fig. 58).
- (3) Staff within the department should be able to move from one clean area to another without passing through unprotected or unclean areas.
- (4) Patients, staff and services should enter through the same control point.
- (5) Air for air-conditioning should move from cleanest to less clean areas.
- (6) The operating theatre should be at positive pressure in relation to adjacent rooms.
- (7) Air movement in the operating theatre should be reduced so that airborne infections do not reach the patient.

(5) Room planning requirements

The following areas should be provided:

- (a) *Reception and office*

In a two- or three-theatre suite, the reception and the theatre sister's office can be merged.

(b) *Transfer area*

This area should be large enough to allow for the transfer of a patient from a bed to a trolley. A line should be clearly marked in red on the floor, beyond which no person from outside the operating department should be permitted to set foot without obtaining authority and putting on protective clothing.

(c) *Holding bay*

This space is required when the corridor system is used and should be located to allow supervision of patients waiting to go into the theatre. One bed per two theatres should be foreseen.

(d) *Staff changing rooms*

Access to staff changing rooms should be made from the entry side of the transfer area. At both the transfer area and the theatre side of the changing rooms, space must be provided for the storage, putting on and removal of theatre shoes.

(e) *Operating theatres*

Each theatre should be no less than 6 x 6 m (36 m²) in area and should have access from the 1 anaesthetic room, scrub-up room and supply room. Separate exit doors should be provided.

(f) *Scrub-up room*

Scrub-up facilities may be shared by two theatres. A minimum of three scrub-up places is required for one theatre, but five places are adequate for two theatres. A clear area within the scrub-up room, at least 2.1 x 2.1 m, must be provided for gowning and for trolley or shelf space for gowns and masks.

(g) *Sub-clean-up*

In suites of four or more operating theatres, a small utility area is required for each pair of operating theatres, for the disposal of liquid wastes, for rinsing dropped instruments and to hold rubbish, linen and tissue temporarily until they are removed to the main clean-up room.

(h) *Sub-sterilizing*

An area for sterilizing dropped instruments should be provided to serve two theatres.

(i) *Trolley parking*

Parking space outside the theatre and clear of all doorways is required for patient trolleys and beds.

(j) *Recovery room*

The recovery room should be located on the hospital corridor near the entrance to the operating department. The number of patients to be held, until they come out of anaesthesia, depends on the theatre throughput; two beds per theatre is usually satisfactory. In hospitals where there is an intensive care unit, additional room and facilities will be needed.

(6) Other important conditions in the operating theatre

- (1) Windows are neither needed nor desirable. Some surgeons, however, advocate the psychological benefit of having a glass panel for an occasional glance beyond the operating theatre. This can be provided internally, above the door height, with no ledges.
- (2) All surfaces in the operating theatre should be smooth and washable.
- (3) Static electricity and related hazards should be avoided. Special anti-static floors, which are quite expensive, should be provided, since floors in which the electrical resistance is below the intended limits can result in electric shocks. When inflammable anaesthetics are used regularly, the anti-static requirements should extend to the walls, or at least 2 m from any possible location of the patient and the anaesthetizing apparatus. Appropriate national standards should be adopted and enforced.
- (4) Full outside air, filtered to a high quality, must be provided. The integrity of the air-handling system must be preserved by careful siting of the main air intake and exhaust. The main air intake must be located to avoid uptake of any obvious airborne contamination, such as dust and road fumes, and well clear of the main exhaust duct, and the siting should take into account the direction of the prevailing wind. Temperature and relative humidity should be controllable.
- (5) Unit room air-conditioners (window type, with 1 ton capacity per 18 m², at least one per theatre) can be provided as a stand-by.

1.5.12 Intensive care unit

The intensive care unit is for critically ill patients who need constant medical attention and highly specialized equipment, to control bleeding, to support breathing, to control toxæmia and to prevent shock. They come either from the recovery room of the operating theatre, from wards or from the admitting section of the hospital.

This unit requires many engineering services, in the form of controlled environment, medical gases, compressed air and power sources. As these requirements are very similar to those in the operating department, it is advisable to locate the intensive care unit adjacent to the recovery room of the operating department (Fig. 61a). If engineering provisions are to be centralized for economy, the recovery room and the intensive care unit should be on either side of the support area (Fig. 61b).

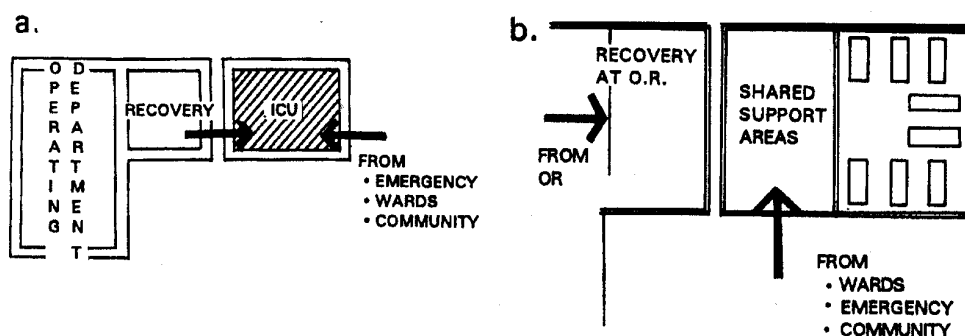


Fig. 61. Location of intensive care unit (ICU; OR, operating room)

The number of beds in this unit should correspond to approximately 1-2% of the total beds in the hospital. In the Western Pacific Region, where district hospitals provide on average 50-100 beds, this would mean only one or two beds. This number would not warrant the provision of an intensive care unit. Such a unit should contain no fewer than six beds in order to justify the highly sophisticated equipment and highly specialized manpower involved.

In the district hospital, therefore, the following alternatives may be considered:

- A patient who requires long-term intensive care should be referred to a higher-level hospital.
- Intensive care beds can be provided within the recovery room of the operating department.
- Patients who are highly dependent on nursing can be given beds or rooms very close to the nurses' station in the ward, sustained with a portable oxygen tank and monitoring equipment.

1.5.13 Obstetrics and gynaecology units

The delivery department is very similar to the operating department in its functional requirements and layout. In many hospitals, the two departments are fused into one, with shared staff and support areas, due to a dearth of doctors, especially in rural areas, where the chief of the hospital is also the public health officer, the surgeon and the obstetrician-gynaecologist. The integration of these two departments, however, violates the basic requirements for aseptic conditions in the operating department, as these are not always required in the delivery department: The two departments should thus at least be segregated. Proximity to the operating department is desirable, however, as transfer of delivery patients may be necessary.

The delivery department is a useful one for primary health care activities. Education and training materials on maternal and child health and on family planning can be effectively transmitted to receptive fathers in the waiting room. An area should be provided for this purpose.

1.5.14 Paediatrics unit

The nursery should be located adjacent to the delivery department to ensure protected transport of newborns. Areas must be provided for cribs for both well and ill babies and for support services that include formula and preparation rooms.

The number of cribs varies depending on the maternal and child health trends in the country. "Rooming-in" (Fig.62) is virtually replacing the well-baby area in space requirements for the nursery; instead, the dimensions of maternity wards are changing to accommodate babies' cribs and other materials. A small night nursery for well babies may still be required.

1.5.15 Geriatric services

The older population of any community is usually best cared for in community-based facilities where their special needs and requirements are provided for in sensitive and Fig. 62. Rooming-in caring designs that allow them to lead independent and

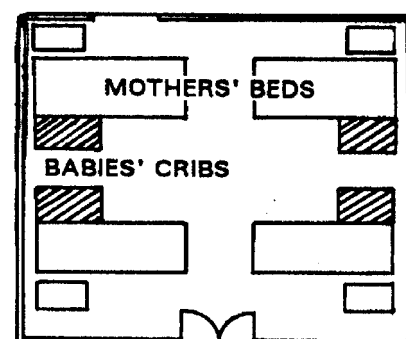


Fig. 62. Rooming-in

dignified lives for as long as possible. However, because older persons are also prone to conditions that cannot be attended to except in the environment of a hospital, a geriatrics ward may be provided within a general hospital if economics would so warrant. If this is not possible, older people may also be nursed in the regular medical or surgical wards, depending on their illness.

There are many situations which would necessitate the confinement of an older person in a hospital. Older persons are usually afflicted with heart conditions and high blood pressures and are prone to attacks that would necessitate hospitalization. Deterioration of vision and motor skills may cause falls which result in fractures which can be very serious in older persons because of their low bone density. The most common fractures for older persons occur in their forearms, hips, and femurs. Older persons are also prone to respiratory ailments with complications. Because of reduced capability to recuperate or regenerate, the confinement of older persons in a hospital usually takes longer than other patients.

As such, a geriatric ward, if provided in a hospital, should be designed for longer than usual confinement. Therefore, spaces should be home-like, cheerful, and non-institutional. Apart from the regular institutional spaces, social spaces such as day rooms must be provided so that the older person can be encouraged to walk about in the process of recovery from the illness. Family spaces must be provided so that the older person may be aided in regaining both his physiological and psychological well-being leading to return to the community.

(1) Services at first referral level

There are facilities that are associated or attached with institutions. They are best provided and operated by the state or by established institutions such as the church or other large charity institutions.

(a) "The hospital"

This facility will handle the health problems, diseases and afflictions of the elderly such as cardiac attacks, abnormally high blood pressures, surgeries, chronic psychiatric symptoms, which are of a nature that cannot be handled any more at the first and second contact levels. This facility provides for high quality medical, surgical and psychiatric treatment and care, and its aim is to cure and to return the patient to functioning status at the shortest possible time, back to the community and family facilities where he permanently resides.

(b) "The hospice"

This is a facility that provides for ambulatory care, but on a continuing basis. The afflictions of the older persons are long-term in nature and so, the hospice may provide for continuing out-patient consultative medical service for him, in addition to psychological consultative service if necessary.

(c) "Continuing Care Retirement Community"

This is a facility that will require high capital cost and high recurring operating budgets, as it would provide in one setting the full range of care that an older person may require - from independent living to start with, through assisted-living and finally to skilled nursing in the venue of a hospital. The older person living in this site development may progress or move from one level to another. Here, even spouses who require different levels of care are in the same vicinity and can be close to one another.

1.5.16 Inpatient nursing wards

These wards provide accommodation for patients who are dependent on others because of their illness. They have the following functions:

- to substitute for the home for regular eating, bathing, sleeping, etc;
- to allow examination, treatment and cure of patients; and
- to prepare patients to return to domestic life.

The wards in a hospital are usually classified according to specialties: medicine, paediatrics, obstetrics-gynaecology and surgery, which are the basic services offered by a district hospital. There are no radical differences between the requirements of medical and surgical wards and only minor differences between those of the other specialties.

(1) Ward forms

Wards are the most easily replicated areas of a hospital, whether on one storey spread over a large site or stacked one on top of the other in a multi-storey structure. The following are commonly used forms of ward (Fig. 63).

(a) *The Nightingale ward (Fig. 63 a)*

This is an open-plan ward containing 25-30 beds. Services are located at either end of a long, rectangular ward; staff supervision is in the aisle between the two rows of beds. This is the noisiest type of ward.

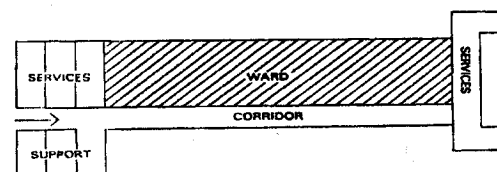


Fig. 63a. Nightingale ward

(b) *Straight, single-corridor ward (Fig. 63b)*

This simple layout has many advantages: all of the rooms can be lit and ventilated naturally through windows. Service rooms and the nurses' station are centrally placed, and distances are minimized. Staff can see down the full length of the corridor, making supervision easier than in other forms. They will know where other staff are working and Fig. 63b. Straight, single-corridor ward can call them quickly in an emergency.

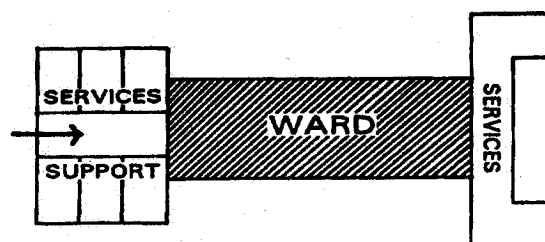


Fig. 63b. Straight, single-corridor ward

(c) *L-shaped ward (Fig. 63c)*

In this layout, the patient beds are on the two legs of the L, and the support services and staff supervision are on the junction. Services and supervision are concentrated at the entrance, with minimal penetration into the patient areas.

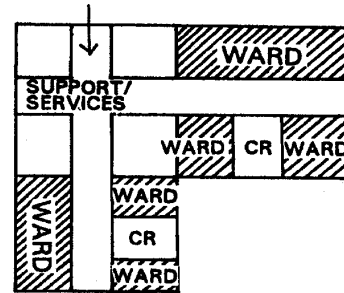


Fig. 63c. L-shaped ward

(d) *T-shaped ward (Fig. 63d)*

The advantages of this form are similar to those of the L-shaped ward. Support and supervision are concentrated on the vertical arm, and the patient areas are located on the horizontal arm.

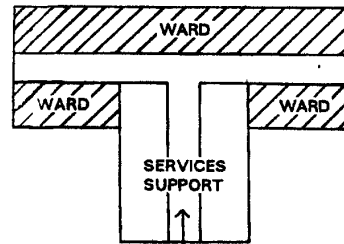


Fig. 63d. T-shaped ward

(e) *The race track (Fig. 63e)*

In this type of ward, the patient areas are laid out at the periphery of a deep rectangle, and the services and staff areas are in the middle. Patients are given a view, but the staff has no view (and perhaps no ventilation when the WARD central air-conditioning is not working!). Staff have long distances to travel, and communication between them is difficult.

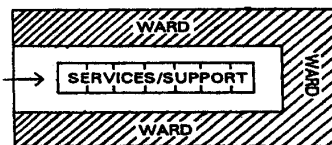


Fig. 63e. Racetrack ward

(f) *The cruciform plan (Fig. 63)*

In this plan, the patient rooms comprise a peripheral arrangement, and the support and supervision areas are laid out at the intersection of the arms. This form results in a lot of cross-traffic. It is used in double wards, where there are two separate ward units but only one set of supervisory staff.

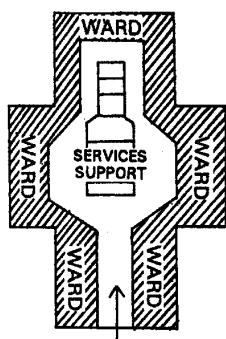


Fig.63f. Cruciform ward

(2) Other factors

The main characteristic of the ward in comparison to the departments of a hospital is that it provides the range of facilities necessary for meeting the basic human needs but in a controlled way. It furnishes the environmental factors of shelter, temperature, ventilation, cleanliness, noise control, privacy and, as far as possible, general comfort. It also provides services such as a supply of food, linen and other items, and the removal of waste products and used materials of all kinds.

Consideration must also be given to the relatives of patients and other visitors. If provision is to be made for relatives to stay overnight, this must be incorporated into the planning. (See also Annex 2, Case no. 3).

1.5.17 General services department

(1) Dietary services

Apart from parenteral feeding (not considered here), hospitals should provide dietary services for those in special need of them (i.e., infants and other patients unable to eat normal meals). These services should be provided whether or not the local custom is for the family to provide regular meals for the patient.

The dietary department of the hospital should advise staff and patients about special diets (that include or exclude specific ingredients, for example gliadin), modified diets (containing increased or reduced amounts of certain components, such as carbohydrate or fat), and normal diets. Decisions concerning special and modified diets should be considered on the basis of the therapeutic programme decided upon for the patient. All meals should be composed with the aim of achieving appropriate nutrition, within the limits of the hospital budget, local food habits, and cultural and religious restrictions.

The hospital and the primary health care centres have the responsibility of giving patients and relatives information on proper nutrition and well-balanced diets. Dietary education should be provided not only during therapeutic care, but on all suitable occasions, and should deal with normal nutrition as well as special diets. A list of food choices may help to illustrate nutritional principles. Such lists should be organized according to traditional food groups and consideration should be given to different ethnic backgrounds that dictate specific feeding patterns.

(a) Location

The dietary department should be located next to the kitchen or anywhere on the ground floor, directly accessible from the service court to receive daily deliveries of meat, vegetables and dairy products. Direct deliveries to the refrigerated section eliminate traffic through corridors and cooking areas. The direction of the prevailing wind must also be considered. The location of the dietitians depends on the main activities. In case that the dietitian is involved in clinical nutrition, it can be convenient to locate the dietitian in the kitchen or next to the kitchen. If the dietitian is involved in primary health care, their location within these services should be considered. When a kitchen is designed, not only the location and the type of the kitchen should be taken into account but also the hygienic rules and regulations should be considered from the start. Kitchens must be located such that heat and odours are not directed towards areas of high population. They should also not be located under wards, especially those for non-ambulant patients, as a fire safety precaution. The planning and design of the kitchen is left to the countries depending upon methods of cooking, social and other religious considerations.

(b) *Food distribution*

The central tray service (centralized food distribution) and bulk service (decentralized) both have advantages and disadvantages.

In the central tray service, patients' trays are prepared in the main kitchen, loaded onto conveyors or carts, open or insulated, and transported to the various wards. Soiled dishes are collected and returned to a central dishwashing area. This system requires fewer staff and initial equipment costs are lower than with a decentralized system; however, the food usually cools during transport and loses some of its quality.

In the bulk service, food is brought to the wards in heated carts. Trays are prepared in a sub-kitchen in each ward and loaded onto a cart, which is rolled alongside the bulk cart; each tray is served from the bulk cart at the patient's room. Dishes are washed in the sub-kitchen. This system is the most suitable in hospitals where the corridor systems are long, to ensure that the food that reaches the patients is still hot and fresh; however, it requires additional space in the wards for washing and storing trays, plates and cutlery.

(c) *Components*

The dietary department has the following main components:

- food refrigeration and storage,
- cooking,
- serving,
- special diets,
- dishwashing; and
- dining.

The department should contain the following facilities, unless commercially prepared diets and service, meals and/or disposable items are used:

- food preparation centre
- food serving facilities, for both patients and staff
- dishwashing facilities (or room)
- pot-washing facilities
- refrigerated storage-3-day supply
- day storage-3-day supply
- cart-cleaning facilities
- cart storage area
- waste disposal facilities

- dining facilities (1.5 m² per seated person)
- dietitian ' s office
- janitor's cupboard storage for housekeeping supplies and equipment, with a service sink.

Some of these activities can be combined, so as to save space, without compromising the norms of cleanliness.

(2) Housekeeping facilities

- (a) The *housekeeper's office* should be on the lowest floor, adjacent to the central linen room.
- (b) The *central linen room* supplies linen for the whole hospital. It must have shelves and spaces for sewing, mending and marking new linen. If laundry is to be handled in the hospital, the central linen room must be adjacent to the "clean" end of the laundry room.
- (c) The soiled linen area is for sorting and checking all soiled laundry from the hospital. It must be next to the "dirty" end of the laundry area and provided with sorting bins.
- (d) *Laundry* can either be done in-house or contracted to an outside enterprise. If it is to be done in-house, proper washing and drying equipment must be installed. If it is to be contracted out, areas must be provided for receiving clean and dispatching dirty linen and for sorting.

The facilities must thus include:

- a soiled linen room;
- a clean linen and mending room;
- a laundry-cart storage room;
- a laundry processing room, with equipment sufficient to take care of 7 days' linen;
- janitor's closet, with storage space for housekeeping supplies and equipment and a service sink;
- storage space for laundry supplies.

The last three are not needed if laundry is to be contracted out.

(3) Storage, stock-keeping and distribution

Purchases of supplies and equipment will follow the accepted rules for the country concerned, whether they are obtained locally, from central medical stores, or directly from vendors. Checking goods, when delivered, is an essential part of cost-efficiency, and the first referral hospital cannot leave this to the central medical stores or other suppliers. A system of local checking prior to acceptance must be established.

The district health council will have to decide to what extent the hospital will be involved in the management and distribution of stocks. Special storage conditions are required for many medical items (e.g. vaccines, X-ray films, and laboratory chemicals and reagents), and it may be economical to

have a central storage area (which may well be within the hospital grounds because the hospital is likely to be the largest user of many of the items stocked). A computer may considerably simplify stock-keeping but cannot wholly replace a card system. Arrangements must be made for the distribution of stocks throughout the district health system. Whether distribution of items to the primary health centres will be linked to supervision of the health centres' work will also have to be decided by the district health council.

As hospitals are regular consumers of a large variety of goods, adequate space must be provided for their storage, inventory and distribution. Many different types of storage facilities will be required, e.g., for some live virus vaccines at -20 °C, for large equipment and furniture, for crude disinfectants, for medical gases, for dangerous drugs, for radioactive agents, which need different space provisions. Designers must obtain all the relevant information to meet the requirements.

The standard for central storage space is 2 m² per bed; in smaller hospitals, this value is usually increased.

The following compartments must be provided in the hospital storage area:

- pharmacy storeroom,
- furniture room,
- anaesthesia storeroom,
- records storage and
- central storeroom.

The risks of fire and explosion in a medical supplies storeroom and storage of dangerous substances such as nitric and picric acids and inflammable materials such as alcohol, oxygen and other gas cylinders merit special attention.

For smooth, rapid flow of materials both to and from the central store, sufficient space and ramps should be provided for handling, unpacking, loading, unloading and inspection. In a hospital planned with a functional central supply and delivery system, many of the traditional ancillary rooms could be eliminated from some departments and be replaced by systems of lifts, with sufficient parking space in the wards for trolleys.

A typical flow chart of the movement of staff and supplies in service areas is shown in Figure 64.

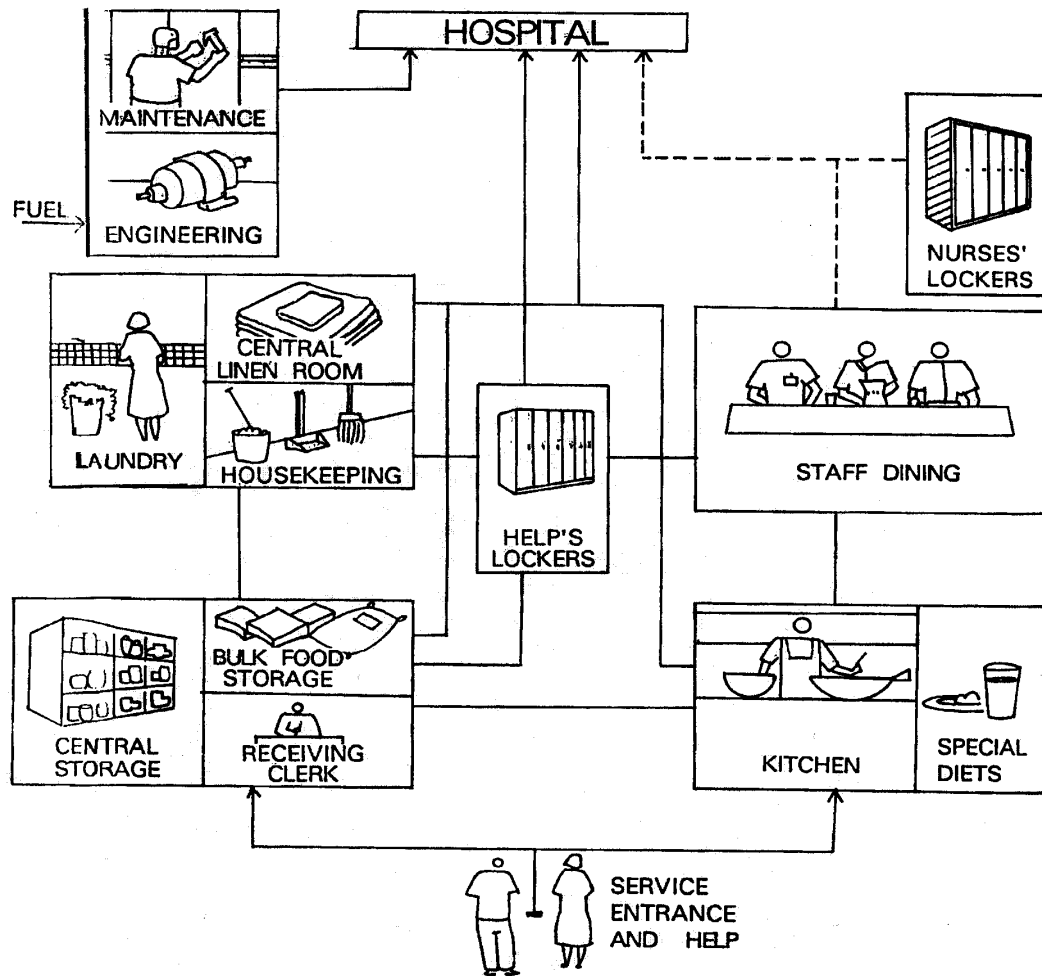


Fig. 64. Flowchart showing movement of staff and supplies in service areas.

(4) Maintenance and engineering area

(a) *Boiler room*

This must be located in accordance with local fire ordinances. The boiler plant must be " designed by a qualified engineer to ensure the safety of patients and staff.

(b) *Fuel storage*

The space will vary according to the fuel used. The designer must know for how many days stock must be kept.

(c) *Groundkeeper's toolroom*

Space must be provided for working and for the storage of equipment and tools for the staff in charge of landscaping and general upkeep of the garden and grounds.

(d) *Garage*

The garage is best located in a shed or building separated from the hospital itself. If the hospital is to maintain 24-hour ambulance service, additional facilities must be provided for drivers' sleeping quarters.

(e) *Maintenance workshop*

A carefully planned and organized maintenance programme for general repair of medical and nonmedical equipment is necessary for ensuring reliable hospital service. A mechanical workshop with an electric shop, well equipped with tools, equipment and supplies, is conducive to preventive maintenance and is most important in emergencies. Failure of lights or essential equipment in an operating theatre, such as respirators, can have serious consequences. Adequate space for equipment like lathes, welding materials and wood- and metal-working machines should be provided, and there should be storage space for damaged material, such as stretchers, beds, wheelchairs, portable machines and food trolleys. A list of the specialized tools and equipment needed for a preventive maintenance system in a district hospital is given in Part II of these guidelines.

As most repair work is done outside of normal working hours, space should be provided for workers, maintenance staff, supervisory personnel and biomedical engineers.

1.5.18 Traditional medicine

(1) The role of traditional medicine

Traditional medicine in one form or another is an ancient and culture-bound medical practice which existed before the application of modern science to health matters. These practices vary widely, in keeping with the social and cultural heritage of different countries. Every community has responded to the challenge for maintaining health and treating diseases by developing a medical system. Traditional medicine has been practised in varying degrees in all cultures.

Traditional medicine provides first line health service to people living in rural and remote areas where service provided by modern medicine may not be available. It may also provide an alternative approach for others who live in areas where the service provided by modern medicine is available.

(2) Use of traditional medicine in the mainstream of the health service system

The primary health care approach was adopted by the Alma-Ata Declaration in 1978 during the International Conference on Primary Health Care sponsored by the World Health Organization and the United Nations Children's Fund at Alma-Ata, formerly USSR, as the key to attaining the target of health for all. The Alma-Ata Declaration recognized traditional medicine and traditional medicine practitioners, including traditional birth attendants, as important allies in organizing efforts to improve the health of the community and recommended that proven traditional remedies should be incorporated in national programmes for the provision of essential drugs for primary health care.

Traditional therapies are applied in public hospitals in China, Japan, the Lao People's Democratic Republic, Mongolia, Republic of Korea, Philippines, Singapore and Viet Nam. In China, there are 2522 traditional medicine hospitals which treat 200 million outpatients and about three million in-patients annually. In addition, 95% of general hospitals in China have traditional medicine departments which take care of about 20% out-patients daily. In Viet Nam, a total of 42 traditional medicine hospitals and 265 general hospitals provide traditional medicine service. In Singapore, the establishment of two acupuncture clinics, which are affiliated with two government hospitals, brings the practice of acupuncture into the public health service facility.

WHO encourages the proper use of traditional medicine and its integration into the mainstream of the public health service system. The World Health Assembly resolution on traditional medicine and modern health care adopted in 1991 urges Member States to intensify activities leading to cooperation between those providing traditional medicine and modern health care, respectively, especially as regards the use of scientifically-proven, safe and effective traditional remedies to reduce national drug costs.

(3) Traditional medicine in district health facilities

Traditional medicine provides simple, cost-effective, affordable and culturally-acceptable remedies which could be integrated into the daily work of district health facilities. Traditional medicine could be applied for out-patients as well as in-patients of district health facilities. The best suited location for traditional medicine is in the out-patient department with one large room for responsible staff with the examination table (which could also be used for acupuncture treatment) and a herbal medicine store. Where the demand for traditional medicine is greater, this department could be separate unit attached to the hospital.

One or several responsible staff for traditional medicine should be appointed in the district health centre. The responsible staff should have adequate knowledge on traditional medicine. He should be able to provide traditional remedies to patients who prefer to be treated by traditional medicine. He should also work closely with colleagues in other units of the district health centre and if required, provide complementary treatment by using traditional medicine to patients who are treated by modern medicine. Traditional medicine could also be used for cases which do not respond to modern medicine very well. The responsible staff should be familiar with plants with medical properties in the district. He should be responsible for guiding communities on the use of traditional medicine as family remedies and for self-medication. Home visits could be provided, particularly to elder patients and the disabled. Traditional knowledge on healthy lifestyles and traditional physical exercise could be an integral part of the health promotion project in the district; He should also coordinate with traditional healers, including traditional birth attendants, if any, who practise in communities, and mobilize them as public health educators and public health providers, where appropriate.

A traditional medicine unit may be created in the district health centre, if possible.

(4) Medicinal Plants

Medicinal plants have been used by the traditional system of medicine as major therapeutic materials for hundreds of years. They are important sources for pharmaceutical manufacturers. The World Health Organization is fully aware of the importance of medicinal plants to many of its Member States and supports their use as well as their products. The WHO Regional Office for the Western Pacific has prepared the *Guidelines for the appropriate use of herbal medicines*.

Medicinal plants and their mixture which provide safe, effective, available and affordable remedies for certain cases should be available in the district health centre.

The use of locally available medicinal plants should be encouraged. The knowledge available in the district and communities about the use of medicinal plants should be recorded. Commonly used medicinal plants should be selected. The basic criteria in their selection should be: (1) locally available; (2) useful for common health problems; and (3) availability of references on their safety and efficacy.

Plants with medical purposes should be cultivated in the gardens and backyards of district health facilities.

As many of the plants that provide traditional and modern drugs are threatened with extinction, attention should be given on their conservation to ensure that adequate quantities are available for future generations.

(5) Acupuncture

Acupuncture involves needle insertion and stimulation of anatomical locations on the skin. It has been widely recognized as a valuable and readily available means of health care. It is effective, requires only simple equipment and is inexpensive.

Acupuncture could be used for the treatment of pain after surgery or dental procedure and control of nausea and vomiting caused by cancer chemotherapy or pregnancy. It is also effective, in some cases, for stroke rehabilitation, as well as in treating headache, tennis elbow, muscle pain, low back pain, carpal tunnel syndrome, asthma and menstrual cramps. In some countries, acupuncture is used for treatment of a wide range of diseases and disorders.

Adverse side-effects of acupuncture are extremely low and often lower than conventional treatments. If such adverse side-effects occur, although on rare occasions, the acupuncturist should know how to deal with the situation.

Simple equipment and devices, such as acupuncture needles in various sizes, moxibustion sticks and electric stimulator will be needed in acupuncture treatment. Acupuncture needles should be sterilized using adequate methods. Each patient should have his own needle. Where economically feasible, disposable needles should be used.

The treatment can be given in the hospital in the unit meant for traditional medicines where the provision for one bed may be made. This unit can also be a separate unit attached to the hospital.

1.5.19 Mortuary

Ideally, every hospital should have a mortuary suitable for the temporary shelter of the dead, with proper refrigeration facilities for an adequate number of bodies. Facilities for autopsy should be provided, if local regulations permit or require it. Hospital policies and procedures must be laid down for the mortuary and for autopsies.

The proper disposal of human tissues from operations and autopsies is important. The hospital staff, together with the district health council, will have to decide whether to incinerate or bury these tissues. The problem of unclaimed remains must be settled by local regulations.

The mortuary has the following functions:

- to hold dead bodies until burial can be arranged;
- to provide a place where a pathologist can investigate causes of death and make scientific investigations;
- to allow viewing and identification of bodies by relatives and other people.

The mortuary should, if possible, be located near the pathology department or laboratory. It should be easily accessible from wards and the emergency and operating departments. A separate access should be available for staff, relatives and undertakers.

The following areas are needed:

- covered access
- body store
- staff changing room with lockers and toilets
- soiled garments holding area
- post-mortem facilities
- viewing room
- visitors' waiting room
- cleaning materials storage room
- cleaner's room
- prayer and religious rites room

1.6 RISKS, EMERGENCIES AND DISASTERS

1.6.1 Overview of current concepts

In developing a facility and ensuring its full functioning, it is of value to consider adopting a risk management approach. The failure to effectively manage risks can lead to very limited services, emergencies or even disasters. To ensure that a hospital can provide the necessary services, those responsible must establish processes to manage risks. If this is done at an early stage, it becomes an integral part of the running of the hospital.

It should be recognized that these sources of risk could come from within the facility itself, internally, or from the environment the facility is surrounded by, externally. A broad categorization of sources of risk is included later in this document. As examples, these types of risks can be seen as structural failure, internal, or a surrounding area cyclone which leaves the facility unharmed, external. Both of these situations will put the facility under high levels of risk which could be planned for in advance if treated correctly.

There are three main concepts which should be considered in this process:

1. Prevention through preplanning rather than responding to problems and events as they arise. It is essential that resources be invested in plans, people and organizations to deal with risks before they can become emergencies or disasters. This spending can be greatly reduced if risk management and prevention is included at this early development stage.

If all the plans and construction take the risks and hazards into account, the extra cost of 'risk management' is very small. For instance, to construct a new building including considerations to withstand high winds raises the cost of construction by as little as 10%, but to retrofit an existing building to new specifications can be extremely costly. So risk management can be both of great value to the community and very cost effective.

2. Participation: the range of possible risks which face a facility and the range of ways to manage those risks is such that it is better to involve as wide a cross section of skills and knowledge as possible to ensure a comprehensive identification of risks; also, a widely based participation will engender a sense of ownership in the plans which are developed to manage risks. When tackling internal and external sources of risk, the communities involved must vary accordingly. Those involved in internal consultation may be doctors, nurses, cleaners and any other staff employed. Externally, the communities and groups involved will depend on the situation and the local circumstances surrounding the facility.

Like any community building, a hospital is a facility that has many stakeholders in its future. These are all the people who wish to see it persist and many may wish to participate in: ensuring its best future performance. These stakeholders range from all of the staff who will work there, to the construction group, to the various communities it will serve and all other bodies involved in establishing its future stability. To ensure cooperation and understanding of all the aspects of risk and planning, there should be as many of these groups represented in the planning process as possible. There have been difficulties, in some cases, when

groups are not consulted during the process of decision-making and are merely informed about the outcomes. Vital information can be missed and it is very useful to ensure that those involved in activities to reduce risk participate in the implementation.

3. Qualitative rather than quantitative. When investigating the risks and hazards faced by the facility, it is best to describe these via qualitative means or methods with explanation, rather than numerically or quantitatively. Quantitative assessments have a tendency to neglect the fact that risks, emergencies and disasters are social issues, not merely an element of costs and figures.

Qualitative explanation leads more readily to flexible and robust answers and remedies to reduce the impact of a risk, emergency or disaster. Additionally, there are distinct problems in estimating numbers to subjects that are not easily valued. There can be an inappropriate resilience for decision-making on very uncertain data. These valuations rarely answer the problems or help decide upon actions to be taken.

1.6.2 Emergency and physical facilities

1.6.2.1 The hospital in emergency situations

The most common scenario that can be painted of a hospital during a disaster and emergency situation is that of a structure or physical facility teeming with people: emotionally shaken; injured and needing immediate medical attention; and worst, dead.

The hospital should, as mentioned earlier, provide the Emergency relief and be a "haven" to the mass of population that had sought shelter in it. It is ironic, however, that in some cases, the hospital that must contain life-saving and life-prolonging activities is in itself a victim of the calamity, having been damaged and has even in its collapse caused the death of people.

Emergency

A sudden occurrence demanding immediate action that may be due to epidemics, to natural or technological catastrophes, to strife or to other man-made causes.

1.6.2.2 Causes of structural failure

A post-evaluation of structural failures of physical facilities after catastrophes, has pointed out the following causes:

- (1) Bad location

This is directly related to the site selection or site adaptability evaluation process that should precede design. Liabilities of a site, such as presence of an earthquake fissure, high water table, unstable or marsh-like soil condition, and openness and exposure to typhoons can be handled by design only up to an extent. The more difficult the design problem, the more expensive the solution. Sometimes, despite its negative features, the site is used anyway because there is no other available site, but because of cost-cutting imperatives, inadequate and inappropriate structural systems are used.

(2) Bad design

Design is a problem-solving activity. Good design is the result of a full knowledge of all conditions and factors bearing on the problem while bad design may result from either a designer's error in the use of good data or a designer's failure to obtain the necessary important data. It may also be caused by the inadequacy of the designer's professional capability.

(3) Wrong use

Structures are designed specific to their use. Live loads are an important consideration, for structural design. The design of the floor of a nursing unit, for example, is different from the design of the floor of a lecture room, or from the design of the floor of an X-ray room. Structural failure will occur if a nursing ward so designed structurally, is converted and used as an X-ray room without proper professional consultation. This means that problems will occur if the intentions of design are not communicated and transmitted to the end-users of a space.

(4) Poor materials

A material may be sub-standard, of poor quality and does not satisfy the specifications, such as a reinforcing bar that does not pass the required standard tests. The use of a particular material may not be appropriate because of a certain condition in a locality, such as the use of wood in termite-infested areas. In either case, the inadequacy of the material has a bearing on the capability and integrity of the building to contain and sustain comfort and safety within its spaces.

(5) Poor construction methodology

Design may be correct, appropriate and safe, but if there are flaws and omissions in construction methodology, in the way the building is assembled from bits and pieces of materials, the probability of structural failure exists. The unnerving reality about this aspect is that it may not be visually evident, the failure only impending and manifesting when triggered by a situation such as the occurrence of a disaster.

(6) Inappropriate technology

Technology, low or high, must find its proper place in the existing conditions of a country. A high technology structural system, for example, requires certain conditions so that it may be erected or constructed such as: a skilled and knowledgeable labour force that understands the system, new types of erection equipment, and adequate financial resources to fund the construction of the system and to maintain it later. If all the required ingredients are not present, structural failure may occur because the system has not been erected properly in the first place and not cared for and maintained when already in use.

1.6.2.3 Nature and type of risk, emergencies and disasters

It is of great importance that a designer understands the physical forces that impinges on his structure. Each type of disaster or emergency brings with it requirements that are unique and different and which call for equally unique design solutions specific to the

situation. The following is a discussion of emergencies and disasters to define them and to give an idea of the nature of their impact.

The World Health Organization has compiled the following rule-of-thumb definitions for emergencies and disasters:

- (1) **Risk**: a concept used to describe the likelihood of negative consequences.
- (2) **Emergency**: a sudden occurrence demanding immediate action that may be due to epidemics, to natural or technological catastrophes, to strife or to other man-made causes.
- (3) **Disaster**: any occurrence that causes damage, ecological disruption, loss of human life, or deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area.
- (4) **Complex Emergency**: a form of man-made emergency in which the cause of the emergency as well as the assistance to the afflicted is complicated by intense levels of political considerations.

The WHO Task Force on Vulnerability Reduction determined that all hazards and sources of risk could be categorized in four broad areas;

1. **Natural**

Earthquake, tremor caused by sudden ground motion. This is the result of the release of energy or stresses inside the earth or the sudden movement of land on the earth's surface.

Tsunami, a great wave generated by an earthquake that occurs on the ocean floor. The wave decreases in velocity but increases in height as it approaches land.

Tropical cyclone, a weather phenomenon that forms in the open sea, bringing high winds, heavy rainfall and usually flooding.

Flooding, accumulation of excessive water from heavy rainfall, snow-melt, high tide and other causes.

Drought, lack of sufficient water supplies for agriculture, livestock, industry and the general human population.

Volcanic eruption/activity, release of energy in the form of molten lava, ash, debris, steam and hot gases.

Land/mud slide, mass movement of soil, snow, lahar or debris triggered by rainfall, earthquake, or existing rock faults.

2. **Technological**

Industrial site containment failure, adjacent industrial sites can fail to protect neighbours sufficiently from leaks, chemicals, gases, fires or explosions.

Structural failure, neighbouring buildings may collapse or fail due to age, poor construction or prompted by another hazard, such as an earthquake.

Chemical, nuclear or biological, threat from gas clouds resulting from failure of man-made structures may be due to transport accident or any number of root causes.

3. **Societal**

Civil unrest, local, regional or national unrest can take the shape of riotous or demonstrative behaviour seriously hampering the performance of the facility.

National or international conflict, a degradation of political cohesion can lead to conflict and potential damage to infrastructure, support and physical structure of the facility.

4. **Biological**

Disease, those employed at the facility are equally prone, if not more so, to regional disease and endemic illnesses.

Epidemics, whether local, regional or national, will lead to a surge of in-patients needs and may cause widespread civil unrest. The numbers involved could limit the ability of the facility to perform at a high level.

This list is by no means exhaustive or fully comprehensive. It merely acts as a guide to the wide variety of hazards that planners must be aware of and take into account at all stages of their process.

1.6.2.4 **Some recommended planning and design considerations**

Design solutions are varied. The following is a discussion of some of them.

Site selection:

The appropriate choice of a site is in itself a protection from calamities. A location surrounded by natural barriers such as mountains and natural rock or soil formations is amply protected by nature itself from the tropical cyclone or the tsunami, as shown in Fig. 65.

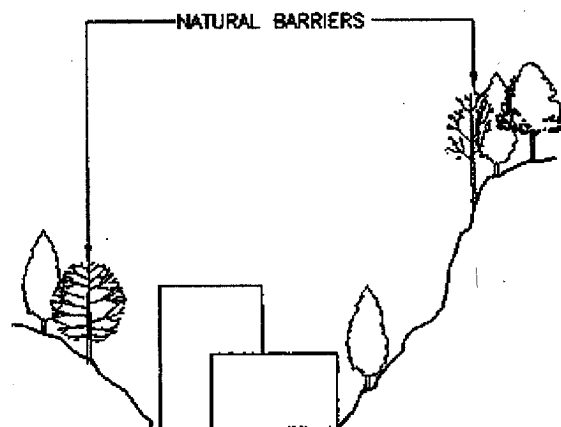


Figure 65. Natural barriers

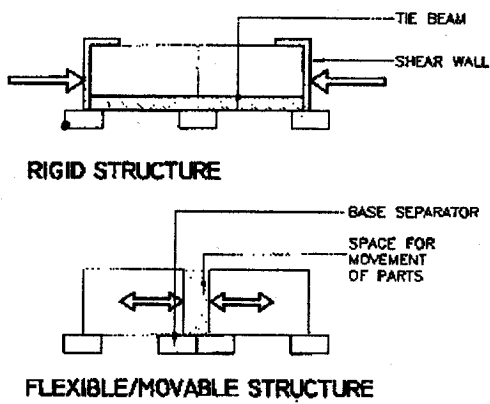


Fig. 66. Structurally resistant structures

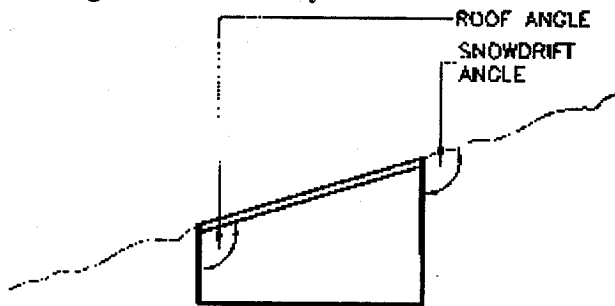


Fig. 67 (a)

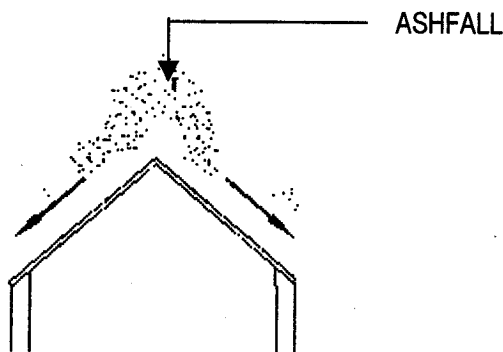


Fig. 67 (b)

Sound structures:

Structural resistance is a kind of response to the collapsing effect of movement. The kinds of disasters or emergencies that it addresses is that which is brought about by an earthquake or a volcanic eruption. Structural resistance means that the structure is rigid and strong to counteract and negate the effect of the movement. On the other end of the spectrum, It also means that the structure is so designed as to "be one" with the movement, to sway and move with it through flexible, movable parts and joint systems. Fig. 66 shows rigid and flexible structures which are both structurally resistant.

Appropriate building forms and details

The roof of a structure in a country with a harsh winter and excessive snow accumulation has a slope that echoes the angle of the snowdrift (Fig. 67a). The roof of a structure in a site close to an active volcano has a pitch that slides off any ash fall accumulation (Fig. 67b).

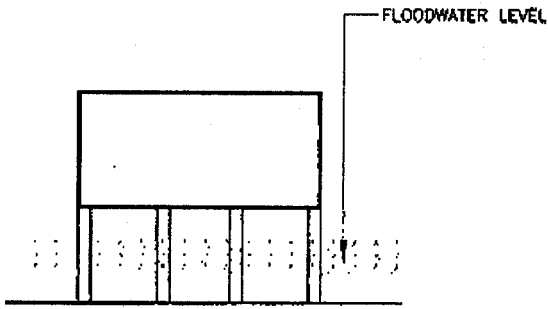


Fig. 67 (c)

Fig. 67c shows a building in a site that is often flooded and is elevated from the finish ground line by stilts.

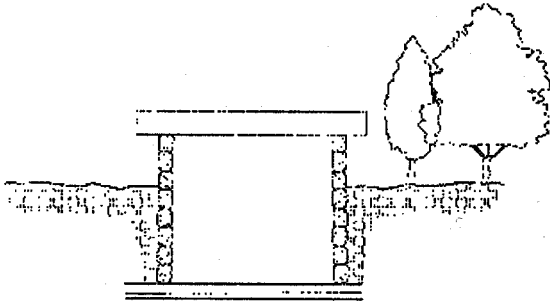


Fig. 67 (d)

The architecture in a locality that is perennially in the path of typhoons is half-buried into the ground, its walls of large and heavy stones act as windbreakers, as shown in Fig 67(d).

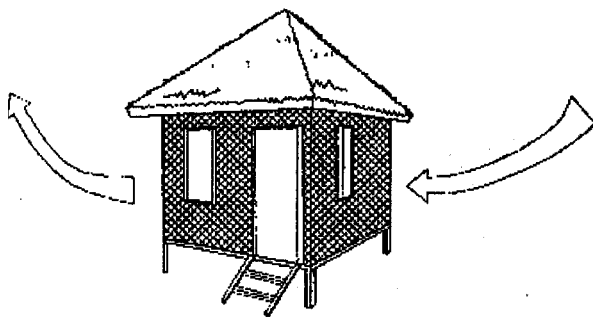


Fig. 67 (e)

In another place frequently devastated by typhoons, the architecture is light, with screen-like walls, punctured by innumerable openings that allow the free passage of high velocity wind, as shown in Fig. 67(e).

These are only some of the adaptations in architectural form and details. Because of the frequency and the constancy of the occurrence of the calamity, they become deeply rooted and permanently integrated into the architecture of a place.

There are situations in many parts of the world where conflicts have erupted and have become part of the daily life of the people. Some have deadly and devastating consequences. In some areas anti-personnel land mines accidentally detonated by unknowing civilians have produced a population of disabled persons. In other parts, evacuation of populations from scenes of conflict has created displaced and mass refugee population in need of health services.

There are also places where the hospital is in the midst of intermittent conflicts and the staff has to work in a specially designed environment. In time of peace, the hospital exists under regular, normal procedures. When rockets and warfare machinery begin to be fired, the staff has to adapt immediately to the high-stress situation and shift all operation to the safest part of the hospital.

In this regard, "adaptability" and "convertibility" are key considerations in evolving design solutions.

The idea of a hospital part specifically designed to operate during emergencies addresses the dynamic and shifting situation,

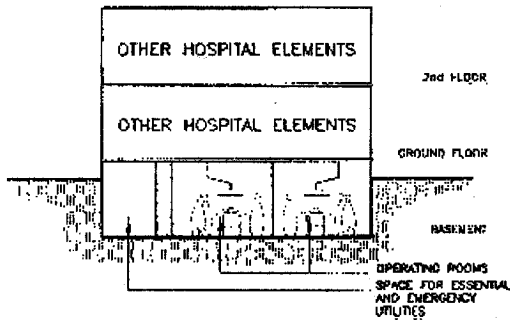


Fig. 68 (a)

The basement of the hospital can be considered as the safest place to shift operations when rockets are being fired above ground level. This otherwise marginal space in any building can be effectively utilized to prepare for emergencies.

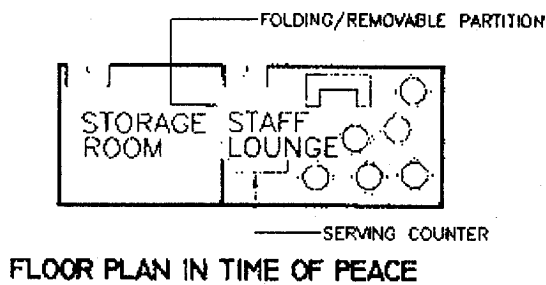
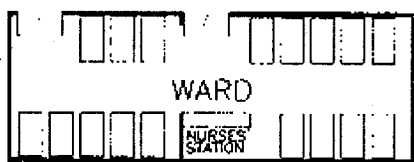


Fig. 68 (b)

While it has become the practice to locate and zone operating rooms in second floors of hospitals, it may be worthwhile to think of the basement as a permanent location for this hospital department in war-torn places, since the operating rooms must continue to be operational and will definitely be laden with workload in an emergency situation.



FLOOR PLAN IN TIME OF CONFLICT

Fig. 68 (c)

Equally important to be located in this safe place, are the essential utilities and the equipment that assure their continuous supply: generators for power and electricity, pumps for water supply, and mechanical equipment for heating and ventilation,

Then also, adequate spaces for nursing wards must be thought about. The determination of how many emergency patients to be provided for is a big decision to make-whether 50, 75 or 100% of the estimated number of victims. This will depend upon the actual situation at a particular place but in order to economize and make it cost effective, minimum emergency beds should be provided for in the original design.

Since it is almost unthinkable to send recuperating patients to the basement during peace time, spaces for "wards-in-time-of-war" should have alternative uses -storage spaces, space for records/files, or any other use that can easily be displaced to give away to the: nursing ward when the emergency situation is in progress. This transformation of uses is shown in Fig. 68 (b) and (c)

1.6.3 Disasters

Disasters brought about by man, such as oil spills, release of radiation, leakage from atomic or chemical plants, atmospheric contamination such as air pollution and haze by forest fires, transport accidents, wars, civil strife and others, or by nature, such as earthquakes, storms, tsunamis, volcanic eruptions and floods can seldom be predicted accurately, if at all. No one can be prepared for all possible contingencies. Experience has shown, however, that much destruction, suffering, turmoil and subsequent loss of lives could have been avoided, lessened and even controlled if organizations and structures designed to coordinate and provide assistance during such events had been in place.

Disaster

Any occurrence that causes damage, ecological disruption, loss of human life, or deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community.

1.6.3.1 Disaster preparedness

In emergency preparedness, WHO's goal is to strengthen national preparedness capabilities through capacity-building at the national level and by ensuring maximum congruence between emergency relief, rehabilitation and long-term development efforts. The net effect should be to promote increased self-reliance in the affected countries.

Disaster preparedness, prevention and control, therefore, consist of a wide range of short- and long-term measures designed to save lives and limit damage to property by a potentially disastrous event. These measures include:

- legislation and operational planning,
- education and training of the population,
- stockpiling of supplies and materials,
- technical training of personnel for relief and rescue operations,
- development and maintenance of adequate communication systems, and
- emergency funding.

The state of preparedness of a country can be measured by the willingness of its people and its technical and financial capabilities to take the necessary precautions to safeguard life and property. Hospitals and other health facilities are essential elements in the network. Collectively, they are the key to preserving lives in the event of a calamity.

1.6.3.2 Hospital disaster preparedness plan

Pre-disaster planning begins with the identification, understanding and analysis of the natural and other hazards in the area. The analysis will make it possible to establish priorities and to decide on the steps to be taken to reduce the risk. While there is no established standard, the following sample format is an appropriate example of an all-purpose emergency plan that can cover all contingencies. This could be adapted to suit each of the individual situations.

Introduction

A hospital disaster plan must be based on a realistic assessment of the capacity for reception and treatment of institutions that will carry out elementary relief procedures at highly technical accidents and emergency departments. The hospital disaster preparedness plan is both an integral part and a complement to the structure and content of the intersectoral health plan (main plan) and the plan of operation (sectoral plan). It should take into account legislation, if any. Consideration must also be given to the topography, climate, demography, industrialization and different government/non-government organizations involved. The history of previous disasters/accidents such as natural or man-made and industrial accidents must be looked into before preparing any disaster plan of a country.

The phases of the plan

The following are the distinct phases of the plan. Each phase needs sectoral planning such as medical transport and communications, as well as arrangement and authority for requesting assistance from outside the planning area.

- Preparation
- Alert
- Response
- Rehabilitation

Content of the plan

The plan will include:

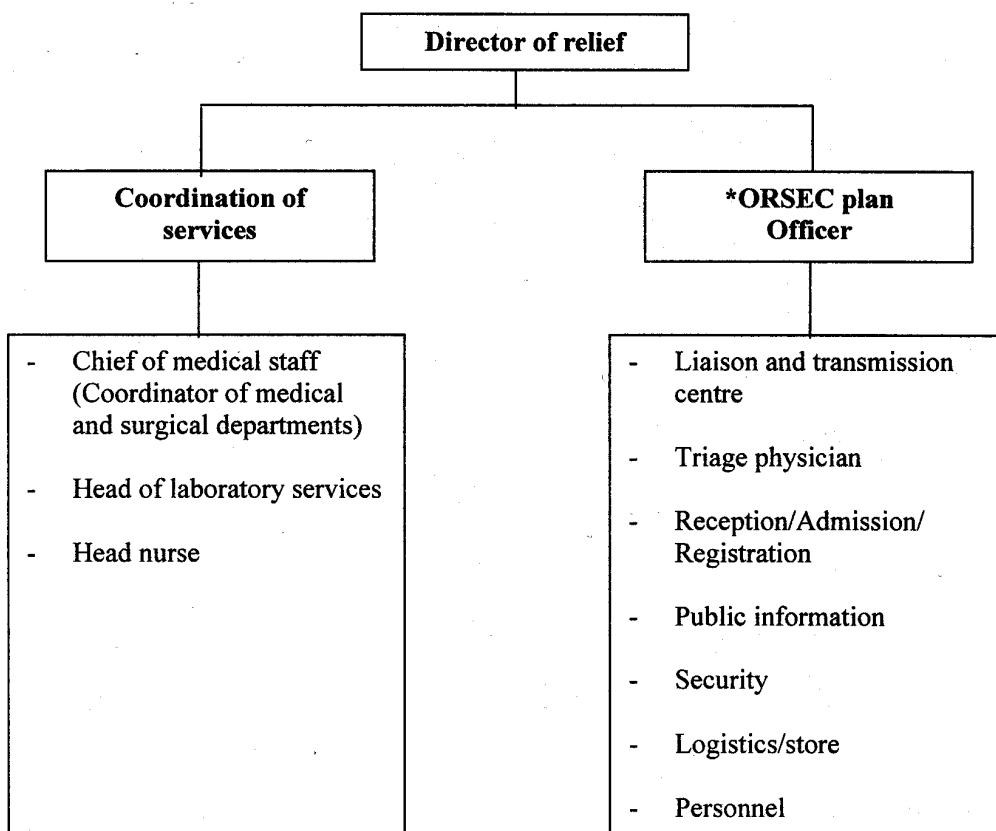
- An organizational chart
- A clear distribution of missions (roles and responsibilities)
- An up-to-date inventory of the resources available
- A diagram of communication and transmission networks
- A plan for the mobilization of these resources and networks

- Conditions for the mobilization and methods for the coordination of external aid.

The hospital disaster plan must contain specific measures relating to,

- Activation of this plan
- Assessment of the hospital's capacity
- Establishment of a chain of command
- Communication and logistics aspects.

EXAMPLE OF AN ORGANIZATIONAL CHART



**ORSEC – Other relief sector*

Characteristics of the plan

The plan should indicate powers and responsibility at each level. It should also command authorities on the post description and role of emergency services. It should be subject to a test and simulation exercise. Furthermore, the plan:

- must be based on real operational capacity;
- must be functional and flexible;
- must specify a clear chain of command;
- must be an integral part of the community health plan;
- must be continually reviewed and updated; and
- must cater for both internal and external events.

i) Internal events

The plan must indicate the events whether these are internal or external, as under. It has a bearing on the activation and realization of the plan.

- Fire
- Explosion
- Contamination

ii) External events

- Natural disasters
- Technological emergencies
- Crisis situations (armed conflicts, etc.)

The planning process

With a few slight differences, the process to be followed in planning is the same as the process described for the intersectoral plan.

The result obtained (plan document) is different in content and the task to be carried out is much simpler (unisectoral, limited in space and with staff under one single administrative command), and is co-related with each item as below in the same order.

Identify the authority responsible for planning

Set up a planning committee

- Undertake an analysis of vulnerability
- Establish planning objectives
- Define the structure of management
- Determine responsibilities
- Inventory and analyse resources
- Work out systems and arrangements for relief management
- Prepare the plan document
- Test the plan
- Update the plan regularly

The actual plan is only one of the results of the planning process. Without the other benefits of the process, it will not be of any great significance.

Activation of the plan

The following steps must be followed for the activation of the plan.

- A responsible person and a number of alternates must be clearly designated for the decision to put the plan into effect.
- Emergency situations that warrant activation of the plan must be determined and defined (these situations will vary from one hospital to another).
- Immediately after the plan is activated, all the necessary resources must be mobilized (personnel, equipment, communications and transport).

Assessment of the hospital's capacity for response

Before accepting casualties, the hospital must determine:

- Whether there is any serious structural damage to the building (including equipment and utilities)
- Whether routes of access are free
- Whether energy and drinking water supplies are functioning

This should be done by the hospital's security and maintenance services.

At the same time, the hospital's treatment and surgical capacity should be assessed, taking account of:

- the personnel available
- the number of beds free or able to be freed
- the equipment and supplies available, etc.

Hospital Treatment capacity

Hospital treatment capacity (HTC) can be defined operationally as the number of casualties that can be treated according to normal medical standards in one hour. HTC will vary depending on several factors:

- human: the number of doctors and nurses available
- material: availability of supplies and support services
- time: the emergency may occur at night or on a public holiday

Empirically, based on the experience of several countries, HTC can be estimated at 3% of the total number of beds.

Simulation exercises and actual emergency experience can help to estimate and define HTC with greater precision.

Hospital Surgical capacity

Hospital surgical capacity (HSC) is the number of seriously injured patients that can be operated on within a 12-hour period. This can roughly be estimated as follows:

$$\text{HSG} = \text{number of operating rooms} \times 7 \times 0.25$$

N.B.: Unless a hospital is exceptionally well prepared, this formula cannot be extrapolated, i.e. it is not possible to operate on four times as many patients in 48 hours. Instruments, supplies and support services will often be limiting factors.

Establish a chain of command

In order to make the plan successful, it is necessary to establish a chain of command. The general methodology would be as under:

A relief coordination centre should be set up at a pre-established site.

This centre must be able to communicate with:

- the different stations inside the hospital (triage, admission, operating theatres, morgue, information point)
- the relief operations coordination centre outside the hospital

The command personnel should include at least one physician, one nurse and one administrator.

Communications

Communications are the key to the success of all coordination efforts.

- In view of the possible hazards to normal communications networks (overload, disaster damage, etc.) provision should be made for special telephone lines or radio links on reserved frequencies
- Simple operating instructions should be drafted during the preparation phase
- Inter-hospital communication may be useful to obtain additional resources or transfer patients in the case of overload.

Logistic aspects

Stocks of the necessary supplies and equipment should be built up in advance, ready for immediate distribution to relief teams as soon as the plan is activated.

Detailed lists showing the destination (intended use) of these supplies should be drawn up during the preparation phase.

Do not forget to ensure rotation of items with expiry dates.

Technical aspects:

The areas that are essential to the functioning of the plan should be identified in advance, as follows:

A. Administrative and treatment areas

- The relief coordination centre is the place from which the tasks of command and coordination of relief operations will be directed. These include:
 - Activation of the plan by the designated responsible person
 - Control and coordination of hospital activities

- Liaison with the relief operations centre (close to the scene of the disaster)

Reliable communications are absolutely essential for the coordination centre to function properly.

- **Reception and triage area:** entry should be restricted to one area for all patients. There may be two points of access to the triage area -one for patients and the other for ambulances.

This area is for rapid assessment of all incoming casualties, assignment of priorities and decision on the action to be taken.

This triage will determine the success of all hospital relief activities.

B. Patient care stations

Specified areas should be designated and clearly labelled for patient care stations, as follows:

- Major trauma and medical cases: the treatment area will be in the accident and emergency department (cardiovascular distress, hypovolemic shock, etc.)
- Minor trauma and medical cases: usually the majority of patients (simple fractures, minor wounds, etc.)

C. Other stations

Admission (pre-surgical): patients with serious injuries stabilized in the emergency area will be sent for admission for surgery.

Surgery: the limiting factor is the number of operating theatres and staff available. The most senior surgeon must take the responsibility of deciding on priorities.

Morgue: may need to be expanded to take more bodies (a mosque, church, etc., may be used).

Decontamination: provision for the decontamination of individuals chemically or radioactively contaminated.

Psychiatry: treatment of anxiety, depression and other psychotic episodes resulting from the loss of people and possessions.

Family waiting area: also used for the discharge of patients. Should be separate from the other patient care stations and have its own separate entrance.

Press area: special care must be taken to cope with the presence of the media at the hospital in major emergencies. It is important:

- to direct journalists to a pre-designated press room well away from all the areas described above
- to prevent any contacts with patients and medical staff .
- to designate a hospital spokesperson to liaise between the relief coordination centre and the press

It will be the task of the security staff to ensure that these instructions are strictly followed.

Documentation of the plan

A hospital disaster plan to be used in a major emergency should be set down in a clear and concise written document and distributed to potential users inside and outside the hospital.

The component chapters are very similar to those of the intersectoral plan, as follows:

- Summary
- Mission and responsibilities
- Distribution list
- Aim and objectives of the plan
- Description of the site and premises
- Results of the vulnerability analysis (for the hospital)
- Activation
- Structure of management (organizational chart)
- Operations management systems
- Glossary (terminology)

An inventory of resources and any special plans should be included as annexes to the plan. Staff training programmes, methodology and procedures for the organization of simulation exercises may also be appended as annexes.

Public information

This could be achieved in the following general manner

- Announcements

- Information releases
- Emergency broadcasting
- Multi-language broadcast

Conditions for effective functioning of the plan

The following conditions are necessary for the effective functioning of the plan.

- to test the plan
- to familiarize all staff and the leaders of the community served by the hospital with its content
- to ensure that the staff who will play a major role in implementing the plan receive training
- to organize simulation exercise (at least once a year)
- to ensure that the plan is regularly reviewed and updated.

In addition to the above, it is helpful if sub-plans for various departments are drawn such as: communications, police fire service, defence, medical, rescue, evaluation, public worker, post and telegraph, civil aviation, power and registration and tracing services.

1.6.3.3 Rehabilitation

It can be seen from this sample format that the medical group is an important part of the planning group during and after a calamity. In any disaster, saving lives is always the first priority. If the planning and design of a hospital can be related to an existing plan for disaster preparedness, it will add an important dimension to the plan. The steps that can be taken by the planners and designers to this end can include:

- (a) collection, collation and analysis of local data based on standard requirements;
- (b) collection, collation, coordination and cooperation in the preparation of:
 - analyses and calculations of vulnerability, elements at risk and specific risk;
 - listing of available resources in the area, such as manpower, transport, supplies, equipment and emergency funding;
 - review of laws, rules, regulations and ordinances;
- (c) establishment of linkage with the national disaster control structure:
 - office of civil defence
 - health relief centres

- hospitals and other health facilities
 - health legislative committees or councils;
- (d) preparation of an operational plan and the foreseeable role and extent of involvement
- on the basis of the local situation and financial capability:
 - plan for probable events, including hospital patients and staff
 - plan for administrative response (staff alert, recall and deployment, operational control and deployment, management of mass casualties)
 - subdivision of plans into self-sufficient units
 - dissemination of information on pertinent groups
 - exercises to test plans;
- (e) determination, ordering of priorities and limitation of involvement on the basis of financial capability; and
- (f) assessment of public awareness programmes.

Such exercises would lead to adoption of norms, criteria and standards that merge acceptable international practice and the dictates of local disaster preparedness.

Most developing countries cannot divert their limited resources to provide for an event that may or may not take place in the near future. The dimensions, strength and durability of the structure and the number and sophistication of the equipment and facilities are dictated by the economic status of the country, which may also be the primary consideration with regard to the adequacy and extent of the safety features to be incorporated. As a result, designers and planners can expect a down-grading or de-sophistication of their design or plan at the working stage. Only in extreme, special situations would additional features or higher standards be imposed.

The type of calamity or disaster and the potential damage it can create is the second major factor to consider. As situations differ from country to country, historical experiences should be reviewed, and previous calculations and analyses can serve as a solid basis for making a decision. National records and advice from specialist departments like the meteorological service, geophysical observations, the mining department and flood control can be helpful in this regard.

Any design or plan of the buildings should be based on the country's experience with regard to the type, frequency and extent of death and destruction brought about by the calamity. For example, a country prone to earthquakes will highlight the seismic consideration in the design of buildings. Countries visited often by typhoons, will give due emphasis to safety measures against typhoons and monsoons.

A second plan may be area specific. In countries that have become virtual battlegrounds as a result of political unrest, special attention should be given to the strength, size and location of a hospital and its support facilities. In areas where there are frequent battles, the designer will have to consider large spaces to accommodate the injured and large mortuary buildings.

Adaptability of spaces for easy conversion into temporary havens for disaster victims and provisions for food may be considered in a third plan. Experience has shown that, during the initial impact of a disaster and for at least the next three days, the population tends to gravitate and seek shelter in hospitals. Subsidy by the government may be possible through emergency calamity funds.

A hospital can be designed to accommodate 50, 75 or 100% of the estimated victims of a calamity. Decisions can also be made on what types of disaster to design for. In the final analysis, however, economics is the overriding factor.

The process of planning for disasters can "payoff". Disasters often call for overall management of a group of resources, of which the district hospital is but one. In an emergency, the control of all facilities must come under one command, each unit becoming part of a larger team. Inter-hospital and health facility cooperation in disaster planning and practice can lead to improved rationalization of the use of resources in everyday operation.

1.6.4 Fire safety

(a) The nature of fire

Fire is the perceptible phase of burning or combustion, which is the chemical combination of oxygen in air with the carbon contained in matter. The process of combustion is affected by:

- Oxygen: Natural air contains 21% of this element; if it is absent or insufficient, combustion will not continue unless the material itself has oxygen in it.
- Heat: Burning starts at the necessary degree of heat. Wood requires 398°C, but if it is exposed to 204°C for 30 minutes, it will ignite. When the ignition point of any material is reached, it will start to flame if sufficient oxygen is present.
- Nature of substance: Thinner materials ignite more easily than thicker ones; gases and vapours are more inflammable than solids.

Smoke is a by-product of fire that contains carbon monoxide, which is harmful to human beings. It also conveys heat and may raise the temperature of substances it touches to ignition point.

(b) Principles of fire safety

- Fire avoidance (Fig. 69) is reduction of the possibility of accidental ignition of materials, or separation of heat sources from inflammable materials. Kitchens should not be located near rooms where combustible materials, such as X-ray films and oxygen tanks are stored.

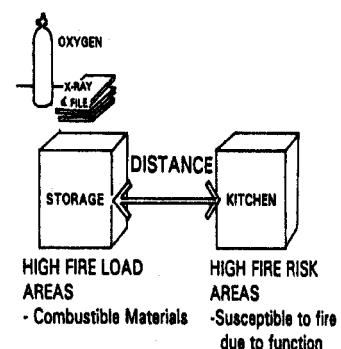


Fig. 69 Fire avoidance

- Fire growth restriction (Fig. 70) is slowing the rate of development of a fire to gain time to take measures for control and evacuation of people. Compartmentalizing the hospital and constructing dividing walls made of fire-resistant materials will slow down the spread of fire.

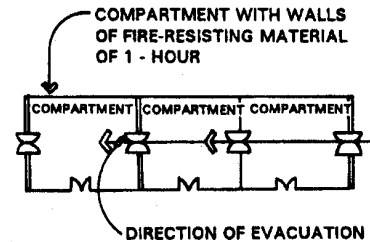


Fig. 70 Fire growth restriction

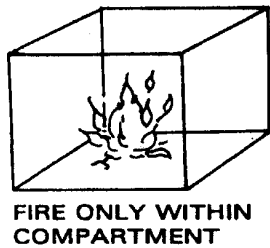


Fig. 71 Fire containment

- Fire containment (Fig. 71) is restriction of the fire at its site, using fire-resistant materials and by plugging all gaps through which it could pass, to allow effective fire-fighting.

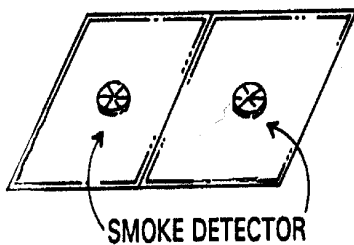


Fig. 72 Fire detection

- Fire detection (Fig. 72) is based on early knowledge of the occurrence of fire, which ensures early action to fight it. Smoke detectors can be installed in the ceiling at various points. Interiors of rooms that contain combustible material should be visible from outside.

- Fire control (Fig. 73). Fire-fighting equipment such as fire hoses and fire-extinguishers must be easily visible and accessible for immediate use. Fire-fighting hose-reels (for use by staff to extinguish minor fires) should be of manageable length and should be located in corridors and exit routes at intervals that will allow the entire building to be covered. A fire-extinguisher (of a type suitable for fires in electrical appliances) should be available with each hose-reel and at the entrances to high-risk rooms, such as laboratories. Manual fire-alarms should be located at exits and be easily visible.

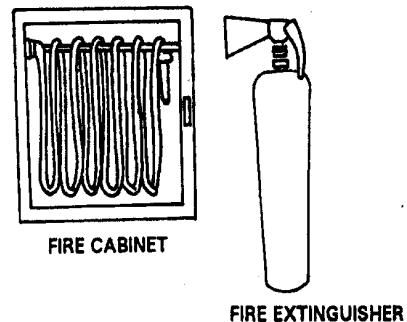


Fig. 73 Fire Control

- *Smoke control* (Fig.74) is the management of the action and effects of smoke. Smoke spreads very quickly and is the greatest hazard to life in case of fire. Instead of designing ceilings with voids in suspension and vertical shafts through which fire and smoke can move, such spaces must be sealed.

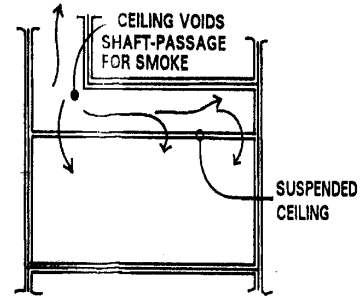


Fig. 74 Smoke control

- *Escape provisions* (Fig. 75) are made for movement away from fire to a place of safety. Alternative escape routes must always be provided. Escape routes must be protected by sealing them from fire and smoke or by creating positive pressure in them. On the ground floor (escape level), an escape stair should have only one set of doors between the stairway and the outside. When the stair is within the building (as in a tower block above a podium), the escape route through the podium should be a fire-protected corridor with no doors between the bottom of the stairs and the exit doors to the outside. Thus, if fire develops in the escape route, smoke will rise in the stairwell, and people on the floors above will be warned that they must use alternative escape routes.

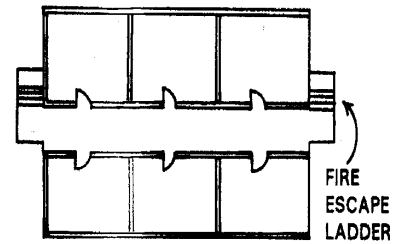


Fig. 75 Escape provisions

Norms for fire-resistance in a district hospital building are as follows:

- (1) The structural framework and building elements of all buildings more than one storey high should be made of appropriately fire-resistant combinations of materials, such as steel, concrete and masonry. Load-bearing walls should be limited to exterior walls, fire-walls and vertical shafts.
- (2) Bearing walls, lift shafts, chutes and other vertical shafts, walls enclosing stairways, boiler rooms, storage rooms of 10 m² or more should be of 2-hour fire-resistant construction.
- (3) Beams and girders supporting masonry should be individually protected with not less than 2-hour fire-resistant construction.

- (4) Columns, girders, trusses, floor and roof constructions, including beams, should be of not less than 1.5-hour fire-resistant construction.
- (5) Non-load-bearing partitions, other than corridor partitions, should be of 1-hour fire-resistant construction.
- (6) The following flame-spreading ratings should be maintained (ASTM Standard E-119):
 - interior finish walls, ceilings of all exits, storage rooms and areas of unusual fire hazard not more than 25
 - all other areas in the building (except that up to 10% of the aggregate wall and ceiling area may have a finish with a rating of up to 200). not more than 75
 - all floor finish materials not more than 75

All lift cars and platforms should be constructed of noncombustible materials, except that fire-retardant-treated materials may be used if all the exterior surfaces of the cars are covered with metal. Cars of hospital lifts should have inside dimensions that will accommodate a patient bed and attendants.

1.7 WATER, SANITATION AND WASTE MANAGEMENT

Provision of a safe, potable water supply and an adequate waste disposal system are of primary importance in a hospital for the obvious reasons, as they contribute to the well-being of patients and reduce the risks of infections and propagation of diseases such as dysentery, gastro-enteritis and other water-borne and food-borne diseases.

In some developing countries, where modern amenities like an efficient water works and distribution system, a centralized wastewater disposal system, and a comprehensive health care waste management system are not available, hospital planners and designers must use flexibility and ingenuity to find other solutions.

1.7.1 Water supply

Water for use in hospitals must be:

- free of disease-causing (pathogenic) organisms, and objectionable and poisonous substances;
- clear, colourless, odourless and tasteless;
- not too rich in calcium, magnesium, manganese, iron, and carborates (hard) for domestic and industrial use;
- free from corrosive substances; and
- at a low, agreeable temperature

It is ideal if all these requirements are met, but there may not be such water source available in the vicinity. Even in developed countries, water must be treated to remove the undesirable elements in it and disinfected by adding chlorine to the distributing reservoir or water mains.

A complete waterworks consists of:

- *Collection system.* This consists of the intake, where the water is drawn from the source of supply; the receiving reservoirs; the transmission line, or the pipe conduit through which it flows; and the pumping machinery to raise the water from one level to another until it reaches the purifying system.
- *Treatment system.* This consists of settling basin(s), where settleable solids are removed; coagulation and flocculation where chemicals are added to aid removal of small suspended solids that cannot be removed by gravity; filtration where flacs are

removed; ion exchange and membrane filters in which hardness is removed; and disinfection usually by chlorine where disease-causing organisms are killed/removed.

- *Distribution system.* This consists of the distribution reservoirs, in which the treated water is stored, and the network of pipes that convey the water to the points of consumption. Normally, storage facilities are provided to store a 36-hour supply for a hospital.

In a simple gravity system, the force of gravity moves the water from the source or the treatment system to the points of consumption. The pressure required in the system for ordinary use is 3.5 kg/cm^2 ; for fire protection without the aid of fire engines, however, the pressure required is 7.0 kg/cm^2 .

When there is no existing waterworks in the area, planners and designers must look for the nearest, appropriate and uncontaminated body of ground or surface water, such as a natural spring, flowing river, lake or reservoir. Using such sources, a simple system of filtration through gravel and sand can be established, and a naturally aerated collecting and storage pond can be dug. In the absence of a spring or river, a shallow tubewell may be dug or drilled fitted with a hand pump or a deep-well fitted with a hand pump or power engine driven pump. Experience indicates that water extracted from a depth of up to about 25 m is generally potable and safe. Deeper wells yield more water and usually of better quality, but more powerful pumps and more piping are needed. An elevated water tank can be used to store the water collected. Whether the water source is a spring, a river or a well, a piped conveyance and distribution system supported by a forced pumping needs to be used when it is not possible to do it by gravity.

The minimum water requirement is about 50 litres per person per day. Normally, however, the water requirement is 115 litres per person per day. A district hospital with about 100 patients and 200 personnel, or a total of 300 people, will need at least 34 500 litres of water per day. An additional volume of about 30 litres per person per day should be added to this basic volume in the computations for watering lawns and as a stand-by for fire protection.

1.7.2 Wastewater and wastewater disposal

Wastewater as it is used here refers to the domestic liquid waste of a community, and sewerage is the system by which it is removed. The sewerage system is thus the totality of the conduits, pumping stations, treatment plants and other works necessary to collect, purify and dispose of the wastewater.

The laws governing the disposal of wastewater vary from country to country. These may be amplified by national sanitation codes, rules and regulations and local ordinances. Normally, wastewater is subjected to at least some preliminary treatment, such as screening, to separate the larger floating solids from the liquid waste, which is then passed through a sedimentation tank to remove settleable suspended matter. The effluent from the process is then treated further using secondary treatment processes such as a trickling filter, activated sludge, rotating biological disk, etc. before it is discharged into a body of water, on natural land, on prepared land, or on specially constructed filter beds of sand and gravel.

1.7.2.1 Choice of disposal system

Raw wastewater contains both organic and inorganic matter. In order to determine the most effective and least expensive method of disposal, the raw wastewater must be analysed for its chemical, biological and physical properties. In planning and designing a hospital, the following information must be available:

- a complete analysis of wastewater at the site or a similar institution;
- an estimate of the volume of wastewater that will be produced daily;
- how it will be disposed of and
- what type of treatment system will be required to meet the effluent discharge standards.

It should be noted that provision of on-site laundry facilities substantially increases the daily volume of wastewater.

The primary aim of a disposal system is to remove organic matter by converting it to bacteria (i.e., biological treatment), separate them from the liquid waste by sedimentation and filtration, and eliminate or neutralize pathogenic bacteria and viruses that may be present in the wastewater which cause cholera, diarrhoea, dysentery, typhoid fever and other waterborne diseases by digestion, drying and disinfection. It should also prevent the creation of nuisance resulting from the process of putrefaction. Bacteria can be divided into three classes, on the basis of how they break down organic matter:

- aerobic bacteria, which can live and work only in a medium that is well supplied with oxygen;
- anaerobic bacteria, which live and work in a medium that is deficient in or devoid of oxygen; and
- facultative bacteria, which live and work in a medium where oxygen is present in a small amount.

Each class works under conditions favourable to itself and is destroyed in the process of putrefaction.

At a project site where there is no existing centralized wastewater collection and modern, advanced disposal system, one of the following two methods of treatment of raw wastewater can be used:

- In septic tanks, in which raw wastewater flowing in is detained for a period of time to allow bacteria to act on it, help in its decomposition and render it relatively

inoffensive. The treated wastewater is disposed of by percolation in the ground, using either a percolation or infiltration well or a trench field. The suitability of the ground for this purpose must first be established by percolation tests.

- Oxidation pond(s), in which the wastewater is exposed to the sun in simple ponds or ponds equipped with mechanical aerators, depending on the condition and quantity of the wastewater to be treated.

More technologically advanced solutions are also available, which include mechanical screening followed by sedimentation, aeration or filtration, digestion, drying or de-watering and disinfection. Such facilities require electrical energy and trained and skilled manpower to operate them; they may not be feasible for small hospitals located in rural areas of developing countries. Strong fermenting agents (microbes and enzymes) are also available that can be used to neutralize or control pathogenic bacteria.

Factors to be considered in determining the method of disposal to be adopted are cost, available land area and the availability of electricity, technical expertise and chemicals needed.

1.7.2.2 Effluent disposal and utilization

The effluents from properly designed, operated and maintained wastewater treatment units can be safely discharged into surface waters such as lakes, streams, rivers, and oceans; injected into the ground; and discharged on the land. Wastewater treatment plant effluent constitutes a valuable source for recharging groundwater; however, the points of recharge must be well arranged and the quantities limited, so that there is no threat to the quality of the groundwater. Partially purified wastewater effluent may be used for fish culture and farming without further dilution, depending on local hydrogeological conditions. When it is used to irrigate fields, much less wastewater effluent needs to be used than with fresh water, because the effluents have a higher concentration of suspended matter.

1.7.3 Health care waste management

A hospital produces not only liquid waste, but also solid waste from food preparation as well as contaminated materials from the wards, operating department and laboratory. The waste generated in hospitals and other health care establishments may be hazardous or offensive and pose a health risk to patients, personnel in health care establishments and the general public, if not handled and disposed of in a satisfactory manner.

Usually, a large portion of waste (as much as 80-85%) generated in health care establishments is non-hazardous, general waste. Such waste does not require special treatment and can be disposed of as normal household or office waste. However, if non-hazardous waste is mixed with infectious and other hazardous wastes, the resulting mixture needs to be treated as hazardous waste and requires special handling and disposal. In order to reduce the cost of waste management, it is essential to segregate the hazardous waste from the non-hazardous component at the point of generation.

1.7.3.1 Waste categories

The hazardous health care waste may be categorized into:

- 1) infectious (non-sharp waste);
- 2) sharps;
- 3) pharmaceutical and chemical wastes; and
- 4) other hazardous wastes (e.g. pressurized containers and cytotoxic and radioactive wastes).

Infectious (or potentially infectious) wastes, other than contaminated sharps, include:

- 1) soiled surgical dressings, cotton wool, gloves, swabs and all other contaminated waste from treatment areas; plasters and bandaging which have come into contact with blood or wounds; cloth and wiping materials used to wipe out body fluids and spills of blood;
- 2) material, other than reusable linen, from cases of infectious diseases (e.g. human biopsy materials, blood, urine, stools);
- 3) pathological waste, including human tissues, organs, limbs, body parts, placenta and human foetuses; animal carcasses and tissues from laboratories and all related swabs and dressings; and
- 4) waste arising from laboratories (e.g. pathology, haematology and blood transfusion, microbiology, histology) and postmortem room waste, other than waste already included above.

Sharps include discarded syringes, needles, cartridges, broken glass, scalpel blades, saws and any other sharp instruments that could cause a cut or puncture and could be infected.

Pharmaceutical waste includes expired drugs, vaccines and sera, including expired drugs that have been returned from wards, drugs that have been spilled or contaminated, or are to be discarded because they are no longer required.

Chemical waste arises from a variety of sources within health care services, but occur primarily in waste from clinical laboratories and associated services. Chemical waste comprises discarded solid, liquid and gaseous chemicals, for example from diagnostic and experimental work, cleaning, housekeeping and disinfecting procedures.

Pressurized containers include compressed gas cylinders, aerosol cans and disposable compressed gas containers. Cytotoxic and radioactive wastes are rarely generated at district hospitals.

Cytotoxic waste includes expired cytotoxic drugs and materials (e.g. swabs, tubings, towels, sharps) contaminated with cytotoxic substances during the preparation, transportation and administration of cytotoxic drug therapy. Cytotoxic drugs are also known as antineoplastic drugs or cancer chemotherapy drugs, and have the ability to kill or arrest the growth of living cells.

Radioactive waste includes solid liquid and gaseous waste contaminated with radionuclides generated from "in vitro" analysis of body tissues and fluid, "in vivo" body organ imaging and tumour localization, and therapeutic procedures.

Non-hazardous waste includes:

- 1) General domestic-type waste: household-type wastes from offices, corridors, public areas, supplies departments, catering areas (other than food), etc. Examples of the components of general waste are newspapers, letters, documents, packing materials, cardboard containers, plastic bags/films, food wrappings, metal cans, food containers, flowers, floor sweepings.
- 2) Kitchen waste: food waste, swills, etc.

1.7.3.2 Handling

Different categories of waste should be placed in different waste containers/bags. These containers/bags may be colour-coded to avoid the mixing of different waste categories. Sharps, should never be placed in soft, puncturable containers (e.g. thin plastic bags). Hard containers should be provided for them.

It is the responsibility of the nursing and clinical staff to ensure that segregation of waste is carried out at source. Waste should be collected daily or as frequently as circumstances demand from wards and departments. Only designated workers should collect waste. Dedicated wheeled containers, trolleys or carts should be used to transport the waste to a designated central storage area in the hospital. The waste will be treated at the central storage area or transported off the site for disposal.

1.7.3.3 Treatment and disposal

The treatment and disposal methods typically employed for health care waste include:

- 1) incineration;
- 2) landfill;

- 3) discharge to sewers; and
- 4) sterilization/disinfection.

The first three of these methods can be carried out either on-site or off-site, while the sterilization/disinfection of waste should be carried out as a pretreatment before disposal, near the source of the waste within the health care establishment.

Various options are available for treating and disposing of different categories of health care waste. Some methods are technically preferred than others, although the preferred methods may not be financially feasible. Table 2 presents the technically preferred methods and other options for each category of health care waste.

Table 2. Treatment and Disposal Methods by Categories of Health Care Waste

Waste Category	Preferred Method	Other Options
Infectious waste	Incineration (accompanied with sterilization of high-risk waste*)	Landfill after sterilization
Sharps	Contaminated sharps by incineration (together with combustible secure containers)	Landfill after sterilization
	Uncontaminated sharps (if separated from contaminated ones) by landfill together with secure containers	
Pharmaceutical waste	Expired medicines by returning them to suppliers, if possible; or if not, by incineration (at a high temperature)	Landfill with secure containment
	Contaminated/spilled waste by incineration (at a high temperature)	
	Small quantity solid and liquid medicines by discharge to sewer	
Chemical waste	Unused chemicals by returning them to suppliers, or recycling if possible	Hazardous chemicals by on-site treatment according to the nature of chemical followed by landfill
	Non-recyclable, non-hazardous chemicals by landfill	
	Hazardous chemicals by off-site hazardous waste disposal facilities, if available.	
Pressurized containers	Large containers (e.g. gas cylinders) by returning them to suppliers	(Never to be incinerated)
	Small un-returnable containers by landfill	
General waste	Disposal as household waste by landfill, etc.	

Note:* Special infectious waste (e.g. waste from cases of infectious diseases, waste from laboratories and postmortem rooms containing pathogens, and waste from surgery and autopsies on patients with infectious diseases).

It is important to choose a disposal method that can be operated by the personnel available at an affordable cost while minimizing risks to the extent possible. Where financially affordable, a high-temperature incinerator would be the most appropriate disposal option, provided that operators are locally available. A less expensive, simple-to-operate incinerator could provide adequate protection, provided that its location in relation to wind direction is properly selected

and burning is carefully done and supervised. Where no incinerator is available, waste can be buried at a designated site in the hospital compound or municipal landfill. It is important to limit the access to the site only to authorized personnel to avoid the uncovering and scavenging of waste.

1.7.3.4 Waste management organization

In order to facilitate the development and implementation of an appropriate waste management system, an effective organization should be established and an in-house waste management plan formulated by each health care establishment. Such a waste management plan specifies not only the duties and functions of each member of the waste management organization, but also detailed descriptions of the generation, segregation, handling, storage, transport and treatment/disposal of waste within the health care establishment as well as procedures for contracting off-site transport and disposal services and for responding to emergencies.

Periodic review of waste management practices by both the regulatory agency and health care establishments should be carried out to improve the protection of health of the workers and the general public, and enhance the cost-effectiveness of the waste management systems.

1.8 ENGINEERING SERVICES

1.8.1 Mechanical engineering

The significance of the combined mechanical-electrical components of a hospital can be deduced from the fact that the cost of installing the equipment is normally about one-third of the total cost of the building. The operation and maintenance costs are also more than the combined expenses for all other parts of the building. Furthermore, their expected life may be only one-half or even one-third that of the buildings.

The primary objective of the designer of the system, therefore, is to bring down the initial cost and evolve a design that has a reasonable maintenance cost. This can be done by providing the simplest mechanical devices possible while using high-quality materials; thus, the number of repairs will be reduced as will costs for labour, fuel and power. It will also ensure that the maintenance is within the capability of local resources. The design should also include adequate protection of the health and safety of staff, public and patients.

The following is a checklist of the components to be considered in the mechanical design of a hospital. Engineering consultants should be brought in at a very early stage of the designing process; consultation should also take place with the necessary government authorities.

General provisions

General description of installations

Fuel

Proposed fuel, with justification

Estimated monthly and maximum daily fuel consumption

Storage of fuel, when applicable

Primary source of energy

Type of heating, temperatures and pressures

Preliminary load and breakdown of main components

Provision for future expansion

Number and capacity of boilers or heat exchangers

Description of boiler and auxiliaries, control and stand-by

Schematic diagram

Sketch of major operational features and maintenance access

Primary distribution system

General description

Domestic heating

Internal design criteria

External design criteria, frequency of use

Infiltration rate assumed

Heating media, temperature, pressures

Preliminary heat load, allowance for future expansion

Scheme of circuitry

Types of heat emitters in different areas

Type of control operation

Piping materials, types of pump

Area to be heated for each type of heating (m²)

Means of absorbing thermal expansion of pipes

Feed and expansion provisions

Domestic hot water

Means of heating

Design criteria, storage, maximum demand with time

Preliminary storage and heat-up capacity

Size of generators, allowance for future expansion

Type of piping

Type and capacity of cold feed system

Steam services (other than for heat or hot water)

Locations (e.g., kitchen, laundry, central sterile supply department)

Required pressure

Criteria for load calculations

Preliminary heat load

Allowance for extension

Ventilation and air-conditioning systems

Description of systems (central or split type)

Types of fan

Areas served by each system

Typical circuitry schemes

Internal design criteria

External design conditions

Design criteria for assessing air volumes:

- supply air temperatures;
- ventilation to remove heat, moisture, odours, fume~;
- minimum rates of air change per hour;
- fresh air and recirculation requirements

Number and capacity of fans and air-handling plants

Sound levels

Control operation and energy conservation

Filter types and efficiencies

Type of cooling and heat rejection system

Type of humidification

Design criteria for cooling equipment:

- ambient conditions for cooling towers, etc. (including frequency if these are exceeded)
- chilled water temperature
- condenser water temperatures

Preliminary cooling load

Allowance for expansion

Numbers and capacity of cooling and heat rejection plants

Air-conditioned area (m²)

Ratio of design cooling load: air-conditioned area (W/m²)

Medical gas services (when piped)

Gases used (e.g., vacuum, compressed air, oxygen)

General description of system

Allowance for extension

Types and capacities of compressors and vacuum pumps

Proportion of stand-by plant used

Fire protection system

Type of system, coverage and classification

Location of control and indicator panels

Manual call points, general locations of alerting devices, type and sequence of operation

Details of water supply for fire-fighting

Dry/wet riser system

Special service systems

Description and justification of any other service

Instrumentation, alarms, monitors and controls

General description of scope and philosophy

Type, of equipment proposed

(1) Heating, air-conditioning and ventilation

Maintaining a pleasant temperature, about 22°C, is the design target for heating and air-conditioning systems in cold and warm countries. Higher or lower temperatures may be attained in specific areas through independent units to suit individual requirements.

Heating and air-conditioning and ventilation systems are related both in physical installation and in their function in the hospital departments. Air-conditioning differs from ventilation in that the temperature and humidity of the air are controlled in the former. It is expensive to provide, operate and maintain, however, and it should be installed only in areas

where it is essential, such as in operating theatres. Wherever possible, therefore, hospital design should minimize or eliminate the need for air-conditioning and mechanical ventilation by providing occupied spaces with adequate windows, cross-ventilated where possible, and by using internal areas for specific purposes, such as operating theatres, darkrooms and storerooms. Careful attention to siting and design to take advantage of any cooling breezes and the use of trees to shade the building can help in optimizing natural conditions.

The ventilation of a hospital is dictated by health, comfort and safety standards. In areas where excessive heat or moisture is generated, or where objectionable odours, dust or toxic gases are present in the atmosphere, a fresh air supply and exhaust system must be provided. Electric fans can be used to augment the system as and where necessary.

Ventilation associated with kitchen, laundry and refrigeration equipment must be designed by qualified engineers in coordination with the users. Special care must be taken in designing extraction systems over cooking installations to avoid any fire hazard due to build-up of fat in exhaust ducts. Filters to trap fat carried in the exhaust fumes should be accessible and should be cleaned regularly.

(2) Technical requirements

Heating, ventilating and air-conditioning systems should meet the following guidelines:

- (a) They should provide the temperatures shown in Table 3 and a relative humidity of 50-60%.

Table 3. Temperatures to be provided in a district hospital

Area	Temperature (°C)
Operating theatre	21-25
Delivery room	21-25
Recovery room	24
Nursery	24-26
Intensive care	24-26

- (b) All air supply and air exhaust systems must be operated mechanically. Fans serving exhaust systems should be located at the discharge end of the system. Minimal acceptable ventilation rates in the major areas should be as shown in Table 4.
- (c) The ventilation system should be designed and balanced to provide the pressure relationships shown in Table 4.
- (d) The ventilation systems serving sensitive areas, like operating theatres, delivery rooms, nurseries and sterile rooms, must be equipped with at least two filter beds.

The exhaust from all laboratory hoods in which infections or radioactive materials are handled must have filters with 99% efficiency.

Table 4. Ventilation system

Area	Pressure in relation to other areas	Minimum total no. of air changes	Recirculated within room
Operating theatre	+	12	No
Emergency operating room	+	12	No
Delivery room	+	12	No
Nursery	+	12	No
Recovery room	0	6	No
Intensive care	+	6	No
Ward room	0	2	Optional
Patient area corridor	0	4	Optional
Isolation room	0	6	No
Treatment room	0	6	No
X-ray (fluoroscopy) room	-	6	No
X-ray (treatment) room	0	6	Optional
Physical therapy room	-	6	Optional
Sterilizing room	-	10	No
Laboratory, general	-	6	Optional
Laboratory, media transfer	+	4	No
Anaesthesia storage room	0	8	No

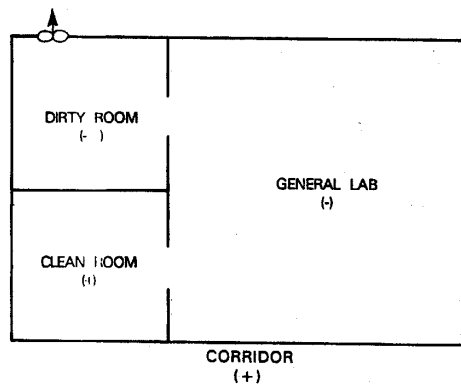


Fig. 76. Air pressure relationships in a laboratory

(e) All filter frames must be durable and provide an airtight fit with the enclosing ducts. All joints between segments and the enclosing ducts should be gasketed or sealed to provide a positive seal against air leakage.

(f) Ducts that penetrate structures to protect against X-ray radiation should not impair its effectiveness. Ducts that pass through fire walls must be provided with automatic fire doors on both sides of the wall.

(g) Duct linings, coverings, vapour barriers and the adhesives used for applying them must have a flame-spread classification of not more than 25 and a smoke-developed rating of not more than 50. Acoustic lining materials should not be used inside duct systems serving sensitive areas, such as operating theatres, nurseries and isolation rooms.

(h) Cold-air ducts should be insulated wherever necessary to maintain the efficiency of the system and to minimize condensation.

(i) Duct systems serving hoods should be made of corrosion-resistant materials.

1.8.2 Electric and electronic engineering

Power is supplied to hospitals in most countries by public or private utility companies. In either case, the hospital must have a back-up gasoline- or diesel-driven generator for use in the case of breakdown, at least for emergency, delivery and operating rooms, selected corridors and exits, and stairs. In addition, battery or automatic generators may be used.

(1) Components in the electrical design

The following is a checklist of those electrical components that should be considered in designing a district hospital. Engineering consultants should be brought in at a very early stage of the designing process. Consultation should also take place with the local electricity supply company and with any necessary government authorities regarding the mode and system of supplying high- and low-tension electricity to the hospital.

Electricity supply

- Point of mains supply
- Maximum capacity
- Supply and incoming voltage
- Tariffs and metering
- Agreements with supplying authority
- Alterations to existing supply

General description

- General description of any existing system (mains and essential services)
- Technical data on existing installation (maximum capacity, assessed connected loads and measured maximum site demand, cable types, protection methods and discrimination)
- General description of new system (with load estimates for both essential and non-essential supplies)

Local distribution

- General description of sub-main and sub-circuit system (routes, board locations and area of coverage)
- Cable types and sub-main load estimates
- Installation and wiring methods
- Protection methods and discrimination

Earthing

- Method adopted for each continuity and electrode system

Sub-stations

- Type and accessibility
- Transformer and switch-gear ratings and type
- Capacity for increased load, provision for expansion

Stand-by plant

- Type and ratings
- Capacity for increased load
- Controls and alarms
- Sensory circuits and starting
- Fuel type and stored quantity
- Provisions for maintenance, including access

Distribution boards

- General description
- Sub-main or sub-circuit protection
- Fault rating
- Capacity for increased load
- Services supplied (assessed loads and area covered)

Special safety and earthing

- Area, location and classifications
- Medical procedures carried out and equipment used
- Type of protection chosen, with justification

General power

- Known major equipment, with assessed loads (e.g., kitchen and laundry equipment, autoclaves, mechanical services plant, medical equipment)
- Typical location and numbers of plug sockets, including number per circuit
- Connections to essential supply, with load estimate
- Hazardous areas and provisions proposed

Interior lighting

- Area classifications
- Illumination levels
- Anti-glare design
- Types of fittings (surface, suspended, concealed)
- Lamp type and colour
- System data: mounting height, hours in use, reflectance
- Estimated connected load and load per circuit
- Connections to essential services with estimated loads

Exterior lighting

- Areas served and purpose
- Type of fitting
- Control and wiring method, including routes

Lightning protection

- Need
- Design criteria
- Description of proposed design

Communications

- Justification for each type of area
- Type of system
- Areas served
- Wiring method

Other features and safety considerations, like call systems, intercommunication systems, fire alarm systems and other special installations may be included as required in the design and computations for the total electric power requirements.

(2) Lighting

Guidelines for hospital illumination are shown in Table 5.

Area	Recommended minimum lux
Autoclave room	150-300
Bathroom	100-150
Blood bank	200
Body store (mortuary)	100
Clean utility room	150
Conference room	300
Consultation room	300
Corridor, general	150-300
Cubicle, general	100-150
Cubicle, treatment	300
Darkroom	50
Delivery room	400
Diagnostic X-ray, couch	20-100
Diagnostic X-ray, work place	300
Dining room, general	50
Dining room, tables	200
Dirty utility room	150
Dispensary, out-patient	300
Doctor's office	300
Enquiry desk, reception	500
Entrance canopy	300
Entrance hall	200
Gymnasium (physiotherapy)	300
Nurse's station, day	300
Nurse's station, night	30-100
Interview room	300

Area	Recommended minimum lux
Kitchen	300
Laboratory, pathology, benches	300
Laboratory, pathology, local	500
Laundry, general	300
Laundry, mending, local	500
Library	300
Lift hall	200
Maternity department	400
Mortuary, post-mortem room	300
Mortuary, viewing room	150
Night-lighting, maternity, paediatric (nurses)	100
Operating theatre, general	400
Operating theatre, operation	10000
Operating theatre, cavity (local)	50000
Pantry	100
Pharmacy	300
Plaster room, operating theatre	400
Reading lights	150
Reception area	300
Records, medical	150-300
Recovery room	300-400
Scrub-up, operating theatre	300
Shower	100-150
Sluice sink	200
Special baby care unit (local)	1000
Staff room	100-200
Stores, general	100
Toilets	100-150
Workshop	300-500
X-ray room, couch	20-100
X-ray room, work place	300

(3) Emergency electrical services

As mentioned above, the district hospital should have a reliable alternative source of power, in addition to the normal electrical service, for emergency lighting, for operation of essential equipment, and for the safety of its occupants. The alternative source should be from:

- a generator, when the normal service is supplied from one or more central transmission lines, or

- an emergency generating set or a central transmission line, when the normal supply is generated on the premises.

The emergency generating set, including the prime mover, should be located on the premises, away from the operating department and the ward block. It should be reserved exclusively for supplying electricity in an emergency. The recommended circuits to which power should be provided are:

Lighting:

- all exits, including exit signs, stairways and corridors
- surgical, obstetrical and emergency room operating lights
- nursery, laboratory, recovery room, intensive care unit, nursing station, labour room and pharmacy
- generator set location, electrical switch-gear location and boiler room
- one or two lifts, if needed for emergency
- telephone operator's room
- computer room, when available

Equipment

- nurses' call system
- alarm system, including fire alarm
- fire pump and pump for central suction system
- blood bank refrigerator
- sewerage or sump lift pump, if installed
- equipment necessary for maintaining telephone service
- equipment in operating, recovery, intensive care and delivery rooms
- one electrical sterilizer, if installed

Heating, cooling and ventilation system

- operating, delivery, labour, recovery, intensive care unit, nurseries and patient rooms.

The capacity of the emergency generating set should be 50-60% of the normal electrical load of the hospital, to maintain the minimum level of services.

The emergency electrical system should be so controlled that, after interruption of the normal electric power supply, the generator brings full voltage and frequency within 10 seconds to all the emergency lighting and equipment listed above. Lights powered by storage batteries can be provided to augment the emergency lighting during the period of transfer switching, immediately following the interruption of normal service; however, these should not be used to substitute for the generator set. A typical diagram of an incoming electricity supply and of how the generator is relayed is given in Figure 77.

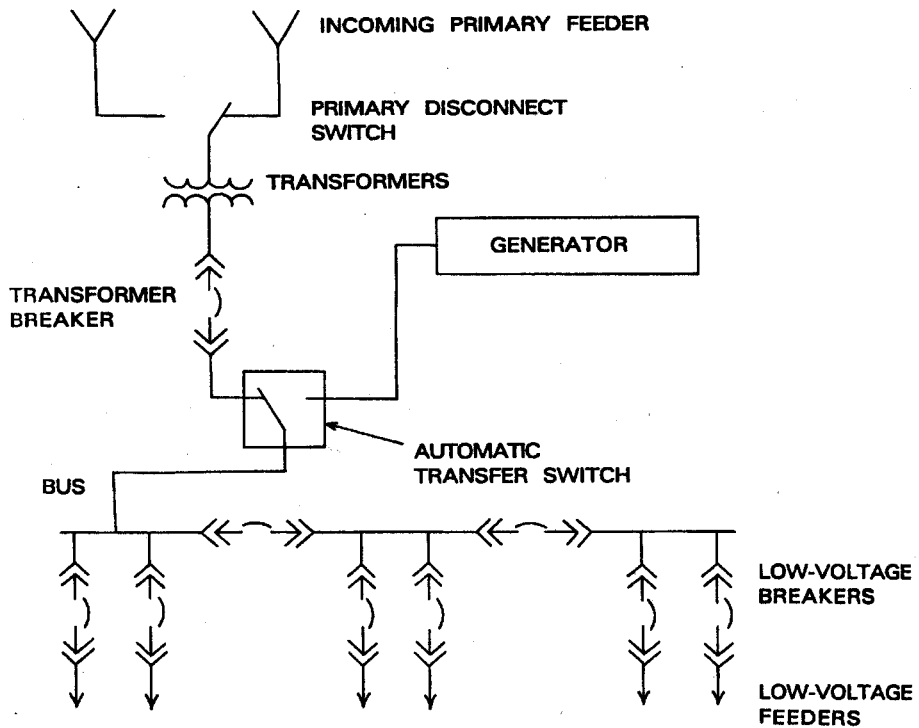


Fig. 77. Modified selective system of electrical distribution, including generator

1.9 PLANNING AND PROGRAMMING CONSTRUCTION

Once the basic planning and preparation of the master plan are finished, a plan should be made for the construction of the hospital. It should proceed as follows:

- plans, specifications and cost estimates; ~
- tender documents;
- selection of contractor and award of work;
- construction activities;
- project management and control; and
- handing over for commissioning.

1.9.1 Appropriate construction technology

The choice of building materials affects the cost and length of construction and also the long-range operation and maintenance costs. Locally available materials and traditional building techniques should be given priority, as they are usually cheaper and better adapted to local conditions. Although walls can be made of local materials, roofing sometimes poses a problem. In many countries of the Western Pacific Region, reinforced concrete, hollow concrete tiles and precast concrete elements are not available locally and must be brought in.

In general, building materials should be economical, durable, easy to clean and to maintain, sanitary and attractive. They should also be easy to handle on the site and to replace in case of breakage or damage.

At the inception of the project, the designer must choose:

- (1) the type of construction of the project:
 - indigenous technology
 - on-site methods,
 - prefabricated modules and components assembled on site, or
 - a combination of prefabricated components and on-site construction.
- (2) the level of technology: low, medium or high.

Types and levels of construction technology should suit the conditions of site, geography, slope, time constraints, availability of labour and raw materials, construction equipment and other related factors. Whenever possible, the methods adopted should be within the capability of local manpower and resources. Sometimes, it may be necessary and practicable to introduce new

methods. Whenever imported techniques are used, the necessary skills should be taught so that the facility can be constructed and maintained using a high percentage of local skilled and unskilled manpower. Similarly, when outside design professionals are hired, they should work in association with local architects and engineers so that there is a transfer of knowledge and enhancement of local ability to design hospitals. This is essential for proper maintenance of the hospital and its expansion when the need arises.

1.9.2 Tendering

Documents for the preparation of bids by contractors for the civil, structural, architectural, electrical and other work for the hospital buildings and services should be drawn up. These documents must contain the following information:

- general conditions of contract;
- technical specifications
- tender drawings; and
- bill of quantities.

(1) General conditions of contract

This should consist of:

- cover or title sheet
- index
- instructions to bidders
- bidding form
- form of agreement
- performance bond and bidding bond forms
- description of the site
- standard labour regulations and other statutory provisions applicable in the country
- right of access to the work by the owner
- details of liability insurance for bodily injury and property damage
- special conditions of contract, if any
- other relevant details, including taxes and duty

(2) Technical specifications

These should supplement the drawings to describe fully the types, sizes, capacities, workmanship, finishes and other characteristics of all materials and equipment, including the

codes of practices and standards, both national and international, to be followed with regard to materials, workmanship and tolerance.

(3) Tender drawings

These should include (i) a survey drawing and the soil investigation report; and (ii) preliminary sketches of plans, as follows:

(a) Architectural and structural

- plans of foundations and basement, floors and roof, showing assignment, sizes and outlines of major fixed and movable equipment;
- all elevations and typical sections showing various finished floor levels; -plot plan, showing roads, paving and sidewalks; and
- indicative details of reinforcement of foundations, beams and columns, floor slabs and special structures, if any.

(b) Mechanical and sanitary

- single-line diagram of all external and internal sewer lines and water lines, indicating the diameter of pipes and location and invert levels of manholes, etc.
- location and size of all soil, waste and vent stacks with connections to house drains and equipment; single-line layout of all ducts and piping systems, including fixture connections;
- diagram of riser and wet drains in the case of multi-storey constructions;
- layout of boilers and major associated equipment, including central heating, cooling and the air-conditioning and ventilation system;
- air-conditioning and ventilation system, with equipment, water and refrigerant piping, ducts and exhaust ventilating duct openings;
- details of pumps and layout of lifts, including other handling systems;
- location and layout of various services in the laboratories and elsewhere, including gas tanks

(c) *Electrical and associated services*

- plans showing space assignments, sizes and outline of fixed equipment, like transformers, main switch and switchboards;
- electricity entry, with switches and feeders to the public service feeders; -emergency electrical system, with details of supply, feeders and circuits;
- fire alarm system, telephone layout and all other electrically operated systems and equipment, showing service entry, switchboards, annunciators and wiring diagrams.

(4) Bill of quantities

The reliability of the cost estimate of any building depends upon the accuracy of the information available at the time the estimate is made. "Preliminary" and "approximate" cost estimates are prepared at the briefing and planning stages, on the basis of approximate floor areas, the cost indices of previous projects and the prevailing market rates for similar projects.

When bidding for a multidisciplinary project like a hospital, contractors should know not only the technical specifications but also the approximate quantities of each item of work (such as excavation, blockwork and shuttering), so that they can price them by considering the labour, raw materials, equipment, taxes and their margin for overhead expenses and profit. Quantity surveyors estimate the quantity of each type of work, with a variation of about $\pm 10\%$, in the form of bills of quantities. If this document is prepared carefully, both the client and the bidder obtain a reasonably accurate idea of the cost of construction.

1.9.3 Project management

Like any other complex process, the planning and construction of a district hospital must be coordinated and monitored if they are to be carried out effectively and delays are to be avoided. A high level of discipline and good record-keeping are essential, because of the numbers of people involved at various stages, the lengthy duration and their intermittent involvement. It is therefore desirable that someone-preferably .a member of the planning team with previous experience in managing planning and construction-act as a *project manager*.

The project manager is responsible for coordinating and expediting the whole process, organizing and motivating all groups, forecasting and programming their activities and monitoring and controlling their performance. The project manager is involved continuously in the project and is committed to its successful completion. It is the job of the project manager to ensure that all team members perform their tasks both on time and within the budget. He or she must obtain from them regularly updated information on all activities, both at the site and on the shop floor, so that corrective action can be taken, either to the budget and financial approvals or to the project. Above all, the project manager must see that everything is properly recorded and must keep everyone informed of all major decisions that are important to them in order to attain completion on schedule.

The job of the project manager does not finish when the building is completed; he or she must ensure that all relevant information for operating and maintaining the facility is handed over to the client. Drawings of all structures and services as they have actually been constructed must be prepared and handed over to the client for future reference. As staff changes, the client who works in the building may not be the same person who assisted at the original briefing and planning of the hospital. Decisions that were made about the intended methods of operation and use at those stages may be questioned at a later stage. An understanding of those intentions and proper communication in recorded form are essential.

The tasks of management and control of the complex, interdependent activities of a construction project become impossible without systematic planning and organization. The most important element in project management is a realistic time schedule. A basic schedule should be worked out at the early stages of the planning process, and this should serve as a framework for all activities. As the lapse of time between the decision to build and the actual taking over of a completed district hospital is very seldom less than 3-4 years, a time schedule should be prepared during the briefing stage, which should indicate the major stages and also provide for such activities as tendering, major construction activities, planning and procurement of medical equipment and furniture.

Once the client has approved the start of the project, the project manager must prepare a time schedule for each of the major aspects of construction and must set a target date for completion of the project. This schedule should indicate how construction of different elements will proceed; at what stages the working drawings and detailed technical specifications will be made available to the contractor by the architects and engineering consultants; when materials will be procured; and when plant and medical equipment will be commissioned and installed. As the choice of construction method and building materials significantly affects the schedule, it should be considered in detail at this time.

Figure 78a shows a typical time schedule for the major steps in setting up a district hospital, from the time the project is approved to its commissioning. This simple bar chart shows the start and finish of specific activities. It shows how they are linked, how long each will take, where they overlap, where they parallel one another, or whether there is a lag between them. It does not, however, show the interdependence of some activities, i.e. in some cases, unless one activity is complete within a predetermined time another cannot be begun, which will result in delay. Such delays are almost always followed by an increase in the cost of the project. This aspect can be monitored and controlled by critical path analysis or project evaluation and review.

(1) Critical path analysis

The nature of a multidisciplinary project like the building of a hospital means that complex, time-consuming, interdependent sequences of events are encountered. These can be organized by critical path analysis, which involves a diagrammatic representation of the project as a network of activities. The major consecutive activities are defined as "the critical path". Any delay in one of the activities on the critical path will delay the overall schedule for completion of the project. Although there is usually only one critical path on a network, there may be more than one sub-critical path. Too much delay in any sub-critical path would turn it into a critical path, and this will require careful monitoring and control so that further delay is avoided. Figure 78b illustrates this approach.

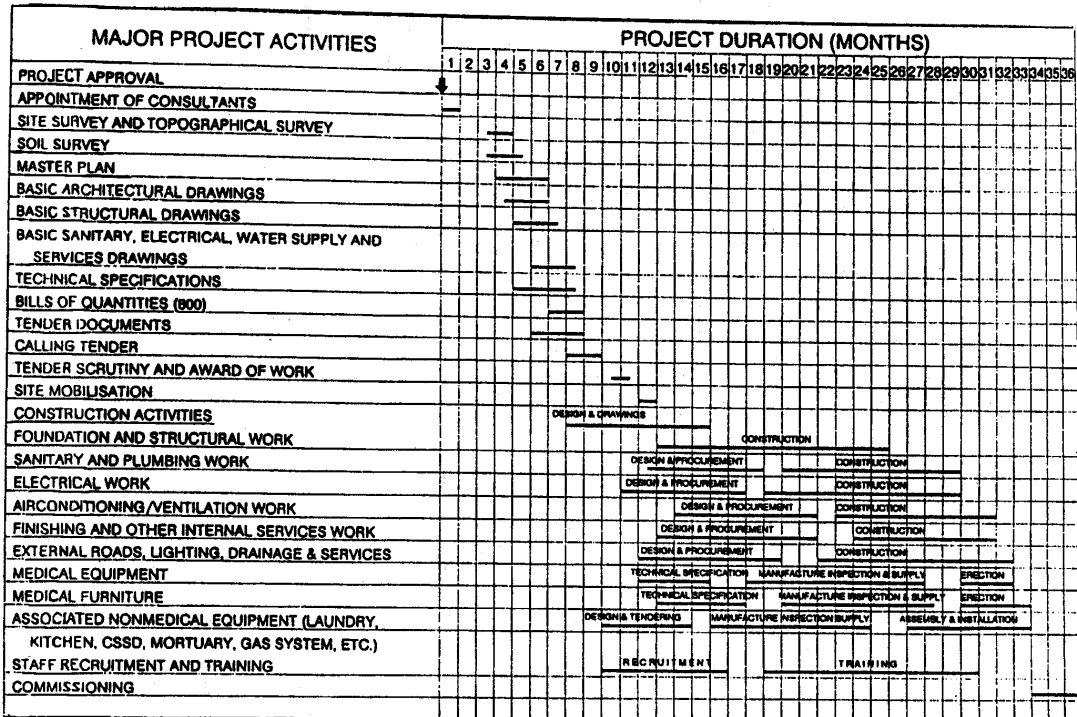


Fig. 78a. Project implementation scheme for a typical district hospital

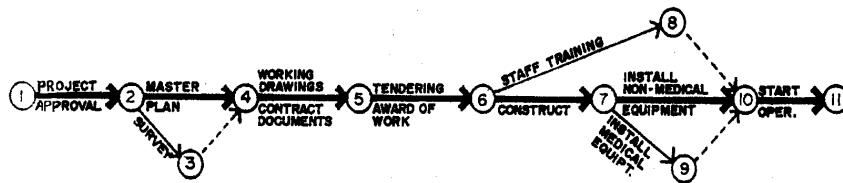


Fig. 78b. Critical path analysis

The process of network planning thus involves four steps:

- breakdown of project activities
- listing of activities
- constraints and sequential relationships of activities
- network diagramming

It is a logical representation of all the activities, with definite points of start and finish. Once the network diagram has been completed, the duration of each activity is determined on the basis of site location, climatic conditions, availability of raw materials, quality of available labour, method of construction, height of construction, safety regulation and all other relevant factors.

Although the contractor has the prime responsibility for progress on site and for completing the project by the scheduled date, the project manager must monitor the contractor's progress in order to ensure compliance. The latest situation can be ascertained by regular comparisons of actual progress with the time schedule. If delays occur, corrective action must be taken immediately to catch up with the schedule.

(2) Cost control

The project manager should also actively control the final cost and not merely passively register payments. The client's acceptance of the budget provides the basis for economic control over the final cost (cost control), payment of contracts and variation orders (payment control) and availability and use of funds (control of cash flow).

Payments to the contractor for work done and services rendered are usually made on a fixed-price basis, either:

- as a schedule of prices, giving unit prices for the items listed in the bill of quantities (item rate contract), or as a
- lump sum for the complete work, as defined by the drawings and technical specifications (lump-sum contract).

The first arrangement is the most common, in which the total price is determined by the actual quantities, measured on the site and multiplied by the unit price quoted in the contract. This is a reasonably fair and straightforward method, which works quite well for present-day construction systems.

In times of high inflation, it is the usual practice in the case of projects with a construction time exceeding one year to pay the contractor some form of compensation for rising prices, if agreed in the contract.

In current international practice, the construction agency usually gets 90% of the payment for work completed each month, and the client holds the remainder as "retention money" until the end of the "defects liability period", usually one year after handing over, during which time the contractor is responsible for remedying any defects in materials or workmanship in the buildings.

Suitable variations to this procedure may be made, depending on practices prevalent in the country, as long as the quality of the work and the construction schedule are not compromised.

The final payment to the contractor is based on the final certificates of the project manager, including a final account. This account should contain a summary of all variations, changes in quantities, price fluctuations and escalations, for which adjustments to the contract sum are to be stipulated.

1.10 EVALUATION OF DISTRICT HOSPITAL FACILITIES

A district hospital is a centre for organizing and dispensing medical services to the community it serves. This is not a fixed, unchanging function, as the size of the population may change, as may its age structure, social pressures and prevalent diseases. If the facility cannot adapt within its planned life to meet these changing needs, it is not successful.

The whole process of developing a district hospital thus comprises the following main stages:

- briefing
- designing
- producing technical documents and drawings
- constructing
- commissioning (bringing the hospital into use)
- evaluating

These are shown diagrammatically in Figure 79.

The intentions of the design must be validated in terms of the actual utilization of the designed structures: the feedback loop must be followed to where the briefing and design process started, in order to build up a body of knowledge about design that is relevant to the 'time and as dynamic as reality.

For the following reasons, therefore, it is important to monitor and evaluate the performance of a new facility after it has been operational for about a year and to continue to do so at regular intervals:

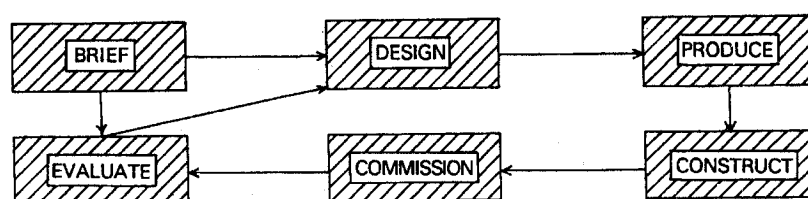


Fig. 79. Process of developing a district hospitals

- Evaluation may reveal defects in operation of the hospital that can be corrected quickly and easily. For instance, the facilities may not be used as intended; or defects in building design might be overcome by changing methods of use.

- Evaluation may reveal defects in the design that can be overcome 'by changing equipment, relocating activities or redirecting traffic. It will reveal where the design is giving trouble in practice and where it is working well. This will indicate where changes are needed and avoid change for the sake of change.

Evaluation comprises five steps:

- (1) deciding the objectives of the study,
- (2) setting up the necessary organization,
- (3) gathering the required information,
- (4) analysing the information, and
- (5) communicating the findings.

The factors that should be evaluated are:

- (a) Performance in use, as perceived by the users, both staff and patients. This factor is, of course, subjective, but it provides a basis on which more objective data can be evaluated. It may also reveal the contribution that good management is making to the efficient, happy functioning of a poor design or, conversely, the deficiencies in management in a building of good design that is functioning poorly.
- (b) Basic records that indicate the known advantages and drawbacks of the buildings with regard to the activities of the users.
- (c) Objective observations of performance on site, including:
 - the activities in relation to the physical layout, physical conditions, equipment, services and infrastructure;
 - the effect of the layout and siting on the activities in relation to the community (e.g., ease of access, communications); and
 - the activities and work needed to keep the facility functioning (e.g., maintenance, cleaning)
- (d) Objective observation of the performance of the hospital as a building, in terms of:
 - layout and siting of buildings,
 - structure,
 - finishes,
 - equipment,
 - engineering services,
 - roads, car-parks and site development, and
 - maintenance needs

- (e) Information on maintenance and running costs for comparison with the planned cost and previous annual recurring costs (from similar hospitals, if any)
- (f) Examination of the extent to which the building fulfils the brief given to the designers and whether it is being used in the way intended at the time the brief was prepared. If the building is not being used as intended, this may be because:
 - the users were not told how it was intended to be used;
 - the needs of the users have changed, or the brief was wrong;
 - the users have found a better way of carrying out their activities, or the brief was wrong;
 - the designer did not fulfil the brief, or the brief was inadequate;
 - the designer found a better way to fulfil the needs;
 - the building and services are not durable and well constructed.
- (g) Review of the planning decisions that led to the preparation of the brief; examination of the relationship between the objectives and the physical conditions observed in the facilities, to give answers to the following questions:
 - Are capital, running and maintenance costs as anticipated?
 - Were the predictions of the planners accurate? (If not, why not?)
 - Are the deficiencies in operation due to inadequacies in the original planning principles?
 - Should experience with this district hospital influence future guidelines or policy? What general conclusions can be drawn for future reference?
- (h) Consideration of the adaptability of the facility to meet future demands and to cope with changing needs.

2. MEDICAL EQUIPMENT

2. MEDICAL EQUIPMENT

2.1 INTRODUCTION

Medical equipment has become an important component of modern health services. The main purpose of this chapter is to provide lists of essential medical equipment for different levels of district health facilities, and to describe methodologies for equipment management and for training maintenance technicians.

Current trend indicates that major medical equipment is increasingly being deployed in the districts to increase the diagnostic and treatment capabilities of primary health care. The spread of major equipment such as x-ray, ultrasound units and laboratory auto-analyzers is reaching facilities below the district hospital level, and the rate of such increase in equipment deployment is accelerating. On the other hand, the capabilities to manage or maintain medical equipment in most developing countries remain rather weak. **This weakness is particularly serious in the districts. The growth in capabilities to manage or maintain medical equipment has lagged far behind the rate of deployment of equipment. This situation risks running out of control.** Capital investment could become wasted while quality of care would suffer.

This chapter is written with the above situation in view. Thus, while providing lists of essential medical equipment, the need for better planning and management is emphasized. In addition to proposing a practical strategy for large-scale training of maintenance technicians for the districts, powerful management methods and tools are described. The establishment of national policies and strategies and the use of more effective management systems to meet the challenge of increasing use of medical equipment are needed.

The key approaches are as follows:

1. Establishment of a national policy on medical equipment management. This will give a clear direction providing criteria and setting priorities to guide health workers who plan to acquire medical equipment. See 2.4.1.
2. Utilization and management of medical equipment is a multi-phasic task. This task is best tackled by giving a multi-disciplinary team a national, community or organizational perspective. See 2.2.2 and 2.4.1.
3. The life cycle approach provides a more effective system to manage medical equipment. Appropriate technology and efficiency of use should be ensured at the planning stage. Maintenance supervisors should be taught management skills based on objectives and information presented in 2.4.1 and 2.6.1.
4. Setting a priority to train a large number of technicians to maintain essential medical equipment is urgent in view of the rapid deployment of medical equipment in district health facilities. A practical strategy is recommended (see 2.6) which also allows the co-existence and development of the public and private sectors in the maintenance field.

Other topics discussed in this chapter include: the significance of generic specification (2.2.1) with examples given for X-ray and ultrasound units (Annex 6). Considerations for potential medical equipment donors and recipients (2.2.3, 2.4.3). Planned preventive maintenance of major medical equipment (2.5 and Annex 5) is described in order to reduce breakdown, to improve the quality of care, and to ensure the safety of patients and workers. Since X-ray units are often the most expensive and complex items, considerably more information in selection, installation and use can be found in Annexes 7 and 8. The specifications of a new X-ray unit, the World Health Imaging System for Radiography (WHIS-RAD), are compared with those of the WHO Basic Radiology System (BRS). Special precautions are needed when deploying major medical equipment in lower-level health facilities (see part II). The selected bibliography provides readers with further references.

Although this section is enclosed within the district hospital description, information here applies to all levels of health facilities.

2.2 ACQUISITION OF MEDICAL EQUIPMENT

Planning and acquisition of medical equipment are initial phases of the life cycle management of medical equipment. These phases must be carefully considered because they can greatly affect later use and maintenance of equipment. A more detailed discussion on life cycle management of medical equipment is given under Section 2.4. In particular, the five policy conditions stated in Section 2.4.1 can greatly help to decide whether acquisition of equipment is appropriate.

2.2.1 Generic specifications and procurement

Generic specifications are written in general, non-proprietary terms specifying the characteristics and performance expected from equipment. Such specifications are not biased in favour of certain manufacturer's products. Generic specifications provide all manufacturers an equal chance to bid in a call for tender. For examples of generic specifications for X-ray and ultrasound equipment, please see Annex 6.

Where many procurement practices simply use specifications describing brands available in the market, equipment procured may not correspond precisely to local health care needs. Furthermore, equipment may cost more than it should due to lack of competition.

Procurement of equipment using funds from multilateral organizations normally requires Intentional Competitive Bidding (ICB) or National Competitive Bidding (NCB). The writing of generic specifications is an essential step in IC,B and NCB.

So far, there is no convenient handbook of generic specification for medical equipment. The task is usually undertaken by technical personnel or clinical engineers familiar with this work. If no expert is available, persons responsible for selecting and procuring equipment must endeavour to specify equipment that is as close as possible to local health services requirements, avoiding the inclusion of features that are specific to particular brands. The key is to provide opportunities for all manufacturers to bid.

2.2.2 Selection of medical equipment: a multidisciplinary team approach

A medical equipment selection team comprising doctors, nurses and technical and administrative personnel should be formed to select medical equipment. The following factors must be included in the consideration: (see 2.4 for proposed Policy conditions)

1. Specific health services needs are met by acquiring equipment.
2. All equipment needs should be identified and costed, including any training of users and servicing staff, physical facilities and auxiliary supplies, such as water, electricity, air- conditioning, protection and safety precautions.
3. Spare parts and technical support from the local agent must be ascertained.
4. Supplier must provide both operation and service manuals.
5. In evaluating tenders, quotations must be compared and evaluated, not only in terms of price and delivery time, but also in terms of availability and quality of back-up support, spare parts and technical staff. Moreover, the need to standardize must be considered so as to facilitate the ease of use and maintenance.

2.2.3 Considerations for equipment providers

One major problem concerning medical equipment in developing countries is the great variety of models from different manufacturers. This greatly complicates the use and maintenance of equipment. Different models entail different operating procedures which can limit the number of users. Unfamiliar users carry high risks of making mistakes. In-service training is often not well established in developing countries.

Different models also require special spare parts and service skills which are again difficult to acquire. Recurrent operating and maintenance budgets pose another problem. Sometimes one can see donated equipment lying unused after the initial excitement of high expectations. If not carefully considered, donated equipment can bring more problems than benefit the patient. Potential donors may consider the following points:

1. Ensure that the equipment is appropriate for the recipient country. Consider the five policy conditions described in 2.4.1.
2. Respect the recipient's need to standardize if such a need is indicated.
3. If equipment is to be given, provision of a package deal which includes training of users and service technicians, a commitment to supply spare parts, maintenance support, and recurrent operating and maintenance costs for a period of five years, is suggested.
4. If the supply of equipment is not appropriate, donors may consider technology transfer by training workers in developing countries. Often effective skills and technology transfer can have greater impact than hardware donation in contributing to international development.

2.3 ESSENTIAL MEDICAL EQUIPMENT

Essential medical equipment means basic equipment needed for a specified health service delivery. This section provides lists of essential medical equipment in a general manner. Users of these lists should keep in mind that equipment is a tool for a particular service. One must first identify what services are delivered in a particular health facility before equipping that facility with appropriate equipment. Furthermore, the type of equipment to provide depends greatly on the local health practice, physical characteristics and culture of the population. These lists provide a starting point for local health workers to work out their real needs.

2.3.1 Scope of clinical services of the sample district hospital

This sample is a first-referral level hospital for the district (about 50 beds). The scope of services with equipment needs may vary from country to country.

DEPARTMENT

Clinical

- Medicine
- Surgery
- Paediatrics
- Obstetrics/Gynaecology
- Dentistry
- Orthopaedic surgery
- Otorhinolaryngology
- Neurology
- Psychiatry

Clinical support

- Anaesthesia
- Radiology
- Clinical laboratory
- Pathology
- Rehabilitation

Essential surgical equipment for general and specialty surgeries has been extensively listed in other WHO publications (see selected biblio.: Cook, Sankaran and Wasunna).

Essential equipment sets for departmental clinics are listed in part II.

Here only typical major equipment used in district hospitals shall be listed. For hospitals, with larger numbers of beds, greater capacities of basically the same type of equipment can be used. For example: instead of using a 100 mA, 120kV X-ray unit for a 50-bed hospital, use a 200 mA, 120 kV unit for a 100-bed hospital. The number of the same equipment can also be increased. For example: increase the number of microscopes for a larger workload; add a microscope, refrigerator and portable cold boxes to set up a blood bank. It is important, however, to ensure the availability of qualified users and service before supplying equipment.

WHO is in the process of developing a software package to be used by countries to generate essential medical equipment lists within their own requirements and conditions including financial considerations.

2.3.3.1 Diagnostic imaging equipment

Diagnostic imaging in small hospitals requires X-ray and ultrasound equipment. In a general "community" hospital, X-ray equipment is the first and essential item. Ultrasound can be added if money is available, but X-ray examinations are needed much more often.

(1) Diagnostic X-ray equipment

X-ray equipment can be stationary, in one room, or mobile. Stationary equipment is essential. Most small hospitals do not require a mobile unit; however, if funding is available, a mobile unit is a useful, albeit relatively infrequently used piece of equipment. It may be necessary for orthopaedic procedures during surgery.

For optional Mobile X-ray and Fluoroscopic Equipment, see Annex 6. Since X-ray units are the most expensive items among essential equipment for district facilities, considerably more information is provided in Annex 7, which is based on a recommended WHO Basic Radiology System (BRS) and the World Health Imaging System for Radiography (WHIS -RAD).

(2) Ultrasound equipment

Many varieties of ultrasound equipment are available, with varying capabilities. The minimum specifications for a general-purpose ultrasound unit are provided by WHO in a technical report from a scientific group, *The Future Use of New Imaging Technologies in Developing Countries* (Technical Report Series No.723). The generic specifications are given in Annex S .

These minimum specifications must be met or exceeded, and particularly the technical requirements for resolution, as poor-quality images lead to inaccurate diagnoses. The WHO publication *Manual of Diagnostic Ultrasound* contains information for testing ultrasound units when first delivered, continuous quality assurance and essential maintenance. The purchase of sub-standard equipment is a poor investment. Comprehensive information on clinical diagnosis is also provided.

For optional recording equipment for ultrasound, see Annex 6.

2.3.3.2 Laboratory equipment

(1) Microscope

An all-purpose microscope for general laboratory use should have a 1.25x binocular body tube and paired 10x wide-field-eye-pieces combined with four objectives to provide magnifications of 59x, 125x, 500x and 1250x, with co-axial coarse and fine focusing controls. The fine focus control should be graduated in 0.002-mm increments.

(2) Blood counter

The mechanical differential counter is still popular, especially in developing countries, although electronic counters are becoming common. A wide range of types is available, from which the laboratory technician can select that which is needed.

(3) Analytical balance

The balance should have a digital read-out. The housing should be enamelled steel, and the pan of stainless-steel. The weighting range should be from 0 to 1909; quantities of 0.1 mg should be readable. It should operate on 220 V, 50 Hz, AC (or 110 V, 60 Hz).

(4) Colorimeter/spectrophotometer

This photoelectric device provides a photometric reading in direct proportion to concentration. The unit should have dual photoelectric cells to maintain accuracy even with line voltage fluctuation. It should also have zero adjustment before readings are taken of standard and sample and a range of filters to cover the visible spectrum.

(5) Centrifuge

A small centrifuge that can accommodate six 15-ml tubes should be available, with a speed control from 0 to 5300 rev/min and an electronic sensor that controls rotation within a tolerance of approximately 1%. The rotational speed should be unaffected by power fluctuations.

(6) Water bath

A water bath is used in the clinical laboratory for stabilizing temperature at 25, 37, 42 or 56°C, depending on the method of investigation. The temperature of the bath must be maintained constant within a narrow range (+ 0.1°C).

(7) Incubator/oven

A small, hot-air oven to carry out standard cultivation and sterilization should be available, with a two-tray capacity and temperature setting and time controls. The possibility of checking temperature using an ordinary mercury thermometer is an advantage.

(8) Refrigerator

An ordinary household refrigerator with a freezer unit, for storing preparations, vaccines, blood, etc., should be purchased. It should stand on a simply constructed wooden plinth to keep it clear of the floor to avoid rusting when there is risk of dampness or condensation.

(9) Distillation and purification apparatus

This apparatus should be housed in a cabinet, made of metal that resists acids and alkali, and should be free standing. It should have an output of one litre or more per hour and a distilled water storage cap with a capacity of six litres or more.

2.3.3.3 General electro-medical equipment

(1) Portable electrocardiograph

A single-channel electrocardiograph unit with paper chart output should be obtained. It should require a common mode rejection ratio of at least 60 dB, a high input impedance of at least 5 MΩ, with lead selection and a two-speed chart motor drive.

(2) DC defibrillator (external)

This instrument should have an adjustable, synchronized output of 400 J maximum, with the output indicated by analogue or digital metering. A suitable electrocardiograph monitor is required for use with synchronization, if it is not built in; however, portable units containing a small monitor and a defibrillator are readily available from most

manufacturers. A rechargeable battery power source should also be available, usually as an internal option. Battery-powered defibrillators should have a trickle-charge option; replacement batteries should be readily available, since batteries invariably have a limited life. Paediatric paddles should also be available.

(3) Portable anaesthetic unit

Two small anaesthetic units should be obtained, complete with a range of masks, incubators and hoses for use on infants and adults. Also required are oxygen and nitrous oxide attachments, soda lime rebreathing canisters and a cyclopropane vaporizer.

(4) Respirator

This should be the pneumatic type, applicable for prolonged administration during post-operative care. It should have a high-pressure alarm for malfunctioning and power failure and should be portable, if possible.

(5) Dental chair unit

A complete unit should be available to carry out standard dental operations, including fillings, extractions and cleaning. Water should be supplied through a water softener or filter; a cold light source should be attached.

(6) Suction pump

One portable and one heavy-duty suction pump are required.

(7) Operating theatre lamp

The unit should consist of a main lamp with at least eight shadowless lamps and an auxiliary of four lamp units.

(8) Diathermy unit (electro-surgical unit, ESU)

A standard cut/coagulating unit should be obtained, operated by hand or foot switch, with variable power control.

2.3.3.4 Other support equipment

(1) Operating theatre table
This should be standard and manually operated.

(2) Delivery table
This should be standard and manually operated.

(3) Autoclave -for general sterilization

(4) Small sterilizer -for specific services (e.g., dentistry)

(5) Cold chain and other preventive medical equipment

(6) Electrical generator

(7) Electrical power regulator

(8) Air conditioner, dehumidifier

(9) Refrigerator

- (10) Ambulance -four-cylinder diesel, four-wheel drive vehicle equipped with medical equipment for emergencies; complete accessories, spare tyres and tools.
- (11) Gynaecological examination table.
- (12) Small, inexpensive equipment and instruments

Equipment and instruments, such as blood pressure measuring apparatus, oxygen manifolds, stethoscopes, diagnostic sets and spotlights, although essential, are not included in these lists. The decision on which and how many of these items are needed is left to the discretion of individual hospital authorities.

2.4 MANAGEMENT OF MEDICAL EQUIPMENT

Medical equipment brings along with its benefits, associated problems. In developing countries, the problem that draws the most attention is maintenance. Lack of maintenance and spare parts has rendered non-functional an enormous amount of medical equipment. Training of engineers/technicians and the supply of spare parts are often cited as solutions to the problem. However, shortcomings at different stages of the equipment life cycle can greatly complicate the maintenance problem. For example: if maintenance capabilities are considered during the initial stage of making a decision to acquire equipment, maintenance problems can be minimized.

For a comprehensive and more effective system in managing medical equipment, the life-cycle approach described below should be used. We shall look at the different stages (phases) of the equipment life cycle, and how to manage each stage for better results.

2.4.1 Aspects of medical equipment management

A typical life cycle of medical equipment has the following phases:

PLANNING (decision to acquire)
 PROCUREMENT
 INCOMING INSPECTION
 INVENTORY AND DOCUMENTATION
 COMMISSIONING AND ACCEPTANCE
 MONITORING OF USE AND PERFORMANCE
 MAINTENANCE
 DE-COMMISSIONING

A NATIONAL POLICY

**Can help greatly to alleviate
 medical equipment problems**

An example of a national policy on medical equipment can be found in a WHO/WPRO document (WP)HSD/MOG/NHP/001

Proper management of each of these aspects has an impact on the others. For example, in the PLANNING phase we can specify the following conditions that should be met to help the decision process:

1. Demonstrated clinical needs;
2. Available qualified users;
3. Approved and reassured source of recurrent operating budget;
4. Confirmed maintenance services and support;
5. Adequate environment support.

A clear-cut national policy on acquisition, utilization and maintenance of medical equipment needs to be established. This will greatly help to reduce any future problems arising out of contracts, spare parts and maintenance of equipment acquired locally, internationally or provided by partner agencies.

A medical equipment policy can be implemented nationwide or only in a single health facility.

The key step is to select a multi-disciplinary team comprising doctors, nurses, paramedicals, technical and administrative personnel to form a medical equipment commission (or committee) (MEC). Members of the MEC should be knowledgeable, impartial and respected by their peers. The MEC must be officially appointed and be given a mandate by the highest authority responsible for national policies. The MEC will have the power to examine each request to acquire medical equipment, and make decisions according to the conditions specified in the policy. The MEC should also have the mandate to appoint *ad hoc* committees to work on and make recommendations on specialist issues. However, the final decision is made by the MEC.

It will be a great challenge to enforce a policy on medical equipment. The extent to which the policy is successfully implemented depends on how strictly it is enforced, the skills of the MEC, and the willingness of the recipient to cooperate with the MEC. Even before the policy is implemented nationwide, it should be broadly disseminated as a position paper or guideline. For example, in many countries health services are decentralized, and local authorities make their own decisions regarding equipment acquisition. Such a guideline can provide critical factors to consider for better decisions. The guideline can also serve as a model for provinces (states) or districts to adopt as official policy.

Frequently, bad decisions are made because there is a lack of awareness and guidance. Sincere managers will welcome good guidance to help them make better decisions. Casual managers will always find excuses to get around the rules, no matter how strictly they are enforced. Therefore, the establishment of a policy should not be ignored simply because it could be difficult to enforce. One reasonable approach towards offenders of the policy is to make it clear that they are obliged to bear the responsibilities of subsequent problems brought on by acquiring equipment

The significance of managing the other aspects is briefly described below. The usefulness of some aspects will be further expanded under Paragraph 2.4.3.

In the PROCUREMENT phase, **the need to standardize** on models or manufacturers of equipment (see Paragraph 2.4.3) should be considered. Furthermore, conditions can be included in the purchase order to specify that the supplier must supply operating and service manuals, operation and service training, and essential spare parts. Other special requirements can also be specified here. Withhold payment if specified conditions are not met.

INCOMING INSPECTION: Incoming equipment should be carefully checked for possible shipment damages; compliance with specifications in the purchase order; and delivery of accessories, spare parts and operating and service manuals.

A medical equipment **INVENTORY AND DOCUMENTATION SYSTEM** provides information to support different aspects of medical equipment management. One important aspect is consideration for standardization (see Paragraph 2.4.3). Inventory entries should include accessories, spare parts and operating and service manuals. It is advisable to make copies of the manuals for distribution to the users, while the originals of the manuals should be kept at the technical document library for safe-keeping.

COMMISSIONING AND ACCEPTANCE: commissioning can be carried out by in-house technical staff if they are familiar with that item of equipment. If commissioning by the suppliers is needed, the process should be monitored by in-house technical staff so that any technical matters can be noted and recorded on the **Equipment Service History** (see Paragraphs 2.4.2 and 2.4.3 and Annex 4). The occasion also provides an excellent opportunity for in-house technical staff to gain familiarity with the new item. Ideally, in-house technical staff should also attend the operator's training session.

It is particularly important to bear in mind that normally the supplier-warranty starts the day after equipment is delivered to the health facility. If equipment is not going to be used for some time after delivery, special arrangements must be made with the supplier to define the warranty period. Such an agreement should preferably be made in the purchase order. No payment to the supplier should be made before satisfactory performance has been confirmed by the in-house technical staff.

MONITORING OF USE AND PERFORMANCE: A common mistake is to think that the warranty period is covered by the supplier so that no in-house technical attention is necessary. It is important that in-house technical staff become the link between user and supplier and observe any supplier's technical services. Such warranty services should be recorded in the **Equipment Service History** (see Paragraph 2.4.2 and Annex 4). This will also provide a good learning opportunity for the in-house technical personnel.

MAINTENANCE: Proper maintenance of medical equipment is essential to obtain sustained benefits and to preserve capital investment. Medical equipment must be maintained in working order and periodically calibrated for effectiveness and accuracy. This topic will be further discussed in this guideline.

DE-COMMISSIONING: Given that the majority of medical equipment in developing countries is old and spare parts are often in short supply, it might not be realistic to assume that such equipment can be replaced within a short period. Therefore, as much as practicable, existing old equipment should be repaired. Some old units can be dismantled to provide spare parts for similar units. This process will also provide an opportunity for cultivating technical innovation using local resources. De-commissioned equipment must be deleted to keep the INVENTORY current.

Good management practice should include all these aspects. Nearly all major hospitals in industrialized countries and some developing countries have in-house clinical engineering departments, which take up this management responsibility. Smaller health facilities often share such services with major hospitals. In many industrialized countries, proper management of medical equipment is a mandatory component for health facilities to be accredited.

District health facilities in developing countries should build up such comprehensive management in gradual steps. **All national and provincial (or state) hospitals should have in-house technical staff to carry out comprehensive medical equipment management. These services can provide guidance and support for the district facilities and help the districts eventually to build up their own comprehensive management programmes. The facility requirements for equipment maintenance workshops for district hospitals are described in Annex 3.**

2.4.2 A practical approach to maintaining medical equipment

Proper maintenance of medical equipment is essential to obtain sustained benefits and to preserve capital investment. Proper maintenance has a direct impact on the quality of care. Various obstacles to expanding medical equipment maintenance capabilities in developing countries have been discussed in detail by the World Health Organization (see selected biblio., WHO, 1987). The maintenance problem is complicated by the ever-increasing use of medical equipment as health care is modernized. To date, the maintenance situation in some countries is getting worse and requires special attention (see selected biblio., Cheng, 1995).

There are two extreme approaches to maintenance services: one is to rely entirely on equipment companies (or another third party). This can be very expensive (see Paragraph 2.6.3). The other approach is to have in-house technicians and expect them to do the full range of repairs. This expectation only leads to a feeling of inadequacy among the technical staff. As a result, they tend to seek never-ending higher training abroad. A more practical approach recommended here is to combine in-house with external services. The reasons are as follows.

In general, for a given piece of equipment there are maintenance problems of different levels of complexity. The majority of the problems are relatively simple and can be corrected by a technician trained in front-line maintenance. An analogy can be drawn from health care: The majority of health problems of the population can be cared for by primary health workers. Only complications and specialty treatments are filtered through to secondary and tertiary care by specialists. Everyone knows that hospital care is both expensive and inconvenient. With regard to equipment maintenance, less complex repairs would be less costly if done by in-house technicians. High-level problems can be left to company specialists. Workshop requirements for in-house medical equipment maintenance for district facilities are described in Annex 3.

Other advantages of having in-house technicians are rapid service, as it is not necessary to wait for service from companies, which may be far away. The technician will also monitor outside services and provide continuity and personal care for equipment. Of great importance is the keeping of **Equipment Service History** by the in-house technician. Technicians from district hospitals can also provide services to lower-level facilities or adjacent hospitals. Furthermore, because of a shortage of technical personnel, multi-skilled services should be encouraged in district facilities. For example: medical equipment maintenance technicians can also be trained to provide electrician or even some plumbing services.

Again, an analogy can be drawn from health care. The patient's medical history is extremely important in personal health care. Similarly, an Equipment Service History is very helpful in equipment maintenance and in standardization consideration for equipment (see Paragraph 2.4.3). The in-house technical staff should keep a history of equipment maintenance. An equipment service history card should be kept for each piece of medical equipment. An example is given in Annex 4. Of course, a computerized database can be very helpful but is not essential for the districts at this stage.

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 to reduce equipment breakdowns. At the same time, this will promote the culture of equipment care and maintenance to improve the quality of health care. ,

2.4.3 More considerations in managing medical equipment in developing countries

- **Some types of sophisticated medical equipment** are designed by industrialized countries where the environment, disease patterns, trained users, and maintenance capabilities are different. When such equipment is used in developing countries, it may not actually give as many benefits as the promoters' claim. Rather, it may bring problems of operating costs, use and maintenance, not to mention the waste of capital expenditure. Care should be taken not to let special equipment become a status symbol. To minimize this problem, consider the policy conditions.
- Special care should be taken in accepting **equipment**, used or new, from the donor countries. Always consider the key policy conditions (see 2.2.3 and 2.4.1) and ask the donors to help meet the conditions. Furthermore, ask the donors to provide assistance in installation, training in use and maintenance, and supply of spare parts.
- One major problem of medical equipment in developing countries is the great variety of models from different manufacturers. This greatly complicates use and maintenance. Policies should be established to **standardize** new acquisitions (used, new or donated) to no more than three or four models for each type of equipment. Here is one area where the Equipment Inventory List and Equipment Service History can provide important information. Models which show frequent breakdowns or which have high operating or maintenance costs should be avoided.

- For new major equipment, the warranty period normally terminates one year after equipment is delivered to the health facility. Some health facilities visited in developing countries had new equipment waiting 2 or 3 years to be used. By the time they started to use the equipment the warranty had already run out.

- In many countries, **the growth in maintenance services has lagged far behind the rate of increase in medical equipment use.** Ministries of health have been mainly concerned with the maintenance of medical equipment in city centre national hospitals, while maintenance services to district health facilities have remained extremely weak. Because the number of major items of medical equipment in district health facilities is increasing rapidly, building up maintenance in the districts must be given top priority.

**A NATIONAL STRATEGY ON MEDICAL
EQUIPMENT MAINTENANCE
DEVELOPMENT**

**can provide a direction to steer various
development efforts towards national goals**

Successful development of medical equipment maintenance services depends to an extent on critical factors such as political will and financial support. Experience from several developing countries, however, reveals that even when all necessary supports have been available, development programmes were still getting nowhere because scattered activities are not effective in solving national problems.

The situation in these countries can be likened to a ship: given a captain and crew (political will, operating support) and fuel (financial support), the ship can move along. If the captain has no clear direction to steer the ship, however, the ship could be moving around in circles in the middle of an ocean. A national strategy is like giving the captain a direction to steer the ship towards a productive destination.

- Some districts feel confident about relying on equipment companies to provide maintenance services. It should be kept in mind that district facilities are often widespread with poor access roads. Company services normally charge by the hour plus expenses. So costs for external repairs can become very expensive, especially when the amount of major equipment is increasing rapidly. The situation could run out of control. **Low-cost local services must be cultivated.**

- Frequently, resources in developing maintenance capabilities are scattered in different directions: many are not too helpful in solving the country's overall maintenance problems, and some are actually counter-productive. A **national strategy** can direct the different resources for better impact.

- Increasingly private equipment companies are hiring away highly trained technical personnel from public services that often offer a relatively low salary. To lower the risks of investments in maintenance training, ministries of health should **concentrate on training a large number of mid-level technical personnel** to provide frontline maintenance (see selected bibliography - Cheng, M. - 1995). Alternatively, they should allow their maintenance services to become private or semi-private so that they are free to offer higher salaries or other benefits to retain highly trained personnel.

- A strategy of combining in-house and company services provides opportunities for both the **public and private** sectors to co-exist and grow.

2.5 PLANNED PREVENTIVE MAINTENANCE

2.5.1 Scope

Planned preventive maintenance is regular, repetitive work done to keep equipment in good working order and to optimize its efficiency and accuracy. This activity involves regular, routine cleaning, lubricating, testing, calibrating and adjusting, checking for wear and tear and eventually replacing components to avoid breakdown.

Productive preventive maintenance refers to the proper selection of equipment to be included in planned preventive maintenance. Decisions must be made on what to include, to reduce costs; inexpensive units that are not necessarily included in the planned preventive maintenance programme can be replaced or repaired when they break down. The overriding consideration is cost-effectiveness.

An important aspect of planned preventive maintenance is the participation and commitment of the user. Preventive maintenance should start with users, and the bulk of the work should be their responsibility. The task must be performed daily, with joint activities involving the user and a technician engineer at the end of the week. Highly technical repairs, which are the engineer's responsibility, may be scheduled every six months.

2.5.2 Setting up a planned preventive maintenance system

In order to establish an effective, efficient planned preventive maintenance system, a registry filing system is needed. The manufacturer's manual for preventive maintenance of the equipment can be supplemented by computer packages in setting up such a system; if a computer is not available, a manual file can be set up. The planned preventive maintenance administrative system requires the following:

2.5.2.1 Equipment inventory

All equipment in the hospital that is in the care of the service workshop should be recorded on cards, as shown in the sample equipment record in Annex 4. All relevant information about the equipment must be entered, including its location, records of repair and maintenance and the manufacturer.

A reference number is given and written on a printed paper label, which is attached to each item. This number is recorded in a ledger of equipment with full identifying details.

2.5.2.2 Definition of maintenance task

The work that must be done to maintain each item of equipment in safe and reliable operating condition must be defined; this is known as the maintenance task. These tasks can be established by consulting the manufacturer's literature and product information.

2.5.2.3 Establishing intervals of maintenance

After determining what is to be done, the frequency of the task must be decided. A heavily used item must be cleaned and checked more frequently than one which is used less often; however, minimum standards must be set. The frequency suggested in the manufacturer's manual can be used as a guide, but the actual usage should determine the maintenance procedure required. Annex 5 provides a sample schedule for planned preventive maintenance, which can be used as a guide.

2.5.2.4 Personnel

Individuals who are qualified and available to do preventive maintenance must be identified. A list should be drawn up of personnel who are readily available. Once the personnel have been listed, specific responsibilities should be assigned, perhaps in the form of a work order, giving clear instructions for the task. Each person should have a clear knowledge of his or her responsibilities. Job assignments must correspond to the training, experience and aptitude of the individual.

Training is discussed in the previous chapter. If the hospital staff includes a large number of well trained, experienced individuals who are familiar with medical equipment, in-service training can easily be undertaken.

2.5.2.5 Reminder system

Maintenance of instruments and equipment is a continuous process: once the equipment has been inventoried, the programme must continue. It may be necessary to develop a reminder system, so that appropriate personnel are notified when certain tasks are to be performed. Whether a card index system or a computer programme is used, the date that each item of equipment is scheduled for its next preventive maintenance should be recorded. The administrator should look up in advance the jobs that need to be done and draw up a monthly or weekly schedule.

2.5.2.6 Special test equipment

People responsible for equipment management and maintenance should have at their disposal a range of test equipment to check the correct functioning of medical equipment as well as its compliance with the basic electrical safety standards. The brand and specifications of such test equipment will vary from country to country; however, a range of general-purpose electrical and safety test equipment for medical use is available in the United Kingdom from Rigel (Graseby Medical Ltd, Colonia Way, Watford, Herts WD2 4LG; Telex 929263 GRAMED G; Fax 92331595) and Ultramedic Ltd (4C Newton Court, Wavetree Technology Park, Liverpool L13 1EJ; Fax 51228 0354). Similar test equipment can be obtained in the USA from Bio-Tek Instruments Inc. (Highland Park, Box 998, Winooksi, VT 05404-0998; Telex 940136 BIO TEK SHVT; Fax 802655 7941) and internationally through a variety of distributors. Such equipment allows the technician to perform basic electrical medical safety tests under controlled conditions. Furthermore, these safety tests indicate whether the equipment complies with the standards laid down by the International Electrotechnical Commission. Since this equipment can be contained in a briefcase, it can be carried by the technician. A wide range of tests can be undertaken, to measure different values for insulation resistance, each continuity and leakage current in different situations, under both normal and single-fault conditions.

For the practical assessment of whether different types of medical equipment are working effectively, a number of specific analysers, calibrators and simulators are available from, for example, Bio-Tek in the USA and Ultramedic in the United Kingdom. These allow technicians to check the function of ventilators and to calibrate blood pressure monitors, pressure transducers, electrocardiographs and the full range of monitoring equipment used in the intensive care unit. Analysers are available for checking the effectiveness of defibrillators, electro-surgical instruments and ultrasonic phototherapy equipment. A special-purpose analyser has been developed to assess infusion devices; this had hitherto been difficult because of their very low flow rates. It may not be appropriate for every maintenance department to be fully equipped with a complete range of such instruments, and some may be located in the major maintenance workshops, provincially or nationally.

Most common items of test equipment are listed below. Others may be specified by manufacturers:

- multimeters: simple, robust, digital multimeter with clamp-on attachment to measure high current in X-ray equipment;
- milliamperemeter: to measure milliamperes in X-ray equipment;
- line resistance meter: low-value meter for the power requirements of X-ray equipment (mainly for generator and control units);
- electrocardiograph simulator: lead II output simulator to check the performance of the electrocardiograph;
- spectrophotometer standards: to check wavelength calibrations; preferably filter standard instead of solutions, for ease of use and transportation;
- pH meter standards: buffer solutions to check the accuracy of readings;
- oscilloscope: standard 50-MHz model, dual trace, for testing, fault finding and calibration;
- DC power supplies: electronic power supplies, approximately 25 V DC variable and 5-V and 10-V outputs for testing equipment;
- signal generators: 0-10 MHz, sine, square and sawtooth waveform generators for calibration and testing;
- X-ray phantoms: various phantoms, such as hand, step wedge and grating, to test for picture quality; and
- defibrillator tester: to measure output (in joules).

2.5.2.7 Technical library

A full technical library should be available. Installation and recommended spare parts manuals, annotated with the number of the corresponding equipment, should be kept together with electronic and component data books and appropriate technical books.

2.5.2.8 Surveillance

After the programme has been set up, periodic surveillance must be carried out to ensure that records are legible and that all entries are being made.

2.5.3 Patient and worker safety

It is the responsibility of those involved in equipment management to see that both staff and patients are protected from the potential hazards that exist in the hospital environment. These hazards arise from the use and presence of:

- radiation,
- electricity, and
- biological materials.

Each of these is covered by a set of national standards and working practices; these may be encompassed by legislation, such as the "Health and Safety at Work Act (1974)" used in the United Kingdom.

The use of increasingly complex electrically powered medical equipment in hospitals has brought about the need for a clearly defined policy to avoid the occurrence of accidental injuries to both staff and patients. In the past, only a massive fault in an electronic device could result in the

electrocution of a patient, as the high resistance of the body often protected the heart. With the advent of sophisticated electromedical instrumentation, this high natural resistance was deliberately minimized to allow more efficient monitoring of the patient, and the danger of electrocution is thus greater. The problem is magnified by the common practice of connecting to the patient several pieces of electrical equipment, each of which is powered independently from the main supply.

Since even a very low current, measured in milli- or even microamperes, could be hazardous, precautions must be taken to ensure proper grounding of equipment and of conductive objects that are within the reach of the patient and attending medical staff. The electrical grounding should be maintained, and periodic checks must be made to ensure that power cords are not frayed, plugs are not damaged and there is no leakage of current within the ratings specified by the manufacturers or the national standards. Medical staff should be trained to understand the need for electrical safety and some of the problems that can arise, so that they can take an active role in minimizing the potential hazards and report those that occur.

As standards of electrical safety are constantly being revised, it is beyond the scope of these guidelines to furnish current details on this subject. Hospital authorities should obtain standards from reliable references developed by such entities as the US Department of Health, Education, and Welfare and the International Electrotechnical Commission.

The sophisticated testing equipment listed in Paragraph 2.5.6, while an essential part of the planned preventive maintenance programme, should not, however, substitute for basic common sense in the use and installation of electromedical equipment that is to be connected to patients. Mains-powered units must have a good earth. A three-pin plug must be used on the appliance lead, which must be directly compatible with the socket outlets in the hospital. Adaptors, extension blocks and extension leads should not be used, since these provide an opportunity for the earth wire to be disconnected, thus seriously compromising basic electrical safety.

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.

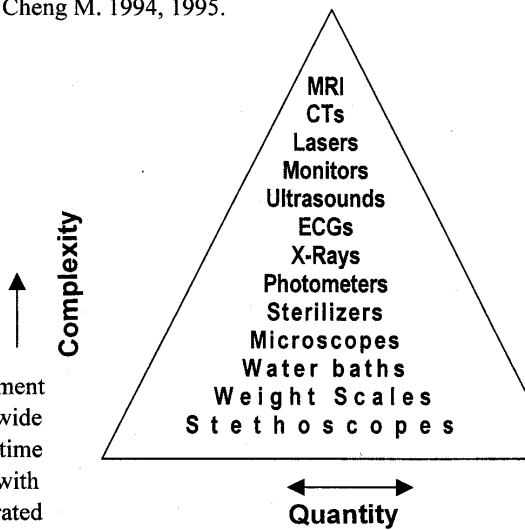


Fig. 80. Medical Equipment inventory pyramid

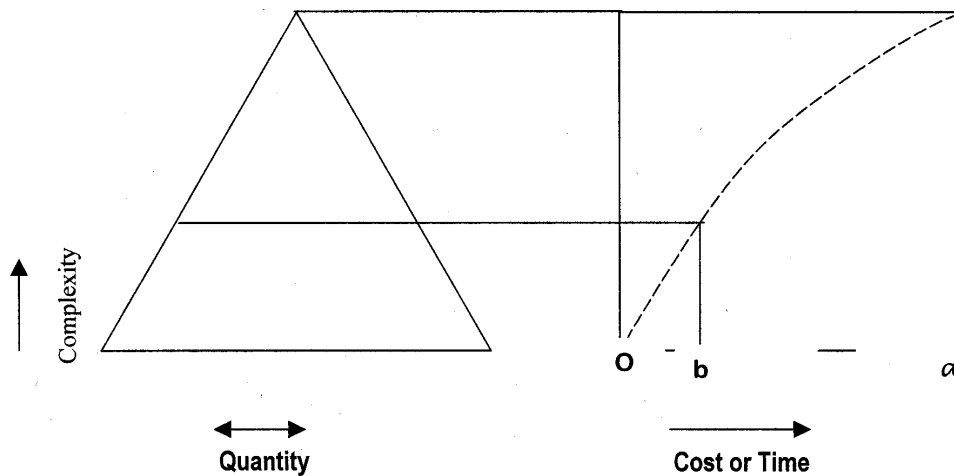


Fig. 81. Training curve based on the complexity of equipment to be maintained

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.

3. ESSENTIAL DRUGS

3.0 ESSENTIAL DRUGS

3.1 Essential drugs

The selection of drugs must be determined nationally since the training and responsibilities of the personnel charged with managing and administering drugs vary considerably. Highly trained workers are able to use a wide range of drugs, while workers with limited training should use only those drugs appropriate to their diagnostic skills, knowledge and experience. For this reason, a shorter, adapted list of essential drugs is often adequate for primary health care. Decisions about which specific drugs should be made available in this shorter list can be made only when all relevant local factors have been taken into account. The following considerations will inevitably influence the compilation of such drug lists:

- Existing systems of medicine

The establishment of health services in developing countries should not result in abrupt disruption of prevailing cultural patterns in rural communities. The work of traditional healers, for example, should be adapted and supplemented so as to ensure that innovation is successfully integrated into existing systems of care.

- The national health infrastructure

The type of health services that a country requires is dependent upon the proximity and nature of the first referral facilities. It is still not unusual in some countries for the nearest permanently staffed health post to be a day's travelling time or more from isolated villages in its catchment area.

- The Pattern of endemic disease

The prevalence of major endemic infections and parasitic diseases may vary from region to region within a country in conformity with climatic, geographical, topographical, social, economic and occupational factors. Careful planning and, in some cases, epidemiological surveys are required to ensure that the most effective drugs are provided and to obtain full benefit from limited resources.

- Supplies

Continuity of essential supplies and information must be assured. It is especially important that drugs be distributed and stored correctly. For example, the cold chain must be maintained for drugs requiring this type of care, such as insulin and vaccines.

- Medicinal drug Promotion

Activities for the promotion and marketing of medicinal drugs can strongly influence prescribing practices. Methods of evaluating new drugs based on their comparative safety, efficacy, availability and cost should form part of the training of health workers. In addition, the WHO ethical criteria for medicinal drug promotion should continue to be widely distributed and followed. This is particularly important for drugs used to treat infections so that inappropriate use is kept to a minimum, thereby limiting both the development of resistance to new antimicrobial drugs and unwarranted expense.

3.2 Criteria for essential drugs

Essential drugs are those that satisfy the health care needs of the majority of the population; they should therefore be available at all times in adequate amounts and in the appropriate dosage forms.

The choice of such drugs depends on many factors, such as the pattern of prevalent diseases; the treatment facilities; the training and experience of the available personnel; the financial resources; and genetic, demographic and environmental factors.

Because of differing views on the definition of an essential drug in terms of what is meant by the "health care needs of the majority" of the population, the model list has been gradually expanded since its introduction. Some drugs are included that are essential only if a therapeutic programme is planned to address the diseases for which these drugs are used. For example, cytotoxic drugs (section 8.2 of the model list in the "Seventh Report of WHO Expert Committee "On the Use of Essential Drugs", WHO Technical Report Series No. 867) are essential only if a comprehensive cancer treatment programme is planned. Such a programme requires adequate hospital, diagnostic and clinical laboratory facilities for its implementation. In contrast, the drugs used in palliative care are always essential, even when a comprehensive cancer treatment programme does not exist.

Only those drugs should be selected for which sound and adequate data on efficacy and safety are available from clinical studies and for which evidence of performance in general use in a variety of medical settings has been obtained.

Each selected drug must be available in a form in which adequate quality, including bioavailability, can be assured; its stability under the anticipated conditions of storage and use must be established.

Where two or more drugs appear to be similar in the above respects, the choice between them should be made on the basis of a careful evaluation of their relative efficacy, safety, quality, price and availability.

In cost comparisons between drugs, the cost of the total treatment and not only the unit cost of the drug, must be considered. The cost/benefit ratio is a major consideration in the choice of some drugs for the list. In some cases the choice may also be influenced by other factors, such as comparative pharmacokinetic properties, or by local considerations such as the availability of facilities for manufacture or storage.

Most essential drugs should be formulated as single compounds. Fixed-ratio combination products are acceptable only when the dosage of each ingredient meets the requirements of a defined population group and when the combination has a proven advantage over single compounds administered separately in therapeutic effect, safety or compliance.

3.3 Essential drug list

A WHO expert committee has selected a model list of essential drugs which is published in the WHO Drug information, Vol. 12, No. 1, 1998. It contains approximately 250 essential drugs and vaccines. The model list is the tenth list since 1977; however, the changes have been minor. While some new drugs have been added, others have been deleted and the list is still limited to approximately 250 essential drugs and vaccines. The model list is revised every two years.

More than 80 countries have adapted the model is to relate to the specific disease burden and financial resources available. Procurement is accordingly confined to a much smaller range of drugs. Only a small list should be drawn as may be decided by the national authorities to be used at the district level and below.

3.4 Updating of essential drug list

An essential drug list must be flexible enough to accommodate, as necessary, new drugs, new information on established drugs and changes in the status of internationally controlled substances. Experience with the original model list and the subsequent revisions, as well as with regional and national lists of essential drugs, has confirmed the need for regular review and updating. Revision is necessary not only because of advances in drug therapy but also in order to meet the needs of practice in the light of experience. Frequent and extensive changes are clearly undesirable since they result in disruption of channels of procurement and distribution and may have implications for the training of health personnel. For this reason a number of drugs have been retained on the model list that have been largely superseded in countries where there is a more extensive range of new medicaments but that are still used widely and successfully elsewhere.

3.5 Procurement of essential drugs

Many developing countries pay extremely high prices for the drugs they use, whether they buy internationally or locally. The less populous countries in particular have been singularly unsuccessful in obtaining generic drugs of good quality at competitive international prices. An improved procurement system, access to market information and the consolidation of orders from different parts of the health system can achieve considerable savings without jeopardizing quality, the savings being used if necessary to purchase more drugs. At present, the best way to obtain drugs of good quality at low prices appears to be through international competitive tender for bulk drugs in standard packages with assured financing.

Procurement requires expert knowledge and skill. WHO may, on request, give guidance to national staff on assessing needs and on developing or improving their own procurement system information on current benchmark prices to enable national staff to make comparisons with their own situation can also be provided.

3.6 Drugs supply management

The central pharmacy in the district hospital is the primary source of drugs and medical supplies. The task of the pharmacy will include planning the selection and procurement of drugs, the safe storage and distribution of vaccines and drugs, record keeping, and provision of education on drugs for hospital workers and the community. The pharmacy may supply the primary care units and help supervise their use. Often, drugs for primary care units are provided in a kit form by a central authority.

In primary health care units, systems need to be in place for estimating drug requirements, maintaining an inventory, storing and stocking drugs, and issuing and controlling the use of drugs. There may be directions from the ministry, or regional authority regarding authorized stock levels for individual items. Regard will need to be had to these also when ordering.

Health workers may believe that inventory control is practical only if and when resources are in good supply. This is not the case. Inventory control is about managing and using the resources available. Good inventory control makes ordering and drug management easier. Essential drug

programmes place a high priority on improving inventory control to improve the supply of essential drugs, vaccines and other items at health facilities. To achieve this aim, staff need to be trained in inventory control storage and ordering procedures.

It is important that attention is given to preparing the best estimate of how much needs to be ordered of a particular drug. Too much may be wasteful especially if any of the remaining supply exceed their expiry date. Too little can result in a shortage and patients may suffer due to the lack of timely treatment.

The anticipated usage should be estimated for a period of time that equates to the purchasing interval, i.e. the usual time taken between the ordering and the supply of drugs. This may commonly be between three and six months.

Drugs received need to be recorded in a stock ledger and stored in a secured way on shelves in a clean, dry, well ventilated and cool place. Systems need to be followed for the issue and control of drugs as well as for maintaining the cold chain for vaccines so that wastage is minimized.

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PART II

PERIPHERAL HEALTH FACILITIES

PERIPHERAL HEALTH FACILITIES

1. INTRODUCTION

The model of a health system based on primary health care in Figure 1 shows that the district hospital as a first referral facility supports a whole network of other district-, community- and family- based facilities to cover an area-wide catchment and to meet the varying levels of health care service this catchment needs at first- and second-contact levels. They are integral components of district health systems and are known as peripheral health units such as primary health care units and community-based services. These peripheral health facilities will be discussed in detail in the succeeding pages to focus attention on the following aspects:

- (1) Functions
- (2) Population served
- (3) Services delivered
- (4) Space requirement
- (5) Human resources
- (6) Basic equipment

Suggested floor plans based on space programmes have also been included so as to assist planners and designers. They are further encouraged to find appropriate local translation, adaptable to any local situation, while using the information and guidelines provided to them.

Primary health care is best delivered by local peripheral health units while the higher-level facilities deliver specialized functions. The objectives are:

- (i) To ensure close contact with the community for services to all community-based facilities such as home care, schools, workplaces, nursing homes, and continuing care retirement community, etc., at the same time facilitating and encouraging community- based activities.
- (ii) To ensure delivery of primary health care services, health promotion and health education on a continuing basis.
- (iii) To ensure collection of epidemiological data, its analysis and information exchange both vertically and horizontally.
- (iv) To maintain proper records for health statistics and forwarding these records to the district health authorities.

2. DESCRIPTION

There are several types of health units at first- and second-contact level, also known by different names depending upon their location and the country but with almost similar functions. These form an integral component of district health systems. These include self-care, all health workers and facilities up to and including the hospital at the first referral level. The main functions are to provide primary health care, health education, preventive care to the community, and limited curative care through the provision of a small number of beds and the participation of specialists from other lateral or vertical facilities in the network. These units are:

- The Polyclinic or the Urban Health Centre. This is a unit that is comprehensively out-patient in nature but, if required, can admit in-patients on some basic specializations.
- The Rural Health Centre. This delivers basically primary out-patient service but is the first peripheral unit in which in-patient service may be delivered on a limited basis; and
- The Health Post. This is the simplest and most elementary structure at the periphery run by resident staff and carrying out basic health care. This is also known as Sub-health centre, Dispensary, Day clinic, Commune Health Station, or First Aid Post, which is the smallest unit in the community on out-patient basis, operating on a partial or full-time schedule through a trained doctor, nurse, midwife or a community health worker depending on their availability and the financial resources of the country. Occasionally, it may provide emergency in-patient service;
- Community-based facilities. These are facilities generally found in the community, may or may not be run by the community.
- Family-based facilities. These are facilities generally attached to home and run by the family members.

3. MEDICAL EQUIPMENT

Until recently, medical equipment for health facilities below district hospitals has consisted of relatively simple items such as delivery tables, surgical instruments and microscopes. However, the recent trend in district health systems is to strengthen the out-patient diagnostic and treatment capabilities of lower-level facilities in order to lessen the number of patients that needs to be referred to the hospital. Major items of equipment such as X-ray, ultrasound, and laboratory analysers are increasingly being used in lower-level facilities.

This diffusion of complex medical equipment in lower levels of health services is a major change. It is very important that workers be educated in the issues of safety, efficacy, proper use and maintenance, if the equipment were to deliver real benefits.

Lower-level health workers have been accustomed to simple equipment which has been relatively easy to manage. Complex equipment, however, requires special attention. Inappropriate use of medical equipment can produce more harm than good.

Appropriate use of major equipment can greatly strengthen the services provided by lower-level facilities. Adequate education and training, however, should take priority before the supply of equipment.

For example: X-ray units carry potential hazards of both high voltage and radiation and they must be correctly installed and used. There are safety requirements for room size and lead-shield protection. Safety standards should not be relaxed when working in the rural areas; sub-standard make-shift installations should not be tolerated. The damaging effects of radiation cannot be immediately seen nor felt, but their cumulative exposure can induce serious health problems. X-ray machines also need to be periodically calibrated to avoid over-dosage. Laboratory reagents carry potential chemical hazards and must be properly stored. Reagent shelf-life must be strictly respected or else test results will be meaningless. Wrong diagnosis certainly can cause harm to patients. Safe disposal of materials such as syringes, needles and pharmaceutical and laboratory wastes must be strictly observed.

Appropriate use of equipment includes clear definition of the services expected from the user. For example: multi-purpose ultrasound units can be used on different organs. Each use requires special training. One important service of lower-level health facilities is antenatal care. The ultrasound unit can be very useful for routine, non-pathological, obstetric scans to detect high-risk pregnancy. The training to provide this service is relatively simple. However, pathological diagnosis on liver, kidney or other organs will require more extensive training. Users should be required to use equipment strictly in domains where they are qualified.

Section 2.4, Part I explains the various management components important in the lifecycle of equipment. All primary care units need to be aware of these and put in place procedures that complement a district-wide approach to equipment management.

In the essential equipment lists for peripheral units, we shall consider common durable items only. Drugs and consumable supplies, in general, have not been listed. These lists are given under the relevant health facilities: polyclinic, the rural health centre and health post. It is important to keep in mind that equipment depends on local health practice, physical characteristics and culture of the population served. Readers should **take these lists as a guide only** to develop the final lists which can best serve local health care needs. For each service, experienced front-line users of equipment (health workers), together with planners, should form working groups to compile the most appropriate lists for local use.

4. THE POLYCLINIC

4.1 Functions

The Polyclinic, inter-commune polyclinic or the Urban Health Centre is a second-level contact facility serving a range of population from 5000 to 10 000 in general, but can extend to as much as 100 000 in certain countries, containing as much as possible all specialties such as:

- ENT
- Obstetrics-gynaecology
- Paediatrics
- Surgery
- Internal medicine
- Dentistry
- Geriatric services
- Laboratory services

It is basically working as an outpatient department only. It is usually not integral to a hospital but links to a hospital for its patient referrals. However, where there are no hospitals in the immediate vicinity, it is best for the polyclinic to contain admission beds numbering from a minimum of 5 beds to a maximum of 20 beds.

The functions of the polyclinic are given under. These can, however, be changed according to the needs of the local population.

- (a) to provide outpatient consultation to a maximum number of specialties delivered by doctors and specialists coming from the district hospital;
- (b) to provide ambulatory service consisting of day-surgeries and nursing;
- (c) to admit limited inpatient service in obstetrics-gynaecology, trauma, and internal medicine;
- (d) to provide diagnostic service;
- (e) to receive, compile, and transfer information and health statistics received from the lower level units to the district hospital;
- (f) to deliver primary service in health education and health promotion; and
- (g) to deliver health care services to the older persons.

Like the rural health centre, the polyclinic offers minor surgery, although it has no operating room. Because of its location in the urban area which normally has a greater population, the polyclinic is usually larger in scale than the rural health centre.

4.2 Staffing

The minimum staff for this centre consists of:

1 - medical officer, full-time

2 - assistant doctors, full time

specialists visiting from the district hospital

nurses, 1 nurse per 4 patients

midwives, number as required

technicians, number as required

volunteer workers

This can be changed as per the needs of the population and availability of the resources, both human as well as financial.

4.3 Space Programme

The following table is a programme of space groupings or blocks of a polyclinic.

Table 6. Programme of space groupings or blocks of a polyclinic

Space Groupings or Departmental Blocks	Qty.	Recommended Dimensions	Remarks
Arrival Area/Main Entry	1	3.0m x 6.0m (18.0 m. ²)	Main entry point
Polyclinic Blocks			
Consult-Exam Clusters	2	6.0m x 6.0m (36.0 m. ²)	Contains 4-consult-exam rooms each basic or start-up clusters
Additional Clusters	(-)	(-) (-)	Indefinite number depending on number of doctors available
Administration Block	1	6.0 x 6.0m (36.0 m. ²)	Contains 1 office for doctor-in-charge, 1 office shared by other doctors, and 1 conference room
Laboratory Block	1	3.0m x 6.0m (18.0 m. ²)	With working counter, sink, storage spaces and shelves
Pharmacy Block	1	3.0m x 6.0m (18.0 m. ²)	With dispensing counter, sink, storage spaces and shelves
X-ray Block			
X-ray Room	1	6.0m x 6.0m (36.0 m. ²)	To contain 1 equipment set
X-ray Support Area	1	6.0m x 6.0m	To contain waiting/ dressing processing/darkroom, film storage, radiologist's reading room
Nursing Block			
Wards	4	6.0m x 6.0m (144.0 m. ²)	To contain 4 beds each, with toilet facilities
Wards	2	3.0 x 6.0m (36.0 m. ²)	To contain 2 beds each, with toilet facilities
Public Toilet Blocks	(-)	(-) (72.0 m. ²)	To contain 2 toilets, one for male, one for female use
Staff Toilets	X	(-) (-)	Incorporated in the blocks

The total Functional Area varies from one situation to another, depending on the number of polyclinics and the number of wards provided. The basic module used is a block of 6.0m x 6.0m dimension. The total Functional Area is the area of the total number of modular blocks used.

A suggested Departmental Blocking Plan is as follows:

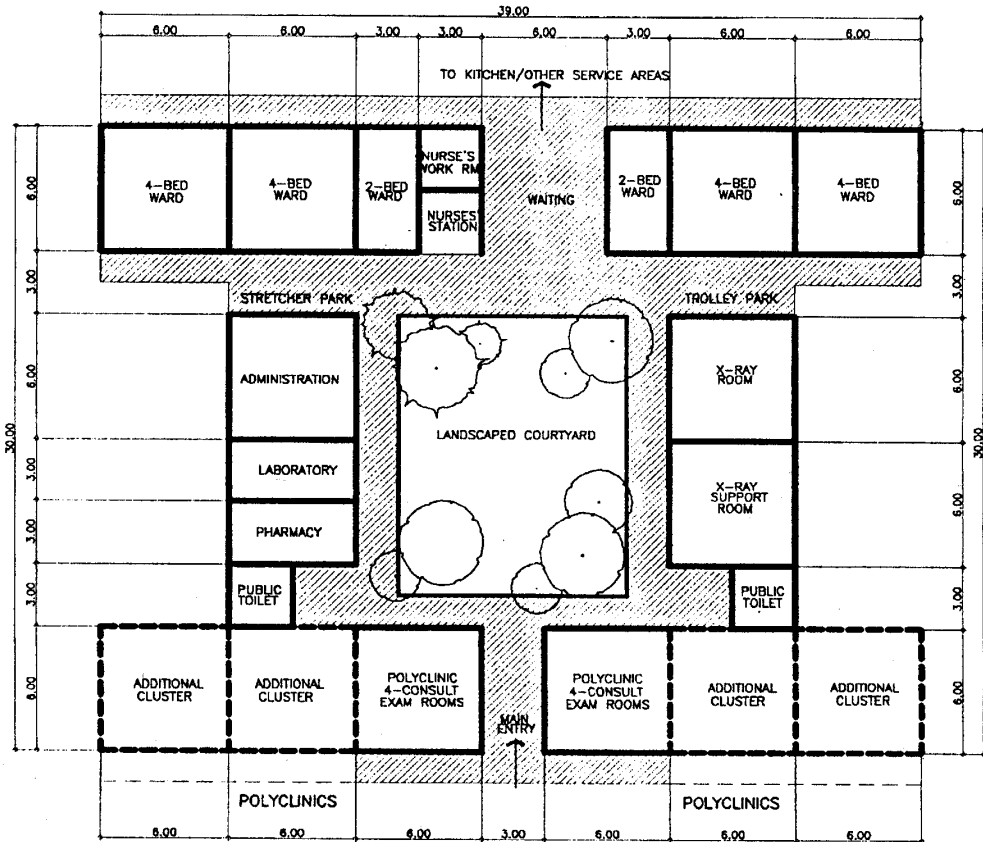


Fig. 82 Suggested departmental blocking plan

Note:

1. The design is developed on a modular basis, using a basic modular BLOCK with a dimension of 6.0 metres by 6.0 metres.
2. The plan shows only two polyclinic clusters of four consult-exam rooms. However, should there be more doctors available from hospitals, the number of polyclinic clusters can easily be increased.
3. Likewise, should there be a need to increase the number of beds, the design is open and has the flexibility for more beds. However, it is suggested that the incremental expansion be by the modular blocks of 6.0m by 6.0m which contain 4 beds.
4. If the polyclinic is close to a hospital, there may not be a need for nursing beds.

5. A veranda may surround the functional areas to serve as access point and circulation corridor.
6. Each polyclinic cluster of four consult-exam rooms will be accessed from two points: from the exterior veranda and from the interior corridor.
7. Requirements for toilets included above should be provided for hygiene and sanitation, with adjustments to local conditions, culture, available and existing systems if any, or none at all.
8. Because of cultural imperatives such as strong family ties in this region, spaces around structure must be open to use by family members for such functions as sleeping and cooking. If possible, the health centre may provide roofed-over structures for them, even if only on a temporary basis.

4.4 List of essential medical equipment

4.4.1 Outpatient Consultation/Medicine

Diagnostics

Stethoscope, adult
 Stethoscope, fetal,
 Sphygmomanometer,
 Thermometer, oral/rectal/armpit
 Tongue depressors
 Light source, battery type
 Tape measure, flexible type
 Vision testing chart, Snellen alphabet/illiterate
 Hammer, reflex testing, solid, rubber head
 Head mirror, adjustable, head band
 Mirror, laryngeal set
 Otoscope set, basic, for clinic
 Pelvimeter, Collyer, external
 Speculum, nasal, child, adult
 Scale, spring, baby, 5kg capacity
 Scale, adult
 Examination table

Treatment

Extractor of tick
 Forceps, splinter/epilation spring type
 Scissors, surgical straight 145 mm
 Tourniquet
 Splints, leg and arm
 Re-usable rubber gloves
 Hot/cold pack
 Disposable gloves
 Catheters, rubber

Emergency

Stretcher, folding type
 Ambu bags, infant, child, adult, with masks
 Laryngoscope

Speculum, nasal, child size
forceps, splinter/epilation, spring type
Suction machine (foot or electrically operated)
Syringes and needles
Examination gloves, reusable

Optional

Oropharyngeal airway
Endotracheal tube with cuffs (8mm and 10mm)
Intubating forceps (Magill)
Endotracheal tube connectors (3 for each tube size)

4.4.2 Obstetrics-Gynaecology

Basic equipment

Delivery bed
Examination table
Sphygmomanometer
Baby weighing scale
fetal stethoscopes
Instrument sterilizer
Spring type dressing forceps (stainless steel)
Kidney basins (stainless steel)
Sponge bowls (stainless steel)
Clinical oral thermometer (dual Celsius/fahrenheit scale)
Low reading thermometer (dual Cel/Fah scale)
Surgeon's hand brush with white nylon bristles
Heat source
Syringes and needles
Suture needles and suture material
Urinary catheters
Adult ventilator bag and mask
Mouth gag
Surgical gloves
Scissors

Delivery pack

Artery forceps (1)
Cord-cutting/blunt-ended scissors (1)
Cord ties (2)
Gloves (2 pairs)
Plastic sheeting (1)
Gauze swabs (4)
Cloth (1)

Perineal/Vaginal/Cervical Repair Pack

Sponge forceps (1)
Artery forceps
Large (1)
Small (1)
Needle holder (1)
Stitch scissors (1)
Dissecting forceps, toothed (1)

Vaginal speculum, large (Sims) (1)
Vaginal speculum (Hamilton Bailey) (1)

Neonatal Resuscitation Pack

Mucus extractor (1)
Infant face mask (2 different sizes)
Ventilatory bag (1)
Suction catheter Ch 12(2)
Suction catheter Ch 10(2)
Infant laryngoscope with spare bulb and batteries (1)
Endotracheal tubes (3.5(1)
Suction apparatus: foot or electrically operated

Insertion and Removal of IUD Pack

Bivalve speculum
Small (1)
Medium (1)
Large (1)
Sponge forceps (1)
Long straight artery forceps (1)
Uterine sound (1)
Vulsellum forceps (1)
Dressing forceps (1)

Equipment for Vacuum Extraction or Forceps Delivery

Vacuum extractor
Obstetrics forceps, outlet, mid-cavity, breech

Basic Equipment for Uterine Evacuation

Vaginal speculum (Sims)(1)
Sponge (ring) forceps or uterine packing forceps (1)
Single tooth tenaculum forceps (1)
Long dressing forceps (1)
Uterine dilators, sizes 13-27 (French) (1 set)
Sharp and blunt uterine curettes, size 0 or 00 (1)
Malleable metal sound (1)
Manual vacuum aspiration
Basic uterine evacuation instruments PLUS:
Vacuum syringes (single or double value)
Silicone lubricant
Adapters
Flexible cannulae, size 4 to 12 mm
Vacuum aspiration with electric pump
Basic uterine evacuation instruments PLUS
Vacuum pump with extra glass bottles
Connecting tubing
Cannulae (any of the following):

flexible: 5,6,7,8,9, 10,12 mm
curved rigid: 7,8,9, 10,11, 12,14 mm
straight rigid: 7,8,9, 10,11, 12 mm

Equipment for Insertions and Removals of Contraceptive Subdermal Implants

Trocar with plunger, no.10
Dissecting forceps
Tweezers

4.4.3 Minor Surgery

Dressing set

Stainless steel box, 17x7x3 cm
Surgical scissors, straight sharp/blunt, 12-14 cm
Kocher forceps, no teeth, straight, 12-14 cm
Dissecting forceps, no teeth, 12-14 cm

Abscess/suture set

Stainless steel box, 22x10x5 cm
Dissecting forceps, with teeth, straight, 12-14 cm
Kocher forceps, straight, 12-14 cm
Pean forceps, straight, 14 cm
Surgical scissors, curved, sharp/blunt, 12-14 cm
Probe, 14-16 cm
Mayo-Hegar needle holder, 18 cm
Scalpel handle, No. 4

Basic surgery set

Stainless steel box, 25x10, 5x5 cm
Sterilizer
Scalpel handle, No. 4
Mayo-Hegar needle holder, 18 cm
Surgical scissors, Mayo curved, 14 cm
Surgical dissecting scissors, Metzemaum, curved, 14 cm
Farabeuf retractors, short
Artery forceps, Halstead, no teeth, curve, 12 cm
Kocher forceps, with teeth, straight, hemostatic, 14 cm
Probe, 14,5 cm
Dissecting forceps, with teeth, 14 cm
Dissecting forceps, no teeth, 14 cm
Hemostatic forceps (Chaput), 14 cm
Hemostatic forceps (Collin), 16 cm
Towel clips (Backaus), 10 cm
Gallipot, 8 cm

4.4.4 Paediatrics

Resuscitator, infant/child, manual
Suction machine, dual operation, with tubes
Otoscope, with infant diagnostic head
Forceps, splinter/epilation, spring type
Speculum, nasal, child size
Scale, infant
Height measuring unit, infant
Thermometer, armpit
Crib, infant

For Control of Diarrhoeal and Acute Respiratory Diseases
Respiratory rate timer (UNICEF cat.no. 08345010)
Plastic cups, 100ml
Plastic pitcher, 2L
Teaspoon, s.s. 5ml

4.4.5 ENT

Head mirror
Light source
Laryngeal mirror set
Speculum, nasal, child, adult
Aural probe, hook, and curette

4.4.6 Dental Service

Examination set

Mouth mirror (2)
Dental explorer, double ended (2)
Tweezer, cotton wool (2)
Instrument trays, 15x10 cm (4)
Mugs for rinsing, s.s. (2)
Tray with lids for keeping sterile instr, s.s. 40x30 cm

Emergency extraction

Dental cartridge syringe for anaesthesia (2)
Extraction forceps (set of 8)
upper teeth: 2x left, 2x right, 1x anterior
lower teeth: 1x molar, 1x pre-molar, 1 x anterior

Cleaning

Set of 4 scalers (2)

Temporary filling

Set of 4 excavators, double ended (2)
2 x large
2 x small
Set of 2 plastic instrument (2)
1 x large
1 x small
Spatula (2)
Mixing slab, glass

Sterilization

Sterilizer, boiling type
Box for sterilizing instruments

Normal Extraction (for qualified practitioners only)

Root forceps: 2x upper, 1 x lower
Elevators, 1 x left, 1 x right, 1 x straight

Preventive and Basic Fillings

- Simple dental chair with spittoon
- Operating light
- Portable dental unit (drills and suction)
- Amalgam balance
- Amalgam carrier (2)
- Amalgam plugger, double ended (2)
- Mortar and pestle for amalgam (1)
- Mixing slab for anterior filling material (1)

Preventive filling material: pit and fissure sealants.

4.4.7 Laboratory Service

- source: mother/baby package (WHO)
- select only sets for services offered in the Facility

Preparation and staining of thin blood films

- Microscope
- Immersion oil
- Clean glass slides
- Glass rods
- Sink or staining tank
- Measuring cylinder (50ml)
- Wash bottle containing buffered water
- Interval timer clock
- Rack for drying slides 0968515
- Leishman stain, methanol

Thick blood films for malaria parasites

- Field stains A and B
- Glass containers
- Microscope slides
- Blood lancets
- Cotton wool

Total and differential leucocyte count

- Counting chamber (Neubauer)
- Pipette (0.05ml)
- Pipette (graduated, 1.0 ml)
- Turk diluting solution
- Tally counter, differential if possible

Estimation of haemoglobin

- Haemoglobinometer
- Blood lancets

Erythrocyte volume fraction (haematocrit)

- Microhaematocrit centrifuge (manual or electric)
- Scale for reading results
- Heparinised capillary tubes (75mm x 1.5 mm)
- Spirit lamp

Blood lancets
Ethanol

Detection of glucose in urine

Indicator papers and tablets or, if not available,
Test-tubes
Rack
Measuring cylinder (10ml)
Dropping pipette
Sodium nitroprusside
Glacial acetic acid
Ammonia

Detection of protein in urine

Indicator papers and tablets or, if not available,
Test-tubes
Pipette (5ml)
Sulfosalicylic acid (300 g/1 aqueous solution)

Detection of bile pigments in urine

Indicator papers and tablets, or if not available,
Test-tubes
Rack
Measuring cylinder (10ml)
Dropping pipette
Lugol iodine solution

Detection of urobilinogen in urine

Indicator paper and tablets or, if not available,
Test-tubes
Ehrlich reagent

5. THE RURAL HEALTH CENTRE

5.1 Functions

The Rural Health Centre or the Commune Health Station is where the first diagnosis should be made and responsibility for providing comprehensive, integrated continuing care should lie. It serves a rural village population of 1000 to 3000 people in general, extending to a range of as much as 5000 to 20 000 in some countries. A working definition of a health centre is that it is the main institution linking services with the people; it has the responsibility and unique potential for providing people with the ability and confidence to solve their own problems; it provides a full range of health promotion and prevention services including mother and child care; it provides curative care primarily to ambulatory patients and those with selected conditions. It has a multidisciplinary team providing a range of services and may not have a doctor. Where a first referral-level hospital is poorly accessible, the health centre may provide limited basic inpatient services as well. Its other functions are: to provide outpatient consultation; admission service for emergency, obstetrics- gynaecology, and medicine; provide diagnostic service; and to serve as transfer centre for data and statistics from the health post to the district hospital.

The services provided in the rural health centre are the following:

- outpatient consultation
- dental consultation and treatment
- laboratory testing
- emergency/first aid/minor surgery
- obstetrics-gynaecology
- medicine

Although minor surgeries will be performed, there will be no operating room in this centre.

5.2 Staffing

The following is the minimum staff recommended for a rural health centre but if the situation warrants and funds require a small amount of money, this strength can be increased accordingly.

- one medical doctor (full time)
- one assistant medical doctor (full time)
- one nurse (full time)
- the usual number of technicians and laboratory assistants as required
- the other professional staff will be visiting staff from the district hospital or polyclinic, etc. as the need arises.

5.3 Space programme

The inpatient content or admission capability is 5 beds and may increase depending on the population requirement and distance of the nearest district hospital. As a rough estimate and example of planning and laying-out of admission spaces, the 5 beds in the health centre may be distributed as follows:

Room 1:

2 beds for obstetrics-gynaecology patients

Room 2:

1 bed for emergency, for transfer and referral to the nearest hospital

1 bed for minor surgery

1 bed for medical patients

In view of the great imbalance in the distribution of beds, with urban areas receiving more than their share of the available hospital beds nationwide, it would be well to consider the provision of these much-needed beds in the first contact facility traditionally offering only primary-care level of service. On the other hand, the hospital is encouraged to abandon its traditional exclusive curative role and to expand its functions to the delivery of primary health care. This change in the traditional separation of roles of first-contact and first-referral facilities would result in a more equitable distribution of beds and a more universal and comprehensive health delivery to all sectors. The following is the general distribution of a space programme according to the functions performed.

Table 7. General distribution of a space programme

Functional Spaces	Qty.	Recommended	
		Dimensions	Remarks
Outpatient	1	3.0m x 3.0m	Consultation-examination room; also used as office of doctor-in-charge of health centre
Consult-Exam Room		(9.0 sq.m.)	
Consult-Exam Room	2	3.0m x 3.0m	Consultation-examination room for other doctors
		(18.0 sq.m.)	
Laboratory	1	3.0m x 3.0m	With working counter, sink, storage spaces/shelves
		(9.0 sq.m.)	
Pharmacy	1	3.0 x 3.0m	With dispensing counter, sink, storage spaces/shelves
		(9.0 sq.m.)	
Nursing Rooms			
Room 1:	1	3.0m x 6.0m	With 2 beds, expandable to 3 beds
Obstetrics-Gynaecology		(18.0 sq.m.)	
Room 2:	1	3.0m x 6.0m	With 3 beds, 1 each for emergency, minor surgery and medicine
General		(18.0 sq.m.)	
Toilets	2	1.5m x 3.0m	With 1 water closet, 1 lavatory, 1 shower
		(9.0 sq.m.)	
Day Room	1	3.0m x 3.0m	Lounge for ambulant patients, interaction area with family and friends, or additional ward space
		(9.0 sq.m.)	
Toilets			
Staff, Male	1	1.5m x 1.5m	With 1 water closet, 1 lavatory, 1 shower
		(2.25 sq.m.)	
Staff, Female	1	1.5m x 1.5m	With 1-water closet, 1 lavatory, 1 shower
		(2.25 sq.m.)	
Public, Male	1	1.5m x 1.5m	With 1 water closet, 1 lavatory
		(2.25 sq.m.)	
Public, Female	1	1.5m x 1.5m	With 1 water closet, 1 lavatory
		(2.25 sq.m.)	
Total Area of Functional Spaces		(108.0 sq.m.)	

Notes:

1. A verandah may surround the functional areas to serve as waiting area and circulation corridor.
2. Requirements for toilets included above should be provided for hygiene and sanitation, with adjustments to local conditions, culture, available and existing systems if any or none at all.
3. Because of cultural imperatives such as strong family ties in this region, spaces around structures must be open to use by family members for such functions as sleeping and cooking. If possible, the health centre may provide roofed-over structures for them, even if only on a temporary basis.

4. In areas with no electricity/power systems, the management of dead bodies may pose a problem. If the health centre does not contain a mortuary, families must be called upon to collect the bodies of their relatives as soon as possible.

The following is a suggested plan translating the above space programme.

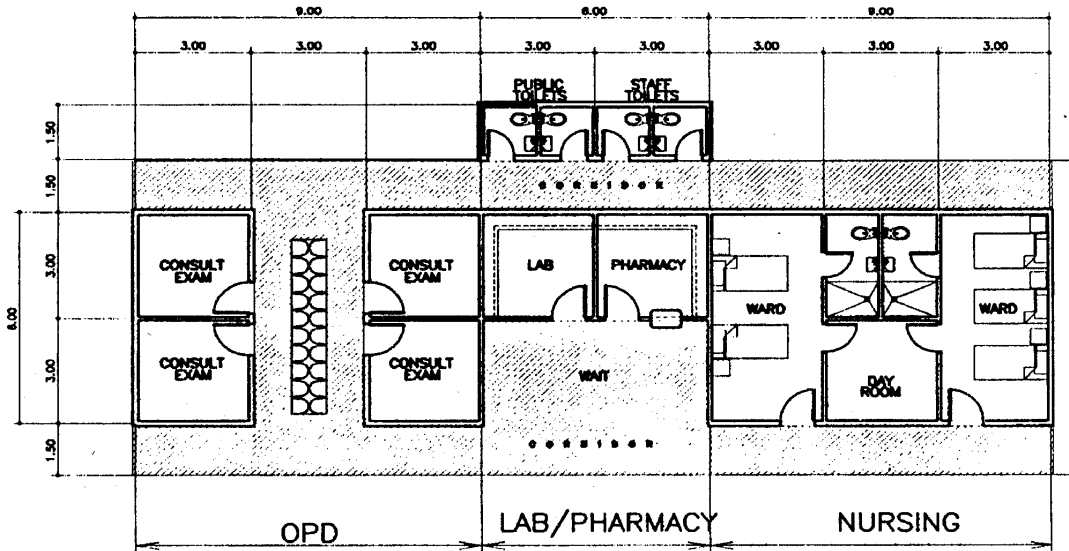


Fig. 83. Plan of a rural health centre

Note:

The design above is developed on a modular basis, using a basic modular dimension of 3.0 metres by 3.0 metres. If a rural health centre is close to a hospital, the total nursing unit or ward shown in the floor plan below may be totally removed.

5.4 List of essential medical equipment

5.4.1 Outpatient Consultation/Medicine

Diagnostics

- Stethoscope, adult
- Stethoscope, fetal
- Sphygmomanometer
- Thermometer, oral/rectal/armpit
- Tongue depressors
- Light source, battery type
- Tape measure, flexible type
- Vision testing chart, Snellen alphabet/illiterate
- Hammer, reflect testing, solid, rubber head
- Head mirror, adjustable, head band
- Mirror, laryngeal set

Otoscope set, basic, for clinic
Pelvimeter, Collyer, external
Speculum, nasal, child, adult
Scale, spring, baby, 5-kg capacity
Scale, adult
Examination table

Treatment

Extractor of tick
Forceps, splinter/epilation spring type
Scissors, surgical straight 145 mm
Tourniquet
Splints, leg and arm
Re-usable rubber gloves
Hot/cold pack
Disposable gloves
Catheters, rubber

Emergency

Stretcher, folding type
Ambu bags, infant, child, adult, with masks
Laryngoscope
Speculum, nasal, child size
Forceps, splinter/epilation, spring type
Suction machine (foot or electrically operated)
Syringes and needles
Examination gloves, reusable

Optional

Oropharyngeal airway
Endotracheal tube with cuffs (8mm and 10mm)
Intubating forceps (Magill)
Endotracheal tube connectors (3 for each tube size)

5.4.2 Obstetric-Gynaecology

Basic equipment

Delivery bed
Examination table
Sphygmomanometer
Baby weighing scale
Fetal stethoscopes
Instrument sterilizer
Spring type dressing forceps (stainless steel)
Kidney basins (stainless steel)
Sponge bowls (stainless steel)
Clinical oral thermometer (dual Celsius/Fahrenheit scale)
Low reading thermometer (dual Cel/Fah scale)
Surgeon's hand brush with white nylon bristles
Heat source
Syringes and needles
Suture needles and suture material
Urinary catheters

Adult ventilator bag and mask
Mouth gag
Surgical gloves
Scissors

Delivery pack

Artery forceps (1)
Cord-cutting/blunt-ended scissors (1)
Cord ties (2)
Gloves (2 pair)
Plastic sheeting (1)
Gauze swabs (4)
Cloth (1)

Perineal/Vaginal/Cervical Repair Pack

Sponge forceps (1)
Artery forceps
Large (1)
Small (1)
Needle holder (1)
Stitch scissors (1)
Dissecting forceps, toothed (1)
Vaginal speculum, large (Sims) (1)
Vaginal speculum (Hamilton Bailey) (1)

Neonatal Resuscitation Pack

Mucus extractor (1)
Infant face mask (2 different sizes)
Ventilatory bag (1)
Suction catheter Ch 12(2)
Suction catheter Ch 10(2)
Infant laryngoscope with spare bulb and batteries (1)
Endotracheal tubes (3.5)(1)
Suction apparatus: foot or electrically operated

Insertion and Removal of IUD Pack

Bivalve speculum
Small (1)
Medium (1)
Large (1)
Sponge forceps (1)
Long straight artery forceps (1)
Uterine sound (1)
Vulsellum forceps (1)
Dressing forceps (1)

5.4.3 Minor Surgery

Dressing set

Stainless steel box, 17x7x3 cm
Surgical scissors, straight sharp/blunt, 12-14 cm
Kocher forceps, no teeth, straight, 12-14 cm
Dissecting forceps, no teeth, 12-14 cm

Abscess/suture set
Stainless steel box, 22 x 10 x 5 cm
Dissecting forceps, with teeth, straight, 12-14 cm
Kocher forceps, straight, 12-14 cm
Pean forceps, straight, 14 cm
Surgical scissors, curved, sharp/blunt, 12-14 cm
Probe, 14-16 cm
Mayo-Hegar needle holder, 18 cm
Scalpel handle, No. 4

Basic surgery set

Stainless steel box, 25 x 10, 5x5 cm
Sterilizer
Scalpel handle, No. 4
Mayo-Hegar needle holder, 18 cm
Surgical scissors, Mayo, curved, 14 cm
Surgical dissecting scissors, Metzembaum, curved, 14cm
Farabeuf retractors, short
Artery forceps, Halstead, no teeth, curve, 12 cm
Kocher forceps, with teeth, straight, haemostatic, 14 cm
Probe, 14,5 cm
Dissecting forceps, with teeth, 14 cm
Dissecting forceps, no teeth, 14 cm
Haemostatic forceps (Chaput), 14 cm
Haemostatic forceps, (Collin), 16 cm
Towel clips (Backaus), 10 cm
Gallipot, 8 cm

5.4.4 Dental Service

Examination set

Mouth mirror (2)
Dental explorer, double ended (2)
Tweezer, cotton wool (2)
Instrument trays, 15x10 cm (4)
Mugs for rinsing, s.s. (2)
Tray with lids for keeping sterile instr, s.s. 40x30 cm

Emergency extraction

Dental cartridge syringe for anaesthesia (2)
Extraction forceps (set of 8)
Upper teeth: 2x left, 2x right, 1x anterior
Lower teeth: 1x molar, 1x pre-molar, 1x anterior

Cleaning

Set of 4 scalers (2)

Temporary filling

Set of 4 excavators, double ended (2)
2 x large
2 x small

Set of 2 plastic instrument (2)
1 x large
1 x small

Spatula (2)
Mixing slab, glass

Sterilization

Sterilizer, boiling type
Box for sterilizing instruments

5.4.5 Laboratory Service

source: mother/baby package (WHO)
select only sets for services offered in the facility

Preparation and staining of thin blood films

Microscope
Immersion oil
Clean glass slides
Glass rods
Sink or staining tank
Measuring cylinder (50ml)
Wash bottle containing buffered water
Interval timer clock
Rack for drying slides 0968515
Leishman stain, methanol

Thick blood films for malaria parasites

Field stains A and B
Glass containers
Microscopes slides
Blood lancets
Cotton wool

Total and differential leucocyte count

Counting chamber (Neubauer)
Pipette (0.05ml)
Pipette (graduated, 1.0 ml)
Turk diluting solution
Tally counter, differential if possible

Estimation of haemoglobin

Haemoglobinometer
Blood lancets

Erythrocyte volume fraction (haematocrit)

Microhaematocrit centrifuge (manual or electric)
Scale for reading results
Heparinised capillary tubes (75mm x 1.5 mm)
Spirit lamp
Blood lancets
Ethanol

Detection of glucose in urine

Indicator papers and tablets or, if not available,
Test-tubes
Rack
Measuring cylinder (10ml)
Dropping pipette
Sodium nitroprusside
Glacial acetic acid
Ammonia

Detection of protein in urine

Indicator papers and tablets or, if not available,
Test-tubes
Pipette (5ml)
Sulfosalicylic acid (300 g/l aqueous solution)

Detection of bile pigments in urine

Indicator papers and tablets, or if not available,
Test-tubes Rack .
Measuring cylinder (10ml)
Dropping pipette
Lugol iodine solution

Detection of urobilinogen in urine

Indicator paper and tablets or, if not available,
Test-tubes
Ehrlich reagent

6. THE HEALTH POST

6.1 Functions

The health post, also known as the first aid post or the day clinic, is a basic unit usually found serving a rural population of about 500 to 2000 people. It is in this small unit where immediate and direct data collection can be undertaken on community diseases, births and deaths, general health condition and other health statistics for submission to the next higher level of the service unit. It is here that health promotion and education can be delivered to the community through lectures, demonstrations and dissemination of informative and educational media print materials. Although no major treatment is undertaken under its roof, the health post can provide first aid for emergency cases and immunization services to the community.

6.2 Staffing

A doctor, nurse, midwife or a community health worker (CHW) depending upon the situations actually prevailing in the country, can be in charge of this health post. The CHW is a local resident who may be a retired staff or who has been recruited or had volunteered for the job and had undergone a special training in a general hospital for a period of three (3) to six (6) months.

6.3 Space Programme

The following space programme of a health post is simple and can be accommodated in an equally simple structure made from locally available materials, even of indigenous materials.

Table 8. Space programme of a health post

Functional Spaces	Qty	Recommended Dimensions and Areas	Remarks
Consultation-Examination Room	1	3.0m x 3.0m (9.0 m. ²)	With consultation table and examination couch, minor treatment, first aid
Immunization Room	1	3.0m x 3.0m (9.0 m. ²)	For administration of injections, immunization and for interviews
Staff Toilet	1	1.5 x 1.5m (2.25 m. ²)	With 1 water closet, 1 lavatory
Public Toilets Male	1	1.5m x 1.5m (2.25 m. ²)	With 1 water closet, 1 lavatory
Female	1	1.5m x 1.5m (2.25 m. ²)	With 1 water closet, 1 lavatory
Storage Room	1	1.5m x 1.5m (2.25 m. ²)	With 1 water closet, 1 lavatory
Total Area of Functional Spaces		(27.00 sq.m.)	

Notes:

1. This minimum functional area of 27.00 square metres can be surrounded by a verandah to serve as covered waiting area and circulation corridor.
2. If the site is well selected, protected, for example, by a canopy of trees, open areas around the health post may be used for lectures and demonstrations and as spill-over spaces for waiting.

The following is a Suggested Form Plan translating the above Space Programme.

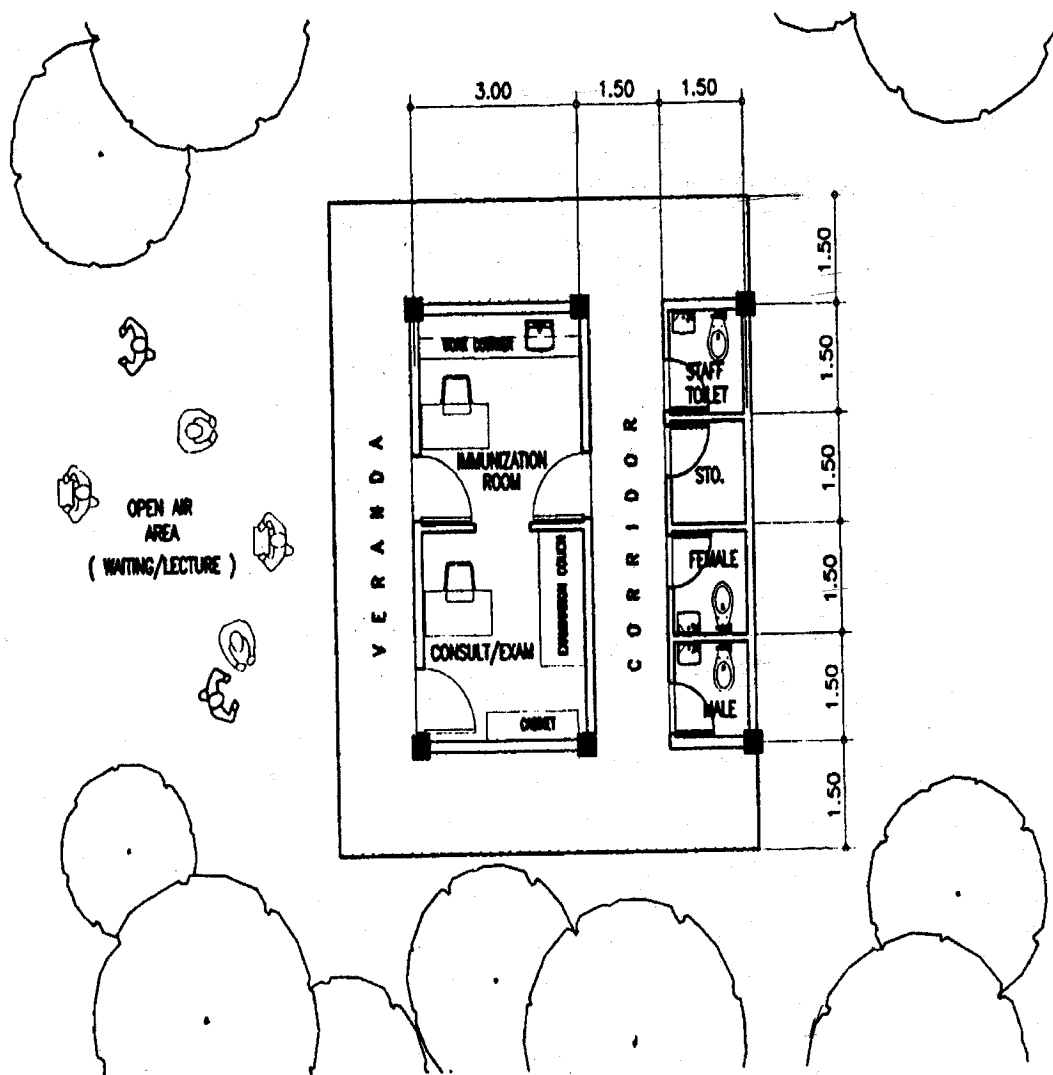


Fig. 84. Suggested plan of a minimum health post

If money is available, this minimum health post may be expanded to a bigger covered structure with the following Space Programme.

Table 9. Space programme for expanded health post

Functional Spaces	Qty	Recommended Dimensions and Areas	Remarks
Consultation-Examination Room	1	3.0m x 3.0m (9.0 m. ²)	With consultation table and examination couch, minor treatment, first aid
Immunization Room	1	3.0m x 3.0m (9.0 m. ²)	For administration of injections, immunization, and for interviews
Staff Toilet	1	1.5m x 1.5m (2.25 m. ²)	With 1 water closet, 1 lavatory
Public Toilets			
Male	1	1.5m x 1.5m (2.25 m. ²)	With 1 water closet, 1 lavatory
Female	1	1.5m x 1.5m (2.25 m. ²)	With 1 water closet, 1 lavatory
Storage Room	1	1.5m x 1.5m (2.25 m. ²)	
Waiting/Lecture Room	1	6.0 x 9.0m (54.0 m. ²)	General waiting room that is convertible into a lecture room for health promotion, capacity 50 people.
Total Area of Functional Spaces		(81.00 m.²)	

Notes:

1. This expanded health post, with an area of 81.00 square metres, may also be surrounded by a verandah as additional waiting area and circulation corridor.
2. Toilet facilities must be provided for sanitation and hygiene. In areas where sanitary pipe lines and systems are not in place, the local system should be used.

The following is a suggested floor plan translating the space programme.

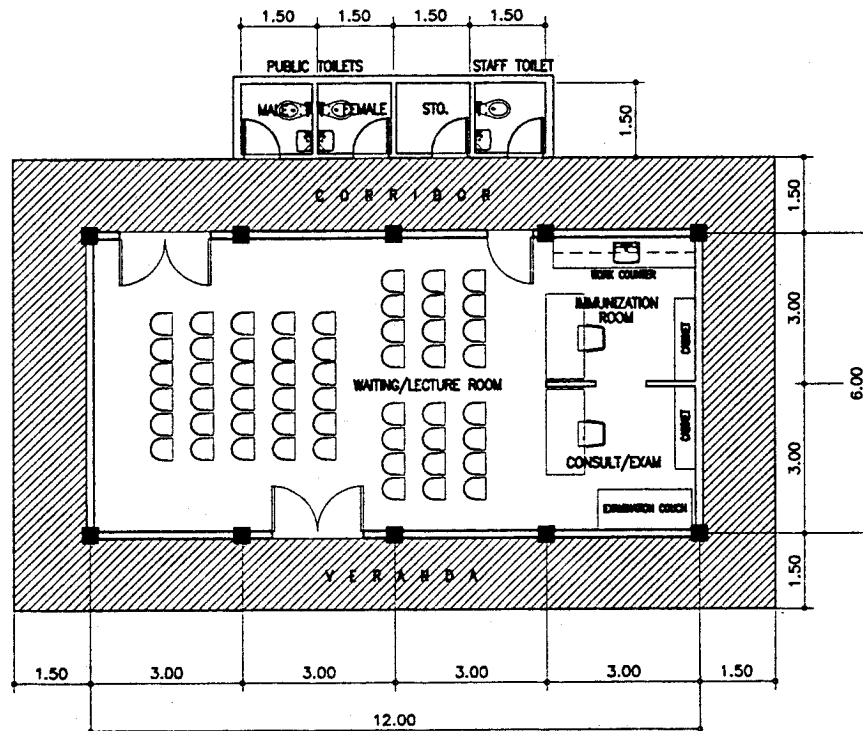


Fig. 85. Expanded plan of health post

6.4 List of essential medical equipment

The health post should at least have the following basic equipment:

Diagnostics

- Stethoscope, adult
- Stethoscope, fetal
- Sphygmomanometer
- Thermometers, oral/rectal/axilla
- Tongue depressors
- Light source, dual power
- Tape measure, flexible type
- Instrument carrying case

Treatment

- Extractor of tick
- Forceps, splinter/epilation spring type
- Scissors, surgical straight 145 mm
- Tourniquet
- Splints, leg and arm
- Re-usable rubber gloves
- Hot/cold pack

7. COMMUNITY-BASED FACILITIES

7.1 Introduction

The average life expectancy at birth of people worldwide is projected to increase from 64.4 years in 1995 to 70.6 years by the year 2020" In the countries that geographically belong to the WHO Western Pacific Region, the average life expectancy is projected to increase from 68.8 years in 1995 to 74.4 years in the year 2020" Technological advancements in the cure of traditional acute diseases have prolonged life resulting in the increase of the number of older people in the world" On the other hand, socio-cultural factors have disintegrated the traditional family structure that used to protect and shield the older people within the folds of an extended family"

Just as there are facilities devoted to attending to the general health of the community, over time there may become a need for special facilities to address the needs of older people in the community. Aging is not a disease but a natural process in the life of everyone and so communities always have older people who have special needs for facilities that must be provided to assist in their independence and enhance their day-to-day existence. Each community will respond differently to the increasing needs of its populations with special needs, such as older persons, those with severe physical or intellectual disability, depending on facilities and the involvement of the private and/or nongovernmental sectors, These types of facilities are likely to require a minimum of medical and technical support and can exist on minimal supervision and occasional visits from health workers" Although the needs of older people are dominant considerations in design, these facilities can be used by other people in the community who have similar requirements such as the physically impaired and those recuperating and rehabilitating from illnesses that have temporarily impaired their physical capabilities"

Although the needs of older people are dominant considerations in design, these facilities can be used by other people in the community who have similar requirements such as the physically impaired and those who are recuperating and rehabilitating from illnesses that have temporarily impaired their physical capabilities.

7.2 Design considerations

Sensitive designs for older persons should focus on addressing the physiological and psychological characteristics as outlined below"

7.2.1 The needs of older persons

To properly provide facilities for older people, it is imperative to understand the situation of aging" The cardinal point to remember about aging is that, basically, it is not a disease but a process and that all human beings go through it if life is not abnormally terminated earlier" In general, older persons suffer from the gradual and progressive deterioration and loss of physical capabilities. In addition, they tend to have heart conditions and high blood pressures which limit the extent of the physical exertion their bodies can take" Complex physiological and emotional changes occur that are sometimes too much to cope with, so they are known to suffer psychologically from the stresses and are prone to depressions.

The most dominant feelings in older persons are loneliness, boredom and fear - loneliness from the loss of friends and loved ones, boredom resulting from greatly lessened mobility and physical capability, and fear of not being able to completely control their own destiny. There are different means for the care of older persons at different levels of facilities. These are discussed in the respective sections. These must be borne in mind while designing either a hospital ward or a separate 'facility for older persons. Special attention needs, therefore, to be paid to some of the features of design, environment and site selection as explained below.

7.2.2 Physical elements that must be specially designed

There are elements in the physical environment that must be specially designed for the elderly to enable independent function if support and help of another individual is not available. The following is a list of some of the physical inadequacies of older persons and the equivalent element in buildings and structures that must be specially designed for them:

Area of Inadequacy	Part of physical facility
<u>Three-dimensional Environment</u>	
Stepping and balance	- entries and doorways
Lifting arm, reaching, finger dexterity	- light switches
Reaching and bending	- outlets
Reaching	- closets
Reaching to grasp	- bars
General support at steps and ramps	- rails
Reaching to high or lower items	- cupboards
Grasp	- hardware
<u>Lighting</u>	
Visual adequacy, placement	- lighting level
Available light, glare	- light placement
Control of glare	- lighting features
<u>Home Furnishings</u>	
Seated positioning, sitting and rising	- chairs
Tripping	- rugs
Bumping, bruising	- furniture edges/features
Tripping	- placement of cords
<u>Finishes</u>	
Tendency to slip and fall	- floor finishes
Visual adequacy	- tactile surface

7.2.3 Appropriate Environment and Ambience

The following are some words that can appropriately describe the atmosphere older persons need. These should be what designers should endeavour to translate in their space design solutions and the ambience these spaces should create and evoke.

cheerful

inviting

have a human scale

non- institutional

naturally lighted
landscaped with indoor-outdoor continuity
caring environment
healing environment
artistic (paintings, sculptures, music)
pleasant (views)

7.2.4 Specific design features

Some design features and solutions that interpret older persons' needs are the following:

- lounging spaces that encourage interactions
- sitting areas with views of activities of children
- areas for actual close interaction with young people
- areas where older persons can feel productive (crafts rooms, workshops)
- phones, doorbells and alarms with lights that flash on and off (visible signals for the hearing impaired)
- walls with bright cheerful colours, texture contrasts, bold graphics and signages (for the visually impaired)
- simple circulation patterns
- special texture and form for door knobs, handrails, furniture and walls (to be perceived and to stimulate the reduced sense of touch)
- adequate turning radius for the wheelchair (for chair-bound older persons)

7.2.5 Site selection criteria for community-based facilities

In the selection of site for all community-based facilities except, of course, home care, the following criteria are recommended for consideration.

(a) Accessibility

The site should be within easy access of community activities so that the elderly may actively participate and become integrated into the mainstream of neighbourhood life.

(b) Convenient transportation

Elderly people are not able to move about by themselves any more. The site should therefore be located where mass transportation is available so that the elderly can be helped to become mobile and able to get to where they would like to go.

(c) Recreational activities

The facility should be flexible enough to be able to accommodate a variety of activities for recreation, occupational and physical therapy, and a variety of cultural activities. It would also be helpful to look for sites where activities within the centre may be augmented and reinforced by facilities around that offer compatible activities and pre-occupations that older persons can participate in. Examples of physical activities that

may be provided are walking, dancing and other forms of exercises. Games such as chess, checkers, cards and billiards can also be provided. Arts and crafts are good avenues for expression and so spaces and furniture where older persons may paint, create ceramics, and do crafts are important. Galleries in the neighbourhood may also serve as venues for the display or sale of these works.

(d) Work opportunities

Opportunities where older persons may be compensated for their work and skills must be provided close to or within the facility. This is important in maintaining self-worth and self-esteem.

(e) Mixed use facilities

This is a criterion for the selection of facility sites that can address and provide solutions to the feeling of isolation that may result if older persons' care facilities are located in areas away from thriving communities. Sites should be selected where older persons' care facility may be integrated with the basic functions of the community. For example, an older persons' care facility located adjacent to an elementary school may facilitate the interaction between the teachers and the older persons in the development of the school programme; and the sharing of the experiences of older persons in the classrooms. Interaction between the old and the young had been found to be mutually beneficial.

7.3 Description

The following are community-based facilities for other people:

- the day care centre, which provides care for older people during the day while younger family members are away and at work.
- the nursing home for older persons, which provides care for a group of older people living together in one common residential facility.
- The continuing care retirement community, which is a specially planned and designed community for a generally older group of people.

7.4 Facilities

7.4.1 Day-care centres

(a) Facility for hospital patients

There are many advantages in having day-care facilities. No staff are required at night or the weekend, patients can sleep in their own homes, and the accommodation can be simpler than a standard hospital ward. There must, however, be a reliable transport system, provided by either the hospital or the patient's relatives.

Day care is particularly applicable in the areas listed below.

- Minor surgery, when the patient arrives in the morning, having fasted overnight, and is sent home after recovering from the anaesthetic. For convalescence to be successful, the patient's home should be visited by a nurse prior to surgery to ascertain that the home environment is conducive to good recovery and that there is somebody responsible in the home who knows how to care for the patient. This visit also provides

responsible in the home who knows how to care for the patient. This visit also provides an opportunity for teaching and for planning the patient's discharge. Patients living at a distance may need to use accommodation near the hospital.

- Rehabilitation for geriatric patients living at home or in sheltered accommodation.
- Making life easier for relatives who care for patients at home.
- The long-term treatment of the mentally ill.
- The provision of specialized units for certain groups of patients (e.g., young people with psychoses)
- Rehabilitation for injured or disabled persons.
- Investigative diagnostic procedures.
- Paediatric care.

Patients admitted in the hospital for a day's treatment must be told how to obtain help, or when to return to the hospital, if there is any unexpected complication or deterioration. The hospital must work closely with the community health services to ensure that care of the patient is continuous: its responsibility does not end when the patient leaves.

Consideration should be given to establishing inexpensive accommodation near the hospital for patients living at a distance who do not require close nursing and medical attention and for their relatives. This will facilitate a certain amount of nursing supervision and enable patients to return to the hospital for additional care. The management of such a hostel should preferably not be the responsibility of the hospital. When possible, health education should be provided for people lodging in the hostel.

(b) Facility for older persons

This type of day care centre provides care for the older person during the day while the family members go on with what they have to do. This is on the same concept as day care centres for children. Here, older persons are provided with lunch, interaction and recreation, even part-time light employment. At night, they go home to their families. The relief these centers give to families had given rise to the term respite centre, which day care centers are also called.

The sample plan for a day care centre in Figure No. 86 shows a basic facility for 20 to 25 persons.

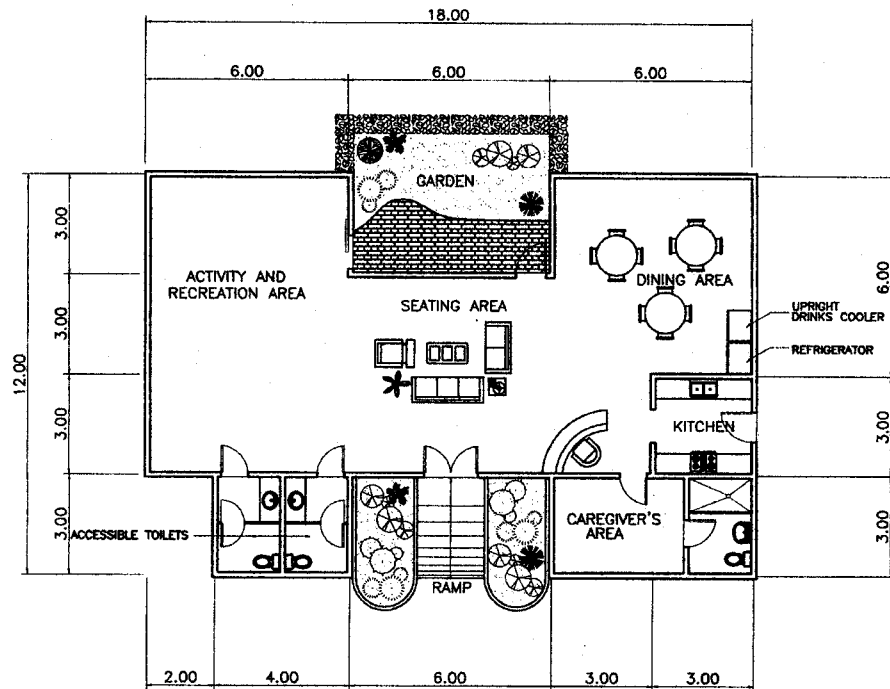


Fig. 86. Sample plan of a day care centre

This facility will require a staffing ratio of one direct care staff member per four older persons or five care givers. They need not be permanent employees in the centre. They may be volunteers, or health care workers coming from the higher district facilities with arrangements to participate in the daily care of older persons.

The features of the design are sensitive to the needs of older persons. A friendly and planted entry with a ramp instead of steps greets the comer who is brought inside into a seating area having a view of a garden court. A spacious activity and recreation area can be the setting of varied activities ranging from music (singing and playing musical instruments to include a piano if affordable); and arts and crafts such as sketching, water colour, oil painting and clay modelling. The dining area is intimate and seating is broken down into small groups of four. A kitchen ensures warm meals all the time. Toilet facilities are accessible and can accommodate users in wheelchairs. The care givers have their own area with toilet facilities and there is a softly curved observation counter that allows the caregiver unobtrusive supervision over all the activity areas. .

The architectural design can be supplemented by non-institutional furnishings and interior decoration for a homely environment.

The total area of the facility is 198.00 square metres broken down as follows:

Table 10. Space programme for facility for older persons

Area/Room	Dimension (metres)	Area (square metres)
Seating area	6.00 x 6.00	36.00
Dining area	6.00 x 6.00	36.00
	1.00 x 3.00	3.00
Activity and recreation area	6.00 x 9.00	54.00
Observation counter	2.00 x 3.00	6.00
Caregiver's area, toilet	3.00 x 6.00	18.00
Kitchen	3.00 x 3.00	9.00
Accessible toilets (2)	3.00 x 4.00	12.00
Garden court	4.00 x 6.00	24.00
Total area of functional spaces		198.00

If desired, a room for assisted bath may also be incorporated so that the activity of bathing the older person is done in the centre, especially for difficult cases.

7.4.2 Nursing home for older persons

When living at home with a family is difficult or impracticable for one reason or another, an alternative action is to consider the possibilities offered by nursing homes. These are long-term care environments with 24-hour protective supervision for a group of older persons living in a common facility. They are also known as Group Homes and range in accommodation for a number of people ranging from the minimum viable number of 8 to as many as 40 older persons. Facilities can be newly constructed specifically for the purpose, or converted from existing large residences adapted for the purpose.

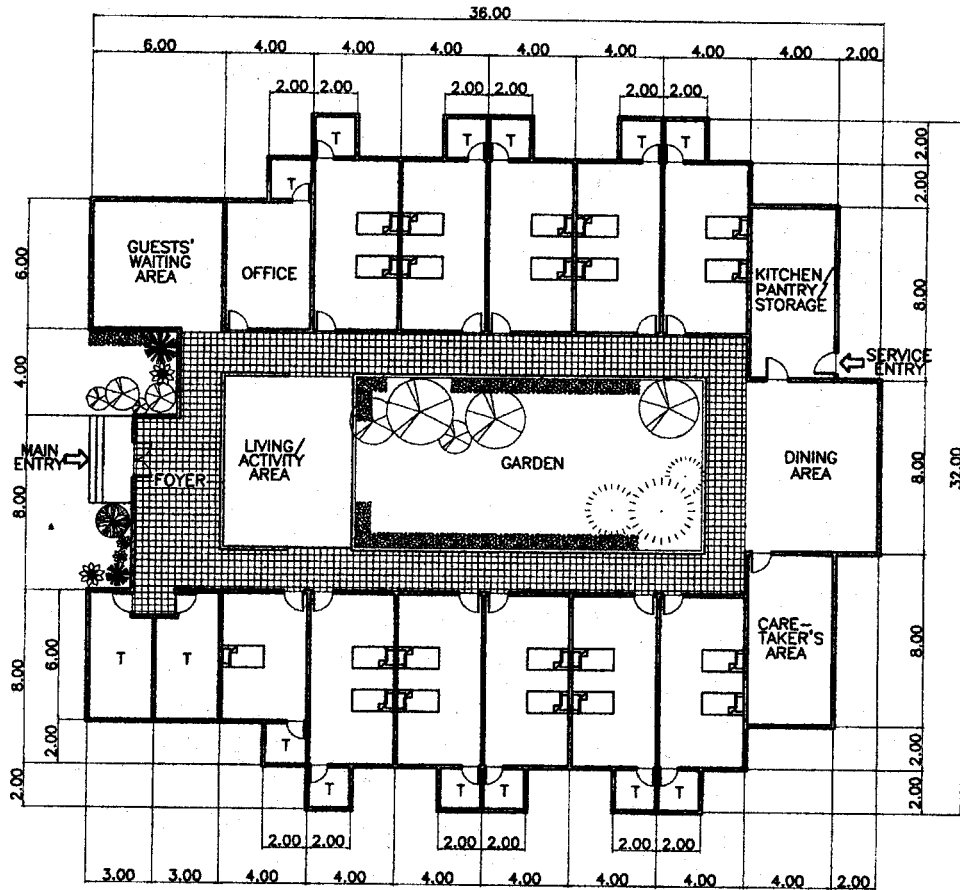


Fig. 87. Sample plan for a nursing home

Figure No. 87 shows a sample plan for a nursing home for 21 residents which can be supervised and run by 5 care givers.

The design attributes of this sample plan are responsive to the requirements of older persons. Although the foyer is friendly, the wall across it gives residents privacy in the use of the common activity areas behind. Guests are provided a waiting area adjacent to the care giver's office. The living, garden and dining areas can be broken down into smaller, more intimate activity alcoves. Because many older persons are prone to wandering, the legible corridor around the garden provides opportunities for meaningful wandering through the integration of points of interest along the way -a painting on the wall, a plant or landscape arrangement on the other side in the garden. A kitchen and care giver's area are located at the rear of the facility.

Because bedroom facilities are provided, the area requirements of a nursing home for the same number of persons are approximately four times that of the day care centre. This sample design has a total area of 790.00 square metres broken down as follows:

Table 11. Space programme for nursing home

Area/Room	Dimension (metres)	Area (square metres)
Foyer	4.00 x 8.00	32.00
Guests' Waiting Area	6.00 x 6.00	36.00
Office	4.00 x 6.00	24.00
Guests' Toilet	6.00 x 6.00	36.00
Bedroom (1-bed)	3.00 x 6.00	1 x 18.00 = 18.00
Bedroom (2-beds)	4.00 x 8.00	10 x 32.00 = 320.00
Toilets	2.00 x 2.00	12 x 4.00 = 48.00
Living/Activity Area	6.00 x 8.00	48.00
Dining Area	6.00 x 8.00	48.00
Kitchen	4.00 x 8.00	32.00
Caregivers' Area	4.00 x 8.00	32.00
Corridor	2.00 x 58.00	116.00
Total area of facility		790.00

7.4.3. Continuing care retirement community

This is a facility that will require high capital cost and high recurring operating budgets, as it would provide in one setting the full range of care that an older person may require -from independent living to start with, through assisted-living and finally to skilled nursing in the venue of a hospital. The older person living in this site development may progress or move from one level to another in a continuum of care, from the least supervised within the retirement community facilities and amenities to the most technologically monitored inside the hospital.

The advantage of this community is the transition of the lifestyle of older persons in an almost indiscernible fashion. A retirement community is like any other community, with individual housing facilities, commercial facilities for shopping, and recreational facilities such as pools, sauna and select sports facilities and, most important, a hospital that will take care of the physiological illnesses of older persons. Its difference from any regular community is the manner in which it had been planned and designed to focus on a community of mostly older persons.

In developments of this kind, the proponents are mostly from the private sector who develop a project package with retiring persons as its marketing target and fitting each residential product to the expected retirement benefits that an older person will get. Thus, while specially providing for the needs and requirements of an aging community, the proponent is encouraged because the benefits of a reasonable profit are also there for him.

8. FAMILY-BASED SERVICES

Individuals with special needs rely on caring and committed family members to provide personal care for their family members. Volunteers can be used to complement the work of families in supporting older people or those with special needs with managing the tasks of personal care and daily living.

8.1 Home care services

It is believed that the best setting for aging is that which is familiar to the older person. The home and network of familiar places around it that had been important parts of a person's life must continue to remain a part of it in the later years making the older person an integral part of a family. As a consequence, adaptations have to be made in the physical configuration of the home itself, in addition to the change of lifestyle of the family to accommodate the special needs of the older persons. If the family is willing and psychologically prepared, the adaptations to the family house can easily be made with sensitivity and consideration for the specific needs of the older person. Some adaptations are the following:

- for those who are wheel-chair bound: ramps instead of steps, adequate turning radii for the wheelchair, and accessible toilet and bath provision.
- for those who are visually-impaired: hand rails for holding and balancing, adequate lighting, simple and easily understandable lay-outs, uncluttered spaces.
- non-skid floor surfaces.

8.2 Family transportation service

Older persons must not be totally confined to the home. They must be given the capability to move about and visit the other places in the community close to their hearts. They must also be able to go to movie houses, cultural presentations and other entertainment and recreational facilities. In this regard, families caring for older persons may organize a reciprocal and mutually beneficial network of transportation services among themselves, taking turns in the process to drive the older persons around in their family cars, or organizing and hiring vans to pick up older persons by groups.

8.3 Bringing services into the home

There are services that can be administered to the older persons within the comfort of the home -such as health workers or nurses' regular visits, social workers' visits, and various forms of physical and occupational therapy. An arrangement can be made between families and health authorities or the hospital staff which would be beneficial to both. While the home provides for the setting and continuum of care, health workers may pay frequent home visits to provide consultation to the family. This relieves the pressure on demand for the number of beds in the hospitals, while assuring technical supervision over the health of the older person living at home. Entertainment and recreation may also be brought by adults, young adults and children alike to the older persons in their homes. The home can be a less expensive but warmer and more comfortable environment than a nursing home.

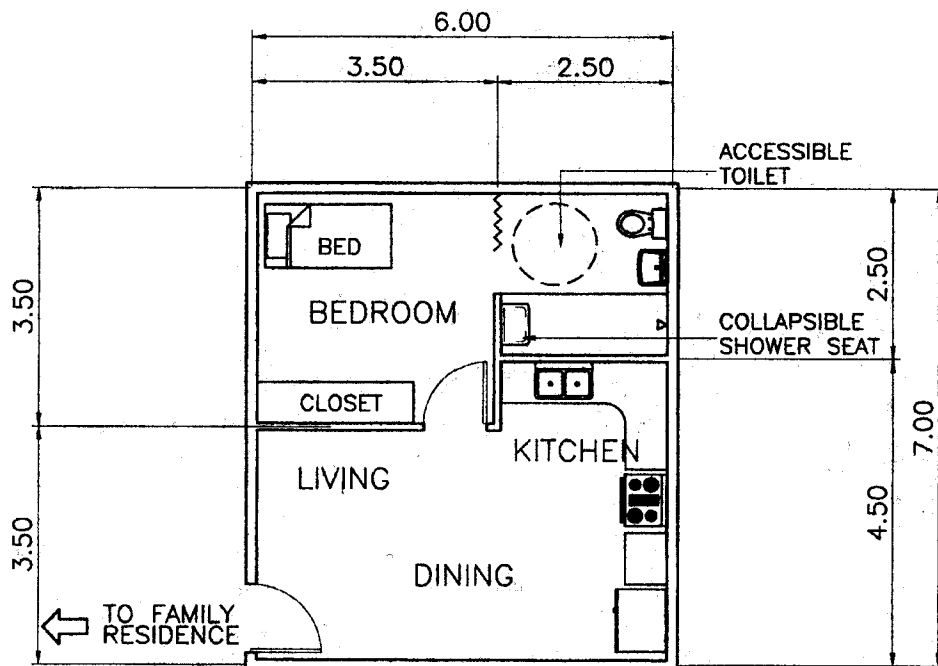
8.4 Echo housing

As mentioned in Para 8.1 above, a family that is caring for an older person must make adaptations in the physical configuration of the home and members must be willing to change their lifestyle to accommodate the special needs of the older person. This might entail too much pressure on the members of the family, especially the children that must live normal lives.

As an alternative to a completely integrated living, the "echo house" has been conceptualized. This is a very unique concept which brings the older person to a younger generation family without impinging totally on the privacy and daily life of the latter. This is achieved through the use of a small separate unit for the older person or couple, constructed permanently or mobile and attached to an existing family residence, thus allowing a son or a daughter, and even grandchildren, to care for a parent living just "next door".

A sample plan for such a unit is shown in Figure No. 88. It shows a simple living unit of approximately 6.00m x 7.00m for a wheelchair-bound older person and provides for the following accommodations.

- 1 - Combined Living-Dining-Kitchen Area
- 1 - Bedroom
- 1 - Accessible Toilet and Bath



"ECHO HOME"
ATTACHED TO AN
EXISTING FAMILY RESIDENCE

Fig. 88. Echo home

However, for economic reasons and if the family is willing and psychologically prepared, the adaptations to the family house can easily be made with sensitivity and consideration for the specific needs of the older person.

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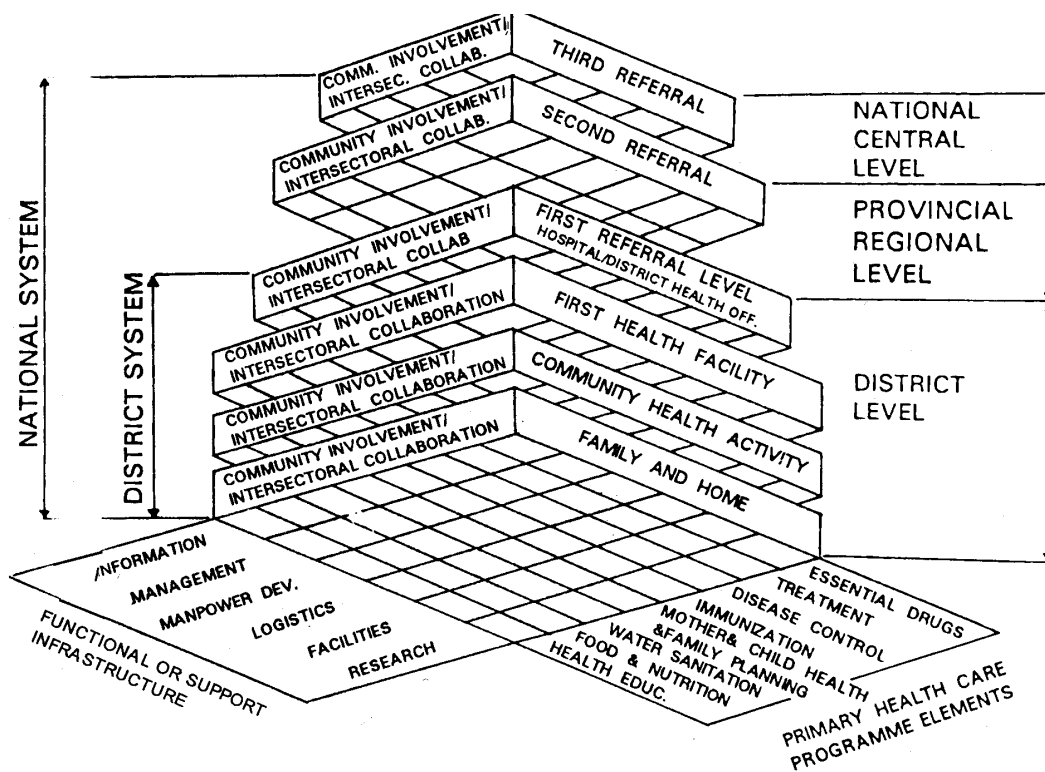
PART III
LINKAGES

LINKAGES

1. Introduction

The WHO Expert Committee on the Role of the Hospital at the First Referral Level, which met in 1985, clarified the importance of the full involvement of hospitals in primary health care. The district hospital system is fully dependent upon all its components in the district such as the home and the family, the community, and the peripheral health units supporting the district hospital. The model of a health system based on primary health care is as illustrated in Fig. 1 of Paragraph 1.1.1 of Part 1 of this book. This is again illustrated below to indicate clearly the linkages to be established in the district, with the hospitals on the one hand and the community on the other.

In its functions, the district hospital has an important role to support and be supported by the peripheral units such as health centres, health posts, etc.



2. Coordination/communication

Effective functioning of a nation's health services requires extensive coordination and communication between all levels of health services and the community they serve. The linkages required of district health services can be broken down into four groups.

- 2.1 Linkages between district hospitals and peripheral health facilities
- 2.2 Linkages with the community they serve
- 2.3 Linkages with tertiary referral hospitals and central government agencies
- 2.4 Intersectoral linkages within the district (i.e., with education, agriculture, local government, etc.)

3. Purpose of linkages

Linkages are required to ensure that better outcomes occur by achieving the following.

3.1 Service coordination and service integration

Multiple levels of the health system are involved in dealing with many of the communities' health problems. The aim of service coordination is for the community to get a "seamless" service, i.e., that they get a service which is delivered efficiently and conveniently as though there was one well organized deliverer of care. When services are well coordinated, everyone knows what their contributions are expected to be and performs accordingly.

An example would be the prevention and treatment of diarrhoeal diseases in the district. The tasks of Primary care workers would be to educate the community on hygiene practices to minimize spread, diagnose and manage mild and moderate cases, and refer severe cases to the district hospital. The tasks of district hospitals are to treat severe cases, perform microbiology testing and monitoring and assist in epidemiological surveillance of the district to identify and pinpoint the source of significant outbreaks. District hospitals should also be the distribution point for rehydration salts. Hospital staff should also have.. a role in educating the patients and their families on hygiene practices as the occasion arises.

3.2 Service planning

Service coordination may evolve naturally, particularly if there is good communication and cooperation between district and peripheral units. However, prior attention to service planning is a surer way to achieve service coordination.

3.3 Logistics support

There is a range of areas where linkages and a common approach to the purchase and distribution of supplies can result in better stock management, lower prices, fewer stock outages and lower inventories, all leading to better service at lower cost. National bulk purchasing arrangements for pharmaceuticals is one example. Within a district, the district hospital might be the central ordering and distribution point for numerous medical supplies.

3.4 Staff development and support

The district hospital is likely to be the focal point for a range of professional and technical staff training programmes and be the source of expertise in most specialized professional and technical areas.

3.5 Job satisfaction

Linkages are important within the district to develop a sense of joint purpose and joint achievement. It enables staff to feel part of the broader strategy to improve the health of the community and, as such, increase staff motivation and satisfaction. Peripheral units do not feel that they are battling on unsupported, and district hospitals do not feel as though they are convenient dumping ground for other problems.

4. Consequences of poor linkages

When linkages are ineffective, a number of problems may occur.

Gaps in service. There may be some necessary services which are overlooked because no one thinks it should be their task. For example, the task of tracing the source of an epidemic may be overlooked, or patients may be referred to the district hospital only to be turned away due to lack of resources.

Service duplication. Here, both peripheral and district services attempt to do the same task, perhaps even competing with each other. They may both purchase expensive equipment for the task when the district could have managed with only one. The result is inefficiency and waste of resources.

Inappropriate division of tasks. Peripheral units may take on tasks they are not sufficiently equipped to do or which could have been handled more efficiently at the district level. On the other hand, patients who could have been treated locally may be treated at the district hospital at higher expense than necessary and using resources which should have been used for patients with more complex problems. Efficiency requires that patients be treated at the earliest level of the referral chain possible. This requires a strong primary health care level and a strong district hospital.

5. Pattern of linkages

A district health system is dependent on strong and efficient linkage between and among its components or elements for it to function in its totality, allowing each component to contribute its specified role and function to the total mission and objective of the system.

For the district health system, linkages must be established in multi-directions horizontally and vertically.

Vertical linkage refers to that between levels in the system hierarchy; such as between health posts (HP) and the Rural Health Centre (RHC) or between the polyclinic (p) and the district hospital (DH). Linkages can also be horizontal, which means that at their own levels in the hierarchy, the facilities must be interconnected between and among themselves.

It is important that these directions of communication be multi-directional, up and down vertically and to and from horizontally, as shown in the diagram below:

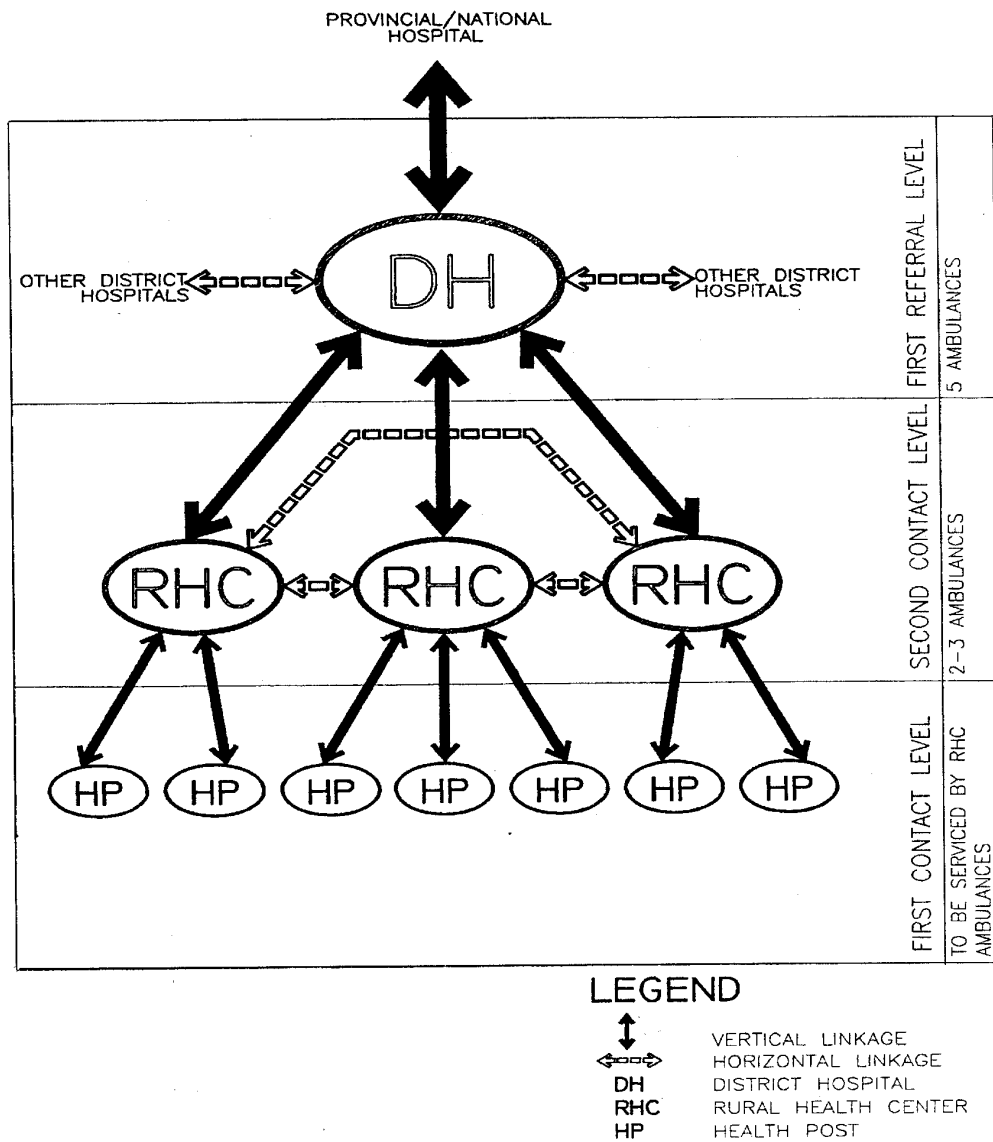


Fig. 89. Linkages Diagram

Linkage may take effect in two ways. The more traditional way requires the physical movement of people and material from one component to the other through the traditional infrastructure system such as roads, using traditional carriages such as cars, trucks, jeeps, ambulances, motorcycles, bicycles, carts and other movement equipment, from the slowest to the fastest in pace. Technology, however, has recently caused the use of the tele-medicine, telephone, fax, wireless, radio and television, computers, etc, instead of roadways for the transmittal of information and data from one component to another without necessitating the physical movement of people and materials. The information system is fast settling in as an important linkage medium, relying on the above infrastructure systems.

The degree or level on which a community relies on either system depends upon its resources and the presence in the area of the infrastructure system that would make the linkage system work.

The traditional system is a modest one that is substantially established to communities. Any community should at least have a basic road system and basic vehicles for transport. In the normal situation, use of public transport should be resorted to for the movement of people and materials but only in specific cases of emergency or referral systems, should ambulances be used. In the case of health education, health promotion and mass immunization, use of public transport and mobile clinics should be made. In the case of ambulances, the maximum limits that could be procured at each of the following facilities is given against each.

i) District hospital	4 -5 ambulances
Polyclinic/urban health centre	2 -3 ambulances
Rural health centres	2 ambulances

The information system, on the other hand, allows for communication and interaction between people without moving from their places of work. Even within the health facility itself, the network of computers minimizes the movement of people and allows them to "talk" through their computer screens without leaving their workstations. This development is changing the space programmes of health care facilities, bringing in new systems called "paperless and/or filmless" medical documentation. This technology has also given to mankind the gift of facsimile and electronic mail transfers of information: tele-conferences, tele-education and tele-medicine, which allow team performance of people even when they are physically separated by distance.

6. Linkage enablers

A number of factors are required to build strong linkages.

- A formal organizational structure that creates a single entity of a district health service (dealt within the administration and management chapter)
- Informal personal relationships
- Communication systems (dealt with in the tele-medicine communications and health information chapter)
- Transport systems (dealt with in the administration and management chapter)
- Integration of management and support functions such as planning, education and training, supplies and maintenance.

PART IV

**TELEMEDICINE,
COMMUNICATIONS
AND HEALTH INFORMATION**

4. TELEMEDICINE, COMMUNICATIONS, AND HEALTH INFORMATION

1. Introduction

Increasingly rapid advances in information and telecommunications technology are revolutionizing life and business around the world. The impact is being felt in the health sector with many new applications of these technologies. Telemedicine is essentially the use of both information technology and telecommunications to provide health services or support health service provision over a distance. The aim of this chapter is to outline the major new health uses of these technologies, describe the technologies, and provide a guide covering the key principles in planning a project for a district health facility.

The following scenarios are designed to show the wide variety of possible applications using current standard technology.

A hospital or clinic without an orthopaedic surgeon uses a digital scanner and computer to relay an X-ray of a broken limb plus relevant history and examination findings to an orthopaedic surgeon in a distant hospital to get advice on treatment and whether referral to the distant hospital for operative treatment is required. The provision of the X-ray image allows much better advice than a phone discussion alone.

A small child is brought to a clinic after taking drugs prescribed for someone else. The clinic worker uses a computer to consult a drug information database for the appropriate course of action.

A doctor in a district hospital wants to maintain their level of professional expertise. By using a computer and the Internet (World Wide Web) the doctor is able to read the online versions of medical journals. Articles on particular topics are identified using online access to Medline.

Information technology can be an important tool for empowering people and enabling them to be more productive and effective in their work. It can also be a tool that exacerbates division and inequality by creating sections of the community which are information-rich and others that are information-poor. The aim of telemedicine developments should reflect this.

Telemedicine should always aim to support health workers providing care as close to the patients as possible. This means information resources should be provided to all levels starting at primary care and clinical telemedicine should be used where possible to prevent referrals to district or tertiary hospitals and support care at the more local level. Used in this way, telemedicine can strengthen care at the primary care and district level.

Appropriate use of technology is all important. Telemedicine should be used to meet locally identified needs, and adequate technical support for users must be available. If not, there is a strong likelihood that the programme will fail due to lack of use.

Human factors are critical in any telemedicine programme. It takes time and training to become familiar and comfortable with IT-related equipment. Telemedicine programmes can only be introduced and grow at a rate governed by the growth in IT expertise and familiarity within the organization or facility. A key success factor is the extent to which this organizational expertise is developed.

Planning for services is exceedingly difficult because of the rapidity of technological advance. The power of computers has doubled approximately every 18 months for the last 15 years and there is no sign of this rate of change abating. Telecommunication and computing technologies are becoming highly interdependent on each other and increasingly difficult to differentiate. This process is known as convergence and, together with telecommunication deregulation around the world, is resulting in advances in telecommunications technology as great if not greater than in computing.

2. Technology

2.1 Introduction

Information can be stored and transmitted as either analogue or digital information. Analogue information uses a continuously varying signal. Digital information has everything reduced to a series of discrete numerical values which in the computer are represented as a series of 1's and 0's. Examples of analogue technologies are broadcast radio and television, traditional telephone, gramophone records, audio cassette players and, in health, X-ray machines and ECGs. Examples of digital technology are computers, audio CDs, digital television, digital mobile telephone and, in health, CT scanning and MRI scanning. It is generally possible to convert information from analogue to digital and *vice versa*. A computer modem is an example of this. It is a device which connects a computer (digital) to the telephone network (analogue). The modem converts the digital computer signal into an analogue signal for transmission and then reverses the process at the receiving computer.

Telecommunication technologies are moving towards digital signals because

- audio, video, graphics and other data can all be converted to digital signals and then transmitted through the same digital network (i.e. multimedia capability)
- digital information can be transmitted more accurately, analogue information always degrades more the further it is sent
- digital signals can be transmitted at extraordinarily fast rates
- digital signals can be switched and routed more cheaply and flexibly than analogue/signals

The technologies involved in telemedicine can be divided into two main groups, those that are involved in the transmission and receiving of the information (i.e. running the network), and the end-user devices which generate and present the information (i.e. computers, televisions, telephones.).

The end-user generally only needs to understand how to use the end-device and confirm that the network will support the service. Details of the networking technology are generally irrelevant. For instance, there is no need for an Internet user to know the details of how the internet functions only that their telephone line will carry sufficient bandwidth to the Internet Service Provider.

2.2 Transmission technologies

(a) *Wires and cabling*

Digital signals are sent as streams of electrical impulses. The existing telephone networks are generally built around copper wires and co-axial cables. The amount of information which can be carried (bandwidth)¹ depends on the type of cable or wire. The major factors for district health facilities will be the connection of the local exchange to the country's telecommunications backbone and the quality of the connection from the health facility to the exchange. The potential bandwidth of the connection to the exchange falls rapidly with distance. Most computer networks within a health facility (local area network or LAN) are connected with co-axial cable.

(b) *Fibreoptic cable*

Fibreoptic cable is very fine glass fibres which carry digital signals as pulses of light. Fibreoptic cable has revolutionized telecommunications because it is able to carry enormous volumes of information. It is also not subject to electrical interference. The initial roll-out is expensive and its main use is in providing the telecommunications backbone which links all of a country's telephone exchanges.

(c) *Radio-based technologies*

This uses radio waves to send information through the air. The fixed equipment required is a transmitter and a receiver. Radio frequencies are regulated in each country with frequency bands being reserved for various purposes. It may be used for radio broadcast or point-to-point telephony as in the mobile phone network. Its range varies with frequency and the power of the transmitter and there are often areas of poor reception if the radio waves are blocked by mountains or buildings. Their advantages are mobility and not being reliant on wires and cabling. Their disadvantages are low bandwidth and lack of reliability.

(d) *Microwave links*

Microwaves can be used to send digital information in a similar way as radio. It is of a higher frequency than a radio and is totally dependent on line of sight from transmitter to receiver. It is usually used on a point-to-point basis over distances up to 50 kilometres. Quite high bandwidths can be achieved.

(e) *Satellite technology*

Satellites are able to receive radio signals from earth and then retransmit them back. The device which does this is a satellite transponder. The geographic area covered by

¹ Bandwidth measures the information-carrying capacity of a communications channel. It is measured in bits per second. A bit, short for binary digit, is equivalent to a 0 or 1. A kilobit per second (kbps) is 1000 bits per second, a megabit per second (mbps) is 1 million bits per second, a gigabit per second (gbps) is 1 billion bits per second.

the satellite signal is known as the satellite's footprint. Most communications satellites are in geostationary orbit over 40 000 kilometres above the equator and have footprints covering very large regions. The equipment required to transmit a signal to a satellite in geostationary orbit is expensive. The equipment required to receive the signal from the satellite is much less expensive. For this reason, satellite technology is often used to broadcast signals, e.g. television or as a means of "trunking" an aggregated signal between telecommunications hubs. Satellite charges have been falling as their numbers and overall capacity have increased.

There are initiatives under way to use satellites in lower orbits. For example, the Iridium network plans to use 66 satellites orbiting at 780 kilometres to provide a mobile phone and paging network covering the whole world. The lower orbit means that hand held phones will be powerful enough to both transmit and receive signals.

2.3 Networks

(a) *Local Area Network (LAN)*

A LAN is used to connect digital devices such as personal computers and mainframe computers over a localized area such as a building or campus of a hospital, university or factory. LANs are normally installed and maintained by the organization and are essentially a small private computer network. Distances are small, 1-2 kilometres at the most, and this allows high data transmission rates. LANs are used to share information throughout an organization. In a hospital they are often used to access a Patient Master Index, medical record tracking, appointment booking systems and pathology test results. In some workplaces, they are used to streamline and control workflows. Any organization with two or more computers will generally have them networked.

(b) *Wide Area Networks (WAN)*

A wide area network is a network which covers a greater geographic area than a LAN. Generally, the dispersed sites are linked by lines leased from the telephone companies. Because of the distance involved, WANs have lower transmission rates than a LAN. Banks, for instance, run WANs connecting their bank branches to their central databases. Credit card companies run WANs which cover the entire globe. In health a typical WAN would connect the LANs from all the hospitals in a city or region.

(c) *Public Switched Telephone Network (PSTN)*

This is the analogue telephone network which is the largest network in existence. It can be used to carry voice and, by using a modem, data as well. It consists of a large number of carriers whose networks are interconnected. Telecommunications companies are continually developing and offering an expanding range of value-added communication services beyond the basic telephone service. For district hospitals ISDN (integrated services digital network) services are the most relevant additional service. An ISDN connection is required for video-conferencing and also for high bandwidth access to the Internet.

(d) *Private Automatic Branch Exchange (PABX)*

Many organizations have a PABX to automatically switch calls between telephone extensions in an organization and to and from the public telephone network.

(e) *Internet*

The Internet is a global network of computer networks. Individual computers or entire networks connect to the Internet via a gateway which converts the information to the required format (TCP/IP) and routes the information. The backbone of the Internet is run by the telecommunications companies. Individuals normally connect their computer using a modem and phone line via an Internet Service Provider. The Internet services include e-mail, file transfer protocol, and access to the World Wide Web.

2.4 End-user equipment(a) *Telephone*

A number of added services are possible. Multi-point audio-conferencing involves three or more telephones dialing into a bridge which gets the multiple feeds in and relays the appropriate signal out. This is often useful for administrative meetings or educational sessions. Voice-based interactive information services provide prerecorded information to a caller by allowing them to navigate through menu choices by dialing individual digits.

(b) *Facsimile (Fax)*

Fax is a device which electronically transmits documents and reproduces them at the other end over phone lines. It is possible to have a device which operates as both a fax and a phone as required. Because of their cheapness fax devices are widespread in most organizations.

(c) *Video-conferencing*

Video-conferencing is similar to a telephone call except that there is a video picture from the other end as well as audio. The equipment for video-conferencing consists of a video camera and microphone, a 'TV', and a codec at each end with an ISDN connection. Cost varies with the quality, size and sophistication of the system. There are a large range of add-ons such as a document camera, electronic white board and slide projection equipment which can be included in the package. The video and audio signal are sent to the codec (a specialized computer) which performs analogue to digital conversion and then compresses the signal. The compressed signal is sent over an ISDN line to the other end where another codec decompresses the signal and converts it to audio and video for viewing on the TV monitor. The minimum bandwidth for video-conferencing is 128 kilobits per second. At this bandwidth a compression ratio of 600: 1 is required. The resulting picture is adequate for interpersonal communication; however, there is some degradation of picture quality and when there is a lot of movement the picture degrades further for a number of frames. A higher quality can be achieved by using a higher bandwidth such as 256 or 384 kilobits per second.

Video-conferencing using an ISDN connection is analogous to using the telephone. The other parties' number is dialed and the call is automatically connected when the call is answered. At the end of the call the parties hang up.

The advantages of video-conferencing as opposed to the telephone are that people form a better rapport and communicate better when they can see the other person. A doctor can take a better medical history from the patient and physical signs and symptoms can be visually demonstrated or inspected. This also applies to administrative meetings.

(d) *Television*

Television is not an interactive media but is suitable for passive education. It is usually delivered by terrestrial broadcasts, satellite broadcast, or videotapes. Public TV is a major influence and educator of the general public and is important in health promotion and preventive health strategies.

(e) *Radio*

Like television, radio broadcasts are not interactive (except talkback radio) but can have a major role in health promotion and preventive health strategies.

(f) *Computers*

Computers are capable of storing, processing and presenting vast quantities of information in a bewildering variety of formats. They are extremely flexible and can be programmed to do virtually any information processing task. PCs (personal computers) are commonly placed on workers' desktops and their main uses relevant to health facilities are word processing, spreadsheets, database services, data analysis, e-mail communication and Internet access.

There are many peripheral devices which can be used with computers. Printers are the most common peripheral device. A scanner is a device which scans and digitizes pictures. In health they can be used to digitize X-rays. CD ROMs (compact disc -read only memory) are able to store over 600 megabytes of data on one disc which is sufficient to store the entire Encyclopaedia Britannica. The CD ROM reader is quite a cheap peripheral device. Sound card and speakers are required for audio output from the computer.

A modem is required to connect a computer to other computers including the Internet using telephone lines.

2.5 Internet services

The Internet is a system of interconnected networks which spans the globe. Most businesses, universities and other organizations as well as many individuals are able to access and use the Internet. It has been estimated that the number of users is greater than 250 million but such estimates are always out of date owing to the phenomenal growth of use. An individual user connects via an Internet Service Provider using their computer, a modem, and an ordinary telephone line. Organizations generally have their computers operating as a LAN and connect the LAN to the Internet via a single computer which operates as a gateway for the others.

For rural and remote users the existence of a reasonably priced local Internet Service Provider may be a limiting factor as long-distance phone charges may make it financially impractical if there is no local Internet Service Provider.

(a) *E-mail. (Electronic Mail)*

E-mail is a system whereby computer users send electronic messages to each other over computer networks. The messages can be stored, read and printed at the receiver's leisure. The Internet uses an e-mail addressing system organized on a world-wide basis. E-mail messages are delivered electronically and an e-mail from one country to another will take only a matter of minutes to arrive. The cost of

e-mail is encompassed as part of the Internet connection charge and so the marginal cost approaches zero. E-mail has great potential in health to allow health workers to communicate and stay in touch with each other.

(b) *The World Wide Web (WWW)*

The WWW is a system organized on a world-wide basis whereby resources on remote computers are downloaded and made available to users of the WWW. Most commonly the user downloads a "page" from the remote computer. This page may contain text, graphics, animations, audio, video, and forms. The downloaded page will contain words or pictures known as hyperlinks which when clicked on with the computer mouse result in another WWW page being downloaded (from the same or a different computer). In this way, the WWW forms a "web" of interlinked pages spanning the globe. The massive amount of material linked by the WWW is a problem in itself. Much of it is advertising and promotional material and there are no controls on quality. Nevertheless it is an extremely cheap method of publishing and sharing information. There is an increasing amount of high quality health-related resources on the WWW. (Perhaps the most authoritative resource would be that maintained by the National Library of Medicine in Washington, USA - www.nlm.nih.com).

3. Health applications

(a) *General approach*

The continuing advances in telecommunications, health information, and telemedicine offer a significant opportunity to improve the effectiveness and efficiency of health services. It is an area which cannot be ignored when planning and providing health care. The aim is to choose those technologies which are both cost-effective and address high priority health needs. The most up to date high technology can be very alluring but often the use of more common and cheaper but well-tested technologies is more appropriate.

Every country has different individual health priorities, technical infrastructure, geography, culture and funding constraints, and so appropriate technology choices will be different from country to country. Directing resources to building a reliable telephone service and introducing hospitals to personal computers may be appropriate priorities for one country's situation, whereas developing tele-consultation services to allow patients in geographically remote areas access to specialist advice from a tertiary referral centre may be appropriate in another. As economies grow and the cost of technology falls it is to be expected that step-by-step adoption of higher levels of technology would be appropriate.

The following health applications are not necessarily exclusive and projects may well use a mixture of technologies to achieve a variety of ends.

(b) *Tele-consultation*

Tele-consultations can be carried out either by telephone or by using video-conferencing. Phone consultations between a patient and a health professional are a common informal part of health care for getting minor medical advice. Video-conferencing adds greater rapport to the medical-history gathering process and also allows the signs and symptoms of the patient to be demonstrated and viewed at the remote end. This can be augmented by pictures of X-rays which can be sent either by using the video-conferencing equipment and a suitably placed backlit X-ray viewing

box or utilizing a parallel system which uses a digital scanner to digitize the X-ray and then send the digitized image via the phone lines. Tele-consultation in this fashion has been used successfully in specialties as diverse as psychiatry, orthopaedics, dermatology, renal medicine, medical oncology and emergency medicine. It can be used also for interpreter services.

The aim of tele-consultation programmes is generally to improve access to scarce health expertise for outlying patients and obviate the need for patients to travel long distances for a consultation. It can be used to support patient management at facilities lower down the referral hierarchy.

From a cost-benefit point of view, because the equipment for video-conferencing is costly there need to be substantial travel savings or better use of extremely scarce expertise to justify these programmes.

(c) *Diagnostic reporting*

Radiology images can be electronically transmitted from a remote location to a central location for reporting or review and second opinion. This is common in many places around the world and would be regarded as well proven technology. The minimum equipment for this is a digital scanner of sufficient quality, a telephone connection and computers and software to transmit and regenerate the image. This is often done in a store-and-forward mode so that the image can be viewed and reported at the convenience of the reporter.

The alternative technology of using the video-conferencing system to send a video picture of the X-ray is satisfactory for many purposes; however, there is always some loss of picture quality due to the compression and decompression of the video picture. This is most likely to be relevant when looking for subtle soft-tissue features on the X-ray. A higher quality of picture can be achieved using a digital scanner and "lossless" compression algorithms. "Lossless" compression algorithms have a much lower compression ratio than video-conferencing algorithms and so the time taken to send an X-ray is quite lengthy if the bandwidth of the connection is low.

Pathology images can also be reported in a similar fashion. A digital camera can be set up on top of a microscope and images sent for reporting and review. In pathology there is generally a very high quality colour image required and this is technically more difficult to achieve. As a result, this does not seem to be as common an application of telemedicine as radiology.

(d) *Accessing health information*

Access to information can be extremely empowering for health workers. Using computers to access information has the advantages of being extremely cheap compared to hard copy; such information is also capable of being continuously updated. An example of this is using a computer to remotely search the Medline database of journal article abstracts available on the World Wide Web. This is available to anyone who has an Internet connection. The hard copy version is not only always out of date but the cost is such that only libraries in universities and large institutions can consider buying them. The disadvantages of electronic health information are the cost of the computer equipment and the training and time required for people to become comfortable using the computer.

Large electronic databases can also reside on a central computer of a hospital's computer network or copied for distribution on CD ROM. CD ROMs are very cheap compared to hard copy; however, they can only be continuously updated by sending out updated replacement discs.

The variety of electronic health information which might be of relevance to district health facilities would include drug information databases, poisons databases, electronic versions of medical textbooks, online medical journals, and patient education materials. Many health information resources are available in a variety of languages with English and other European languages being most common. Most countries have a range of their own health information resources published in their own languages, tailored to their own specific needs. These may be put in an electronic format that is relatively inexpensive. When doing this it is important to spend enough money to make it user friendly and to hold people's interest.

(e) *On-going education of staff*

The maintenance and improvement of health professionals' knowledge and skills is a key determinant of the quality of a health service. Nearly all of the technologies discussed here can be used for educational purposes. Audio-conferencing and video-conferencing can be used to conduct lectures, tutorials and discussions between a number of geographic sites. The savings in staff travel costs and travel time have to offset the cost of the technology. Distance education courses can also be conducted using e-mail or the World Wide Web to distribute educational material and supervise the students. Electronic communications such as e-mail arrive virtually instantaneously and so the course can be far more interactive than distance education methods using ordinary mail.

Non-interactive technologies such as satellite TV, radio, audiotapes and videotapes can be used to deliver educational materials effectively.

A well organized educational programme would generally use a variety of interactive and non-interactive methods, some using telecommunications technology, and some not using it. The most suitable methods of teaching need to be determined on a case-by-case basis. District health facilities should be able to provide those technologies most commonly used in their country and region. Efficiency requires that the development of educational materials be spread over as broad a base of recipients as possible and for this reason educational programmes should use a consistent group of technologies throughout each country (or region).

(f) *Advice and information on selfcare*

The majority of health problems are initially managed without advice from a health professional. Minor problems such as coughs, colds and cuts do not require outside advice. Information on self-care is usually gained through word of mouth from family and acquaintances. Other sources are books, newspapers, magazines, radio, TV and schools. All are important. Online advice is only useful if the target population have ready access and the skills to use computers. Telephone call centres are an option for providing either prerecorded information or telephone access to a nurse or other health professional. It is possible for the person answering the telephone to have access to computerized information which guides them through what questions to ask for a given symptom and provides a checklist of recommended advice.

hospitals which provide telephone advice may wish to look at using computerized information to streamline and improve such services.

(g) *Health promotion and preventative health*

The mass media has a major role in health promotion and in educating the public about preventative health measures. Online health information is only likely to be significant if and when computers become a ubiquitous form of mass media.

(h) *Electronic patient records*

Efforts are under way in some countries to develop comprehensive electronic medical records which allow real-time electronic access to the individual patient's clinical records wherever that patient may be. Health is widely regarded as many years behind other service industries in developing this type of infrastructure. In the financial services industry, for example, people can electronically access their bank accounts using credit cards on a global basis, and credit histories are accessible electronically on a national basis. There is no technical barrier to patients' medical histories being accessible electronically in the same way.

A number of benefits are expected. It will be possible to do away with paper records with consequent cost savings. There will always be a complete set of clinical information available when seeing a patient with a corresponding improvement in patient care. There will be no need to unnecessarily repeat tests, delay treatment whilst seeking information from previous providers, or provide treatment when ignorant of past episodes of care. As health care involves increasing numbers of providers and patients become more geographically mobile, sharing of clinical information becomes more important.

The database of clinical information offers a major opportunity to increase medical knowledge by searching and analysing the electronic data.

There are numerous problems to be overcome, however. The task of migrating all records from paper to computer is enormous. For some years it is necessary to run dual paper and electronic records. There is a large cost in providing computer workstations throughout the hospital. Finally, there is often resistance from professional health staff to input clinical notes electronically as it is initially slower than writing, and many are not comfortable using computers.

District health facilities would generally have very limited use of electronic patient records. The first steps would usually be a computerized index of patients for administrative purposes and tracking the paper records. Pathology and radiology test results are areas which commonly keep results in electronic records.

(i) *Administrative*

There are a number of potential administrative uses of information technology and telecommunication within district health facilities. These include:

- finance and accounting systems
- human resource systems including payroll
- supply systems for stock inventory management, stock ordering
- management information systems which summarize the above information.

4. Management issues

4.1 Planning

(a) *Role of central coordinating body*

It is desirable to have a central coordinating body for telemedicine development at the national or regional level. The central body's role includes establishing national standards to ensure technological compatibility of projects throughout the country, sponsoring pilot projects in high priority areas, planning for expanding successful pilot projects, and ensuring that adequate cost-benefit analysis is performed.

It is important to distinguish pilot projects from established programmes. The objectives of pilot projects relate to proving basic concepts such as technological feasibility, whereas the established programmes must be justified on the basis of cost-effectiveness and health outcomes.

(b) *Review of local and national infrastructure*

The standard of local telecommunications infrastructure is a limiting factor in any planned service. Adequate communication is exceedingly difficult if there is no local telephone service. Ordinary telephone service allows person-to-person voice communication, fax, access to Internet services such as e-mail and the World Wide Web, and the ability to transmit and receive other electronic data.

Higher bandwidth services such as ISDN are required for video-conferencing and faster access to the Internet.

If local telecommunications infrastructure is inadequate it may be possible to aggregate telecommunications needs with those of other government services and the private sector in order to justify or fund improvements.

(c) *Needs analysis/consultation with end-users*

The needs analysis should involve talking to a number of potential end-users about the planned service. This will enable a judgment to be made about realistic objectives for the service, potential impact on the health of the community, and the degree of support and enthusiasm of health workers for the project. It is particularly important to have a core group of enthusiastic users, as without this many projects fail due to minor setbacks and teething problems in the early stages. It is not unheard of for computers or other equipment to be installed and left virtually unused if a group of key enthusiastic users does not exist. The existence or absence of a local champion to enthuse the project participants and ensure that the project is carried to completion is one of the strongest predictors of success or failure.

It is generally advisable for the capabilities of the proposed technology to be demonstrated to the end-users. This may involve temporary installation of the equipment for demonstration purposes or travel to a site where the technology is installed. The latter is generally preferable as it enables discussion with colleagues using the technology and a better appreciation of the benefits, costs, and local implementation issues.

(d) *Staff capabilities*

Staff capabilities to use the proposed technology must be assessed. The development of any service involving information technology and telecommunications cannot proceed at a faster rate than the capabilities of staff to learn to feel comfortable using them. Once staff become comfortable with the technology they will then begin to integrate the technology into their work habits. Some staff are technophobic (scared of new technology) and will avoid using new technology for surprising lengths of time.

The starting point must reflect current staff capabilities; a planned staged approach to introducing new technology is likely to be more successful than a "big bang" approach.

(e) *Technical support*

The close availability of technical support is critical. Telemedicine projects should absolutely not be contemplated unless close-by technical support is available. Where possible, in-house staff should be trained to deal with minor problems. Problems as basic as locating switches, loose connections or using software can often cause major frustration to users in the early stages. Again, introduction of technology cannot proceed faster than the development of this expertise.

(f) *Technology selection*

Technology selection should always start with the identifiable needs and organizational goals it is planned to address. The starting point should never be the availability of the technology. The applications of the technology need to be identified and all categories of staff who will be involved with the project be given the opportunity to test-drive the possible choices. This includes clinical, technical and administrative staff. The views of all these stakeholders need to be acknowledged and taken into account in the final decision.

A number of vendors should be surveyed regarding available technology and its suitability. Verification of the capabilities of equipment should be sought from independent sources such as technology consultants or previous customers.

The technology should be compatible with local telecommunications infrastructure and must be able to inter-operate with equipment at other sites with whom one wishes to communicate. This is best achieved through buying technologies based on open standards rather than proprietary standards. For example international telephony is possible because all countries have agreed to a single international standard.

(g) *Cost-benefit analysis*

A cost-benefit analysis should be done prior to making the final decision to proceed. All costs and benefits should be identified and quantified. A decision can then be made as to whether the expenditure is justified in terms of the priorities of the organization. It is sometimes difficult to quantify benefits such as a better educated workforce, reduced professional isolation or better staff retention. Technology which has multiple formal and informal effects such as better communication due to the telephone or e-mail is also difficult to quantify. Nevertheless, a formal process of identifying all costs and benefits results in more transparent and better decisions.

Each project should plan to collect information which will allow ongoing costs and benefits to be assessed as part of the post-implementation evaluation.

4.2 Implementation

(a) *Project management*

A project manager should be appointed to oversee the implementation of the project.

The project manager should be responsible for all organizational aspects of the project. A project team including all the main people using the new technology should meet regularly to review progress and agree on actions to solve any problems which arise.

A key success factor is the presence of a clinical champion, a health professional who is enthusiastic about the project and is willing to persevere through the initial teething problems and actively promote the project among colleagues.

The project manager also must arrange an ongoing promotional programme to raise staff awareness of the project and keep them informed of new developments and progress. He must also arrange for staff training in the new technology.

(b) *Staff training and support*

All staff will need training in the new technology. This should include formal training sessions, supervision when using the new technology until confident /with the equipment, provision of appropriate manuals and checklists, and ready availability of support when they start using the technology on their own. It is particularly important that initial experiences with equipment are positive. This means that the organization will need at least two to three staff to become fully conversant with the operation of the equipment.

(c) *Evaluation*

Evaluation is designed to assess the degree to which the project has successfully achieved its goals and objectives and the factors which contributed to the success or failure of the project. It should be incorporated into the project from the earliest stages. The project team should determine the most suitable method of evaluation for their specific programme.

Routine monitoring of usage and cost data is the most basic evaluation tool. Low usage or unexpected costs may be the first indication that the project needs to review its approach. Evaluation may also include formal research on clinical effectiveness, acceptance by patients and health professionals, technical evaluations, and cost-benefit analysis.

4.3 Other

(a) *National standards and strategies*

Communication media such as telephone, TV and the Internet enable people all around the globe to communicate with each other. This is only possible because of the development and adoption of international standards. Telemedicine development also requires the adoption of standards to allow ready and free communication between health facilities. In some technological areas standards are well developed and universal, in others such as electronic patient records there are numerous competing technologies. District health facilities need to choose technologies which conform to national and international standards and with national strategies for the introduction of technology.

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PART V

**ADMINISTRATION AND
MANAGEMENT**

ADMINISTRATION AND MANAGEMENT

1. DISTRICT HEALTH SERVICES

1.1 Introduction

The challenge before district health services is to ensure that the district is organized, managed and sustained in ways that accord with the principles set out in the Global Strategy for Health for All: namely; equity , accessibility , emphasis on promotion and prevention, intersectoral action, community development, decentralization, integration of health programmes and coordination of separate health facilities.

The key objective for district health services is to achieve gains in the health status and quality of life of the district population. A primary health care approach that focuses on populations as well as individuals is the vehicle for doing this. The extent of improved health outcomes is strongly influenced by how well the district health services resources are managed and orientated towards a primary health care approach.

The management of district health services must support this objective by managing the resources in the most efficient and effective way. Efficient use of human, physical and financial resources requires good management systems to be in place, for example, for staff to be supported by efficient systems of drug and other material supplies and transport. Effective use of the resources requires attention to areas such as the education, training and support of staff, their appropriate deployment, programme evaluation' and quality assurance.

The World Health Organization, Western Pacific Region, provides directions for the future through its document, *New Horizons in Health*. An objective for the Region's health system is *to provide a physical and social environment that enhances the quality of life*. This requires the planning and management of health care facilities and services to take into account the physical and social needs of people. A people-oriented district health service will address these needs in the development and operation of its services and use community participation in its various forms as a means of doing so.

This chapter aims to be a stimulus to action and further development of management at the district health level. It is not intended as a detailed 'how to do it' manual. Suggestions for further readings are included after some sections for district management team members as sources of practical management advice and information on tools and processes for putting systems in place.

Feedback on the value of the contents of this chapter and the further readings as well as ideas for further development would be highly valuable.

1.2 Current management issues

There are many opportunities for further developing management at the district level. There are a number of areas that can be highlighted as needing to be strengthened. These are:

- the definition of roles, objectives and procedures;
- the level of organization, planning and management expertise;

- the extent of integration of special programmes into a comprehensive district implementation plan;
- the level of working together between communities and hospitals, health centres and local programmes;
- the analysis and use of routinely collected health information;
- systematic collection of information needed for decision making and monitoring;
- use of a systematic approach to problem solving by district teams;
- the extent of involvement of district hospitals and their staff in health promotion and education; and
- the adequacy of many forms of basic support in the district such as transport, repairs and maintenance.
- the growth in capability to manage/maintain medical equipment. This has tagged far behind the rate of increase in use of equipment.

It is in light of this type of environment that this chapter has been developed.

1.3 Implementation of integrated district health services

1.3.1 Integrated health services

WHO encourages countries to develop a sustainable health infrastructure which will provide health care in an integrated way. The integration of health services has been defined as a process to bring together common functions within and between organizations to solve common problems, develop a commitment to a shared vision and goals and using common technologies and resources to achieve health goals, for the community.

Health facilities within a district have often been put in place as needs have arisen as individual discrete units. The facilities have provided services with relationships among one another that are evolving more or less on an informal basis. This process by which some facilities have grown up within a district may not have resulted in the most favourable circumstances that would promote an integrated health service.

The various elements of integrated health services are:

- **integration of service tasks;** for example, integration of certain functions previously confined to specific facilities, e.g. providing primary preventive and outreach services from hospitals;
- **integration of management and support functions;** such as planning, budget and financial processes, transport, communication and information systems, training, supervisory visits, quality assurance and research; and
- **integration of organizational components;** such as making the hospital an integral part of the district health services, putting in place coordinating mechanisms such as health committees or councils, having the accountability for discrete facilities linked structurally so that all resources -human, physical and financial -are part of the one organization employed to achieve stated objectives for the district community .

Implementation of the following approaches will form a solid basis for the integrated district health services,:

- Decentralization
- Integration of the district hospital within district health services
- Patient referral system
- A settings approach to health promotion
- Community participation, and
- A district health service structure

1.3.2 Decentralization

A 1997 review of the district health system found that the concept of a district health system and decentralization of authority to the district level has been adopted and applied in almost all countries. The central health agency of a government is in charge of developing and enforcing health policies and legislation. It is primarily concerned with developing human resources for health and setting directions for health research policy rather than service delivery. District health services are expected to deliver services that are in tune with national policies and guidelines.

Countries vary in the extent to which they decentralize authority for public planning, management and decision making from the national to regional or district level. A minimum requirement is:

- one or more senior staff responsible for managing health activities within the district with clearly defined discretionary powers;
- a health district for a known population and geographical area;
- a known staffing establishment and budget to enable flexible use of resources to suit local circumstances; and
- channels for letting national planners know the health development needs of the district

The advantages of decentralization are that it;

- allows services to be customized to the individual needs of a community;
- promotes more equitable and integrated services;
- promotes greater cost control and reduces duplication of services;
- improves coordination among government, private and non-government services where intersectoral contact locally is less formal;
- encourages greater local community involvement in developing local plans that can be more responsive to changing community needs; and
- provides more motivation for staff

Decentralization of planning may be limited initially by the availability of planning skills at a local level. Decentralization needs to be accompanied by efforts to develop such skills. District development of detailed annual work plans can be a start to gaining such skills, while policies, priorities and strategies continue to be developed initially at the regional or national level.

Where a district health service is given a responsibility, the necessary authority to do the duties involved should be delegated at the same time. This authority to act, use resources and implement cannot be separated from accountability for the proper performance of the relevant tasks.

1.3.3 Integration of the district hospital within district health services

The integration of hospitals into district health services is essential if health services are to be provided to communities in the most equitable, efficient and effective way. Within the district health service, the hospital is the direct link to the national system of health services. It is the service that is always available and it is a resource for all staff within the district at any time. Areas where the district hospital can provide support to the peripheral health units will usually include:

- leadership in district health planning and service coordination and integration;
- collection and sharing of information, including local health status, needs and priorities, and its analysis;
- emergency (including disaster) planning and prevention;
- supervision and monitoring of field staff and their ongoing education and training;
- assistance with transport ,attaining, storing and distributing drugs, supplies, managing equipment, and building maintenance;
- involvement in budgeting and auditing where appropriate;
- involvement with quality assurance and safety monitoring;
- evaluation of health protection programmes;
- cooperation with local health staff to link with other sectors to promote opportunities to improve the community's health. Adopting the concept of a health settings approach to health promotion would be intrinsic to this;
- responsiveness to patient referrals from peripheral health units and sharing information on their care on hospital discharge;
- referral back to peripheral health units where patients' needs can be managed; and
- complementary work to that of the units, for example, by the hospital promoting itself as a resource centre for health development or by providing outreach outpatient sessions, where appropriate.

A formal structural relationship between the district hospital and the peripheral health units is important for smooth cooperation in relation to the above forms of support. At the same time, such a relationship will strengthen primary health care and provide greater commitment to using hospital resources in the cause of promoting health. The hospital and the peripheral health units should not be seen as separate elements of the health programme but rather that of partners intimately bound together providing services to improve the health and quality of life for the district community.

New Horizons also advocates the strategy of adopting a settings approach to health promotion whereby all health workers will be encouraged to promote healthy behaviours in all settings of the community and at the same time act as role models for personal health improvement. Adopting a settings approach to health promotion in the hospital will reinforce the need to integrate the hospital within the district health system.

1.3.4 Patient referral system

The district hospital is a focal point for referral. The movement of patients between different levels of health care is an aspect of the health system that can affect the population very directly. The hospital's role is to treat patients as best as it can, discharge them as soon as possible consistent with appropriate care, and tell the referring practitioner or health worker its findings and the patients, further care requirements.

This can be done in an organized and impersonal way with little professional contact on a regular basis between the hospital and the peripheral health workers. Under these circumstances, self-referral by patients can be more common than referral by peripheral health practitioners and workers. This situation can result in people bypassing their local health centre and going direct to the hospital. The consequences are that the hospital gets swamped with primary care work and expensive resources intended for secondary care are used for this work and the resources at the peripheral health units may be underutilized with negative effects on the self-esteem and morale of the local health workers.

Related problems can be:

- the hospital is overwhelmed by a combination of self-referrals and poorly judged referrals;
- lack of transport, accommodation and financial problems may delay or deter patients arriving at the hospital;
- poor community confidence in the care offered by the local health unit results in self-referral; and
- inadequate flow of patient information to and from the hospital.

Referral systems are easy to design but very hard to put into practice. Factors encouraging the adoption of referral procedures include:

- recognizing that the whole referral system is an integral part of the district health system;
- ensuring that the hospital does not do work that can be done equally well at a health centre, by referring back to health centres, where practical;
- developing the referral system in consultation with potential users (health workers, public and private) and community representatives, testing it, reviewing and refining it periodically;
- referring patients back to the source of referral as soon as possible with full information; .introducing financial incentives such as not charging referred patients;
- ensuring that contacts between hospital and peripheral health workers occur regularly and
- support is provided to such workers in the form of continuing education, guidance and advice on problems and technical backup; and
- avoiding overly rigid procedures.

A referral system needs to have well designed forms readily available that specify what information needs to be provided. Training needs to be given to health workers in the community in the use of the forms as well as use of referral protocols that relate to different types of presenting problems.

1.3.5 Settings approach to health promotion

To develop a settings approach to health promotion at the district health level, the following two major commitments are required of a health promoting district hospital and peripheral health units:

1. a healthy workplace and a health promoting physical environment for patients and their families; and
2. the district hospital is a centre for information on health development and, as a partner with other primary health care services, promotes health education of the community.

The benefits arising from a settings approach to health promotion in the district hospital and peripheral health units may include; a healthier workforce, increased morale, reduced absenteeism and, in turn, increased productivity, commitment and loyalty as well as community benefits such as improved health and confidence in the health sector.

The development of a district health facility as a healthy work place and a health promoting physical environment for patients and their families requires attention to both its structural and functional components. The development of the hospital as a centre for health development and a primary care partner in promoting health education requires adoption of a wider mission as well as facilities, resources and staff orientated to this approach. Chapter I includes the planning requirements for health education in the hospital.

This management chapter includes the development needs of a health promoting health facility in the areas of quality management of a district health service, healthy workplaces and facilities management.

1.3.6 Community participation

Community participation can occur in a number of ways. It may involve community members having a say in decision making about health and health-related matters through, for example:

- community membership of a governing district health council;
- community involvement in the development of district health plans; and
- community participation in partnership with health providers determining what direct action is required to implement specific strategies, e.g to increase breast-feeding levels

Community participation may take the form of community representation in the selection of local staff and volunteers. It may involve also the community making contributions of materials, labour and money to health promoting activities.

A major challenge is to get people in the community to feel that the health system is theirs; that they own it, are proud of it, and support it because it meets their needs and fits in with local traditions. The district health staff need the skills of working with the community to engage them in activities to improve their health and well-being.

There is no universal model for community participation. Factors such as culture, history, educational and economic circumstances influence the extent and quality of participation. Local village committees and clubs may be a means to developing closer relationships between service providers and the community.

Community participation differs in different situations. For example:

- in 'top- down' planning, central planners develop the plans and may involve the community by explaining the plans and modifying some aspects prior to implementation to reflect community discussions. Or
- in bottom-up planning, the planners may involve community representation from the beginning of the planning process. With encouragement, the community may identify a set of priorities and action required by the community to achieve its goals.

Community participation is likely to be highest when activities clearly meet peoples' needs. Health-related activities may not be high on the list of its needs, and hence intersectoral and broad-based activities are more likely to be successful. By involving communities in identifying their needs and developing ways to meet these needs, people's awareness of their health and other problems will be raised and they will become more committed to doing something about their problems.

The right attitude by health workers is fundamental to the success of community involvement. A desirable attitude is one that says to the community that the district health service has certain medical skills and knowledge of how people can keep themselves healthy. Acknowledgement is needed that the community understands best how this knowledge can be applied. A partnership is needed between health workers and the community to attain improvements in community health.

The perspective of the community is also relevant on how services and facilities are run. This is an important feature of a people-oriented health service. Surveying community views on local services can identify opportunities for improvement as well as build community trust if tangible changes occur in response to community concerns or ideas. District health services, by seeking and acting on community views, will build relationships and help create a community willingness to participate at other levels in local health services.

1.3.7 District health services structure

District organizational structures have been put in place often to meet a particular need and added on to as service types expanded. This process of evolution may not result in a structure that is most favourable to promoting an integrated district health service. The structure needs to ensure that all staff in peripheral health units and the district hospital are responsible and accountable to an identified local manager or team leader who is, in turn, accountable to the director of the district health service. A structure that includes the hospital is a key step in making it an integral part of the district health service. Instead of being a distinct institution that operates as a referral centre, it is also more clearly a district resource for support services for peripheral units.

Peripheral health units include health post, health centres and polyclinics and geriatric services such as day-care centres.

The individual managers or team leaders are responsible for the staff and physical resources used by their team and may have the authority to recruit. Ideally this should also include responsibility and accountability for the financial resources. Having a structure that links all

managers or team leaders within the district to the director of the district health service provides clear channels for communication, planning, coordination and implementation of district-wide service policies and practices. Together these positions form the district management team, which has overall responsibility for the annual district work plan.

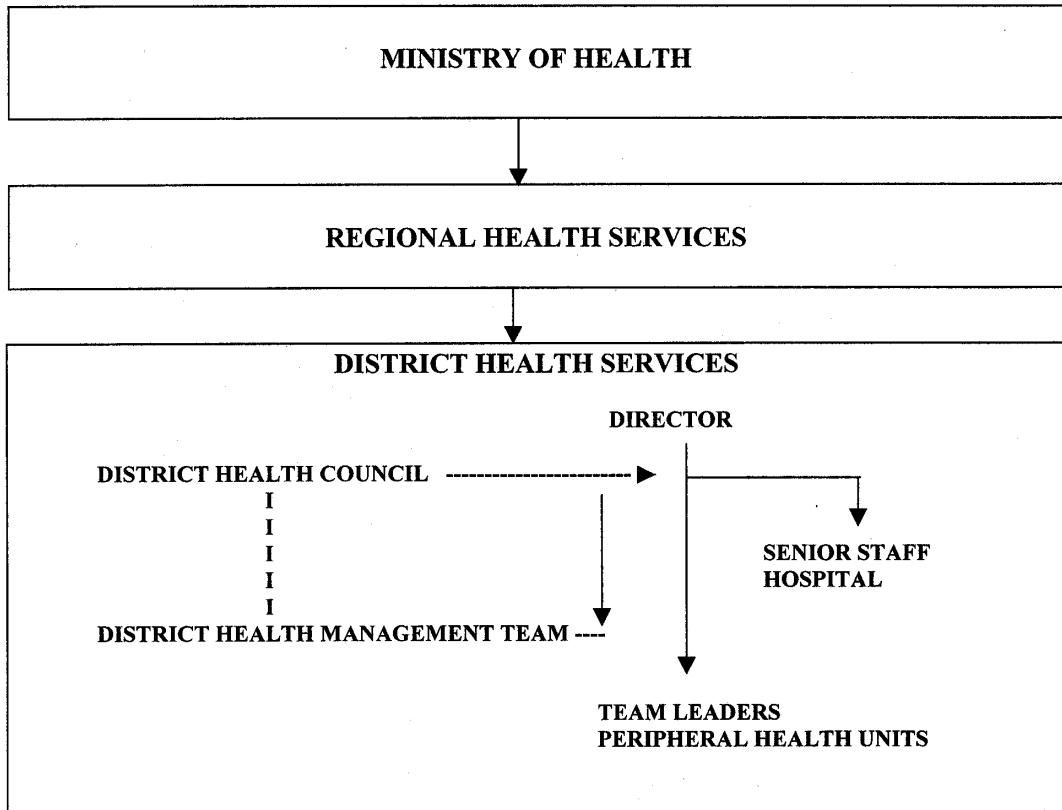


Diagram 1. District health services structure

District Hospital Structure

The district hospital with its diverse groupings of clinical, support and administrative functions needs a structure to allow the director to delegate much of the day-to-day management. This is necessary for practical reasons internally and because of the many district-wide roles of the position.

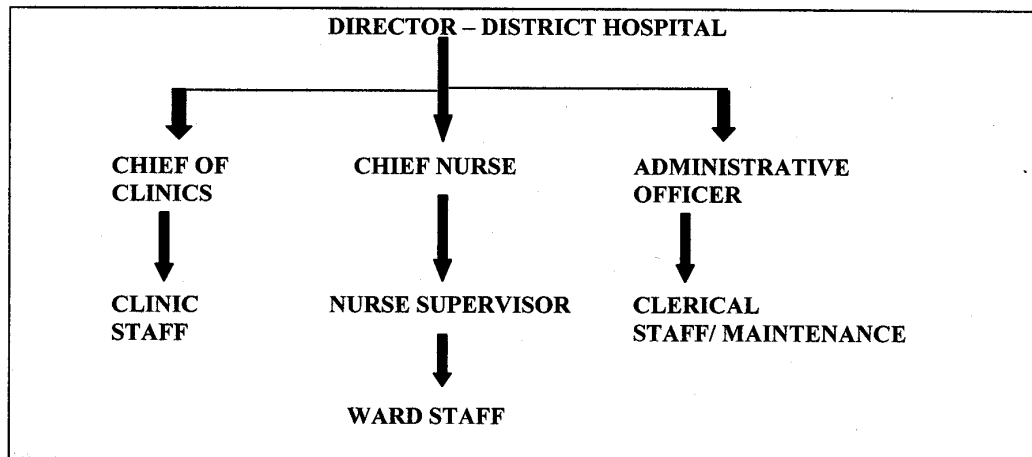


Diagram 2. District hospital structure

1.3.7.1 District health council

The overall development of district health services can be overseen by a district health council, the principal charter of the council being to have the responsibility and accountability for developing and monitoring district health objectives and targets, for individuals with special needs, families and the community. Its functions should include:

- providing leadership in developing health strategies that should contribute to achieving district health objectives and targets and promote intersectoral cooperation;
- approving the district budget and ensuring that they are applied for the purpose they were intended;
- ensuring that expenditure is distributed in such a way as to support all forms of primary health care, namely; prevention, promotion, curative, and rehabilitative
- regularly reviewing district activities and advising on desired changes.

Membership of the council should include a range of key leaders in the community whose participation will help gain broader community commitment and ownership of district plans and strategies. It should include:

- district health officer
- district manager
- senior nurse
- representative of local nongovernment health bodies

- representative of the local authority
- representative of related sectors, education, social services, agriculture
- community representation
- civic or religious leaders as appropriate

In some circumstances, the council may confine itself to the advisory functions of (1) and (4) above. Where such a council is not feasible, these functions can be performed by a district health management team.

1.3.7.2 District health management team

The district health management team should be responsible for the coordination and implementation of district health programmes and activities. Its functions should include:

- preparing the health development plan that defines the population needs and ways of addressing these needs;
- planning and coordinating health activities to gain the best use of all types of resources;
- ensuring that all district health activities are adequately supervised and that staff training needs are met;
- being responsible for the collection of data on health needs, coverage of services, impact of the services on health, data analysis and recording and the use of such information to improve services.

Membership of the district management team should include:

- district manager/director
- district medical officer
- district health officer
- district public health nurse
- director of health information system
- community representatives
- representative from individual health units

1.3.7.3 Director, district health service

A director would be responsible for all the work of a district and usually be known as the hospital director as well. This person's hospital management function would include the management of human resources, finance, materials and facilities. These functions can be delegated to team members, but the director would be ultimately responsible. An administrator or hospital secretary might be delegated most of the non-clinical functions.

The Director's duty statement should include the following:

- leadership of district health service
- responsibility for staff management
- service planning, coordination and evaluation

- linking role to community and other sectors
- staff and team development
- financial planning
- qualification and/or background required

A district medical officer with a public health background should be the preferred leader. If such a person is not available, the leadership can go to a senior nurse, or a public health officer. This will work if there is a strong medical presence on the hospital management team and the district health management team.

1.3.7.4 Team leaders, peripheral health units

Depending on the size of the unit, there should be a local team leader responsible for the management needs of the unit. Within the unit some of the nonclinical management tasks can be delegated. There should be a line of responsibility from this person to the hospital director

2. MANAGEMENT

2.1 Management processes

Management of district health services is a process whereby action is taken related to resources, such as people, finances, equipment and facilities, to achieve identified goals. Its actions are to:

- | | | |
|--------------|---|---|
| Plan | - | What needs to be accomplished in a given time |
| Do | - | Put the plan into effect. |
| Check | - | Collect data to quantify the outcome of actions taken |
| Act | - | Put successful aspects of plan on an ongoing footing within the service's administration. |

The diagram set out below draws together the importance:

- in the planning stage - providing leadership and engaging people (both staff and the community) in the process;
- in the implementing stage - focusing on achieving through people (both staff and the community) and equipping them with skills where necessary to do so;
- in the reviewing stage - having the information available and the tools to analyse the impact of the action and the skills to assess the levels of achievement and identify what needs to change; and
- finally, in acting out of new initiatives-showing the leadership to ensure that the lessons learnt are applied in the field or in the administrative processes.

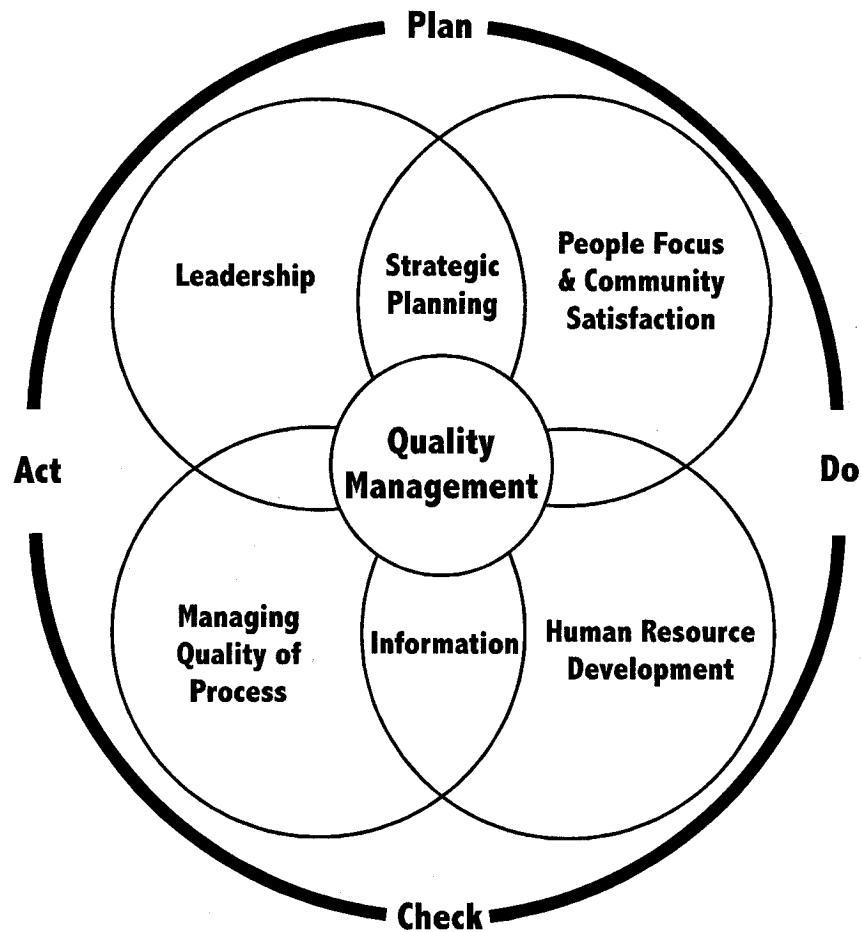


Diagram 3. Quality management

2.2 Planning

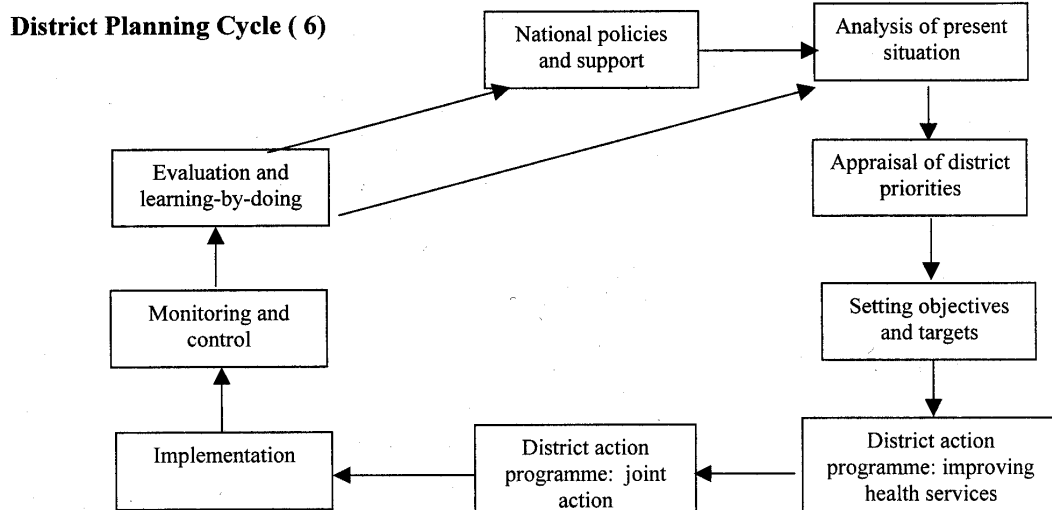
Management planning takes different forms:

Resource planning

- Annual budget planning that describes staffing and operational costs to deliver defined services for individual facilities or the district service as a whole;
- Long-range resource planning for the district health services that sets out expected investment needed for new or modified facilities, equipment and staff. The planning time-frame may be phased over a 3-to-5 year period. Such a document should also identify any flow on operating costs from such investment.

Service planning

- The district needs an overall development plan to carry out its activities. The plan should include:
 1. An analysis of the district's geographical and demographic features, population trends, morbidity and mortality, local disease and risk distribution by age and location.;
 2. An assessment of all current services and identification of those not provided having regard to prevention, promotion, curative and rehabilitative services and organizational aspects;
 3. Review of the current distribution of resources with reference to population, service usage etc;
 4. Formulation of service objectives, priorities and strategies to achieve these. Priorities among health problems should be selected on the basis of their prevalence, seriousness, preventability and treatability; and
 5. Timetable for completion of strategies and an evaluation of the results in relation to the targets set.
- Part 4 above is virtually a Strategic Plan (*What Can Be*) as it covers mission, objectives, strategies and targets. When it is reviewed annually, a process of considering strengths, weaknesses, opportunities and threats (SWOT analysis) should identify ways of addressing weaknesses and threats to ensure the strategic plan's ongoing relevance.
- Part 5 above is the annual Work Plan (*What Will Be*).



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Diagram 4. District planning cycle

2.3 Leadership

The Director of a district health service is the leader of a group of senior people whose responsibilities include a significant management role. This group includes the team leaders, primary health care units, district health officer, senior hospital staff such as chief of clinics, chief nurse and administrative officer. Each of these people needs to show a leadership role within their sphere of authority.

The leadership role involves:

1. Setting the direction:

Challenging the status quo
Viewing things broadly
Making choices
Being flexible
Creating a vision and strategies

2. Aligning people

Communicating with staff, community, other agencies
Keeping messages simple
Allowing constructive questioning
Maximizing credibility
Recognizing the size of the task

3. Motivating and inspiring

Appealing to the values of staff and the community
Providing autonomy
Encouraging
Recognizing and rewarding

2.4 Management role

Many health workers have not been trained to be managers and often have management responsibilities thrust upon them. Often senior health workers will have dual roles of clinical and management. Wearing a management hat does require an understanding of what it means to be a manager. The key characteristics of a manager are being able to:

- have a big picture focus by understanding the role of the work unit in the broader system;
- understand the objectives of the district, be able to communicate them to staff and the community;
- organize people and allocate tasks to achieve service objectives within the context of a work plan;
- balance the need to manage the present with the need to plan for the future;
- make decisions using the qualities of fairness, good judgement and a reasoned approach; .delegate, motivate and develop staff;

- develop and maintain systems using problem-solving techniques;
- evaluate systems and services; and
- be an agent and advocate for change.

Managers need to understand that the perspectives of the patients, the community and the staff are not the same but different. This means they must take into account in any plans matters such as the local social structure, village decision-making processes, obligations within the extended family, and accepted moral and legal codes applying locally.

Managing well involves working through other people to get things done. Managers who invest time in developing good working relationships with staff will promote a better working environment as well as be more effective in their work. Some of the ways of doing this involve:

- ongoing, open communication whereby, for example; staff receive clear directions regarding tasks and what is expected of them, staff are kept informed, have meetings for addressing day-to-day issues and finding solutions and have the opportunity to contribute to planning processes;
- offering support and supervision to staff and encouragement to be self-directed in accordance with skills and experience, mentoring staff in developing their career aspirations;
- focusing on getting the work done and where things go wrong use problem-solving techniques that focus on processes rather than blaming individuals;
- motivating staff by appealing to their values, providing autonomy and flexibility appropriate to skills, encouraging through prompt and balanced feedback and giving recognition and incentives;
- encouraging opinion leaders amongst staff to become advocates for change
- involving leaders in quality improvement projects, etc;
- sponsoring a team approach to improve outcomes, provide greater support and more learning opportunities; and
- supporting staff to be healthy by paying attention to safety, stress management and potential workplace hazards;

2.5 Team work

Team work is an effective way of getting work done. The collective effort of a team will produce better results than individuals working separately in isolation. Teamwork benefits from the collective knowledge and skills of the individuals in the group, and it provides opportunities for learning and engaging staff commitment through the trust and enthusiasm generated by team work. Team building requires a process whereby some ground rules are established by the members on how best to work together. These may include being punctual, letting everyone have a say, sharing information, allowing constructive criticism and being supportive of one another. Staff motivation is an important factor in achieving ongoing successful teamwork.

Teams need to have a shared understanding of what objectives they need to achieve, what needs to be done, who is to do what and by when. Teams have important roles in managing the present and planning for the future. They carry out the functions of planning, coordinating and implementing the strategies and activities associated with managing the service delivery and the support services.

There are different types of teams: ongoing teams such as management teams, programme teams (maternal and child) and centre or service-based teams; and short-term, issue-based or project teams involved in problem solving, evaluation or quality assurance. The key ongoing teams are:

- district health management team;
- hospital management team; and
- peripheral health unit team.

Some staff will be members of more than one team.

Key team leader skills are:

Vision - the capacity to create a picture of how things ought to be so that staff are inspired to perform.

Communication - the ability to portray the vision in away that staff will commit to it.

Persistence - the ability to stay on course regardless of obstacles.

Empowerment - the ability to create a structure for working together that harnesses the energies of each other to achieve desired ends

Organizational ability - the capacity to monitor the activities of the group, learn from mistakes and use the resulting knowledge to improve the performance of the team. - the capacity to motivate and inspire people through shared values, encouraging, recognizing and rewarding staff.

2.6 Achieving through people

A team approach is required to maintain and develop a range of strategies, tools and systems that will improve the management of the district health service. Answers to the questions posed below can only come about by achieving through people.

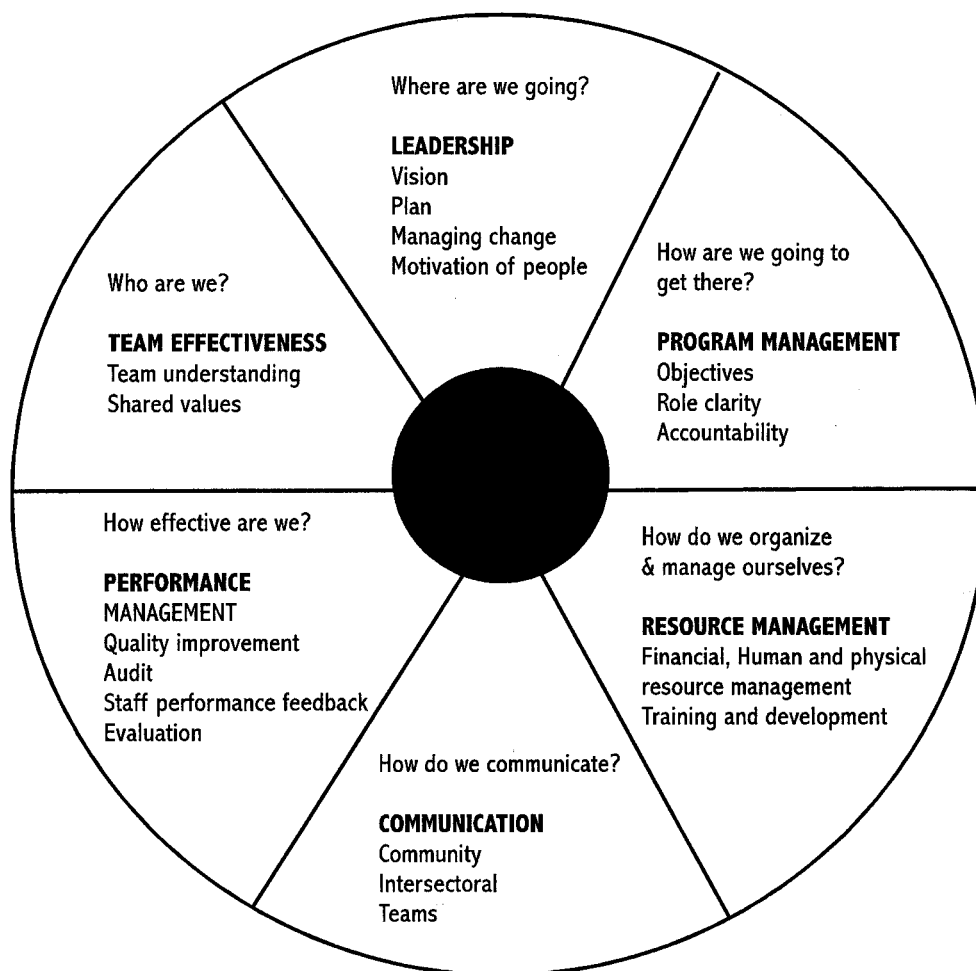


Diagram 5. Achieving through people

2.7 Evaluation

Evaluation is not possible without goals that are related to the questions of what, how much, who, where and when as it assesses changes in terms of effects. Evaluation is more effective if it is part of an ongoing cycle with a feedback loop to those making decisions.

The purpose of evaluation is to improve health care and the health infrastructure and to guide the allocation of resources in current and future services. The evaluation process needs:

- indicators that are variables which help measure changes;
- criteria that are standards by which actions are measured;
- where no suitable indicators or criteria are available, pertinent questions should be asked about the activity being evaluated; and
- evaluation needs the support of valid, relevant and sensitive information.

The evaluation process consists of the following components:

- specific subject
- (ensure) information support
- (verify) relevance
- (assess) adequacy
- (review) process
- (assess) efficiency - compare the results with norms and targets
- (assess) effectiveness - compare the results with targets or objectives
- (assess) impact - judge the extent to which the targets and objectives have been met.
- (draw) conclusions and develop proposals for future action.

Standards for the evaluation of the District Health System

1. Action Plan. There should be a district action plan that included:
 - an assessment of the current situation
 - a process whereby the plan's development involved wide consultation
 - priorities and targets were set
 - costs were estimated
 - coverage included the following:
 - curative services including quality control
 - maternal and child health services including immunization and family planning
 - health promotion services, prevention and control of communicable and noncommunicable diseases
 - environmental and occupational health services
 - outreach and/or mobile services
2. Joint Action. There should be:
 - an intersectoral district advisory committee that meets regularly and keeps records
 - intersectoral village development committees that discuss health
 - cooperation with nongovernmental agencies and political and religious organizations

- cooperation with traditional birth attendants and other traditional practitioners
- cooperation with communities in the selection of health workers including volunteers

3. Improved management. There should be:

- a readily accessible organizational chart
- a list of essential equipment and drugs for all units
- an effort to get the average national staffing levels for the district .job descriptions for all staff types
- regular recorded meetings of the district management team with record available
- various opportunities for maintenance and updating of staff skills
- a staff incentive programme
- aggregated records of staff expenditure
- ongoing availability of drugs and other essential supplies
- availability of essential means of transport.

4. Monitoring. There should be:

- district monthly reports
- reports by all health units
- visual presentation of information

5. Evaluation. There should be:

- an evaluation group to assess progress and programme quality
- established methods of assessment and standards
- follow up of group's findings
- use of quality process reviews to find solutions to problems

6. Impact. This should be reflected by:

- improved organization and management of the district health system
- increased coverage with essential care

7. Findings could be recorded by reference to such aspects as:

- % of female population who are literate

- % of female population who are literate
- % of villages with clean water within 15 minutes' walk
- % of houses with latrines
- % of children fully immunized
- % decrease in maternal mortality rate
- % decrease in infant mortality rate

Evaluation should not just be from the perspective of health workers alone. The perspective of patients and their experiences and that of the broader community is also relevant. Ways need to be designed to gain users' feedback data and input into their views of how services and facilities are run. This is an important aspect of a people-oriented health service.

Ways of getting feedback include asking for suggestions or feedback from village committees, patients, community organizations and other health providers. A formal complaint system may be appropriate as well.

2.8 Quality assurance

Quality of care is very important for improving the health of the community. The quality of services provided needs to be monitored and evaluated. The art of promoting quality is a changing one and quality assurance is one process for improving quality. It is important that the district health management team understands that quality assurance is a tool for improving the quality and efficiency of health care and includes quality assurance activities in its annual plan.

Quality assurance processes are not confined to being used to assess the performance of clinical services, they are applicable to support services too. The notion of good performance includes the effectiveness and the efficiency of health care as well as the acceptability of care to patients and the wider community.

The main purpose of quality assurance is to foster a consciousness and valuing of quality amongst those providing district health services. A positive attitude to improving quality will alert people to problems of performance and acceptance of responsibility for identifying the problem as a quality assurance project.

The standards against which performance is assessed need to take account of limitations on the availability of resources. They need to be related to local problems, resources and feedback. The identification of standards or norms does require work. Some standards may be available nationally. Examples of clinical indicators of care are:

- incidence of postoperative infection in clean wounds
 - incidence of infections contracted within the hospital
 - numbers of children seen with preventable infectious disease
 - rate of late transfer of complicated maternity cases
- efficiency indicators are:

- number of late payments of staff wages in a 6-month period
- time taken between transmission of order for common supply items and delivery
- correct use, periodic inspection and calibration of medical equipment
- time taken for repair common items of equipment

Sustainable quality assurance requires:

- long-term plan for district health service that specifies the strategies necessary to support quality assurance;
- written standards based upon a balance of client needs, community values, health professional judgment and resource availability;
- communication and ownership of such standards by staff;
- regular monitoring to ensure appropriateness of standards and that they are being achieved; and
- systems for performance improvement and changes to plans.

Patient and community satisfaction of local services should be surveyed to identify opportunities for improvement through quality assurance processes.

2.9 Infection control

The district management team needs to endorse local infection control policies and procedures. National or regional documents can be adapted for local use. All staff need to be trained so that they are able to:

- understand the importance of preventing infection in hospital and peripheral health units;
- understand basic concepts about safe water supply and drainage;
- practise safe handwashing and skin antisepsis;
- process instruments and equipment in a safe manner between each use; and
- safely dispose of health care wastes.

Preventive and control procedures should include practices related to sterilization and disinfection, cross-infection and isolation, laundry, food handling, surgical and nursing procedures, ventilation, etc.

There need to be policies and procedures for infectious patients and those requiring isolation including:

- Accommodation
- Work areas and equipment to assist in disease control

- Facilities for hand washing and for implementing good isolation techniques

A staff member at each district facility is designated to coordinate an infection control programme. The member should report on an agreed basis to the district health management team or infection control committee. The type of reporting would include:

- Results of regular inspections done throughout the facility for the purpose of reviewing policies and procedures related to infection control. Documentation helps assess infection potential, infection control and identification of ongoing training needs.
- Difficulties which limit the use of procedures or recommended practice
- Surveillance of hospital-originating infection rates on a regular basis.

The designated staff members need to have access to adequate orientation and training in this role.

The process of surveillance in hospitals is of particular importance and it should include the following:

- definitions of source of infection, e.g. hospital, community , maternal;
- systematic case-finding and consistent data collection;
- data tabulation, analysis and interpretation; reporting to infection control committee; and .monitoring of impact of control measures.

The aims of surveillance should be:

- identify hospital-induced infections;
- identify outbreaks and epidemics;
- assess the appropriateness and effectiveness of isolation and other measures;
- identify problems associated with-procedures, practices and equipment;
- report communicable diseases to infection control agency;
- check the sensitivity of the organism to antibiotics in use and educate the staff about its resistance; and
- track resistant organisms and tell the appropriate staff.

2.10 Audit

Internal audit is a review of the service's operations including administrative activities for the purpose of advising management as to the quality and efficiency of management practices and controls. It is usually concerned with such areas as:

- integrity of information;

- compliance with formal instructions, policies and directives;
- security of assets;
- economy and efficiency of resource use;
- effectiveness of operations; and
- diagnosis of problems

Audit within a district health service would need the commitment of the district health council and/or team to:

- participate in the task of planning audits on an annual and longer term basis.;
- setting out a process of performance evaluation on the auditing function; and
- ensuring periodic review that the outcomes of audits are implemented.

Audit reporting need not be a complex matter. A summary of a basic approach is outlined below:

- identify the readers and what they need to know;
- develop a uniform format;
 - scope and goal of audit
 - key issues and performance criteria addressed
 - data collection methods and analytical tools and findings
 - proposed solutions .
- concentrate on the important issues;
- identify solutions, not simply state problems;
- circulate draft for comment to key persons;
- finalize report acknowledging managers' action, if any, to rectify problems;
- include a plan for implementing recommendations;
- circulate good practices identified and lessons learned to staff; and
- provide a report to district management committee including a follow-up report of action taken.

2.11 Management information systems

Management information systems are needed within a district health service to aid decision-making and meet regional and/or national accountability and planning needs. The chapter on Telemedicine, communication and health information discusses the role of computers in assisting in the maintenance and analysis of district databases. Other parts of this chapter indicate the types of databases needed by different areas of district health services for managing their day-to-day operations and planning and evaluation of programmes and services. There are many difficulties with management information systems at the district level that need to be addressed, including:

- while a number of health workers are required to collect and deliver large amounts of information, in many situations they receive little feedback on the data that are useful for making decisions;
- health workers are overwhelmed by having to prepare monthly overlapping reports to meet the needs of vertical programmes. Often separate information systems have been created focusing on single disease categories, specialized services or management sub- systems rather than addressing management functions adequately;
- where vertical programmes send feedback it may not be to district managers and the data may become obsolete because of the protracted time taken to report back;
- managers and service providers often rely on intuition in decision-making rather than using the pertinent information;
- it is common for health services to develop somewhat unwieldy databases of inputs. Many items of statistics are collected for political or financial accountability and few are collected related to quality or client outcomes. This is a pattern not confined to developing countries; and
- often there is not the skilled people or the priority given to data analysis.

The role of a district health service management information system is to support the district management team and district health council by:

- providing managers with information on programmes, individual health facilities and the district as a whole;
- enabling monitoring, analysis, decision-making, planning and evaluation of services. Data are useful in describing the interrelationships of variables. They also support planning processes with a synthesis of past trends and current conditions that provide a basis on which to predict happenings;
- providing a basis for quality assurance activities and efficiency assessment; and
- providing minimum data requirements for national or regional agencies.

Minimum data requirements are usually set by national and maybe regional agencies for districts. The district should have a coordinated process for the collection, collation, analysis and reporting of required information. As previously suggested, the district hospital should provide support to the peripheral units by taking on the role of collecting and sharing information and performing its analysis.

Information to be collected may relate to:

- the output of health facilities or programmes e.g. data of types of treatments, types of services and/or activities;
- input of resources, e.g. financial, personnel, consumables, etc.; and
- the efficiency of the operation of the facility, e.g. bed occupancy rates, wastage of drugs, vehicle and equipment breakdown.

In developing or strengthening district management information systems the following steps should be taken:

- 1) Identifying information needs and indicators, e.g.
 - select essential health indicators for overall health monitoring
 - identify information needs for particular patient groups, e.g. follow up of pregnant women in the primary health care unit
 - identify indicators to ensure efficient management of areas such as drugs, transport
 - identify indicators to monitor quality of resource management matters such as supervision by team leaders and quality of care
- 2) Defining data sources and improving data-generating instruments, e.g.
 - develop monthly reporting form for activities at peripheral health units
 - define data sources for situational analysis at district level
- 3) Developing data transmission and processing procedures. The coordination process could include:
 - standard forms, registers and medical records for the collection of given types of information for services and facilities;
 - clearly identified responsibilities of staff both at peripheral health units and at the district level to be responsible for collecting and processing information at agreed regular times;
 - appropriately skilled staff to manage the management information systems;
 - data definitions available to staff with data responsibilities;
 - steps to ensure that monthly report forms are entered in the district computer or data bank in a timely and accurate manner;
 - steps to review records periodically to verify the accuracy of the information; and

- acknowledgement of reports to encourage those responsible to send regular reports in time.

4) Ensuring that information is used by developing user-friendly feedback formats for district managers and team leaders.

Obviously, the amount of data that could be collected on a regular basis is almost limitless. Much information in a district will be stored in raw form in its files. If retrieval and compilation need to be done manually, as is often the case, district managers need to be aware of the pertinence of the information and alternatives to routine collecting. Not all data requirements need be collected continuously. It may be possible for management teams to decide to undertake sample surveys to extract and then extrapolate certain types of data to provide information to meet some national and/or local management needs. Managers and staff need the skills to be able to undertake such an approach. Sampling permits data to be gathered at less cost, by less manpower and in less time. The actual costs should be considered when determining the amount and depth of data required in organizing a management information system.

Management information systems should enable information to be generated in a timely manner for aiding decision-making processes. A well designed management health information system is also a major tool for improving the quality of care delivered. Examples of this are:

Continuity of care: patient records that document the data, findings and treatment given, help the health worker to make better decisions for a patient visiting a rural health centre;

Integration of care: a health worker needs access to immunization history as well as primary care so that when a child, for example, presents with a rash and diarrhoea, the worker knows whether the child has been vaccinated; and

Community information: district health officers need to compare the availability of safe water supplies with the occurrence of diarrhoea.

3. RESOURCE MANAGEMENT

The information set out below is intended to assist those in management or team leader positions within the district health service. Such staff may be based in a hospital or peripheral health unit setting. Each component addresses the question of what needs to be done or put in place. The suggested further reading is offered as a source of information on specific procedures, or formats for collecting and presenting data or techniques to use in developing good practice.

3.1 Human resources

Staff are the cornerstone of district health services. Without staff there is no service. Staff are the most important asset of the district as they appreciate in value to the district over time if the circumstances are right. The support and development of health workers is critical to the improvement of district health services. (See Section 2.0 for details of important roles of managers in supporting and working effectively with staff.) Even if physical facilities, administrative systems and communication networks are of a high standard, without a well selected, trained and well managed staff, the value of such infrastructure systems is much reduced. If staff supervision and training is good, they will progressively overcome the obstacles of poor infrastructures.

Human resource management at the district level takes place within the context of national human resource policies that will define such matters as appropriate staffing mix and ratios.

3.1.1 Pay and conditions

Staff need to be given, on starting their new job, information that describes the functions of their job, an outline of who they will report to directly as their supervisor, terms and condition of employment, ongoing education and training opportunities. Staff responsibilities spelt out should include, as appropriate, working within a team and liaising with community groups and agencies.

Confidential staff records should be maintained. These should include leave entitlements, date and source of references given and received, results of staff appraisal and, where appropriate, qualifications, evidence of registration, and records of clinical placement

There are many disincentives to working in the more remote areas where the needs are often high. The types of difficulties include the late payment of salaries, inadequate housing, poor working conditions and few career prospects. Types of incentives that may be used to encourage staff to go to remote areas include access to housing, ongoing education and training, supportive supervision, hardship allowances, long service awards and better and regular payment of salaries.

3.1.2 Recruitment

There should be written procedures for the recruitment of staff, advertising, shortlisting, composition of selection panel, interviewing approach and appointment.

Staff selection criteria for health workers and managers should include:

- understanding of team work
- primary health care principles
- community participation

3.1.3 Induction

There needs to be a structured orientation programme for new staff that aims to prepare them for their role and responsibilities. The programme should include written information such as:

- service goals, activities and policies;
- management structures, team processes and staff list;
- workplace health and safety issues; and
- location of first aid and fire equipment.

In addition, new staff need information on:

- role, function and responsibilities
- communication linkages
- visits to relevant agencies
- meetings with key staff
- familiarization with local area, its needs and programmes

3.1.4 Training and education

The changing roles for health workers at the district level mean staff need to be able to work with a wide range of groups and disciplines, not necessarily in the health sector, to ensure that sustainable improvements in health and a better quality of life occur locally. Health workers must become skilled in applying people-centred health interventions that focus on positive health rather than disease as the object of human development. They will also need to enhance their ability to transfer knowledge and skills to other workers as well as to patients and other recipients of services. Traditional training of health workers has not promoted these abilities.

Assessing staff competencies is a pre-requisite to determining staff development needs.

Many current health workers have been trained without health promotion and health protection capabilities. They now carry out many functions in addition to their traditional role such as supervising volunteers, building and coordinating teams of care and simply being apart of many loosely aligned partners. Training needs to support workers in developing and strengthening these roles.

The district service needs the following arrangements to be in place to support staff development:

- methods of identifying educational needs which are derived from service goals and staff appraisal schemes;
- criteria for allocating resources to staff education activities;
- ways of sharing knowledge and skills gained in staff development.; and
- library services that contain adequate material on community and primary health matters

There are many approaches to meeting staff educational and training needs. WHO has been active in encouraging community-focused educational programmes, promoting team-building and problem-oriented methods of teaching and learning.

Nationally, many disease-specific programmes provide training. There may be little integration of teaching materials and aids and this can cause overlap of courses carried out by different ministries. Health workers have to attend separate training for each disease programme which causes confusion and waste of time. Supervision and follow up may not be part of teaching packages. Health workers at the district or peripheral level need access to training that understands the nature of their work and builds on their capacity to provide opportunistic care, e.g. if they are in a home to see a mother and baby, the opportunity can be taken to provide information on environmental health and lifestyle issues.

Development of different forms of distance education and training courses can be used to address health workers' needs for ongoing education as well as their development of new skills. Radio, computer networks and telecommunications are some of the ways distance learning can occur. See Part IV.

3.1.5 Healthy workplace

The district should have at least one designated staff member whose responsibilities include promoting a healthy workplace by having a concern with staff health and safety issues. As appropriate, written procedures should be developed for:

- reporting incidents and accidents;
- safe use of equipment;
- debriefing after stressful incidents;
- smoke-free environments; and
- managing aggressive people.

Policies and procedures to prevent transmission of communicable diseases should also be in place related to:

- use of universal infection control guidelines;
- systems for sharps/other waste disposal;
- procedures for needle stick injuries; and
- staff access to vaccinations.

As previously emphasized under Section 2.0, Management, managers who invest time in developing good working relationships with staff will promote a better working, healthier environment. See 2.3 and 2.4 for ways of doing this.

3.1.6 Volunteers

The use of volunteer health workers at the village level is an important feature of primary health care. The types of task they perform will depend on a range of individual factors as well as the training and supervision available. They will need the good sense to be able to keep within their acquired limits of competence. Community participation in the selection of volunteers is desirable as the community will need to trust them. The use of traditional health practitioners and members of their families should be considered in the first instance. Such persons are usually the ones whom villagers may well turn to for advice.

A system of rewards and incentives are a factor in the success of a voluntary service. These may take various forms and could include access to some form of transport such as bikes, inclusion in certain planning activities and acknowledgement and feedback by the district health management team or council.

Orientation of volunteers should include role, function and responsibilities, patient confidentiality, primary health care principles and practices. Ongoing education should also be an obligation of the service. Where radio is used for distance learning, volunteers should also have access to education through this method.

3.2 Financial Resources

3.2.1 Budget and costings

The three main aspects of budget management at the district level relate to:

- how the funds are allocated and controlled by officials at the more centralized levels of government;
- how funds are allocated within the district; and
- how funds are mobilized and used locally in peripheral health units.

In centralized systems, information on district budgets and cash balances are not often effectively communicated to health managers. Where budgets are allocated from central sources, there may be constraints as to how flexibly funds can be used. This can partly arise from some programme funds being expressly marked for sole use, e.g. family planning.

District health management teams should have overall control of the district's budget with individual managers and team leaders accountable for parts of it. Within the district the director might delegate management of the nursing budget to the chief nurse, the facilities support budget to the administrative officer and the outpatient services budget to the chief health officer.

Where a budgeting system is working well, greater responsibility can be given to those closer to the delivery of services, e.g. health centre team leader.

Budgets can be set out in the form of lines for different categories of costs, such as direct worker and associated costs, treatment and other supplies, operating costs, and repairs and maintenance. Expenditure can also be reported against these lines. However, another useful format is the presentation of the information on a programme basis. This approach allocates funds for specific programmes such as immunization, health promotion, family planning. The budget and actual expenditure can be then reviewed in the light of programme activity levels and measurable objectives set out in the district plan.

The district health management can use this sort of information to make comparisons of the unit costs of certain activities carried out at different centres or comparisons of the costs of different programme activities and their level of achievement of objectives.

Every country will have its own form of hospital cost accounting system where unit costs are estimated and used in the preparation of the budget. The training of the district team in the use of simple cost-accounting procedures is a first step in cost control at the local level.

Where financial information is not available at the district level to assess how much is being spent on what, managers cannot make everyday decisions with regard to costs.

An approach to costing out an activity involves the following:

1. Cost centre is identified, e.g. immunization programme, health centre
2. Allocation of costs to cost centre: e.g. direct costs, (salary of health centre staff, treatment costs, operating costs, etc.) and indirect costs, (e.g. share of district director salary)
3. Number of units of services provided, e.g. number of people seen at centre
4. Cost ratios. Use of cost centre figure and the number of units of service gives the unit cost of the service.

Cost per health centre visit = $\frac{\text{annual cost of the health centre}}{\text{No. of visits to the centre}}$

This unit cost can be used to compare costs of one health centre with another, to estimate a possible fee per visit or compare with the cost of other programmes such as home visits or mobile unit visits.

3.2.2 Revenue

Sources of revenues may include government revenues and contributions, user fees, payments by insurance companies, external institutions and donations. Public sector funds continue to be the main source of income for districts. User fees are becoming more common. They can be successful in improving efficiency in the use of resources, quality of care and promoting participation and accountability of the users. When fees are introduced, a significant decline in service utilization can result in part due to a shift in user preferences and also due to the fee being a financial barrier to low income groups. Fee exemptions for certain groups may reduce the problem of user fees becoming barriers to access to services. Exemptions need clear criteria as they can be difficult to administer.

User fees assist local management to gain control over the budget with opportunities for efficiencies created by this. For example, the use of fees to finance rational prescribing (using diagnostic algorithms and a list of essential generic drugs) will reduce the unit cost to nearly 50% in health centres in one country's districts. A couple of countries have encouraged the use of referral services by exempting referred patients from charges at district hospitals.

The use of community based insurance is being tried in the form of prepayment schemes, cooperatives, and pre-insurance systems. They do not assist communities having very low income.

3.3 Physical Resources

3.3.1 Asset management

Assets include such items as clinical plant and equipment, general plant and equipment, furniture and fittings, fire sprinklers, electrical and plumbing services, computers, telecommunications equipment, radios and videos.

Asset management procedures need to be in place to cover the life cycle of assets. These are as follows:

- procedures to plan for the future acquisition of assets through forward expenditure plans as well as the disposal of assets that are no longer required;

- processes whereby proposed acquisitions are assessed using a life-cycle costing approach together with consideration of all alternatives. Recurrent costs such as replacement parts, maintenance and access to utilities need to be included. All items related to the asset being acquired need to be taken into account, e.g. special space, support equipment, staff;

- a properly costed preventive maintenance programme needs to be designed and implemented for all assets;

- a planned replacement programme needs to be slotted into forward expenditure plans; and

- procedures need to be in place to keep adequate physical security and safeguarding of assets, including a regularly updated assets register.

3.3.2 General supplies

Inventory management procedures need to be set up and responsibility for operating them at the district hospital should be clearly stated. The procedures should cover safe storage, a distribution system to ensure that supplies are in the right place at the right time, an efficient records system and an alerting mechanism for restocking.

Each peripheral health unit should have a good storage area. All peripheral health staff need to know how the supply system operates to ensure regular supply of the essential requirements for providing primary care. Too little held in stock will lead to frequent shortages while too much in stock is costly and provides more chance for deterioration, pilferage and over-ordering.

In determining how much stock to hold, it is suggested that the following are relevant:

- Monthly requirements for each item
- The time taken between placing an order and receiving goods
- The cost of each order

3.3.3 Facilities management

A facilities maintenance programme should ensure timely cleaning, repair and upkeep. Security measures need to be taken to ensure the protection of patients, staff and the facility from assault or loss of property.

Facilities management should also have a focus on providing a healthy environment for staff, patients and the community. This could involve periodically reviewing the way in which potentially toxic chemical, biological and other material is stored and disposed of within the facility. The aim is to be alert to any potential for spillage or leakage.

Facilities management should also focus on creating a supportive social and physical environment for patients and their families. Facilities need to be more user friendly and provide a more restorative and supportive atmosphere. Examples of features that may be important in this regard are having ways of providing sufficient privacy, maintaining clean and uncluttered premises and ensuring that the amenities are easily accessible to people with physical disabilities.

As some cultures traditionally provide care to extended family members who are admitted to inpatient beds, amenities need to be extended in some cases to include cooking facilities and water and sanitary services to public areas adjacent to inpatient services.

A healthy social environment associated with health facilities requires attention to making spaces outside such facilities clean and attractive. This can be done through the planting of trees to provide shaded areas, making healthy food affordable and available, providing a safe play space for children and having admission and discharge procedures in place.

In order for facilities to be environmentally responsible, environmental issues should be considered when, for example, purchasing equipment, cleaning agents, disposable clinical equipment and cups and car fuel. Establishing recycling schemes for paper, glass and aluminum cans would be supportive of the environment.

The days and times of operation of facilities should be determined in accordance with the needs, patterns of life (e.g. market days) or life-styles of the communities and not just suited to the staff only. Such an approach should lead to better utilization of services and greater community preference for district health services.

3.3.4 Equipment management

The management of equipment in the health sector is a major and complex matter. There is a chapter specifically on this subject. (See Section 2.4 of Part I.)

3.3.5 Transport

The selection of transport needs to have regard to expected patterns of use, location, alternatives, ongoing costs, and anticipated replacement. Most of the principles of a life-cycle management approach to medical equipment as outlined in Part I apply also to vehicles. Recommendations on types and numbers of vehicles are provided in Chapter x. Mobile services are also a means of getting supplies and/or services to communities. Further details are provided in Part 1, 1.5.1.

Forms of transport are an essential support to district health services. Transport is needed for:

- | | |
|-------------------------|---|
| Patients | Those referred to hospital or sometimes the health centre for treatment. |
| Staff | Where walking is not an option, public health nurses, health educators and others working in the community and hospital doctors providing outreach clinics <ul style="list-style-type: none"> - staff supervision and support - training in the movement of teachers and staff and <i>vice versa</i> - mobile teams dispensing drugs, health education, etc - regular meetings of peripheral health unit and hospital staff and other visits. |
| Supplies/Support | <ul style="list-style-type: none"> - distribution of drugs and supplies - distribution of data /information among different district health facilities - wages of locally based staff |

Given the importance of transport in supporting district health services, a number of procedures and plans need to be in place. These are for each type of health facility:

- a transportation schedule
- an emergency transportation plan;
- procedures for the use of bicycles and motorcycles that cover scheduling, storing and securing, maintenance and repairs;
- procedures and form for requesting vehicle maintenance and repair;
- procedures and form for reporting vehicular accidents; and
- a list of local transportation resources should also be collated that includes types of available transport for occasional or emergency use such as other government vehicles (police, agriculture), public transport and private transport.

Transport needs to be properly coordinated in the district so that any regular return trip between one health facility and another is used for a range of purposes such as movement of staff for training, supervision or support, distribution of drugs and supplies, payment of wages, and exchange of data and information.

Lack of maintenance or fuel may be a major reason for shortcomings in transport. If transport problems occur, one of the common results is poor supplies of drug and other necessities. The impact of such situations is that staff will become frustrated on account of not being able to perform their job properly and patients lose confidence in the district health services. Para 3.3.5 provides some guidelines for dealing with common transport problems.

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ANNEXES

ANNEX 1

EXPERIENCES IN DISTRICT HOSPITAL PLANNING AND DESIGN

The Western Pacific Region of WHO comprises countries that diverge widely socioeconomically, politically, geographically and climatically. Divergences are found in populations, ranging from a few thousands of people in one country to one billion in another, climate, from very cold to tropical; and economic level, from highly developed to the least developed in the world.

This variety of conditions has resulted in a variety of responses with regard to the provision of health facilities, each country responding uniquely. This section gives the experiences of five countries in the planning and design of district hospitals, highlighting special conditions in the country and some creative innovations that were adopted to respond to those conditions.

1. Country A

County A is a small archipelago of hundreds of islands, with two main, exceptionally rugged islands. As it lies in the warm-humid, tropical belt, it experiences air temperatures as high as 30°C in the hot months of May to October and diurnal temperatures as low as 18°C in the cool months of November to April. During those cool months, storms of hurricane strength occur.

The population of about 700 000, living on 18 000 km² of scattered islands, is served by nursing stations and health centres, which are focal points of primary health care, comprising preventive and limited curative services.

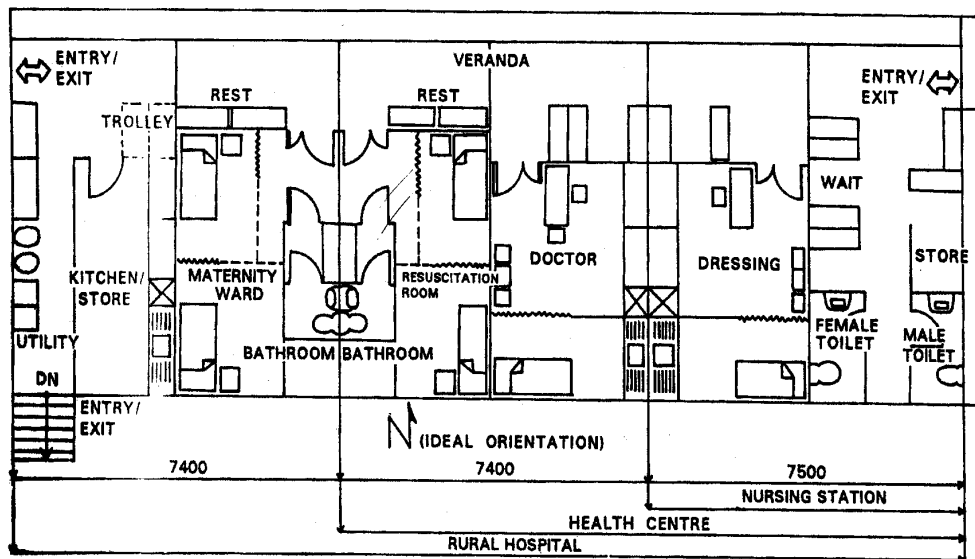
Construction on small islands using heavy, standard construction materials by skilled building teams brought from the main islands was problematical. The workers required living allowances and regular trips home.

The response to this situation was to employ prefabricated units, so that only a skeletal skilled team is required which is supported by community labour. A "kit" was developed, with a detailed explanation of the erection of interchangeable component parts, which are transported and assembled on site. The assembled basic module can serve initially as a nursing station, but it can later grow into a larger health facility. The modules can also be adapted to nurses' quarters, schools, workshops or even large dwellings. These modules are therefore known as an "open system", with many possible uses, as opposed to a "closed system", in which the modules are designed for one use.

The structural frame and other large parts are made of timber, designed to resist hurricanes. The floor of the building is raised for protection against floods. The materials are light and easy to transport.

The floor plans given in Figures 90 and 91 show the standard designs and the increments by which the facility can grow from a basic nursing station to a health centre and ultimately to a hospital.

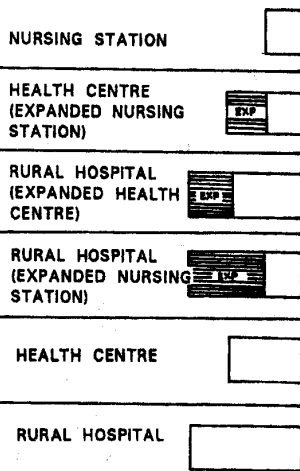
Country A therefore solved the problems of construction in the field and evolved a scheme that can be easily phased and is suitable for conditions of limited finance.



FLOOR PLAN

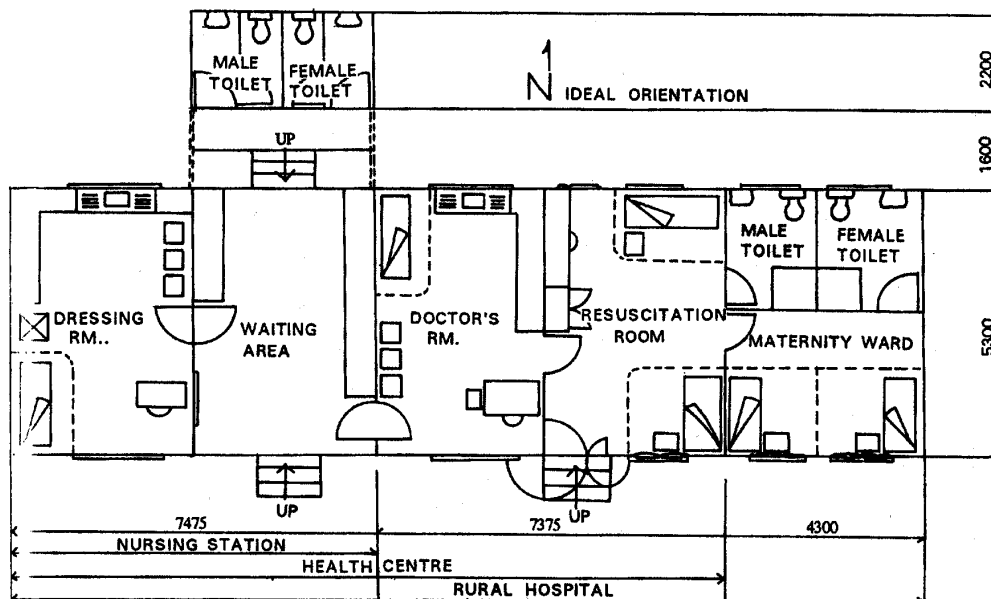
SCALE 1:130 M

PROJECTS KEY PLANS



INCREMENTS OF GROWTH

Fig. 90. Floor plan (1), Country A



FLOOR PLAN
SCALE 1:125 M

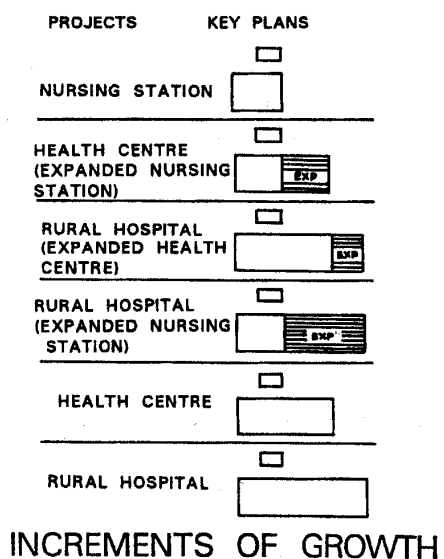


Fig. 91. Floor Plan (2), Country A

2. Country B

Country B is a small Pacific nation, with a population of only 160 000 distributed over two main islands and seven others, with a total area of about 2800 km². It is a relatively young nation and has a subsistence economy, based mainly on agriculture. Its national health programme, however, is aligned with the global aim for health for all by the year 2000 through primary health care.

As it is a small country, the provisions for health facilities are also small. The hierarchy of facilities is as follows:

- the sub-centre, in which a nurse or midwife provides service;
- the health centre with two holding beds;
- the district hospital, typically with 20 beds; and
- the national hospital, which is the referral hospital for all specialities.

Population health coverage is almost 100%.

The district hospital provides no clinical or support services, except for minor emergency operations. The hospital shown in the plans in Figures 92 and 93, however, has facilities for delivery, maternity wards and spaces for a laboratory and future X-ray equipment.

The design shown lends itself to phased building construction, the wards occupying one building, the operating, delivery and diagnostic areas occupying another, and the rest of the facilities occupying a building each, interconnected by a covered walk. The open plan is ideal for a tropical climate.

In the two main buildings, housing the wards and the operating, delivery and diagnostic areas, functional rooms occupy the peripheral areas and are naturally lit and ventilated. The interior, public spaces are lit and ventilated through skylights, designed to allow for dissipation of hot air.

This design solution reflects the circumstances of the country with regard to the provision of health care.

3. Country C

Country C is an archipelago of over 7000 islands, with a total combined area of 300 000 km². Its population of 55 million is served by a health network with three levels of health care:

- primary care, the basic community unit giving service on an out-patient basis and delivering such services in minimal health facilities;
- secondary care, at district hospitals which provide out-patient and in-patient services in the basic specialities; and
- tertiary care, at provincial, regional and national levels, in which out-patient and in-patient services are provided for complicated cases referred from the lower levels in equivalent higher-level physical facilities.

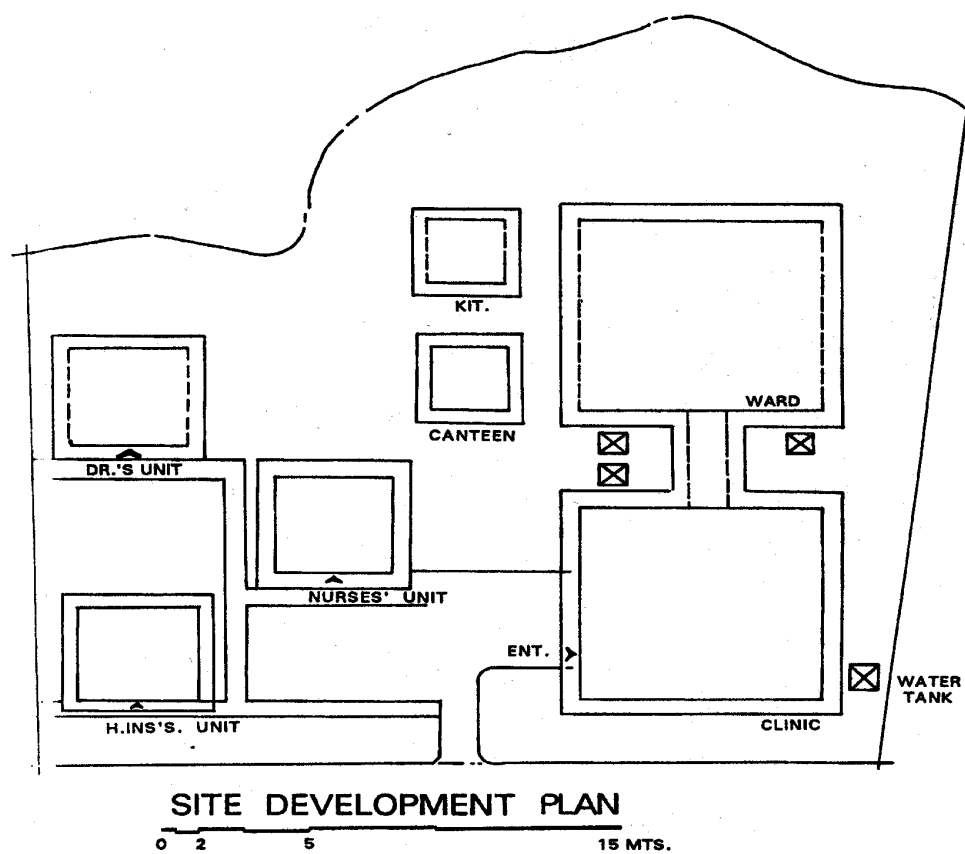


Fig. 92. Site development plan, Country B

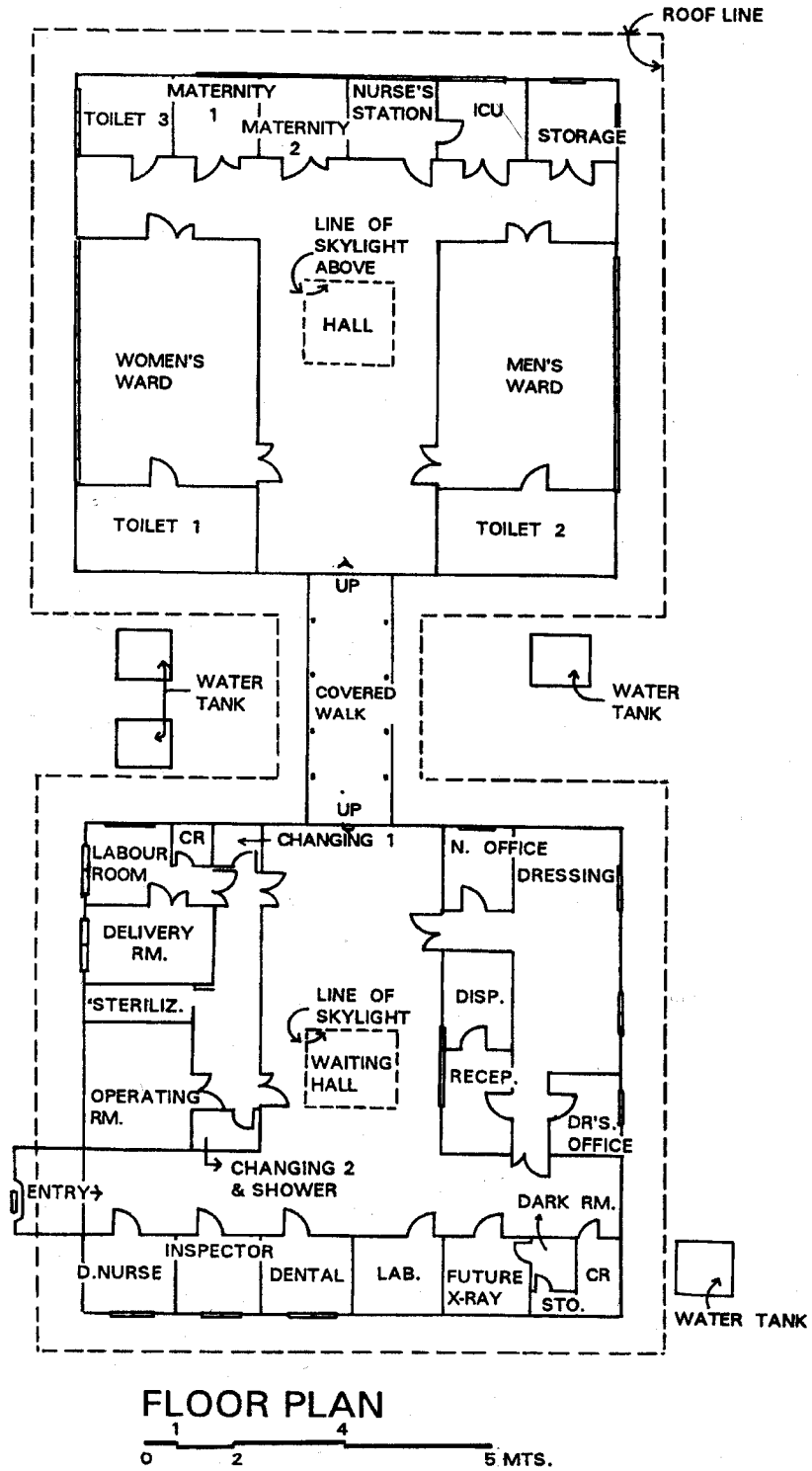


Fig. 93. Floor Plan, Country B

The floor plan shown in Figure 95 reflects this situation. The hospital had been expanded and altered through the years, some parts being demolished and others added here and there, constructed whenever funds were available. The original design has been blurred by the large number of piecemeal additions, which were neither controlled nor regulated by a master plan for growth and expansion.

As a result, some of the rooms that have been added have locked-in existing spaces, which now have neither natural nor artificial ventilation; the corridor system is incoherent; and departments have lost their functional interrelationships. Since this is a common situation in hospitals in the country, measures had to be instituted to stop unguided, uncontrolled expansions, additions and alterations. An approved "master site development plan" (Figure 94) was made a prerequisite before any demolition, addition or alteration could be made. Furthermore, approval from the health infrastructure management office formed at the national level is now required for projects that exceed a specified scope.

4. Country D

The scale of health provisions for Country D is very demanding. Unlike the three countries described above, its population is huge-1.03 billion-and its total area 9.6 million km².

Innovative ways had to be found to deliver health services to many ethnically diverse people living under various geographic conditions with marked variations in climate. A comprehensive network of primary health care had to be made available to both the urban population, comprising 20% of the total, and the rural population, comprising the remaining 80%. Structures for organizing services to populations in defined geographical areas had to be well formulated. Health provision was thus stratified as follows:

- health workers and midwives, not necessarily based in a health facility, would care for groups of 200-600 people;
- a cooperative station staffed by both locally recruited and trained medical workers would serve a population of 2000-6000 people;
- a rural hospital, with 65-100 beds, would serve populations of 20 000 - 60 000;
- city and county general hospitals would serve populations of 200 000-600 000.

Over the past four decades, great strides have been taken in the development of health services; and a programme for the development of health facilities, which has intensified over the last decade, has increased the number of health facilities enormously.

The choice of only two forms of hospital architecture, shown in Figures 96 to 99, is intentional. The picture of the rural health worker delivering service at the grassroots level from a minimal physical base has caught the attention of other countries and inspired them to adopt and adapt the programme to their local circumstances. The picture shown here is at the other end of the spectrum-of the facilities from which the technical guidance, logistic support and training of health personnel emanates for implementation of the village-level facilities and programmes.

The scale of provision in these two sample hospitals is large-140 beds in model no. 1 and 740 beds in model no. 2. The services range from general to specialized, to include even plastic surgery and burn treatment, and the design solutions have endeavoured to match this high level of technology. The deviation from the usual right-angle intersection of walls should be noted particularly.

In model no. 1, the use of the circle is explored in the out-patient department, emergency department and conference hall. Although circles are more expensive to construct, this form allows distribution of rooms around the nucleus: in the out-patient and emergency departments, functional, areas surround the staff base; in the conference hall, the seating arrangement focuses attention on the central speaking area. Corridors and other movement routes are shortened.

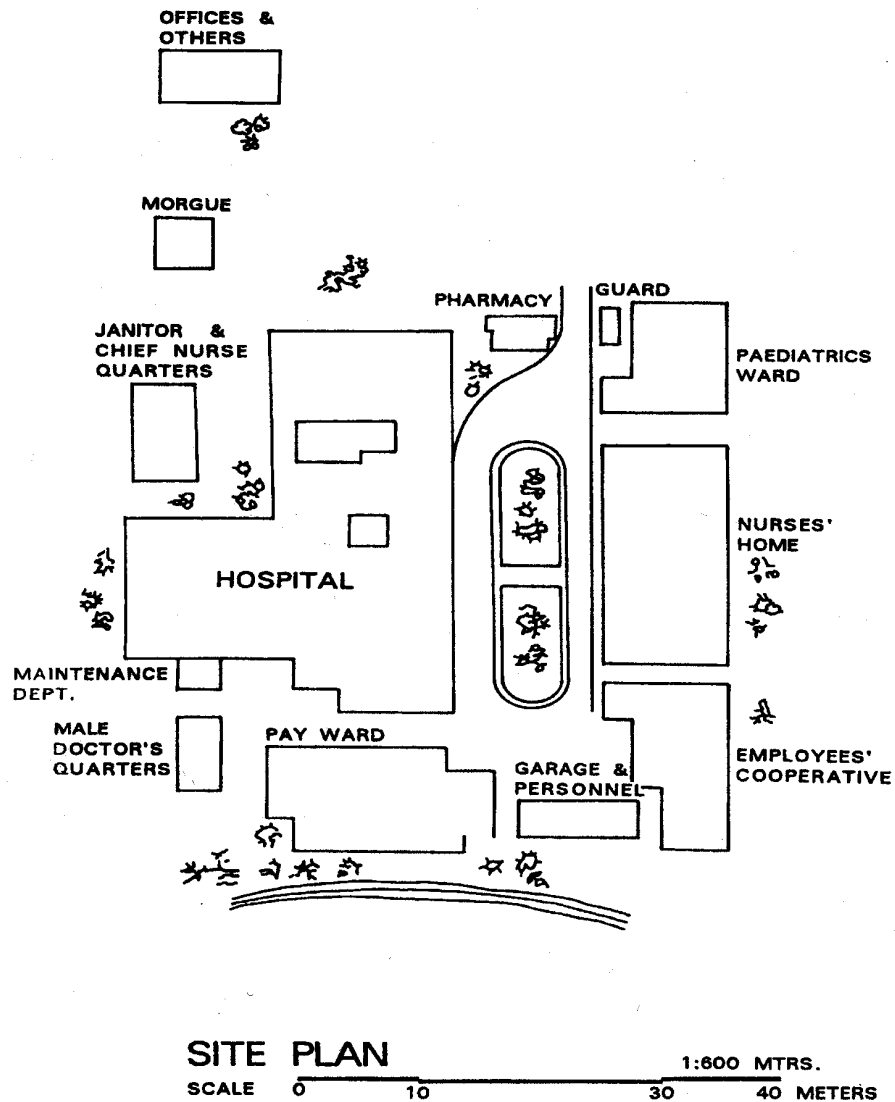


Fig. 94. Master site plan, Country C.

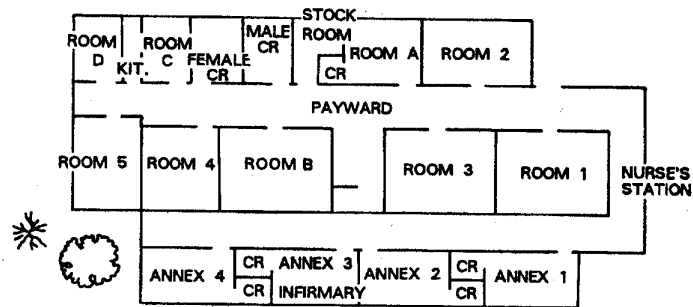
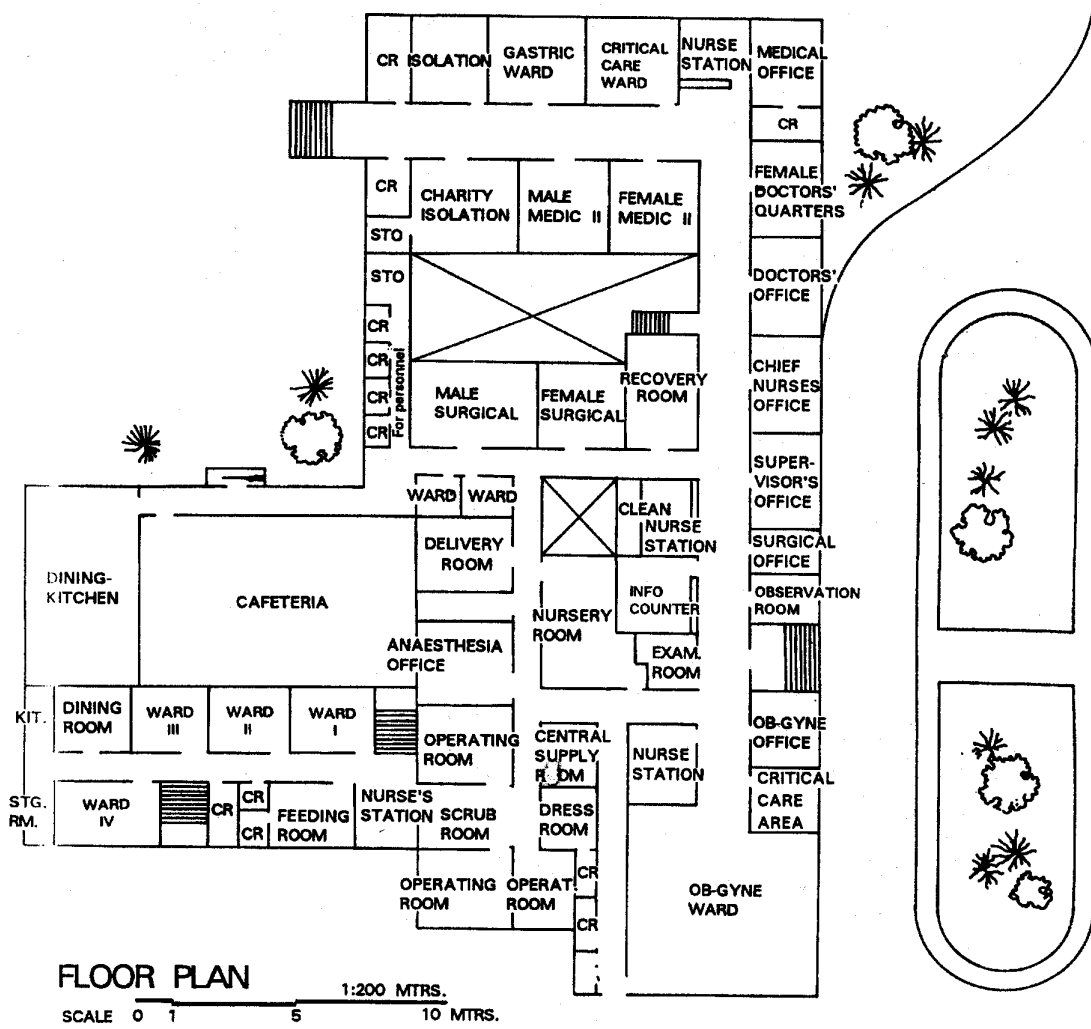


Fig. 95. Floor plan, Country C.

In model no. 2, hexagons are clustered to produce a progressively larger hexagonal form. Although the perimeter walls enclose spaces in longer lengths, in fact circulation is shortened and focused. The concept of space distribution is similar to that in model no. 1, except that the perimeter is broken into several straight lines instead of a continuous curved line.

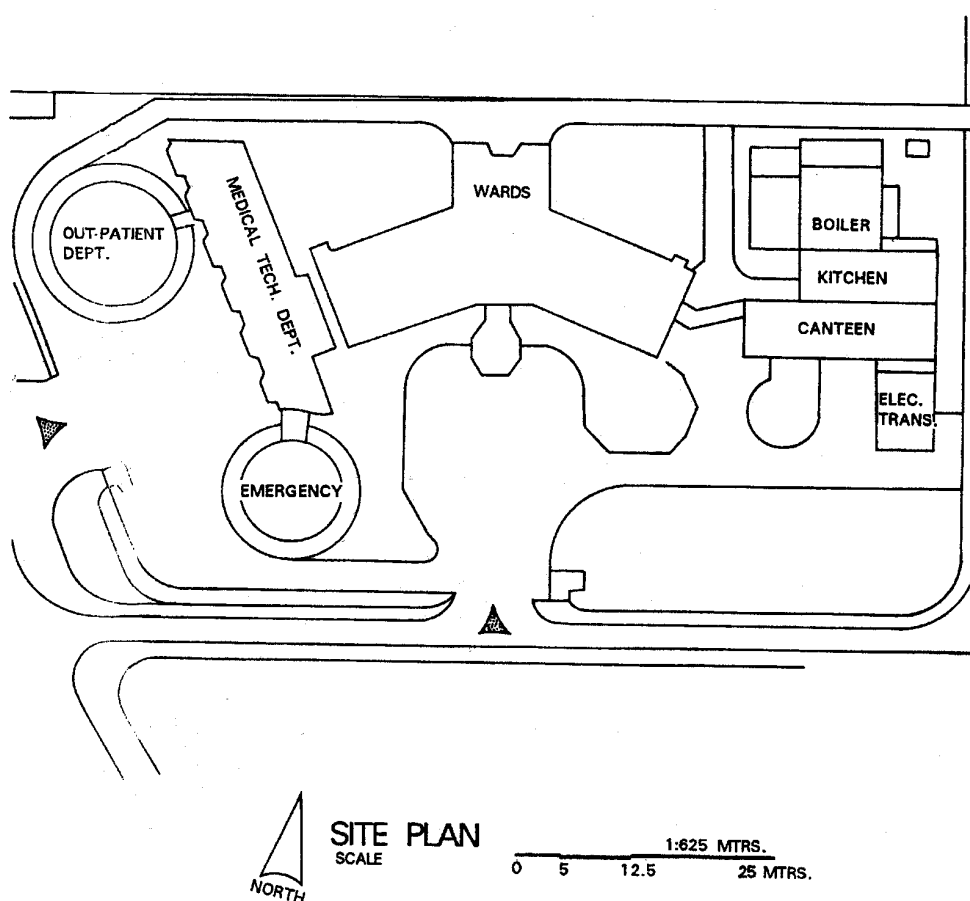


Fig. 96. Master site plan (1), Country D.

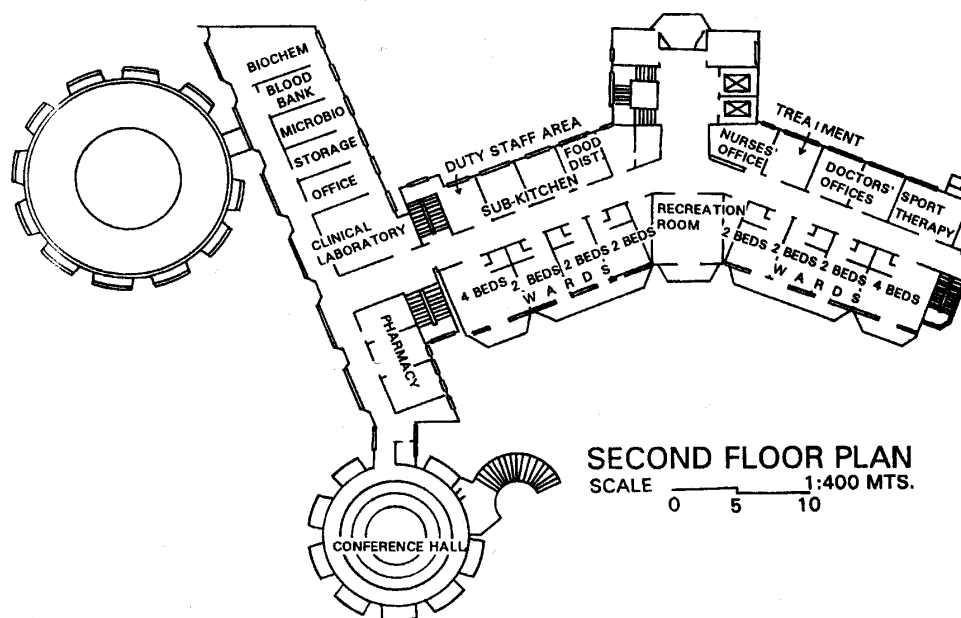
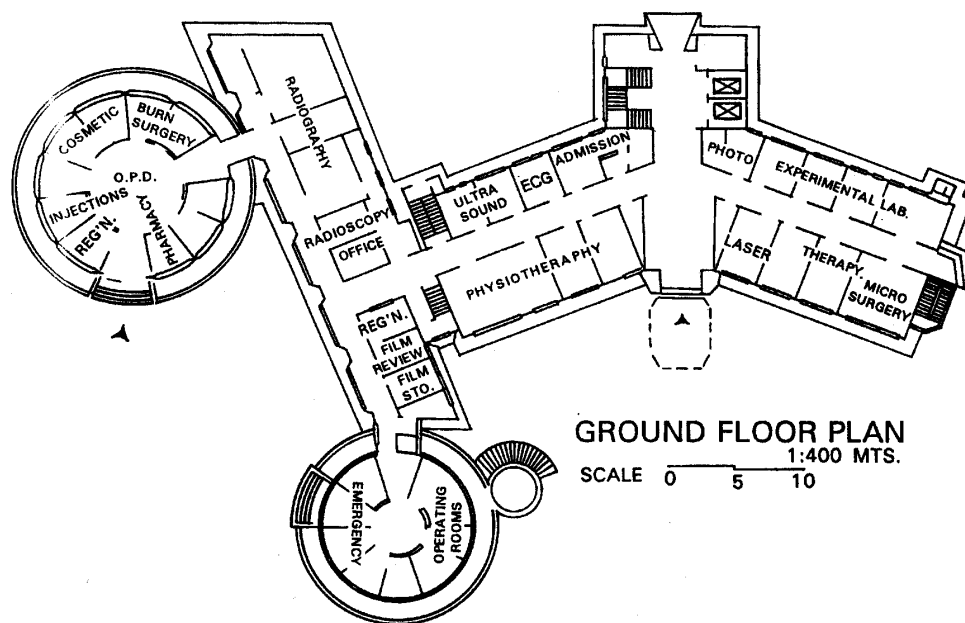


Fig. 97. Floor plans (1), Country D

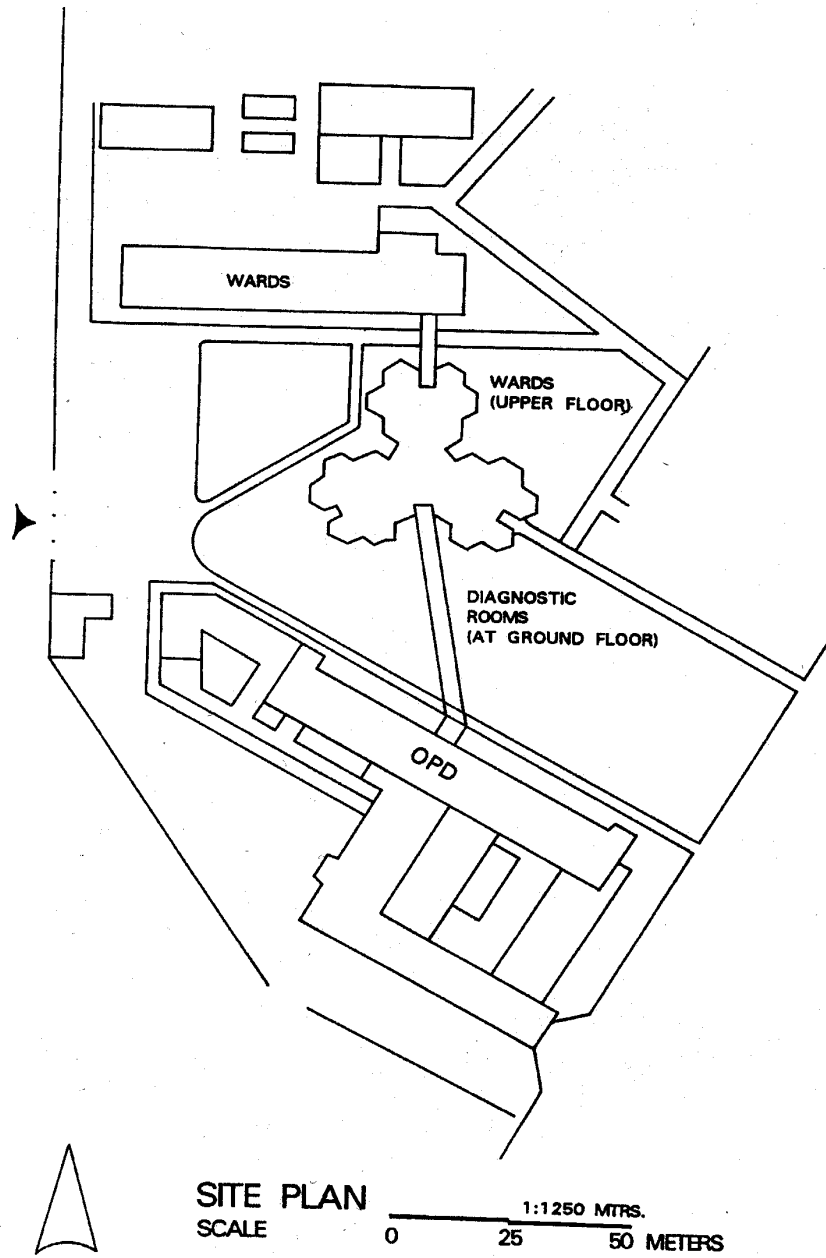


Fig. 98. Master site plan (2), Country D

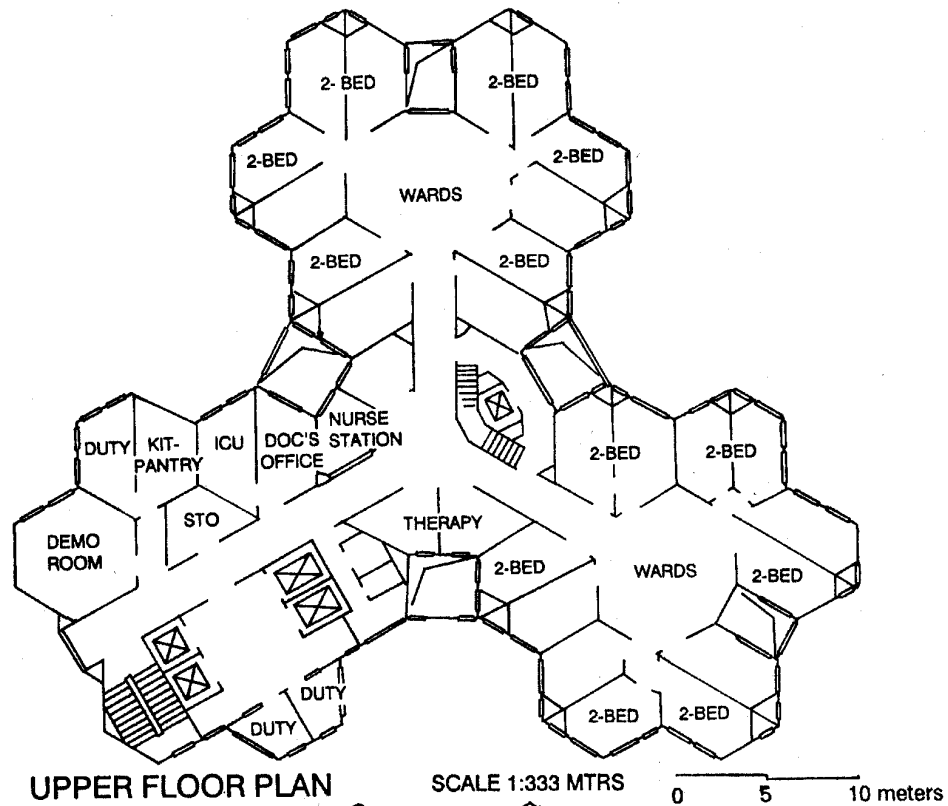
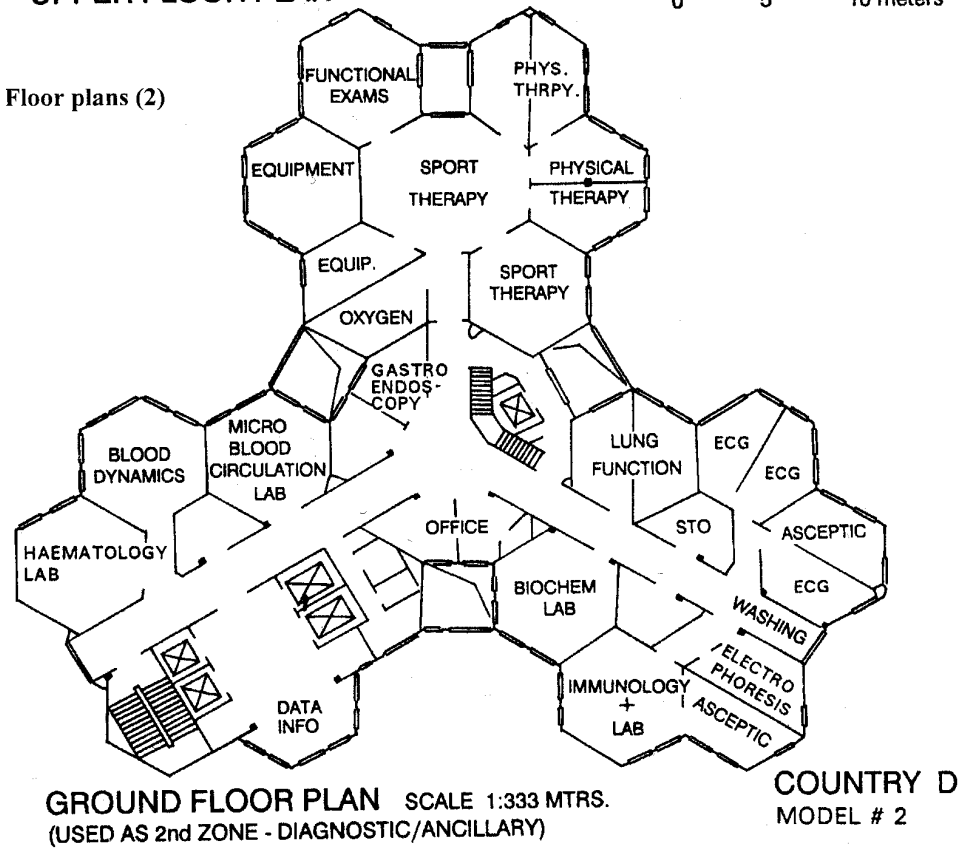


Fig. 99. Floor plans (2)



5. Country E

Country E has a population of 121 million people, 76% of whom live in urban areas; the remainder live in rural areas in a geographic setting in which 75% of the land is mountainous.

The country experience is one of massive reconstruction, with a basic policy of reducing provisions and their costs to a minimum in order to distribute resources equitably; expansion and upgrading were done on a small scale, only when necessary. This resulted in chaotic hospital facilities, which could not function efficiently.

Four decades of growth and development brought the country to a high economic level. It became easier to upgrade health facilities, either by constructing new hospitals on new sites or by altering existing hospitals. Urban needs are now provided by hospitals of 100 beds and more, and rural needs by hospitals of fewer than 100 beds.

The plans shown in Figures 100 to 102 are those of a 200-bed hospital that was constructed in the 1950s, before the period of rapid economic growth. The hospital has a readily legible circulation system, with a major spine corridor running north to south and various minor corridors branching out from it into the departments located on either side of the spine. The master site development plan shows a very generous site, which allows the hospital to expand easily, merely by breaking walls and occupying immediately adjacent open spaces. This design shows, however, long corridors, which may increase the distance and time for travel for staff.

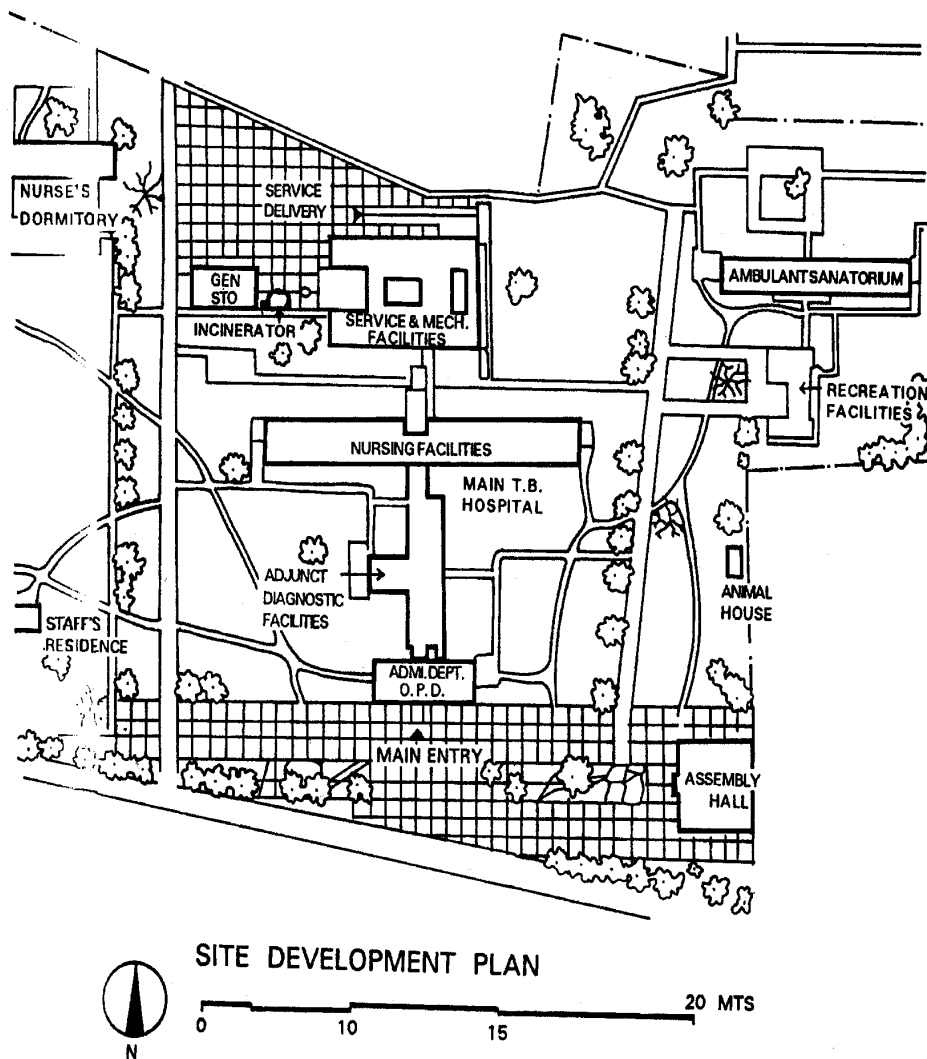


Fig. 100. Site development plan, Country E

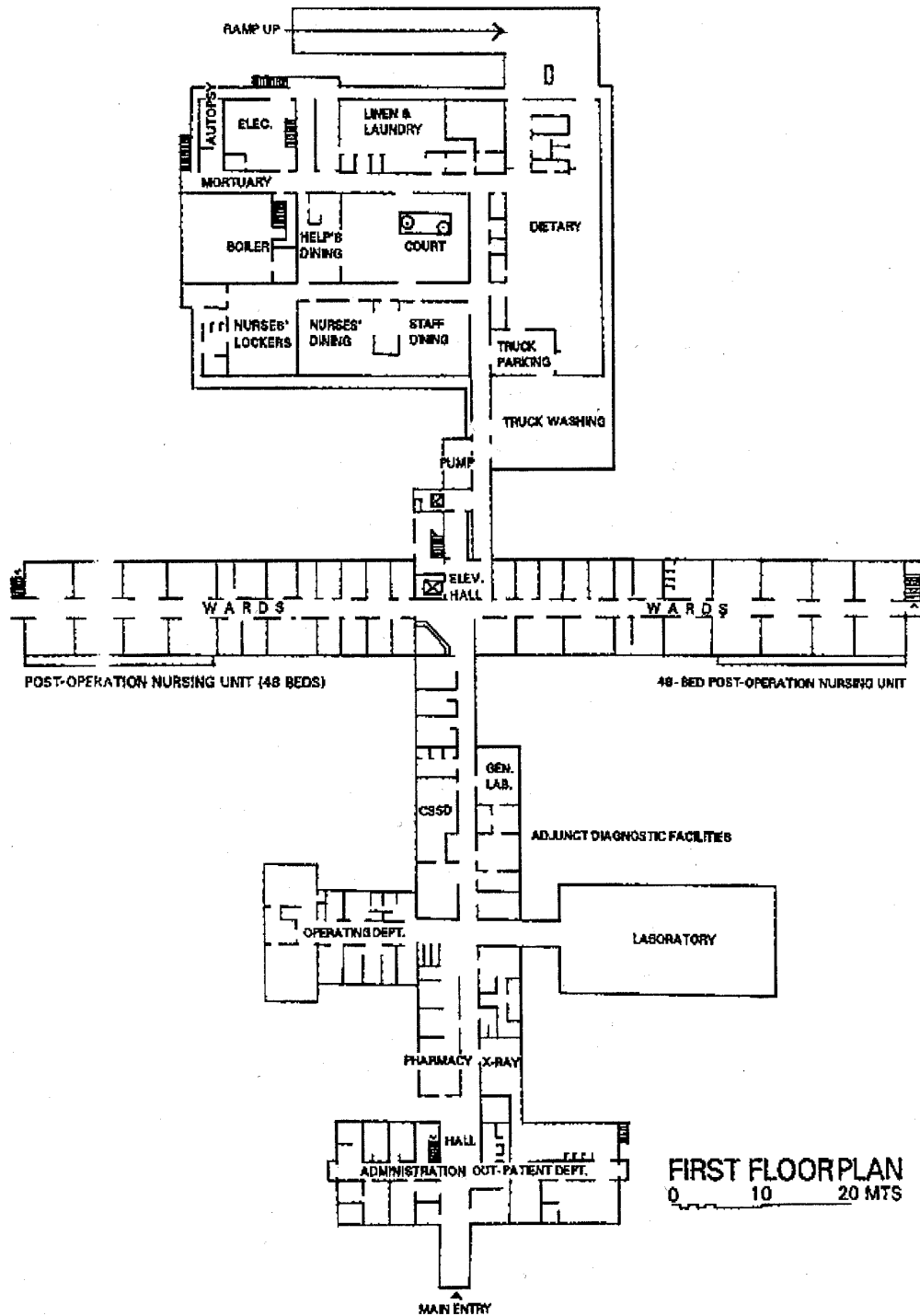
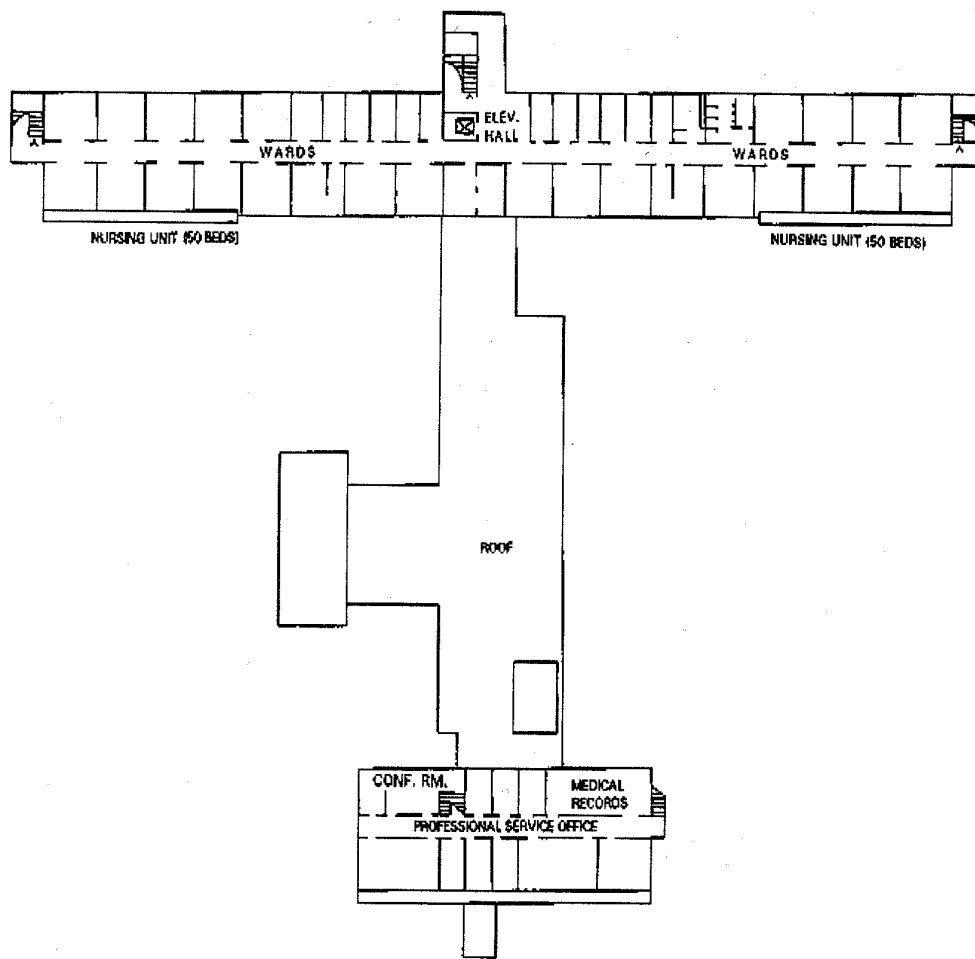


Fig. 101. First floor plan, Country E



SECOND FLOOR PLAN
0 10 20 MTR.

Fig. 102. Second floor plan, Country E

ANNEX 2

ASPECTS OF HOSPITAL UTILIZATION: DESIGN INTENTIONS *VERSUS* USE

1. Case No. 1 (Fig. 103)

The ward was originally designed for 52-bed occupancy. Patient areas line the exterior spaces, where the windows are, and receive natural lighting and ventilation; they also have the amenity of the view from the windows. The staff spaces and supporting service areas are on the other side of the ward corridor, along the walls adjacent to the corridor that leads to the lifts on one side and to the stairs on the other. This arrangement allows for access to the clean and dirty utility areas, the kitchen and other service areas without penetrating the inner patient areas and is a good example of the segregation of functional uses to prevent cross-traffic.

The ward design thus follows the well-developed British concept of "peripheral banding", in which patient spaces line the periphery of the building and staff spaces adjoin the corridor, from which services arrive. This must have been the design intent.

In actual use, when observed, the ward was teeming with people. Apart from the ward staff on duty, 69 patients had been admitted into the 52-bed ward-17 more than it could efficiently and comfortably serve. Additional beds had been brought in, which filled the available space for movement; and the beds had been spaced closer than the standard distance so that it was hard for the nurses to get round them. The presence of many family members compounded the crowded situation; however, they performed many of the nursing functions of the staff, and especially observation of the patients.

2. Case No. 2 (Fig. 104)

This out-patient department was originally designed as a centrally air-conditioned unit. Thus, the design was for a compact plan, in which interior rooms abound and in which artificial ventilation specifically designed for the area is used to ensure comfort and a healthy environment.

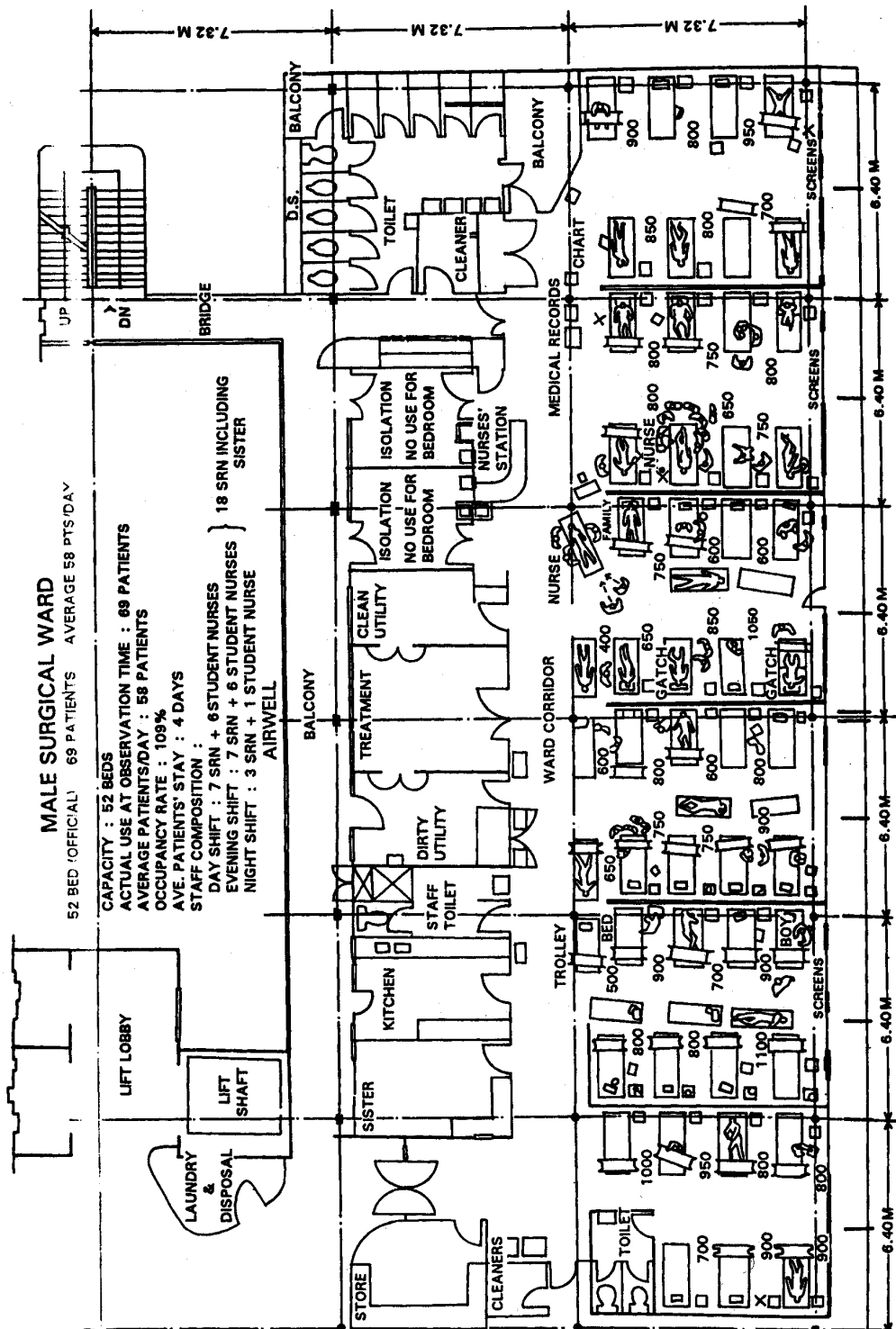


Fig. 103. Male surgical ward, Case No. 1

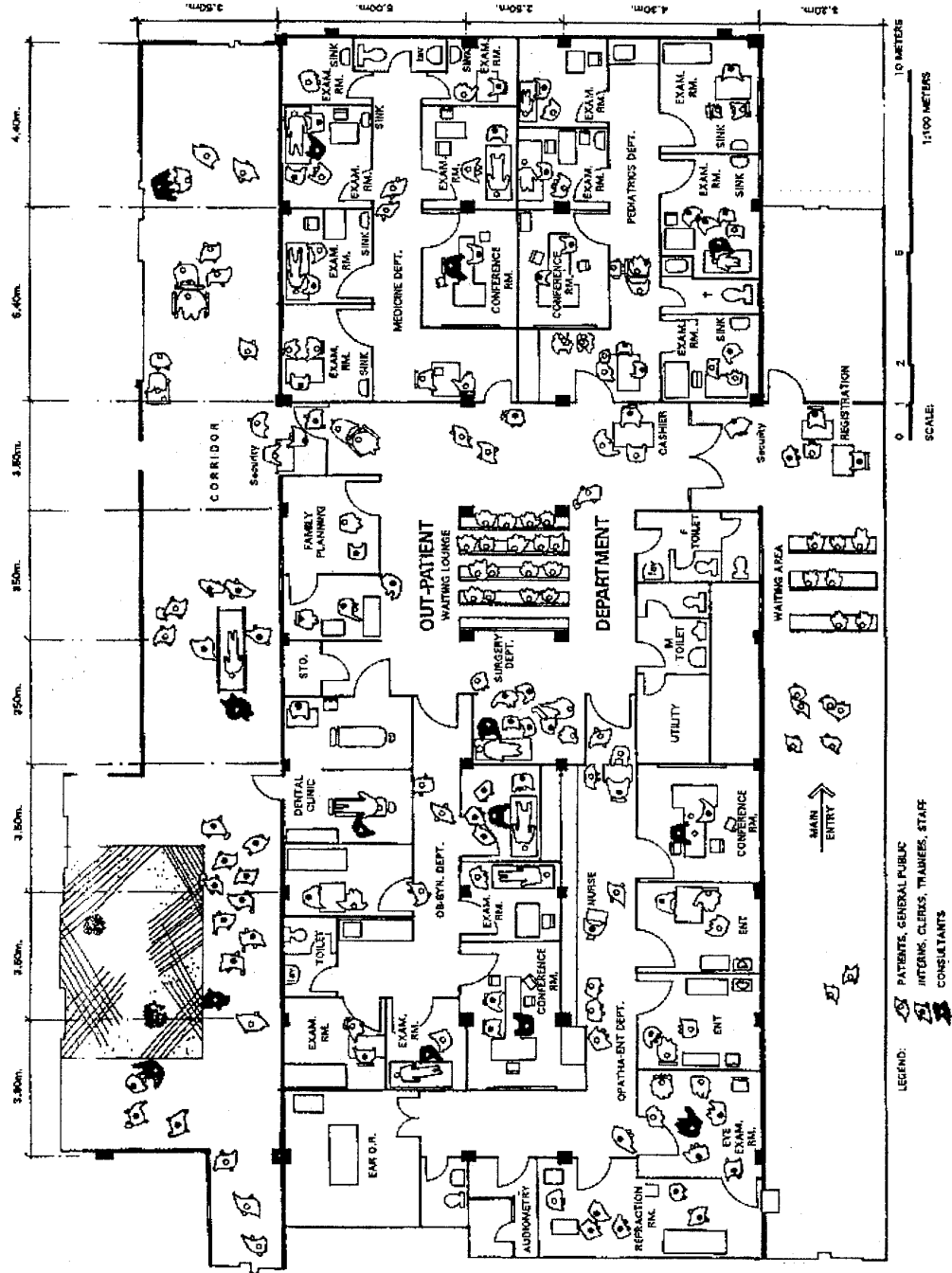


Fig. 104. Out-patient department, Case No. 2

Specialties were given specific areas for their permanent use, as opposed to a flexible, open arrangement in which specialties can use a pool of consultation-examination rooms interchangeably. Thus, the design had to be based on a clear specification of the expected number of patients per specialization, in order that there be no waste in providing for them.

For the first several years, the department functioned efficiently. The area provisions were adequate, and the air-conditioning system was working. After some years of operation, however, the system broke down for lack of adequate maintenance; difficulties in procuring spare parts compounded the situation-. The system had ultimately to be removed, and the equipment parts occupied a large storage space on the hospital premises.

In the meantime, the number of out-patients has multiplied, and the department has become very congested. The centralized air-conditioning units were replaced by portable electric fans to provide comfort, but the closed atmosphere deteriorates throughout the day. Those in interior rooms suffer the most.

The times have therefore overtaken the validity of the design. The circumstances under which it was assumed the department would operate are no longer valid. The time is ripe for reassessment of growth and of the necessary changes.

3. Case No. 3 (Fig. 105)

This general surgery ward was designed for an occupancy of 34 patient beds, as follows:

- four wards with one bed,
- nine wards with two beds and
- two wards with six beds.

The design makes use of the single-corridor form, in which the deeper, larger rooms (the six-bed and two-bed wards) are on one side of the corridor and the smaller ones (staff areas and one-bed wards) on the other.

The nurses' station is located centrally, to maximize patient care. Theoretically, progressive nursing care requires that patients be positioned in the wards according to their level of dependence and nursing needs, the highly dependent patients being closest to the staff base.

This concept is not, however, evident in actual use. In the countries of the Western Pacific Region, the family is a very strong institution. This cultural fact is both a bane and boon to hospital designers, planners and users in the Region. While families add to the crowding, confusion and population inside the hospital, they can, if properly guided, be ideal helpers when there is a dearth of manpower. The ward illustrated here is a good example, as there are only three nurses to fulfil the requirements of 34 surgical patients. The closeness of the family ties ensures loving care, which the staff can supplement with technical guidance and supervision.

Table 12 shows the level of family participation in patient care in this ward, where 80% of the patients are attended by their families on a 24-hour basis and an additional 12% are attended overnight. With this arrangement, patients requiring intensive care can be assigned to rooms distant from the staff base-in this case, rooms 5202,5214,5215 and 5216.

With this cultural background, the wards become virtual living rooms for family and guests, and the patient becomes the central focus of socializing. Patients who have almost recovered entertain people in their wards as if they were in their own living room. This situation must be considered in design.

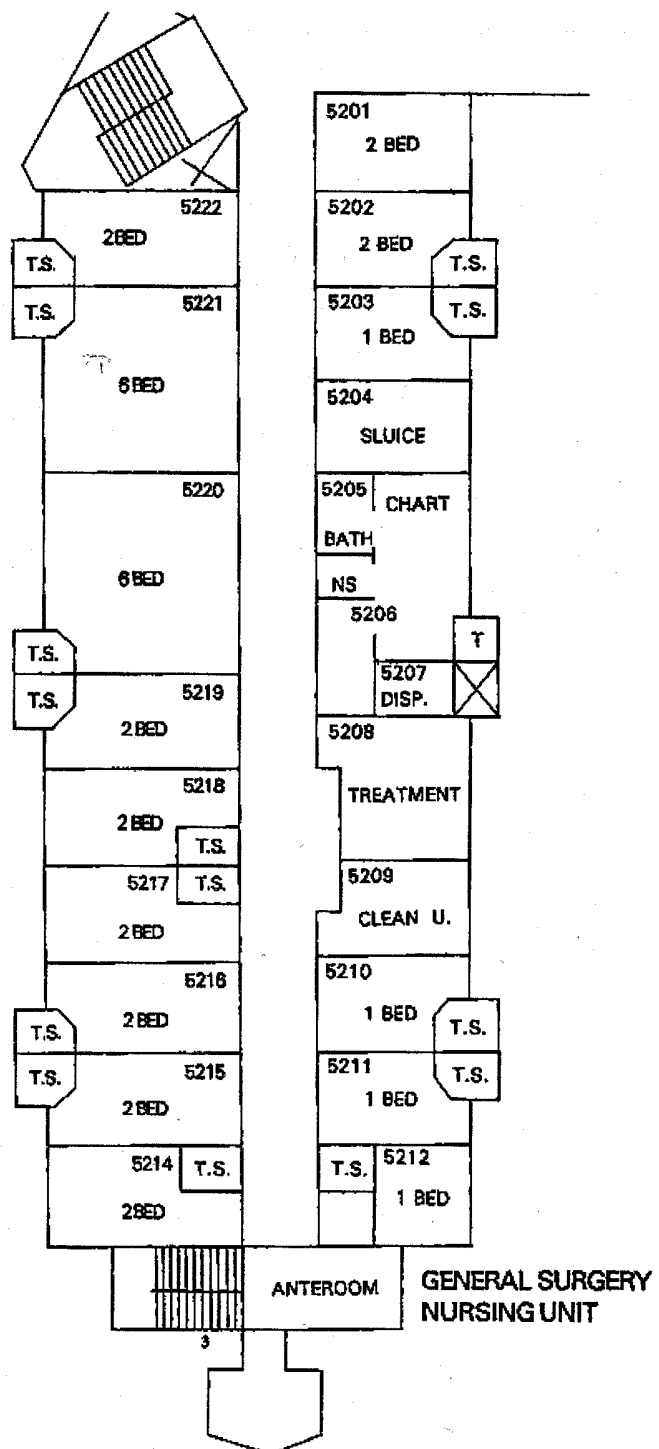


Fig. 105. General surgery nursing unit, Case No. 3

Table 12. Family participation in patient care in a surgical ward with three nurses for 34 patients (case no. 3)

Room No.	Sex	Age (years)	Degree of nursing needed	Length of stay (days)	Attendance
5201	F	37	Intermediate	5	24 h by family
5201	F	38	Intermediate	6	24 h by family
5202	F	62	Self	7	24 h by family
5202	F	64	Intensive	0	24 h by family
5203	M	64	Self	6	24 h by family and 24-h professional aid
5210	M	71	Intermediate	1	Overnight by family and 24-h professional aid
5211	F	53	Self	28	Overnight by family and 24-h professional aid
5214	F	65	Intensive	4	24 h by family
5214	F	61	Intensive	8	24 h by family
5215	M	63	Intensive	10	24 h by family
5215	M	47	Self	1	24 h by family
5216	F	36	Intensive	9	Overnight by family and 24-h professional aid
5216	F	51	Self	8	None
5217	M	57	Intermediate	7	24 h by family
5217	M	42	Self	1	Overnight by family
5218	M	71	Intensive	5	24 h by family
5218	—	—	Self	0	24 h by family
5219	F	—	Intermediate	13	24-h professional aid
5219	F	41	Intermediate	3	24 h by family
5220	F	60	Self	23	None
5220	F	60	Intensive	1	24 h by family
5220	F	31	Self	8	24 h by family
5220	F	59	Intensive	6	24 h by family and 24-h professional aid
5220	F	52	Intensive	8	24 h by family
5220	F	60	Intensive	8	24 h by family
5221	M	53	Self	4	24 h by family
5221	M	55	Intermediate	5	24 h by family
5221	M	43	Intermediate	6	24 h by family
5221	M	—	Discharged	0	24 h by family
5221	M	—	Self	5	24 h by family
5221	M	61	Self	4	None
5222	M	57	Intermediate	2	24 h by family
5222	M	27	Intermediate	1	24 h by family
5212	—	—	Intermediate	—	24 h by family

ANNEX 3

SAMPLE CHECKLIST OF MAINTENANCE WORKSHOP REQUIREMENTS FOR AN UNDER 100-BED DISTRICT HOSPITAL

1. Staff

Head of workshop (supervisor)	a specialized technician, preferably in electronics (an electrical background with some knowledge in electronics would be suitable); will be in charge the workshop and will supervise the maintenance and repair of satellite units.
Multi-skilled (general) technician	will be responsible for the maintenance of plant and electrical equipment as well as routine maintenance and repairs to standard medical equipment and other equipment used in health clinics and centres
Craftsmen (plumber, boilerman, mason)	will be responsible for the maintenance of buildings

2. Facilities

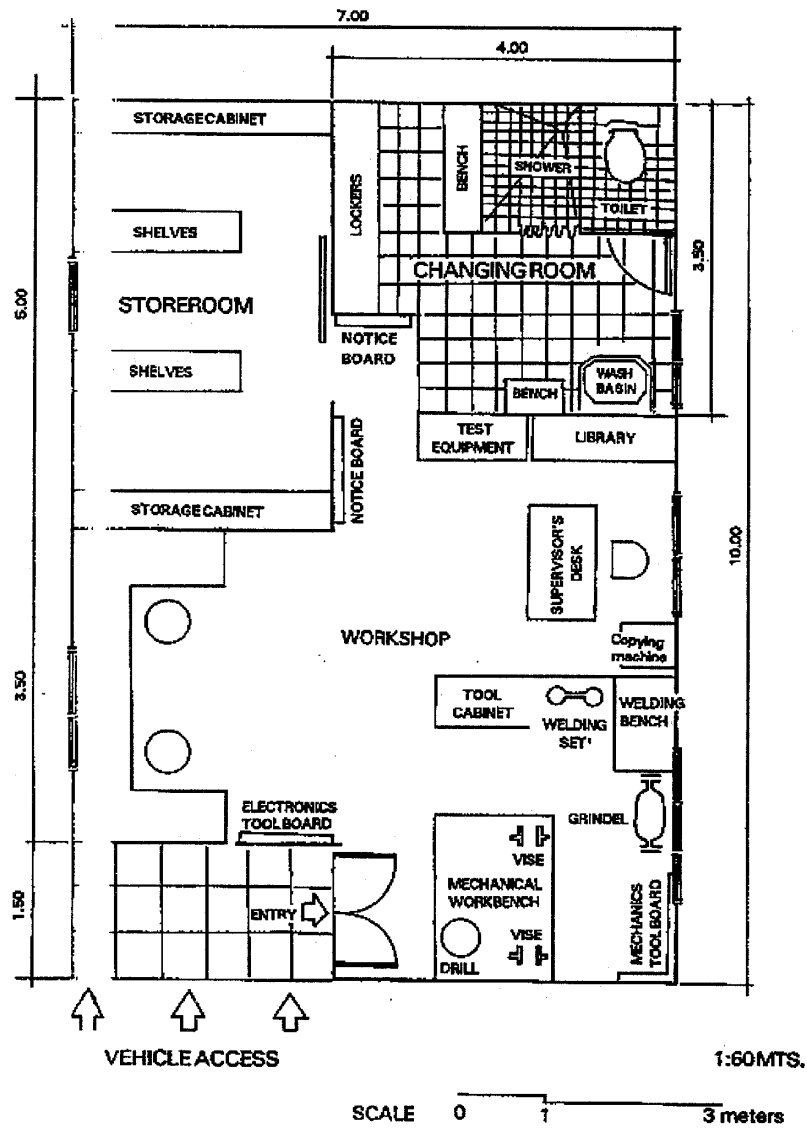
Workshop	30 m ² , fitted with work-benches, storage cabinets for tool kits and equipment, one electronics work-bench, welding module, grinder, drill on stand
Storeroom	12 m ² , fitted with storage shelves for spare parts, supplies and small equipment awaiting repair or delivery
Changing room	6 m ² , fitted with lockers, benches, shower and toilet cubicles
Vehicle	Land-Rover or Jeep type, fitted with mobile tool kit, extra diesel container, mobile cabinet for spares and supplies

3. Equipment

Electronics test instruments	multimeters (3), DC power supplies (1), soldering irons (heavy- and light-duty) (3), electrocardiograph simulator
Mechanical equipment	vices, grinder and drill on stand, hand drills (2), welding set (electric and air compressor oxyacetylene)
Basic tools	general sets of screwdrivers, pliers, cutters, round-nose pliers for both heavy-duty and electronics work; selection of hammers, steel and rubber; sets of metric and imperial spanners, including pocket size; adjustable spanners and wrenches; taps and dies, metric and imperial; steel saws, small hacksaws, files (large and pocket-size); sets of Allen keys, metric and imperial
Spare parts	set of preferred values for resistors, capacitors, transistors, very common integrated circuits, general-purpose O-rings, washers, screws, bolts, nuts; consumable items for electromedical equipment

4. Typical layout

A typical layout for such a workshop is shown in Figure 106.



TYPICAL LAYOUT FOR A WORKSHOP OF A UNDER 100-BEDS HOSPITAL

Fig. 106. Typical layout for the workshop of a under 100-bed hospital

SAMPLE CHECKLIST OF MAINTENANCE WORKSHOP REQUIREMENTS FOR AN OVER 100-BED DISTRICT HOSPITAL

1. Staff

Head of workshop (supervisor)	a technician/engineer, preferably in electronics (an electrical or mechanical background with some knowledge in electronics would be adequate); will be in charge of workshop and will supervise the maintenance and repair of satellite units.
Multi-skilled (general) technician	will be responsible for plant and electrical equipment as well as routine maintenance and repairs to standard medical equipment used in health clinics and centres
Craftsmen (plumber, boilerman, mason)	will be responsible for the maintenance of buildings

2. Facilities

Electronics workshop	21 m ² , fitted with work-benches, storage cabinets for tool kits and equipment
Mechanical workshop	28 m ² , fitted with drill, grinder, welding module, work-bench, carpenter's bench, compressed air
Storeroom	12 m ² , fitted with storage shelves for spare parts, components, supplies and equipment awaiting repair or delivery
Changing room	9 m ² , fitted with lockers, benches, shower and toilet cubicles
Vehicle	Land Rover or Jeep type, fitted with mobile tool kit, extra diesel container, mobile cabinet for spares and supplies

3. Equipment

Electronics test instruments	Multimeters (5), DC-stabilized power supplies (2), soldering irons (heavy- and light-duty) (6), simple oscilloscope (1)
Mechanical equipment	vices, grinder and drill on stand, hand drills (3), welding set and air compressor
Basic tools	general sets of screwdrivers, pliers, cutters, round-nose pliers for both heavy-duty and electronics work; selection of hammers, steel and rubber; sets of metric and imperial spanners, including pocket size; adjustable spanners and wrenches; taps and dies, metric and imperial; steel saws, small hacksaws, files (large and pocket-size); sets of Allen keys, metric and imperial
Spare parts	set of preferred values for resistors, capacitors, transistors, very common integrated circuits, general-purpose O-rings, washers, screws, bolts, nuts; consumable items for electromedical equipment

4. Typical layout

A typical layout for such a workshop is shown in Figure 107.

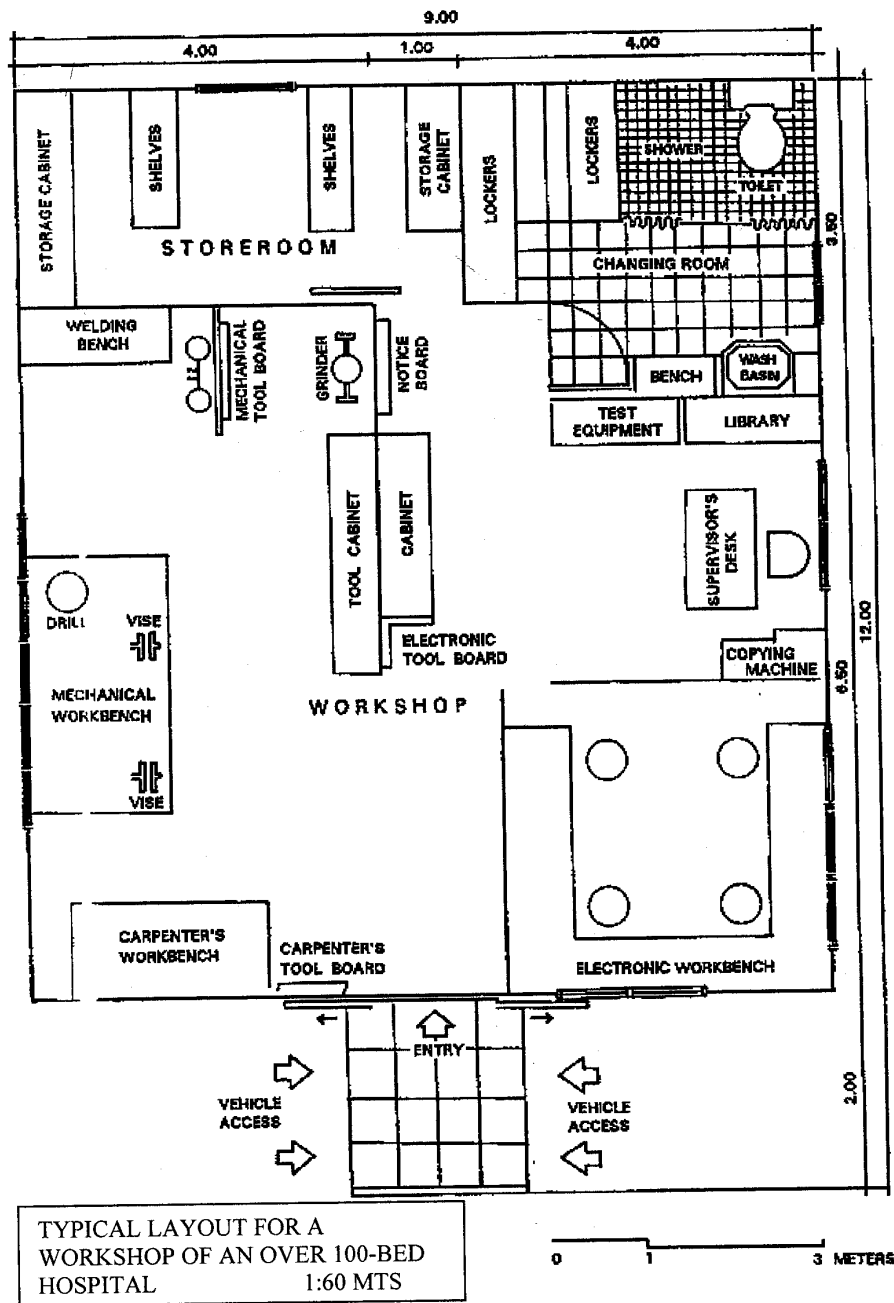


Fig. 107. Typical layout for the workshop of an over 100-bed hospital

ANNEX 5

SCHEDULES OF PROCEDURE FOR PLANNED PREVENTIVE MAINTENANCE

The schedules presented here are meant to serve only as guidelines; modifications may be introduced to conform to manufacturers' specifications.

Each schedule should be amended to indicate to the maintenance engineer carrying out the work that each test should be checked against a checklist and all measurements should be recorded on a card. An outline record card could be included with each schedule for this purpose. The engineer should also note on the record card any item that needs to be replaced, if work is to be carried out later, and whether or not the same engineer is to carry out the work.

1. X-Ray equipment

Apparatus: General-purpose radiographic and fluoroscopic unit

<i>Procedure</i>	<i>Total time</i>
Every 6 months	7.0 h

1. Check controller assembly

- Thoroughly clean interior and exterior of unit using vacuum cleaner.
- Check mechanical integrity of control knobs, switches, etc.
- Check mechanical integrity of connectors, relay contacts, etc.
- Inspect physical condition of high-tension cables.
- Check function of back-up safety timer.

2. Check high-tension transformer

- Clean exterior units.
- Check all connections to high-tension transformer.
- Check oil level in transformer.
- Inspect high-tension cable terminals; clean as necessary.
- Inspect physical condition of high-tension cables.
- Check main power input connections.

3. Check X-ray tube (under-table and over-table)

- Check physical condition of tube(s); i.e., cracks in anode, oil leaks on housing, etc.
- Inspect high-tension terminals; clean as necessary.
- Inspect collimator alignment.
- Check tube focal spots.
- Check serial changer or spot film device (fluoroscopic).
- Check resolution of image intensifier and television system.
- Check under-table collimator or smooth operation of shutters.

4. Check over-table tube assembly (floor-to-ceiling or ceiling-mounted)
 - Check function of locking machine.
 - Check physical condition of counterweight cables and clamps.
 - Check bearing for wear; lubricate as required.
5. Check X-ray tables
 - Clean thoroughly and remove debris.
 - Clean spot film device.
 - Check bearing and bearing surfaces; lubricate as necessary.
 - Check physical condition of counterweight cables and clamps.
 - Check function of safety devices and electromagnetic locks.
 - Check condition of Bucky grid and cassette tray; check Bucky locks.
6. Check vertical Bucky stand or chest/erect X-ray stand
 - Check condition of X-ray grid.
 - Check cassette stand.
 - Check bearing and counterweight cables; lubricate and tighten as necessary
7. Check tomographic attachment
 - Clean bearing surfaces.
 - Lubricate bearing as necessary.
 - Check motor bearing.
 - Check for excessive movement.
8. Check radiator output, i.e., mA, kVp and time.
9. Check fluoroscopic output, i.e., kVp, mA.
10. Check radiographic and fluoroscopic timers and radiographic back-up timer.
11. Verify correct meter indications and appropriate audiovisual signals.

Annual total-12-16h

II. Laboratory equipment

Apparatus: Microscope

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of transformer power cord and plug.
3. Clean and inspect microscope for signs of damage.
4. Clean eyepieces, condenser, objective and illuminator assembly.
5. Check adjustment of aperture diaphragm and condenser assembly.
6. Check stage assembly for smooth movement.
7. Check fine and coarse focus for smooth movement.
8. Thoroughly clean interior and exterior of unit using vacuum cleaner.

Apparatus: Colorimeter

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h
1. Check integrity of electrical grounding.	
2. Check physical condition of power cord and plug.	
3. Check mechanical condition of all knobs and switches.	
4. Clean interior and exterior unit.	
5. Clean cleanliness of cuvette assembly.	
6. Check alignment of galvanometer lamp and projector.	
7. Clean lenses and optical filters.	
8. Check transformer voltage.	
9. Check operation of unit and adjust mechanical zero.	

*Annual total-2.0 h***Apparatus: Centrifuges**

<i>Procedure</i>	<i>Total time</i>
Every 6 months	0.5-2.0 h
1. Check integrity of electrical grounding.	
2. Check physical condition of power cord and plug.	
3. Check mechanical integrity of switches, controls, meter, cover latch, gasket, etc.	
4. Inspect unit for signs of physical or electrical damage.	
5. Clean commutator, check brushes; replace if necessary.	
6. Check head balance.	
7. Lubricate motor and bearing, if applicable.	
8. Clean interior and exterior of unit.	
9. Check operating unit for vibrations and excessive noise.	
10. Check speed, and calibrate tachometer if necessary.	
11. Check accuracy of timer.	
12. Check braking system.	
13. Check safety interlocks.	
14. If unit is refrigerated, check temperature, clean coils and check for leaks.	

Apparatus: Flame photometer (analog and digital)

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.5 h (analog) 2.0 h (digital)

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, control, etc.
4. Inspect air filter assembly, if applicable; examine filter cartridge and replace if necessary.
5. Check air and gas filters, if applicable; replace micron filters.
6. Clean burner assembly; replace O-ring seals.
7. Clean optical filters.
8. Clean and inspect electronic circuitry for signs of damage; check power supply voltage.
9. Check operating unit.
10. Check aspiration rate; adjust as necessary to manufacturer's specifications.
11. Check fuel and air pressures, if applicable; adjust fuel: air ratio.
12. Verify proper operation of read-out; check electronic alignment, if applicable.
13. Calibrate unit using standard.

Annual total-3-4 h

Apparatus: Haemoglobinometer

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, etc.
4. Clean interior and exterior of unit.
5. Inspect interior for signs of damage.
6. Clean cuvette assembly thoroughly.
7. Check tubing; replace if necessary.
8. Check condition of lamp and phototube housing; clean as necessary.
9. Check lamp voltage and blank voltage; adjust if necessary.
10. Check operating unit.
11. Calibrate, using standard solutions and blood control.

Annual total-2.0 h

Apparatus: pH meter

<i>Procedure</i>	<i>Total time</i>
Every 6 months	0.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, connection and meter/display.
4. Clean and check interior for signs of damage.
5. Check condition of electrodes and electrode holder.
6. Calibrate meter or digital display with millivolt/pH calibrator.
7. Adjust slope as required.
8. Check batteries, as applicable, and replace as necessary.
9. Check overall operation of unit by measuring pH of known solution.

Annual total-1.0 h

Apparatus: Bilirubinometer

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Thoroughly clean interior and exterior of unit.
4. Check mechanical integrity of switches, controls and knobs.
5. Check condition of reference standard and sample chambers; clean as necessary.
6. Clean slide mechanism.
7. Check condition of source lamp; replace if darkened;
8. Check operation of unit.

Annual total-2.0 h

Apparatus: Blood-cell counter

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, meter, etc.
4. Examine and thoroughly clean interior and exterior.

5. Check condition of vacuum regulator; lubricate pump if necessary.
6. Check integrity of manometer and clean; change mercury if necessary.
7. Inspect tubing; replace as necessary.
8. Check regulated power supply voltage.
9. Check operating units.
10. Check linearity and reproducibility.

Annual total-3.0 h

Apparatus: Chloridometer/Chloride analyser

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls and knobs.
4. Check meter movements for sensitivity and zeroing.
5. Inspect generator electrodes; check electrode voltages
6. Examine indicator electrodes; clean with silver polish; examine insulators.
7. Inspect stirrer motor to ensure free rotation.
8. Check and replace battery, if applicable.
9. Inspect electrical and electronic components for damage.
10. Check operation and calibration of unit; recalibrate, if necessary, using manufacturer's specifications.

Every 12 months	0.5 h
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1. Inspect drive belt and stirrer shaft bearing; replace belt if necessary.

Apparatus: Blood-gas analyser (analog and digital)

<i>Procedure</i>	<i>Total time</i>
Every 3 months	2.0 h (analog) 4.0 h (digital)

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Clean accumulations of salt from interior and exterior .
4. Inspect water baths for leaks, deteriorated tubing and cracks; clean interior water bath thoroughly.
5. Check water pump motor and lubricate; check vacuum system.
6. Check electronic component for signs of damage.

7. Check mechanical integrity of all controls, switches, connectors, etc; check condition of analog/digital display.
8. Inspect electrodes and electrode cables for signs of deterioration or cracks; clean electrodes and install new membranes.
9. Reassemble unit; check water circulation, water bath temperature control, vacuum and aspiration.
10. Check and calibrate pH, PO₂, PCO₂ electrodes.

Every 12 months 1 h

1. Replace water-bath seals, tubing, O-rings and grommets.

Annual total-9-17 h

Apparatus: Electronic balance (table-top)

Procedure *Total time*

Every 6 months 0.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls and display.
4. Check calibration of display, using manufacturer's service and standard weight.
5. Clean exterior and ensure balance on a firm stand-
6. Check operating units.

Apparatus: Spectrophotometer (visible and ultra-violet spectra)

Procedure *Total time*

Every 6 months 0.5 h (analog)
2.0 h (digital)

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and knobs.
4. Clean exterior, particularly cuvette well.
5. Check integrity of photosensing device on cuvette wall.
6. Check mechanical zero of wavelength calibration, following manufacturer's instructions.
7. Check wavelength calibration using buffer solutions or, preferably, calibrating filter standard, following manufacturer's instructions.
8. Clean optical filters in front of cuvette well.
9. Check operation of unit.

Annual total-1-4 h

Apparatus: Hot-plate magnetic stirrer

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and knobs.
4. Clean exterior.
5. Check magnetic properties of stirrers.
6. Check transformer voltage.
7. Check operation of unit and speed of rotation.

Annual total-2.0 h

Apparatus: Hot-air incubator/oven

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and knobs.
4. Clean interior and exterior.
5. Check transformer voltage.
6. Check accuracy of temperature calibration of thermostat, using external thermometer.
7. Check accuracy of calibration of timer, using a stop-watch.
8. Check operation of unit and adjust as indicated in manufacturer's service manual.

Annual total-20 h

Apparatus: Water bath

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Clean and inspect for corrosion.
4. Check and clean heating element from corrosion due to hard water.

Annual total-3.0 h

Apparatus: Water distiller/softener

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls and connectors.
4. Check water circuit for leakages and calcification.
5. Check for presence of chemicals and condition of filter.

Annual total-3.0 h

III. Electro-medical equipment**Apparatus: Electrocardiograph**

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding from instrument chassis.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and controls.
4. Inspect condition of patient cables and switches.
5. Clean interior of unit using a vacuum cleaner.
6. Inspect internal components for signs of wear or damage.
7. Clean lead selector and other exposed switch contacts.
8. Check chart recorder speed.
9. Test maker stylus.
10. Check condition of writing stylus; adjust heat and pressure as necessary.
11. Test and adjust gain of amplifier according to manufacturer's specifications; check amplifier balance, frequency response and common mode rejection.
12. Check integrity of electrical grounding from each electrode in all modes.
13. Check operation of unit: run a strip of all lead configurations using a cardiac simulator.

Every 12 months	0.5 h
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1. Sparingly lubricate recorder motor and gears as required.
2. Check and adjust test pulse reference voltage.

Annual total-2.5 h

Apparatus: Defibrillator/Cardioverter

<i>Procedure</i>	<i>Total time</i>
Every 4 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, connections, meters, etc.
4. Check physical condition of electrodes, defibrillator paddles and cables.
5. Check interior for signs of damage; clean as necessary.
6. Check operation of unit; measure energy output at all watt-second settings. Take care.
7. Check operation of synchronizer, if used.
8. Check voltage gain calibration of monitor, recorder, etc, if used.
9. Check trace on oscilloscope, if applicable.
10. Check chart recorder, stylus condition, stylus heat and pressure and recorder speed, if applicable.
11. Check electrical current leakage from each electrode, if applicable.

Every 12 months	1.0 h
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1. Sparingly lubricate recorder motor and gears as required.
2. Check batteries and replace with correct spares as required.

Annual total-4.0 h

Important: Add warning about the hazards of maintaining or testing a defibrillator without having had training on the unit to appreciate the high voltage (about 5 kV) and high currents (about 50 A) that can be generated. This unit is potentially hazardous to all staff.

Apparatus: Electrosurgical unit

<i>Procedure</i>	<i>Total time</i>
Every 4 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, connectors, etc.
4. Check physical condition of footswitch and cable.
5. Inspect accessories for signs of deterioration or defective cables.
6. Clean and inspect interior for damage.
7. Check condition of spark gaps and vacuum tubes, if applicable.

8. Measure radio frequency output in all operating modes; refer to manufacturer's specifications.
9. Verify patient plate and footswitch for correct grounding; test function of patient ground guard circuit.
10. Check radio frequency of interference with other surgical devices, e.g., patient monitor.

Annual total-3.0 h

Apparatus: Anaesthetic machine

<i>Procedure</i>	<i>Total time</i>
Every 6 months	2.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check all rubber fittings (O-rings, diaphragms, gaskets, valve seals, etc) and replace if necessary with manufacturer's approved replacement parts.
4. Check for gas leakages.
5. Clean and check calibration of flow meter.

Annual total-4.0 h

Apparatus: Fetal monitor

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, controls, connectors, meters, etc.
4. Check physical condition of cables and transducers.
5. Check interior of unit for signs of damage.
6. Sparingly clean and lubricate recorder as necessary.
7. Check operation and calibration of unit in accordance with manufacturer's specifications.

Every 12 months	1.0 h
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1. Check amplifier gain, frequency response and common mode rejection.

Annual total-3.0 h

Apparatus: Cardiac monitor

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check integrity of electrical grounding and current leakage

2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches, knobs, connectors and cables.
4. Clean interior with damp cloth.
5. Check voltage gain calibration for all lead positions.
6. Test rate meter and rate meter alarm functions, if applicable.
7. Clean and inspect electrodes, straps and patient cables.
8. Check trace on oscilloscope.

Every 12 months 1.0 h

1. Test input circuitry.
2. Replace reference cell if necessary.
3. Check battery, if applicable.

Annual total-3.0 h

Apparatus: Respirator

Procedure *Total time*

Every 6 months 2.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.
3. Check mechanical integrity of switches and knobs.
4. Inspect high-pressure hose assembly for wear and leaks.
5. Check high-pressure inlet filter and associated O-rings; clean all parts.
6. Check control pressure regulator; replace if necessary.
7. Inspect operation of all gauges; calibrate if necessary.
8. Check operation of cycling mechanism and related controls; comply with manufacturer's test procedures.
9. Inspect and clean all tube and manifold assemblies.
10. Clean and check nebulizer assembly; replace O-ring if necessary.
11. Complete final check of system as recommended by manufacturer.

Annual total-4.0 h

Apparatus: Short-wave/Micro-wave diathermy

Procedure *Total time*

Every 6 months 1.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord and plug.

3. Check condition of radio frequency cables and applicators for cracks, overheating or deterioration; replace if required.
4. Check mechanical condition of all accessories, front-panel controls, switches and output.
5. Clean and inspect interior for signs of damage; vacuum if necessary.
6. Clean ventilation screen and oil blower motor sparingly.
7. Check operation and functioning; refer to manufacturer's specifications for tuning.
8. Check for corona and arcing at high-power setting.
9. Check timer and safety shut-off.
10. Check power output with radio frequency wattmeter; compare readings with previous measurements.

Annual total-2.0 h

Apparatus: Infant incubator

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord, connectors and plugs.
3. Check mechanical integrity of switches and controls.
4. Inspect condition of oxygen and air inputs.
5. Check water-level gauge and inspect distilled-water compartment.
6. Clean or replace water and air filters.
7. Check temperature indicator and thermometers according to manufacturer's specifications.
8. Check temperature cut-off alarm.
9. Check power failure alarm.
10. Check operation of unit; warm to temperature setting on temperature control and check with external thermometer.
11. Check canopy for breakage; clean interior and exterior of unit.

Annual total-3.0 h

Apparatus: Dental chair unit

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord, connectors and plugs.
3. Check mechanical integrity of switches and controls.

4. Check for leakages in water circuit; replace rubber rings and other consumable materials according to manufacturer's recommendations.
5. Check all water pipes for calcification; check integrity of filters; clean or replace as necessary.
6. Check for leakages in air circuit; replace elements accordingly.
7. Check movement of chair, tray, light and other parts.
8. Check for correct movement of all hand-pieces.
9. Check X-ray unit for correct exposure by exposing dummy dental film.
10. Check operation of unit.

Annual total-3.0 h

Apparatus: Suction pump

<i>Procedure</i>	<i>Total time</i>
Every 6 months	0.5 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord, connectors and plugs.
3. Check mechanical integrity of switches and controls.
4. Check two-way air valve.
5. Check for damage to bottles and clean.
6. Check air circuit for leakage and absorption.
7. Check operation of unit.

Annual total-1.0 h

Apparatus: Operating table and lamps

<i>Procedure</i>	<i>Total time</i>
Every 6 months	1.0 h

1. Check mechanical movement of moving parts and oil accordingly.
2. Check hydraulic up-down movement of table.
3. Check hydraulic circuit for leaks and replace rubber parts according to need and manufacturer's specifications.
4. Check stand-by theatre-light battery for switch-over operation; correct water level of cells, battery acidity and voltage.
5. Check mechanical integrity and operation of footswitches, if used.
6. Check operation of lights and table.

Every 6 months	1.0 h
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1. Check battery water level, voltage and acidity.

Annual total-4.0 h

Apparatus: Intensive care monitoring system

<i>Procedure</i>	<i>Total time</i>
Every 6 months	2.0 h

1. Check integrity of electrical grounding.
2. Check physical condition of power cord, connectors and plugs.
3. Check mechanical integrity of switches, connectors, cables and controls.
4. Check signal connection between central panel and monitors by giving known signals and monitoring centrally.
5. Clean exterior of unit with damp cloth.
6. For bedside monitors, follow procedure given under "Cardiac monitor."

Annual total-4.0 h for system connected to 4-bed unit

ANNEX 6

GENERIC SPECIFICATIONS FOR X-RAY AND ULTRASOUND UNITS

1. Stationary X-ray units

The major requirements for any stationary X-ray unit are as follows:

- (i) Medium or high frequency converter with a tube generating potential (voltage) range of 45-120 kV.

Note: Some type of power storage may be required, e.g., a capacitor or battery (see below). A generator with falling tube current (mA) during exposure is preferable to one with constant tube current.

- (ii) Minimum power, 11kW (at 0.1 s); minimum available energy, 25 kW.s.

Note: If the relative speed of the screen-film system is 400, the energy requirement may be reduced to 12kW.s. The power requirement remains the same.

- (iii) Focal spot size, 1 mm or less.
- (iv) Accurate, variable collimator, which cannot be removed.
- (v) Minimum focus-film distance, 100 cm for vertical-beam radiography; 140 cm for chest radiography with horizontal beam.

It should be noted that single-phase two-pulse generators (not involving multi-pulse converter technology) and capacitor discharge units without constant voltage (kV) during exposure are not recommended.

2. General-purpose ultrasound scanner

- (1) *Transducer*

Standard unit: 3.5 Mhz centre frequency.

Optional unit: 5.0 Mhz centre frequency.

Fixed in-slice focusing on both units desirable but not essential.

Sector angle 400 (sector scanner) or better.

Array length: 58 cm (linear array scanner).

(2) *Controls*

To be simple and clearly arranged.

Gain control is required.

Time gain compensation to be by choice of present and variable conditions.

(3) *Frame rate*

5-10 Hz (sector scanner), 15-30 Hz (linear array scanner).

(4) *Frame freeze and display*

512 x 512 x 4 bits (to provide 16 "grey" levels).

(5) *Omnidirectional callipers*

One pair to be provided, with facility for quantitative read-out and recording.

(6) *Patient identification*

Facilities to be provided for manually entering and recording data-patient identification, date, etc.-on the image screen.

(7) *Permanent recording*

Provision must be made for the economical preparation of good-quality permanent image records.

(8) *Construction*

The unit should be portable (not more than 8 kg), drip-proof, and dust-proof. Proper and continuous operation should be possible under the following conditions:

Temperature: 0°C to + 40°C.

Humidity: up to 95%.

Prolonged storage should be possible under the following conditions:

Temperature: -30°C to +50°C.

Humidity: up to 100%.

The unit should be rugged and capable of withstanding the vibration likely to occur during rough, cross-country transport. Special care should be taken to avoid failure of the transducer, its cable, and its connector under the above conditions. The mechanical design of the transducer should include:

- (a) Maximum protection against damage by dropping;
- (b) Tolerance of the use of a variety of coupling media, particularly local vegetable oils.

(9) *Electrical and mechanical safety*

This equipment should conform to the standards set out by the International Electrotechnical Commission (Medical Electrical Equipment)¹. Where interventional use is intended, particular care must be taken to ensure that the relevant standards of equipment earthing (grounding) and leakage of current are met.

(10) *Power supply*

The equipment must be capable of working from any of the following types of supply:

Direct current: standard batteries, preferably rechargeable.

Alternating current:

- 50 and 60 Hz

- 00,110, 117,125 and 200,220,240 V.

- line voltage variation + 15%.

Surge protection to be provided.

(11) *Servicing and quality control*

Although modern equipment should be reliable and stable in performance, both failures and degradation should be anticipated; the following quality control procedures are highly recommended:

- (a) At regular intervals (at least every 3 months and preferably every week) the resolution and sensitivity performance of the unit should be checked using a suitable phantom. Corrections should be made if there is any appreciable change in performance over a period of time.
- (b) Arrangements should be made (with the manufacturer or otherwise) for a centralized repair and maintenance service to be provided, to cover a number of units in a country or region.
- (c) Provision must be made for a supply of spare parts to be rapidly available. These parts must include spares for the transducer, the display monitors, and the principal electronic assemblies.

(12) *Space*

Ultrasound examinations may be made at the bedside, but it is preferable to set aside a room that will provide both privacy (if necessary by curtains) and a suitable horizontal support for the patient. It is helpful if the room illumination can be reduced. A toilet should be provided close to this room. In busy departments the provision of several changing cubicles will increase the number of patient examinations that can be carried out. No added structural protection is required.

¹ *General requirements*. Geneva, International Electrotechnical Commission, 1977 (Publication No. 601-1). *Particular requirements for specific types of equipment (including ultrasound and computed tomography)*. Geneva, International Electrotechnical Commission (in preparation) Publication No.601-2).

ANNEX 7

OPTIONAL MEDICAL IMAGING EQUIPMENT

1. Mobile X-ray units

If a mobile X-ray unit is purchased, the power source can be batteries (preferred) or mains. A battery-powered unit needs a mains connection only when the batteries are being charged. Most battery-powered mobile units can deliver 10-12 kW for at least 2.5 s, resulting in a total energy output of 25-30 kW.

A mains-connected mobile unit must contain a built-in capacitor to reach the output needed. Capacitor discharge (also known as condenser discharge) X-ray units store enough energy for a single X-ray exposure. They must be connected to a power source during operation for recharging, but this source can be a standard grounded wall outlet. The capacitor may be connected on the primary (low-voltage) side or on the secondary (high-voltage) side of the high-voltage transformer.

Connection on the secondary side is usually combined with constant X-ray tube current (mA), resulting in falling kV during the exposure. Such a unit can be used to X-ray the chest and the extremities only and should not be purchased for general purpose radiography.

Connection of the capacitor on the primary side of the transformer is usually combined with a multipulse converter circuit with falling mA but constant kV during the exposure. This is a very good technical solution, often resulting in high initial power output (20-30 kW) and a satisfactory total energy output of about 10 kW.

Do not purchase a mobile unit that requires special high-power wall outlets to function. This rules out use of all two-pulse single-phase units.

As already noted [para (a) (1)], a mobile unit is not essential in many small hospitals but may be needed for orthopaedic surgery. Almost all other immobilized patients are better taken to the X-ray department for examination on their beds.

2. Fluoroscopic equipment

WHO does not recommend the purchase of fluoroscopic equipment, even with image intensification, unless a specialist radiologist is present to use it. As stated in WHO Technical Report Series No. 689, *A Rational Approach to Radio diagnostic Investigations* (section 4.2), "A general and important recommendation is that all barium studies should be carried out only by qualified radiologists using appropriate fluoroscopic equipment.

There are several reasons for this recommendation :

- (i) Over 90%, often 95%, of all the imaging required in 50-100-bed first-referral hospitals is of the chest and skeleton. Radiography of the abdomen, gall-bladder and urinary tract accounts for most of the other needs. None of these examinations requires fluoroscopy. In particular, WHO strongly recommends that chest fluoroscopy be replaced by radiography (a chest film) (WHO Technical Report Series No. 689, section 2.3.8).

- (ii) The initial cost of fluoroscopy equipment and the recurring costs are considerable and not cost-effective.
- (iii) The radiation dose delivered during fluoroscopy is high.
- (iv) The diagnostic accuracy of fluoroscopy is very low. In particular, "routine" chest fluoroscopy is never indicated as part of a medical examination (WHO Technical Report Series No. 689, sections 2.1.5 and 2.3.8).
- (v) Ultrasound adds considerably to the diagnosis of abdominal problems and involves no exposure to radiation.
- (vi) Gastrointestinal examinations should be performed only by specialist radiologists.

3. Recording the ultrasound image

If the physicians are conscientious, the results of an ultrasound examination, including measurements, can simply be written in the patient's records, without an accompanying image. If affordable, however, a permanent image is preferable. A permanent record of the image can be obtained in several ways, which vary in expense and efficiency; all require additional attachments:

- (i) The least expensive is to record on special paper. At present, the resulting image is not of very good quality.
- (ii) Recording on Polaroid® film requires a special camera which photographs the video image. This method is quick and efficient, but the film is expensive and not always available.
- (iii) Recording on X-ray film requires a separate recorder, which produces an excellent image after the film has been processed in the X-ray darkroom. The recorder is expensive.

Careful discussions should be held with the medical staff and the company that will supply the equipment in order to clarify the needs, the initial cost and the recurring costs.

ANNEX 8

USE AND SPECIFICATIONS OF THE WHO BASIC RADIOLOGY SYSTEM (BRS) AND THE WORLD HEALTH IMAGING SYSTEM FOR RADIOGRAPHY (WHIS-RAD)

For the past 20 years, WHO has been supporting the development of the Basic Radiology System (BRS). This system provides good quality images, and is easy to use and maintain. Since 1993, the system has been further improved and called the (WHIS -RAD). The difference between the two systems is summarized at the end of this Annex by Dr Thure Holm, of the WHO Collaborating Centre for Radiological Education in Lund, Sweden.

Potential users of these X-ray units should be aware that there are low quality copies of such units on the market. Ask your potential suppliers to provide you with references from current users of their products, and enquire yourselves directly with the current users.

1. Introduction

The World Health Organization has developed a concept of diagnostic radiology that has been named the Basic Radiological System (BRS). The BRS is primarily intended to be used in communities currently deprived of radiodiagnostic services. Long practical experience has shown, however, that the BRS is equally applicable in industrialized countries. The BRS concept comprises X-ray equipment, as well as equipment for film processing and viewing of X-ray films, and manuals for radiographic technique, darkroom technique and film interpretation.

The BRS is aimed at providing:

- (1) better radiographic coverage of the population in the entire world;
- (2) an adequate radiographic system capable of performing at least 80% of all radiographic examinations required at university level;
- (3) radiographic equipment which can be operated by personnel who have had shorter training than fully qualified medical radiology technicians (MRT);
- (4) better radiodiagnostic facilities to physicians working in less accessible places of the health care system.

The attainment of these objectives will result in:

- better diagnosis and prognostication of disease;
- improved therapeutic decisions and consequent management of patient care;
- reduced cost to patient, community and government due to the shortened period of disability and bed occupancy, and the reduced need for patient transportation;

- lowered radiation dosage per examination.

The development of such a BRS requires an X-ray apparatus with the following major characteristics:

- (i) Utilization restricted to general X-ray examinations not requiring fluoroscopy, tomography or serial film changers.
- (ii) Simplified design and increased reliability permitting:
 - operation by persons with less training than that of an MRT;
 - operation under adverse climatic conditions;
 - operation in places where no electrical power line is provided or where it is undependable due to frequent power cuts, wide fluctuations in voltage and frequency, etc.
 - simplified procedures for faultfinding and repair in case of breakdowns, thus increasing the viability of the equipment as much as possible;
 - operation at a reasonably low level of radiation exposure to patients and operating personnel, in compliance with international standards.
- (iii) The cost of the X-ray equipment has to be reasonably low, so that large numbers of complete installations can be made available to national health authorities even in developing countries with limited resources.

2. Place of use

The BRS equipment with the characteristics described above is intended for use in:

- (a) small rural hospitals covering the needs of rural populations;
- (b) large health centres and polyclinics with many outpatients;
- (c) larger hospitals (rural or urban), as additional equipment in the casualty department, thus sparing the more sophisticated and expensive X-ray equipment for special X-ray diagnostic procedures, fluoroscopy, etc. Another utilization will be in private medical practice, where such equipment will bring acceptable radiodiagnostic quality within reach of privately financed practices.

3. Examinations to be performed

This list of examinations to be performed by the BRS equipment should serve only as a guide.

The more common indications and examinations include:

Skeleton	:	fractures, bones and joint diseases
Head	:	trauma and infections
Chest	:	tuberculosis, pneumonia and other respiratory infections, heart enlargement, tumors, trauma

- Abdomen : intestinal obstruction, calcifications, trauma and possibly intravenous urography, cholecystography, and problems in pregnancy
- Soft issue : Foreign bodies, calcifications

Contrast medium examinations are only recommended when an experienced person is available, able to carry out and interpret such examinations and treat possible complications of contrast injections. Several of the above-mentioned examinations require special consideration of horizontal beam utilization on the recumbent patient.

4. Technical characteristics of the BRS apparatus

4.1 X-ray generator

The power output of the X-ray generator is critical for two of the examinations specified above:

- (a) the chest, which requires a very short (<50 ms) radiographic exposure, and therefore a high power output for a very short time;
- (b) lateral view of the lower lumbar spine, which requires a very large amount of radiation to penetrate a considerable thickness of tissue and thus high power for a longer time.

The output of the X-ray generator should be high enough to produce a minimum exposure of the 0.5 mR (within .10%) at a focus-film distance of .140 cm and a tube tension of 120 kV:

- (a) behind a 12 cm water phantom in 50 ms or less, and
- (b) behind a 30 cm water phantom in 1 second or less. The exposure conditions include the employment of a focused lead/aluminum grid with 40-50 lines per centimeter and a ratio of 10:1 and an irradiated field at the position of the cassette collimated to 400 square centimetres. The X-ray generator must also be capable of delivering a maximum total output of 25 kW. (This may be produced by a converter generator with an output at the X-ray tube of 10-12 kW at 120 kV).

Recent developments indicate that in the future most X-ray generators will be using the converter principle. These generators use a DC source and convert the DC to AC with higher frequency than regular mains frequency (50/60 Hz). The higher frequency AC utilizes very small and often inexpensive components. The power source may consist of batteries or rectified low impedance AC mains.

Generators using batteries are to be preferred because the main supply will often be unreliable in the working locations to be expected. Preference is given to lead-acid batteries because of the experience from practical tests conducted by WHO working groups. For the same reason, preference is given to X-ray generators using AC frequencies above 2 kHz and automatic control of X-ray tube voltage (kv) at a present value, preventing voltage drop during exposure.

Generators directly connected to the mains have different requirements on the mains impedance for good performance. A mains-operated generator should be considered only when it could be shown that the mains impedance is consistently lower than 0.5 ohm.

4.2 Choice of exposure factors

The choice of exposure factors needs to be restricted to simplify the operation. If the "two-component" system (kV and mAs) is used, the number of available kV-values should be restricted to 4 fixed values: 55-70-90-120 kV + 2%.

The minimum range of mAs-values, usable in the entire kV -range, is 0.8-200 m As in 25 steps for converter generator. The increments between the steps should be 26%. If a single-dial technique is used, changing kV and mAs at the same time and approximately following an iso-watt curve, the number of steps must be increased to more than 30.

4.3 Control panel

This should indicate the state of the electricity supply (mains or battery) before exposure and the chosen values of kV and mAs or object thickness in centimetres of water.

The exposure switch should be mounted on the control panel, so that the operator must stand behind the protective screen during exposures.

The protective screen, large enough to protect a standing operator, should be available as an integral part of the control panel. The lead equivalent needed is 0.5 mm if the X-ray beam is never directed towards this screen. The screen must have a lead glass window not smaller than 30 x 30 cm, placed in a convenient position to give a good view of the patient.

4.4 X-ray and collimator

The X-ray tube should be able to handle at least 20 kW during 0.1 second and 10 kW during 1 second. The focal spot should be smaller than 1 mm. This requires a tube with rotating anode. The anode angle may be as small as 10°.

The total permanent filtration in the useful beam shall be equivalent to not less than 2.5 mm Al and not more than 3 mm Al.

The tube must be provided with an adequate collimator enabling restriction of the size of the beam to that of each of the film formats. A movable pointer or other reliable system for centering of the beam must be provided. The collimator design should enable its easy replacement by an adjustable light-beam collimator in countries whose regulations make these mandatory. The smallest format of the collimator may not be larger than 18 x 24 cm. The collimator design must also prevent any part of a patient from being closer to the radiation source than 30 cm.

4.5 Support for X-ray tube and cassette holder

It is necessary to have a design which will ensure that the X-ray tube is always connected to the cassette holder in a rigid and stable way, providing precise and simple centering of the X-ray beam. The focus-film distance should be fixed at 140 cm. A stationary, focused lead/aluminium grid having 40-50 lines per centimetre and a ratio of 10:1 must be incorporated in the cassette holder and must cover the full area of the largest film. The cassette holder must include a lead screen in the back wall with a minimum thickness of 0.5 mm Pb. This requirement may obviate the need for further radiation protection of the walls of the examination room if the floor dimensions are 3 x 4.5 m or larger and no more than 2000 X-ray examinations are made per year.

The design of the examination stand must permit:

- (a) the use of horizontal beam for examinations of recumbent patients;
- (b) the use of the patient trolley as a "floating" table top in such a way that the longitudinal midline of the trolley can be offset at least + 12 cm from the midline of the cassette holder;
- (c) the use of angulated beam + 30° from the vertical and horizontal beam directions;
- (d) the use of horizontal beam in the range of 50-170 cm above the floor;
- (e) the use of the cassette holder as a small horizontal examination table at a distance from the floor not less than 90 cm. The cassette holder, when used as a table top must permit a load of at least 15 kg without misalignment of the focused grid or slipping of the brake for the vertical movement of the arm carriage;
- (f) the design of the stand should also permit the use of horizontal boom in two opposite directions unless a "mirror image" version of the stand is available.

The film sizes to be used should be standardized and not more than four film sizes are recommended. The cassette holder must accept at least the following formats: 35.5 x 43 cm, 18 x 43 cm and 24 x 30 cm.

4.6 Patient support

The patient support should be rigid, with an X-ray permeable top, approximately 2.0 x 0.65 m in size and approximately 0.7 m from the ground. It must be able to support a weight of 110 kg without appreciable distortion, should be easy to keep clean, impervious to fluids and resistant to scratching. The design of the trolley must permit positioning of the cassette holder in such a way that when the vertical beam is used the distance between table and film plane must not exceed 8 cm. The distance between the front wall of the cassette holder and the film plane should be not more than 2.5 cm. When the beam is angulated + 30° from the vertical direction, the distance between the tabletop and the film plane should not exceed 25 cm in the central beam. The wheels must be of a size to permit easy movement of the trolley with all 0 kg patient, and the locking mechanism should preferably be central and immobilize at least one wheel at either end.

5. Selection and Use

5.1 Choice of power supply

In many rural areas and some towns and cities, the main electrical supply is unreliable, both in continuity and voltage control. Marked variation in line voltage can severely damage X-ray equipment. Where variation is known to occur, an additional line voltage regulator should be installed to protect the X-ray generator. If the power line is weak or unreliable, it can be replaced by a power storage system. The simplest and most reliable is a set of lead-acid batteries (96-120 V, 25-60 Ah); it is also possible to use a large capacitor on the primary side of the high-voltage transformer, provided it meets the energy requirements (12-25 kW) given above under 2 (ii).

Battery-powered generators have several advantages for small hospitals:

- it is very easy to reach a power output of about 15 kW and an energy output of 30 kWh within 2-3 s.
- Work can continue for 1-3 weeks without recharging the batteries (depending on their size).
- Batteries are not affected by variations in voltage or frequency.
- Batteries can be recharged by solar power or by an intermittent power source such as a weak or otherwise unreliable power line or a small independent petrol- or kerosene-powered electricity generator.

Sealed and maintenance-free lead-acid batteries are the best to use with an X-ray generator. They tolerate well the near-short-circuiting which occurs during an X-ray exposure. They may last for more than five years and require practically no maintenance.

The alternative, nickel-cadmium batteries, require sophisticated maintenance and recycling once or twice a year. This cannot be done at the hospital. Nickel-cadmium batteries are not recommended.

X-ray generators with a large capacitor for power storage are a very attractive alternative, if the following conditions are fulfilled:

- The capacitor is connected on the primary side of the high-voltage transformer.
- The X-ray tube voltage is maintained constant and the tube current is falling during the exposure.
- A reliable low-power source (0.8-1.2 kW) is available.
- The X-ray exposure does not require more energy than 10-12 kWh.

A capacitor discharge X-ray generator that fulfils the above requirements may be connected to any household wall-outlet of 220-250 V. It is the best choice for a chest X-ray unit.

5.2 Choice of X-ray tube support and patient support

The X-ray is supported on a column with a tube-arm. The WHO-BRS design (Fig. 108) stipulates a single floor-column with a rotating arm that supports the X-ray tube and the cassette holder. This model requires minimal attachment to the wall and is easy and quick to install. No separate chest stand is needed. The patient support is a mobile trolley, which can also be used to fetch patients from the ward or emergency area. There is no weight on the ceiling.

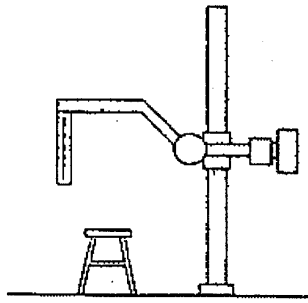


Fig. 108a. BRS unit with horizontal X-ray beam

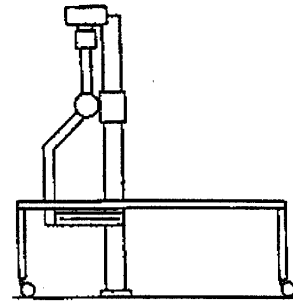


Fig. 108b. BRS unit with vertical X-ray beam and patient trolley

The alternative is a tube-column which runs on floor rails (Fig. 109) and also has a ceiling track. The two sets of rails must be exactly parallel, and the intervening distance must not vary. This requires a level floor and a strong ceiling. The X-ray table is fixed, and an additional, separate chest-cassette holder is required. Tube-columns are available that run on two floor rails, without ceiling support (Fig. 110); these are unstable and are not recommended.

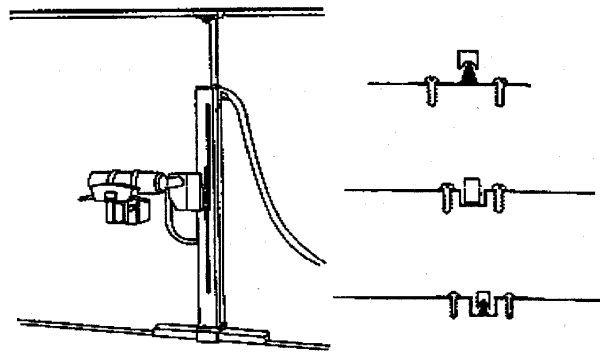


Fig. 109. Column X-ray tube support mounted on floor rails with a ceiling rail: three possible types of rail

The WHO-BRS tube and patient supports are strongly recommended. This design has been well tested in rural hospitals, is very easy to use and, with the WHO-BRS Manual of Radiographic Technique; can be used to provide all the X-ray examinations required in hospitals where there is no specialist radiologist (and will even be satisfactory when there are fully trained radiological staff).

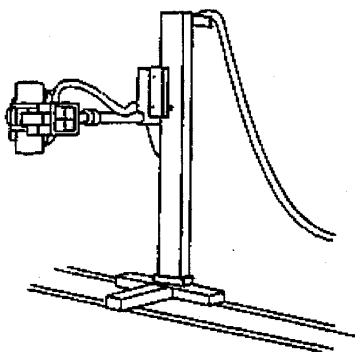


Fig. 110. Column X-ray tube support mounted on floor rails

5.3 Secondary radiation grids

When X-rays pass through a part of the body, some are scattered within the tissues. This reduces the contrast in the radiographic image. A so-called "grid", interposed between the patient and the film cassette, will greatly reduce the amount of scattered rays that reaches the film (Fig. 111). A grid appears as a 2-3 mm thick, flat plate and contains very thin strips of lead (about 0.05 mm wide and 2 mm high), supported by interleaving strips of an X-ray-translucent material (about 0.2 mm wide and 2 mm high), arranged as a venetian blind.

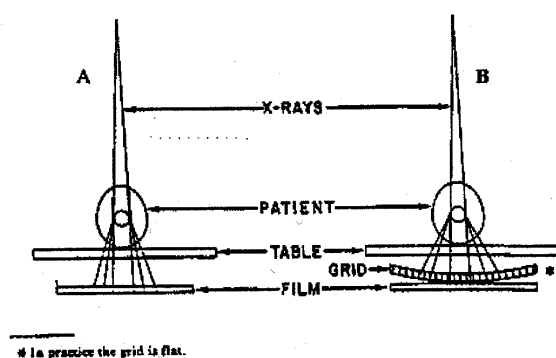


Fig. 111. Scattering of radiation: A, without a grid; B, with a grid

The grid lines will be visible on the film if it is viewed at a very short distance (<30 cm) or if the grid is not correctly focused. The lead strips of focused grids are arranged in such a way that each line is imaged practically without magnification, permitting nearly 80% of the direct radiation to pass through. A focused grid must be used, however, at only one distance from the X-ray tube. If this cannot be done, or if the grid lines are wider than 0.05 mm, the grid can be moved (oscillated) during the exposure to blur the image of the lead strips. Such a moving grid is called a "bucky". Bucky mechanisms are complex mechanical devices and are also expensive.

If different focus-film distances are used in radiography, different grids must be used in different imaging geometrics. Grids are expensive items. WHO recommends the use of a single standard focus-film distance, which permits the use of a single focused, high-quality grid for all examinations.

5.4 X-ray films and screens

X-ray films, which have photographic emulsion on both sides, are placed between two fluorescent "screens" inside a light-proof cassette. When X-rays pass through the patient and the cassette, the screens give off light, which exposes the film emulsions, recording an image. Screens vary in their response to X-rays and their capacity to reproduce details of the image.

X-ray-intensifying screens are currently rated in four main groups by the manufacturers (Table 13). Unfortunately, there is no clearly defined nomenclature, and the "fast" screens from one manufacturer may be similar to the "medium" screens from another.

Table 1.3. Main groups of X-ray intensifying screens

Group	Resolution (lines/mm)	Relative speed Blue/UV systems	Green systems
Fine/detail	8-12	80-125	80-125
Medium/universal	6-8	100-200	200-250
Regular	4-6	160-250	320-400
Fast	3-4	200-500	500-800

Intensifying screens emit ultra-violet/blue or green light. They must be used in combination with film that has the appropriate colour sensitivity. Use of a blue-sensitive film with green-emitting screens, or the reverse, results in a loss of speed of about 50% and must be avoided.

Green-emitting screens are considerably more expensive than most blue/ultra-violet-emitting screens, but they in general reduce the patient dose by a factor of 2 or more, for the same quality of image. Green systems are also much less likely to show "film graininess". This effect almost always depends on quantum noise and frequently appears in blue systems when the speed exceeds 250 and in green systems when the speed is over 500. Green-sensitive (orthochromatic) film has a longer shelf-life (is less sensitive to ageing); however, it is not yet generally available and may be more expensive in some markets.

Note: Never mix cassettes or film for blue and green systems.

Provided the X-ray generator meets WHO requirements for a BRS generator (converter generator with minimum 11 kW, 25 kW), a "medium" speed of about 200 is the safest choice because such screens and films are universally available.

Note: The traditionally used amber-coloured filters for blue-sensitive X-ray film cannot be used with green-sensitive film. Green-sensitive film requires a filter of a rather dark ruby-red colour.

To ensure a constant supply of X-ray processing chemicals, it is advisable, but not essential, to buy film and chemicals from the same supplier. Most chemicals can be used to process any make of film. Note that three essentially different types of developer are available. One is used for large automatic processors at high temperature and needs special "starter" and "replenisher" solutions. Another is used for automatic processors with low capacity and small tanks at high temperature and does not require "starter" and "replenisher". The third type is used for manual processing at 20-25°C and is less aggressive; no "starter" or "replenisher" is used.

5.5 Processing X-ray films

After exposure, X-ray films are taken in the cassette to the darkroom, where they are removed for processing, which can be done manually or automatically.

- (i) All automatic processors require a constant electrical supply and can be used only with good-quality X-ray film. Small, "table-top" processors are reliable, easy to install and provide well-processed, dry X-ray films within 3-4 min. If more than 15-20 patients are X-rayed every day, an automatic processor is desirable; if the electrical supply is unreliable, however, back-up manual processing is essential.
- (ii) Manual processing tanks should be made of high-quality, chemical-resistant stainless-steel. Plastic tanks are cheaper but will warp, crack and leak (although manufacturers claim otherwise). Specifications are given in paragraph 6. Most metals, including regular stainless-steel, are rapidly destroyed by X-ray chemicals.

Both manual and automatic film processors must be connected to running water, preferably both hot and cold. There must also be adequate drainage: plastic, porcelain or other chemical-resistant pipes are essential, as the water running off contains chemicals (Fig. 112).

5.6 Safe lights and other darkroom accessories

Details are given in paragraph 6. The following information is also important:

- (i) X-ray chemicals cannot be mixed in the darkroom, as good ventilation (e.g., open air) is required during mixing. Designated buckets for developers and fixer are essential equipment.
- (ii) Do not install a film-viewing box in the darkroom, as it will interrupt and delay processing. Provide a carrying tray to catch the wet drips if films are processed manually, and carry the films to a viewing box in the office (not in the X-ray room).
- (iii) The switch that controls the filtered safe light should be located immediately inside the entrance door at the regular height for light switches used in other rooms. The switch for the white ceiling light should be placed above the safe-light switch but at a somewhat "inconvenient" height above the floor: 180 cm is recommended. This arrangement averts the possibility that the white light will be turned on by mistake, which would fog or completely destroy the X-ray films.

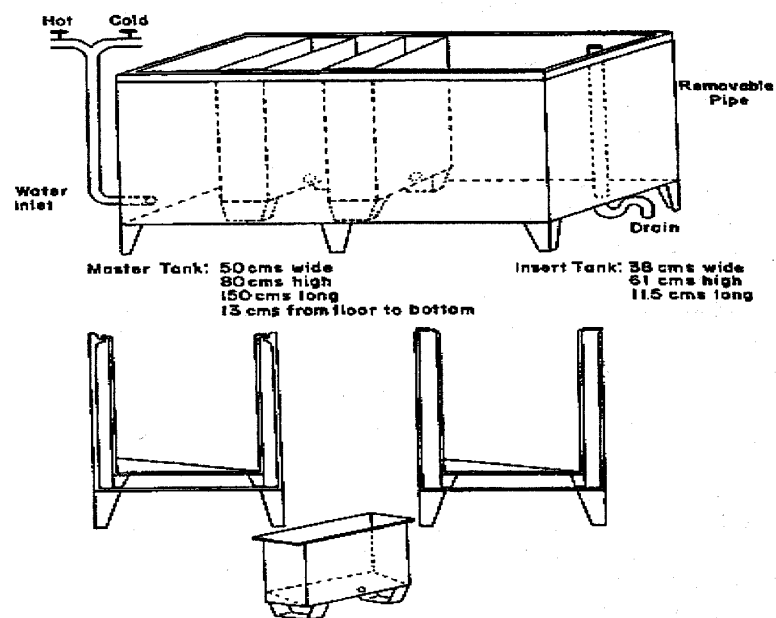


Fig. 112. Processing tank

(iv) The normal entrance to the darkroom, through a maze, a light trap or a narrow, light-tight door, cannot be used for bringing in processing tanks and other large pieces of furniture. A door wide enough for this purpose must be available. This door must be closed or boarded over to be made light proof when the darkroom is used.

(v) Adequate light proof ventilation is essential in the darkroom (Fig. 113), and the floor must be chemical proof. Ordinary wooden floors are not satisfactory; concrete or tiles are preferable.

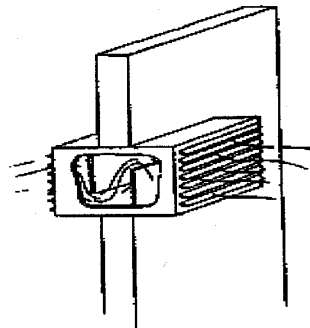


Fig. 113. Lightproof darkroom ventilator

5.7 Radiation protection and safety

Ionizing radiation, such as X-rays, is harmful to human (and animal) tissues. All people who work with X-ray equipment must constantly be aware of the danger. A regular radiation monitoring service for personnel should be established.

Lead-protective clothing must be provided and worn when appropriate. X-ray personnel should never hold or support patients during examination. All protective clothing must be checked regularly and the results documented.

Detailed information regarding radiation protection and personnel monitoring is given in the *WHO Manual on Radiation Protection in Hospitals and General Practice* (Volume 1, *Basic Protection Requirements*; Volume 3, *X-ray Diagnosis*; and Volume 5, *Personnel Monitoring Services*).

Building specifications are described in Annex 6.

6. Installation

Location of the X-ray unit

The location of the X-ray unit must be chosen primarily for ease of access for all patients. With the BRS, radiation protection is not a critical factor in the choice of location.

The majority of patients will be ambulatory outpatients but some patients will arrive on trolleys or in wheelchairs. The X-ray unit should be located close to the hospital entrance, preferably on the first floor. There must be no steps, thresholds or other obstacles which would impede trolleys and wheelchairs.

Space required for the X-ray department

A minimum of three rooms are required examination room (X-ray room), darkroom and office/viewing room. Some additional storage space must also be available and a special film file is required if the processed X-ray films are to be filed within the X-ray department.

The X-ray room must be at least 12 m², not including the control area, where the operator is standing during the exposures. The minimum work area for a BRS stand is 2.9 x 4.2 m. See Fig. 114a.

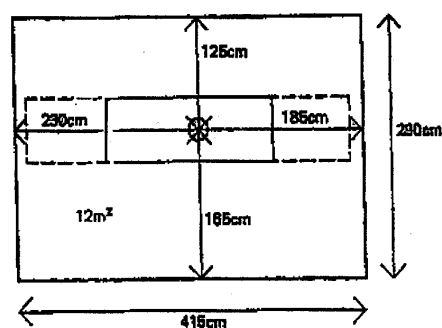


Fig. 114a. BRS examination room

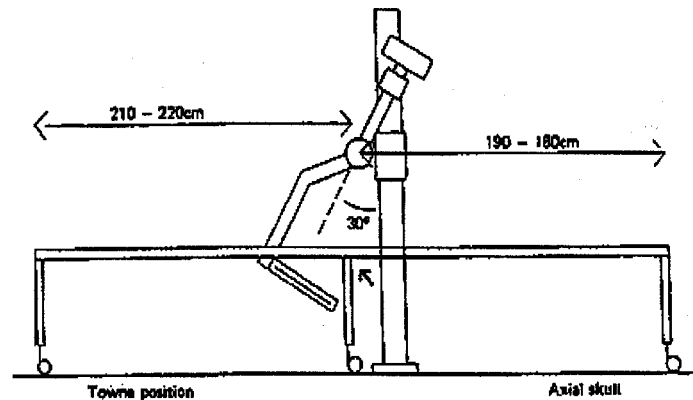


Fig. 114b. Working range of BRS stand

The control of the X-ray generator may be located behind a lead screen inside the X-ray room. A better solution is to have the control in a small separate space outside the examination room. The total area of the examination room including the control should be at least 18 m².

The amount of radiation absorption needed in the room walls depends upon the size of the room and the number of examinations per year. If the walls are made of concrete or clay-bricks with an effective thickness of 5 cm, the following conditions are valid for a maximum of 5 mSv (0.5 rem) per year outside the room:

Room size	Distance to nearest wall from vertical central beam	Ceiling height*	Max. number of exams/year
3 x 4 m	1.5 m	2.5 m	2 000
4 x 5 m	1.8 m	2.8 m	3 000
4.6 x 5 m	2.1 m	3.0 m	4000

*if floor above is occupied

The *darkroom* should be at least 5 m² for manual processing. No dimension of the room should be smaller than 2 m. If an automatic processor is used and the room is not continuously manned, the room may be as small as 1.5 x 2m.

The *office/viewing room* should at least be 8 m². If a film file is maintained in the office, the room must be considerably larger with dimensions depending upon the anticipated size of the film archive. Also if the room is to be used for film-viewing in groups, the room must be larger.

Storage space is required for chemicals, unexposed X-ray film, linen, film envelopes, etc. Unused chemicals may be stored in the darkroom. Unused X-ray film must be stored standing in the original light-tight boxes away from heat, humidity and radiation.

Relationship between the rooms

Several complete floor plans for small BRS departments are shown in figures 115a-115c. The larger ones contain storage and utility rooms and a small area for waiting. It is important that the darkroom is close to the control area of the examination room. It is also vital that the darkroom is not too close to the radiation source.

Design of the X-ray room

Unless the X-ray room is very small or the number of examinations is very large, it is unlikely that special arrangements will be necessary for radiation protection. Walls made of wood or fibre-board are not suitable, however. Brick, concrete or gypsum plate are usually satisfactory. The walls should have a protection capability equivalent to that of 0.25 mm of lead or more and the distances mentioned in the table above should be observed. A shorter distance may be compensated for by an increase in the lead equivalence but more than 0.5 mm of lead is never needed with the BRS unit.

If the X-ray room has windows, no part of the window may be less than 2 m from the outside ground.

The X-ray room floor must be strong to support the weight of the stand column and the X-ray generator. The weight of the stand column will be in the range of 250-500 kg and the support area may be very small (about 400 cm²). The X-ray generator has a wider base and may weigh as much as 350 kg if it contains lead/acid batteries.

It is essential that the floor is completely level because patient trolleys will have to move over it. It should be waterproof, washable, and free of dust. The best construction material is concrete covered with vinyl.

The ceiling height should be at least 2.5 m. The ceiling will not be required to support any weight.

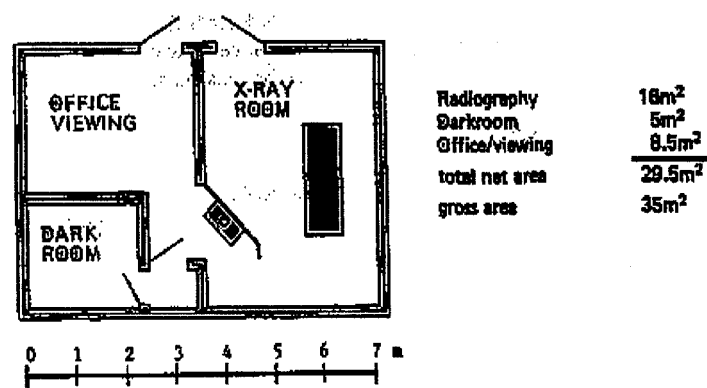


Fig. 115a. Minimum BRS department

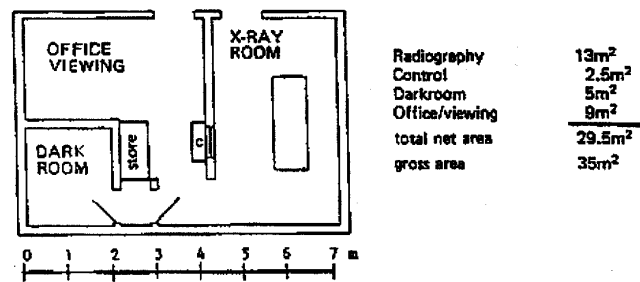


Fig. 115b. Minimum BRS department 2

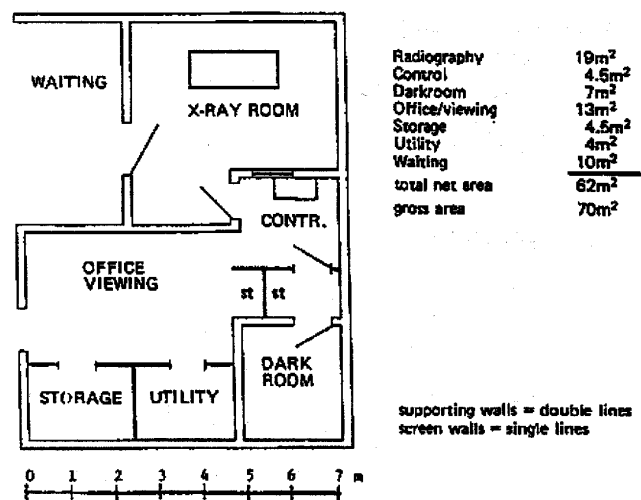


Fig. 115c. Small BRS department

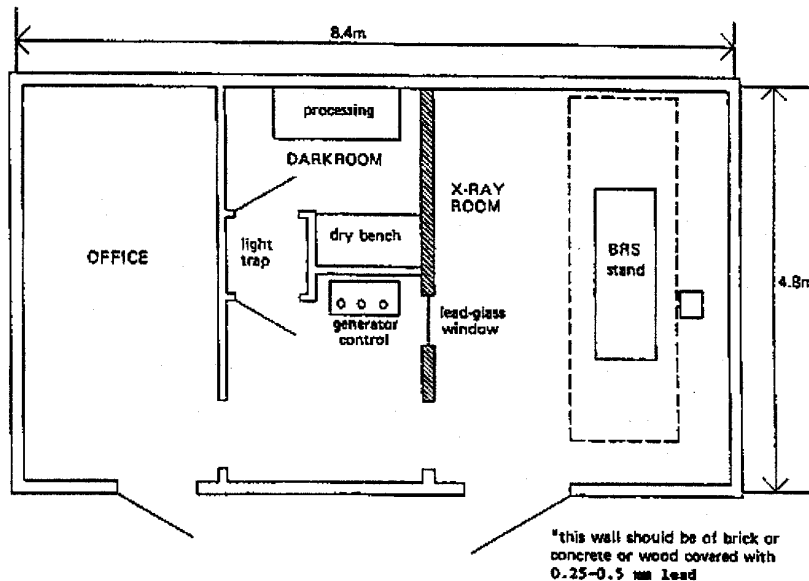


Fig. 116. Small X-ray department showing working area for BRS stand

The walls should be painted with washable semi-gloss paint in a very light (pastel) colour or be almost white (cream). The ceiling should be white. It is preferable to use subdued indirect light when supine patients are examined. Separate fluorescent light sources should be available in the ceiling for cleaning and service needs.

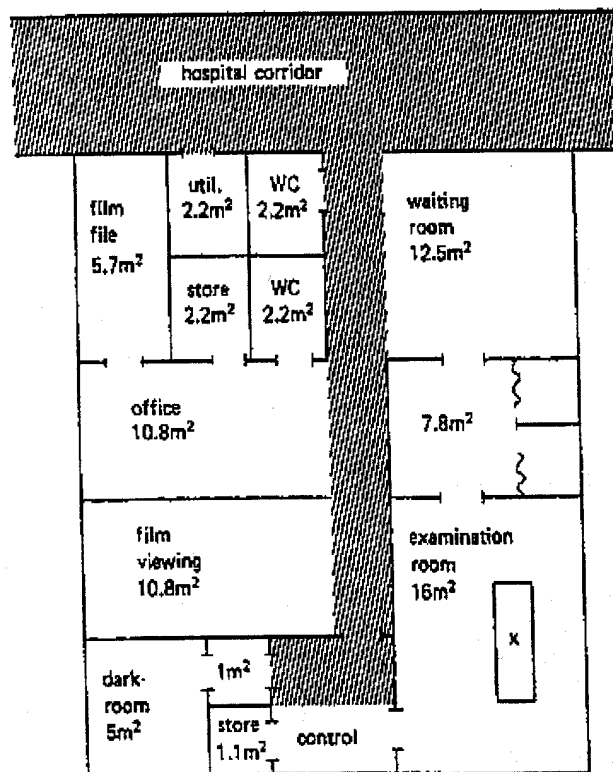
The door between patient corridor and examination room must be wide enough to admit a bed—usually 110-120 cm. There should be no step or threshold. It is preferable to use a steel door but if the distance to the radiation source is long (more than 3 m) or the patient load is small (less than 10 examinations per day), a wooden door may suffice. It must be possible to lock the door from the inside.

If the X-ray room is large enough (18 m² or more), the X-ray generator may be located behind a panel inside the room. The panel must permit full protection of the operator and of cassettes with unexposed film and should contain at least 0.5 mm lead or the equivalent thickness of bricks (Fig. 116). It is often more convenient to have a separate small room for the generator control. The design of this room must prevent primary or secondary radiation from reaching the BRS operator or the X-ray cassettes even if the opening between the examination room and the control room does not have a door.

Design of darkroom

The important factors in the design of the darkroom are the size of processing equipment and the need to work in almost total darkness with only safe-light illumination. There must be separation of a wet area and a dry area.

The darkroom must be entirely lightproof, however bright the outside sunlight. Light-tightness of door, window and ventilation ducts must be tested carefully. No light leak from outside may be visible to someone who has spent 10 min inside the room in total darkness.



		0	1	2	3	4	5	m	net area range (m ²)	this dept (m ²)
Patient area	Waiting room								10 - 20	12.5
	Dressing cubicles								2 - 4	} 7.8
	Space for trolley								2 - 4	
	Patient toilet								2 - 3	
Examination room (incl. control)									16 - 20	18.5
Personnel area	Darkroom								6 - 8	6.0
	Viewing room								8 - 12	10.8
	Office								8 - 12	10.8
	Film file								5 - 10	5.7
	Storage and supply								2 - 4	3.3
	Utility								2 - 4	2.2
	Personnel toilet								2 - 3	2.2
Total net area									65 - 104	82.0m ²

Fig. 117. Floor plan for primary care radiography 4000 or more examinations per year

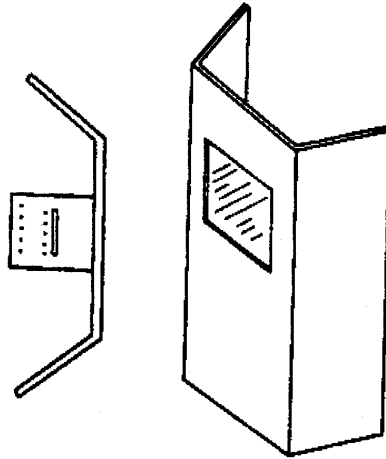


Fig. 118. Control protective screen and control panel

The entrance to the darkroom should be close to the X-ray generator control but it need not be directly from the X-ray room. If the workload is small (one examination per hour or less), and floor space is a problem, it may be sufficient to use a simple light-tight door.

The darkroom floor should be waterproof, level and washable. A floor drain is very useful. Ceiling and walls should be painted with a semi-gloss chrome-yellow colour with no white pigment added. A pure chrome-yellow paint does not reflect any blue light which might expose the X-ray film. Also, the walls should be washable.

Three separate light sources are needed in the darkroom.

- (1) General white light: a 4-watt incandescent bulb in the ceiling (a fluorescent tube gives afterglow and is not acceptable)
- (2) Indirect filtered light: a 25-40 watt incandescent Indirect filtered light filtered light in a reflector directed upward towards the ceiling (Fig. 119a)
- (3) Direct filtered light: a 15-watt incandescent filtered light in reflector directed downwards towards surface of the dry-bench. Distance between bulb and table surface, 120 cm. The reflector must have the words "MAX 15 WATT" written in large letters on the outside 3 (Fig. 119b).

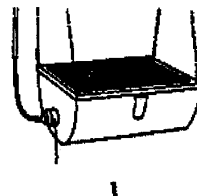


Fig. 119a. Indirect filtered light

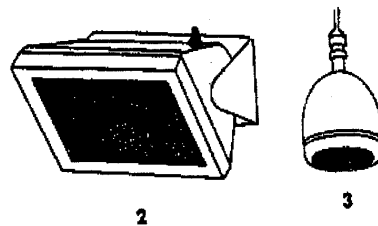


Fig. 119b. Direct filtered light

All light sources must have separate switches located so that confusion is impossible.

The darkroom must have a dry side with a dry-bench for unloading and loading of cassettes and a wet side with processing tanks. Separation of wet side and dry side becomes unnecessary if an automatic processor is used. The darkroom must also have a regular sink, preferably of stainless-steel.

The minimum equipment for film processing is a 26-litre developing tank, a fixing tank of the same size or 50% larger and a rinsing tank which can handle at least the expected film production from one hour of work: usually 15 cm or more in length.

Design of office/viewing room

Several different activities will go on in the office and will affect the design of the room:

1. reception and dismissal of patients;
2. keeping of records;
3. drying of X-ray films;
4. viewing of X-ray film, sometimes by several people;
5. filing of X-ray films and reports in envelopes.

The room must have viewing boxes with fluorescent light for viewing of several films at the same time. A minimum is one viewing box with a light area of 43 x 72 cm for wet films (with a drip tray) and one with a minimum light area of 43 x 100 cm for dry films.

The room should also contain a drying rack or drying cabinet for film, a regular office desk with room for typewriter, telephone, etc., and shelves for film and records.

Storage

Storage space should be provided for unexposed X-ray film, processing chemicals, envelopes, office supply, linen, etc.

Electrical supply

If the generator is dependent on a mains connection, the manufacturer of the X-ray generator will specify the power requirements. Some generators may require as much as 150 A for up to 3 seconds from a 220 V source with a small impedance (0.5 ohm or less). In this case a 50 slow fuse usually will suffice, however. Generators using batteries or large capacitors may operate from standard grounded 220 V outlet and do not require more than 3 A during operation.

If an automatic processor is used, its power consumption may be as much as 5 kW for short periods.

The electrical supply for room lighting and viewing boxes can be standard grounded wall outlets for 220 V, 10 A.

For further information, specific questions may be sent to:

Dr Thure Holm
St. Lars Roentgen
Lund University Clinics
S-220 06 Lund, Sweden (Tel: 046-16 45 09)

7. Summary of differences between WHO-BRS/85 and WHIS-RAD/

This summary is following the layout of WHO document WHO/RAD/TS/95.1: "Technical specifications for the World Health Imaging System for Radiography"

WHO-BRS 1985	WHIS-RAD 1995	Comments
<p>Mains supply An x-ray generator directly connected to the mains supply should be considered only when the impedance is lower than 0.5 ohm. (Assuming a 230 V AC source; the amperage needed is not mentioned.</p>	<p>Mains supply Assuming the use of energy storage (23-39 kW available per exposure), a supply mains for 2.3 kW (230 V/10 A or 115 v/20 A) is sufficient. The value of the mains impedance becomes un-critical.</p>	<p>Generators without energy storage, operating directly from the mains, are not recommended, unless a 3-phase, 380 - 400 V, $<0.3\Omega$ (ohm) power line is available. Peak power loads of 23 - 30 kW for 0.1 s and energy loads of 23 - 30 kW are to be expected.</p>
<p>X-ray generator Multipulse generators using inverter technology and energy storage in lead/acid batteries are recommended.</p> <p>Available kV-values: 55 - 70 - 90 - 120 kV (+ / - 2%).</p>	<p>X-ray generator Multipulse generators using inverter technology and energy storage are required. Lead/-acid batteries are preferred.</p> <p>Available kV-values: 46 - 53 - 60 - 70 - 90 - (100)- 120 kV (+ / - 2%), 100 kV for testing purposes only.</p>	<p>Multipulse generators are now generally available. Maintenance-free, sealed lead/acid batteries (≥ 2 kWh) have an expected lifetime of 5-8 years and are the best energy source.</p> <p>The wider selection of kV-values is an important improvement, making it easier to programme the mAs-values and easier to work clinically.</p>
<p>Tube current values: Not mentioned, but at least 100 mA is needed to reach the specified electrical power rating.</p>	<p>Tube current values: The tube current shall be or exceed 100 mA.</p>	<p>Unless "falling load" is used, fixed tube current values of 100, 125, 160, 200 and 250 mA are required to reach the shortest possible exposure times at different tube loads.</p>
<p>Time-current product: Minimum range 0.8 - 200 mAs (in 26% increments).</p>	<p>Time-current product: Required range: 0.5 - 250 mAs (in 26% increments).</p>	<p>Extension of the mAs-range upto 250 mAs is often important. Values <0.8 mAs are seldom needed.</p>
<p>The exposure time range is not specified.</p>	<p>Exposure time range: 0.005 - 2.5 s</p>	<p>Exposure times <5 ms are difficult to reach with linear $\mu\text{Gy}/\text{mAs}$ response, times > 2.5 s are unacceptable.</p>
<p>Electric power rating: minimum 11 kW at 90 kV.</p>	<p>Electric power rating: minimum 12 kW at 100 kV.</p>	<p>Comparison of power ratings: 125 mA at 90 kV = 11.25 kW and 125 mA at 100 kV = 12.5 kW</p>
<p>Electric energy rating: minimum 25 kW.</p>	<p>Electric energy rating: 23-30 kW at 90 kV.</p>	<p>NOTE: Use of green-emitting screens and green-sensitive x-ray film with nominal speed >400 may compensate for an energy rating below 23 kW.</p>
<p>Linearity and reproducibility are not mentioned</p>	<p>Linearity ($\mu\text{Gy}/\text{mAs}$) and reproducibility are expected to be close to + / - 2% in the entire mAs range</p>	<p>Linearity and reproducibility of multipulse generators are very much better than required by IEC for 50/60 Hz generators.</p>

X-ray tube (rated at 125 kV)
Focal spot: 1 mm or less.
Anode angle: >10.

Nominal power rating:
20 kW (at 0.1 s)
Long time power rating:
10 kW at a loading time of
2 s (= 20 kW). [10 kW for
1 s = 10 kW is incorrect!]

X-ray tube (rated at 125 kV)
Focal spot: 0.8 - 1mm
Anode angle: 12 - 15°

Nominal power rating:
23 -030 kW (at 0.1 s)
Long time power rating:
12 - 15 kW at 2 s (=24 -
30 kW) = energy rating).

A 0.8 mm focus is available with a power rating of 23 - 30 kW. A power rating of 30 kW and an energy rating of 30 kW are required when the "reference man" is 78 kg/178 cm. (It is possible to use 20 kW/24 kW x-ray tubes in many parts of the world, e.g. South East Asia.)

WHO-BRS 1985	WHIS-RAD 1995	Comments
Expected lifetime not mentioned	Expected lifetime (loss in efficiency around 20%): at least 50 000 exposures at normal distribution of examinations.	"Normal examination distribution" = 35-40% chest, 30-42% extremities, 10-15% spine and pelvis, 3-4% head and neck, and 8-10% abdomen.
Total tube filtration: 2.5 - 3 mm Al.	Total tube filtration: 3 - 4 mm Al.	Increased filtration saves dose without increasing the tube load.
Collimator (to limit the irradiated area): minimum requirement: fixed formats 18x24, 24x30, 18x43 and 35x43 cm in longitudinal direction plus a mechanical backpointer to indicate the central beam. A variable light-beam collimator is available as an option.	Collimator (for selection of irradiated area): A standard, multi-level, light beam collimator, which can give any format up to 43x43 cm, and has reliable format indicators for 12, 18, 24, 35 and 43 cm for a focus film distance of 140 cm. No backpointer.	The possibility of a free selection of correctly centered film sizes and formats is an important improvement. The first level of the collimator must be a square diaphragm (beam stop), limiting the irradiated field to 43x43 cm at the film position.
Examination stand with cassette holder for use with horizontal, vertical and angulated x-ray beam. Trolley on wheels. Cassette formats: min. 24x30, 18x43 and 35x43 cm in longitudinal direction.	Same BRS examination stand and trolley on wheels (12 - 15 cm diam.) but with a cassette holder for free choice of film formats:) Minimum 18x24, 24x30, 18x43 (or 20x40), and 35x43 (and/or 35x35) cm.	The examination stand has a new cassette holder with free choice of cassette formats, which is an important improvement. Any format can be used, longitudinally and transversally.
Swivel arm angulation: + / -30° from vertical and horizontal beam directions with retained balance.	Swivel arm angulation: Same as for BRS, but added optional possibilities to create horizontal and vertical x-ray beams, NOT directed towards the cassette holder.	The added optional angulation possibilities make the stand usable in emergency rooms for immobile patients, arriving at the x-ray department in bed or on a stretcher.
Impossible to angulate the cassette holder separately.	Lead shield in the cassette holder back wall: 0.8 mm thick, covering a minimum area of 49x49 cm.	NOTE: This emergency use (for qualified radiographers only) takes away-the radiation protection by the lead screen in the back wall of the cassette holder.
Lead shield in the back wall of the cassette holder: 0.5 mm Pb, outer dimensions not specified.		

CHOICE OF RADIATION QUALITIES

WHO-BRS 1985			WHIS-RAD 1995			Comments
KV	grid	examined body parts	KV	grid	examined body parts	
53	no	extremities	46	no	extremities 1-7 cm thick	
70	yes	skeleton, abdomen, iodine contrast	53	no	extremities 7-12 cm thick	
90	yes	skeleton, abdomen, child chest	60	+/-	testing and special use	
120	yes	adult chest	70	yes	skeleton, skull, abdomen	very dens
			80	yes	spine, IVP, paranasal sinuses	obj.: + 10 kV
			90	yes	lateral lower spine, child chest	
			100	+/-	for testing purposes only	
			120	yes	chest, (GI with barium contrast)	

This comparison was prepared in October 1997 (replacing the earlier one by Dr Thurne Holm, Consultant Radiologist at the WHO Collaborating Centre for Radiological Education, University Hospital, Lund, Sweden, Fax: +46-46-211-6411).