Health care facility projects in developing areas: Planning, implementation, and operation

Bogdan M. Kleczkowski
Formerly, Chief Medical Officer, Resource Group, Division of Strengthening of Health Services, WHO, Geneva, Switzerland

Nils O. Nilsson
Architect, Gothenberg, Sweden
Publications of the World Health Organization enjoy copyright protection in accordance with the provisions of Protocol 2 of the Universal Copyright Convention. For rights of reproduction or translation of WHO publications, in part or in toto, application should be made to the Office of Publications, World Health Organization, Geneva, Switzerland. The World Health Organization welcomes such applications.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

The authors alone are responsible for the views expressed in this publication.

TYPESET IN INDIA
PRINTED IN ENGLAND
83/5773—Macmillan/Clays—7000
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>vii</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. PROJECT PLANNING</td>
<td>4</td>
</tr>
<tr>
<td>The need for planning</td>
<td>4</td>
</tr>
<tr>
<td>Area-wide planning</td>
<td>6</td>
</tr>
<tr>
<td>Intersectoral coordination</td>
<td>9</td>
</tr>
<tr>
<td>Balance between needs, resources, and use</td>
<td>10</td>
</tr>
<tr>
<td>Planning capability</td>
<td>13</td>
</tr>
<tr>
<td>The multiprofessional planning team</td>
<td>14</td>
</tr>
<tr>
<td>Education and training for health facility planners</td>
<td>16</td>
</tr>
<tr>
<td>3. PROJECT IMPLEMENTATION</td>
<td>20</td>
</tr>
<tr>
<td>Implementation stages</td>
<td>20</td>
</tr>
<tr>
<td>Project management</td>
<td>23</td>
</tr>
<tr>
<td>Type-plans and standardization</td>
<td>30</td>
</tr>
<tr>
<td>Construction and materials</td>
<td>38</td>
</tr>
<tr>
<td>Building maintenance and improvement</td>
<td>49</td>
</tr>
<tr>
<td>Climatic considerations</td>
<td>50</td>
</tr>
<tr>
<td>Local methods and skills</td>
<td>52</td>
</tr>
<tr>
<td>4. PROJECT OPERATION</td>
<td>55</td>
</tr>
<tr>
<td>Management capabilities</td>
<td>55</td>
</tr>
<tr>
<td>Cost management</td>
<td>60</td>
</tr>
</tbody>
</table>
CONTENTS

Maintenance management .................................. 65
Monitoring and evaluation ................................ 67

5. CONCLUDING REMARKS ................................. 76

GLOSSARY OF TERMS ...................................... 78

REFERENCES .................................................. 83

ANNOTATED BIBLIOGRAPHY ................................. 85
Acknowledgements

We express our thanks and appreciation to all contributors who, through their discussions, advice, and comments helped in the preparation of this book, in particular Mr M. el Bagir Aziz, Head, Health Project Unit, Ministry of Construction and Public Works, Khartoum, Sudan (member of the WHO Expert Advisory Panel on Organization of Medical Care), and to the participants in a WHO technical meeting on “Planning, programming, design, and architecture of health care facilities in developing countries” (Geneva, 1980); Dr F. Borrego, Director of Investments, Ministry of Health, Havana, Cuba; Mr B. Diongue, Health Statistician, Ministry of Health, Dakar, Senegal; Mr D. Downham, Representative of the International Hospital Federation; Mr R. England, WHO Consultant; Dr S. Falkland, WHO Field Consultant; Dr J. Kasonde, Permanent Secretary, Ministry of Health, Lusaka, Zambia (member of the WHO Expert Advisory Panel on Organization of Medical Care and Co-Chairman); Miss C. Lenngren, WHO Field Consultant; Mr P. Mein, formerly Research Fellow, Housing Research and Development Unit, University of Nairobi, Kenya (Rapporteur); Dr C. Montoya-Aguilar, Medical Officer, Health Planning, Division of Strengthening of Health Services, WHO, Geneva; Professor R. Moss, Director, Medical Architecture Research Unit, the Polytechnic of North London (member of the WHO Expert Advisory Panel on Organization of Medical Care and Co-Chairman); Dr E. Pütsep, Representative of the International Union of Architects–Public Health Group; Dr T. López Ramirez, Head, Directorate of Establishments and Medical Care, Ministry of Health and Welfare, Caracas, Venezuela; and Dr Omer El Baghir Salih, Director-General Health Statistics Department, Ministry of Health, Khartoum, Sudan.
1. Introduction

The Global Strategy for health for all by the year 2000, adopted by all the Member States of the World Health Organization (1) emphasizes the need to provide technical guidance for national decision-makers on the rational development of the physical facilities available to health services, particularly in developing countries where resources are most limited and costly mistakes must be avoided. Throughout the developing world, a large number of health care facilities are being developed but, contrary to expectations, many of these either do not function adequately or are too expensive to run properly, or both. There are several reasons for this, and in this book an attempt is made to identify both the causes of the failures and the methods necessary to correct them. This volume will be useful to all those involved in the development of health systems, from those who determine national health policy and the allocation of resources, to the international agencies that support relevant projects in developing areas. But, in particular, the book is aimed at people who are engaged daily in the important tasks of planning, implementation, and operation of national health facility projects.

For many years, it has been assumed that health care facilities in developing countries should be modelled on those found in the more developed countries and that only a few modifications, mainly because of climatic conditions, should be necessary (2). Surprisingly, this view is still held by many “experts” who wish to participate in projects in developing countries but who lack experience in the problems involved. In the developing countries themselves, some health workers, who have become accustomed to using sophisticated equipment during their studies or travels abroad, share these views. Similarly, some decision-makers are tempted to incorporate sophisticated technology into a hospital in order to increase its prestige, whereas in some of the more affluent countries the need for this same technology is now beginning to be questioned (3).

On the other hand, some decision-makers, planners, architects, or health workers have been aware of the constraints imposed by limited financial and labour resources, harsh climates, insufficient or unreliable utilities, and specific social and cultural traits. Consequently, there are many hospitals and health centres in developing countries that are examples of reasonable and appropriate planning. Facilities that were
simply copies of buildings in affluent countries began to be seriously criticized when they proved extremely costly to construct and operate, difficult to manage, and almost impossible to maintain.

Unfortunately, such costly mistakes, even if they were a lesson for those involved, did not receive the adverse publicity they deserved. As a result, the same errors have been repeated in other countries and places. In addition, the almost total lack of published material proposing reasonable solutions adapted to the conditions of developing countries made it impossible for planners and architects in these countries to rely on well tried and documented guidelines.

For this reason, the World Health Organization decided in 1974 to undertake a study on the planning, programming, design and architecture of hospitals and other medical facilities in developing countries and to disseminate its results in a series of publications. At the time, this study was thought likely to result in the publication of manuals or monographs. However, there was an urgent need to provide initial guidelines that would permit the users to determine whether the relevant problems had been identified, the proper methods chosen, the local constraints envisaged, and the various alternatives considered, before a decision to build a facility was taken. Therefore, an effort was made to examine a series of specific subjects of particular concern to health administrators, planners, and architects, and to do it in such a way as to make each aware of the other’s problems and constraints. This is why, in each of the four volumes of Approaches to planning and design of health care facilities in developing areas (4) published to date (the fifth volume is in preparation) subjects relevant to these various readers were treated without attempting a systematic and exhaustive coverage of the subject.

The concerns of other interested bodies such as the WHO Regional Offices, the International Hospital Federation, and the Public Health Group of the International Union of Architects were taken into account in this study, and they were consulted and involved from the outset. An example of this common approach was the gathering in Nairobi, in November 1974, of a Joint IHF/IUA/WHO Seminar on “Planning and building of health care facilities under conditions of limited resources”. While this meeting provided evidence that some participants had not yet understood the specific problems likely to be encountered when planning health care facilities in developing countries, the proceedings were widely disseminated by publication in two special issues of World hospitals (5).

Following the publication of the first and second volumes of the Approaches to planning and design of health care facilities in developing areas several country-based case studies were carried out, showing under what constraints, and with what results, the planning and implementation of the health system physical infrastructure was taking place in practice. It was thought that identification of any mistakes

---

might be of value, provided their causes could be elucidated and their consequences analysed. Original solutions to recurrent problems were examined to determine whether they could be adapted to different contexts. The Swedish International Development Authority (SIDA), financed case studies in six countries: Algeria, Cuba, Senegal, Sudan, Venezuela, and Zambia. The studies were devised so as to be of immediate use to the actual countries involved. Subsequently, the results have been analysed by the national authorities and volume 5 of the “Approaches” will be devoted entirely to the main lessons learned from these case studies.

In parallel, WHO Regional Offices conducted studies and developed projects. In the region of the Americas a project on “National systems for maintenance and engineering of health care facilities” began in Venezuela, and was later extended to include other Latin American countries. The subregional congress on “Health care facilities programming, development and maintenance”, convened in Venezuela in 1980, was the preparatory phase of a complex health facilities project involving countries of the whole Andean Region (Bolivia, Chile, Colombia, Ecuador, and Peru). In the Western Pacific Region, the intercountry project on “Hospital management, design and maintenance” was developed and supported by the United Nations Development Programme. In the South-East Asia Region, various activities have been concerned with facilities in relation to basic health services, and with problems of the maintenance of equipment. The African, Eastern, Mediterranean, and European Regions have been directly involved in national case studies, and their concern with health care facilities is clearly increasing.
The Need for Planning

Health care facilities are essentially only shelters in which health care functions can be performed. Until those functions are defined, the actual building requirements cannot be identified. This necessitates a planning process capable of assessing the priorities among health problems and of defining the action required to deal with these problems at various levels. Some countries are now trying to find solutions that are economically and physically feasible, and are defining the roles and responsibilities of the groups of workers involved. Only then can the building needs be identified, and the appropriate equipment and materials be supplied. In short, the implementation of health facility projects follows the overall health system planning process—it does not precede it.

The key issues in community-oriented health planning are: (1) what is the most cost-effective package of services that is likely to achieve the most relevant and equitable distribution of health care, and (2) what is the appropriate role of facilities in this package? Practical experience, including that gained through WHO-sponsored case studies (see Introduction), has shown that many primary health care tasks can be performed without special buildings—in the home, the school, the workplace, or even in the open air. Nevertheless, some tasks are performed much more satisfactorily in a building designed and built with those particular tasks in mind. These tasks do not necessarily involve high-technology medicine, but may consist of simple surgery (6), management of difficult births, treatment of accidents, or diagnosis requiring specific equipment (7). Complex buildings are not required, but the availability of facilities of a reasonable standard may be beneficial (8). However, the planning, implementation, and operation of these buildings do provide many opportunities for expensive mistakes.

Within this framework, the role of existing facilities, particularly the front-line hospital, has also been examined (9). Although hospitals have

---

1 Monkobolo, G. The role of the first-line hospital within the local health services. WHO unpublished document SHS/SPM/80.2, 1980.
a supporting and complementary role in primary health care, care should be taken to ensure that community-based health efforts and supporting facilities do not suffer as a result of excessive allocation of available resources to the hospitals. It is recognized that the role of the hospital in the context of primary health care will inevitably change, although it is difficult to predict to what extent until primary health care programmes have become more firmly established. For example, the over-use of larger facilities such as hospitals becomes less of a problem as the quality and relevance of care at the community level is improved. Moreover, the rigid polarization between the advocates of the hospital versus those of primary health care development should no longer be emphasized, since hospitals, albeit in a modified form, and primary health care should both be integrated into an appropriate "local health system", with clearly defined "essential requirements", in terms of manpower, facilities, and supplies, relevant to the health tasks to be performed. In emphasizing the importance of rural health care, the increasing problems of primary care in underserved urban and peri-urban areas should not be overlooked.

At the stage when an actual plan of the infrastructure of the overall health system is being prepared, it is difficult to define and allocate tasks effectively if adequate epidemiological and other data on community needs are not available. Decisions on the type of services to be provided must often be made, therefore, on the basis of incomplete information. Also, the attitude prevalent among medical groups with a "vested interest", is that the majority of cases dealt with at the primary level are trivial; these groups tend to favour "facility-orientated" plans.

The development of inappropriate buildings is often the result of inadequate briefing of architects and other building specialists. Problems can also arise because of unrealistic ideas concerning medical and construction technology. Even where facilities are appropriately built, they are often not used properly, as a consequence of conditions particular to a facility, such as the lack of equipment or the special interests of the staff. For instance, in two of the countries participating in the WHO case studies, all the facilities, from the primary health care units to the district hospitals, formed a well defined system. As each type of facility had a standard staffing pattern and in principle covered a defined population range, the ratio of functions to facilities and population was thought to be excellent. However, in one of these countries, owing to the lack of supervision and the existence of the "by-pass phenomenon", the facility did not operate as predicted in theory. In the other, where there was good supervision and little by-passing, the theoretical function was realized in practice.

The following text, describes an approach to the improvement of planning procedures and methodology. Special consideration is given to area-wide planning and physical master planning of health care facilities.
Area-wide Planning

National and regional health planning is something to which health planners have aspired for many years. This approach should allow the construction of new hospitals, health centres, and health posts to be tailored to the requirements of the users and should enable buildings to be distributed rationally. Health services can thus be provided according to a regionalized system, in which different levels of complexity, adapted to the needs of the patients, can be distinguished and the point of entry to the health system can be identified. (10).

If regional planning is to become a reality, it must be based on a precise definition of the objectives and functions to be performed at each level of the health system. The money and manpower available, as well as the current and possible future roles of the existing health care facilities, must be assessed. The planning process must also involve representatives of those who provide the services and those who receive them. This latter requirement would mean the progressive decentralization of decisions in the health planning process.

It is very common for decisions on the realization of new health facilities to be taken by institutions that are under considerable political pressure. In such cases, the facilities are often constructed in unsuitable locations, their services are inadequate for the local health needs and/or do not meet the real health problems, and the architectural design does not allow satisfactory circulation of patients and staff since there has been no prior functional planning. In short, the outcome is a costly investment that does not serve the purposes for which it was planned. Examples of such buildings are to be found in all countries.

A regionalized health service system—implying decentralization of planning and referral mechanisms—has enormous advantages, not only from the point of view of better utilization of resources, but also in providing ready access to the level of services best suited to the patients’ health care needs. The additional objectives of such a system can be summarized as follows:

— to provide comprehensive preventive, curative, and rehabilitative health services when required, without financial or other barriers, and making the best possible use of the available scientific and technological knowledge;
— to reduce the cost of treatment, giving priority to primary care and outpatient and preventive services, reserving hospital treatment for those in absolute need;
— to decentralize health care so that each person enters the system at the level best suited to his or her individual needs and so that all services, from the primary to the specialized level, are accessible to everyone through an appropriate information and referral system;
— to organize a “health team”, composed of professional, technical, and auxiliary staff in various disciplines who assume responsibility for the health of the community, acting individually at different levels, but
with their activities coordinated through an effective system of communication and supervision.

All these features must be taken into account when establishing the functional programme and architectural plans for the facilities as part of the process of regional planning. The provision of health care is, however, a dynamic and changing process and, consequently, any architectural design must allow for this fact (11).

The location, type, and characteristics of the facilities should be adapted to the levels of care defined in the regionalization scheme, bearing in mind that each facility does not constitute an independent or isolated service but is an integral part of the system (Fig. 1). The existence or creation of each facility should be justified in so far as its functioning contributes positively to meeting the health care needs of the locality and region concerned, its activities fit into an ordered system that provides the appropriate service when required, and its running expenses can be met.

Fig. 1. Hypothetical example of general pattern of regionalization showing programme area and type of facility

Reproduced from reference 11.

Once the need to improve the health care facilities has been demonstrated and the principal characteristics of each facility have been determined, the general frame of reference for necessary future investments will have been established. The investment plan for the
improvement and expansion of existing facilities or the creation of new ones should, however, be a direct response to real health needs and the requirements of the area; other considerations should influence the planning and programming of health facilities to a lesser extent.

In view of the high cost of constructing and equipping buildings for health care, especially hospitals, the possibility of achieving a lasting, sound, economic, and functional solution by remodelling the existing services should be thoroughly explored. Nevertheless, since many hospitals in developing countries are in very old buildings that are in a poor state of repair and differ greatly from modern buildings in functional design, any decision to undertake remodelling or adaptation must be examined carefully since the apparently low initial cost may be deceptive.

A planning and programming study for the development of health care facilities should be conducted in two phases: firstly, an investigation of the localities that the regional plan indicates as being potentially suitable for coverage; and, secondly, classification and selection of facilities, taking into account the available resources.

The purpose of the investigation phase is to increase knowledge about the localities with regard to the following aspects:

— the type of construction work to be undertaken, identifying the requirements for erection, extension, or remodelling of buildings and the provision of emergency, maternity beds, surgical wards, etc;
— the time required for the work, taking into account local construction materials and facilities available, with an indication of the starting and finishing dates;
— the body responsible for the work and the participation of other sectors;
— the parent institution to which the facility will be attached functionally and administratively, for purposes of supervision, provision of supplies, and referral of patients;
— the geographical accessibility of the higher-level facility, with an indication of the types of travel problem likely to be encountered;¹
— the population to be covered by the services;
— the building construction and equipment costs;
— the sources of financing;
— the manpower and economic resources that are available or will have to be provided for the operation of the service.

Next, a study must be conducted to classify and select facilities according to the priorities indicated by the selection criteria, of which the most important are:

— inclusion in, and support to, comprehensive development programmes in the area;

¹ The time it takes a patient to reach a health facility is more important for planning purposes than the actual distance he has to travel. Isochrones are lines on a map showing the distances from which the facility can be reached in the same length of time (II).
—need for the service in order to conduct programmes in the sector, and
acceptability of service to the community (assessed by local
participation and motivation);
—time required for execution of the work and anticipated date of
opening;
—resources (particularly manpower) available for operation;
—coverage to be provided;
—degree of accessibility;
—degree of integration with the regionalized system provided for in the
plan;
—availability of contributions to set up the facility.

On the basis of the results of the surveys and analyses carried out, a
plan should be formulated to guide all future development of health care
facilities. Such a development control plan should be prepared in two
phases.

Before any actual building takes place immediate action must be taken
to prevent further deterioration of existing premises. For instance, if a
building is in need of repair, this should be done in the first phase of the
development control plan. This immediate action phase should specify the
measures needed to bring the building and services to a reasonable
standard for the immediate future. However, if, according to the
development control plan, a building is to be demolished or is soon to
undergo major remodelling it might be wasteful to complete all of these
improvements.

Since an existing health care facility must often continue to operate
fully during the entire development period, the phasing of the planned
development is vitally important.

**Intersectoral Coordination**

One of the problems of health planning in many countries,
particularly those with market economies, lies in the multiplicity of
decision centres, including various health service agencies. Sometimes
this is related to positive developments, such as the participation of
other sectors (i.e., education, industry, military, etc.) and the community
itself in the financing and construction of facilities. However, this often
puts a strain on the coordination function of ministries of health and
other health authorities, and means that they must have strong planning
and administrative capabilities, as well as political and legal influence.

In some countries, particularly in Latin America, social security funds
build their own networks of facilities, many of which appear from a
national viewpoint, to be unnecessary. In other countries, important
economic complexes (mines, plantations, etc.) construct and operate
capabilities regardless of the guidelines of the national health care system.
There are also many examples where ministries of education or defence
have developed conventional teaching hospitals or other specialized
facilities that have no coordinated function in national, regional, or local health systems.

Many epidemiological priorities need more than just health services for effective intervention and control. Improvements to water supply and sanitation, housing, employment, and food are also required. This implies more effective participation by health authorities in other sectors, at national, regional, and local levels, so that all health-related programmes and facilities are better coordinated.

There are sometimes liaison problems between the ministry of health, which is responsible for the planning of health care facilities, and the ministry of public works, which is responsible for their construction. This is often due to inadequate staffing; for example, a shortage of architects in the ministry of health to plan and evaluate projects, or the absence of a proper “health unit” capable of health planning in the ministry of works. One of the countries participating in the case studies had an efficient interministerial planning committee that met weekly.

Problems of cooperation between ministries affect not only the design and building processes, but also maintenance work, where responsibilities are not always well defined. A few countries have maintenance teams at all levels of the health administration and in the large hospitals; sometimes even this is not sufficient and maintenance jobs are carried out by private contractors. One of the countries participating in the case studies is carrying out preventive (programmed) maintenance, and this is more effective than dealing with emergencies after they have occurred.

**Balance Between Needs, Resources, and Use**

The allocation, organization, and evaluation of human, technological, and physical resources are the principal functions of planning. Despite the inadequate state of present knowledge about causes and effects in large social systems, planners are still required to plan as rationally as possible. Since the planner rarely has sufficient time and resources at his disposal to develop a perfect solution, most improvements in planning are incremental.

However, there are already a number of ways in which comparable data on perceived needs, resources, and use can be combined to permit more rational planning. It is possible, for instance, to compare geographically defined areas not only to see whether their arrangements for promoting health care are “better” or “worse”, but rather to see whether an appropriate balance has been achieved between perceived needs, resources, and use, provided these are defined uniformly for all areas and based on comparable data (12).

Table 1 shows a system for classifying areas on the basis of need, resources, and use of health services. The inclusion of an area in a given category depends on whether its level of need, resources, and use is above or below the median level for all areas in the group. In this
Table 1. Framework of relationships between needs, resources, and use of health services

<table>
<thead>
<tr>
<th>Use</th>
<th>High need</th>
<th>Low need</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High resources</td>
<td>Low resources</td>
</tr>
<tr>
<td>High</td>
<td>TYPE A Balanced appropriate allocation of resources</td>
<td>TYPE B Compensatory high productivity of resources</td>
</tr>
<tr>
<td>Low</td>
<td>TYPE C Unbalanced underuse of resources</td>
<td>TYPE D Unbalanced under-investment in resources</td>
</tr>
</tbody>
</table>

NOTE: Needs, resources, and use may be defined by any appropriate measures as long as they are uniform over all the areas being considered.

Reproduced from reference 12.

model, for example, an area with a high level of resources and a high rate of use together with a high rate of perceived need is defined as “balanced” (Type A). In this case, the population’s perceived need for physician or hospital care is reflected in an appropriate supply of physicians or hospital beds, i.e., there is neither excess capacity of, nor unmet demand for, a particular resource category. Conversely, an area with a low level of resource allocation, in conjunction with low use and low need, is also regarded as “balanced” (Type H).

One complication of this concept is that as an area or country reduces the level of a particular need for which efficient intervention by health care resources is possible, the investment in such resources can probably be reduced. As a result of this, the levels of use should decline commensurately, since health services are no longer needed or provided as before. Indeed, perceived need may have become relatively low because of high resource allocation and high use appropriate to former levels of perceived need. Such a shift from Type A to Type H could be considered as a logical step in the planned evolution of a health service system, in accordance with a model for planning that uses the feedback of health statistics and information to guide decisions. In the present example (a shift from Type A to Type H) the information made available to decision-makers would show them that the use of the services or the allocation of resources had become excessive in relation to perceived needs, and this would allow them to reduce investment in costly resources that were no longer justified by the needs of the population.
As a rule, however, decision-makers cannot respond quickly to such information. The phasing-out of excess hospital beds is not always a possible option, although a lower ratio of hospital beds to population can be achieved by not building facilities to keep up with the population growth. Nor can physicians be exported as a matter of policy. But there are some options that can be exercised over a period of time: improvements in the distribution of physicians, reduced emigration, smaller medical school classes, and a policy of not filling vacancies caused by retirement. The change is evolutionary, rarely radical; in fact, when countries or areas within a country are compared, they are frequently not balanced with respect to resource allocation, investment, or productivity (i.e., the volume of services produced without reference to their effectiveness or efficiency). For instance, the combination of relatively low use and low resource levels where there is high perceived need (Type D in Table 1) suggests relative under-investment of resources; the use rates are low simply because there are not enough resources to service the perceived needs of the population. The unmet need in such circumstances will be high. The combination of low use and high resource levels in the face of high need (Type C) is equally disturbing, for it suggests that there is an under-use of resources, which may be due to a variety of causes: inappropriateness or inaccessibility of the resources, inadequate coverage, lack of knowledge, financial barriers, behavioural factors impeding use, or a combination of these.

In contrast, the pattern of high use and a low level of resources where there is a high perceived need (Type B) implies an intensive use of the relatively few available resources (i.e., high productivity). The high level of fulfilled demand may deplete the resources or may alter their efficiency and effectiveness; this imbalance may delay the shift of an area or a country from high need to relatively low need. Similarly, in a situation of relatively low need, a low use of services may indicate over-investment in resources (Type G) whereas if there is high use, an over-use of resources (Type E) is indicated. Finally, imbalance is also reflected in relatively high use, and probably high productivity, of available resources in the presence of relatively low levels of need and resources (Type F). Relative imbalances such as Types E and F seem to be characteristic of health care systems where there is a strong incentive (through payment mechanisms) to fill hospital beds or to occupy the available working time of professional staff. Types B and F are, however, the last stages before a relative balance at one of the two extremes is achieved; the strain imposed by high productivity when there are only relatively limited resources can be relieved by additional resources if the need is high or, if the need is low, by discouraging use or by education of the public in a more appropriate use of self-care, family care, or the formal health care system.

The arrows in Table 1 show the direction of movement between the different classifications that is required to achieve balance for a specific level of need, although other transitions and combinations are possible in practice. For example, there could be a shift from Type G to Type H,
a reduction in demand in both state-controlled and free-market economies being accompanied by a reduction in supply. But as the perceived need falls (as it should if the health care system is effective), Type A may shift to the unbalanced state of Type E or G and, as a consequence, the resource allocation must eventually be reduced because of, or in order to produce, a decline in demand and use.

Planning Capability

More effective planning is essential if cost-effective health services are to be developed and if facilities are to assume an appropriate role in those services. Some of the most costly mistakes are made at the point where an overall facility plan is being derived from the health services plan. This reflects the problems of task definition and subsequent poor briefing of architects and physical planners, or insufficient coordination between the various sectors. However, there can be other problems, one of which is the shortage of basic situational information.

There are several ways of collecting the necessary information. A national inventory of facilities and heavy equipment that is periodically updated through surveys, visits, or reports should provide a minimum amount of information on the number, types, and age of the facilities, their present condition, and the associated problems (13).

Even where the basic information is available, often there is not the physical planning capability within the ministry of health to develop it into a comprehensive physical plan relating health service priorities to an action plan for the development, rehabilitation, and upgrading of facilities.

In many countries this aspect of planning needs to be strengthened, and should, if necessary, be supported by international agencies. External technical and financial assistance would be much more effective if used for the support of planning activities rather than for the construction of individual prestigious facilities.

The facilities plan is, of course, merely a component of the overall health strategy that also includes manpower plans, supplies, transportation, etc. It must also be developed in relation to the intersectoral aspects of national planning.

The advantages of integrating the plans for building health care facilities into more comprehensive plans covering the entire infrastructure of regional communal services are apparent from some case studies. The effectiveness of health care facilities is limited if all-weather roads, water supplies, and electricity are not available locally. The application of multiservice modules is another example of comprehensive physical planning.

Planning authorities often have very tenuous links with the agencies responsible for the design, construction, and maintenance of facilities that are often carried out by ministries of works. This means that important information about existing facility inventories, prevailing
capital and recurrent costs, or maintenance budget requirements is not available to the planner.

There are several possibilities available to alleviate this problem. In one of the case-study countries, planning for development projects starts at the local level. Local proposals are comprehensively discussed at provincial level, then the provincial proposal goes to the ministry of health. The ministerial advisory committee, composed of all the directors and assistant commissioners of health, and at which the ministry of construction and public works is represented by the chief of the health projects unit, approves or amends the plan within the framework of the budget figures provided by the ministry of finance, before the proposal is transmitted to the national planning commission.

In other countries, planning units have been set up in the ministry of health to prepare basic functional and architectural programmes for facilities and to control and approve designs prepared by the ministry of works. The make-up of such a unit in one country is as follows: assistant director of medical services, a doctor, a medical research officer, a statistician, a health planner, and an architect.

The resolution of many of these problems requires decisions on policy matters in the ministries concerned. In addition, detailed proposals on programme adaptation and implementation may be needed, and if these are carried out, they may require the allocation of additional personnel resources and funds.

However, some modification and reorganization is necessary to clarify:

—procedures
—activities
—responsibilities and authorities.

In the following text some approaches are presented for the training of the planning team and the organization of planning resources, which may help to improve planning activities and make them more efficient.

The Multiprofessional Planning Team

A truly representative multiprofessional planning team (14) combines both the clients and those undertaking the work, and is responsible for preparing project policies and programmes. Furthermore, the multiprofessional planning team is the focus for communication between the users of health care facilities and the project design team. This principle and its links and overlaps are illustrated in Fig. 2.

The multiprofessional planning team, therefore, includes people who may be regarded as "proxy clients"; since they are continually in touch with, and represent the views of, all classes of health care facility users, while, at the same time being aware of the designers' problems. In short, the planning team is in an ideal position to communicate with three groups: those who use facilities (the clients); those who pay for them
(government or other corporate bodies); and those who design and build them (design firms, consultants).

Obviously, it is impossible to communicate with every user. Consequently, the planning team must use the combined knowledge and experience of doctors, nurses, and administrators, together with that of their design-trained collaborators. The results of surveys of users' needs and desires are considered to be additional to, rather than a substitute for, the combined experience of the team.

The above discussion has dealt with the group representing the client on the planning team. Another group that is made up of professionals—i.e., architects, engineers, and quantity surveyors—must also be
represented if communication between the planning team and the designers is to be as effective as that between the client group and the planning team.

These professionals will have made a special study of the design problems of facilities and, in addition to providing the technical links between the planning and design teams, they will ensure that the brief is realistic and attainable within the terms of the schedule of accommodation, engineering services, costs, and the overall programme. They will also act as policy advisors, e.g., on standards of space and environmental conditions in the various facilities, as well as general technical advisors to their planning team colleagues.

The climatic, socioeconomic, political, educational, manpower, commercial, and maintenance conditions can vary widely from region to region in developing countries, and it is therefore essential that planning teams make known clearly their requirements. This is particularly important when foreign design teams are employed. In some circumstances an overseas team may be used in the initial stages of planning, but it must be emphasized that a misapplication of imported expertise can result in designs that are expensive to build, as well as difficult and costly to maintain.

Whether the planning team is central or regional, it is important to ensure that only essential facilities are built, and these in the most effective and economical way.

Education and Training for Health Facility Planners

In many countries, most of the people currently serving on multiprofessional planning teams have learned their trade in a practical way, building upon the particular type of professional education and experience they have received (15). The most effective way of educating the members of a planning team may be for them to teach each other. This requires, however, basic skills in communication, a willingness to evaluate previous work, and the chance to work together over a number of years. Unfortunately, such ideal conditions rarely exist. All too often, planning team members come together with the purpose of putting forward their own "professional" viewpoint. For example, doctors promote the views of their specialist colleagues; architects are concerned either with the aesthetic quality of the environment they are creating, or perpetuating their traditional leadership role; engineers frequently separate engineering from building as a result of their desire to maintain their separate but equal status vis-à-vis architects; quantity surveyors try to control costs, frequently in a way that appears to others to be against the concept of true value for money; administrators, lacking the necessary skills for design evaluation that would enable them to control the quality of the project, concern themselves primarily with observing the bureaucratic procedures; and nurses, who perhaps more than any other member of the team represent the views of the widest range of
users, appear in certain circumstances to be over-concerned with their own status.

However, all these professionals have legitimate and constructive contributions to make to the planning and design processes. To produce an optimum design solution it is therefore necessary to bridge the gaps between these various, purely professional viewpoints. This process appears to be largely a question of establishing a common technical language as a means of understanding and defining common objectives that take into account the problems of all the people concerned. But, if some progress has been made—and there are now considerably more design data to draw on in various parts of the world—why has the task of planning and designing health facilities not become easier, and why have the results not improved significantly?

The real reason is difficult to find. The problem of the use and meaning of words can be easily identified; but perhaps a more fundamental cause of the widening gap between professions is increasing specialization, and the associated use of technical jargon. Indeed, with the increasing sophistication of planning and design concepts, the language problem has become more acute over the past few years.

Perhaps even more serious is the destruction of any frame of reference or design method that might have emerged if the members of the multiprofessional planning team had been similarly oriented. If the team cannot define common problems and procedures, the frame of reference disintegrates; and because of this, the constant exchange of ideas which "planning" or "designing" involves becomes more complicated. The result is that people who are supposed to be collaborators adopt opposing positions rather than supporting one another.

Team fragmentation and the current philosophy of learning-by-doing have denied members of planning teams the opportunity of discovering as much as they should about each other, about the real needs of users, or about the interactions between the closely related patterns of activities that occur in health care facilities. Learning-by-doing has become merely doing. Until a fully structured educational programme becomes available for all members of planning teams, there appears to be little hope of halting this process, quite apart from reversing it.

However, the potential for conflict is not the same between all the professions involved. Doctors and nurses on planning teams are responsible for the quality of both patient care and the therapeutic environment. Architects and engineers are responsible for meeting these demands by designing facilities not only for present users, but for subsequent generations of users. Architects and engineers are seen as the people who provide the buildings that health workers and patients use every day and consequently they are held responsible for any failures that occur. Because of this continuing responsibility, architects and engineers and, to a lesser extent, doctors and nurses, have developed certain common fields of interest such as user satisfaction, ease and cost of maintenance, and environmental quality. Professional pride also plays an important part. Doctors, nurses, architects, and engineers conceive
the design and the architects, engineers, and constructors give birth to it. Consequently, they can feel either pride, or shame, or both; but the responsibility for the entire project remains theirs.

The undisputed role of the quantity surveyor is to secure what is called “value for money”. The questions arise immediately of what the quantity surveyor considers to be value, and by what “economical” means should he set about achieving it? The methods used are the natural end product of a combination of his professional education, the disintegration of a recognizable multiprofessional operational framework mentioned earlier, and the unreasonable expectations of the administrators who may have underestimated the cost involved. The task of the quantity surveyor has become mainly one of cost “control” in the shallowest sense of the word. The fields he is expected to cover, i.e., building economics, cost planning, performance specifications, etc., require a degree of knowledge that can be fully achieved only when the rest of the planning team is very sympathetic. This is not intended as a criticism of quantity surveyors, but rather an analysis of a situation that frequently develops. One of the most serious results of this potential conflict is that operational function, and the design that is intended to serve it, are progressively pulled apart; as a result, facility design and operational efficiency suffer.

The role of the administrator is frequently that of manager for all or part of the combined design and building process and, because of his lack of knowledge of the design process, misunderstandings and friction often result. In many ways the administrator has a similar outlook to the quantity surveyor, and it is interesting that training programmes for administrators, like those for quantity surveyors, do not usually deal with user requirement investigations or with the “design process” as understood by design specialists. As a result, the administrator often works “according to the book”, i.e., a particular objective has to be reached on time, within a defined cost. Certainly some team discipline, including time and cost restrictions, is vital, but these constraints should be based on a real understanding of the problems involved.

Although possibly true of other professions as well, it is apparent that the quantity surveyor and the administrator are involved in the project in ways that have no obvious consequences for the user of the building. Therefore, they are less likely to identify with the project, either in the same way or for as long as their colleagues, and this introduces a psychological factor that may encourage the fragmentation of the team.

It is possible to summarize some of the problems as follows:

(a) planning is a multiprofessional exercise, and in the planning process the gaps between different areas of professional knowledge become more important than the professional knowledge itself;

(b) planning teams lack a common language, and they are incapable of adequately defining their common objectives;

(c) often, common objectives cannot be defined, and the framework of reference for the team disintegrates as a consequence;
as a result, function and design become so divorced that function-based planning and meaningful, objective evaluation become increasingly difficult.

The gaps between the various planning team professions could be filled by a common language, a knowledge of the planning and design process, theoretical exercises, and practical experience. However, practical experience should come last, whereas in the majority of cases it has come first. Short courses cannot be reasonably expected to bridge these gaps completely since it takes time to become acquainted with the skills involved in problem definition. In such courses, topics such as the methodical collection, sifting, storing, and application of data would hardly be touched. Nevertheless, short introductory courses could be useful if run in conjunction with longer courses from which future teachers might emerge.

The question facing countries with no existing expertise is how to establish multiprofessional planning teams. In these countries, self-help schemes may provide the best solution, and both health care and health facility planners should be trained at an early stage to undertake the work themselves or to scrutinize critically the work of others commissioned to do it on their behalf.

The planning of health services should precede the planning of health buildings. In some places, service and building planning are undertaken by the same group. Whichever system is preferred, students sent on full-time training courses could, on their return, take part in local induction training schemes. In the meantime, only consultants who are skilled in both service and building planning should be considered if a completely new or revised start is being contemplated. In considering a strategy for the proposed health service, existing traditions, services, and buildings should all be utilized as part of the new service whenever possible, and where it is desirable; only then can any new building requirements be determined. In the absence of personal knowledge, advice on the selection of such consultants is always available on a government-to-government basis.
3. Project implementation

Implementation Stages

A construction project covers the entire working process from the inception of the idea of a health care facility to the successful use of the completed structure. It consists of many interdependent activities, and involves many individuals and organizations. The working process can be divided into a series of stages (16): briefing, designing, constructing, and commissioning. These should, of course, be followed by an evaluation period. The scope of these four stages may differ from one project to another, but their content should be clearly defined in the terms of reference drawn up for each project. By clearly defining the purpose of each stage, the tasks to be undertaken, and the decisions to be reached, the entire implementation process can be shortened, often resulting in considerable savings.

The work done in the early stages of a project is very important. It is essential to consider the relationship between the funds expended and the amount of design modification possible at various stages of the project. Once the construction stage has been reached, and funds are being rapidly utilized, it is almost impossible to alter the size and shape of the building. The possibility of influencing the design during the various stages is illustrated in Fig. 3. Clearly the crucial period is during the review of the project brief by the “owner” for final approval; it is at this time that substantial savings can be made (this aspect will be discussed later under “Cost Management”).

Briefing

The purpose of the briefing stage is to prepare a general outline of requirements and to provide the future user with an appraisal and recommendations, so that he can ensure that the project is functionally, technically, and financially feasible. Alternative courses of action and project location should be given particular emphasis during this stage.

For some projects, the initial user requirements may be unclear, the location uncertain, and the cost limit undecided. In such cases it may be helpful to prepare the project brief in steps; first clarifying the major
aspects of the project and outlining the alternative courses of action and their consequences. Those alternatives that appear to be most feasible may then be studied further. Such a study should present the functional, technical, and financial aspects of the project in enough detail to enable the management team to prepare its recommendations on how the project should proceed.

Finally, it should be stressed that any substantial cost savings on the project can be made only during the briefing stage, through a careful appraisal of the user requirements.

The main participants at this briefing stage are the management team and the briefing team. Depending upon the nature and the complexity of the project, the briefing team should include the following:

— architect
— structural, mechanical, and electrical engineers
— quantity surveyor
— specialists (such as health planners, organizational planners, etc.)
— user representatives.

Designing

The purpose of the designing stage is to complete the project brief and to determine the layout, design, and method of construction in order to
obtain the necessary approvals from the public authorities involved. In addition, the necessary production information, including working drawings and specifications should be prepared, and all arrangements for obtaining tenders should be completed.

In most projects, the design stage is divided into several substages, such as outline proposal, scheme design, detail design, and production information. The first two substages are sometimes referred to as “sketch plans”, and the last two as “working drawings”. In this way, it is possible to take step-by-step decisions on user requirements, technical problems, design matters, etc., and a realistic cost estimate of the project should be possible from the scheme design substage. The project brief should not be modified after this stage.

Contact should be maintained between the management team and the design team, preferably through a series of regular meetings at which progress reports can be considered and decisions on any outstanding issues made.

The main participants in the designing stage are the management team and the designing team. The designing team should include the same representatives as specified above for the briefing team.

Constructing

The purpose of this stage is to complete the construction of the project design within the agreed cost, time, and quality targets. The construction stage must be planned very carefully, since failure of one of a number of interrelated activities can disrupt the entire production schedule.

The main participants are the management team and the construction team. Depending on the nature and complexity of the project, the construction team should include the following:

—main contractor
—subcontractors
—suppliers of materials and equipment
—designers and specialists.

Normally, the main contractor has the greatest responsibility within the construction team. Usually, the subcontractors are directly responsible to the main contractor, even if they have been chosen by the facility’s owner.

Commissioning

The purpose of the commissioning stage is to ensure that the construction work is completed according to the approved drawings and specifications, and that the project, when handed over to the user, is fully operational; it should also provide operating instructions, together with practical staff training, to ensure proper functioning and maintenance of the finished health care facility. The commissioning stage is the transitional period between the construction and the occupation
and use of the fully operational facility. For large and complex projects, the commissioning is often carried out in several substages. It must be planned well in advance so that the deliveries of furniture and equipment, as well as the recruitment and training of service personnel, can be coordinated with the construction timetable.

The main participants during the commissioning stage are the management team and the commissioning team. Depending on the nature and complexity of the project, the commissioning team should include:

— the owner or his representative(s)
— the users or their representative(s)
— designers and specialists
— contractor and subcontractor(s).

Project Management

In many developing countries, health facility construction costs alone account for about 50% of the total health care budget, so the good management of these projects is extremely important (10). However, the availability of capital is often not the only problem; difficulties in implementing the project can also be a serious constraint.

Project management is the process of planning, executing, and controlling a given project from its inception to its completion, within set time and cost limits, and taking account of the available technical and human resources. However, some modification of the project may become necessary if the basic assumptions change, the original estimates are no longer valid, or unanticipated events and restrictions occur.

The main objectives of the project management process are outlined in Fig. 4. These activities form a dynamic cycle of planning, executing the work according to plan(s), and taking appropriate remedial measures. This cyclic process does not only apply to a complete project or parts of a project, but is continuous and results in revisions, modifications, and alternative solutions to new problems as they arise.

The main parties involved in the project working process are shown in Fig. 5. Some people participate throughout the project although the degree of their involvement may vary from stage to stage.

The term “owner”, sometimes replaced by “client”, is used for the organization (or the individuals within that organization), usually the ministry of health or other health care authority, that has the power to order and to approve the project and to allocate the funds for its execution. The relevant responsibility may be delegated entirely, or in part, to people in the owner’s own organization who have the appropriate expertise, for example, to project managers, designers, or other specialists.

The composition of the four project teams illustrated in Fig. 5 (named according to the project stage) depends upon the type of project and its
content. In general, these teams include all people or parties involved in the work at that stage, such as managerial staff, designers and specialists, owner and user representatives, contractors, and suppliers.

The management team is headed by a project manager who has the responsibility and authority to direct the execution of the project. To perform his duties effectively, the manager must be acquainted with management practice, and must have a thorough understanding of the project he is directing. This understanding should cover not only the physical aspects of a health care facility, but also the objectives and motivation behind the construction project itself (e.g., arising from the overall national health policy or local requirement). The team may comprise other specialists such as planners, medical experts and advisors, administrators, and supervisors, depending upon the nature of the project. Small and simple projects may be undertaken without sophisticated management procedures but, for complex projects, some degree of organized project management is essential.

The various activities included in each implementation stage all require their own, separate organizational structure. These structures depend upon the size and character of the project, the existing institutional framework, and the manpower available. How the various activities should be carried out (in what order, to what extent, in what way, and by whom) must be carefully assessed for each project and
Fig. 5. Project teams and other parties involved in the project working process

Reproduced from reference 16.

presented in the form of a work programme. This so-called work plan, can be drawn up either by the owner’s own organization or by appointed experts. Indeed, some form of approved work plan is essential when independent resources are used for the various tasks. Owners and consultants must be aware of the procedures to be followed, and of when consultations, cost-checks, and approvals are required. The amount of detail in the work plan will depend mainly on the size and complexity of the project, as well as the attitudes and policies of the owner organization. Mutual cooperation in project development is essential, and the project manager must, therefore, gain the confidence of all parties concerned.

In principle, the management team should be kept as small as possible. However, depending on the size and nature of the project, certain supporting services will be needed, for example, planning, procuring, controlling and secretarial services.
The project manager takes an active part in the briefing, designing, and construction processes. He coordinates the activities of all the designers and specialists involved, brings in a contractor for early discussions, if required, and makes sure that all work is carried out as planned. To fulfill these tasks in large construction projects he may need the support of specialists or assistant managers to deal with certain briefing, design, and construction activities.

An owner organization with a fluctuating workload, or an owner who builds only rarely, may have difficulty setting up an internal management team. In such cases, consultants can be employed to provide certain managerial services. However, one person within the owner organization should be appointed to coordinate and express the owner's requirements. A management team composed of consultants must have the same aims and objectives as a team from within the owner's own organization, because any conflicts of interest could adversely affect the progress and economy of the project. Consequently, the most suitable consultant may be a project management specialist, rather than someone who participates directly in the briefing, designing, and construction work. However, if a project is fairly simple, a professional firm, usually the firm of architects, should be employed to manage the project on the owner's behalf. The architect may be supported, where necessary, by a quantity surveyor to deal with cost assessments, bills of quantities, etc.

Within an owner organization where different departments or parties are involved, it is usual to set up an ad hoc committee, often called a project committee. The members of this committee should represent, at an executive level, the owner's planning, financing, executing, and operational interests, as well as the interests of the potential users. However, the exact powers of such a project committee may be uncertain, and it is essential that the project manager should maintain total responsibility and authority for a project. It may be better, therefore, to form a joint committee or coordinating committee with a purely advisory and coordinating role. Whichever kind of committee is decided upon, a direct link should be established between the owner and the project manager, and all directives should be channelled through him. Representatives of the project's operating personnel and other potential users should be appointed to the project or coordinating committee and careful attention should be given to their advice, especially during the early stages. These user-level consultations may provide some very useful and pertinent practical views, and they create a feeling that a positive contribution is being made by those who will eventually work or live in the building.

The simultaneous management of several construction projects occurs particularly within organizations such as ministries of works, whose main responsibility is to deal with construction projects on a countrywide scale. In such an organization, one person may be responsible for managing a number of projects, each of which is likely to be at a different stage of completion. This complex situation requires special methods of project planning and control, usually based on...
diagrams specifying the major dates in the time-schedule of each project. Based on these diagrams, workloads can be assessed, resources allocated, and calculations made of the overall cash flow. In order to be able to compare the actual with the expected progress of the project, these diagrams have to be updated at regular intervals, if necessary by a special secretariat.

Planning the project management process

Because of the complexity of most health care facility projects, systematic planning of the work is necessary to ensure that all management functions are carried out as required. A systematic process of project management consists essentially of a set of established methods and guidelines that aid the project manager and the management team to plan logically, to identify problems easily and promptly, and to solve them rationally.

Proper planning ensures that adequate resources are available when required, that enough time is allowed for each stage in the process, and that all the various component activities start at the appropriate time. The project manager is responsible for the planning process during all stages of implementation of the project. However, the manager and his team will be assisted by the briefing, designing, construction, and commissioning teams, depending on which stage the project has reached. Each team should be responsible at every project stage for the detailed planning of its own activities.

Several methods have been developed over the years to assist in the planning of the project management process. These range from simple checklists and bar charts, to more complicated charts, schedules, and network plans showing the interrelation of different activities. For most projects a bar chart is normally adequate. It can be prepared as follows:

- prepare a checklist of the appropriate activities to be undertaken;
- analyse each item on the checklist considering when it needs to be carried out, and the length of time it requires;
- indicate all activities, in chronological order on a bar-chart time-schedule.

The planning of project activities should cover the following major aspects:

- time;
- briefing and design capacity;
- construction and commissioning capacity;
- supply of machinery and materials;
- allocation of funds;
- staffing.

The most important task in the planning process is the preparation of a realistic time-schedule. A basic time-schedule should be worked out at
a very early stage and should serve as a framework within which all key activities can be planned.

The time-lapse between the decision to build and the completion of the project is rarely less than 2–3 years, even for small projects. During the briefing stage, therefore, it should be possible to prepare a time-schedule which indicates not only the timing of the major project stages, but also that of such activities as the planning and procurement of furniture, plant and equipment, financing, planning permissions, etc. The time-schedule should also allow adequate time for the appraisals and approvals between each project stage that are required by the management team, the owner, the users, etc. (Fig. 6). Unfortunately, such provisions are often not made, and this invariably results in delays and shortages of funds.

Fig. 6. Time-schedule for different stages of project implementation

![Time-schedule diagram]

Reproduced from reference 16.

During the first part of the design stage, the design and management teams should together prepare a time-schedule covering in detail the activities up to and including the proposed tender action. This time-schedule should also indicate the activities to be undertaken by the different designers and specialists in the design team and the activities required of the management team, showing clearly where these activities are dependent upon each other. Working drawings and tender documents are prepared during the second part of the design stage. The time-planning during this stage should also cover the tendering activities and the construction stage. The time-schedule should include such activities as the calling for and the opening of tenders, the awarding of the contract, and in addition, the major phases of construction and commissioning.

During the construction stage, the contractor should prepare a detailed time-schedule based on the time-limits in the contract. This schedule should indicate how the construction will proceed, including
the installation of plant and equipment, and the advance procurement of any materials. The project manager must ensure that any materials or equipment not included in the construction contract are obtained in time.

At the commissioning stage, the project manager will be responsible for planning activities to be carried out after the building has been completed and handed over, for example, the running of plant and equipment, the installation of furniture, and staffing.

One of the first things the project manager should consider is the briefing and design capacity that is available. The owner must assess the available capacity and competence within his own organization before employing external resources. The selection and employment of designers and specialists must also be considered.

The size and organization for the construction of health care facilities varies from one country to another. Smaller projects are often constructed on a self-help basis or by means of direct labour schemes. Larger projects are normally built using more permanent agencies such as construction units or contractors. Whichever method is selected, the project manager is responsible for assessing the capacity of the selected agency, and for taking this into account during the preparation of the basic time-schedule. It should be noted that the choice of construction method may have a significant impact on how the production documents are eventually prepared.

Many projects are not completed on time owing to a lack of, or delay in the delivery of, certain vital materials and equipment. Such delays can, in many cases, be avoided by proper planning of the procurement of material supplies and equipment. During the design stage, the project manager should check whether the major materials and items required during the project will be available, and if any vital item may be difficult to obtain, he must take the necessary steps to avoid possible delays.

Whether the project is funded from private capital, a bank, or the government, it is necessary to draw up a total budget showing what funds are needed and when (16). Funds must be available not only for the actual construction but also for plant, water, electricity, equipment, etc., as well as for the payment of managers, designers, and other specialists (Fig. 7). The time-schedule provides the first indication of when funds should be made available, and the design team should assess how much money will be required at the different project stages (see "Cost Management" p. 60).

At an early stage, proper consideration must be given to the staffing of the completed project, and the planning for this should start during the briefing stage. A list of the potential users of the building should be prepared during this stage and should form part of the briefing documents which the management team can use to ensure that adequate staff will be available. If it is impossible to obtain adequate staff by the time the project is completed, alternative measures may have to be considered. For example, the completion date for the whole project could be put back, or the project could be completed in phases.
Type-plans and Standardization

The development of standard type-plans can have several advantages. Primarily, it saves architectural manpower and theoretically allows the architects to concentrate on the briefing and design stages, so that the design may be improved. Unfortunately, the additional design input required to produce good standard designs is not always available and, as a result, expensive buildings are produced. Usually, type-designs are not sufficiently adaptable to meet regional variations in climate, local customs, building materials, and health service requirements. To overcome this problem, buildings should be available in a range of subtypes and, more importantly, in various sizes in order to avoid overbuilding in sparsely populated areas.

Observations made in the countries where case studies were carried out (see "Introduction") were generally favourable towards standard designs, especially in comparison with more ad hoc solutions. In one
country, standard designs were being modified at the regional level to meet local requirements. This emphasizes the need for functional programmes to accompany the building plans so that the implications of design changes can be fully understood.

However, the use of standard designs in non-industrialized countries is accompanied by certain important problems. Sometimes the designs are not followed correctly, particularly when the initiators do not belong to the ministry of health, or they may be followed too rigidly. A range of designs is necessary, even for the same type of facility, to allow for regional variations in climate, building materials, and possibly local customs. Moreover, the use of standard designs tends to promote resource-oriented programmes possibly at the expense of more relevant non-facility-based programmes.

If mistakes are to be avoided, it is important not to construct a large number of buildings of a particular design before the earlier ones have been fully evaluated. Although very few countries seem to be conducting functional evaluation of their health care facilities, in one instance a flexible outpatient department was so constructed that the space could be rearranged in several ways, thus making it possible to test alternative arrangements and to choose those most suitable for wider application (17).

The possibility that type-designs might reduce construction costs depends upon the type of building technology available. One of the countries participating in case studies had adopted standardized designs following the decision to use prefabricated buildings for all construction work, notably in health, education, and housing. However, this approach seems to be unsuitable for many developing countries and should be tested on a small scale before being applied widely.

**Standardization modules**

Various so-called standard modules have been developed to help simplify the construction of health care facilities (18). The internationally accepted construction module dimension is “M”, equivalent to 10 cm. The vast majority of construction products, fittings, technical equipment and service installations are now based on multiples of this M-module, for example the 3M-module. In Europe, framework modules may be 60–90M for beam spans between columns, and 120–150M for floor slab spans. Extensive technical and economic studies have shown that for the load-bearing framework of a building these dimensions are best suited to the available construction equipment and skills and are cost-effective. However, the optimum module will vary from country to country, depending on such factors as the building technology generally available, the quality of building materials, and the cost of labour.

In developing countries, where the application of, and dependence on, modular prefabricated building systems is not so widespread, modular construction may still provide design benefits. When choosing the primary module, it must be decided whether a single modular dimension
should be applied throughout the facility, or whether different dimensions for each group of main functions would be advantageous. A single module may not provide for optimal use of the space for some functions or make full use of the available space for others; therefore, an attempt should be made to find the best overall spatial solution. The use of two, three, or more different module dimensions would reduce the number of compromises necessary in different facilities or departments, and although there might be increases in both building costs per square metre and project management problems, there may be a saving on the total floor space and hence in the overall cost.

The concept of standardization also depends on the building layout and the design of individual rooms. It is therefore important to produce designs and dimensions that allow for considerable variations in room layout. One example of this is the use of movable partition walls (Fig. 8), another is the use of multipurpose units (Fig. 9) (19).

Fig. 8. Examples of room designs using movable partition walls

Reproduced from reference 19.

Room-size alterations can be achieved by rearranging the non-loadbearing walls or by a system of movable partition screens. However, with both of these systems, it is complicated and expensive to provide sound insulation and sanitary connections, especially where technical expertise and building skills are limited.

An intermediate solution is preferable in which partition walls can be rearranged without major alterations. In many cases, systems with load-bearing walls are particularly suitable for use in the lower-tier of health
care establishments. In a "universal building" the room dimensions are chosen to allow for the widest range of uses; this allows an interchange of functions with only the minimum amount of structural alteration. In such cases, the uniform module and its limited number of potential room layouts must be chosen to satisfy the majority of user requirements. Subsequently, only modifications to equipment and services are required to rearrange the rooms. Such an arrangement allows for the maximum interchange of different activities between rooms, even though some may have slightly too much floor space and others too little. The resulting accommodation is nevertheless usually acceptable.

These points illustrate how various aspects of the structure of a complex health care facility, and particularly that of a hospital, are interrelated. A change in one element is likely to trigger off a series of subsequent changes and adjustments before the system becomes re-equilibrated. It is clearly essential to minimize these disturbances, since health services must be maintained at all times.

The uses to which standardized rooms can be put are essentially determined by the furnishings and equipment provided. When the dimensions of the furniture are also carefully chosen and standardized, any interchange between the various rooms will be simplified, thereby increasing the functional possibilities of each room.

Although the standard of equipment may be determined separately for each project, locally-made building materials and standard fixtures or other products, should be used whenever possible. Specialized fixtures
and medical equipment, however, will probably have to be imported until suitable home-produced products are available. The choice of modular-designed items, from whatever source, will increase the flexibility of the arrangement and allow for any change of location.

The aim of the interior design should be to create the best possible working conditions for the staff and to reduce any patient stress that may be associated with outpatient treatment or hospitalization. Within the limits set by technical considerations, the gap between an institutional environment and the out-of-hospital surroundings familiar to the patient should be narrowed as much as possible.

**Type-plans**

A type-plan is the standardized use of spaces to satisfy certain functional needs specified by the user. The aim is to obtain imaginative groupings of such spaces, taking into consideration location, sites, materials, and manpower deployed and, above all, cost and construction time.

A type-plan aims to eliminate waste and to offer solutions to the problems that impede the construction of particular facilities in the required place, at the right time, and at a reasonably acceptable cost.

A type-plan is often the result of the study and diagnosis of problems at the planning and design stage, or of implementation and use. The evolution of an acceptable type-plan reduces the cost of producing designs and drawings and speeds the implementation procedures. In some countries, the adoption of type-plans helps in the bulk ordering of materials and equipment for several facilities, thereby reducing costs. A type-plan offers faster orientation for staff if they pass from one facility to another, resulting in improved performance and the maximum utilization of the space provided.

Although a type-plan has its advantages, there are some disadvantages that cannot be overlooked or underestimated. Such constraints, if not considered, can have repercussions that make such facilities unacceptable. For instance, a type-plan should harmonize with the terrain and satisfy the different geographical requirements that may be present even within a single country. A type-plan should also allow for the social and cultural differences that exist in a country. In addition, the available building materials and the manpower needed must be reflected in the designs.

Although type-plans are designed to answer certain functional requirements, some variations may occur because the workload of each unit is influenced by the population it serves. Such variations may result in under- or over-utilization of the spaces provided and consequently affect the workload of the staff employed.

**Primary health care unit as an example of the type-plan**

In the past, the function of the smallest health care unit was to offer curative care. Thus the unit was staffed by one nurse who had received
hospital training. The unit building was usually one room and a verandah.

In one of the countries studied, the old type-plans were revised following the preparation of the National Health Programme (20). The functions determined by the new approach cover both curative care and preventive care. The unit is staffed by a community health worker who divides his time between the unit and the community in his catchment area.

In principle, each primary health care unit serves a maximum population of 4000, within a catchment radius of 10–15 km. Where necessary, adjustments are made to take into account any difference in population density. For every five primary health care units, a dispensary provides referral facilities, supportive supervision, and supply functions. This group forms a primary health care complex.

The primary health care unit consists of four basic areas (Fig. 10):

— subdivided store room for drugs and equipment;
— reception and waiting area;
— examination room;
— subdivided room for dressings and injections.

Fig. 10. Type plan of a primary health care unit (dimensions in cm or m)

Reproduced from reference 20.

The internal dimensions of each of these areas are 300 cm x 480 cm. The plan is based on internal wall-to-wall dimensions in multiples of 30 cm. This modular dimension allows for some flexibility in wall thickness, so that, for instance, stone or hollow cement blocks may be used instead of red bricks in some areas.
Rooms have a standard height of 3 m between the finished floor and the ceilings. The dividing partitions, which are 1.5 m in height, allow for cross-ventilation and the movement of air between room spaces.

The reception and waiting area is between the subdivided store room for drugs and equipment and the examination room, and is well protected from the morning and afternoon sun. It has a roof, but is left open on both sides to allow adequate cross-ventilation for the patients in the waiting area. The examination room and the subdivided room for dressings and injections are grouped together for easy use by the community health worker, with the minimum of movement. Two toilets are provided, one for males and one for females.

A simple shed is provided for use as protection against the sun, by the relatives accompanying sick patients, and also by the unit guard, whose duties include gardening and cleaning.

The plot size chosen for the unit allows for future expansion when the unit develops into a dispensary (Fig. 11). In the future, the dispensary is

Fig. 11. Site plan of a primary health care unit (dimensions in metres)
expected to become the lowest level facility. To create a pleasant environment for both staff and patients, and to moderate climatic extremes, special attention is given to the provision of green spaces, and it is planned to provide a fence for the unit by planting trees.

The roof of the unit is made of timber or steel trusses, securely fixed to the top string coarse beam, and has large overhangs for protection against sun and rain. The roof cover is of either zinc or asbestos sheeting fixed to purlins running across the trusses. The underside of the roof overhang is of close-boarded timber or bamboo to prevent birds entering the roof space. Hardboard or chipboard ceiling panels are used, and are interspersed with wire mesh panels through which light can penetrate. This discourages the gathering of bats, which can be a problem.

The detailed design of the foundations differs from one area to another, depending upon the soil conditions. The example shown in Fig. 12 is for an expansive clay soil. For this type of soil, short concrete columns are used with ground-grade beams, the undersides of which are left void in order to allow for any upward lift during the wet season.

Glass panels for light are confined and fixed to the top parts of windows. This is to give them all-day shade from the roof overhang, and protect them against damage.

Fig. 12. Cross-section of a typical primary health care unit

Reproduced from reference 20.¹

¹ It also reflects some of the components that may be used in a dispensary, a rural health centre, or ward units of general rural or district hospitals.
Construction and Materials

Having developed a building plan from the guidelines set out earlier, a decision must be made on the most efficient method of enclosing the space shown on the plans (27). Over 80% of the cost of setting up a new health care facility is often spent on the building alone; the following text attempts to show how this figure can be reduced without lowering the quality of the health care provided.

Rationalized traditional construction

In practice, this often recommended method falls between two extreme approaches. The first widely used approach is the prototypical standardized solution, in which a building system is designed and constructed regardless of the local conditions. Therefore, it fails to meet the precise local requirements with respect to climate and topography and money cannot be saved by using local materials and techniques. The other extreme approach is to consider each design problem completely separately, and thereby produce an entirely individual solution for each medical unit. This method, though time consuming, produces better results, but is not usually practical because of the lack of architectural manpower.

In a reasonably rationalized traditional construction, local variables are taken into account and are incorporated into the buildings in a systematic way, usually by basing designs on a standard building module (such as described earlier). Further rationalization can be achieved if all factors (such as space standards) not subject to local variation are standardized.

Prefabrication

It was hoped that prefabrication might be the best way to provide inexpensive buildings quickly. Generally, these expectations have not been realized in practice, even in the industrialized nations. In the developing world there are some fundamental objections to industrialized building systems:

—they are capital-intensive relying on expensive machinery rather than manpower, whereas in most developing countries manpower is plentiful and capital is in short supply;
—centralized dispatch of manufactured building components to scattered sites is often not feasible if the transportation network is not sufficiently developed;
—the materials from which components are made and certainly the machinery used in their manufacture is usually imported;
—prefabrication generally requires expensive handling equipment on-site (cranes, etc.) which is beyond the resources of a small contractor.
Therefore, prefabrication is not recommended except for the on-site production of such items as roof trusses, lintels, formwork, and common joinery.

Local materials

Local building materials should always be preferred to imported materials. The reasons for this are obvious, but are worth repeating:

— it is usually cheaper to use materials and equipment that do not include transportation charges or import duty in their price;
— the local economy and employment situation are stimulated by using locally manufactured goods;
— local materials can always be easily maintained or replaced;
— by using local materials, the architecture of the new building can be harmonized with that of its neighbours.

However, there are also potential disadvantages. The first is that many items needed in even the most simple construction, such as cement or roofing timbers, may not be produced locally. The second is the belief that only certain materials (ceramic tiles, PVC floors, etc.) are suitable for health care buildings whereas others (fair-faced blockwork, concrete floors, etc.) are not. Where resources are extremely limited, this attitude must change.

Determining construction standards

It is neither necessary nor desirable that all health care buildings are built to the same standard. In fact some, including relatives’ shelters and self-care wards, need satisfy only the basic requirements of soundness, durability, and shelter from the elements. From this basic level, a range of construction types of the appropriate standard can be evolved to suit the function of each health care building, thus making the best use of the money and materials available.

The many different building methods found in the developing world are not detailed here. Instead, a number of alternative construction methods and main building materials are discussed, as well as their suitability in different circumstances. With these notes, it should be possible to make the best selection of materials and building methods for a particular job.

Foundations

The most common type of foundation is a poured concrete-strip footing where a trench is dug (usually 300 mm wider than the wall to be supported) to a depth where the ground is firm and undisturbed. The bottom of the trench should be square and flat and the sides vertical. The thickness of the footing should be equal to the projection beyond the wall or 150 mm, whichever is the greater (Fig. 13).
In some circumstances, cement may be too expensive or difficult to obtain. In this case a burnt-brick or stone footing can be used, but the bricks must be laid up with a proper cement–sand mortar to avoid deterioration due to moisture penetration. This precaution applies equally to foundation walls that are built off the footing, but are nevertheless still below ground. These walls should always be made of durable materials jointed with good quality mortar and with a damp-proof course (D.P.C) of bituminized felt, polyethylene, or similar material running through the wall at the floor level (Fig. 14). This last measure is especially important, as often more damage is caused by damp rising up from the foundations than from rain falling on the wall itself. The provision of an inexpensive damp-proof course can add years to the life of a wall, even when it is constructed of “impermanent” materials.

Floors
Most rooms require a 75 mm thick concrete floor slab cast over a 225 mm layer of hardcore of stones or broken blocks with sand or ash binding (Fig. 15). In areas where the soil is stable or where there is very little rainfall, the hardcore can be omitted and the slab laid directly on well-rammed earth. For some rooms, such as shelters for relatives or
temporary accommodation erected in times of epidemics, a rammed earth floor alone will be adequate. It should be possible to trowel the surface of a concrete slab sufficiently smooth to use as a finished surface. However, a floor that is too smooth can become dangerously slippery when wet. The finished floor level should always be at least 150 mm above the surrounding ground level to avoid the penetration of moisture.

If the quality of workmanship is low, and a poor surface is left on the slab, then a sand and cement screed of not less than 2.5 cm can be applied to the slab. This is an expensive item, being rich in cement, and is liable to crack if not properly laid; therefore it should be avoided wherever possible.

Timber floors should not be used since they are susceptible to attack by termites and other insects. More expensive floor finishes, such as thermoplastic tiles, are an unnecessary extravagance; in addition, they require maintenance and are difficult to replace.

Walls

The simplest and most economical methods of wall construction are those using locally obtained earth, either in the form of mud bricks or blocks, rammed earth, or mud and wattle. They have all the advantages previously mentioned in connection with the use of local materials. The disadvantages are lack of durability and the relatively poor quality of the internal surface. Both of these can be mitigated by applying a thin rendering of mud mixed with a binder, such as cow dung, to the surface and renewing it yearly. Regular whitewashing has a preservative effect as well as giving a clean and bright appearance. Common mud walls are very durable in dry areas, but in areas where there is heavy rainfall a large roof overhang of at least 800 mm is essential. If the mud walls are reinforced with sticks they should be treated with dieldrin or another preservative, either directly or by adding it to the water when making the mud. This will ensure that termites do not destroy the wall by eating away the internal wood skeleton. Alternatively, timber such as mangrove, which is not susceptible to termite attack, might be used, if available locally. These forms of earth construction are indigenous to
large areas of the world and should not be rejected out of hand for some buildings such as the shelters required for relatives or self-care wards.

Burnt clay bricks combine the good qualities of mud bricks with permanence and greater structural strength. The production of these bricks unfortunately requires a good supply of firewood (or other fuel) and clay of a suitable quality. By-product fuels such as coffee husks and sugar cane waste have been used successfully, and their use should be contemplated where more traditional fuels are in short supply. Clay containing 1 part in 5 of sand is ideal, and this kind of mixture can often be found about 50 cm below the surface in river valleys and plains. Brick-making is not difficult provided that the proper procedures are followed carefully and the technical literature is consulted. Brick is one of the most attractive and versatile building materials if skilled bricklayers are available. It can be used not only for plain walling, but also for columns, window sills, vaults, and arches, so that expensive reinforced concrete lintels and metal sills are not needed.

Natural stone is an excellent building material. It is permanent and attractive, with a hard surface that weathers well, and can be used in the same way as brick for forming arches and sills. The cost and availability of natural stone can be a problem, but if there are local quarries, semi-dressed stone will probably be cheaper than concrete blocks.

The use of concrete blocks has become the standard solution for low-cost wall construction, although it is much more expensive than the more traditional methods mentioned above. It relies entirely on the availability of cement, not only for the blocks, but also for the bonding mortar. Cement, besides being expensive, may in some cases be unavailable. Concrete blocks produce a sound wall which, however, is not waterproof. This can be overcome by covering the outside surface with a layer of sand–cement rendering of at least 10mm. Alternatively, a plain wall can be protected from the rain by a generous roof overhang, or verandah, and by painting the base of the wall up to 400 mm above the ground with bituminous paint (Fig. 16). Since the rate of rain penetration through a wall 150 mm thick is almost the same as that through one of 200 mm, the former is the better choice, unless greater thickness is a structural requirement.

Fig. 16. Wall protection—dimensions in mm

Reproduced from reference 27.
Where there is a sufficiently high standard of bricklaying craftsmanship, plaster should not be used as an internal finish, since this will double the cost of the wall. A reasonable substitute, costing one-third of the price, is a wash of sand and cement brushed on to fill up the small cavities in the blocks. The wall can then usually be finished off with whitewash, or with one coat of emulsion and two coats of gloss paint if a high quality, washable finish is required. From an aesthetic point of view, block-work is rather dull and does not harmonize with more traditional buildings, unless it is rendered and lime-washed on the outside.

Burnt brick and stone walls should preferably be laid with cement mortar, but if this is not available, mud mortar can be used instead, without losing too much strength since this type of wall has a natural stability which is not so dependent on the strength of the joints. Conversely, concrete block walls are more dependent on good-quality joints and should always be laid with cement mortar. Moreover, there is little to be saved by economizing on mortar since it accounts for less than 10% of the cost of the wall, whereas in brickwork it can account for as much as 30%.

Timber walls are often not used because of their vulnerability to termite attack. However, timber can be used for walls if it is available already pressure-impregnated with preservative or if there are local species of wood that are not susceptible to attack. Timber combines high strength and lightness with ease of use, and it is ideal in hot, humid climates where ventilation can be readily obtained by the use of louvres and shutters. In addition, timber can be easily used for on-site prefabrication of wall panels, roof trusses, etc., a procedure that will speed up the building process.

Corrugated iron has been extensively used for walls, since it can be erected quickly and is effective in keeping out the rain. The chief disadvantages are that it has very poor thermal insulation qualities, it needs regular repainting, and it may become increasingly expensive since it is usually manufactured from imported materials. It has, however, frequently been used for temporary buildings where a lower standard of construction is acceptable. Such buildings are often used for a number of years before they are replaced, and even then the corrugated iron sheets can be carefully removed and reused for roofing a more permanent building.

**Roof materials**

Thatching, whether of grass, reeds or palm leaves, is comparable with mud walls as regards suitability. It has the same advantage of minimal cost and it can always be erected, maintained, or replaced using local materials and labour. The permanence of thatch largely depends upon the workmanship and type of thatch used. A well-laid roof of papyrus reed can last for more than ten years. The quality of workmanship and
materials on neighbouring buildings is a good indicator of the local standard of work.

Thatching has two additional advantages: good thermal insulation and lightness in weight. The latter means that the supporting structure can be very simple, for example, consisting of wooden poles or bamboo. However, thatch can harbour insects or even snakes and there are risks of fire and leakage during heavy rain. But, as with mud walls, the thatched roof is quite suitable for ancillary buildings.

Of the sheet roofing materials, corrugated galvanized iron is by far the most common, although by no means the most effective. As with other sheet materials, an orderly support structure is required, preferably with a simple rectilinear roof shape to minimize cutting and waste. The roof structure can be light; the weight of the covering material is less important than the weight of the persons involved in maintaining the roof. The reasons for the widespread use of corrugated iron are that it provides the cheapest "permanent" roof, it is light to transport and handle during construction, and requires little skill to erect. However, it is becoming increasingly expensive, it requires some maintenance in the form of painting to retard rusting, it provides virtually no thermal insulation, and it is very noisy in heavy rain. These last two points can be overcome to some extent if some form of ceiling is installed, although this considerably increases the cost.

In terms of performance, asbestos cement sheets are superior in almost every respect, particularly because they are maintenance-free, provide some insulation, and are quieter in heavy rain than corrugated iron. However, owing to the risk of cancer associated with the manufacture and use of asbestos, they cannot be recommended.

In some areas aluminium sheeting is used, but it is usually more expensive than iron sheeting with little improvement in performance. The rust-proof quality of aluminium is counterbalanced by its tendency to corrode as a result of electrolytic action due to the alkaline components in the concrete or cement mortars used to fill the gap between the top of the wall and the roof sheeting. If this problem is avoided by separating or coating the vulnerable surface with bitumen, little maintenance is required when aluminium is used. The thermal properties of aluminium are superior to those of corrugated iron, being comparable with those of asbestos. It not only reflects sunlight but it emits quite slowly any heat that it has absorbed.

Tiles of clay or concrete make a durable and attractive roof and, although they are heavy and need a substantial supporting structure, they are not necessarily expensive. Recent studies in Kenya have shown that the cost of several types of locally made tiles compares favourably with that of corrugated galvanized iron sheeting, even allowing for the additional cost of the supporting structure. Concrete tiles have poor insulating qualities compared with clay tiles. However, where the nights are cold, tiles should not be used without a ceiling, because the open nature of a tile roof allows cold air to enter the building and following rain evaporative cooling can cause considerable discomfort.
Shingles are lighter than tiles, and can make a good roof if properly laid. If cedar is available, no prior treatment is necessary. If a poorer quality wood, such as cypress, is used, the shingles should be impregnated by soaking in motor oil to increase their water-resistance. The periodic re-oiling of shingle roofs serves little purpose because wet rot usually occurs between the overlapping pieces of wood where the water is retained but the oil does not penetrate.

**Roof design**

The overall shape and slope of the roof are as important as the choice of materials. The standard pitched roof with gable ends is commonly used because of its simple construction, allowing the use of uncut sheet materials, and economical roof trusses for the supporting structure. The most important design consideration is the slope of the roof, which is in turn determined by the covering material. As a general guide, the minimum recommended slopes are shown in Fig. 17. If the walls are made of concrete blocks, the slope of the roof should be such that little cutting of the blocks is required where the gable wall meets the underside of the roof. For this, a slope of 1:3 gives the best results.

![Fig. 17. Different types of roof](image)

Reproduced from reference 27.

A mono-pitch or lean-to roof is suitable for small spans of about 3 m with the advantage that if a single sheet is used it can be laid almost flat (e.g., 1:10). This type of roof is less satisfactory for large spans because it is difficult to use a truss for the supporting structure, and the pitch of
the roof must be steeper since a single roofing sheet can no longer be used. Furthermore, a steep slope on a mono-pitch roof tends to create a high wall on one side of the building, which is difficult to shade and wasteful in material.

Hipped roofs are more difficult to construct as they involve special rafters and cutting of the covering material. They also restrict the lengthwise expansion of the building. When a hipped roof is used, however, the masonry work is cheaper since the wall area is cut to a minimum; this type of roof also gives what many people consider to be a friendly appearance. Other more unusual roof shapes, such as domes and vaults, are not discussed here, but their use should be encouraged if they conform to the local architectural pattern.

Ceilings

In areas where either the nights are cold or the days very hot, the installation of a ceiling is essential, especially if the roof covering has poor insulating qualities. Where extreme cleanliness is required, such as in the operating theatre and the laboratory, it is also advisable to install a ceiling. However, in most hospital rooms, including the wards, ceilings are functionally unnecessary. In addition, ceilings can present problems, providing excellent breeding places for insects, birds, and bats, which can create extremely unpleasant odours and an insanitary environment. Consequently, ventilation openings should be well screened; bats can be deterred by allowing some light to enter the ceiling spaces. Wherever possible it is both sensible and economical to omit ceilings, since the addition of a ceiling adds about 50% to the overall roof cost.

If ceilings are needed for insulation in paramedical buildings, traditional local materials such as bamboo, papyrus, or split sisal poles can be used. However, since such ceilings tend to harbour vermin, they are inappropriate for use in medical buildings. Where a sealed ceiling is required, softboard and expanded polystyrene are commonly used, polystyrene having an approximately 60% higher thermal insulation value.

Softboard (12-mm thickness) is fairly robust and usually available, but it can be attacked by termites, and is susceptible to mould in damp climates. Polystyrene (19-mm thickness) is a much better insulator, is cheaper, and is unaffected by moisture or insects. It requires careful handling both in transit and construction to avoid chipping or cracking, but if care is taken to keep the surface clean, it needs no painting. If painting does become necessary, then a PVA emulsion must be used, whereas a simple lime-wash can be used on softboard ceilings.

Hardboard (3-mm thickness) is the cheapest ceiling material with a paintable surface of good quality. However, it often sags badly because the supporting battens are too widely spaced. This common mistake occurs because hardboard is stiff when it is new, giving a false impression of strength. It loses its initial rigidity after some months, particularly in humid climates, and the ceiling then tends to sag. The
simple remedy is to ensure that the ceiling battens are spaced not more than 60 cm apart in both directions. Hardboard is a poor insulator and varies a great deal in quality; some types are little more than improved cardboard which is quite unsuitable for any building purposes. The better qualities have a first-class surface and are less susceptible to deterioration by moisture than, for example, softboard.

Plaster ceilings are excellent, but they are costly and difficult to install, and are therefore rarely seen in remote areas. Similarly, corrugated iron ceilings with an earth backing, are rarely used today because of their considerable weight and poor appearance, although they are durable and provide good thermal and sound insulation.

Windows

The simplest and probably the most common type of window found in rural areas is a timber-framed, unglazed opening covered with 50 mm steel mesh for burglar proofing, if necessary, and a side-hung wooden shutter. This structure is cheap and effective for many health care and hospital buildings, including kitchens, laundries, and even wards and offices, although it is unacceptable climatically in some areas, for example, where it is cool during the daytime.

Insect-proofing is essential in some areas such as the operating theatre and laboratory, and in some regions may be desirable in all the rooms. The choice between galvanized metal and nylon mesh will depend upon the cost and the availability. Both materials can deteriorate, the former by rusting and the latter from the effects of ultraviolet light. Any type of insect mesh tends to reduce the free flow of air through an otherwise open window, and an allowance should, therefore, be made when estimating the area for ventilation.

The use of timber-framed, glazed windows attempts to combine natural lighting with variable ventilation, but in most cases these windows are unsatisfactory. The main problem is that in order for the small wooden frame around the opening part to hold the glass in place for a number of years, well-seasoned wood treated with preservative and expert joinery are required. Otherwise, the joints will open and eventually the glass will break. A recommended alternative combines permanently fixed glazed areas that are thus not liable to deteriorate; in such cases ventilation can be regulated by means of wooden shutters or louvres over unglazed openings.

Metal casement windows, often made from standard steel sections, provide a long-lasting window, if the metalwork is painted approximately every five years. Casement windows are quite effective ventilators, capable of scooping air into a building when they are opened in the right direction. However, there is no vertical control of air movement and the often large, fixed panes reduce the total area that can be opened. When the panes are small, the cost of replacing broken glass is minimal, and there is usually no need for separate burglar proofing if the latches are secure. Cheap casement windows are often
made locally from standard sections, but the quality should be checked before ordering.

The use of the adjustable louvre window (Fig. 18) has become more popular in medical buildings for several reasons: it is inexpensive (cheaper than the factory-made metal casement); allows for variable ventilation up to nearly 100% of the opening and for control of the direction of the breeze; and it can be adapted to any width of opening simply by cutting the glass louvre blades to the correct length. The objection to louvres, that they are more difficult to burglar-proof, is not relevant in many hospital buildings, but if necessary, horizontal bars can be placed between the louvres. An additional advantage is that if ventilation, but not light, is required, (for example, in the lower portions of examination room windows) the glass louvres can be easily replaced by an opaque material, such as asbestos, or the glass panes simply painted white.

Fig. 18. Louvre window

Reproduced from reference 21.

Doors

For external and internal doors, a well-made, ledged and braced door is usually the best solution, being cheap, durable, and often made locally. Flush doors are not recommended because the cheaper types, that can compete in price with ledged and braced doors, are likely to be damaged by trolleys, etc. They also tend to disintegrate under harsh climatic conditions, as they are entirely held together by glue. Panelled doors are attractive, but need a high level of craftsmanship; if this is available, then this type of door is a good choice for the main entrance. There are usually two widths of door required: those to allow the passage of a bed or stretcher must be 1.1 m wide; and those for normal use need only be 80cm wide. Doorways also have an important role in ventilation since, if well placed, they can provide the low level of ventilation necessary in hotter areas. Doors with separately hinged upper and lower sections are extremely versatile for both light and ventilation, and their use should be seriously considered.
Building Maintenance and Improvement

Maintenance policy

An important factor in the selection of building materials is their durability throughout the lifetime of the building. When considering material costs, the maintenance cost should be taken into account as well as the purchase price. For a number of years, industrialized countries have accepted high initial costs for sophisticated, highly durable materials with the expectation that maintenance costs will be minimized. However, in developing countries, where capital is extremely limited and imported materials are expensive, it is sensible to use cheaper local materials, whose maintenance will provide much-needed local employment.

A clear distinction must be made between maintenance, which is labour-intensive, and the replacement of worn-out elements, which is capital-intensive. It is better to add, for example, 25% to the cost of a roofing material (which will add only 5% to the total building cost) than to be faced with replacement costs within a few years that, due to inflation, may be considerably greater than the initial cost of a more durable material. It follows, therefore, that materials that have a long life should be chosen, even if they require some maintenance during their lifetime. This applies, in particular, to the main elements of the building: the floors, walls, roof, etc., where additional investment is really worthwhile. The potential for improvement is basic to economic construction in situations where, owing to lack of funds, buildings must often be constructed initially in the simplest possible way.

Preservation from insect and fungal attack

One important factor that affects the durability of buildings in tropical countries is the deterioration of timber as a result of insect or fungal attack. Insect attack is mainly by termites and various wood-boring beetles, and can be discouraged by design modifications, such as isolating all the timber components from the ground with metal termite shields or, preferably, by pre-treatment of the timber with some kind of preservative. Preservatives can be applied in a number of ways. Painting the timber with preservative is almost totally ineffective and is unacceptable; the on-site method of immersing the timber for 24 hours in a bath of preservative is more efficient and acceptable where a better alternative is not available. Timbers should be immersed when they have been cut to their final lengths so that the preservative soaks well into any exposed end-grain. The best method, however, is to purchase timber that has been pressure-impregnated at the timberyard; this method is very effective, and although such facilities are available only at main yards, it is worth the transportation surcharge involved to obtain timber treated in this way.

Another precaution, particularly against termites, is to treat the soil
beneath and immediately around the building with a solution of dieldrin. In practice, this means treating the foundation trenches and all the ground upon which the building will stand with 4.5 litres of a 3g/l emulsion of dieldrin per m², raked in to a depth of about 150 mm. Further protection can be obtaining by digging a 400 × 400 mm trench around the building, and treating it with a similar solution using 2 l/m, then replacing the soil in the trench and treating it in the same way. This procedure, although effective, should not be carried out where there is any danger of contaminated groundwater running-off into nearby streams or wells. The life of mud-and-wattle and sun-dried brick buildings can be extended by using a similar solution of dieldrin instead of plain water to make the mud.

Fungal attack occurs only in timber with a relatively high moisture content (over 20%), and is usually caused by inadequate curing of the timber or by the timber coming into contact with a source of moisture within the building, for example, a roof timber lying directly under a crack in the roofing material. It can also occur in damp areas, such as floor or roof spaces, that are not sufficiently ventilated to keep the timbers dry. Fungal attack can be avoided by using only seasoned timber, and by not allowing the type of conditions described above to occur. But, as with insect attack, the most effective defence is to build only with pressure-impregnated timber. The seasoning of timber on-site is a simple procedure; the timber should be ordered 2–3 weeks before it is used and should be stacked so as to allow air to circulate around each board and, of course, be protected from the rain.

Fire protection

Finally, the danger of fire in timber buildings or building components must be considered. In single-storey buildings, this is not a major problem, as long as the burglar-proofing does not prevent escape in the event of fire. Often, if fire breaks out, the furnishings within the building, particularly foam cushions and mattresses, cause death by smoke inhalation long before the structure of the building catches fire. Nevertheless, it may be prudent to use a timber preservative containing a fire retardant, since fire-retardant paints are expensive and not very effective. Some local timbers are particularly fire resistant, and any timber with a large cross-sectional area (more than 100 × 100 mm) will resist fire for a considerable time.

Climatic Considerations

The effect of the climate on building construction and materials is very complex (22) and this makes generalized statements difficult and possibly misleading. Therefore meteorological data, as well as local experience, should be considered long before the implementation phase. In all tropical areas, the key building component for thermal comfort,
is the roof. A light-weight roof is unlikely to provide a comfortable environment in hot or cold climates unless the external surface is reflective, and insulation in the form of a ceiling is incorporated on the underside. In this respect, it has been shown that no thermal advantage is gained by increasing the height of the ceiling, and there is little advantage in ventilating the roof space. This is because, in both cases, the heat being transmitted is radiant and is little affected by the volume or temperature of the air between the source and recipient surface. Therefore, it is almost as effective for the ceiling to follow the roof slope as it is to construct a horizontal ceiling, which may be more expensive. The ceiling material should also be chosen with thermal insulation in mind. In addition, the overall shape of the roof can affect the level of comfort inside the building; a steep roof is cooler than one of shallower pitch because the roof presents a sharper angle of incidence to the sun’s rays. If a gable roof is used, this allows a high level of ventilation in the end wall, which can have a beneficial cooling effect. However, a hipped roof with a good overhang at the eaves gives effective shading to the walls on all sides of the building. These factors should be taken into consideration when designing the roof shape.

There are two approaches to the design of walls to meet different climatic conditions. The first is to build heavy walls using materials with a high thermal capacity, such as brick or concrete block. (The thermal capacity of a material is proportional to its density, and is the extent to which it can absorb heat per unit volume.) This type of construction is suitable for regions where the days are hot and the nights cold, such as desert or highland areas, with generally low levels of humidity. Under these conditions, the heavy walls absorb much of the sun’s heat during the day, and prevent the inside of the building from heating up rapidly. At night, when the air temperature drops, the walls emit their heat, keeping the rooms warm. The second type of wall is one made of lightweight materials that have a low thermal capacity, such as timber or open blockwork. This kind of wall is suitable where the days are hot and the nights are only a few degrees cooler. The structure of the building soon loses the heat it has absorbed during the daytime, allowing the maximum benefit to be obtained from whatever drop in air temperature occurs at night. It is also desirable to have efficient ventilation so that the cooler air can pass easily through the rooms.

Whatever the type of wall construction, it is important to shade as much as possible the wall area from direct sunlight by providing a generous roof overhang (at least 800 mm for a wall of normal height). Glazed windows are a particular problem because the glass allows the short-wave solar radiation to enter, but prevents the lower temperature long-wave radiation from leaving the building, thus creating what is commonly known as the ‘green-house effect’. Windows can be shaded by canopies or blinds, the latter being more efficient if placed outside the glass. The verandah is a valuable architectural device, as shown by its extensive use in traditional buildings in tropical countries. It provides shade for the whole of the main wall of the building, and reduces the
amount of glare from the sky, which can be a major source of discomfort. Whatever the wall or roof design, any advantage will be lost if the long sides of the buildings do not face north and south.

Finally, climatic conditions can have an adverse effect on building materials. Changes in temperature cause the materials to expand and contract and over a long period this can cause cracking in rigid walls or roofs, especially if the changes occur quickly, for example, as a result of the cooling effect of rain. Expansion and contraction caused by wetting and drying following rain can be equally serious, as this often causes cracks in concrete blockwork. Apart from protecting the walls from the sun and rain by an overhanging roof, and the inclusion of a damp-proof course, cracking can also be prevented by including frequent vertical expansion joints (about every 2–3 m in concrete blockwork) in the wall material.

The ultraviolet content of solar radiation can cause chemical changes in materials, which may result, for instance, in the rapid deterioration of bituminous products. For this reason, asphalt roofs should be protected from direct sunlight by light-coloured stone chippings, aluminium paint, or even a coat of lime-wash. Paints deteriorate more rapidly when exposed to solar radiation, since this is liable to induce depolymerization and loss of plasticity, thus causing cracking and flaking.

Local Methods and Skills

In general, the maximum use of locally available building methods and skills helps to ensure that appropriate buildings are constructed. Conversely, the extensive use of imported skills and technology has tended to result in buildings that do not fit in with local functional requirements, geographical conditions, climate, and cultural values of the people.

The use of local skills also encourages local employment and industry. In the case studies, it was found repeatedly that community involvement through self-help projects was extremely beneficial. In one participating country, 50% of the rural building expenditure was provided locally. In another, the cost of facilities constructed by the community was only 3% of that of similar government-built facilities.

Although the involvement of communities in the development of their own health care facilities is generally greatly valued, some research is still needed to realize its full potential. Local involvement usually entails the provision of finance, labour, or both. The health authorities then run the completed facility, and pay either all the running costs or only the salaries of the personnel. It is important that the health authorities are actively involved from the very beginning of the project so that the facilities are not badly conceived, inappropriately placed, and do not create an imbalance in the distribution of services.

The shortage of trained and experienced health facility designers is one of the primary obstacles to the implementation of an appropriate
building programme within the framework of local health services. This
shortage is evident at different stages of the implementation process. For
example, architects are frequently not involved in formulating the project
brief at the moment when decisions are being made on the size and
scope of facilities, and their general standard of construction and
equipment. At the design and production stages, excessive project loads
result in the general lowering of professional standards and the adoption
of ad hoc designs (prepared initially for one particular location) as
standard solutions. Supervision of construction is generally overlooked,
because the scarce manpower resources are concentrated centrally,
sometimes with disastrous effects on building quality and stability. The
evaluation of completed projects is rarely assigned a high enough
priority to justify the manpower that would be required for this job.

All of these problems are serious and indicate the need for a
fundamental re-ordering of building and equipment priorities. This may
involve completely new types of building, design approaches, methods of
construction, uses of materials, and modes of implementation. Since the
available manpower is barely able to keep pace with the demands of
current programmes, it is very unlikely that this re-ordering will take
place without a special effort.

The shortage of building designers is aggravated by their frequent lack
of experience with health buildings in general or primary health care
facilities in particular (22, 24). Architects in ministries of works are
frequently expected to cope with a wide range of other types of building
and are often unable to build up experience within the framework of a
multidisciplinary health unit. Those who do develop some expertise are
often attracted into the more lucrative private sector, either in their own
country or abroad. Specialist training is rarely available locally, and
training overseas is generally not relevant to the needs of developing
countries, resulting in inappropriate designs and often a sense of
professional dissatisfaction.

Attempts to mitigate the problems arising from this shortage of
experienced professionals have met with varying degrees of success. The
search for appropriate technical literature and the use of foreign or local
architectural and engineering consultants are probably the most
common solutions.

Foreign consultants are usually welcomed in developing countries
since their fees are often covered by bilateral aid agreements. However,
they are generally used to working on large-scale projects with
sophisticated manpower, materials, methods, and equipment at their
disposal, and they often produce inappropriate facilities that are
expensive to build and frequently require an organization and staffing
pattern not adapted to the local manpower resources and skills and
that therefore result in inordinately high running costs. In a developing
country these costs rapidly offset any gain that may accrue from a free
consultant or even a free building. Local consultants, on the other hand,
are more likely to be familiar with local conditions, and the experience
they gain can be retained within the country. There is nevertheless the
question of the fee structure (usually based on construction cost) that may make the construction of simple buildings unattractive to them.

Nevertheless, there are a number of projects that have been satisfactorily undertaken by foreign consultants who have spent substantial time and effort in the countries concerned in order to obtain a better understanding of the local conditions. Throughout a project, the foreign consultant should cooperate with a local consultant if possible. This arrangement provides good opportunities for the exchange of experience, and the training of local architects and engineers.

In addition, or as an alternative, to the use of consultants, technical assistance personnel may be engaged. They sometimes have specialized knowledge of health care facilities, although this experience has often been gained in developed countries and can lead to problems similar to those found with foreign consultants. They are also a stop-gap solution and will take any expertise gained with them when the job is finished.
4. Project operation

Management Capabilities

It is well-known that in developing countries there are shortages of trained and experienced managers at all levels of the health care system. In particular, this applies at the local level, where managerial functions, including the administration of various health care facilities, are the responsibility of medical practitioners. These are invariably so fully occupied with clinical duties that they often neglect their administrative work.

The shortage of effective health managers is due partly to the lack of candidates, because the job is thought to be unattractive, (there is also competition from the private sector) and partly to the lack, in some countries, of training facilities and career prospects specifically geared to health management. Other reasons for this problem are the heavy responsibilities of health managers who nevertheless have little authority. The shortage of managers subsequently leads to poor coordination, as well as the inefficient use of facilities and equipment.

In the following text, some guidelines are given on the management of health services and health care facilities (25).

Management tasks and functions

By gathering information and opinions, the health manager should be able to assess the main problems and needs of his locality and its services. Similarly, by study and consultation, the health manager must prepare a list of priorities for future changes and developments, and the options available for realizing these priorities. The functions required to develop health services, including the specific tasks required and the personnel responsible for them, will now be described in detail. Without this clear definition of functions and tasks, it is impossible to assess accurately the resources and organization of health services that will be necessary to implement the selected options, and to monitor their performance.

At its simplest, the assessment of resources and organization involves an estimate of the number, type, and location of staff and facilities
(together with an estimate of their cost) needed for the required functions and tasks. It should ideally include a statement of the resources and organizational structure required to:

—introduce change and development;
—clarify linkages and communications with other sectors of the health system and related agencies;
—recruit appropriate staff;
—motivate staff, patients, and the public;
—provide orientation and training for staff, both initially and throughout their careers;
—exercise day-to-day decision-making and control its implementation;
—provide appropriate support services;
—record, monitor, and evaluate performance and its outcome;
—plan for future development.

The failure to provide adequate resources and organizational structures is responsible for many of the difficulties or problems that have become apparent in many health care programmes and facilities.

Management skills

A further and more serious cause of difficulties and problems is the absence of, or deficiencies in, management skills at various levels in the health care system. Management training will not immediately solve the many problems of health care provision, but considerable improvements in performance, efficiency, and effectiveness could be achieved by the more rapid development of appropriate management skills, since the operation of health care facilities depends not only on their design, construction, and equipment, but also on their management. Some positive results of the skilled management of health care facilities were observed in the national case studies mentioned earlier (see Introduction), e.g., well-defined catchment areas, clear assignment and control of personnel, programmes for maintenance and supply, or financial accountability. Conversely, some facilities that were well designed, had many insufficiencies because of unskilled management.

Health care technology and health management technology are both of great importance in the health care system. Physicians, nurses, and other health workers may be adequately trained in the former, but are too often inexperienced in the latter. In most developing countries, full-time managers or administrators (medical and non-medical) still do not have sufficient opportunity (or incentive) to obtain the relevant skills in health management technology.

As already implied, management skills must be related to defined functions and tasks. Thus, for any given health system structure, it is necessary to identify the management skills required for:

—management of primary health care and community health development, both in rural and urban areas;
—management of health services in rural and urban areas;
—management of health care facilities such as hospitals or health centres (including referral from and support for other health services);
—management at the central and intermediate levels of national health systems.

Although specific to the present considerations, the management of health care facilities has to be viewed within the broader context of the skills required for the management of national health systems.

Management training

In recent years, there have been many national and international reports stressing the importance of developing appropriate health management training schemes. In some countries much has already been achieved, but in others more action is needed to put these principles into practice. With so many demands competing for the limited resources available in some developing countries, management training often comes relatively low on the list of priorities.

As a background to the initiatives and developments now taking place, it is useful to refer to the conclusions of a WHO-sponsored working group on “Education of managers in health services”¹, in which four types of activity have been distinguished:

—management education, which aims to provide the knowledge, attitudes, and skills that would permit health managers to perform successfully a large variety of tasks in various organizational situations and settings;
—management training, which is more organization-specific and is intended to prepare people for well-defined jobs by developing skills immediately useful for common tasks and assignments;
—management development, which is intended to enhance the efficiency of practising health managers through a variety of job-related educational activities within a policy of continuing education;
—organization development, which aims to improve relationships, communication, team-functioning, etc., within organizations, so that individual managers can use newly acquired skills to improve organizational performance.

These definitions provide a useful framework within which any country can formulate its own training needs, priorities, policies, and programmes. A survey report entitled *Health services management for developing countries*, produced by the International Hospital Federation (26), makes a number of recommendations, some of which are listed

---

below. Others have been added in the light of further information and advice:

—training in management should preferably be given in the country or region where a manager is going to work, rather than in a foreign country;

—wherever possible, the aim should be to develop existing training institutions, rather than build new ones (for example, it may be preferable to extend the work of an existing institute of public administration, rather than establish a completely new and separate institute of health service administration);

—it may be appropriate to aim at developing one or more regional centres in each continent for training and research in health service management, and for the exchange of information and ideas within and between countries;

—equally important is the need to develop, nationally and/or regionally, institutions and methods for training the teachers of health managers;

—in preparing training programmes, it must be recognized that in many respects, health service management has a strong humanitarian component, and patterns of service are influenced by political and ideological attitudes and policies;

—in organization and training for health management, primary health care must be distinguished from other health services, “vertical” health programmes (e.g., malaria, tuberculosis, etc.) and institutionalized services (e.g., hospitals, health centres);

—some management orientation should be included in the training programmes for all grades of health workers. Conversely, there should be some health orientation in the training programmes for non-medical administrators. Encouragement could also be given to joint training sessions and seminars;

—managers at every level of national health systems (or institutions) should be encouraged to promote the self-development of staff who are responsible to them, and they should be instructed how to train and coach their subordinates—to produce a “cascade” effect that gives beneficial effects for a small initial expenditure;

—in each country, the development of a professional association of health managers should be encouraged, in order to improve professional standards and to represent the views of administrators to government and other organizations;

—finally, training programmes should be evaluated continuously because it is inevitable that newly-instituted programmes will require modification in the light of experience.

These recommendations refer to the extension of existing training institutions rather than to the establishment of completely new ones. This point is worth re-emphasizing because in many countries,
institutions already exist, within and outside the health system, that could be used for health management training.

Much greater use could also be made of available expertise relevant to health management training; particularly in relation to first-line, supervisory, and middle levels of management, as well as to the support service aspects of institutional management, such as maintenance, supplies, transport, cleaning, catering, etc.

In the past, the lack of definition of health management structures, tasks, and job descriptions made it difficult for any training institution to assess its possible contribution to the health services. If clear definitions are established, however, it becomes much easier to devise and implement appropriate methods of collaboration between training institutions and the health services.

**Career prospects**

People in any occupation will normally expect to have some idea of the career opportunities and prospects open to them as they become more experienced and more highly trained. In most professional occupations, the rewards and satisfactions in prospect at the top of the career ladder will largely determine the quality of the recruits entering the profession. Doctors and most other health professionals have traditional, well-defined career opportunities and prospects, but in many developing countries this does not apply to the full-time medical or non-medical manager/administrator. Consequently, the quality of recruits entering this profession suffers, and the standard of management in health services falls. Full-time managers or administrators are not required at every level in a country's health system and, in primary health care or technical units, the necessary administration can often be performed satisfactorily by doctors, nurses, or other health professionals, if they have had some management training. Nevertheless, in any national health care system there will be important roles for full-time managerial staff, particularly in hospitals and larger health care institutions. If standards of management are to be maintained or improved, it is important to define not only management structures for the national health services, but also the career structure for managers. However, many countries experience some or all of the following problems:

—the management needs and tasks at different levels of the health system (central, regional, and community health services; hospitals, health centres, etc.) are unclear, as are the different skills required (e.g., in planning, programming, operation);
—in consequence, in many countries there is no clearly defined pattern of career structure for medical and non-medical managers, and the management training that is provided is not related to any career structure;
—appointments to health managerial posts are too often made on the basis of professional (medical) competence rather than on management
ability or potential, and management qualifications are seldom
required for senior posts; this leads to tension and rivalry between
medical and non-medical administrators, and considerable frustration
on the part of the latter, who feel relegated to positions of non-
professional status;
—this situation, in turn, has an adverse effect on the recruitment of able
candidates into the field of health facilities management, and
encourages those already in posts to move to industry and commerce
where the financial rewards and other prospects are more attractive.¹

To overcome these problems, as stated earlier, it is essential to have a
properly designed management structure at each level, with well-defined
career structures for medical and non-medical administrators. There
should also be clarification of the management responsibilities of doctors
and other health professionals whose main concern is with clinical and
technical work. To attract good candidates to non-medical management
careers, it is vital that they can be offered careers that provide
opportunities to experience true responsibility and also hold the prospect
of satisfying and rewarding posts at the top of the ladder.

Cost Management

In general, it is important to take a more comprehensive view of costs
embracing planning, construction, and recurrent costs², especially since
recurrent costs over a three-year period often equal the initial building
costs.

There are many ways in which long-term costs and efficiency can be
influenced by design and construction. For instance, over-extended
facilities or units, in which the zoning of activities and the circulation
flows have not been properly thought out, automatically mean that the
staff requirements will be 5, 10, or 15% higher than expected for the life
of the facility. Several examples of this situation were seen in the
national case studies. If the operational budget is insufficient, as
happened in one country, then the facilities are understaffed, undersup-
plied, and under-utilized, which is equivalent to having wasted a part of
the investment. In some areas, faulty building techniques made extensive
repairs necessary soon after the inauguration of the units. On the other
hand, concern for costs alone may result in longer-term inefficiency. In
one country participating in the case studies, for instance, equipment
suppliers were selected by the national controller’s office solely on the
basis of the lowest price. This proved to be a serious obstacle to the
rationalization of equipment, with important consequences for mainten-
ance, acquisition of spare parts, and training of staff.

¹ Report on hospital management, design and maintenance project. Manila, WHO/WPRO document
WPRO 4304-E, 1974.
² BURFIELD, J. & LAW, A. Construction standards and methods appropriate for simple building needs.
4. PROJECT OPERATION

The clear interrelationship (either explicit or implicit) between the choice of technology and cost should be considered at the outset of a project when the cost plans (or budgets) are being prepared, and external funding is being assessed. By the process of cost management actual costs are contained within those predicted, and this process should be continuous from the time a budget is established. The preparation of a realistic budget is therefore very important to the financial success of the project, always remembering that it is as serious to be substantially under the budget limit as it is to exceed it. Those who are responsible for establishing the budget should use all the resources available to them to ensure that, as far as possible a realistic budget is set. Since this budget will be calculated well in advance of project realization, assumptions must obviously be made on the building technology, as well as on the time involved, the quality, and regional cost variations.

For internationally-funded projects concerning simple institutional buildings, a credit or loan from the World Bank is frequently negotiated well in advance of the project design or realization. To all intents and purposes, therefore, that credit or loan must be considered as the budget. Such budgets are usually derived from cost-assessment studies and are of considerable significance, since the size of the budget will determine, to a large extent, the type and quality of building technology that can be used to construct the facility in question.

Although there are several acceptable methods of establishing a budget (it is usually most effective to employ several as a means of cross-checking), one of the methods most frequently used is that based upon historical data relating to the cost per unit of area. Such data are, however, usually only available for conventional construction techniques. There is a danger, therefore, that budgets established in this way may inhibit a more in-depth evaluation of resources or a search for innovations that might lead to the use of a more appropriate method.

It is therefore important to adopt a system that will clearly identify the appropriate relationships between technology and cost in order not to discourage technology selection or innovation. The process of cost modelling, based upon a realistic budget, could fulfill this requirement.

The budget for a building project is derived from assumptions on the cost of a wide variety of factors, including:

-space to be provided
-function to be performed
-time-frame for completion
-climatic conditions
-topographical conditions
-complexity
-market conditions
-economic indications
-building techniques
-resource availability.
Some of these assumptions can be made more confidently than others, because of the availability of relevant historical data and by using experienced judgement. However, the possibility of inaccuracies in the budget exists, and the smaller the historical data bank, the greater is the degree of uncertainty as to the accuracy of the budget. Whatever information is available, however, cross-checking is important to ensure that every available piece of data has been incorporated.

Following the establishment of the budget, the next stage in the cost management process is to develop a cost model for each building type. A cost model is, simply, a typical average distribution of cost throughout the various elements of a building. This model is based upon the same historical data as were used for the budget, and must be corrected in accordance with the project in hand. It must also be prepared in association with a key or outline specification. However, since it is prepared in advance of the design, it must be considered as a predictive control tool based upon average conditions and adjusted by assessment. The value of the model, however, lies in its ability to express, in cost target form, assumptions on building techniques, quality, complexity, etc., and to provide a basis for detailed evaluation of cost plans derived from the actual designs.

It has already been emphasized that the preparation of the budget must incorporate, in one form or another, an assessment of the appropriate building technology. The cost model is an extension of this since the allocation of cost throughout the elements of the proposed building requires details of the building techniques upon which the model is based. Thus, in helping to decide which methods to adopt, the cost model can assume a very important role, providing a comparative tool by which the effect of alternative forms of construction on cost can be measured.

In terms of the decision-making strategy and criteria evaluation, however, capital cost is only one aspect involved in the determination of the most appropriate technology. Consideration should also be given to life-cycle or ultimate cost, a topic discussed in the next section.

**Life-cycle costing**

Until comparatively recently, in almost every country in the world, agencies responsible for the provision of new facilities in both the public and private sectors considered cost under two distinct headings—namely, the initial or capital cost and the operating and maintenance cost. Little or no attention, however, was given to the interrelationship of these two costs, and the normal procedure was, and frequently still is, to construct a facility with the lowest possible capital cost. The consequences of this practice were borne by the future users of the building who were responsible for finding sufficient funds not only to operate and maintain the building during its early years, but also to replace and adapt as necessary throughout its total life-span.

This approach has serious consequences in poor countries. The
4. PROJECT OPERATION

provision of high-capital-cost buildings, which are expensive to maintain and operate, is an unacceptable and costly process, even though the initial capital cost may be provided interest-free or at low interest rates by international aid agencies. Although there are many arguments for and against the lowest-capital-cost approach, a constantly changing international economic structure and the world energy crisis have resulted in new emphasis being placed on "total facility cost". This is the expression and evaluation of all the costs attributable to a building throughout its total useful life, known as its "life-cycle cost". The technique used to evaluate this is known as "life-cycle cost analysis".

The examination and evaluation of the constituent parts of a facility's life-cost provide: a method for analysing the historical financial performance of a building; a tool which allows project managers to evaluate cost options prior to a commitment to build; and a technique that may also be used to analyse and evaluate the relative cost and benefits of construction systems and subsystems after the decision to build has been taken. In addition, life-cycle costing can be applied to estimate the potential running costs of complete buildings or parts of buildings that are potentially useful as health care facilities.

Life-cycle cost analysis may be used in:

—evaluating the options in meeting space demands;
—the comparison of design and planning alternatives, and analysing their costs during the life of a building;
—the prediction of the total costs to the owner during the life of the facility;
—the procurement of buildings and their components.

Further variations of these four basic functions are, of course, possible.

Examination of the distribution of total cost throughout the useful life of a building will show the advantages of applying the life-cycle costing theory to a project. This approach is illustrated in Table 2. It shows that the capital or initial cost is only one of the major cost components. If the total "cost of ownership" is considered to include all the costs associated with the useful life of the building, the part associated with the design represents by far the smallest proportion. Yet, at the same time

<table>
<thead>
<tr>
<th>Initial/Capital</th>
<th>Operation &amp; Maintenance</th>
<th>Replacement &amp; Renewal</th>
</tr>
</thead>
<tbody>
<tr>
<td>land, construction</td>
<td>building repairs</td>
<td>major renewals</td>
</tr>
<tr>
<td>furniture &amp; equipment</td>
<td>custodial care</td>
<td>remodelling</td>
</tr>
<tr>
<td>design fees</td>
<td>utilities</td>
<td>replacement</td>
</tr>
<tr>
<td>supervision, etc.</td>
<td>ground maintenance</td>
<td>salvage</td>
</tr>
<tr>
<td></td>
<td>security</td>
<td></td>
</tr>
<tr>
<td></td>
<td>management costs, etc.</td>
<td></td>
</tr>
</tbody>
</table>
time, it is the designer who, by his skill as a planner and his technical
ability, can make the greatest impact on future costs. This highlights the
need for effective decision-making during the design stage, in order to
create long-term benefits.

Accepting that the distribution of costs shown earlier is typical (and
many studies have indicated that this is the case), it can be seen that a
relatively small increase in capital cost can be justified if it decreases the
cost of operating and maintaining the project. This would effectively
reduce the life-cycle cost, and therefore prove to be a sound investment.
Similarly, the technique can be used to evaluate the costs and benefits of
short-life, high-maintenance buildings with low initial cost.

Perhaps, more fundamentally, the analysis of life-cycle costs can be
used as a decision-making tool when considering options for fulfilling
space requirements. Using this technique, the options of leasing,
remodelling, new construction, etc., can be qualified and analysed. Cost
models may also take into consideration investment returns, tax rates,
capital, maintenance, operating, renewal, and salvage costs, thus
allowing the total life-cost of each option to be fully reviewed and
evaluated prior to final selection.

Essentially, life-cycle cost analysis is a technique that evaluates a series
of options with regard to their total financial consequences over a given
period of time. However, life-cycle cost analysis considers only the
financial impact of decisions, and it must therefore be treated as only
one component of the total decision-making process, that leads to the
selection of appropriate technology. Table 2 identifies the typical range
of costs that might be included.

Setting the time-scale for the analysis is important; the overall time
for the study (the life-cycle) must be decided, as well as the point in time
for starting the analysis, and, where relevant, the individual life-
expectancy of the various options being considered.

The objective of life-cycle cost analysis is to assess all future spending
requirements. In order to do this these costs must be discounted at a
given percentage rate. The rate selected will depend upon the particular
example, or it might be the "opportunity cost" if that money was
invested elsewhere.

Total or ultimate cost may be evaluated on a "present value" or
"equivalent uniform annual cost" basis. In the first analysis, all costs
(whether recurrent or non-recurrent, present or future) are brought to a
"present-day" basis. The second analysis converts a series of costs over
a period of years to a constant amount for each year in the life-cycle.
While these two bases are interchangeable, the "present value" basis is
currently recommended, particularly when a number of options are
being evaluated.

The application of life-cycle cost analysis can be justified at all levels
of project appraisal, since it can be used to help evaluate the fulfilment
of space requirements, and in the selection of the appropriate
technology. In addition, this technique might assist all those concerned
to carry out a total analysis of existing facilities, availability of staff,
functional use, financial capability, etc., in order to justify the supposed need for a new capital investment programme.

As already mentioned, life-cycle cost analysis could also be an effective method in the selection of appropriate technology. In the health sector, the main requirement is to provide basic health care for as many people as possible in a given period of time and with the limited amount of capital available. Therefore, this method could be used as one way of deciding which building option would best satisfy that requirement, and represent the most effective investment.

Maintenance Management

In establishing an effective maintenance operation, it must be realized that each agency, organization, or factory has unique problems and needs. Health care facilities are individual institutions and the maintenance requirements differ not only between facilities of different sizes but also from one department to another. However, despite these differences, there are certain principles that are basic to any effective maintenance operation (27).

Maintenance objectives

The first step in preparing a maintenance programme is to establish its general objectives. Often they are stated as follows:

—to extend the useful life of assets (i.e., every piece of land, building, plant, machinery, medical equipment, etc.);
—to ensure optimum availability of installed equipment for services, and to obtain the maximum possible return on investment;
—to ensure the operational readiness of all equipment for emergency use at all times, such as generating sets, fire-fighting and rescue units, central sterilization, supplies of oxygen and other gases, etc.;
—to ensure the safety of personnel using and operating the facility;
—to create an overall environment (indoor and outdoor) that is safe and healthy, and that promotes good public relations, so that not only the patients but also their relations can develop a feeling of belonging.

Maintenance and economy

When a legitimate request for maintenance work has been made, every effort should be made to carry it out as quickly as possible. It is also important that maintenance work does not interfere with programme functions. The optimum number of maintenance workers should be assigned to perform the various functions, since each maintenance task, whether it is the repair of diathermy equipment, a lift or a dental chair, or the servicing of an X-ray unit, may best be performed by one or a dozen men, depending on experience or established norms. In addition,
it is important to have the right equipment (e.g., tools and mechanized or specialized equipment) necessary for the job in order to do maintenance work economically. Workmen must be provided with proper spares, accessories, cleansing materials, testing equipment, etc., to accomplish their tasks. The economy of materials is particularly applicable to repair work.

**Scope of the maintenance engineering department**

Although in practice the scope of activities of the maintenance engineering department is different in each health care facility, being influenced by its size, type, administrative policy, etc., it is possible to group these activities into two general classes: *primary functions*, including most of the usual activities expected of a maintenance engineering department; and *secondary functions*, including other tasks that, for a variety of reasons, are delegated to the maintenance engineering department.

*Primary functions* usually include:

- maintenance and operation of existing plant, buildings, and grounds;
- equipment inspection and lubrication;
- general utilities and distribution;
- additions and alterations to existing equipment and buildings;
- new installations of equipment and buildings.

*Secondary functions* can include:

- store-keeping;
- plant protection, including fire protection;
- waste disposal, including incineration;
- salvage;
- property accounting or estate management;
- sanitation service;
- pollution and noise abatement.

**Maintenance cost considerations**

A maintenance operating budget that is soundly established and properly used will provide valuable information about changes in conditions and trends. However, in the absence of adequate cost and trend analyses, the operational budget is incomplete, and may well give incorrect information when used for coordination and comparison. The reasons for variations from the estimated expenditure for each budget item can only be determined by adequate cost and trend analyses. Such examination enables more accurate future budgets to be developed, and can also be used as a basis for the elimination or change of inefficient or undesirable conditions.
Two basic principles are important in achieving an adequate maintenance cost control programme:

(1) the use of maintenance labour and supervision must be related to defined tasks and workloads;
(2) responsibility for each item of maintenance expenditure must be assigned to a specific individual.

If the cost data are to be meaningful and useful, expenditures must be directly related to the work accomplished. Separate cost figures for each function carried out by the maintenance division should be recorded, and the cost of spare parts and labour should be recorded separately.

Maintenance of buildings and equipment, however, cannot be considered only as an economic problem. Building design has often failed to allow for the shortage of trained maintenance staff, and the advantages of using local and hence more readily available materials and equipment. There are also many examples where there is a lack of adequate control and supervision of maintenance staff. The case studies revealed several examples of poorly motivated and badly organized general maintenance staffs. Between inspections by authorities, floors were often not washed for long periods. Examples of broken pipes and fused electrical systems were often ascribed to the lack of staff with basic training in utility maintenance.

In the case of equipment and vehicles where there is no standardization and control of purchasing, there is such a proliferation of types and manufacturers that it is impossible to stock an adequate supply of spare parts. For more sophisticated medical equipment, maintenance personnel are often trained by the supplier, and they may be unable to repair the equipment of another manufacturer. This problem of standardization can be further exacerbated by gifts of equipment from donor agencies, by trade agreements between countries, and by the obvious need to find the best value for money in the market. In this last respect, the tendering system of purchasing leads to over-diversification if tender lists are not restricted.

Monitoring and Evaluation

A manufacturing enterprise will normally re-examine its product and distribution system periodically to assess its success and efficiency. Equipment will be checked for wear and tear; the use of floor space adjusted to improve efficiency, and the sales distribution streamlined; all this to save on costs, and to improve operations. What is applicable to manufacturers also applies to the management of health care facilities. Examination reappraisal requires close scrutiny so that facilities can be made to perform effectively and efficiently in terms of space utilization, deployment of staff, logistics of supply, suitability of design, and maintenance of building fabric and equipment (28). Continuing with the same analogy, a company running a number of factories will always
monitor size and location, taking the opportunity to expand, contract, and build, as the market forces alter. The distribution network of health care facilities is similar, being subject to changes in population, infrastructure, and medical care techniques. However, the normal practice of reappraisal in the management of a factory is frequently neglected in the area of health facility structure and function.

The planner's contribution should not cease once the facility has been opened. Monitoring the performance of a building once it is completed, enlarged, or renovated should be an essential and intrinsic part of the development process. These monitoring data together with the latest information on medical, technical, and economic developments will help to ensure improvements in future design and operation of health facilities. Unfortunately this exercise is rarely carried out in the developing countries; evaluation has either a low priority or is non-existent. This neglect means that little, if any, time and resources are used to find out how facilities and equipment actually function. Maintenance policies and priorities are overlooked. Facility distribution is too frequently subject to ad hoc decisions.

The lack of suitable staff at ministry and lower levels may reduce or prevent evaluation monitoring. This means that mistakes that might have been revealed during the evaluation process remain undiscovered, resulting in added expense and wasted resources. Although it is impossible to determine the cost of such an evaluation process, it is possible that savings resulting from the recommendations of the evaluation teams would outweigh the training operational costs of these teams. There is little benefit from forward planning that is based on assumptions, opinions, and theories rather than on factual evidence obtained by thorough investigation. Evaluation and information feedback should be an essential stage of the whole building development cycle: concept, brief, design, building, commissioning, and finally evaluation and feedback. The resulting information could be collated, analysed, and disseminated for the benefit of future developments and the improvement of existing stock. This important stage in the cycle should be given a positive priority by the developing countries with resources and manpower allocated accordingly.

Benefits of evaluation

The benefits derived from evaluation studies cannot be over-emphasized; they can be applied to every aspect of health facility planning, highlighting the strengths and weaknesses of organization and performance. The process focuses attention on a vast range of issues, both simple and complex, and the results of particular studies can affect legislation and policies at all levels of government administration. For instance, studies that reveal inadequacies in fire protection or provision for the frail and disabled imply that amendments to existing legislation are needed or that new laws should be introduced. The shortcomings revealed by health building evaluation will result in the recommendation
of physical, functional, and organizational changes that will help improve the efficiency of existing buildings, provide suggestions for the raising of standards for future development, and indicate whether further studies are required. Deficiencies will either be of major significance (e.g., design principles), or small modifications to the fabric, services, or layout that can be undertaken without too much disturbance to the running of the facility. In-depth studies of layouts, programmes, materials, construction, basic installations, and equipment will reveal situations that can be altered to the benefit of the users, introducing greater operational efficiency, cost savings, and building flexibility.

A national inventory of facilities, types, numbers, condition, main problems, plus complex equipment, will provide a basic knowledge of the country's building stock so that future planning can be appropriately and realistically carried out, the facts being periodically updated.

Scope of evaluation

Evaluation studies can be grouped into a number of general areas including:

—a rational look at the types of facilities, the sizes, locations, and provision of a network on a regional or national scale;

—the physical and functional content of groups of facilities, or of one facility or even part of one. This could include the identification of cycles of activity within one facility, or of a number of similar buildings examined on a comparative basis. It may also be necessary to assess how similar activities differ depending on alternative building shapes. Another approach may be to study the personnel movement in space and time, and the utility of a selected activity or organizational unit (e.g., a nursing station). Alternatively, analysis of the space requirements of a piece of new equipment in a number of alternative settings might be needed. Studies can also be undertaken to assess the internal environment, the underuse or overcrowding flexibility, or the envisaged workload, and the size and relationship of individual rooms or departments, the degree of non-functioning of equipment, the use of waiting areas, etc.;

—a further series of evaluation studies can be centred on maintenance. This would cover programmes, operation, staff, finance, and frequency of maintenance work. One of the major weaknesses found in recent national case studies was the lack of maintenance of both buildings and equipment. Maintenance was too often undertaken only in an emergency, and did not form part of a systematic review. No regular checks were made on buildings, and no national priority system existed for the upkeep of facilities. All too frequently, the tendency was to build new facilities and not provide money for maintenance evaluation programmes.

Many countries operate a system in which the larger hospitals have their own maintenance teams and stores. The smaller units are
independently maintained by government or outside agencies or, alternatively, by the hospital maintenance teams.

Again, evaluation studies could perhaps reveal the need to alter the system for distribution and storage of materials to make the carrying out of repairs, at the peripheral units, more effective.

Measurement

It is sometimes very difficult to judge the success of a building, especially if subjective and variable factors come into the assessment, such as the morale and motivation of the staff. This judgement can be made easier by considering, firstly, the work that has to be carried out in the building and the environment within which the work takes place, and, secondly, the structural conception of the building, in particular as regards the areas that must allow for growth and change and those that can remain unchanged.

Evaluation will also be easier if comparisons can be made between the original planning concepts (briefs and plans) and the present layout of the facility. Useful lessons for future planning can be learned through this form of measurement. The changes become even more apparent if initial operational policies are written down. The reasons for change and their significance are instructive and useful for future designs. Analysis will show whether or not there was enough forethought at the time when the plans were drawn up. For instance, were the population and medical-care changes anticipated adequately? If the reasons why original planning decisions were taken were not made clear, the task of evaluation will be more difficult. It is therefore wise to obtain as much of this background information as possible; the more that can be assembled the better.

Continuous evaluation

Evaluation should be a continuous exercise, and not restricted only to the period after a new building has been completed, or to when a new one is anticipated. This regular assessment will show how modifications could help to improve the facilities. Too often, architects are only contacted to deal with urgent problems. Nobody tries to discover if there are any imminent problems that could be solved before a crisis situation is reached. Where a project takes a number of years, there should also be a continuous record of policy and design decisions. Although lessons may be learned too late to be incorporated into that scheme, if there is flexibility in the design, the chances of adjustment and modification during development will be increased. Where the intention is to build a large number of buildings of a particular design, a thorough evaluation of the first should take place ideally before the others are built. Improvements and modifications can then be included in the new facilities.

Another approach in similar situations would be to establish
evaluation teams at selected large facilities at the beginning of operations to monitor the function, and assess materials and the environment. Regular meetings can then be held between teams to discuss findings and feed information back to the architects, design teams, and committees responsible for the future development of these standard facilities. Foreign health advisers can be asked to assist, if there are not enough local personnel available. Their wide experience with new facilities and their implementation can provide useful support.

Gathering the information

Information for the evaluation of facilities can be obtained from existing documents, planning policies, and designs, also from data on building and running costs and from statistical returns. The evaluation team will be able to expand these sources of information by the addition of surveys, observations, and recorded interviews. It is important that from the beginning of the whole evaluation exercise, its objectives are clarified, the methods and procedures for such matters as collection and analysis are defined, responsibilities are allocated, and time-scheduling and cost implications worked out in detail.

Example of an evaluation study

The following résumé of objectives and methods was used in an all-embracing pilot study of health care facilities in the Sudan by a WHO/Sudanese evaluation team¹ (and subsequently applied in five other developing countries). This extract illustrates one approach that can be used in a study of this nature.

The objectives of the study were to identify constraints and opportunities in the planning, design, and operation of health care facilities, within the context of the national health services system. The study was directed, in particular, at a selected sample of health facilities from all levels, with the aim of finding out:

— to what extent their functions were appropriate to the level at which they operated;
— whether their location and design were well adapted to these functions;
— whether their staffing, management pattern, and referral system were adequate;
— what kind of support to primary health care they provided; and
— whether more satisfactory or more cost-effective alternative solutions to the above points were possible.

The methods used for the study consisted mainly of:

— surveys: including data collection through field studies, review of documentation, site visits, examination of buildings, activity studies, and interviews;

—analysis; evaluation and interpretation of data through team discussions with nationals and WHO consultants/staff.

The working tools used were:

— a methodical framework for the elements relevant to the study: background information; functioning of the system, both planned (policies) and in operation (realities); and health care facilities (both policies and realities);
—checklists for the in-depth study of each facility examined were used as a reminder of the points to be examined, and can be used in any country in the future, irrespective of size or sophistication. They provide a means by which information gathered in various countries may be placed in the same framework.

For the adaptation of the working tools, the collaboration and contribution of the nationals at all levels was invaluable.

As a method of analysis, the activity studies proved extremely revealing, since they allowed the quantification of many factors involved in the functioning of facilities, e.g., overcrowding, patient movement between different parts of the facility, use of equipment, and the employment of staff time. No matter how many discussions take place over questions of this nature, it is only by actual observation that a true picture emerges.

Data collection was achieved by:

—interviewing officials, doctors, specialists, heads of divisions at the ministry of health, personnel from other ministries, supplies departments, assistant provincial commissioners, local councillors, staff of the facilities visited, and members of the public. Information on health policies and system planning was collected from those in authority;
—reviewing published documents;
—analysing forms from the facilities visited and the ministry of health, relating to statistical returns, patient attendances, registrations, etc.;
—analysing statistical records (concerning attendances, lengths of stay, patient residence, diagnosis, etc.) covering a period of two weeks, which were tabulated for study by the staff of facilities visited;
—studying maps from the survey department, ministry of health, and the district assistant commissioners;
—obtaining plans of facilities from the ministry of construction and public works, either already published or drawn up for the study;
—examining facilities: their relationship to the community, design, layout, materials, infrastructure, activity studies, equipment staffing, storage, supplies, hygienic standards, patient care, disease patterns, etc. These were either collected in note form or plotted on the plans.

The aim of the analysis of data was to identify the relationship between function and the completed structure, and the issues and problems that deserve the attention of national planners and decision-makers in the future. The analysis phase took longer than the data collection phase.

Techniques

There are a number of well-tried evaluation techniques that are suitable for the study of facilities in developing countries. A trial run is
recommended in order to eliminate many of the unforeseen problems
that will arise during a large survey. This will help the team to arrange a
format for a check-list and timetable, and to establish the size of the
undertaking, bearing in mind the available personnel. Observations,
interviews, and activity studies are essential tools. The movements and
numbers of staff, patients, and visitors must be checked at both quiet
and busy times to obtain a true impression of the situation. The time
taken to undertake tasks, and the frequency and distances travelled, will
provide additional information. The interviewer may be required to
follow a pattern of procedures or personnel around a facility, or simply
to make his observations from a fixed point within the facility. An
architect who attempts to design a facility, or part of a facility, without
first observing and evaluating the existing situation and detailed use of
space required, will lack valuable information. New ideas related to
design principles, layouts, and equipment can be tested on mock-up
model bases. When studying a complex facility for the first time, a
rushed approach (noting down a multitude of material finishes and
comments at each floor level) should be avoided. Some time should be
spent becoming familiar with the layout and in general observation.
Later, the various important points can be summarized. Material finishes
and their general condition can be tabulated floor by floor.

A checklist will act as an aide-mémoire and help with the task of
comparing facilities, if the same questions are asked at each facility.
Despite the advantages and convenience of checklists, there is no
universally suitable checklist system. Questions asked in one country may
be inappropriate in another because of differing social and religious
customs, as well as living standards, for example. Nevertheless, a
checklist produced for use by a small working team (usually two
architects and a doctor) during the previously mentioned World Health
Organization case studies of facilities in developing countries, was found
to be reasonably suitable for all countries at various stages of
development.

Approaches and attitudes

It is important to talk to the staff at all levels, but especially those in
charge of departments. The director of a hospital can give an overall
view of the organization and running of the facility, but it is necessary to
talk with those directly concerned in the day-to-day management of the
various sectors to develop a fuller understanding of the facility's
operation. It is also advisable to obtain the views of members of the
hospital advisory group and local community leaders, as well as those of
patients. It is assumed that the necessary discussions with ministry
officials will be held at the appropriate times, and ample time should be
allowed for this important phase. Once the problems affecting
individuals and the facility as a whole are evaluated and analysed, the
methods necessary for improvements can be worked out.

The correct psychological approach and climate for discussion are
important since people may not answer in full straight away, being shy or inhibited by the presence of other officials, particularly their superiors. It is important to establish a rapport, gain their confidence, make sure they feel at ease, are treated courteously, and know exactly why the evaluation is being carried out. Quite often, answers will need to be thoroughly checked, either by asking several people for their opinions on the same point or by asking the same person the question in a different way. It is important to make sure that the questions have been understood and that the answers are not invented, either because the person does not want to appear ignorant or because there may be some misunderstanding owing to language differences.

Discussions should be as informal as possible, and one question will naturally lead to another. Hasty assumptions must not be made since the truth may appear only after more prolonged questioning. Also, a given answer to one question may well be influenced by a combination of factors. For instance, concerning increased floor space—is this the result of introducing new equipment, advances in medical science, changes in referral patterns, an increase in the population being served, or changes in the infrastructure resulting in easier access to the facility? Another situation might be that patients have difficulties finding their way around a building—is this due to a lack of signposting, the erection of many unrelated buildings, lack of corridor links between buildings so that access is difficult in the wet season, or are departments badly orientated with regard to the site entrance and transportation routes? Another example—the presence of broken surfaces or missing tiles—may not be a result of poor maintenance organization, but of the fact that the original tiles were imported and are no longer available, the lack of local materials and skills preventing their replacement. When questioning, therefore, it is necessary to probe beneath the surface to avoid drawing incorrect conclusions. Problems are often interrelated; for instance, staff shortages may be because of the insufficient provision of staff housing, which in turn may be due to a lack of local funds.

To make arrangements for the visits of evaluation teams, it is useful to send copies of the evaluation brief to the staff in advance. Convenient dates for the meeting, and perhaps a preliminary visit, should be arranged. Patients, trade unions, and professional organizations should also be told of the visits. It should be stressed that the evaluation is not an inspection, in the normal sense of the word, but an investigation exercise. The evaluation should be conducted, as far as possible, against a normal, everyday background.

The evaluation team

The size of a team assembled from within a developing country will doubtless be restricted because of the few people likely to have the necessary experience and available time. Where possible, the team should be made up of representatives from medical, nursing, administrative, architectural, and engineering backgrounds, as well as any specialists
required. The team size and the time spent on the exercise will vary, but the numbers should be kept relatively small to avoid too much disturbance and distraction of the staff. As already stressed, the team is there simply to observe, take notes, and interpret information, not to be critical. The members will undoubtedly have other commitments in their respective areas of work, and will not form part of a permanent evaluation task group. It would, however, be useful if the team could build up a selective, discriminative approach by regularly taking part in evaluations. If a team is disbanded after one assignment and a new team appointed to undertake the next investigation, this would disrupt the continuity of work experience, established methods of tackling a job, and the full understanding of fellow members' contributions, which may take some time to appreciate.

The team may be answerable to a higher authority which would provide guidance and advice, and would coordinate future programmes, and disseminate those results that are of general interest. The time spent on preparing a thoroughly structured survey will save time in the field. It may also be useful to look at the approaches and recommendations of a number of evaluation teams commissioned to undertake studies in the health field, as they may provide guidance on the preparation and composition of studies, especially in those countries unfamiliar with evaluation work. If all team members have defined tasks to perform and frequent meetings are held during the evaluation to discuss problems, the operation is likely to run more smoothly.
5. Concluding remarks

- Since many developing countries are investing large amounts of capital in vast national networks of health care facilities, the success or failure of their planning, construction, and operation becomes a priority issue. Health decision-makers therefore need to be fully aware of all the many phases in the development of the facilities, from the formulation of health and investment policies of the country, to the construction, maintenance, operation, and eventual replacement of each individual facility. For example, most of the problems observed in the case studies can be explained by omissions or deficiencies in the very early stages of the process: the overall national health policy and plan formulation, and the design of the health system infrastructure.

The basic importance of the balance in the system among the different types of organizational unit and the different levels of care must be stressed. This balance should be achieved using the guiding principles of universal accessibility to essential services, economic feasibility and efficiency, and ability to manage the organizational units. On a global basis it is impossible to promote or discourage particular types of facility; each country must identify its own imbalances and strive to correct them. Usually, the primary level of a health system has to be built up before the more central supporting tiers. The technical and managerial cohesion of a balanced health system is easy to achieve by applying the principles of regionalization. This is the only means of reducing the by-passing of peripheral units by users, that leads to their underutilization and to overutilization of the larger and more costly facilities.

Harmonization of the health system infrastructure with other components of the environment, such as roads, communications, energy sources, community organization, local culture, and economy, is also essential to proper health system design, and hence to appropriate decisions on the number, type, and location of the facilities required. Integrated physical planning of all essential services for certain communities was seen in some countries involved in case studies, and it appears to be a possible solution that should be carefully considered by national policy-makers.

This type of finding led to the development of the description and
analysis of the entire health system in each country involved in the case studies, together with coverage, architectural design, and construction aspects. The lessons learnt in this way are being communicated to the appropriate decision-makers in the various countries. The national process in this area should be interdisciplinary and multisectoral, as required by the nature of health facilities planning. In countries where case studies have been, or are likely to be, undertaken, it can be initiated or renewed by means of workshops in which evaluation results can be discussed, and which may then produce recommendations for action\(^1\).

The development of such national initiatives would be the best basis for international cooperation in the planning, construction, and operation of health care facilities. They would show the areas where support is needed, develop the ability to absorb and adjust the transfer of appropriate technology, and make useful experience available to other developing countries, thus fostering the application of the United Nations "technical cooperation among developing countries" (TCDC) approach. It has been shown that national experience can be pooled and exchanged among countries on a bilateral, regional (e.g., Western Pacific Region), or sub-regional (e.g., Andean group of countries) basis.

WHO should continue to play a promotional and coordinating role in these processes, until they can be undertaken by the countries themselves.

Other international organizations that may collaborate with national efforts towards the improvement of planning, construction, and operation of health care facilities, include: funding agencies (such as UNDP, World Bank, regional development banks, multilateral and bilateral aid agencies); agencies providing information and training support in the areas of architecture and construction (such as UNESCO, International Union of Architects, or international training centres in health architecture, e.g., in Buenos Aires, London, Louvain, and Manila); and agencies providing information and training in health institution management (such as the International Hospital Federation, Association of University Programmes in Public Health Administration, regional and national management institutes, e.g., in East and West Africa, India, etc.).

The World Health Organization is deeply involved in improving collaboration with all of the above agencies so as to evolve a common approach to the problems of health care facility planning in the developing countries.

Glossary of terms

Area: gross area—area per floor calculated to the exterior of the containing walls; net area—area per floor calculated to the interior of the containing walls; total gross floor area—total area of all floors between outer faces of containing walls of a property, a group of properties or a collection of premises; total net floor area—total floor space calculated to the inner faces of containing walls of a property, a group of properties, or a collection of premises.

Bill of quantities: a document prepared from complete production information that describes in detail the quantities of all the building materials and components required.

Briefing stage: the initial stage in the building process when a general outline of requirements is prepared to provide the client with proposals and recommendations, so that he may determine the form in which the project is to proceed.

Briefing team: the team of users, designers, and specialists, and in some cases the contractors and suppliers, involved during the briefing stage of the project.

Building density: ratio between the area actually occupied by the buildings and the total area of the land on which the construction is situated.

Capital expenditure or costs: that expenditure required for financing permanent or semi-permanent goods; for example, buildings, machinery, equipment, vehicles. In case of doubt, where goods last for more than one year, they are considered as capital goods.

Capital projects: projects that require capital investment.

Cash flow: the flow of funds necessary during the course of a project.

Clerk of the works: on large and many medium-sized construction projects, it is common to have a clerk of the works as a resident superintendent. He is responsible for checking the quality of building work, and can be employed either by the designer on behalf of the client, or directly by the client.
Client: the person or organization responsible for ordering the project, appraising the proposals, and allocating the funds.

Commissioning stage: the final stage in the building process when it is confirmed that the construction work has been completed according to the approved drawings and specifications so that the facility is fully operational. At this stage, operating instructions are provided, together with staff trained to ensure its continued good functioning and maintenance.

Commissioning team: the team of users, designers, specialists, contractors, and suppliers, involved during the commissioning stage.

Competitive tendering: a form of tendering where open invitations to submit a price for the construction of a project are sent to contractors. Stringent rules are usually attached to the attendant administrative procedures.

Construction team: the team of contractors, designers, specialists, and suppliers involved during the construction stage.

Constructor/builder: the person or private organization, usually a contractor or direct labour force, that is responsible for the erection of the building.

Consultant: a person who provides professional or expert advice.

Contract: a binding agreement between two or more parties.

Contingencies: allowances for costs resulting from unforeseen events, changes, accidents, etc.

Coordinating committee: an ad hoc committee established by the client to coordinate the work of the parties involved, and to advise the project manager.

Cost checks: checks undertaken on the price of materials or workmanship, or the current accumulated cost of the project.

Cost control: active measures taken to ensure that the cost of the construction project does not exceed the budget of the project.

Cost forecast: an estimate of the likely or probable final cost of the project.

Cost reimbursement contract: a form of contract in which the contractor/consultant is paid for those costs that he can show have been incurred, plus a pre-determined additional fee.

Defects liability period/maintenance period: a period following the completion of the project, during which the builder is responsible for remedying any defects in workmanship or materials which may become evident in the building.
Department/room data programme: a schedule outlining the functions and floor-space requirements of each department or room in the project.

Designing team: the group responsible for the design of the project, ranging in size from a single architect to a number of professionals drawn from various disciplines.

Drawing: execution drawing—a graphic document, based on the rough draft, giving all the necessary instructions on an adequate scale to allow the accomplishment of the work in its entirety; assembly drawing—a detailed drawing of the construction of a building showing the location of components in relation to their function.

Feasibility study: a detailed investigation and analysis, often forming a part of the briefing stage, that is conducted to determine the feasibility and advisability of a proposed project from the financial, technical or any other point of view.

Final cost: the actual cost of the project to the client, including construction, consultants' fees, fitting-out, moving and occupational expenses, interest on loans, salaries, and overheads of the client's staff.

Funds: monetary reserves for financing the project.

Index costs: allowances for additional costs as a result of inflation during the course of the project.

Land allocation: the setting aside of land for a fixed purpose.

Land use: all the considerations that ensure that the positioning of constructions, their nature, size, appearance, and surroundings are established according to their intended purpose and in consideration of the general interest.

Lump sum: a fixed amount payment.

Management team: the team of specialists, such as planners, administrators, and supervisors, working under the direction of a project manager, and who are responsible for managing the project.

Module: unit of size used as an increment to determine the proportion of the different architectural elements.

Nominated subcontractor/supplier: subcontractors or suppliers selected before appointment of the main contractor.

Norm: quantitative index established scientifically in order to determine certain characteristics to be adopted for the construction work.

Owner: another name for the client, usual in American terminology; the "building owner" in the United Kingdom.

Payment report: a report summarizing the payments that have been made, and the present financial status of the project regarding the project budget.
Periodic cost forecast: an estimate of future costs, drawn up periodically.

Plan: master plan—plan to guide the broad outline of the development of a given territory, particularly concerning the disposition and use of the land; development plan—plan to regulate the disposition and use of land, with the aim of securing the best living conditions for the inhabitants; detailed plan—development plan whose graphic document gives all present or future details; site plan—plan that topographically situates a ground plot, a building, or an installation in its region, agglomeration, or district; layout plan—plan giving the relative position of installations or buildings, constructed or planned, usually bearing an indication of the volume constructed above the ground and enabling the identification of the site.

Procurement: the acquisition of any kind of external resource needed to carry out the whole or part of a construction project.

Production information: drawings, specifications, schedules, and bills of quantities prepared by the design team, and describing for the construction team what has to be built.

Project budget: the sum that the client has available for the entire project, including land acquisition, construction, equipping, professional services, interest, and contingencies.

Project committee: an ad-hoc committee established by the client to direct the work and activities of the project manager.

Project management: the process of planning, executing, and controlling a project from start to finish in a given time, at a given cost, for a given end product, using available human and technical resources.

Project manager: the person with the authority and responsibility to manage the project according to his terms of reference.

Public authorities/agencies: authorities or agencies staffed by civil servants whose role is to serve public needs.

Quality control: activities and methods aimed at ensuring that materials, methods, workmanship, and the completed project will meet the stated requirements.

Quantity surveyor: a person who estimates the amount and cost of materials and labour required for the construction, and advises the client on cost matters.

Remodelling: synonym for renewal (planning).

Renewal: systematic substitution of new elements for old in order to satisfy, or correspond with, new conceptions of the present needs.

Resident engineer: a person often employed on large construction projects in addition to the clerk of the works, as the engineer's site representative.
Resource plan: a plan that summarizes the availability and allocation of resources, and enables effective planning of their future use.

Retention money: the money subtracted from the valuation of the work completed by the main contractor and subcontractors, and held by the client to cover the costs of remedying any defects in materials or workmanship.

Scale of fees: approved graduated payments for various valuations of work undertaken by specialists, and published by professional bodies as a basis for ensuring quality of service.

Schedule of payments/rates: an alternative method to payment by valuation of work done. Usually the number of payments and the value of payments are agreed before construction work commences.

Siting: delimitation of an area of land for construction of the project.

Sketch plans: drawings, often free-hand, to determine the general approach to the layout, design, and construction of a building.

Specifications: a comprehensive description and explanation of the project, its components, materials, and the required workmanship.

Standard: type, model, or constant that can be used for comparative purposes in relation to a particular element of the construction or the entire building.

 Tender documents: the set of documents on which the tenders are to be based, and that are sent to the would-be tenderers. The documents usually include the project description, specifications, bills of quantities, plans and elevations, and working drawings.

Time plan/schedule: a time-based plan of the work to be undertaken indicating the respective order, and the time for the start and finish of the activities in the project (see Work plan).

Type designs/drawings: standard design proposals for a particular type of building or part of a building.

Work plan: a statement or network indicating the sequence of work that has to be undertaken, by whom, and its appropriate timing (see Time plan).

Working drawings: drawings intended for use by the contractor or subcontractor, that form part of the contract documents and provide all the necessary information to carry out the project or part of it.

Zoning: repartition of an area into zones, each zone having a defined occupation or land-use.
References

5. Planning and building health care facilities under conditions of limited resources. World hospitals, 11, No. 2, 3 & 4 (1975).


23. Orofino, E. Health and health centres under conditions of limited resources: an approach to planning and design of community based health care facilities in tropical regions of South America. Louvain, Postgraduate Centre, Department of Construction, University of Louvain. (Offset), 1980.


Annotated bibliography


In developing countries there is, in most cases, both a problem of coordination of existing health care facilities and a need for improving their number, capacity, and efficiency. This review of the basic prerequisites attempts to show that the goal is not out of reach of relatively simple planning organizations. Examples and conclusions aim at encouraging the health authorities of developing countries to overcome the reluctance of those who, because of tradition and routine, may feel that the present planning and designing methods for health care facilities are too complicated to be used to solve their own problems.


This handbook is offered not only to the architect, but to the whole project team, who take part in decisions upon shape and space as well as the choice of installations and equipment that will determine their pattern of work for years to come.


The publication is aimed at those who wish to find out more about the hospital development project and its research background than is possible by looking at the drawings or visiting the building. During the five-year planning period, and to an even greater extent since the building work started, there has been a steadily increasing volume of enquiries concerning research and briefing aspects. This book should help to explain the methods that were used.

Planning and building health care facilities under conditions of limited resources. *World hospitals*, 11: No. 2, 3 & 4 (special issues).

The organizers of the Nairobi Seminar on this subject (November 1974) have published the original papers that were presented at the meeting. In this way, it is hoped to provide a fairly complete picture of the situation throughout the world as far as the main theme was concerned. The papers are arranged to lead from general observations on regional planning, design, and building of individual facilities, and the economic aspects of health care to proposals, solutions, and practical details. It became clear that to plan and build health care facilities with limited resources requires, more than anything else, a methodological approach, and that the buildings themselves
must have the greatest possible flexibility to develop functionally, structurally, and technically.


Based on practical experiences, this series provides important new information not only for developing countries themselves, but also for professionals from developed countries, who often do not realize to what extent their knowledge is out of phase with the conditions and needs of developing areas.


This report is a contribution to the study of the problems associated with the provision of health care services in developing areas. It illustrates a health centre, and describes its workings in some detail. The study is offered as a design primer and reference for people faced with planning and design problems in the field.


This manual contains design, construction, and cost guidelines for the building and extension, or improvement of medical facilities. It has been prepared primarily for the doctor and his staff who, in rural Africa, must often be their own architects. It may also be of value to the architect who is confronted with the special problems associated with the provision of medical buildings in developing areas. Furthermore, it provides information that could be useful to people who are engaged in raising funds for medical purposes in developing countries.


In this book the emphasis is placed on the effects of budget constraints on the timely completion, opening, and use of health facilities. Also, the effect of a new building on district services as a whole, and the associated problems of the change of use of other health care facilities is discussed.

Mukerji, K. Primary health care facilities in developing countries. Report on a research project. Starnberg, Institute for Building in the Tropics, 1981.

Based on regional case studies in East Asia, West Africa, and Central America, the report provides a useful analysis of planning and organizational principles of national health systems, as well as design guidelines and standards for various health care facilities at primary care level.


In order not to aggravate the current economic situation, it is desirable that the “type-drawings” reduce the reliance on imported materials and sophisticated services and equipment, as far as possible. The proposed type-drawings of a district hospital are based on functional programmes related to cost and staff limitations. There is a set of standard designs, plans, and layouts for each hospital unit, together with complete “tender documents”,
including the necessary working drawings, specifications, and bills of quantities.


Small and simple construction projects may be undertaken without sophisticated management procedures, but for complex projects some degree of organized project management is essential. This guide explains the fundamentals of overall project management in terms of planning, executing, and controlling a construction project from its inception to completion, in accordance with available funds, time, and technical and human resources.

OROFINO, E. *Health and health centres under conditions of limited resources: an approach to planning and design of community-based health care facilities in the tropical regions of South America*. Louvain, Postgraduate Centre, Department of Construction, University of Louvain, 1980 (Offset).

Based on practical examples, the work indicates that the correct approach to health care facilities development projects must be by the identification of priority health problems and main task definition in accordance with the limited resources.


The main purpose behind the preparation of “type-drawings” is to speed up the entire rural health building programme, including the upgrading of existing facilities, by reducing the need for separate design studies for each health centre project. The proposed set of “type-drawings” is based on functional programmes taking account of what can be achieved under particular conditions. It comprises standard designs, plans, and layouts for each type of rural health facility.


This work arose out of a practical need to find a reliable way of measuring, assessing, and re-examining existing patterns of space use in order to identify any possible improvements, the limits to increased utilization, and any bottlenecks in the system, and the sort of techniques that might be needed to implement recommendations.


These two international agencies have combined to examine the selection of appropriate construction methods for small buildings—such as schools, clinics, and health centres. The study details the many conditions that determine the suitability of a particular method in any environment, the economic and social objectives, its structure and organization, and the availability and quality of resources.
<table>
<thead>
<tr>
<th>Country</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALGERIA</td>
<td>Société Nationale d’Édition et de Diffusion, 3 bd Zirout Youssef, ALGERS</td>
</tr>
<tr>
<td>ARGENTINA</td>
<td>Carlos Hirsch SRL, Florida 165, Galerías Cíesmen, Escritorio 435/465, BOLDOS ARES</td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>Hunter Publications, 58 Gipps Street, COLLINGWOOD, VIC 3066 — Australian Government Publishing Service (Mail order sales), P.O. Box 94, CANBERRA, A.C.T. 2600; or over the counter from: Australian Government Publishing Service Bookshops at 70 Alinga Street, CANBERRA, A.C.T. 2600; 294 Adelaide Street, BRISBANE, Queensland 4000; 332 Swanston Street, MELBOURNE, VIC 3000; 300 Pitt Street, SYDNEY, N.S.W. 2000; Mt Newman House, 200 St. George’s Terrace, PERTH, WA 6000; Industry House, 12 Pirie Street, ADELAIDE, SA 5000; 156-162 Macquarie Street, HOBART, TAS 7000 — R. Hill &amp; Son Ltd., 608 St. Kilda Road, MELBOURNE, VIC 3004; Lawson House, 10-12 Clark Street, CROWN’S NEST, NSW 2065-Gerold &amp; Co., Gruben 31, 1011 VIENNA 1-AUSTRIA</td>
</tr>
<tr>
<td>BANGLADESH</td>
<td>The WHO Programme Coordinator, G.P.O. Box 250, DHAKA 1 — The Association of Voluntary Agencies, P.O. Box 3945, DHAKA 3-BELGIUM</td>
</tr>
<tr>
<td>BELGIUM</td>
<td>For books: Office International de Librairie s.a., avenue Maxima 30, 1050 BRUSSELS. For periodicals and subscriptions: Office International des Périodiques, avenue Maxima 30, 1050 BRUSSELS — Subscriptions to World Health only. Jean de Lanays, 202 avenue du Roi, 1060 BRUSSELS-BHUTAN</td>
</tr>
<tr>
<td>BOTSWANA</td>
<td>see India, WHO Regional Office-BRISBANE</td>
</tr>
<tr>
<td>BRAZIL</td>
<td>Botsolo Books (Pty) Ltd., P.O. Box 1352, GABORONE</td>
</tr>
<tr>
<td>BULGARIA</td>
<td>Biblioteka Regional de Medicina OMS/OPH, Uidade de Venda de Publicações, Cais Postal 20.381, Villa Clementina, 00023 São PAULO, S.P.</td>
</tr>
<tr>
<td>BURMA</td>
<td>see India, WHO Regional Office-BURMA</td>
</tr>
<tr>
<td>CANADA</td>
<td>Canadian Public Health Association, 1335 Carling Avenue, Suite 210, OTTAWA, Ont. K1Z 8K8. Subscription orders, accompanied by cheque made out to the Royal Bank of Canada, Ottawa, Account World Health Organization, may also be sent to the World Health Organization, PO Box 1800, Postal Station B, OTTAWA, Ont. K1P 5C2-CHINA</td>
</tr>
<tr>
<td>CYPRUS</td>
<td>“MAMT”, P.O. Box 1722, NICOSIA</td>
</tr>
<tr>
<td>CZECHOSLOVAKIA</td>
<td>Aria, Ve Snezech 30, 111 27 PRAGUE 1</td>
</tr>
<tr>
<td>DEMOCRATIC PEOPLES REPUBLIC OF KOREA</td>
<td>see India, WHO Regional Office-DEMOCRATIC REPUBLIC</td>
</tr>
<tr>
<td>DENMARK</td>
<td>Muskegrod Export and Subscription Service, Nørre Sydsgade 35, 1370 COPENHAGEN K (Tel: +45 1 22 85 700)</td>
</tr>
<tr>
<td>ECUADOR</td>
<td>Libreria Científica S.A., P.O. Box 362, Bajo 223, QUITO-EGYPT</td>
</tr>
<tr>
<td>FIJI</td>
<td>Office for Books and Reviews, 50 Kerr El N1 Street, CAIRO-FINLAND</td>
</tr>
<tr>
<td>FRANCE</td>
<td>Akareenny Kiragava, Keskskatus 2, 01011 Helsingfors 10-FRANCE</td>
</tr>
<tr>
<td>GABON</td>
<td>Librairie Arnette, 3 rue Casimir-Delavigne, 75006 PARIS-GERMANY</td>
</tr>
<tr>
<td>GERMANY</td>
<td>Buchhaus Leipzig, Postfach 410, 701 LEIPZIG-GERMAN DEMOCRATIC REPUBLIC</td>
</tr>
</tbody>
</table>
| GERMANY, FEDERAL REPUBLIC OF | see Germany, WHO Regional Office-

**Ghana**

Fides Enterprises, P.O. Box 1628, Accra

**Greece**

G.C. Eleftheroudakis S.A., Libraria International, rue Nikis 4, ATHENS (T. 126)

**Haiti**

Max Boucheveau, Librairie “A la Cervelle”, Bôte posteale 111-B, PORT-AU-PRINCE

**Hong Kong**

Hong Kong Government Information Services, Beaconfield House, 6th Floor, Queen’s Road, Central, HONG KONG

**Hungary**

Kultura, P.O.B. 149, BUDapest 62 — Akadémiai Könyvverlag, Váz utca 22, BUDAPEST V

**Iceland**

Snaefells-Jonsson & Co., P.O. Box 1131, Hafnarfjörður 9, REYKJAVIK

**India**

WHO Regional Office for South-East Asia, World Health House, Indraprastha Estate, Mahatma Gandhi Road, New Delhi 110002 — Oxford Book & Stationery Co., Scindia House, New Delhi 110001; 17 Park Street, CALCUTTA 700006 (Subagencies)

**Indonesia**

P. T. Kaplan Media Penjual, Pusat Perpustakaan Seren, BLOCK 1, 4th Floor, P.O. Box 3433/JKI, JAKARTA

**Iran (Islamic Republic Of)**

Iran University Press, 85 Park Avenue, P.O. Box 54/551, TEBRIZ

**Iraq**

Ministry of Information, National House for Publishing, Distributing and Advertising, BAGHDAD

**Israel**

TDC Publishers, 12 North Frederick Street, DUBLIN 1 (Tel: 749855-749777)

**Italy**

Estatuto Minerva Medica, Corso Bramante 83-85, 10126 TURIN; Via Lamarmora 3, 20100 MILAN

**Japan**

Muraoz Co. Ltd., P.O. Box 5590, Tokio International, 100-31

**Jordan, The Hashemite Kingdom Of**

Jordan Book Centre Co., University Street, P.O. Box 301 (Al-Hubielah), AMMAN

**Kuwait**

The Kuwait Bookshops Co. Ltd., Tameem Al-Ghitam Bldg, P.O. Box 2942, KUWAIT

**Laos Peoples Democratic Republic**

The WHO Programme Coordinator, P.O. Box 343, VIENTIANE

**Lebanon**

The Levant Distributors Co. S.A.R.L., Box 1181, Makdasi Street, Hanna Bldg, BEIRUT

**Luxembourg**

Librairie du Centre, 49 bd Royal, LUXEMBOURG

**Malawi**

Malawi Book Service, P.O. Box 506/44, Chichewa, BLANTYRE 3

**Nepal**

The WHO Programme Coordinator, G.P.O. Box 269, KATHMANDU

**Philippines**

See Philippines, WHO Regional Office

**Portugal**

See Portugal, WHO Regional Office

**Russia**

See Russia, WHO Regional Office

**Singapore**

See Singapore, WHO Regional Office

**South Africa**

See South Africa, WHO Regional Office

**Spain**

See Spain, WHO Regional Office

**Sweden**

See Sweden, WHO Regional Office

**Thailand**

See Thailand, WHO Regional Office

**United Kingdom**

See United Kingdom, WHO Regional Office

**United States**

See United States, WHO Regional Office