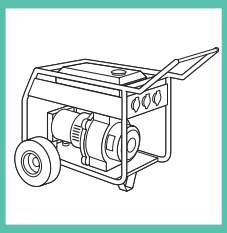
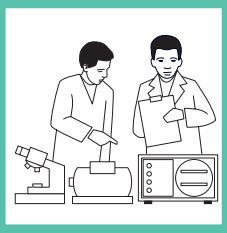


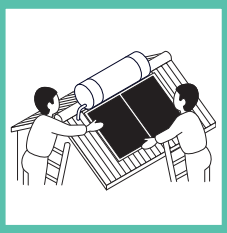
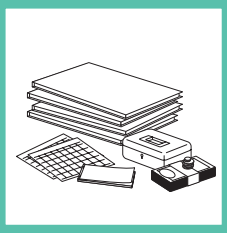
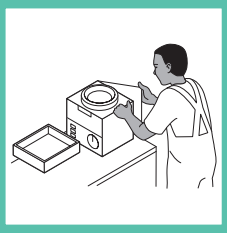

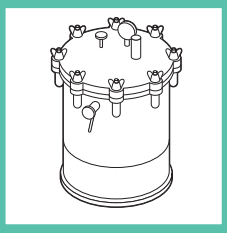

'How to Manage' Series for Healthcare Technology

Guide 1

How to Organize a System of Healthcare Technology Management

Management Procedures for Health Facilities and Health Authorities

ZIKEN INTERNATIONAL

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TALC Teaching-aids At Low Cost

Dedicated to baby Nathan and Trevor, for their patience and help.

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website: www.talcuk.org

Ziken International (Consultants) Ltd,
Causeway House, 46 Malling Street, Lewes, East Sussex, BN7 2RH, UK
Tel: +44 (0)1273 477474, fax: +44 (0)1273 478466, email: info@ziken.co.uk,
website: www.ziken.co.uk

'How to Manage' Series for Healthcare Technology

Guide 1: How to Organize a System of Healthcare Technology Management

Guide 2: How to Plan and Budget for your Healthcare Technology

Guide 3: How to Procure and Commission your Healthcare Technology

Guide 4: How to Operate your Healthcare Technology Effectively and Safely

Guide 5: How to Organize the Maintenance of your Healthcare Technology

Guide 6: How to Manage the Finances of your Healthcare Technology Management Teams

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Edited by Rebecca Lowe, Swan Media Services (email: swanmedia@ntlworld.com)

‘How to Manage’ Series for Healthcare Technology

Guide 1

How to Organize a System of Healthcare Technology Management

by:

Andreas Lenel
Health Economist Consultant, FAKT, Stuttgart, Germany

Caroline Temple-Bird
Healthcare Technology Management Consultant,
Ziken International Consultants Ltd, Lewes, UK

Willi Kawohl
Financial Management Consultant, FAKT, Stuttgart, Germany

Manjit Kaur
Development Officer, ECHO International Health Services, Coulsdon, UK

Series Editor

Caroline Temple-Bird
Healthcare Technology Management Consultant,
Ziken International Consultants Ltd, Lewes, UK

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Foreword

This Series of Guides is the output from a project funded by the UK government's Department for International Development (DFID) for the benefit of developing countries. The output is the result of an international collaboration that brought together:

- researchers from Ziken International and ECHO International Health Services in the UK, and FAKT in Germany
- an advisory group from WHO, PAHO, GTZ, the Swiss Tropical Institute, and the Medical Research Council of South Africa
- reviewers from many countries in the developing world

in order to identify best practice in the field of healthcare technology management.

The views expressed are not necessarily those of DFID or the other organizations involved.

Garth Singleton
Manager, Ziken International Consultants Ltd, Lewes, UK

Preface

The provision of equitable, quality and efficient healthcare requires an extraordinary array of properly balanced and managed resource inputs. Physical resources such as fixed assets and consumables, often described as healthcare technology, are among the principal types of those inputs. Technology is the platform on which the delivery of healthcare rests, and the basis for provision of all health interventions. Technology generation, acquisition and utilization require massive investment, and related decisions must be made carefully to ensure the best match between the supply of technology and health system needs, the appropriate balance between capital and recurrent costs, and the capacity to manage technology throughout its life.

Healthcare technology has become an increasingly visible policy issue, and healthcare technology management (HTM) strategies have repeatedly come under the spotlight in recent years. While the need for improved HTM practice has long been recognized and addressed at numerous international forums, health facilities in many countries are still burdened with many problems, including non-functioning medical equipment as a result of factors such as inadequate planning, inappropriate procurement, poorly organized and managed healthcare technical services, and a shortage of skilled personnel. The situation is similar for other health system physical assets such as buildings, plant and machinery, furniture and fixtures, communication and information systems, catering and laundry equipment, waste disposal, and vehicles.

Preface (continued)

The (mis-)management of physical assets impacts on the quality, efficiency and sustainability of health services at all levels, be it in a tertiary hospital setting with sophisticated life-support equipment, or at the primary healthcare level where simple equipment is needed for effective diagnosis and safe treatment of patients. What is vital – at all levels and at all times – is a critical mass of affordable, appropriate, and properly functioning equipment used and applied correctly by competent personnel, with minimal risk to their patients and to themselves. Clear policy, technical guidance, and practical tools are needed for effective and efficient management of healthcare technology for it to impact on priority health problems and the health system's capacity to adequately respond to health needs and expectations.

This Series of Guides aims to promote better management of healthcare technology and to provide practical advice on all aspects of its acquisition and utilization, as well as on the organization and financing of healthcare technical services that can deliver effective HTM.

The Guides – individually and collectively – have been written in a way that makes them generally applicable, at all levels of health service delivery, for all types of healthcare provider organizations and encompassing the roles of health workers and all relevant support personnel.

It is hoped that these Guides will be widely used in collaboration with all appropriate stakeholders and as part of broader HTM capacity-building initiatives being developed, promoted and implemented by WHO and its partners, and will therefore contribute to the growing body of evidence-based HTM best practice.

The sponsors, authors and reviewers of this Series of Guides are to be congratulated for what is a comprehensive and timely addition to the global HTM toolkit.

Andrei Issakov, Coordinator, Health Technology and Facilities Planning and Management, World Health Organization, Geneva, Switzerland

Mladen Poluta, Director, UCT/WHO HTM Programme, University of Cape Town, South Africa

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This Guide was written:

- **with specialist support from:**

  Juergen Clauss, formerly Consultant in Healthcare Technology, FAKT, Stuttgart, Germany

  Andreas Mallouppas, Director, Service for External Affairs and Projects, University of Cyprus, Nicosia, Cyprus

- **with assistance from an Advisory Group of:**

  Hans Halbwachs, Healthcare Technology Management, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ-GmbH), Eschborn, Germany

  Peter Heimann, Director, WHO Collaborating Centre for Essential Health Technologies, Medical Research Council of South Africa, Tygerberg, South Africa

  Antonio Hernandez, Regional Advisor, Health Services Engineering and Maintenance, PAHO/WHO, Washington DC, USA

  Andrei Issakov, Coordinator, Health Technology and Facilities Planning and Management, Department of Health System Policies and Operations, WHO, Geneva, Switzerland

  Yunkap Kwankam, Scientist, Department of Health Service Provision, WHO, Geneva, Switzerland

  Martin Raab, Biomedical Engineer, Swiss Centre for International Health of the Swiss Tropical Institute, Basle, Switzerland

  Gerald Verollet, Technical Officer, Medical Devices, Blood Safety and Clinical Technology (BCT) Department, WHO, Geneva, Switzerland

  Reinhold Werlein, Biomedical Engineer, Swiss Centre for International Health of the Swiss Tropical Institute, Basle, Switzerland

- **and reviewed by:**

  Dr. P. Asman, Head of the Bio-engineering Unit, Ministry of Health, Accra, Ghana

  Tsibu J. Bbuku, Medical Equipment Specialist, Central Board of Health, Lusaka, Zambia

  Sue Carr-Hartley, Director of Nursing, Aga Khan Foundation Private Hospital, Nairobi, Kenya

  Ms. Sok Chann, PAM Coordinator at Biomedical Engineering Unit, Ministry of Health, Phnom Penh, Cambodia

  Juliette Cook, Biomedical Engineer, Advisor to Ministries of Health of Mozambique, and Vanuatu

Peter Cook, Biomedical Engineer, ECHO International Health Services, Coulsdon, UK

Freedom Dellosa, Chief of Hospital Equipment Maintenance Service Division, Region 9 – Mindanao Peninsula, Department of Health, Zambonga City, Philippines

Pieter de Ruijter, Consultant, HEART Consultancy, Renkum, The Netherlands

Roland Fritz, HCTS Coordinator, Christian Social Services Commission, Dar es Salaam, Tanzania

Andrew Gammie, Project Director, International Nepal Fellowship, Pokhara, Nepal

Dr. Nichodemus Gebe, Medical Devices Training Coordinator, Biomedical Engineering Unit, Accra, Ghana

Richard Hudson, Team Leader, Technical Assistance Programme, International Nepal Fellowship, Nepalgunj, Nepal

Muditha Jayatilaka, Deputy Director General of Health Services (Biomedical Engineering Services), Ministry of Health, Nutrition and Welfare, Colombo, Sri Lanka

Godfrey Katabaro, Biomedical Engineering Technologist, Kagera Medical Technical Services, church health sector, Kagera, Tanzania

Timothy Mukoko, Senior Bio-medical Equipment Technologist, University Teaching Hospital, Lusaka, Zambia

Sulaiman Shahabuddin, Director, Patient Services, Aga Khan Foundation Private Hospital, Nairobi, Kenya

Birgit Thiede, Physical Assets Management (PAM) Advisor, Ministry of Health, Phnom Penh, Cambodia

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Abbreviations

AHA	American Hospital Association
BP	British pharmacopoeia
CE	European conformity
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CT	computed tomography (scanner)
ECRI	Emergency Care Research Institute (of the US)
EFTA	European Free Trade Association
EP	European pharmacopoeia
ETSI	European Telecommunications Standards Institute
EU	European Union
FAKT	German consultancy company for management, training, and technologies
FDA	Food and Drug Administration
GMP	good manufacturing practices
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Government Technical Aid Agency)
HMIS	health management information system
HND	higher national diploma
HTM	healthcare technology management
HTM-IS	healthcare technology management information system
HTMS	healthcare technology management service
HTMWG	healthcare technology management working group
IEC	International Electrotechnical Commission
IP	international pharmacopoeia (of the WHO)
ISO	International Organization for Standardization
MBEHOMA	Mbeya Hospital Maintenance Association, Tanzania
MIS	maintenance information system
MOH	Ministry of Health
MRI	magnetic resonance imaging
NGO	non-governmental organization
PPM	planned preventive maintenance
US $	United States dollars
USP	United States pharmacopoeia
WHO	World Health Organization

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1. INTRODUCTION

Why is This Important?

This introduction explains the importance of healthcare technology management (HTM) and its place in the health system.

It also describes:

- the purpose of the Series of Guides and this Guide in particular
- the people the Guides are aimed at
- the names and labels commonly used in HTM, in this Series.

The Series of Guides is introduced in *Section 1.1*, and this particular Guide on how to organize a system of healthcare technology management in *Section 1.2*.

1.1 INTRODUCTION TO THE SERIES OF GUIDES

Healthcare Technology Management's Place in the Health System

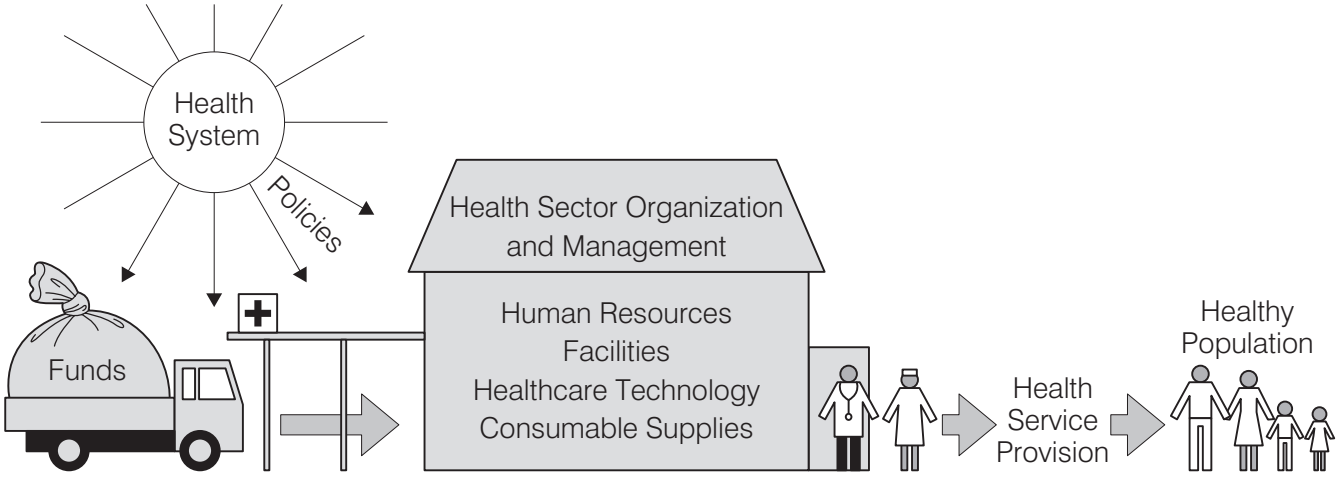
All health service providers want to get the most out of their investments. To enable them to do so, they need to actively manage health service assets, ensuring that they are used efficiently and optimally. All management takes place in the context of your health system's policies and finances. If these are favourable, the management of health service assets can be effective and efficient, and this will lead to improvements in the quality and quantity of healthcare delivered, without an increase in costs.

The health service's most valuable assets which must be managed are its human resources, physical assets, and other resources such as supplies. Physical assets such as facilities and healthcare technology are the greatest capital expenditure in any health sector. Thus it makes financial sense to manage these valuable resources, and to ensure that healthcare technology:

- is selected appropriately
- is used correctly and to maximum capacity
- lasts as long as possible.

Such effective and appropriate management of healthcare technology will contribute to improved efficiency within the health sector. This will result in improved and increased health outcomes, and a more sustainable health service. This is the goal of healthcare technology management – the subject of this Series of Guides.

Figure 1: The Place of Healthcare Technology Management in the Health System



What Do we Mean by Healthcare Technology?

The World Health Organization (WHO) uses the broader term 'health technology', which it defines as including:

'devices, drugs, medical and surgical procedures – and the knowledge associated with these – used in the prevention, diagnosis and treatment of disease as well as in rehabilitation, and the organizational and supportive systems within which care is provided'

(Source: Kwankam, Y, et al, 2001, 'Health care technology policy framework', WHO Regional Publications, Eastern Mediterranean Series 24: Health care technology management, No. 1)

However, the phrase 'healthcare technology' used in this Series of Guides only refers to the physical pieces of hardware in the WHO definition, that need to be maintained. Drugs and pharmaceuticals are usually covered by separate policy initiatives, frameworks, and colleagues in another department.

Therefore, we use the term healthcare technology to refer to the various equipment and technologies found within health facilities, as shown in *Box 1*.

BOX 1: Categories of Equipment and Technologies Described as 'Healthcare Technology'

medical equipment	walking aids	health facility furniture
communications equipment	training equipment	office equipment
office furniture	fixtures built into the building	plant for cooling, heating, etc
service supply installations	equipment-specific supplies	fire-fighting equipment
workshop equipment	fabric of the building	vehicles
laundry and kitchen equipment	waste treatment plant	energy sources

For examples of these different categories, see the Glossary in *Annex 1*.

Often, different types of equipment and technologies are the responsibility of different organizations. For example, in the government sector, different ministries may be involved, such as Health, Works, and Supplies. In the non-government sector, different agencies may be involved, such as Health, and Logistics.

The range of healthcare technology which falls under the responsibility of the health service provider varies from country to country and organization to organization. Therefore each country's definition of healthcare technology will vary depending on the range of equipment and technology types that they actually manage.

For simplicity, we often use the term 'equipment' in place of the longer phrase 'healthcare technology' throughout this Series of Guides.

What is Healthcare Technology Management?

First of all, healthcare hechnology management (HTM) involves the organization and coordination of all of the following activities, which ensure the successful management of physical pieces of hardware:

- Gathering reliable information about your equipment.
- Planning your technology needs and allocating sufficient funds for them.
- Purchasing suitable models and installing them effectively.
- Providing sufficient resources for their use.
- Operating them effectively and safely.
- Maintaining and repairing the equipment.
- Decommissioning, disposing, and replacing unsafe and obsolete items.
- Ensuring staff have the right skills to get the best use out of your equipment.

This will require you to have broad skills in the management of a number of areas, including:

- technical problems
- finances
- purchasing procedures
- stores supply and control
- workshops
- staff development.

However, you also need skills to manage the place of healthcare technology in the health system. Therefore, HTM means managing how healthcare technology should interact and balance with your:

- medical and surgical procedures
- support services
- consumable supplies, and
- facilities

so that the complex whole enables you to provide the health services required.

Thus HTM is a field that requires the involvement of staff from many disciplines – technical, clinical, financial, administrative, etc. It is not just the job of managers, it is the responsibility of all members of staff who deal with healthcare technology.

This Series of Guides provides advice on a wide range of management procedures, which you can use as tools to help you in your daily work. For further clarification of the range of activities involved in HTM and common terms used, refer to the WHO's definition of the technology management hierarchy in *Annex 1*.

Box 2 highlights some of the benefits of HTM.

BOX 2: Benefits of Healthcare Technology Management (HTM)

- Health facilities can deliver a full service, unimpeded by non-functioning healthcare technology.
- Equipment is properly utilized, maintained, and safeguarded.
- Staff make maximum use of equipment, by following written procedures and good practice.
- Health service providers are given comprehensive, timely, and reliable information on:
  - the functional status of the equipment
  - the performance of the maintenance services
  - the operational skills and practice of equipment-user departments
  - the skills and practice of staff responsible for various equipment-related activities in a range of departments including finance, purchasing, stores, and human resources.
- Staff control the huge financial investment in equipment, and this can lead to a more effective and efficient healthcare service.

Purpose of the Series of Guides

The titles in this Series are designed to contribute to improved healthcare technology management in the health sectors of developing countries, although they may also be relevant to emerging economies, and other types of country. The Series is designed for any health sector, whether it is run by:

- government (such as the Ministry of Health or Defence)
- a non-governmental organization (NGO) (such as a charitable or not-for-profit agency)
- a faith organization (such as a mission)
- a corporation (for example, an employer such as a mine, who may subsidize the healthcare)
- a private company (such as a health insurance company or for-profit agency).

This Series aims to improve healthcare technology at a daily operational level, as well as to provide practical resource materials for equipment users, maintainers, health service managers, and external support agencies.

To manage your technology effectively, you will need suitable and effective procedures in place for all activities which impact on the technology. Your health service provider organization should already have developed a Policy Document setting out the principles for managing your stock of healthcare technology (*Annex 2* provides a number of resources available to help with this). The next step is to develop written organizational procedures, in line with the strategies laid out in the policy, which staff will follow on a daily basis.

The titles in this Series provide a straightforward and practical approach to healthcare technology management procedures:

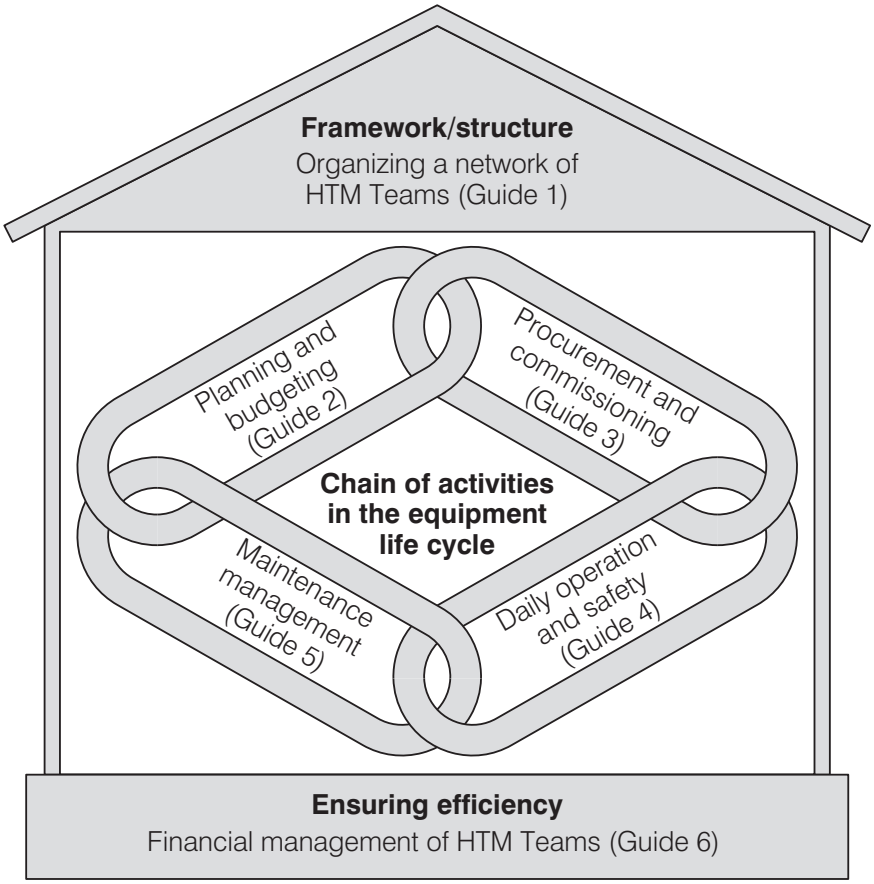
Guide 1 covers the framework in which Healthcare Technology Management (HTM) can take place. It also provides information on how to organize a network of HTM Teams throughout your health service provider organization.

Guides 2 to 5 are resource materials which will help health staff with the daily management of healthcare technology. They cover the chain of activities involved in managing healthcare technology – from planning and budgeting to procurement, daily operation and safety, and maintenance management.

Guide 6 looks at how to ensure your HTM Teams carry out their work in an economical way, by giving advice on financial management.

How the Guides are coordinated is set out in *Figure 2*.

Figure 2: The Relationship Between the Guides in This Series



Who are These Guides Aimed at?

These Guides are aimed at people who work for, or assist, health service provider organizations in developing countries. Though targeted primarily at those working in health facilities or within the decentralized health authorities, many of the principles will also apply to staff in other organizations (for example, those managing health equipment in the Ministry of Works, private maintenance workshops, and head offices).

Depending on the country and organization, some daily tasks will be undertaken by end users while others may be carried out by higher level personnel, such as central level managers. For this reason, the Guides cover a range of tasks for different types of staff, including:

- equipment users (all types)
- maintenance staff
- managers
- administrative and support staff
- policy-makers
- external support agency personnel.

They also describe activities at different operational levels, including:

- the health facility level
- the zonal administration level (such as district, regional, diocesan)
- the central/national level
- by external support agencies.

Many activities require a multi-disciplinary approach; therefore it is important to form mixed teams which include representatives from the planning, financial, clinical, technical, and logistical areas. Allocation of responsibilities will depend upon a number of factors, including:

- your health service provider
- the size of the organization
- the number of decentralized levels of authority
- the size of your health facility
- your level of autonomy.

The names and titles given to the people and teams involved will vary depending on the type of health service provider you work with.

For the sake of simplicity, we have used a variety of labels to describe different types of staff and teams involved in HTM.

This Series describes how to introduce healthcare technology management into your organization. The term **Healthcare Technology Management Service (HTMS)** is used to describe the delivery structure required to manage equipment within the health system. This encompasses all levels of the health service, from the central level, through the regions/districts, to facility level.

There should be a referral network of **workshops** where maintenance staff with technical skills are based. However, equipment management should also take place where there are no workshops, by involving general health facility staff. We call these groups of people the **HTM Team**, and we suggest that you have a team at every level whether a workshop exists or not. Throughout this Series, we have called the person who leads that team the **HTM Manager.**

At every level, there should also be a committee which regularly considers all equipment-related matters, and ensures decisions are made that are appropriate to the health system as a whole. We have used the term **HTM Working Group (HTMWG)** for this committee, which will advise the Health Management Teams on all equipment issues.

Due to its role, the HTMWG must be multi-disciplinary. Depending on the operational level of the HTMWG, its members could include the following:

- Head of medical/clinical services.
- Head of support services.
- Purchasing and supplies officer.
- Finance officer.
- Representatives from both medical equipment and plant maintenance.
- Representatives of equipment users from a variety of areas (medical/clinical, nursing, paramedical, support services, etc).
- Co-opted members (if specific equipment areas are discussed or specific interest or need is shown).

The HTM Working Group prepares the annual plans for equipment purchases, rehabilitation and funding, and prioritizes expenditure across the facility/district as a whole (see *Guide 2* on planning and budgeting). It may have various sub-groups to help consider specific aspects of equipment management, such as pricing, commissioning, safety, etc.

How to Use These Guides

Each Guide has been designed to stand alone, and has been aimed at different types of readers depending on its content (*Section 1.2*). However, since some elements are shared between them, you may need to refer to the other Guides from time to time. Also, if you own the full Series (a set of six Guides) you will find that some sections of the text are repeated.

We appreciate that different countries use different terms. For example, a purchasing officer in one country may be a supplies manager in another; some countries use working groups, while others call them standing committees; and essential service packages may be called basic healthcare packages elsewhere. For the purpose of these Guides it has been necessary to pick one set of terms and define them. You can then modify them for your own situation.

The terms used throughout the text are outlined, with examples, in the Glossary in *Annex 1*.

We appreciate that you may find it hard to pursue the ideas introduced in these Guides. Depending on your socio-economic circumstances, you may face many frustrations on the road to achieving effective healthcare technology management. We recognize that not all of the suggested procedures can be undertaken in all environments. Therefore we recommend that you take a step-by-step approach, rather than trying to achieve everything at once (*Section 2*).

These Guides have been developed to offer advice and recommendations only, therefore you may wish to adapt them to meet the needs of your particular situation. For example, you can choose to focus on those management procedures which best suit your position, the size of your organization, and your level of autonomy.

For more information about reference materials and contacts for healthcare technology management, see *Annex 2*.

1.2 INTRODUCTION TO THIS SPECIFIC GUIDE

The Importance of Healthcare Technology Management

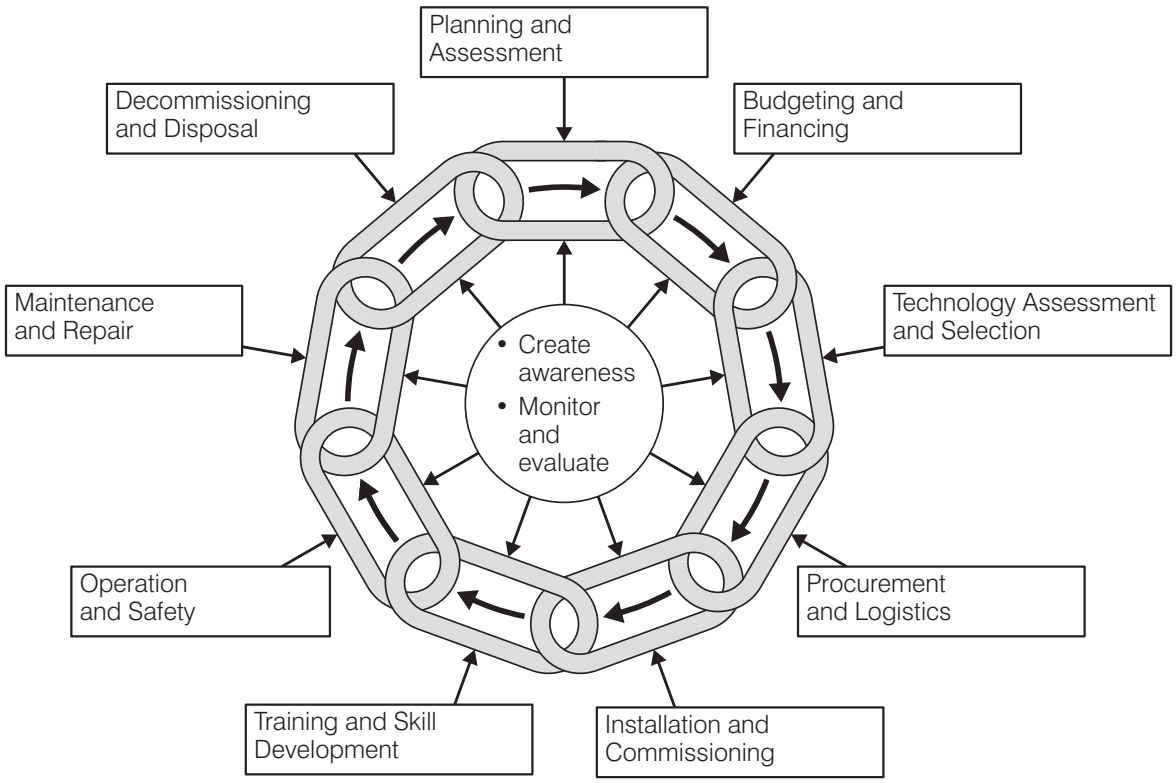
Healthcare technology is such an important part of healthcare today that it cannot easily be ignored. It has a very wide application; for example equipment is used to:

- help *diagnose* whether a patient has malaria
- *treat* a patient by removing their gall stones
- *monitor* the condition of a patient's heart
- provide *therapy* in order to get a patient moving about again
- *control* the environment by supplying heat and light
- *provide* necessities such as running water
- *transport* patients and staff
- *feed* patients and staff
- provide *clean* surroundings.

Healthcare technology management is essential to ensure that such equipment continues to function effectively in a good working condition. For example, proper maintenance can extend the life of equipment – this is essential for providing good health services and saving scarce resources.

This is why maintenance is such a key technical activity. But, in addition to maintenance, HTM also involves other essential activities which ensure that equipment is effectively planned and budgeted for, procured, and operated, etc. Healthcare technology management in fact involves a cycle of activities in the life of equipment, as shown in *Figure 3*.

Figure 3: The Healthcare Technology Management Cycle



Very often, healthcare technology management is not introduced, because it is considered to be too costly and too complicated. The aim of this Series of Guides is to demonstrate how you can introduce healthcare technology management into your health system. This first Guide explains the reasons why you should undertake HTM. It describes the general framework that proper HTM requires, and outlines the organizational set-up needed to implement it, both throughout your health service provider organization and countrywide.

Who is this Guide Aimed at?

This Guide is particularly suitable for the following:

- health planners and policy-makers
- government staff in charge of regulating and supervising health systems
- technical (maintenance) staff at the different levels of the HTM Service
- health management teams
- external support agency staff.

However, other types of staff involved with healthcare technology management may also find it useful. For example:

- managers and administrators
- human resource managers
- finance officers
- equipment users
- purchasing officers.

All of these staff should have a good understanding of the reasons for healthcare technology management, the activities involved, and the different possibilities for delivering HTM.

The recommendations and procedures outlined in this Guide are primarily aimed at policy-makers, planners, and managers at central and decentralized authority levels. However, the Guide also explains what the responsibilities are for all staff involved in HTM at all levels of the system, to enable you to see the bigger picture.

What Topics are Covered?

This Guide concentrates primarily upon the organizational set-up for delivering healthcare technology management. It outlines issues to consider for HTM, such as:

- regulations and standards
- technical requirements
- models for delivery
- organizational structure
- human resource requirements
- monitoring progress.

We recognize that, alongside repair and maintenance, technical staff are also responsible for the wide range of HTM activities shown in *Figure 3*. Recommendations and procedures for all these tasks are provided in *Guides 2 – 6* of this Series. However, in this Guide, maintenance activities are frequently used as an example to illustrate the technical requirements for your HTM Service.

The Guide aims to:

- Encourage those organizations without an HTM Service to begin the process of developing one.
- Help those organizations that have started developing an HTM Service with strategies for expanding and developing it further.
- Clarify the issues for organizations that already have an HTM Service.

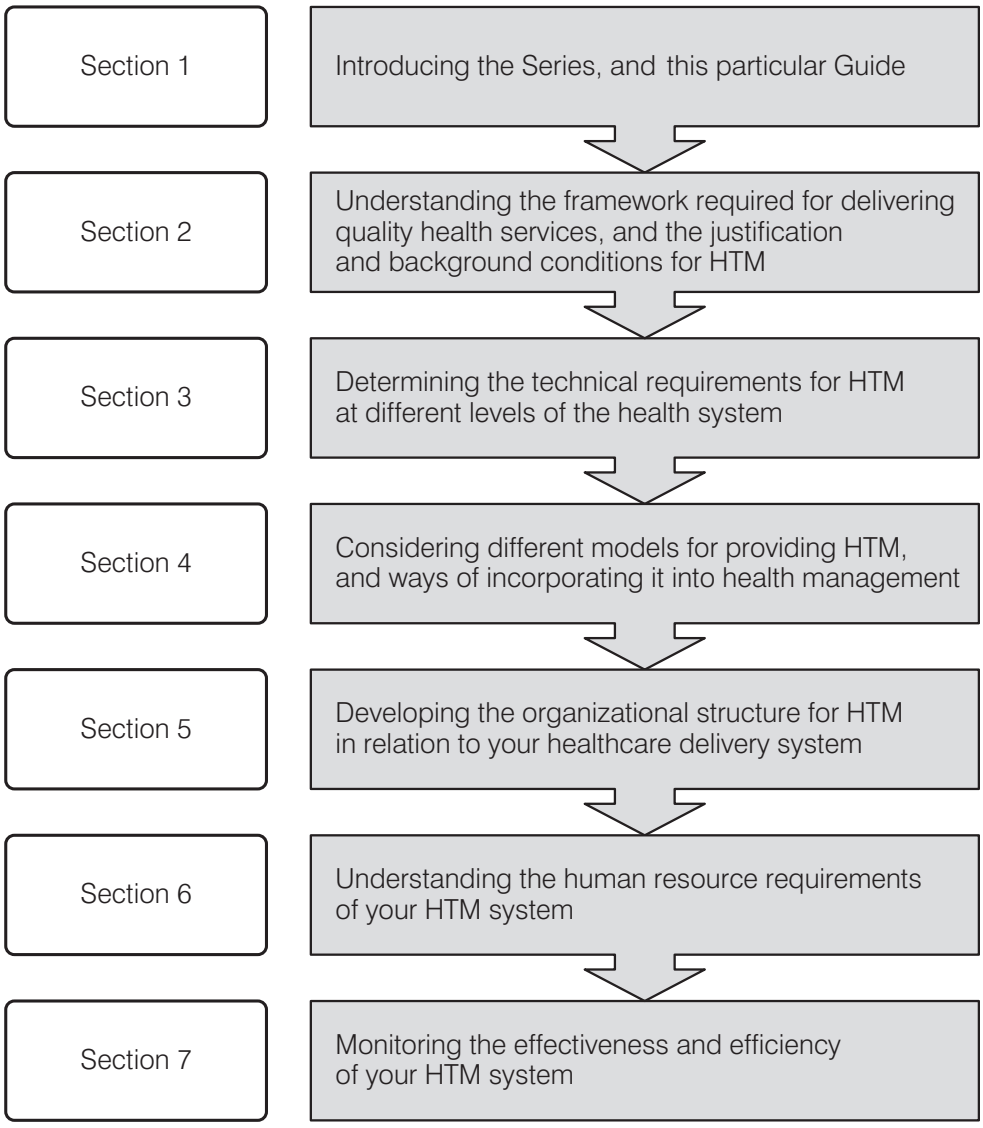
The system introduced in this Guide provides a solid approach to organizing healthcare technology management. However, we recognize that there are other ways of organizing these issues which may be more appropriate for your administrative system. The important thing is to implement a well-functioning system.

As you read through the recommendations in this Guide, you may find it useful to refer to advice in other Guides in the Series, as indicated in the text. Additional useful reference materials and contacts are given in *Annex 2*.

How is This Guide Structured?

The structure of *Guide 1* highlights the justification for undertaking healthcare technology management and the issues to consider when organizing HTM within your health system, as shown in *Figure 4*.

Figure 4: The Structure of Guide 1



Who Does What in Organizing HTM?

Since equipment that is well managed lasts a long time and enables you to deliver the health services required, it is important for HTM to be seen as a collective responsibility. Thus many people have a role to play, as shown in *Box 3.*

BOX 3: The Collective Responsibility for HTM

Working Together	**Government**	◆ provides the regulatory framework for quality health services, including HTM *(Section 2)*
	Your health service provider	◆ conforms to the legislation, regulations, standards, and policies set by government for health services *(Section 2)*
	Health policy-makers, planners, and managers at central level of your health service provider organization	◆ decide which providers of HTM activities to use (*Section 4.1*) ◆ ensure that HTM is incorporated into the health management system (*Section 4.2*) ◆ determine the best organizational structure for the HTM Service across the different levels of your health system, according to the technical requirements calculated by technical staff (*Section 5*) ◆ ensure annual goals and plans are set and monitored for the improvement of the HTM Service (*Section 7*)
	HTM Managers and their technical staff at all levels	◆ determine the different technical requirements for HTM activities, in terms of skill and workload requirements, in order to help design the HTM Service (*Section 3*) ◆ ensure there is appropriate division of labour when placing staff at the different levels of the HTM Service (*Section 5.2*) ◆ ensure appropriate responsibilities are undertaken at the different levels of the HTM Service, including supervision, planning, and monitoring (*Section 5.3*) ◆ ensure that HTM activities are carried out effectively throughout the HTM Service (see *Guides 2 – 6*)
	HTM Teams at facilities without workshops	◆ oversee the condition and running of equipment on a daily basis ◆ are the contact point for all equipment and maintenance matters ◆ are responsible for finding the correct solution (for example, calling in technical support from the workshops, or external contractors) ◆ undertake the maintenance or repair work themselves (if it is a job for which they have been trained)
	HTM Teams at facilities with workshops	◆ deliver all aspects of healthcare technology management (see *Section 3.1*, and *Guides 2 – 6*) ◆ provide a referral network for HTM activities (*Sections 4 and 5*) ◆ act as a zonal workshop to provide HTM by outreach to the zone, such as a district or a region, as appropriate (*Section 5.2*)
	HTM Working Groups (at facility, district, regional and central level)	◆ advise health management teams at their level on all equipment matters

Continued overleaf

BOX 3: The Collective Responsibility for HTM (continued)

Working Together	**Health Management Teams (at facility, district, regional and central level)**	◆ address the practical issues involved with implementing HTM activities ◆ ensure annual goals and plans are set and monitored for the improvement of HTM activities (see *Guides 2 – 6*)
	Finance Officers	◆ allocate sufficient funds for all HTM activities (see *Section 6.3* and *Guide 2*)
	Human Resources Departments	◆ hire suitably skilled technical staff for the HTM Service and offer attractive packages in order to retain them in post (*Section 6*) ◆ facilitate in-service training to improve the skills required for HTM (*Section 6*)
	Equipment Users	◆ are **key** to successful HTM since they greatly affect the life of equipment and form the first level of the HTM Service ◆ take good care of equipment ◆ operate equipment properly and safely ◆ undertake user planned preventive maintenance, and care and cleaning of equipment ◆ report faults promptly to their Section Heads ◆ educate new users (see *Guide 4*)

2. FRAMEWORK REQUIREMENTS FOR QUALITY HEALTH SERVICES

Why is This Important?

In order to deliver quality health services, it is essential to undertake effective healthcare technology management.

There are various framework requirements to help you do this. These include legislation, regulations, standards, and policies.

These framework requirements create the boundary conditions within which you undertake healthcare technology management. They include central or national guiding principles, policy issues, and high-level assumptions that can impede or assist you in your work.

It is very difficult to function effectively if these framework requirements do not exist, and you should lobby your organization to develop them.

Depending on how autonomous your health facilities are, you may be able to develop these framework requirements at facility, region/district, or central level.

In most industrialized countries, laws, regulations, policies and guidelines form an indispensable part of health service management. For many developing countries, however, these regulatory procedures have yet to be developed. By considering them in this Section, we see that effective healthcare technology management (HTM) is essential in order to deliver quality health services.

This Section offers advice on:

- the regulatory role of government (*Section 2.1*)
- establishing standards for your health system (*Section 2.2*)
- policy issues for HTM, such as a vision, financing, standardization, and maintenance (*Section 2.3*)
- the importance of introducing an HTM Service (*Section 2.4*)
- managing change (*Section 2.5*).

This Section provides the justification for undertaking healthcare technology management. Although some of the ideas proposed may seem idealistic for your own country's situation, you should view this as a blueprint to work towards. The best approach is to start by introducing small changes, but at least to act. The longest journey starts with the first step.

2.1 REGULATORY ROLE OF GOVERNMENT

Health systems are organized differently all over the world. For example, they can be:

- mainly public
- mainly private for-profit (for example, run by a commercial organization), and private not-for-profit (for example, run by faith organizations, NGOs)
- a mixture of government and private organizations.

One of the major distinguishing features of different health systems is the role played by the government.

The World Health Organization (WHO) identifies four distinct functions for health systems:

- the provision of health services
- the financing of health services
- the creation of health resources (investment in facilities, equipment, and training)
- the stewardship of health services (regulation and enforcement).

The government may be involved to a lesser or greater degree in the provision and financing of health services as well as the creation of health resources. Alternatively, these functions may be provided by the private sector alone, or by a mixture of both government and private sector. However, stewardship is largely the responsibility of government, either directly or through independent bodies acting under the broad direction of government.

Experience in El Salvador

The health sector of El Salvador is divided into public and private health providers. The public health sector is run by the Ministry of Health (Ministerio de Salud Pública y Asistencia Social), the National Social Insurance Agency (Instituto Salvadoreño de Seguridad Social), and approximately 17 other public institutions.

The MOH regulates the health sector. It also runs a health service network with facilities at different levels of a referral system, consisting of specialized hospitals in the capital, general hospitals, and health centres. According to its statutes the MOH should look after the preventive needs of the total population, and the curative needs of around 85 per cent of the population. In reality it is covering approximately two-thirds of the population. Approximately 17 per cent of the population is covered by the National Social Insurance Agency.

The remainder of the population is covered by the private sector. This consists of private professionals and service organizations which work for profit, such as pharmacies, doctors, dentists, and private health facilities, together with a number of non-governmental agencies which operate as not-for-profit organizations. This private sector covers some 10 per cent of the inpatient service demand of the population, and a much higher share of the outpatient demand.

Box 4 shows various options for organizing health systems.

BOX 4: Alternative Ways of Organizing the Health System

Option	Health system functions:			
	Service financing	**Service provision**	**Resource creation**	**Stewardship**
1	Government budget financing, through: Ministries of Finance and Health	Government service provision, through: government hospitals, government doctors, etc	Government capital development and training	Government regulation and enforcement
2	Private financing, through: health insurance (social security, private and community pooling), donations, direct payments, etc	Private service provision, through: private hospitals, not-for-profit hospitals, independent doctors, etc	Private investment in health facilities, and privately-funded education	Government regulation, and quasi-public bodies enforcing regulations
3	Mixed financing	Public and private service provision	Public and private investment in health facilities and training	Government regulation, and public or quasi-public bodies enforcing regulations

Clearly, a wide range of options exists for the financing and provision of health services, and the creation of resources. In recent years, mixed solutions have become increasingly common, for example:

- Government may provide the majority of health services, but the services themselves are increasingly paid for by health insurance companies and patients.
- Government may finance both public health facilities and some costs of the not-for-profit facilities, such as mission hospitals.
- Other health facilities may be financed by patients, employer contributions, and insurance companies.

Thus we can see that health service provision and financing, as well as resource creation may be taken on by both the government and private sector. However, the government is solely responsible for regulation. The reason for this is that the government has a duty to ensure the quality of healthcare delivered in order to protect the safety of the population. These regulations may then be enforced directly by government bodies or they may be enforced by publicly funded bodies, such as professional associations, which apply government sanctioned regulations.

Most governments would agree that the protection of health and the guarantee of safety of health services are vital. However, in many countries this regulatory function is underdeveloped, with weak legal and regulatory frameworks.

To regulate health services, the government should:

- Adopt suitable quality standards for all aspects of health services, including acceptable international or national standards for healthcare technology, drugs, and supplies in order to ensure their efficacy, quality and safety (*Section 2.2*).
- Establish systems to ensure standards are met, so that the bodies enforcing regulations have legal sanctions they can use if standards are infringed (*Section 2.2*).
- Establish wide-ranging polices covering all aspects of the utilization, effectiveness, and safety of healthcare technology, drugs, and supplies (*Section 2.3*).
- Establish systems to ensure these policies can be implemented (*Sections 2.3, 2.4 and 2.5*).

For health services, the Ministry of Health is the body most likely to develop these government regulations. Other health service providers need to be guided by government laws, and should look to the Ministry of Health for guidance or follow their direction if required to do so by law or regulation.

It is not possible for this Guide to elaborate on all these steps in detail. However, *Box 5* outlines the steps required to guarantee that the government is able to regulate health services effectively.

BOX 5: A Checklist for Your Regulatory System

Check whether the system existing in your country meets the following requirements:

- Has your government taken responsibility for the regulation of health services?
- To regulate health services, has your government:
  - adopted suitable quality standards for health services in general?
  - specifically adopted acceptable international or national standards for healthcare technology?
  - established legal sanctions for infringements of standards?
- Which bodies/agencies are responsible for enforcing government regulations?
- To enforce government regulations, have these bodies/agencies:
  - put in place systems to check whether the standards are being met?
  - used the legal system to effectively prosecute infringements of the standards?
- Has your government developed:
  - wide-ranging health policies?
  - specifically policies for healthcare technology?
  - established systems for implementing these policies?
- Does your health service provider follow the guidance provided by government?

2.2 ESTABLISHING STANDARDS FOR YOUR HEALTH SYSTEM

Standard
a required or agreed level of quality or attainment set by a recognized authority, used as a measure, norm, or model

The government should agree on which quality standards have to be met by the health services in general. They will cover areas such as:

- administrative, medical, and surgical procedures and the training of personnel
- construction and operation of health facilities
- acquisition and use of healthcare technology, drugs, and supplies
- safety and environmental issues
- quality management practices.

In practice, the Ministry of Health is most likely to be responsible for undertaking this task, in collaboration with any other relevant regulatory authorities (for example, those regulating construction, or environmental impact issues). The body responsible should ideally be a ministerial multi-disciplinary committee, with representatives from all health service providers, and which takes technical advice from any bodies with expertise in healthcare technology management – such as the HTM Service (*Section 2.4*).

Since drawing up these standards can be both time consuming and expensive, governments may often choose to adopt acceptable international standards (such as ISO), rather than develop their own. However, they must be suitable and applicable to your country situation and fit in with your country's vision for health services (*Section 2.3*). For example, an international standard may require operating theatres to have a ventilation system that produces negative pressure air-flow over the operating table (to promote a sterile environment). But the reality in developing countries may be that operating theatres do not have a ventilation or air-conditioning system (other than opening windows) and manage to ensure low levels of sepsis through other surgical practices. Thus, such an international standard would be both impractical and costly to enforce.

The adoption of suitable international or national standards for healthcare technology is of particular relevance to this Guide. These are important since countries can suffer if they acquire sub-standard and unsafe equipment.

Country Experiences

Many countries do not have a system in place for establishing and enforcing equipment standards for all equipment purchases and donations. This has led to the supply of sub-standard equipment. For example:

- *metallurgy microscopes supplied instead of medical microscopes*
- *infant incubators containing asbestos*
- *suction pumps constructed with poor internal wiring so that they smoke when used*
- *instrument autoclaves not manufactured as pressure vessels which leak, do not sterilize the contents, and are dangerous*
- *operating tables constructed with such poor tolerances in the hydraulic systems that they consistently leak oil and sink under the weight of a patient*
- *operating lights manufactured with mains voltage (alternating current) wired into the lamp-head, instead of the required safe 12 volts (direct current)*
- *veterinary equipment instead of the necessary human equivalent medical ones.*

A wide variety of formal standards and guidelines now exist which relate to healthcare technology. They apply to:

- design, development, and manufacturing practices for hardware, associated consumables, and software
- safety and performance requirements for certain classes of technologies (such as radiation or electrical safety)
- procedures and training for equipment operators and maintainers
- environmental issues such as the disposal of hazardous medical waste (for more details on this, see *Guide 4* on operation and safety).

Did you know?

- Standards and guidelines are produced and/or adopted by government agencies, international organizations, and professional and specialty organizations and societies.
- The Emergency Care Research Institute (ECRI) in the United States lists over 13,000 individual standards and guidelines relating to healthcare technology, produced by over 800 organizations and agencies from North America alone.

Again, in the majority of cases ministries of health would save money and time by adopting suitable internationally recognized standards (see *Annex 2*). Specialist support may be required to assist with this process. *Box 6* provides a summary of the important standards you are likely to see reference to. For more information on introducing internationally recognized standards into your procurement procedures, refer to *Guide 3* on procurement and commissioning.

Experience in Indonesia

The Indonesian Government asked the German Technical Cooperation Agency to assist the Directorate of Cosmetic and Medical Devices Control in establishing a system for registration/certification of medical equipment. This would involve defining standards for medical equipment, as well as the relevant test methods which equipment must pass if it is to be allowed to be imported or used by health institutions.

This task was particularly difficult since the Directorate had, in the past, concentrated its efforts on the registration/certification of drugs and cosmetics and had only limited experience with medical equipment. Thus during the assistance project, the Directorate realized that unique national standards for medical equipment could not be developed by the Ministry of Health, since the technical requirements for this did not exist in the MOH. Therefore they decided to register selected equipment based on available international standards.

As a result of the project, Indonesia introduced the respective internationally accepted standards for a group of eight types of medical equipment. In addition to the standards, the Directorate also took responsibility for registering all medical devices that met the selected standards and passed the tests, and providing the operational permits for them.

BOX 6: Examples of Important Safety and Performance Standards

All equipment should meet international, regional, or national safety and performance standards (see *Annex 2*). The most important standards include:

- ***IEC (International Electrotechnical Commission)*** – these are international standards for the **electrical safety** of any electrical and electromechanical equipment (such as refrigerators). IEC 60101 is the international standard specifically addressing **medical electrical safety** that manufacturers must conform to if medical equipment is to be electrically and mechanically safe for use by staff with patients. As part of their responsibilities, maintenance staff should also safety test equipment to ensure it meets these standards (see *Guide 4* on operation and safety).
- ***ISO (International Organization for Standardization)*** – these are international standards for industry, technology and business, with special standard series for **quality management and systems in any field**. ISO 9000-9004 is a series of standards covering the quality of manufacturing processes, design and development, construction, installation, and servicing. ISO standards do not currently exist for all equipment, but do apply to a range of medical devices (for example, ISO 13485 and ISO 13488). ISO standards, however, do not have a status of official standards unless they are adopted by a competent national authority. ISO is made up of its members. A member body of ISO is the national body 'most representative of standardization in its country'. Examples are BSI (British Standards Institution, UK), ANSI (American National Standards Institute, US), DIN (Germany), SAI (Australia).

Continued overleaf

BOX 6: Examples of Important Safety and Performance Standards (continued)

- ***EU standards*** are developed through the organs of EU, EFTA, and the three European standardization organizations CEN, CENELEC and ETSI. Directives are issued by the EU authorities and the standardization organization prepares the technical standards according to the directives. These become standards to be adopted nationally. There are three main medical devices directives for Europe. These are: i) 90/385/EEC for active implantable medical devices; ii) 93/42/EEC covers vigilance and compliance in general for medical devices; iii) 98/79/EC for in-vitro diagnostic medical devices.
  CE markings indicate that a product meets European Union directive standards of **performance and safety** and, for example, apply to all sterile medical supplies.
- ***American Standards*** are adopted from the international work of organizations like the IEC and ISO, or are developed nationally. ANSI is the national organization that facilitates national standards development by accrediting procedures of standardization organizations. All new medical equipment has to be approved by the Food and Drug Administration (**FDA-approval**) before it can be commercialized.
- ***Pharmacopoeia specifications*** – quality specifications for the most commonly used drugs and some medical supplies, such as bandages, tape, and swabs. Important pharmacopoeias include the British (BP), European (EP), United States (USP), and the WHO's International Pharmacopoeia (IP).
- ***Manufacturer's Certificates*** – these are validated by the government of the exporting country confirming that the **exported device is approved for domestic use in the exporting country**. In this way, the importing country can be assured of the same risk exposure as the citizens of the exporting country
- ***Export Certificates*** – allow manufacturers **to export equipment that is *not* manufactured for the exporting country's domestic sale or use**. At present, there is no uniform certificate for different countries, so it is wise to be cautious in interpreting such 'export certificates'. (Note: the WHO export certificate at present only applies to pharmaceutical products).
- ***Good Manufacturing Practices (GMP)*** – where this has been introduced, a manufacturer's Quality System is audited and monitored to **ensure standards of production and safety** are maintained and are consistent. GMP has recently been established for manufacturers of equipment. (For example, quality system standard for medical devices: 1128 in Japan, and 21 CFR part 820 in USA)
- ***Registration or Licensing*** – of manufacturers, wholesalers, importers, and retail outlets by a local regulatory authority.

Note: be aware that:
- apparently standard quality certificates may indeed be based on varying parameters
- export certificates and GMP are both issued by authorities in the country of origin, and their value depends upon the capacity and diligence of the issuing Regulatory Authority.

It is not enough simply to establish these standards; they also need to be adhered to. For this reason, you should establish a national supervisory body that has the power to ensure that health service providers comply with the standards in force. To be effective, such an enforcement agency must be allocated sufficient financial and personnel resources. It should also be linked or networked with corresponding international bodies.

Much healthcare technology in developing countries is received through foreign aid and donations, but such products do not always meet international standards. Therefore, your country will need to negotiate with external support agencies. The best way to do this is to develop regulations for donors that supply equipment (see *Annex 2*, and *Guide 3* on procurement and commissioning).

The legal system plays an important role in enforcing such standards, by ensuring that any infringements can be effectively prosecuted. It is therefore essential that the legal system is allocated sufficient financial and human resources to enforce claims against any institution operating equipment that does not meet the prescribed standards.

Box 7 outlines the issues to consider if you wish to improve your standards.

BOX 7: A Checklist for Improving Your Standards

Check whether the following requirements have been met by your country:

- Which quality standards has your government defined for health services in general?
- Which international or national standards has your government defined for healthcare technology, relating to:
  - manufacturing?
  - safety?
  - use?
  - disposal?
- Which national supervisory bodies in your country are responsible for ensuring the different sets of standards are complied with?
- Do these supervisory bodies use the legal system to enforce claims against any institution operating equipment that does not meet the prescribed standards?
- Does your health service provider conform to these government standards?

2.3 DEVELOPING POLICIES FOR HEALTH SERVICES

Every country needs to establish wide-ranging policies covering all aspects of health services. National health policies are usually developed by the Ministry of Health (or its equivalent). If these policies are linked to regulations, then other health service providers must also follow them. Each health service provider can expand them internally, and must establish systems that ensure they are implemented.

Of relevance to this Guide, are the necessary policies for the utilization, effectiveness, and safety of healthcare technology. One key framework requirement for this Series of Guides is that your health service provider should have started work on a Healthcare Technology Policy. Healthcare technology policies have been developed by many countries, and there are several written resources and agencies which offer guidance (see *Annex 2*). You may need specialist support with this process.

A Healthcare Technology Policy usually addresses all the healthcare technology management (HTM) activities involved in the life-cycle of equipment, as shown in *Figure 3* (*Section 1.2*). Here we will consider just four issues that provide key background conditions for this Guide:

- a vision for health services
- standardization
- the provision of maintenance; and
- finances.

Ultimately you will need an HTM Service to ensure that you can deliver HTM throughout your organization. Its organizational structure will also be part of your policy document. This is discussed in *Section 5* of this Guide.

2.3.1 A Vision for Health Services

Every health service provider needs a realistic vision of the service it can offer. This should include a clear understanding of its role in relation to other health service providers in the national health service. Only when this vision is known can the health service provider decide what healthcare technology is needed, and prioritize the actions required to develop its stock of equipment.

It is unhelpful if lots of individual health facilities pull in different directions, with no coordinated plan for the health service as a whole. The central authority of each health service provider should be responsible for considering what sort of healthcare should be offered at each level of their health service. Preferably they will collaborate with the Ministry of Health, or follow their guidance if regulated to do so.

Your country and health service provider may already have developed central level guidance such as 'Essential Service Packages'. In many other countries and organizations, the definition of the functions for each level of healthcare delivery may not, as yet, be written down in a policy document. If there is no health service plan, there is no framework on which to base decisions. *Guide 2* provides further information on developing a vision and planning your healthcare technology stock.

To develop strategies for healthcare delivery, health service providers should take into account:

- healthcare trends
- demographic data
- epidemiological profiles
- priority health problems
- clinical and referral features of the target area
- the available infrastructure, finances, and human resources.

The standards you adopt (*Section 2.2*) must necessarily be linked to the type of health services you decide to offer.

2.3.2 Standardization of Healthcare Technology

Standardization
(also known as rationalization, normalization, and harmonization) – the process of reducing the range of makes and models of equipment available in your stock, by purchasing particular or named makes and models.

Having developed a vision for health services, many health service providers find it helpful to introduce an element of standardization for healthcare technology in order to limit the wide variety of makes and models of equipment found in their stock. In this way, they benefit from technical, financial, logistic, and training viewpoints, as shown in *Box 8*.

BOX 8: The Benefits of Standardization

Standardization helps you to improve:

Quality:

- by ensuring that only products which meet the defined standards are acquired, without the need for additional cumbersome tests and checks.

Procurement and logistics:

- by limiting the number of types of spare parts, accessories, and consumables that you have to keep in stock for different types of equipment.
- by helping you to rationalize your sources of supply and supply routes, and make savings through bulk purchasing.

Skill development and performance:

- by enabling staff to become more knowledgeable about the operation and maintenance of the products, as it limits the variety of items they have to be familiar with.

After sales support:

- by giving suppliers greater incentives to provide after-sales services and establish long-term relationships with you due to the bulk sales.

It is easier to achieve standardization if equipment is planned and ordered on a country-wide, district-wide or health service provider basis. Procurement by one facility at a time almost certainly generates singular types of equipment that are unaffordable to maintain. It is therefore important to combine forces with other facilities or health service providers, and it may be wise to collaborate with or follow the standardization strategies of the Ministry of Health (see *Guides 2 and 3*).

To ensure that you standardize to safe well-made makes and models, it is usual to standardize equipment to the healthcare technology standards you have set, as described in *Section 2.2*. In fact, introducing standards for healthcare technology automatically starts the process of introducing an element of standardization as it restricts purchases to those items that meet the standards.

Tip

- To achieve standardization you need to go through a tender process that ensures the limited range of makes and models eventually selected are consistent with agreed specifications and conform to existing standards you have set.

It is important that standardization efforts do not just apply to products purchased by the health service providers, but also to donations. To achieve this, it is important that regulations for donors have been established (see *Annex 2* and *Guide 3*).

Standardizing your healthcare technology may be difficult for a number of reasons. Your country and local businesses may have their own trade practices and interests. National donors may have tied-aid practices, while the procurement procedures of international funding agencies, health service institutions, and individuals may act against your standardization strategies (see *Guide 3* on procurement and commissioning).

You may need to hold discussions with organizations such as the Ministry of Industry and/or Trade, the chambers of commerce or specific business associations, as well as external support agencies. However, it is well worth persevering, as standardization offers many benefits, both in terms of cost and efficiency.

2.3.3 Provision of Maintenance

Having established standards for the equipment you purchase, you need strategies to ensure it continues to meet the standards required throughout its entire working life. Maintenance is a key activity for achieving this.

Undertaking maintenance belongs to the service provision function of health systems (*Section 2.1*). Therefore, this means that the government is not necessarily directly involved in carrying out maintenance. Maintenance could, in principle, be carried out by the government, the private sector, or by a mixture of the two.

It is useful to organize the maintenance system along similar lines to the health service provision already existing in your country. For instance, if the health system is predominantly run by the government, it is probably simplest to let the government run the maintenance organization as well. In contrast, if private organizations run the health services, it makes little sense for the maintenance activities to be carried out by a government body. In the majority of cases, a mixed system is most likely.

However, the government may wish to take a regulatory role and establish regulations that will guarantee that healthcare technology performs effectively, accurately, and safely. The rules established should be valid for all health service providers, irrespective of their type of organization – applying equally to centralized and decentralized public health systems, private health providers, or NGOs running their own health services.

Country Experiences

Some countries, such as Germany and Austria, have introduced a medical products law (Medizinproduktegesetz) which regulates that planned preventive maintenance (PPM), and many other healthcare technology management activities, must be undertaken in order to guarantee the safety of medical products. An advantage for maintenance departments is that as a result finances are automatically allocated for PPM as it is prescribed that it must be undertaken. Such examples of strict regulations are a crucial pre-requisite for the safety of medical products, provided that they can be enforced.

Details of how maintenance is organized would not need to be prescribed by the regulatory body. Instead, it is up to individual health service providers to decide how maintenance activities are to be delivered. Maintenance services can be organized in many different ways. However, the nature and the complexity of some maintenance services often call for partnerships between the public and private health service providers. Partnerships may also exist between health service providers and private sector sources of maintenance support. Such partnerships are discussed further in *Sections 3 and 4*.

To provide maintenance services, you will normally need to establish good links between maintenance workshops. This will create a network that supports the needs of all your health facilities. Maintenance is, of course, only one of many HTM activities that need to be carried out. However, the fact that maintenance workshops usually already exist in most countries serves as a useful starting point for establishing a physical HTM Service across your health service provider organization and across your country (*Section 5*).

2.3.4 Finances

To ensure that healthcare technology is utilized effectively and safely throughout its life, your health service provider will need to plan and allocate adequate budgets. These budgets need to cover all expenditure requirements:

- Capital investment for new and replacement equipment, as well as training.
- Recurrent costs for consumables, maintenance, administration, etc.

Guide 2 of this Series provides advice on how your health service provider can plan and budget for all activities relating to your healthcare technology.

In a government-organized system these funds are mainly provided by government budgets, while private systems or mixed systems must generate the required funds from their customers, or from benefactors and donors (see *Box 4*).

Depending on your health service provider and country, your HTM Service may be able to generate income by charging for services provided. Whether this income can be used to further improve the HTM Service depends on the policies of the responsible financing authority, such as the treasury (in the government sector) or a central finance office. *Guide 6* of this Series provides advice on how to manage the finances of the HTM Service, including the possibilities for generating income.

Experience in Malawi

The government of Malawi has recognized that the establishment of a National Physical Asset Management System is crucial, in order to meet the objective of the National Health Plan 'to improve efficiency and equity in resource allocation'.

As a first step, the Ministry of Health and Population in 1998 created a Physical Assets Management Division within the Department of Health Technical Support Services. In November 2002, as a next important step, the Malawi National Health Physical Assets Policy was launched. This comprehensive policy regulates the organizational structure of physical assets management, the planning and budgeting of funds for maintenance activities, equipment procurement policies including donation policies, maintenance management guidelines, information policy, and staff development.

The policy specified a referral system under the Physical Assets Management Division consisting of three regional maintenance units at strategic locations in the country (Lilongwe, Blantyre, and Mzuzu). These regional maintenance units are responsible for healthcare technology management (including inventories, planning, repair, etc) in all health facilities. Their maintenance and repair attention is especially targeted at equipment that requires special skills, test equipment, and tools not usually available at health facilities. Below the regional maintenance units, hospital maintenance units are to be established at central and district hospitals. Hospital maintenance units will carry out maintenance and repair services on buildings, plant and utilities for all facilities in their respective catchment areas.

Box 9 outlines the issues to consider if you wish to improve aspects of your Healthcare Technology Policy.

BOX 9: A Checklist for Improving Your Healthcare Technology Policy

Check whether the following requirements have been met by your country:

Existence of a policy

- Does your government have a National Healthcare Technology Policy?
- Are there regulations that require your health service provider to follow the national policy?
- Has your health service provider developed its own Healthcare Technology Policy?
- Does your policy cover all healthcare technology management activities?
- Does your policy cover the necessary organizational structure for an HTM Service?

Check whether the following aspects are adequately covered in your policy:

Developing a vision

- Has your health service provider established a vision for its health services, which details the type of healthcare to offer at each level?
- Does this vision conform to the national vision for health services?
- Is the vision used to help you plan what healthcare technology your health service provider should own?

Standardization strategies

- Has your health service provider set up policies to introduce an element of standardization in the purchase of healthcare technology (equipment and equipment-related supplies)?
- Is your standardization policy closely linked to the international or national standards set by your government for healthcare technology (equipment and equipment-related supplies)?
- Has your health service provider introduced systems which ensure that even items supplied through foreign aid and donations also meet your standards, as well as your standardization and purchasing policies?
- Does your standardization policy conform to the standardization strategies of government, and other health service providers in your country?

Continued overleaf

BOX 9: A Checklist for Improving Your Healthcare Technology Policy (continued)

Providing maintenance

- Does your government require that maintenance takes place, in order to ensure the continuous effectiveness and safety of healthcare technology?
- Does your health service provider, therefore, provide sufficient resources so that maintenance can take place?
- What sanctions are imposed if maintenance does not take place?
- What different maintenance organizations are involved in assisting health services in your country, and what activities do they undertake?
- Are all health facilities in your country being supported by these national maintenance organizations?
- Are the staff in your health facilities sufficiently qualified to undertake maintenance?
- Does your health service provider collaborate with other agencies in order to provide maintenance?
- What are the major constraints to maintenance in your health service provider organization?

Finances

- Does your health service provider have adequate capital and recurrent budgets for all healthcare technology management activities, such as planning, procurement, operation, maintenance, training, safety, disposal?
- Does your health service provider finance the running of an HTM Service?
- Do these funds come from government budgets, or do you generate the required funds from customers/donations?
- Can your HTM Service generate income?
- Can this income be used to further improve the HTM Service?

2.4 THE IMPORTANCE OF INTRODUCING A HEALTHCARE TECHNOLOGY MANAGEMENT SERVICE

We have established the importance of:

- adopting standards for healthcare technology, in order to ensure they are safe and perform effectively (*Section 2.2*)
- developing healthcare technology policies which cover all aspects of healthcare technology management activities (*Section 2.3*)
- establishing systems to ensure the policy is implemented (*Section 2.3*).

All these aims could be achieved if each health service provider practised healthcare technology management (HTM) as part of the everyday life of their health service. The best way to do this is to have an HTM Service incorporated into each health service provider organization.

Box 2 (*Section 1.1*) shows that HTM provides a wide range of benefits. It helps you to provide quality health services and meet health service standards by, for example:

- ensuring the safety of equipment
- developing operational skills
- disposing of equipment without harming the environment
- planning equipment purchases that are cost-effective
- running services economically.

It is difficult to express this in financial terms, but *Box 10* gives an idea of the sort of savings that can be made if HTM is effectively carried out.

BOX 10: Savings Derived from Effective Healthcare Technology Management

Problems that effective HTM could avoid	Resulting waste you could save
Policy/planning:	
◆ lack of standardization	◆ 30–50% additional cost for extra spare-parts and extra maintenance workload
◆ purchase of sophisticated equipment for which operating and maintenance staff have no skills	◆ 20–40% of equipment remains underutilized or unused
Procurement:	
◆ impact on equipment and buildings during installation, unforeseen at the initial tender stage	◆ extra modifications or additions required for 10–30% of equipment
◆ inability to correctly specify and foresee total needs when tendering and procuring equipment	◆ 10–30% additional unplanned costs
Training:	
◆ improper use of equipment by operating and maintenance staff	◆ loss of 30–80% of the potential lifetime of equipment
Operation and maintenance:	
◆ excessive equipment down-time due to absence of preventive maintenance, inability to repair, and lack of spare parts	◆ 25–35% of equipment out of service

Adapted from: Mallouppas, A, 1986, 'WHO: Strategy and proposed action concerning maintenance of hospital and medical equipment', WHO, Geneva, unpublished document

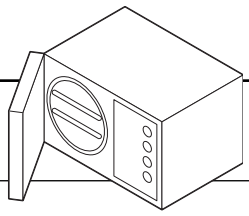
Taking maintenance as an example, we can examine the benefits of carrying out effective healthcare technology management in greater detail. Maintenance not only has a positive impact on the safety and effectiveness of healthcare technology, but also has two important economic benefits:

- It increases the lifetime of equipment and thus helps to save scarce investment resources.
- It enhances the demand for health services, since demand for services is crucially dependent upon the availability of functioning healthcare technology.

Healthcare technology that is out of order quickly leads to a decline in demand, which will in turn reduce the income and quality of services of the health facilities. You will lose clients if, for example, it becomes known that malfunctioning of sterilization equipment may endanger the health of the patients. Similarly, patients will avoid visiting health facilities that do not possess functioning diagnostic equipment.

Box 11 provides two examples that illustrate the financial benefits of extending the lifetime of equipment as a result of proper maintenance.

BOX 11: The Financial Benefit of Maintaining Equipment

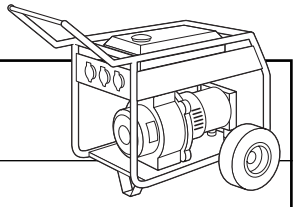


Example 1: An electrically operated autoclave, horizontal bench-top model

With maintenance	Without maintenance	Effect
◆ Average lifetime is 12 years if properly maintained	◆ Obsolete after 5 years according to a study by the German Technical Cooperation Agency (GTZ)[1]	◆ Without maintenance, you lose 7 years of potential life of the equipment.
◆ One new autoclave is required after 12 years = US$3,500	◆ 2.4 new autoclaves required over that 12 year period = US$8,400	◆ Maintenance allows you to postpone reinvestment for 7 years. Without maintenance the additional autoclaves you require over that period = US$4,900.
◆ Maintenance of medical equipment (such as this model with sophisticated electronic controls) requires an average of 5% of purchase price per year = US$2,100 over 12 years	◆ No cost incurred for maintenance	◆ Maintenance costs are less than the cost of the additional replacement autoclaves required if no maintenance is carried out.
◆ Total cost = US$5,600	◆ Total cost = US$8,400	◆ Even when funding maintenance, you still obtain considerable economic benefit =US$ 2,800.

Continued opposite

BOX 11: The Financial Benefit of Maintaining Equipment (continued)



Example 2: A stand-by generating set, 8 kVA petrol model

With maintenance	Without maintenance	Effect
◆ Average lifetime is 15 years if properly maintained	◆ Obsolete after 7.5 years	◆ Without maintenance, you lose half the potential life of the equipment.
◆ One new generating set is required after 15 years = US$6,500	◆ 2 new generating sets required over that 15 year period = US$13,000	◆ Maintenance allows you to postpone reinvestment for 7.5 years. Without maintenance the additional generating set you require over that period = US$6,500.
◆ Maintenance of plant (such as a quite sensitive petrol model which needs regular maintenance) requires an average of 4% of purchase price per year = US$3,900 over 15 years	◆ No cost incurred for maintenance	◆ Maintenance costs are less than the cost of the additional replacement generating set required if no maintenance is carried out.
◆ Total cost = US$10,400	◆ Total cost = US$13,000	◆ By undertaking maintenance you obtain a net saving = US$2,600.

Since foreign exchange is very precious in developing countries and local currencies depreciate against hard currencies all the time, such savings are even more valuable.

1. H. Halbwachs, 2000, 'Maintenance and life expectancy of healthcare equipment in developing economies', Health Estate Journal, Vol.54, No.2, p. 26-31, Portsmouth, UK

Thus, the justification for introducing an HTM Service is that it will benefit you economically and clinically, by ensuring that healthcare technology continues to meet the standards required throughout its working lifetime.

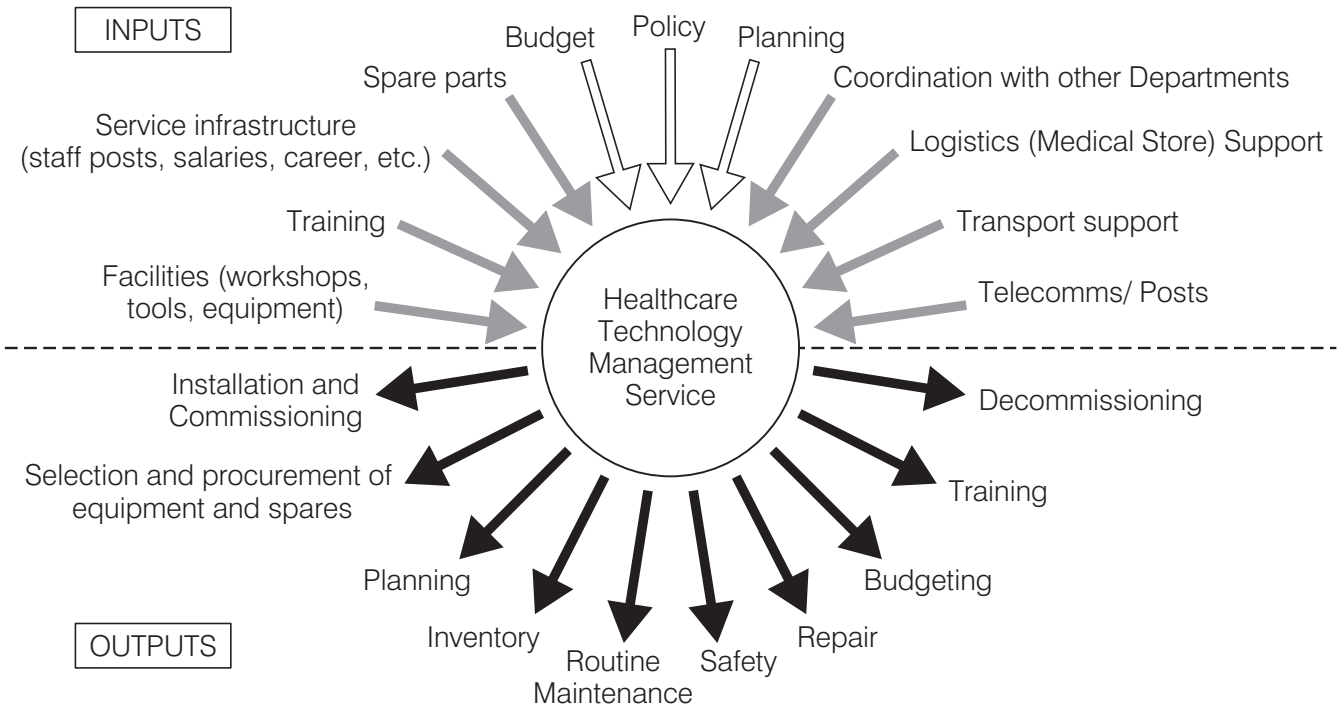
The activities of an HTM Service belong to the service provision function of health systems (*Section 2.1*). However, the government may wish to take a regulatory role and establish regulations that guarantee that HTM occurs. To achieve this, it will be necessary to have:

- a government body to provide regulations which will ensure the continued performance and safety of healthcare technology throughout its life
- a control mechanism to check that all health service providers pursue these healthcare technology management activities effectively
- legal or other sanctions that are enforceable if the rules are infringed.

The government body responsible for providing regulations could be the central level of a national HTM Service. Each health service provider could then develop its own HTM Service. It should involve a network of teams and committees that enable HTM to be practised in all facilities. The process for developing such an HTM Service is discussed in the remainder of this Guide.

In order to establish an effective HTM Service, you will need to provide sufficient inputs. Only in this way will you get the outputs and benefits that you require. *Figure 5* illustrates these requirements.

Figure 5: HTM Service Inputs and Outputs



Source: WHO, 1987, 'Inter-regional meeting on the maintenance and repair of health care equipment: Nicosia, Cyprus, 24–28 November 1986', Geneva, Switzerland, WHO/SHS/NHP/87.5

Box 12 outlines the issues to consider if you wish to see how important an HTM system is to your country and organization.

BOX 12: A Checklist for Understanding the Importance of HTM to Your Country and Organization

Check whether the HTM system existing in your country meets the following requirements:

- Has your government set up regulations that require health facilities to undertake healthcare technology management?
- Is there a government HTM Service whose central level provides guidance on HTM activities?
- Does your government demand that private and non-governmental health service providers also practise HTM?
- Has your government set up mechanisms that fine, sanction or sue health facilities that do not provide efficient and safe healthcare technology?
- Does your health service provider have its own HTM Service made up of a network of teams and committees?
- Does your health service provider allocate sufficient resources for the implementation of HTM activities in its own facilities?

2.5 HOW TO MANAGE CHANGE

The regulatory requirements presented in this Section may appear somewhat idealistic, compared to the reality in many health systems. However, the aim is not to highlight the deficiencies of existing systems, but to provide a blueprint for a functioning healthcare technology management system. Hopefully, this will enable you to get the right framework conditions in place, and thus improve the effectiveness and the safety of your health services.

We are **not** recommending that your health service provider:

- throw out all their current HTM strategies and start again
- make sudden and sweeping changes that are likely to fail if they are over-ambitious.

Rather, it is better to take a step-by-step approach, introducing changes gradually, with a careful review process. To implement an HTM system with all the complexities described in this Series of Guides will take several years, and to try to achieve everything at once could be disastrous. However for healthcare technology management to improve, it is important to act.

It is possible to write down all the correct procedures and yet still fail to improve the performance of staff. To ensure that your HTM procedures are effective, it is important for there to be good managers who can find ways to motivate staff (*Sections 6 and 7*). Simply ordering staff to implement new procedures usually does not work. It is much better to discuss and develop the procedures with the staff who will implement them. This could take the form or discussion, working groups or training workshops. People who are involved in developing ideas about their own work methods are more likely to:

- understand the objectives
- understand the reasons why processes are necessary
- be encouraged to change their way of working
- be more interested in making changes which result in improvement
- see that the aim of the HTM procedures is to improve their delivery of healthcare.

We recognize that many readers will face difficulties such as staff shortages, poor finances, lack of materials, a lack of influence and time, and possibly even corruption. Introducing new rules and procedures into a system or institution that has no real work ethic, or which possibly employs dishonest workers, will not have any significant effect.

Therefore, strategies may be required to bring about cultural and behavioural change. For example:

- When materials are short, instead of focussing upon breakages and loss, place more emphasis upon the importance of staff working hard and putting in the hours.
- Favour good managers who are seen to be present and doing what they preach.
- Encourage an atmosphere where staff are praised for good work, rather than a culture of judgement and criticism.

Introducing rules and administrative procedures alone will not be sufficient to bring about cultural change. You will also need to find ways of increasing performance and productivity, and acknowledging/rewarding good behaviour is essential. For example:

- it is better to break a tool while actively undertaking maintenance, rather than breaking nothing but never doing any work
- it is better to break a rule in an emergency (such as withdrawing stocks from stores), rather than stick to the rules and risk the possible death of a patient.

Annex 2 has some examples of useful reference materials. To bring about such changes, you will require skills in:

- managing change
- staff motivation
- effective communication
- encouragement, and
- supportive training with demonstrations.

All parties involved in the network of HTM Teams and HTM Working Groups need to participate in developing the HTM Service. This will encourage a sense of ownership of the Service and its responsibilities, and will lead to greater acceptance and motivation among staff. If you are short of skilled staff (such as technicians, managers, planners or policy-makers), you may need to obtain specialist support to assist with some of these tasks.

Box 13 outlines the issues to consider if you wish to improve the management of change within your organization.

BOX 13: A Checklist for Improving Your Ability to Manage Change

Check whether your organization meets the following requirements:

- As a staff member in your organization, in your opinion, do you face problems with shortages of staff, finances, and materials, a lack of influence and time, or corruption?
- In your opinion, is there no real 'work ethic' in your organization?
- Does your health service provider employ strategies to bring about cultural and behavioural change, in order to improve performance and productivity in your organization?
- To develop and introduce rules and procedures, does your health service provider use strategies such as discussion, working groups, and training workshops with the staff that will implement them?
- Does your organization have skills in managing change, staff motivation, effective communication, encouragement, and supportive training with demonstrations?
- Did all parties involved in the network of healthcare technology management teams and working groups (committees) participate in developing the HTM Service?
- Does your health service provider introduce changes gradually, step-by-step, with a careful review process?

Box 14 contains a summary of the issues covered in this Section.

BOX 14: Summary of Issues in Section 2 on Framework Requirements

Regulatory Role	**Government**	◆ actively regulates health services whether they are delivered by public providers, private providers, or a mixture of the two ◆ develops checking systems and legal sanctions for infringement of health regulations
	Public or quasi-public bodies	◆ enforce government regulations
	All Health Service Providers	◆ conform to regulations and guidelines provided by government

Continued overleaf

BOX 14: Summary of Issues in Section 2 on Framework Requirements (continued)

Establish Standards	**Government**	◆ adopts suitable standards for quality health services, including those for: - procedures and training of personnel - construction and operation of health facilities - supply and use of healthcare technology, drugs, and supplies - safety and environmental issues - quality management ◆ specifically for healthcare technology, adopts standards for: - design, development, and manufacturing - performance and safety - use and training - waste disposal ◆ develops donor regulations to ensure all equipment received through foreign aid and donations also complies with the standards ◆ establishes a supervisory body to enforce the standards
	All Health Service Providers	◆ conform to the standards set by government
Develop Policy	**Ministry of Health**	◆ develops national policies for health services ◆ specifically develops a Healthcare Technology Policy to cover all healthcare technology management activities including: - a vision of the function of each level of healthcare delivery - an element of standardization in equipment purchases and donations - provision of maintenance through partnerships between public and private bodies - provision of finances for all HTM activities (capital and recurrent) - the organizational structure for an HTM Service (*Section 5*) ◆ regulates on these issues (if required) ◆ establishes a system that ensures the policies are implemented
	Other Health Service Providers	◆ follow the policies of the Ministry of Health if regulated to do so ◆ develop their own internal Healthcare Technology Policy and expand strategies on a vision, standardization, provision of maintenance, finances, and an HTM Service ◆ establish a system that ensures the policies are implemented
HTM Service	**Ministry of Health**	◆ develops an HTM Service made up of a network of HTM Teams and HTM Working Groups (*Sections 3 to 7*) ◆ uses the central level of the HTMS as the national regulatory body, if necessary ◆ provides sufficient inputs to ensure the HTMS is effective
	Other Health Service Providers	◆ develop their own HTM Service made up of a network of HTM Teams and HTM Working Groups (*Sections 3 to 7*) ◆ follow MOH regulations concerning the HTM Service if regulated to do so ◆ provide sufficient inputs to ensure the HTMS is effective
Manage Change	**All Health Service Providers**	◆ implement strategies to develop skills in managing change, staff motivation, effective communication, encouragement, and supportive training with demonstrations ◆ introduce rules and procedures using discussion, working groups and training workshops, with the staff that will implement them ◆ include all parties involved in the network of HTM Teams and HTM Working Groups in the development of the HTM Service ◆ introduce changes to the HTMS step-by-step, with a careful review process.

3. HOW TO DETERMINE YOUR TECHNICAL REQUIREMENTS

Why is This Important?

Very often health facilities fail to introduce healthcare technology management because they believe the technical requirements are too difficult. However, if we break down the technical requirements into different levels of complexity, we can see that many tasks can already be undertaken with relatively limited skills. We can also determine which activities are too complex for health service technical staff with few qualifications, and what the workload implications might be.

The following presentation will help you to evaluate the technical requirements of your particular health facility, and for different levels of the health system.

To help you design your HTM Service, we need to consider the technical requirements for each level of healthcare delivery.

In this Section, the term 'technical requirements' refers to:

- the range of activities involved in healthcare technology management
- the different types of technical staff required to complete this range of tasks – such as, general member of health staff trained to carry out maintenance activities (handyman), artisan, technician, technologist, engineer, manager (see *Section 6* for an explanation of these terms)
- the maintenance (preventive) and repair (corrective) needs of different types of technology
- the workload due to the different tasks.

This Section investigates these needs by looking at:

- a summary of technical requirements for HTM (*Section 3.1*)
- skill requirements (*Section 3.2*)
- workload (time) requirements (*Section 3.3*).

3.1 A SUMMARY OF TECHNICAL REQUIREMENTS FOR HTM

As *Figures 3 and 5* show, healthcare technology management covers a wide range of activities. Here are just some of them:

- providing technical advice
- selection and procurement
- training users and maintainers
- maintenance and repair work
- decommissioning and disposal
- managing staff
- managing the inventory
- managing waste
- planning and costing work
- installation and commissioning
- operating equipment
- monitoring contracts
- managing workshop facilities
- record-keeping
- stock control of parts, consumables, etc
- implementing safety protocols.

All these activities require different technical skills. It is important, first, to determine the particular skills required for the various different activities, at each level of healthcare delivery. Next, you need to consider the workload required for different skill levels. This will help you to decide how to provide the HTM services required (*Section 4*).

Who Should Calculate the Technical Requirements?

Preference

The expertise of technical staff should be used to determine the skill and workload requirements for HTM activities.

Who?		Takes what action?
Senior technical staff or existing HTM Teams (*Section 1.1*)	→	Should study and estimate these requirements, then pass the information on to senior planners so that the model and organizational structure for the HTM Service can be designed (*Sections 4 and 5*).
Which level?		**Takes what action?**
All levels of technical staff working together	→	Central level staff should take responsibility and collaborate with staff at region/district and facility level, to estimate these requirements.

Tip

- The calculation of skills and workload requirements will only be of use if central planners commit to providing HTM Teams with sufficient resources (such as spare parts and transport) to carry out the identified workload.

To assist with this estimation process, HTM staff need to use *Sections 3.2 and 3.3* to help them determine the skill and workload requirements for HTM activities.

3.2 SKILL REQUIREMENTS AT DIFFERENT LEVELS OF THE HEALTH SYSTEM

3.2.1 Understanding the Skill Requirements

Since maintenance and repair tasks require the greatest amount of technical skills we will concentrate on them here as a key example. A brief summary for other healthcare technology management skills is also given, that you can then expand upon.

Maintenance Skills

For simplicity, the term 'maintenance' is used to cover both the preventive maintenance tasks and the corrective repair tasks that are required.

It is important to maintain all healthcare technology, including medical equipment, plant, service supply installations, the fabric of buildings, vehicles, office equipment, and furniture. This may not be limited to those items of equipment found in health facilities, but could also include those in staff accommodation and training facilities.

Failure to appropriately maintain the physical assets of the health service is often blamed on lack of financial resources, lack of qualified personnel, or organizational and managerial deficiencies. These reasons would be perfectly understandable if very sophisticated equipment was being used, as this would require highly skilled staff and expensive spare parts. The reality, however, is that only a very limited percentage of equipment is that sophisticated.

The argument that maintenance is too costly can be countered by looking at the specific maintenance and repair requirements of your health facility. There are likely to be different technical levels of skills required, depending on the type of maintenance problem and the types of healthcare technology you use, as shown in *Box 15*.

BOX 15: Skill Levels Required According to Maintenance Needs

Level of complexity	Type of technology and maintenance task	Service provision by:
Skill level 1	Basic maintenance tasks on basic equipment – for example, oiling castors on beds. Basic maintenance tasks on more complex technologies – for example, cleaning and replacing the air filter of an infant incubator.	Equipment users, with training – clinical, medical and paramedical staff, general health personnel, plant operators, attendants, patients, in-house maintainers, patient caretakers, administrative staff, drivers. Local artisans – private sector artisans and in-house artisans.
Skill level 2	Medium-level maintenance tasks on basic equipment – for example, adjusting scale balances. Medium-level maintenance tasks on more complex technologies – for example, checking the integrity of electrical grounding.	In-house craftspeople and technicians – maintainers with polyvalent skills (in other words, skills that cover a range of engineering disciplines).
Skill level 3	High-level maintenance tasks on medium-level technologies – for example, overhauling the hydraulic system of an operating table. High-level maintenance tasks on more complex technologies – for example, fault-finding problems with diathermy machines.	Maintenance specialists – technologists, engineers.
Skill level 4	Sophisticated-level maintenance tasks on high-level technologies – for example, calibrating flowmeters on anaesthetic machines. Sophisticated-level maintenance tasks on sophisticated technologies – for example, repairing CT scanners.	Specialized firms – manufacturers' representatives, independent private companies.

Depending on the size of your health facility, a broad spectrum of skills may be required to cover the maintenance needs for the whole range of equipment. However, not all of these skills need to be permanently present and some may be required only very rarely. Thus, it is often more cost-effective for specialists to be spread across a number of different facilities, rather than devoting all their time to the needs of one facility. These workload issues are discussed in *Section 3.3*.

The various different skill levels for maintenance can be further defined as follows:

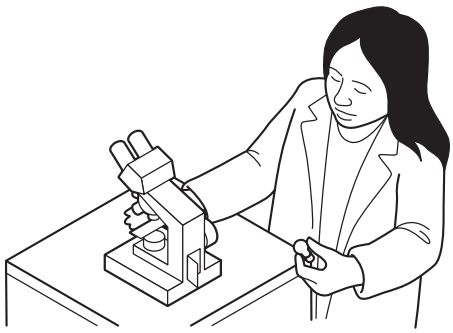
Skill Level One – Semi-skilled

The skills required at this level are simple, so maintenance can be carried out:

- either by local private sector artisans and any in-house ones
- or, often, by the equipment users themselves, with some additional training.

Examples of these kinds of maintenance activity include:

- changing an ophthalmoscope bulb
- changing cracked tubing
- changing a compressor's engine oil
- replacing a tap washer
- replacing the castors on a wheelchair
- replacing rubber seals on sterilizers
- changing a microscope bulb.

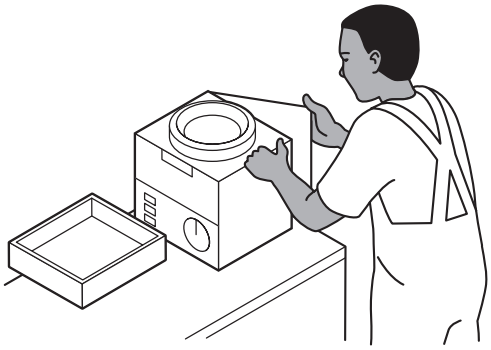


Skill Level Two – Skilled

The tasks at this level require some further skills which existing in-house technical staff may have (such as craftspeople and technicians with informal training, certificates, or diplomas). If they do not have these skills, they can be relatively easily taught via retraining programmes.

The trained staff can then work as 'polyvalent' maintainers (with multi-disciplinary engineering skills) for these medium technology tasks. Examples of this type of maintenance activity include:

- replacing a heating element in an autoclave
- replacing brushes in a centrifuge
- checking the mechanical integrity of items such as switches, controls, connectors, and meters in any equipment.



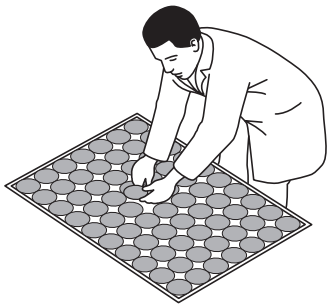
Tip

- Maintenance activities at both skill levels one and two can often be carried out by existing staff within the health facility, without the need to hire new or highly trained staff. In spite of this, very often these tasks are ignored by health management teams, claiming a lack of staff or financial resources. This situation can be resolved by securing the required funds and establishing a retraining programme for existing staff.

Skill Level Three – Highly Skilled

These jobs should be reserved for highly skilled maintenance specialists (technologists, engineers). They would normally require:

- either a higher national diploma (HND) or degree in a suitable engineering subject (such as electronics or mechanics) which they have applied to the work in the health service
- or an HND or degree in clinical or hospital engineering, if a dedicated course is available.



Examples of this type of maintenance activity include:

- calibrating the light source of a photometer
- fault-finding problems with autoclaves
- replacing photocells on solar panels
- replacing rubber fittings on anaesthetic machines.

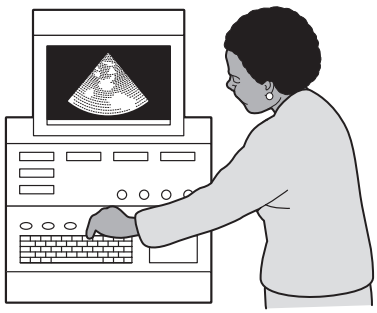
Tip

- If your facility does not have the resources to employ such a specialist, you could consider getting together with other health facilities to jointly run a maintenance service with specialists. For example, in some countries, specialists at large central facilities also provide sophisticated services to smaller facilities. In others, the specialists might be based at district or regional workshops and care for all facilities in their area. *Sections 4 and 5* discuss various options for the organization of such services.

Skill Level Four – Specialized

The maintenance skills required for level four activities are so specific that they cannot be performed by technologists or engineers who work in multi-disciplinary maintenance services. Instead they require the intensive training and experience that comes from specializing on particular equipment makes and models. Very often, these services can only be provided by:

- either the equipment manufacturers and possibly their representatives in your country
- or independent private sector maintenance companies.



Examples for this type of maintenance activity include:

- repairing MRI equipment
- resolving computer software problems
- repairing ultrasound machines.

Other HTM Skills

Alongside maintenance skills each level of healthcare delivery will have varying needs for skills for other HTM activities. These are the types of skills used to manage issues such as work, equipment, people, and money. These requirements are discussed further in *Section 5* on responsibilities, and in the job descriptions provided in *Annex 3*. Examples of the skills required can be defined briefly as follows:

At Skill Level One

The following sorts of activities are required:

- planning the work and materials required
- keeping a record of work
- reading manuals and drawings
- training equipment users.

At Skill Level Two

In addition to the tasks at skill level one, activities such as:

- making work schedules and drawings
- advising on selection and procurement
- planning and costing work
- training other maintenance staff
- monitoring and ordering stores
- monitoring contracts.

At Skill Level Three

In addition to the tasks at skill level two, activities such as:

- managing the equipment database
- financial management
- installation and commissioning
- writing reports and keeping statistics
- managing and supervising other technical staff.

At Skill Level Four

It is unusual to hand over control of the other HTM activities relating to management of work, equipment, people, and money to private sector companies (except when you have asked them for help with installation, commissioning, and training). Thus for other HTM activities, the skills at level four are required by your most senior technical staff at the central level of your health service provider organization. In addition to the tasks at skill level three, they will take on overall planning and supervising roles, including the development of contractual relationships with the private sector (*Section 4.1*).

3.2.2 Determining Your Skill Requirements

It is useful for you to determine what your own skill requirements are at your particular health facility. A number of countries have used their equipment inventories to help make a methodical calculation of the skills requirements for each type of health facility. To do this, you would:

- look at the different types of equipment you own in your facility or service level
- for each type of equipment, determine the maintenance tasks required under the four skill levels, using your experience of:
  - typical operator errors
  - common problems and repairs
  - planned preventive maintenance needs
- assess the other HTM activities required at each skill level for your facility or service level
- lay out the information in some form of spreadsheet.

By carrying out this process, you will begin to see the number of tasks required at each of the four skill levels. The process of translating this into workload requirements is discussed in *Section 3.3*.

Tip

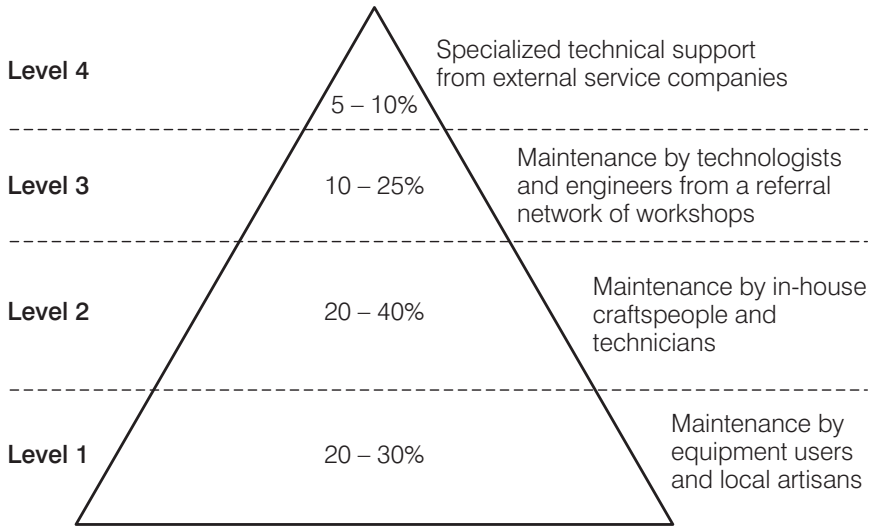
- One advantage of having an equipment inventory, is that you can use it to forecast your budget, manpower, contract, spare parts, and replacement needs. For more information on preparing and using equipment inventories, see *Guide 2* on planning and budgeting.

3.3 WORKLOAD REQUIREMENTS

3.3.1 Understanding the Workload Requirements

Box 15 (*Section 3.2*) describes a wide variety of skills to cover the maintenance needs for the whole range of equipment. However, not all of these skills need to be permanently present in your health facility, and some may be required only very rarely. *Figure 6* provides an illustration of how much of the maintenance work is undertaken at each skill level, across your whole health service (not necessarily at each health facility).

Figure 6: Division of Maintenance Work by Skill Level in the Health Service



Adapted from: Raab, M, 1999, 'Maintenance strategies', Swiss Center for International Health, Basel, Switzerland, August 1999

Figure 6 shows us that, as the skill level increases, the workload for the maintenance required decreases. As much as 40–70 per cent of the maintenance requirements for your health service could be undertaken by people with skill levels one and two (equipment users, existing in-house craftspeople and technicians, and artisans). Technologists and engineers are only required for about a quarter of the work, and specialist private sector support is required rarely. Thus, in order to make maximum use of resources, the more expensive specialists should be shared across your health service in such a way that their skills are put to good use and benefit as many facilities as possible. A suitable organizational structure for achieving this within the HTM Service is discussed in *Section 5*.

Also, as the skill level increases, the workload includes a greater amount of the other HTM activities, as shown in *Box 16*.

BOX 16: Possible Division of Time Between Maintenance and Other HTM Activities (Section 3.2.1)

Skill level one – equipment users, private sector and in-house artisans	80% on maintenance 20% on other HTM activities
Skill level two – craftspeople and technicians	70% on maintenance 30% on other HTM activities
Skill level three – technologists and engineers	60% on maintenance 40% on other HTM activities
Skill level four (specialized maintenance) – specialized firms	80% on maintenance 20% on other HTM activities
Skill level four (other HTM activities) – central level managers	20% on maintenance 80% on other HTM activities

3.3.2 Determining Your Workload Requirements

To determine your workload requirements, you first need to consider the hours required for carrying out the HTM activities. Next, you need to analyze the implications in terms of staff numbers.

Hours Required for the Tasks

Using *Section 3.2.2* you can break down the technical tasks for your health facility or service level, according to their level of complexity and the skills required to perform them. Armed with this information, you can now calculate the probable working hours required to carry out these HTM activities.

Look at the typical problems and work requirements you identified in *Section 3.2.2*, and consider the typical time it takes to attend to them. This is a useful tool for HTM Managers as it can be used to convince planners of the need for different types of staff (*Section 6*).

As an illustration, below we have given some examples based on a large number of samples of government and mission facilities in various West and East African countries. The hours required for maintenance were calculated by considering all the likely problems which could occur.

In *Box 17*, the amount of time required for the maintenance of a sample of different equipment is calculated for a typical health centre (a small facility with several beds – see *Annex 1*). Time estimates are also given for the other HTM activities, using the percentages from *Box 16*.

Box 18 presents the situation for a typical 100-bed district hospital. Thus, these boxes reflect **primary care requirements**.

We recognize that the size of your country, health system, and health service provider will affect the size of your health facilities and their equipment contents. A health centre in one country may require the same amount of equipment as a small hospital in another. Our equipment contents for a 100-bed district hospital may be suited to a smaller hospital in some countries, or a secondary level facility in others. However, the figures given in *Boxes 17 and 18* are intended to provide you with a realistic example of typical equipment needs.

In *Boxes 17 and 18,* we have grouped together a selection of major equipment items and maintenance needs, under the generic heading 'technical functions'. This is not intended to be an exhaustive list, but provides an example of some typical maintenance needs. To determine the needs of your own health facility, you would need to carry out your own inventory identifying your specific equipment and maintenance requirements.

However, the examples here provide a useful illustration of the different technical needs of such facilities, and the trends in workload. In particular, they are useful in highlighting the fact that most technical tasks required are at the lower (less skilled) levels.

BOX 17: Samples of Estimated Hours per Year at Each Skill Level for HTM at a Typical Health Centre

Health centre (typical, several beds)					
		Hours per year (estimated)			
		Skill level 1	**Skill level 2**	**Skill level 3**	**Skill level 4**
A. MAINTENANCE					
Technical functions	*Sample equipment*				
Facilities, infrastructure					
Building structures	*Roofing, furniture*	28	8		
Power supply	*Generators, solar plants*	2	4	6	
Water supply, sewerage	*Storage tanks*	8	4		
Sanitation	*Latrines*	16	8		
Waste management	*Incinerators*	6	18		
Equipment for basic medical services					
Sterilization	*Autoclaves*	8	8		
Cooling, air condition.	*Refrigerators*	6	16		
Basic diagnostic eqp.	*Sphygmomanometer*	4	8		
Basic laboratory eqp.	*Microscopes*	4	4	6	
Sub-total maintenance hours/year 172		**82**	**78**	**12**	**0**
B. OTHER HTM ACTIVITES *(Section 3.2.1)*					
Work hours (based on percentage of work time, as shown in *Box 16*)		21	34	8	0
Total hours/year 235		**103**	**112**	**20**	**0**

The findings from *Box 17* for a typical health centre are that:

Total maintenance needs for the sample:

Skill level one	=	48% of the total	=	82 hours
Skill level two	=	45% of the total	=	78 hours
Skill level three	=	7% of the total	=	12 hours
			=	172 hours per year

Conclusions:

- 93 per cent of the maintenance requirements of a typical health centre are at the first and second skill level and could be performed by equipment users (with some additional training), private sector artisans, or retrained health service craftspeople and technicians.

- Only seven per cent would require skills of the third level (in order to undertake work such as servicing the microscopes and the power generating equipment).
- No skills at the fourth level are required.

Box 18 shows the example of a typical 100-bed district hospital. Here, the maintenance needs are much more extensive.

BOX 18: Samples of Estimated Hours per Year at Each Skill Level for HTM at a Typical 100-Bed District Hospital

District hospital (typical 100-bed)					
		Hours per year (estimated)			
		Skill level 1	**Skill level 2**	**Skill level 3**	**Skill level 4**
A. MAINTENANCE					
Technical functions	*Sample equipment*				
Facilities, infrastructure					
Building structures	*Roofing, furniture*	960	192	14	
Power supply	*Generators, solar plants*	170	425	42	
Water supply, sewerage	*Storage tanks*	100	300	13	
Sanitation	*Latrines*	120	120	8	
Waste management	*Incinerators*	160	50	4	
Equipment for basic medical services					
Sterilization	*Autoclaves*	120	120	20	
Cooling, air condition.	*Refrigerators*	12	26	2	
Basic diagnostic eqp.	*Sphygmomanometer*	48	100	16	
Basic laboratory eqp.	*Microscopes*	20	120	20	
Basic surgical eqp.	*Suction pumps*	20	40	15	
Sophisticated equipment for treatment and diagnosis					
Surgery	*Operation table*	8	92	20	
Anaesthesia	*Anaesthesia app.*	4		30	20
Obstetrics	*Foetal heart detector*	4	16	8	
Gynaecology	*Ultrasound equipment.*	6		10	14
Ophthalmology	*Slit lamp*	4		24	24
Laboratory	*Photometer*	8		8	
Radiology	*X-ray apparatus*	16		24	56
Other hospital support services					
Transport	*Vehicles*	300	500	20	
Communication, data processing	*Telephone system*	35	145	7	
Technical department	*Measuring equipment*	12	80	16	
Sub-total maintenance hours/year	**4,888**	**2,127**	**2,326**	**321**	**114**
B. OTHER HTM ACTIVITIES *(Section 3.2.1)*					
Work hours (based on percentage of work time, as shown in *Box 16*)		532	997	214	456
Total hours/year	**7,087**	**2,659**	**3,323**	**535**	**570**

The findings from *Box 18* for a typical 100-bed district hospital are that:

Total maintenance needs for the sample:

Skill level one	=	44% of the total	=	2,127 hours
Skill level two	=	48% of the total	=	2,326 hours
Skill level three	=	7% of the total	=	321 hours
Skill level four	=	2% of the total	=	114 hours
			=	4,888 hours per year

Conclusions:

- The majority of maintenance requirements relate to the two basic skill levels.
- 44 per cent of all maintenance requirements belong to the first level and could therefore be performed by local private or in-house artisans, and equipment users with some additional training.
- Another 48 per cent of activities need to be undertaken at the second skill level and could be performed by retrained in-house craftspeople and technicians, with proper supervision by the health service maintenance specialists from maintenance level three. Due to the time input, this work could be undertaken by a small number of craftspeople and technicians based at the district hospital (see section below on implications for staff numbers).
- Only seven per cent of the maintenance requirements have to be undertaken by health service technologists and engineers at maintenance level three. Due to this low time input, a single maintenance specialist could serve several district hospitals and health centres simultaneously. The engineers are also needed to supervise technical staff throughout the HTM Service and to maintain the high technology equipment. Thus, technologists and engineers should be based at a higher level of the HTM Service (such as regional level) in order for their skills to benefit as many facilities as possible. The skills of each of these costly specialists can then be utilized across all levels of the health service, thus spreading the workload and sharing the costs for technologists and engineers among various facilities or across a larger area. This would help to reduce the financial burden for each facility.
- Sophisticated maintenance operations account for just two per cent of the time requirements, and these would have to be purchased from the private sector.

The examples given above show that, to a large extent, maintenance at the primary care level does not depend on highly skilled staff, and therefore does not necessarily need to be extremely costly. Depending on the human resources available in your organization, the majority of the maintenance activities could be undertaken by existing technical staff with support from general health staff. However, you may need to provide some additional retraining to ensure they can cover the bulk of general maintenance needs.

Next, we need to find a way of examining the implications of the technical needs we have already identified, in terms of staffing numbers.

Implications for Staff Numbers

Once you have an understanding of the hours required for HTM activities, you can use that information to calculate probable staff numbers.

However, this is not a straightforward calculation that is uniform around the world. How the hours of work required are converted into probable numbers of staff will depend on:

- how many days a year and hours a day your staff work
- the productivity of your staff (how much of the time available is used for work)
- how far staff have to travel to reach the job
- how long staff have to wait for the necessary inputs, such as spare parts, finances and transport
- quantity and age of equipment items.

One issue to consider when looking at workload is the full range of HTM activities that staff must undertake. Sometimes traditional maintenance tasks (such as carrying out repairs) are mistakenly considered to be of higher value than other HTM activities (such as administration, planning or management activities). This is mostly due to the fact that they produce more tangible results and are therefore 'chargeable'. However, all HTM activities are valid and important if you want to improve the condition of healthcare technology, the health service's ability to use it, and the efficiency of the HTM Service. Thus workload estimates should be based on all HTM activities and not simply maintenance alone.

The second issue to consider when estimating workload is the productivity of your staff. Productivity reflects the time that staff work compared to the total time available for work, and depends upon factors such as cultural work practices, distances to travel, and constraints to undertaking work. Such a 'percentage efficiency' for the use of time is specific to your country. Therefore, you should not compare your productivity to international figures but to the performance of other public and private sectors in your country.

Issues such as chargeable tasks and productivity are discussed in more detail in *Guide 6* on financial management.

As an illustration, we present an example that has taken these workload factors into account. The example is based on a study of large hospitals (ranging from 100 to 1000-beds) in Ghana, Nigeria, and Kenya. They used an alternative method for calculating the hours required for maintenance, and considered the typical number of job requests. They were, however, looking at busy and effective maintenance departments.

Tip

- There is a danger of basing your calculation of the required hours on numbers of job requests. If staff in your health facility typically do not report faults and your maintenance staff do not attend to many jobs per month, your estimate of the necessary workload will be artificially low.

In *Box 19*, the amount of time required for the maintenance and repair of healthcare technology is calculated for a typical 600-bed hospital. Thus, this box reflects s**econdary or tertiary care requirements**.

Box 19: Estimated Workload for a Workshop at a Typical Well-Patronized 600-bed Hospital

Things to consider	Assumption	Outcome
◆ A typical well-patronised hospital with 600-beds	◆ Has on average approx. 1,000 outpatients per day and 110 per cent bed-occupancy	◆ The predicted number of maintenance and repair job requests per month to the on-site workshop is 130
◆ Hours required to do maintenance	◆ Each job takes about three hours to do and check thoroughly	◆ About 390 hours of technical input is required per month to deal with repair jobs and other requests for maintenance
◆ Hours required for all HTM activities	◆ Maintenance and repair job requests account for only 60 per cent of all technical activity	◆ The total for all technical activity would then be 650 hours per month
◆ Allowance for staff productivity levels	◆ The 'percentage efficiency' of the use of total available staff-time can reach 50 per cent (as achieved by the public and private sectors in these countries)	◆ Thus, a total of 1,300 hours per month of technical staff input is required to service such a hospital.
◆ Calculation of staffing levels	◆ Staff working hours are 150 hours per person per month	◆ This is equivalent to 8–9 full-time competent staff for such a hospital

The study found that the amount of maintenance work required relates to:

- the size of a health facility
- how busy it is
- whether it has an on-site maintenance workshop.

A busy facility will cause more wear and tear on assets than a quiet one. Also around 80 per cent of the requests for service made to the maintenance department relate to facilities and technologies primarily involved with inpatient care. On this basis, *Box 19* shows how technical requirements have been calculated, and how local workload factors affected the conversion of hours into numbers of staff.

We can use this technique of converting hours of work into staff numbers for the primary care examples which were given in *Box 17* and *Box 18*. The countries concerned estimated, for example:

- 3,323 hours per year for HTM at skill level two for a 100-bed district hospital
- 535 hours per year for HTM at skill level three for a 100-bed district hospital.

Using the same percentage efficiency and staff working hours assumptions as used in *Box 19*, the total hours for technical input per year become:

- 6,646 hours per year at skill level two – this translates to three craftspeople/technicians to cover one district hospital, or four to cover one district hospital and 7 health centres
- 1,070 hours per year at skill level three – this translates to one technologist/engineer to serve two district hospitals, or one technologist/engineer to serve one district hospital as well as many health centres, and the supervision of other technical staff.

Further information about how to calculate your personnel needs for the HTM Service is given in *Section 6*.

These examples are useful as they illustrate that the trend is for few staff at the primary care level, with the majority at the lower skill level. Staff at the higher skill level are used to support many health facilities.

The example in *Box 19* also highlights that larger hospitals need larger HTM Teams. For secondary and tertiary care facilities with large numbers of hospital beds, a greater percentage of the equipment is complex or sophisticated. Also, not all manufacturers' representatives in your country will have the technical capacity to support this equipment. So for many countries, one solution is to increase the numbers and levels of technical staff within their HTM Service for these large facilities (*Section 6.1*).

Box 20 outlines the issues to consider if you wish to determine the technical requirements for your organization.

BOX 20: A Checklist for Understanding Your Technical Requirements

Check what your technical requirements are:

- Do your facilities have equipment inventories that would help you to determine the major maintenance requirements?
- Using the examples highlighted, would you be able to determine the major maintenance and other HTM requirements at your facility or district?
- Which of these requirements could be covered by the staff which currently exist in your facility, district, or region?
- Which of these requirements could be covered by technical staff which exist in other facilities or in the private sector?
- Using the examples highlighted, would you be able to determine the workload requirements at your facility or district?
- What are the personnel resources available for HTM in your facility, district, or region?
- Can these staff cover the workload requirements?
- Which parts of healthcare technology management could already be introduced in your facility/district or region?
- What deficiencies are there in your HTM system?

Box 21 contains a summary of the issues covered in this Section.

BOX 21: Summary of Issues in Section 3 on Determining Technical Requirements

HTM Activities	**Senior technical staff, or existing HTM Teams, at all levels**	◆ collaborate to determine the technical requirements for HTM at different levels of the health service ◆ use estimates of skill and workload requirements (*Section 3.1–3.3*) for this purpose ◆ pass on the information to senior planners
	Senior planners in health service provider organizations	◆ use the technical requirements to design the model and organizational structure for the HTM Service (*Sections 4 and 5*).
Skills Needed	**Senior technical staff, or existing HTM Teams, at all levels**	◆ use the equipment inventory to determine the skill requirements for maintenance and other HTM activities, in order to help design the HTM Service ◆ ensure that HTM activities are carried out effectively throughout the HTM Service (see *Guides 2–6*)
Workload	**Senior technical staff, or existing HTM Teams, at all levels**	◆ determine the hour requirements for maintenance and other HTM activities ◆ translate the hour requirements into probable staff numbers according to local workload factors, in order to help design the HTM Service

4. HOW TO CHOOSE THE MODEL FOR YOUR HTM SERVICE

Why is This Important?

There are several different models for providing HTM activities. It is useful to understand the options that may be available to you when developing your HTM Service, and to choose the most appropriate model that suits your situation.

For HTM to be effective, it needs to be seen as a normal part of general health management activities. HTM activities need to be integrated into the health management system. There are a number of strategies for doing this.

Having determined the technical requirements for different levels of your health system (*Section 3*), you can investigate the best model for satisfying those needs. In this Section, we discuss:

- different providers of HTM activities (*Section 4.1*)
- ways to incorporate HTM into the health management system (*Section 4.2*).

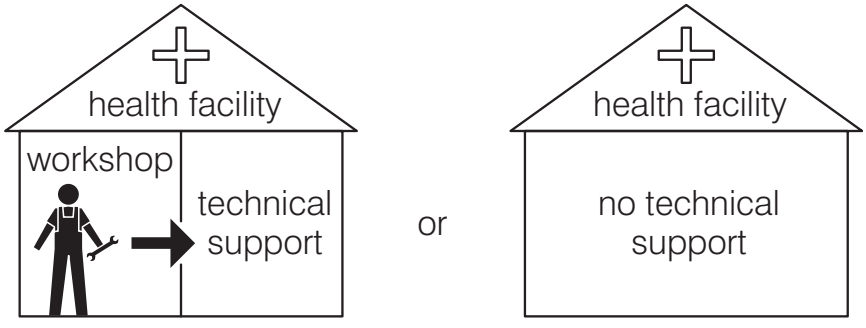
4.1 PROVIDERS OF HTM ACTIVITIES

4.1.1 Possible Sources

In any country, a range of HTM activities can be provided in different ways. The key providers of HTM activities are outlined below:

i. Individual 'In-house' Skills

In a number of developing countries, individual facilities have invested in technical staff (such as artisans, technicians, engineers), **as well as the resources they need to function effectively**. In these instances, the facilities greatly benefit from having in-house technical skills for healthcare technology management.



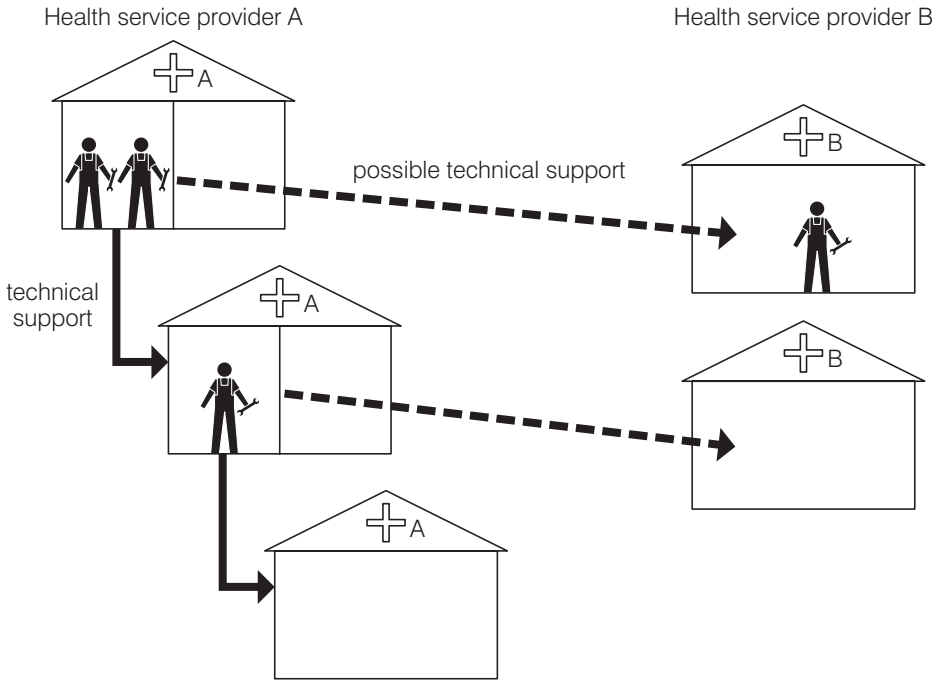
Advantages: Having your own technical staff available on site is invaluable for providing advice and a quick response. Thus there is a crucial role for in-house providers of HTM activities.

Disadvantages: If each health facility develops separate individual in-house skills, the technical staff on site may become isolated, with no back-up or support, and many activities and skills have to be duplicated across the health service.

Also, in many developing countries the reality is that health service providers rarely provide an adequate maintenance service within their facilities, let alone the broader HTM role. In many cases some maintenance services are planned, but cannot be implemented properly due to lack of financial and personnel resources. In these instances, you may need to retrain existing staff, employ staff, or contract additional technical support from the private sector.

ii. Existing Technical Referral Networks in the Health Sector

In a number of countries, different health service providers have already set up a referral network of maintenance workshops to cater for the technical needs of their own health facilities. In this way, the in-house skills at individual health facilities are linked in an overall HTM Service.



Advantages: A referral network offers a greater range of skills to health facilities by outreach from other locations, as well as support and supervision for individual maintenance staff from their colleagues.

Since small health service provider organizations may not find it economical to develop such a network (see disadvantages below), an attractive idea for those with an existing HTM Service is the possibility of expanding their network to cover, and sell services to, facilities owned by other health service providers. Thus, government, NGO, and private health service providers could all consider an expansion of their role.

For health service provider organizations with an existing HTM Service, expanding their coverage to facilities of other providers would be relatively easy, since they already have an organization in place, together with some qualified staff and a support structure.

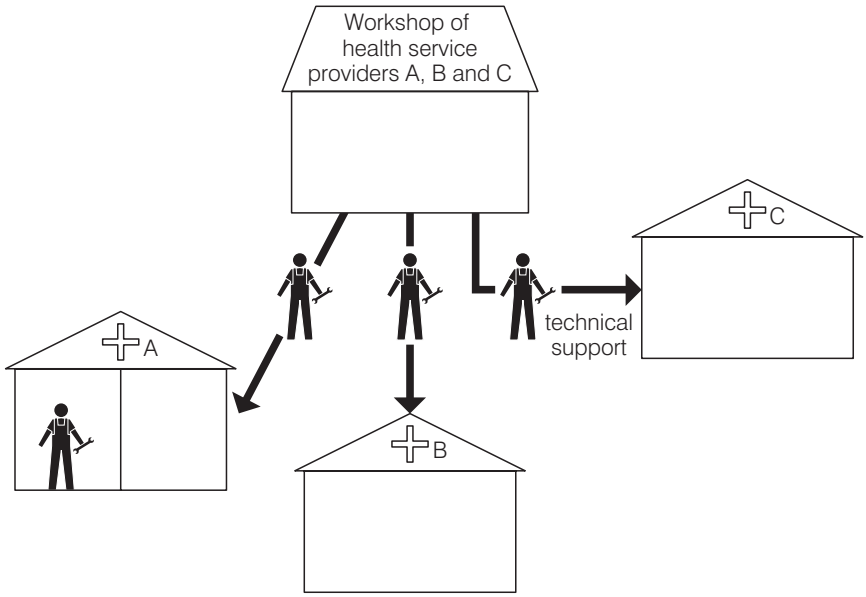
Disadvantages: The capital investment required to establish a referral network of workshops may not be economical for health service providers that only have a few health facilities.

For health service provider organizations with an existing HTM Service, expanding it to cover facilities of other providers would introduce an extra workload which, at the beginning, may not generate sufficient additional income to cover the cost increases. This may be the case for a number of years, and may even require some subsidies.

iii. Collaborative Arrangements

An alternative approach to creating a referral network would be for a number of health facilities under different ownership to collaborate to form a new organization, which is jointly owned. This would then provide an HTM Service for them all. For example, there could be collaboration between:

- the government and the mines
- one church organization and another
- groups of facilities under different ownership in one region.



Advantages: Such networking is very important. It may be the only way to obtain an HTM Service, due to the high capital investment involved in its establishment. Such a collaboration between organizations enables the various health facilities to have an influence over the way the HTM Service is run. Such a joint venture could also generate significant savings compared to running an independent HTM Service in each health service provider organization.

Disadvantages: When creating such a partnership there would be a lack of any supporting services and structures in the beginning. These would subsequently have to be jointly developed. In addition, it may be necessary to hire technical and administrative staff.

Experience in Tanzania

The Mbeya Hospital Maintenance Association (MBEHOMA) is a non-profit organization that installs, maintains, and repairs hospital and other technical equipment. In the 20 years of its existence, it has proved that a regional maintenance service can be operated without large subsidies.

Currently, most of its operating cost is covered by the income obtained from the sale of services. MBEHOMA's income is composed of different fees. The annual membership fees of the member hospitals help to cover overheads. In return, members are served first and charged reduced fees for actual service and mileage. In addition to service and mileage fees, MBEHOMA also charges a fee for procuring equipment or spare parts. Only hospitals are accepted as members of MBEHOMA. By 1999 it had eight members – seven church hospitals of different denominations and one private hospital of a tea company.

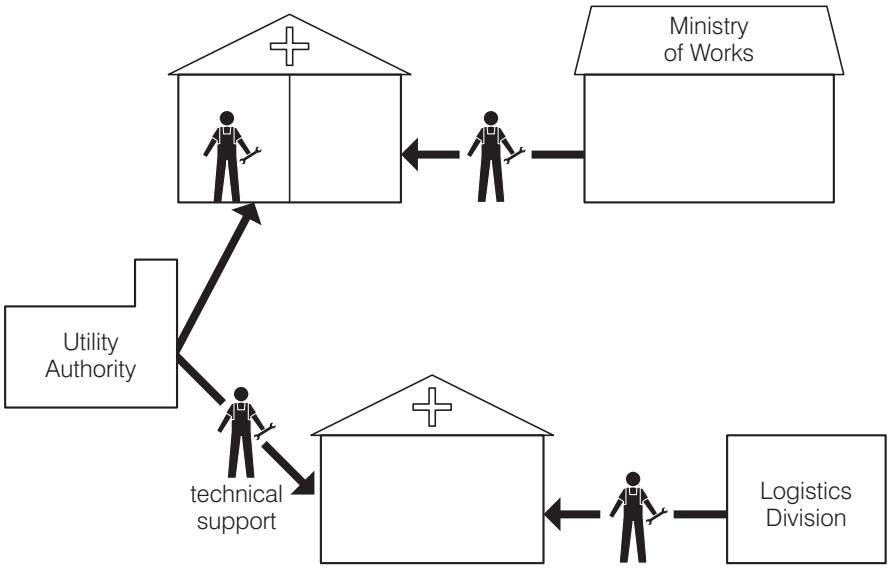
Due to the good reputation of MBEHOMA, members of the MBEHOMA team work 40 per cent of their time for private customers such as schools, hotels, or local entrepreneurs. As they are charged more than the member hospitals, the fees from private customers amount to 60 per cent of the total income. As well as medical equipment, the technicians are able to plan for and maintain a wide range of other equipment – for example electrical installations, water pumps, cars, and even solar-powered systems.

iv. Maintenance Services From Other Sectors

In some countries, other agencies have been given the authority for the maintenance and procurement of certain types of equipment. For example:

- In the government sector, the Ministry of Works may be responsible for health buildings, plant, and service installations, the Ministry of Supplies may be responsible for furniture and office equipment, and the Ministry of Transport for vehicles.
- In the non-government or private sectors, there may be a Maintenance Service or a Logistics Division separate to the Health Division that has authority over different types of equipment.
- There will also be national electricity supply, water supply, and telecommunication authorities with varying responsibilities for different types of equipment.

Therefore these agencies also run HTM Services, and will need to organize and improve their management skills accordingly.



Advantages: If these other agencies are effective, they carry out important work for your health service provider. You need to follow their policies and guidelines for the types of equipment they are responsible for, and should not interfere with any equipment outside of your responsibility.

Disadvantages: These agencies usually have lots of other clients besides your health service provider and may not give you the response and time that you require. If you are unhappy with the service provided, your health service provider may need to re-negotiate the responsibilities of the different agencies, in order to ensure that all the equipment the health service relies upon is in good working condition.

Ideally, the health service provider should have overall management control of all its equipment. In reality, you have no control over the finances allocated by these other maintenance agencies for your needs. It can often be difficult to coordinate and control staff from other maintenance agencies working on health facility sites. With many agencies involved, there is often a duplication of skills on site (such as welders, electricians, carpenters).

For this reason, it is sensible to ensure your in-house HTM Service is multi-disciplinary, and includes technical skills for all different types of equipment. The staff members of such a multi-disciplinary service have one boss only (the health service provider), work together for the good of all the physical assets of a health facility and not just some of them, and pool their skills.

Experience in Zambia

As in many developing countries, Zambia had established a Public Works Department (PWD). This was responsible for maintaining the buildings, plant, service supply installations, and furniture of all government facilities including health facilities. But the PWD had a large workload, and had a financial system that did not transparently show money per client (for example, the Ministry of Health). Thus, the government decided to disband the PWD and allow individual ministries to take on their maintenance responsibilities and the management of all their physical assets.

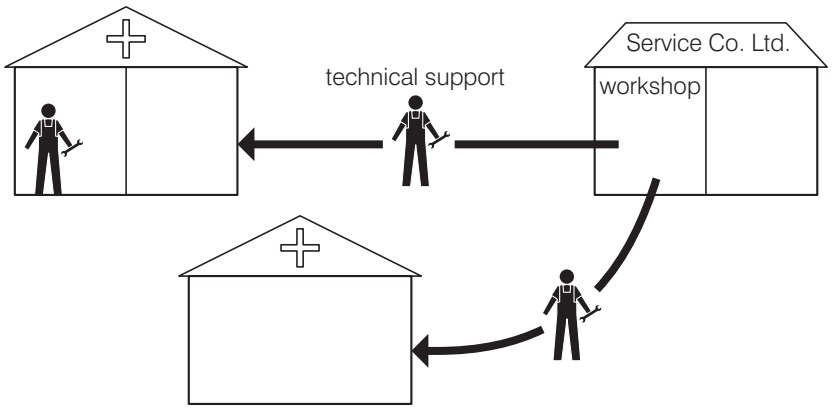
The Ministry of Health absorbed many of the PWD plant technicians to join their existing medical equipment technicians. In this way, they created multi-disciplinary maintenance teams at hospital workshops for all technical needs, under the control of a single authority – the hospital.

v. Private Sector Companies and Individuals

Most countries need to count on private sector support for some, if not all, of the following:

- maintenance and repair
- supplies of spare parts
- technical advice
- installation and commissioning
- training.

Private sector companies may include the manufacturers of equipment, representatives of the manufacturers, or enterprises that should contain suitably skilled personnel and resources. Private sector individuals may include artisans acting as sole traders, who should have recognized certified skills and their own tools.



Advantages: Private sector companies and individuals (such as artisans) can have substantial technical skills, plus extensive knowledge about the equipment they make or sell. Before appointing them, however, you should make sure they are skilled, reputable, and have sufficient resources to carry out the job (such as a workshop, technical staff, and spare parts).

Disadvantages: Private sector individuals may have few resources and limited access to the spare parts required. Support from private sector companies is usually limited to certain brands of equipment, which they also sell. It is unlikely that private enterprises will be either able or willing to expand their services to cater for all brands of equipment. In any case, health service providers would not want to be tied to such a monopoly situation. For a fuller discussion on contract management, see *Guide 5*.

It is also rare for private sector companies and individuals to be based at your health facility site, so the quality of their support may be affected by factors such as the distance to travel, response time, and their workload.

Besides maintenance, repair, installation, commissioning, and training, it is unusual to hand over control of any other HTM activities to private sector companies that you have contracted, such as:

- making work schedules
- advising on selection and procurement
- planning and costing work
- monitoring and ordering stores
- managing the database
- financial management
- writing reports and keeping statistics
- managing and supervising technical staff.

Thus you will always need in-house technical staff to undertake these tasks, manage the contracts with the private sector, and monitor the work of private sector personnel. It is a good idea to develop a register of these artisans and firms, which can be updated regularly to include new sources of support or exclude others who have not performed to the required standards. For more details on how to do this, see *Guide 5* on maintenance management.

4.1.2 Strategies to Consider

HTM activities come under the 'service provision' function of health services (*Section 2.1*). This means that, as with health services, they could be controlled and run either by:

- government agencies, such as Ministries of Health, Works, or Defence
- non-government organizations, such as churches or charities
- private sector companies, such as mines, plantations, or health insurance companies
- a mixture of these organizations.

In reality, it is usually simplest for your HTM Service to be controlled and run along the same lines as your health service provision system. For example:

- if health service provision is totally dependent on the government, it is advisable to include the HTM Service in government services
- if health service provision is run privately or by a mixture of the private and public sector, it might be more effective for your HTM Service to be run privately.

In either case, you would need to establish a regulating system in order to ensure quality, standards, and safety of the services provided (*Section 2*).

An HTM Service provides your health service provider with an internal technical and managerial capability for HTM activities. This is essential if you are to obtain overall management control of all your equipment.

For this to happen smoothly, we suggest the **first requirement** for your HTM Service is to have your own HTM Team (*Section 1.1*) at each health facility and administrative level, whether a workshop exists or not, to undertake technical activities. The **second requirement** is for these in-house teams to be linked in a referral network, which will provide access to an increased range of skills and support. In *Sections 5 and 6*, we discuss ways in which you can achieve these requirements with limited staff. We also provide a description of the responsibilities of the HTM Teams at different levels of the health service.

Although your HTM Service will oversee HTM activities it does not have to carry them all out itself. In reality, it would not be able to do so. Therefore, the **third requirement** for your HTM Service is to ensure all HTM activities you require (as identified in *Section 3*) take place, by using a range of the different providers (*Section 4.1.1*). It is common for a mix of providers to be used to deliver the full range of technical activities, for example:

- the government health service may have a technical referral network, services provided by other sectors (such as Ministry of Works), and make use of the private sector
- church health service providers may use collaborative arrangements, and contract help from another health service provider
- private health service providers may have in-house skills and make use of private sector support.

Of course, the model you use to deliver all your technical requirements will depend on the size of your health service provider, the area it covers, and the available providers of HTM activities. However, innovative solutions arise when health service providers consider new collaborations, and make use of other sectors to cover the HTM activities they cannot currently cope with themselves. Your HTM Teams should therefore:

- offer to provide their services to other health service providers, where possible
- oversee the work of other providers of HTM activities who you contract in to help.

Experience in Tanzania

In Tanzania, over recent years, eight separate HTM Services have been created in different parts of the country. These 'zonal health care technical services' are associations of various hospitals and health facilities. The health facilities are run by the government, the private sector, or churches and NGOs.

Each of the zonal health care technical services covers 10 to 15 hospitals in one or more regions of the country and also assists the health centres in that area. The member hospitals usually have to pay a yearly membership fee, which assures them of preferential treatment by the zonal health care technical service and preferential fees for HTM activities, including a limited number of free maintenance services. Non-members also receive support, but have to pay much higher service fees.

The zonal health care technical services are supported by a country-wide health care technical service, which is assisting the zonal services by supervising them and providing networking activities. The country-wide health care technical service is provided by the Christian Social Services Commission, which is a national organization representing the public sector and the major churches active in Tanzania.

4.2 INCORPORATING HTM INTO HEALTH MANAGEMENT

Very often healthcare technology management is seen as an independent task with very limited links with the other parts of the health service. This has meant that, in the past, technical staff were rarely involved in such crucial tasks as investment planning, evaluation of the quality of health services, or organizational issues. Fortunately, these attitudes are slowly changing.

Therefore, we suggest that the **fourth requirement** for your HTM Service is to have the head of each HTM Team – the HTM Manager – as a member of the relevant health management team (at facility, district, regional, or central level). The HTM Manager will represent the HTM Team in management committees at all levels, ensuring that:

- a technical viewpoint is present in health planning decisions
- healthcare technology management is seen as a collective responsibility for all health staff.

In addition, we need to ensure HTM finds its proper place in the health system (*Section 1.1*), and becomes part of normal health management activities undertaken by health staff at all levels of the health service. Equipment should not be managed in isolation, but must be linked to all the other components which are necessary for healthcare delivery, including the aims, procedures, finances, staffing levels, supplies, and support systems at each level of the health service.

To achieve this, we suggest that the **fifth requirement** for the HTM Service is to establish an HTM Working Group at each level (facility, district, region, centre). This multi-disciplinary group should report to the health management team, and be responsible for reviewing the equipment situation and planning equipment needs at that level. It should comprise all types of stakeholders that have an important role to play in HTM, such as administrative, medical, finance, supplies, and technical personnel, as detailed in *Section 1.1*. Some members of the HTM Team are therefore also part of the HTM Working Group.

Teamwork is very important and collective decisions should be taken on all equipment management matters. Working Group members should communicate regularly and help one another solve daily operational problems. The healthcare technology management considerations of this HTM Working Group could include:

- identification of health needs (see *Guide 2* on planning and budgeting)
- equipment purchase plans (see *Guide 2*)
- budgeting for equipment purchases and maintenance (see *Guide 2*)
- establishment and updating of inventories (see *Guide 2*)
- specification of equipment needs (see *Guide 3* on procurement and commissioning)
- supervision of procurement processes (see *Guide 3*)
- logistics support (see *Guide 3*)
- training of users and technical staff (see *Guide 4* on operation and safety, and *Guide 5* on maintenance management)
- organization of the supply and storage of accessories, consumables, and spare parts (see *Guides 4 and 5*)
- ensuring maintenance and repair activities take place (see *Guide 5*)
- ensuring the efficiency of the HTM Teams (see *Guide 6* on financial management).

In this way, the full range of HTM activities (*Section 3*) become part of the normal working considerations of the health management team.

However, the HTM Working Group should only undertake the tasks for which they have the appropriate management skills.

Tip

- It is important not to decentralize responsibility too quickly before the necessary management skills are in place. For example, some countries have tried to decentralize the funding for equipment maintenance, but when funds were short the local authorities, without an appreciation of its importance, simply cut planned preventive maintenance activities.
- The range of HTM activities undertaken at each level of health management should depend upon the development of management skills at that level.

In a number of developing countries, moves have been made at central or national level to try to incorporate HTM into the general health management system. However, it is commonly recognized now that it is essential for equipment management activities to form part of district planning processes. Thus HTM should be interlinked with all the conventional elements of the (district) management cycle, such as:

- planning and coordination of budgets, staff, supplies and transport
- the Health Management Information System (*Section 7.3*), including inventories
- communication, supervision and support, monitoring and evaluation
- human resource development and training
- operations research.

The HTM Service does not require a separate management system for daily operations but should be part of the district management system. Setting up special management schemes for specific work areas in healthcare ('vertical programmes') is widely seen as inefficient due to duplication of effort, and may also be unsustainable. However, internal workshop and technical work organization should be managed with professional technical support from within the HTM Service

If HTM Teams are to support other facilities by outreach, the hospitals where they are based must appreciate the HTM Team's dual role – to undertake HTM activities both for the hospital, and also for other health facilities, as part of a broader organization-wide network.

Box 22 outlines the issues to consider if you wish to determine the model to use for your HTM Service.

BOX 22: A Checklist for Determining the Model for Your HTM Service

Check which delivery models and strategies already exist in your country:

- Can you describe the different types of HTM providers available in your country?
- Which HTM providers does your health service provider make use of?
- Are there other collaborations you could make that would usefully cover some of your unmet HTM needs?
- Is your HTM organization a network covering many facilities at the same time?
- Do you have HTM Teams at each facility and decentralized authority level for technical tasks?
- Do your technical staff get involved in health planning issues, by being present on health management committees?
- Is HTM seen as a normal part of health management?
- Do you have HTM Working Groups at each facility and decentralized authority level to advise on equipment issues?

Box 23 contains a summary of the issues covered in this Section.

BOX 23: Summary of Issues in Section 4 on Choosing the Model for Your HTM Service

HTM Providers	**Health Service Providers and Health Management Teams**	◆ investigate what types of HTM providers are available ◆ consider new collaborations so that all HTM needs are covered ◆ develop HTM Teams at facility and decentralized administration levels ◆ link these HTM Teams in a referral network
Incorporate HTM	**Health Service Providers and Health Management Teams**	◆ incorporate HTM into health management at all levels of the health service ◆ ensure HTM is linked to its complementary components for delivering healthcare ◆ ensure HTM Managers participate in health management committees ◆ create multi-disciplinary HTM Working Groups to advise health management teams

5. HOW TO DEVELOP AN ORGANIZATIONAL STRUCTURE FOR THE HTM SERVICE

Why is This Important?

A Healthcare Technology Management Service (HTMS) has specific tasks at different levels of the health system. It is important to understand the variety of tasks that should be undertaken by the HTM Teams and HTM Working Groups at the various levels. A clearer understanding of how the various different levels of the HTMS relate to one another will help you to clarify staffing roles and ensure an adequate division of labour across the health service.

You need to design an organizational structure for your HTMS that is suited to your health service provider organization, and can be incorporated into any countrywide system.

Having chosen your model for providing an HTM Service (*Section 4*), you need to establish the organizational structure required to implement it. In this Section, we discuss:

- the relationship between the health delivery system and the HTM Service (*Section 5.1*)
- the placement of staff at different levels of the HTM Service (*Section 5.2*)
- responsibilities at each level of the HTMS (*Section 5.3*).

The way in which your HTM Service is organized will depend upon your country and health service provider organization. It will depend upon factors, such as:

- the geography of the area
- population distribution
- financial and human resources
- the form of health service provision.

However, it is important for the HTM Service structure to spread throughout your health service provider organization, and for there to be an HTM organizational structure throughout the country.

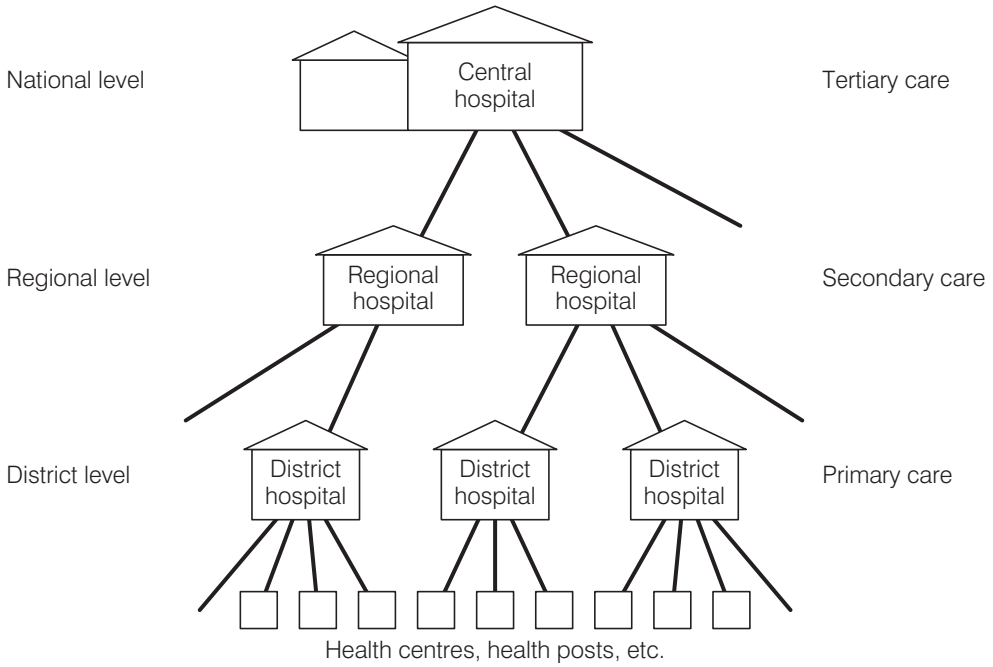
In this Section, we present a complete example of an organizational structure for the HTM Service. This is based on a concept already being implemented in many developing countries. However, you may need to adapt this model to suit your own country's situation. If your health service provider is a small organization, or if you are just starting out, your organizational structure may form only a small portion of the structure presented here.

5.1 RELATIONSHIP BETWEEN THE HEALTH DELIVERY SYSTEM AND THE HTM SERVICE

The level and complexity of services offered determines the structure of health delivery systems. At the lower end of the network are health service units, such as health posts and health centres (see the Glossary in *Annex 1*), which perform only limited tasks. At the top of the network are more complex facilities, such as a central hospital covering all the specialities present in the country.

Such a network is known as a referral system, because the many health facilities at the lower level refer patients for more complex treatment to the fewer facilities at higher levels, where specialists are concentrated and can provide the sophisticated services required. An outline of a typical national referral system in the government sector is shown in *Figure 7*.

Figure 7: Pyramid Referral System of Government Health Services



As the example in *Figure 7* is from the government sector, the decentralized levels are based on political administrative divisions in the country, such as regions and districts. The referral system for other health service providers will look slightly different. Their administrative levels will cover facilities in different geographical zones based on features of the organization, for example:

- Church organizations may administer their health facilities by diocese, and refer patients to a diocesan hospital.
- The private sector may have facilities spread over a large area and administer them by province, and refer patients to a provincial hospital.

The type of zones, their labels, and the number of zonal levels will vary with the health service provider.

Our first consideration for the HTM Service is that it should cover the needs of the different types of health facility of your health service provider. In *Section 3.2.1* (*Box 15*), we distinguished four skill levels required for the maintenance of our equipment stock, and for HTM activities in general:

skill level one – basic-level tasks

skill level two – medium-level tasks

skill level three – high-level tasks

skill level four – sophisticated-level tasks.

We discovered that:

- The major workload at primary care facilities (health posts, health centres, and the first-referral hospital, such as a district hospital) is at skill levels one and two. It should be possible to tackle this workload with the staff present in the district, with some additional training.
- Anything more complex (requiring skill level three) could be referred up to a location with more specialist technical staff. These specialists would be fewer in number and grouped at locations where they could offer technical support by outreach to a range of health facilities.
- Finally, there would be central level supervision and support (at skill level four) from technical managers overseeing the HTM Service as a whole, and sophisticated maintenance input from the private sector.

Our technical requirements for HTM will therefore naturally fall into a referral system that mirrors the health delivery system.

In *Section 4* we determined that healthcare technology management should be a part of health management at each level of the health service. Therefore, the second consideration for the structure of the HTM Service is that it should fit the decentralized health authority levels of your health service provider organization.

We defined five requirements for the HTM Service:

- an HTM Team at every facility and level, whether a workshop exists or not
- the teams to be linked in a referral network
- all HTM activities to be covered by making use of other HTM providers for unmet needs
- the head of each team, the HTM Manager, to sit on the health management team
- a multi-disciplinary HTM Working Group at every facility and level to advise the health management team on equipment issues.

If we combine these needs we can start to see the sort of organizational structure required for an HTM Service that reflects the referral nature of healthcare delivery. This is laid out in *Section 5.2*.

This hierarchical referral structure for the HTM Service helps us to determine the sort of partners that HTM staff will work with at each level. An example is shown in *Figure 8* for the government sector. Again, for other health service providers the names of the partners may vary (such as a diocesan health management team, a provincial HTM Team), although the principle remains the same.

Figure 8: Partners Working with HTM Staff at Each Level of the HTM Service

Level	HTM Actors	Partners
National Level	**National HTM Team and HTM Working Group**	Ministry of Health Regional HTM Teams Regional HTM Working Groups External support agencies Training facilities Private sector companies Hospital health management teams Central hospital Regional hospitals Equipment users in hospitals Other HTM providers HTM Services of other health service providers
Regional Level	**Regional HTM Team and HTM Working Group**	Regional health management team District health management teams District HTM Teams and Working Groups Hospital health management teams Regional hospital District hospitals Equipment users in hospitals Private sector companies and individuals Other HTM providers
District Level	**District HTM Team and HTM Working Group**	District health management team Facility HTM Teams and Working Groups Facility health management teams District hospital Health centres Health posts Equipment users Private sector companies and individuals Other HTM providers
Facility Level	**Facility HTM Team and HTM Working Group**	Facility health management team Smaller health facilities Equipment users Private sector companies and individuals Other HTM providers

5.2 PLACING STAFF AT THE DIFFERENT LEVELS OF THE HTM SERVICE

The HTM Service should be structured in order to provide a clear division of labour between the different levels of the HTM system. We recognize that the overall number of HTM Teams and levels will depend on the size of your country, size of your health service provider organization, number of health facilities, and how far you have gone in developing your HTM Service. However, using the recommendations from *Section 5.1*, the following levels are suggested.

Facility Level

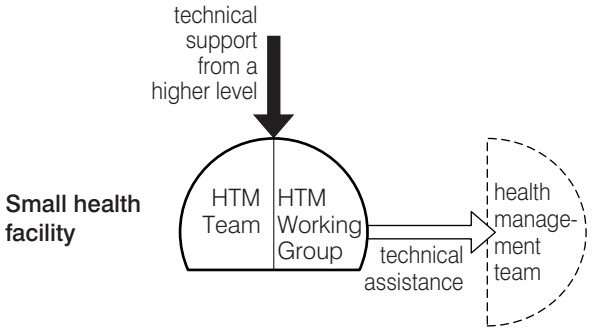
Facilities Without Workshops

Equipment maintenance and general management need to take place even where there are no workshops. Thus, general health facility staff should be included in the HTM Service. A number of countries have developed the first level of their HTM network as 'maintenance teams' or 'equipment management teams' based at small facility level where there are no workshops. Such HTM Teams are made up of a couple of suitable and interested staff from any discipline (such as a nurse, an administrator, a storesperson), who are given additional training. They:

- oversee the daily running of technology within the facility
- are the contact point for all equipment and maintenance matters
- are responsible for finding the correct solutions to problems
- possibly undertake the maintenance themselves (depending on the size of the facility, the skills available, and the training provided).

These Facility HTM Teams ensure that basic-level tasks (skill level 1) are undertaken by themselves, equipment users, or locally available artisans (*Section 3*), with support from a higher referral level (see below). All the tasks at other skill levels are undertaken by technical staff from higher up the HTM Service (see below) or by other HTM providers (*Section 4*).

To complete the HTM Service at this level, there is a Facility HTM Working Group that advises the health management team on equipment issues. The multi-disciplinary Facility HTM Working Group should include the head of the HTM Team (the HTM Manager). For small health facilities (such as a health centre with only a few beds, and few staff) the health management team will be small, but members can still be nominated to be responsible for HTM issues. For very small facilities (such as a health post with no beds and only a couple of staff), there may be no health management team but a community committee instead. This committee could consider how it can respond to minor HTM issues (mainly to do with the fabric of the building), and more major issues could be referred to the district health authority.



Experience in Madagascar

In Madagascar, a maintenance system is being developed in Majunga Province that uses existing health workers at sub-district level without workshop facilities. The health workers are called 'Agents de Maintenance'. They look out for technical problems and coordinate maintenance interventions with their provincial workshop. They are being trained by workshop staff and equipped with a set of tools to undertake some of the work themselves. To date, the 'Madagascar Model' has worked more effectively than expected. The main reason for its success is that the individuals involved have experienced an increase in prestige, and have started to utilize their newly acquired maintenance knowledge outside their work, enabling them to supplement poor salaries. The personnel made responsible for maintenance are being supported and supervised by the technicians of the provincial workshop and, hopefully in future, by the provincial supervision team.

Facilities With Workshops

Larger health facilities will have Facility HTM Teams containing different types of technical personnel (such as artisan, technician, technologist), and will require a workshop. Which type of hospital has technical staff based within it, and which type has a workshop of its own, depends on your country, your health service provider, the facility size, and how recently you began to establish an HTM Service.

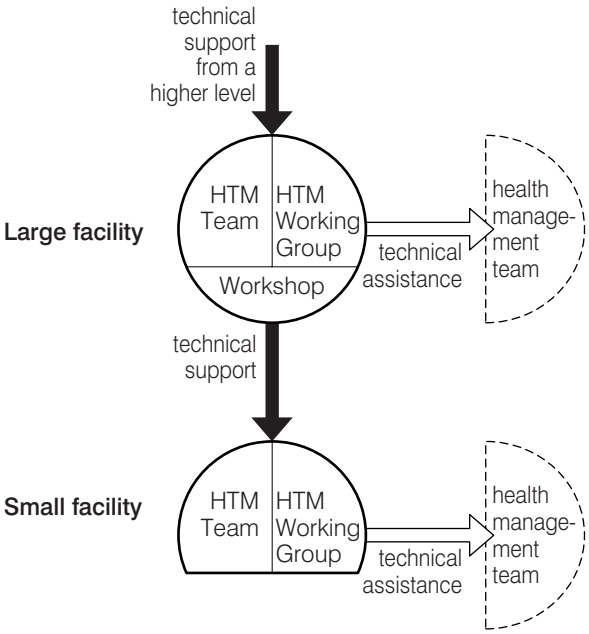
For example, a district hospital could have a workshop and three to four technical staff (artisans and technicians), who would carry out the appropriate HTM tasks at skill levels 1 and 2 (basic- and medium-level tasks) as described in *Section 3*. Depending on your organization, these tasks could be undertaken by the existing technical staff in your hospitals, after receiving appropriate retraining.

Bigger hospitals would have larger HTM Teams and would require skills for medium- and high-level tasks (levels 2 and 3). Their HTM Team would therefore include technologists and possibly an engineer, depending on your country (see zonal level below).

For facilities with workshops, the head of the HTM Team, the HTM Manager, will have technical skills. The HTM Manager should sit on the health management team, a large committee, to provide technical advice. The HTM Manager should also be a member of the multi-disciplinary Facility HTM Working Group, which will advise the health management team on equipment issues.

Since hospitals with workshops have larger HTM Teams with a greater variety of skills, these HTM Teams can act as referral centres for lower-level health facilities (such as health posts and health centres) in the surrounding area. Back-up support would be provided by technical staff higher up the HTM Service.

The technical team based in a hospital will therefore require sufficient staff, skills, and resources to enable them to provide technical support to smaller facilities. In particular, such teams need access to support staff, such as a cleaner, clerk, secretary, storesperson, and driver. Which type of hospital offers technical support by outreach will depend on your health service provider and country. The workshop at a hospital offering technical outreach support may be designated as a district workshop or a regional workshop in the HTM Service (see zonal level below).



Zonal Level

The facility level needs to be supervised and supported by a workshop at a higher level. Such a workshop can be based at the administrative division of a particular country – a district, or a region. Alternatively, it can be based on a 'zone' – a specially formed geographically coherent area. For the HTM Service, such areas could be determined on the basis of the following criteria:

- Coverage of an area with unsatisfied demand.
- Availability of a strong and competent HTM implementing agency.
- Sufficiently large numbers of health facilities to ensure economies of scale and financial viability for HTM activities.
- Existence of a commercial centre for provision of equipment, spare parts, and sub-contractors.

The number of administrative levels in the HTM Service will depend on the number of zonal levels you use. This will depend on your organization, and how far you have developed your HTM Service. For example, many countries place a workshop in a large zone such as a region or province, each of which covers a number of districts. Ideally, at some point you will develop your HTM Service to also have workshops at a smaller zonal level, such as the district or diocesan level. This is important since equipment management activities should form part of district planning processes.

District or Diocesan Level

The HTM Service should be represented at district level and be responsible for all health facilities in the district. The district workshop acts as a referral centre for HTM needs from the periphery, and undertakes HTM activities by outreach for facilities within the district. There is no set rule for locating the district workshop. Some health service providers expand the responsibilities of the district hospital workshop to cover the needs of the whole district. Others establish a workshop at a separate site to cover the needs of health posts and health centres, and leave the district hospital workshop to care for the hospital's needs.

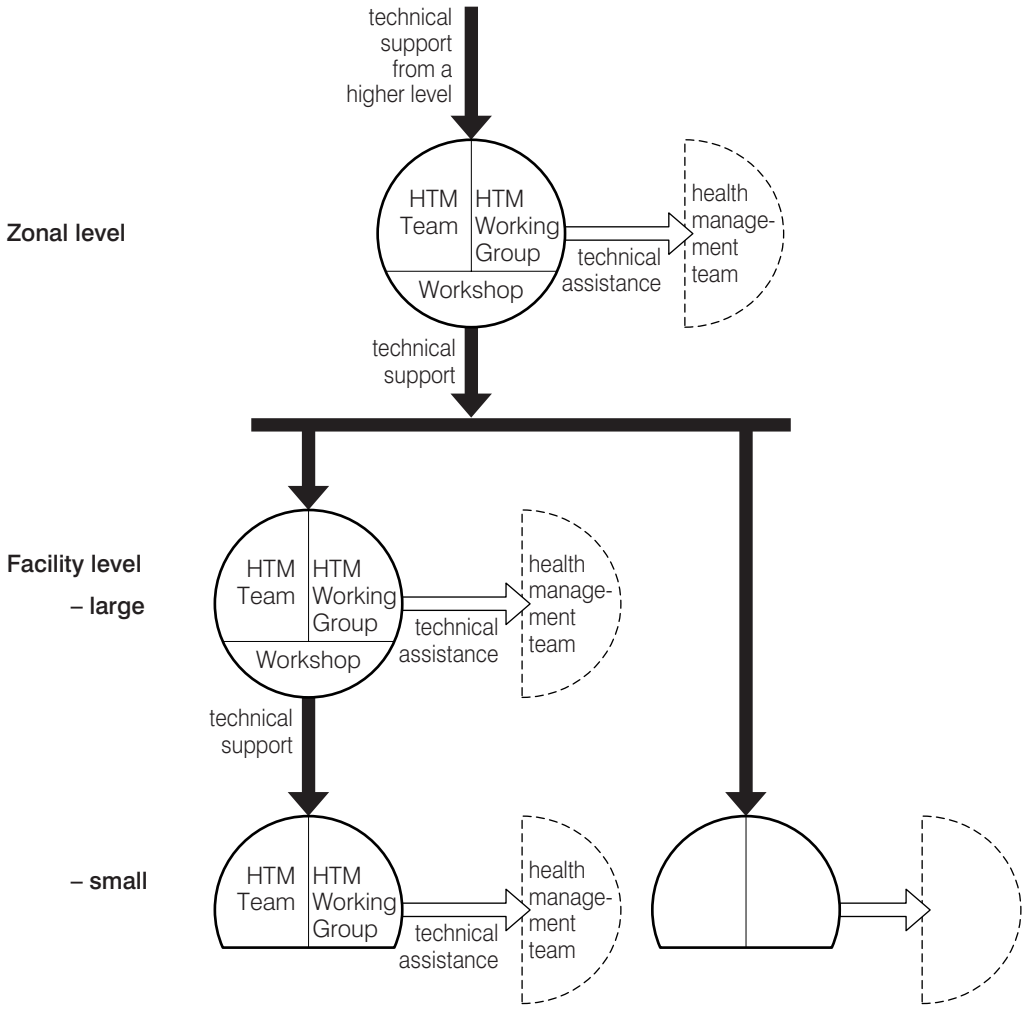
The District HTM Team is usually in charge of basic- and medium-level technology tasks (skill levels 1 and 2). It looks after the maintenance needs of the health centres and health posts, which rarely have their own technical staff. Thus all HTM activities within the district can normally be carried out using the skills already available, such as:

- equipment users, with additional training
- retrained technical staff that already exist, based at your hospital or district workshop
- private sector artisans.

However, in order to carry out these activities, they would require back-up support from technical staff higher up the HTM Service, such as a Regional or Provincial HTM Team (see below).

The activities of the District HTM Team are headed by the District HTM Manager. To ensure all HTM activities are considered at district level, the District HTM Manager sits on the multi-disciplinary District HTM Working Group, which advises the district health authority on equipment issues.

Depending on the organizational arrangement, the District HTM Team reports to the district (or diocesan) health authority for daily operational issues. For technical and professional issues, the District HTM Team reports to a higher level HTM Team, that offers supervision and support (see below).



Regional or Provincial Level

The HTM Service is also represented at regional level, in order to supervise and assist both the district and the facility levels contained within the region. The regional workshop acts as a referral centre for HTM needs that cannot be undertaken in the districts, and undertakes HTM activities by outreach for facilities within the region. Again, there is no set rule for locating the regional workshop – it could be an expansion of the role of the regional hospital workshop, or it could be at a separate site.

The Regional HTM Team is usually in charge of high technology tasks (skill level 3) for the region. It also supervises and supports the work undertaken by the District and Facility HTM Teams and the private sector artisans and firms. Thus the Regional HTM Team should have technologists, and even engineers, to offer this higher level of referral support.

To begin with, the maintenance specialists at regional level will need to devote a large part of their time retraining artisans and technicians at lower levels of the service. In time, the artisans and technicians in the districts will be able to carry out many of the necessary jobs by themselves, turning to the specialists only in difficult cases and for certain equipment. The Regional HTM Teams will then be able to concentrate on more complex jobs, sophisticated equipment, and their supervisory role, with help from the Central or National HTM Team.

The Regional HTM Team is headed by a Regional HTM Manager. To ensure all HTM activities are considered at regional level, the Regional HTM Manager sits on the multi-disciplinary Regional HTM Working Group which advises the regional health authority on equipment issues.

Depending on the organizational arrangement, the Regional HTM Team reports to a Regional (or Provincial) health authority for daily operational issues. For technical and professional issues, the Regional HTM Team reports to a higher level HTM Team that offers supervision and support (see below).

Central or National Level

At the head of the HTM Service, an HTM Team acts as a coordinating and supervising unit for the entire system. Depending on your organization, this will be your Central HTM Team or the National one. Such a Central HTM Team supports and supervises the Zonal and Facility HTM Teams and Working Groups.

The Central HTM Team may have its own central workshop. This may be based at the largest type of hospital in your organization (for example, a national referral hospital in the government sector) or at a separate site. This is where the highly qualified HTM staff, such as engineers and engineering managers, are based to supervise the work of all other HTM Teams.

The skills of the staff at central level are such that they could undertake, and will monitor, most of the jobs required at lower levels of the system. However, the major workload at this level should be advisory and supervisory tasks. The central level manages the contracts with the private sector for specialized maintenance tasks (skill level 4). The Central HTM Team undertakes all other HTM activities at skill level 4, in collaboration with the multi-disciplinary Central HTM Working Group that advises the central body of the health service provider organization.

Figure 9 (overleaf) completes the organizational structure of the HTM Service. It provides a sample organizational chart showing the relationship between the different levels of the HTM Service, and shows that it follows a typical health service referral structure.

The organizational chart in *Figure 9* is only an example. The number of administrative levels in your HTM Service will depend on the number of zonal levels you use. This depends on your health service provider organization, the geographical area to be covered, and the number of health facilities. Also the shape of your organizational chart will vary, depending on when you started to develop your HTM Service and whether you started developing an HTM Service at district level, or from the top down. Some service providers and countries have:

- no HTM Service
- a central level and nothing else
- an organizational structure at facility, district, and regional level, but no central level
- a narrow organizational chart, as they only have a few zones
- a large structure with many zones, and workshops at both district and facility level.

Tip

- Start with the skills and resources you currently have, and expand later. Decentralization should only take place when you have the technical staff and skills in place, backed up with the appropriate knowledge in the health management system, and the necessary physical and financial resources.

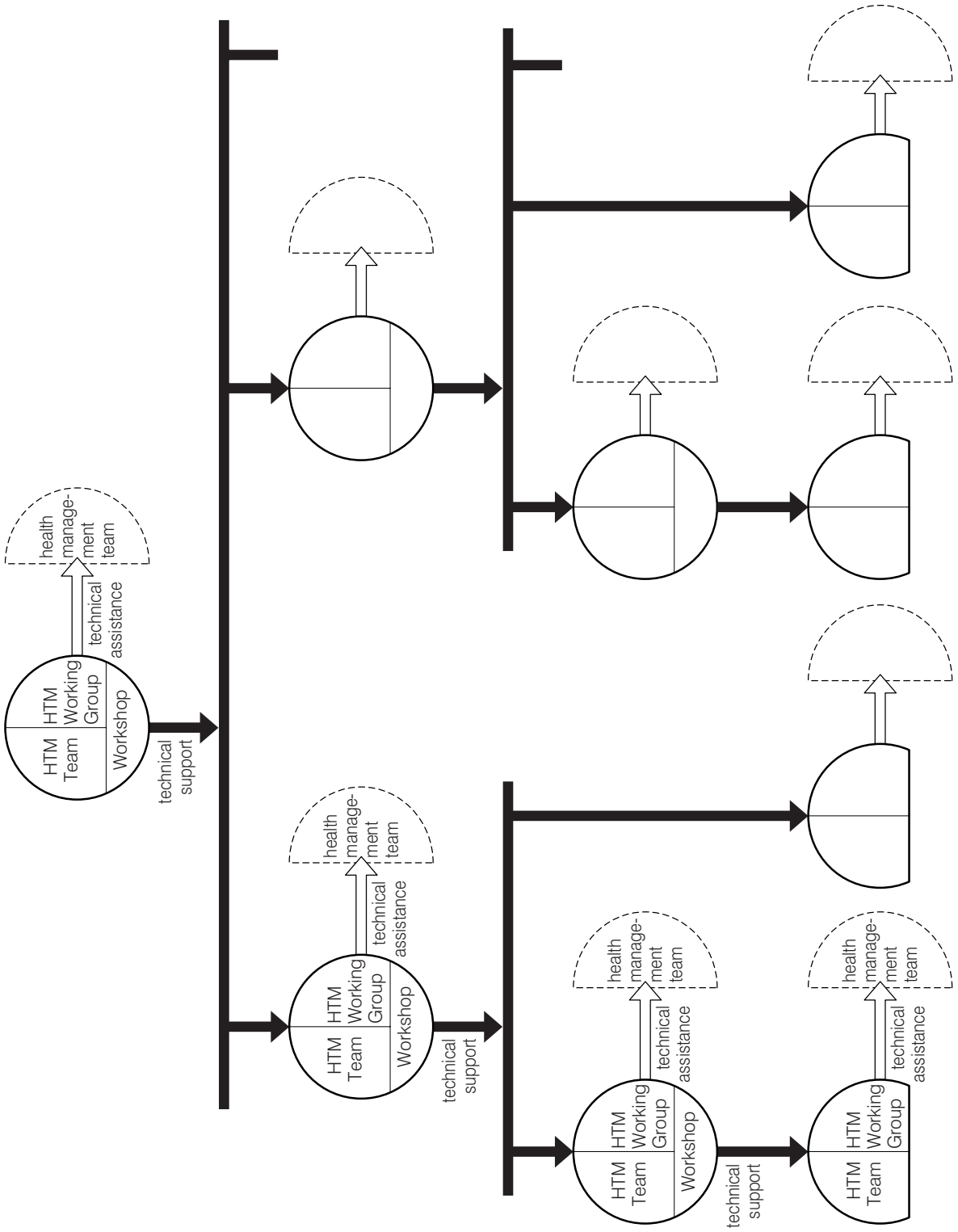


Figure 9: Sample Organizational Chart for the HTM Service

Box 24 outlines the issues to consider when assessing the organizational structure of your HTM Service, and how staff are placed within it. *Section 6* discusses possible numbers of staff required in such a network.

BOX 24: A Checklist for the Organizational Structure and Staff Placement for Your HTM Service

Check which of these structures are available in your country:

Facility level

- Are there HTM Services based at this level in your health service provider organization or in your country?
- Which facilities are not covered by such services?
- What types of staff exist in the HTM Services at this level at the moment?
- Is use made of general health staff in the HTM Service at this level?
- What skill level (*Section 3*) can the HTM staff offer at this level?

District/diocesan level

- Are there HTM Services based at this level in your health service provider organization or in your country?
- Which areas are not covered by such services?
- What types of staff exist in the HTM Services at this level at the moment?
- What skill level (*Section 3*) can the HTM staff offer at this level?

Regional/provincial level

- Are there HTM Services based at this level in your health service provider organization or in your country?
- Which areas are not covered by such services?
- What types of staff exist in the HTM Services at this level at the moment?
- What skill level (*Section 3*) can the HTM staff offer at this level?

Central/national level

- Does your health service provider organization have a Central HTM Team to coordinate the Service?
- Is there also a National HTM Team for the country as a whole?
- What types of staff exist in the HTM Services at these levels at the moment?
- What skill level (*Section 3*) can the HTM staff offer at these levels?

5.3 RESPONSIBILITIES AT EACH LEVEL OF THE HTM SERVICE

In *Section 5.2*, we outlined a proposed structuring of staff at the various levels of the HTM Service. This was based on the skills that would be required to enable HTM activities (*Section 3*) to take place, as well as planning, supervision and monitoring activities.

Of course, what can be achieved at each level will depend on the skills of the staff you have available at each level. The example that is presented below assumes that all the skill requirements for HTM activities (described in *Sections 3 and 4*) are available. Additional information on reporting structures is given in *Section 6.2*.

Facility Level

The responsibility of the Facility HTM Team and Working Group depends on whether the facility has a workshop with technical staff based in it.

Facilities Without Workshops:

Together, the HTM Team and Working Group:

- advise the health management team on healthcare technology issues
- are the contact point for equipment and maintenance problems which they try to solve
- supervise private sector artisans
- support and supervise equipment users
- undertake maintenance and other HTM activities (*Section 3*) at skill level 1, if they have received the training
- liaise with a higher zonal level of the HTM Service (for example, district or region).

Hospitals With Workshops

In addition to the responsibilities listed above, the HTM Team and Working Group at these types of facility also:

- undertake maintenance and other HTM activities (*Section 3*) at skill levels 1 and 2 in the hospital itself (and possibly level 3 if a large hospital), and sometimes for health centres and health posts in their area by outreach
- keep stocks of spare parts according to first-line maintenance levels
- monitor and supervise the work conducted by private companies
- undertake quality assurance and cost control at facility level
- provide adequate representation of HTM in the planning and budgeting of the facility health management team.

The Facility HTM Team and Working Group should report to the health facility board, or equivalent. In principle, the facility technical staff should be employed by the health facility or the district health authority, and be supervised and assisted by the Zonal HTM Team.

Zonal Level

District or Diocesan Level

Ideally each small administrative zone (such as a district or a diocese) should establish its own HTM Team and Working Group under the district/diocese health board or authority. At this level, the HTM Service undertakes the following tasks:

- advises the district health management on healthcare technology issues
- undertakes maintenance and other HTM activities (*Section 3*) which require basic- and medium-level skills (skill levels 1 and 2) in the district hospital, as well as the health centres and health posts in their area
- keeps stocks of spare parts according to their maintenance level
- monitors and supervises work conducted by private sector companies and artisans
- supervises and supports the work of Facility HTM Teams and Working Groups in their area
- undertakes quality assurance and cost control at district level
- provides adequate representation of HTM in the planning and budgeting of the district health management team
- liaises with a higher level of the HTM Service (such as a region or the centre).

It may be that the District HTM Service cannot initially carry out all of these tasks. In many countries, experience has shown that decentralization should be undertaken gradually. If too many responsibilities are given to a District HTM Team and Working Group at the start, it can prove overwhelming.

Tip

- It is helpful to keep responsibilities in certain crucial areas, (such as advice on planning and budgeting), at the regional level and only decentralize these activities at a later stage.
- When decentralizing, it is helpful to keep finances for basic maintenance in a budget line of its own. This will ensure that the maintenance activities take place and the monies set aside for them cannot be diverted for other activities.

In principle, the district technical staff should be employed by the hospital at which they are based, or by the district health authority. They should be supervised and assisted by a larger Zonal HTM Team or the Central HTM Team.

Regional or Provincial Level

Each large administrative zone (such as a region or province) should also establish its own Regional HTM Team and Working Group, which is responsible for running the HTM Service in their area. At this level, the HTM Service will:

- provide consultancy support as well as management and technical advice to regional and district health management teams on healthcare technology issues
- undertake maintenance and other HTM activities (*Section 3*) at skill level 3 in the regional hospital, as well as the hospitals, health centres, and health posts in their area
- supervise and monitor the work undertaken by private sector firms and artisans
- advise on the procurement and stock control of equipment accessories, consumables, spare parts, and working materials for standardized equipment
- in selected cases, undertake centralized bulk purchasing of equipment accessories, consumables, spare parts, and working materials on behalf of health facilities in their area
- organize training courses, contact training facilities, and train equipment users and facility and district HTM Teams
- supervise and support the work of HTM Teams and Working Groups at lower levels of the HTM Service
- implement all aspects of the HTM policy
- undertake quality assurance and cost control of HTM activities at the regional level
- provide adequate representation of HTM in decision-making bodies concerned with planning and budgeting at regional and district levels
- liaise with the highest level of the HTM Service (the central or national level).

The Regional HTM Service should form a link between all the health facilities they cover in their area, and act as a means for exchanging information. The Regional HTM Working Group will also help to integrate technical services into the existing healthcare system.

Activities carried out by the Regional HTM Team will include:

- determining the range of equipment to be serviced
- visiting the health facilities in their region at regular intervals to carry out maintenance, commissioning, training
- dealing with emergency cases; and
- supervising local activities.

In principle, the regional technical staff should be employed by the hospital at which they are based or by the regional health authority. They should also be supervised and assisted by the Central HTM Team.

Central and National Level

In order to make efficient use of the proposed HTM system, the work of all the HTM Teams and Working Groups needs to be properly coordinated and monitored. This task is carried out at the central level of the HTM Service. The HTM Service of your health service provider organization will have its own central level and, in addition, the government HTM Service will have a National HTM Team and Working Group with extra responsibilities.

Your Central Level

The central level assists and supervises the zonal HTM activities, but cannot organize and run zonal HTM activities itself. Thus the responsibilities of the Central HTM Team and Working Group are to:

- provide consultancy support as well as management and technical advice to the central health management team on healthcare technology issues
- undertake maintenance requiring high level skills (level 3) for any health facility in the health service provider organization, as required
- undertake other HTM activities (*Section 3*) at skill level 4 for the facilities of the health service provider organization
- support and supervise the zonal and facility HTM Teams and Working Groups
- set budgets and supervise costs and service conditions for provision of HTM activities
- organize regular information exchanges between all parts of the HTM Service, and with the government HTM Service
- establish contacts with external training facilities, and organize and supervise regular training activities
- assist in recruitment of skilled staff for the HTM Service
- introduce nationally developed healthcare technology standards into health facilities
- introduce standardization into the health service provider's acquisition policy, preferably in line with national standardization efforts
- collect, document, and disseminate all relevant technical and economic information regarding the performance of the HTM Service
- liaise with other health service providers, donor agencies, and other relevant institutions regarding HTM issues
- establish contacts with key suppliers to ensure the provision of adequate maintenance and repair services, draw up contracts with them, and monitor and supervise their work.

Specialized maintenance tasks at skill level 4 will be undertaken by the private sector. In many countries, up until now, it has been difficult to monitor and evaluate the cost-effectiveness and quality of the services provided. Therefore, one of the key advantages of the proposed HTM system is the fact that the Central and Regional HTM Teams can supervise the quality of these contracted maintenance tasks. This ensures that the costs charged are related to the quantity and quality of services.

The central technical staff should be part of the central health authority, in a specific Healthcare Technology Management Service (HTMS) division within the health service provider organization.

The National Level

If your health service provider is the Ministry of Health, the central level of your HTM Service will be the national level that has additional countrywide responsibilities. Thus, in addition to the responsibilities listed above, the National HTM Team and Working Group also:

- advise the Ministry of Health on questions of standardization and setting-up of regulatory standards
- develop HTM policy covering all HTM activities
- develop and introduce healthcare technology standards in health facilities countrywide
- help introduce standardization in government equipment acquisition policy
- supervise and support training facilities in the country to improve the training syllabus and to control the quality of particular training institutions
- liaise with key suppliers and encourage them to establish good quality maintenance support services in the country or geographical region
- collect, document, and disseminate all relevant technical and economic information regarding healthcare technology management
- liaise with other health service providers, government authorities, donor agencies, NGOs and other relevant institutions regarding HTM issues.

The national technical staff should form a specific Healthcare Technology Management Service (HTMS) division within the Ministry of Health.

Box 25 outlines the issues to consider if you wish to determine responsibilities within your HTM Service.

BOX 25: A Checklist for Determining Responsibilities in Your HTM Service

Check whether the HTM responsibilities existing in your organization meet the following requirements:

- Is there a clear delineation of responsibility between the central, regional, district, and facility levels of your HTM Service?

Facility level

- Does any Facility HTM Team and Working Group take part in all major decisions relating to their field in their facility?
- What are the major tasks of the existing HTM Service at this level at the moment?
- Which activities are presently not provided by the HTM Service at this level?

District/diocesan level

- Does any District HTM Team and Working Group take part in all major decisions relating to their field in their district?
- What are the major tasks of the existing HTM Service at this level at the moment?
- Which services are presently not provided by the HTM Service at this level?
- Does the district-level HTM Service supervise and advise lower levels of the HTMS?

Regional/provincial level

- Does the Regional HTM Team and Working Group take part in all major decisions relating to their field in their region?
- What are the major tasks of the existing HTM Service at this level at the moment?
- Which services are presently not provided by the HTM Service at this level?
- Does the regional-level HTM Service supervise and advise lower levels of the HTMS?

Central level

- Does the Central HTM Team and Working Group take part in all major decisions relating to their field in your health service provider organization?
- What are the major tasks of the existing HTM Service at this level at the moment?
- Which services are presently not provided by the HTM Service at this level?
- Does the central-level HTM Service supervise and advise lower levels of the HTMS?

National level

If your health service provider is not the Ministry of Health, in addition:

- Does the National HTM Team and Working Group take part in all major decisions relating to their field in your country?
- Does the National HTM Team and Working Group provide advice and support on HTM issues to your HTM Service and health service provider?

Box 26 provides a summary of the issues covered in this Section.

BOX 26: Summary of Issues in Section 5 on the Organizational Structure for the HTM Service

Delivery System	**Health policy-makers, planners, and senior technical staff at the central level of your health service provider organization**	◆ determine the referral structure of the health delivery system for their health service provider organization ◆ using the technical requirements calculated in *Section 3*, the model chosen in *Section 4*, and current resources, determine: - the number of zonal administrative levels to have in the HTM Service to fit in with the health delivery system - the types of facility to have workshops ◆ determine the partners which will work with HTM staff at each level of the HTM Service (*Figure 8*)
Placing Staff	**Health policy-makers, planners, and senior technical staff at the central level of your health service provider organization**	◆ establish Facility HTM Teams and Working Groups at facilities without workshops comprising general health staff, with additional training ◆ establish Facility HTM Teams and Working Groups at facilities with workshops comprising technical staff suited to the hospital's size and outreach responsibilities ◆ preferably, establish District (or Diocesan, for example) HTM Teams and Working Groups at district level comprising small groups of existing but retrained artisans and technicians ◆ establish Regional (or Provincial, for example) HTM Teams and Working Groups at regional level comprising retrained artisans and technicians, with technologists and possible engineers ◆ establish a Central (or National) HTM Team and Working Group at central level including engineers and engineering managers ◆ ensure the technical staff at each level report to the appropriate authority
Responsibilities	**Health Management Teams, and technical staff throughout your health service provider organization**	◆ ensure tasks at the appropriate skill level (*Section 3*) are undertaken at the correct level within the organizational structure of the HTM Service ◆ ensure each level of the HTM Service supervises and supports the levels below ◆ ensure planning and budgeting responsibilities are only decentralized when appropriate management skills are available at that level ◆ ensure all other administrative and management tasks are undertaken at the relevant level of the HTM Service

6. HOW TO DETERMINE THE HUMAN RESOURCES REQUIRED

Why is This Important?

The Healthcare Technology Management Service has different human resource requirements at the various levels of the health system.

The specific requirements, including job descriptions, need to be examined in order to evaluate whether existing staff fit the requirements or need additional training. In some cases it will be necessary to hire new staff.

Strategies are required to help you to recruit suitable staff and also to retain the valuable pool of human resources in post.

Having decided on the organizational chart for your HTM Service (*Section 5*), you need to determine the human resources required to fill it, and how to obtain them. In this Section, we discuss:

- the types of staff required (*Section 6.1*)
- the numbers of staff required (*Section 6.2*)
- establishment posts and career progression (*Section 6.3*)
- terms and conditions of employment (*Section 6.4*).

6.1 TYPES OF STAFF REQUIRED

Types of Staff, their Qualifications, and Training Requirements

Different types of skills are required at the various levels of the Healthcare Technology Management Service. These are provided by:

- equipment users
- craftspeople, artisans, and technicians
- health service technologists and engineers
- HTM Managers
- support staff.

In the section that follows, we list the qualifications required for these different types of staff for employment in the HTM Service. Typical job descriptions for the technical staff are given in *Annex 3*.

Job descriptions are essential tools for managers, enabling them to make the best use of the staff available, to plan for further training, and to recruit suitable people. A clear job description is equally important for each worker, providing a guideline for the work expected of them, the required skills, and possible ways to achieve promotion. However, you must be careful not to limit any individual to work only at a specific level, since doing so could seriously hamper the running of the HTM Service. An engineer must sometimes be prepared to do work described for technicians – or even, occasionally, to carry out the work of a cleaner.

Equipment Users

Equipment user
someone who operates equipment

Equipment users play a key role in ensuring that the HTM system runs smoothly. They are often the first to detect deficiencies when using the equipment and, through correct use of the equipment, can help to avoid problems later on. If they have been taught the relevant skills, they can also maintain and repair some equipment at skill level one (*Section 3.2*).

Equipment users cover a very broad group consisting of people such as:

- clinical staff, medical personnel, health personnel
- plant operators
- attendants
- patients
- in-house technical staff
- patient caretakers
- administrative staff
- drivers.

Some equipment users, such as laboratory technicians or laundry supervisors, may already have received training in handling their equipment. Others need intensive training to cover the proper care and basic maintenance of all types of healthcare technology (see *Box 1*). Equipment users also need skills for other HTM activities, such as safety procedures, record-keeping and stock control of consumables. This training needs to be provided regularly. Much of it can be undertaken on-the-job, but planned refresher courses are also helpful. See *Guide 4* on operation and safety for more details.

For HTM activities, equipment users need supervision by the technical staff in the HTM Service.

Craftspeople, Artisans, and Technicians

Craftsperson skilled person who works with their hands; a craftsperson is someone with craft skills such as a plumber, carpenter or electrician. The category encompasses both those with informal training (such as handymen) and also trade-test holders at various levels (known as 'artisans').

Technician someone skilled in a craft such as mechanics, refrigeration, electricity with academic knowledge of how to put the science of their skills into practice. This category ranges from those with a craft certificate at various levels from a vocational training college, to those with a basic-level technical diploma from a technical college.

Existing craftspeople and technicians can often carry out basic maintenance tasks in health facilities. To perform these tasks, staff do not necessarily need to have successfully completed a formal technical training programme in healthcare technology. Staff who have graduated from secondary education and are able to use conventional standard equipment such as hand tools, drilling machines, presses or grinders, can be retrained for these jobs.

It is possible that your country may already provide nationally recognized trade-testing schemes at various levels for artisans, and vocational training courses at various levels for technicians (such as plumbers, electricians, mechanics, masons, etc). If so, you might simply be able to employ technical staff who have already been through these training schemes. Such staff would provide a skilled pool of resources and would require less re-training. However, they will still need to be trained in areas such as the specifics of working in a health facility, particular requirements of electro-medical equipment, and the full range of HTM activities (*Section 3*).

Many countries find it most useful for these craftspeople and technicians to be 'polyvalent' – in other words to have skills in many engineering disciplines. This all-round knowledge makes them the most useful to employ when you have few posts but a wide range of tasks to address. It also means that at all times they can make use of one or other of their skills, rather than waiting for jobs to arise that call for one specific skill.

Your training (or re-training) programme for such technical staff could include:

- Basic training – this should be sufficient to acquire a fundamental knowledge about basic electricity, mechanics, optics, pneumatics, as well as the characteristics of working materials.
- On-the-job training – this should orient staff to the particular needs of healthcare technology, working in the health service, and other HTM activities such as record-keeping, stock control, and updating inventories. This training could be provided by staff from the Regional or Central HTM Teams.
- Skill-development – participation in tailor-made, short-term training courses at vocational training institutes.

On successful completion of their training, the handymen, artisans, and technicians could gradually take over most of the basic tasks (skill levels one and two – see *Section 3.2*) in health facilities and at the district level.

Health Service Technologists and Engineers

Technologist someone highly-skilled in a craft such as refrigeration, electronics, electricity, with considerable academic knowledge of how to put the science of their skills into practice; someone with a technical diploma at various levels from a technical college.

Engineer someone qualified in a branch of engineering such as electrical, mechanical, or electronics, with advanced academic knowledge of controlling, designing, and building equipment, and using their skills to develop original ideas. This ranges from someone with a higher national diploma from a technical college to someone with a bachelor degree in engineering.

Health service technologists should have basic-level diplomas from local technical colleges in one or more of the range of technical skills required for healthcare technology (mechanics, electronics, refrigeration, etc). If there are no specific healthcare technology training courses in your country, these staff will also require extensive on-the-job retraining.

Health service engineers usually require a degree in electrical or electronic engineering. In some places a degree in mechanical engineering is required, to reflect the large contribution of plant and service supply installations. The engineers also require considerable work experience in biomedical engineering, preferably in the health service.

In the regional and large HTM Teams, the health service technologists and engineers are capable of performing the more complex tasks at skill level three (*Section 3.2*). However, their roles and responsibilities vary.

Health service engineers undertake the highest level tasks due to their engineering degree background. They lead the activities of the HTM Service, supervising and directing the work of technologists, technicians, and craftspeople. To allow the engineers to concentrate on the more sophisticated jobs, it is important that they are supported by the full range of other technical staff, who can perform the lesser skilled work.

Since the engineers also assist the regional and district health management teams, they require some management skills and business knowledge. This enables them to actively participate in budgeting, cost accounting, and personnel management. They also require teaching skills that enable them to deliver formal and on-the-job training to the technicians and craftspeople in the HTM Service.

HTM Managers

Heads of all HTM Teams are called HTM Managers. However the proportion of management (compared to technical) work will vary according to their level within the HTM Service structure (*Section 3.3.1*). A greater depth of management skills is required at the higher levels of the HTM Service.

At lower levels, within facilities up to district hospitals, the HTM Manager will be the most senior technical person available. It is likely that it may be sufficient for them to have learned management skills on-the-job from supervising managers within the facility, or from higher up the HTM Service. For Regional and Central HTM Managers, who are likely to be engineers, it would be appropriate to have undertaken some formal management training.

The Central and National HTM Managers are engineering managers. They require additional skills to those at regional level, since they are the head of their HTM Service. They should possess much greater work experience, preferably not only limited to one region or country. The National HTM Manager also requires significant skills in human relations and experience in dealing with government bureaucracies, in order to negotiate changes in the national regulatory framework. The status of the National HTM Manager is important, thus training should enable them to be on the same level as similar programme managers within the hierarchy of the health service.

Support Staff

Throughout the HTM Service, support staff are also required, such as:

- clerks
- secretaries
- cleaners
- stores personnel
- drivers.

The training of support staff should be appropriate for, and equivalent to, similar workers elsewhere in the health sector. In-service training should be provided to ensure they have the skills appropriate to their role within the HTM Service.

Training Summary

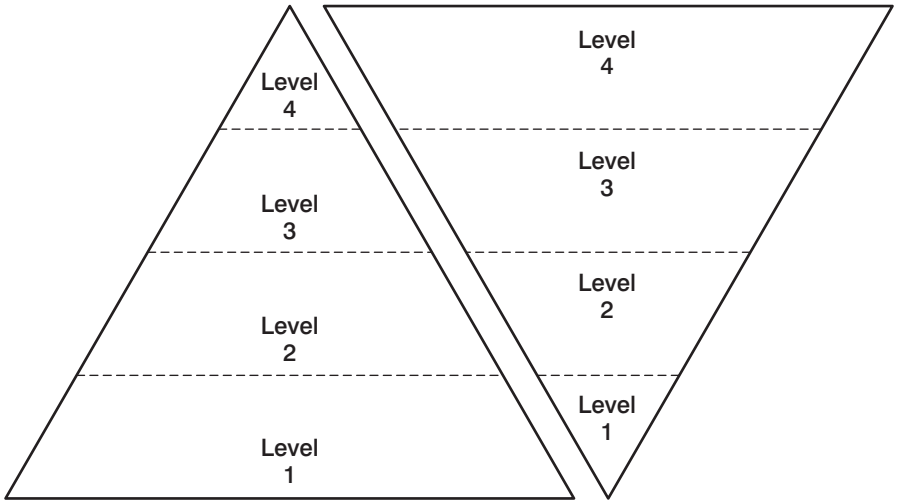
To be able to recruit technical staff with the skills described, you will need to identify sources of basic training in your country or geographical region. *Box 27* presents the different sorts of basic training required. Your health service provider and the HTM Service can negotiate with training institutions to modify some courses to be more useful to the fields of healthcare technology maintenance and management (see *Guide 5*). Depending on your country, the availability of such courses and your access to them will vary.

BOX 27: Basic Training Requirements (see *Annex 2*)

- on-the-job training
- various grades of trade tests for artisans
- various grades of certificates and diplomas for technicians and technologists
- degrees for engineers
- healthcare technology specific training courses
- management training courses

In summary, *Figure 10* provides a visual way of understanding how staff are allocated across the HTM Service. You will see that you need many people with lower skills and a few with the highest skills. However, those few highest skilled staff require the greatest training input. Adequate in-service training is required for each type of staff (as described above) if you are to fill the wide variety of technical posts, and ensure that specialists for many technical disciplines are available.

Figure 10: Relationship Between HTM Service Staff Skills, Numbers Required, and Training



Left-hand pyramid – numbers and skill level of required personnel
Right-hand pyramid – level and breadth of training required

Adapted from: WHO, 1989, 'Inter-regional meeting on manpower development and training for health care equipment management, maintenance and repair: Campinas, Brazil, November, 1989', Geneva, Switzerland, WHO/SHS/NHP/90.4

Country Experience

Some developing countries, with a sufficient planned throughput of students, have established specific training courses for healthcare technology maintenance and/or management to supply their own HTM Services. Often, they have also opened these courses to students from their geographical region.

For example, appropriate technician training courses, partly recognized by WHO, have been established with GTZ assistance in Kenya, Senegal, Jordan, Peru, El Salvador and Chile.

Other recommended training courses offering higher qualifications in healthcare technology maintenance and/or management are based at universities in British Columbia (Canada), Glasgow (Scotland), Compiegne (France), and Cape Town (South Africa) (see Annex 2 for further reference materials and contacts).

6.2 NUMBERS OF STAFF REQUIRED

If your health service provider is to guarantee the good physical condition of its equipment, it is essential to recruit sufficient staff, with the appropriate skills, for the HTM Service. Without the necessary staff, it will be very difficult to ensure effective equipment operation.

Each HTM Team needs a minimum staffing level to be able to carry out the required HTM workload for all types of equipment, whether carrying out the HTM activities themselves or monitoring others doing them. The responsibility for managing the equipment should always remain with the health service provider. Therefore, as an absolute minimum, you need to employ sufficient staff to maintain full control of equipment, as well as monitoring the work of contractors and staff hired on an occasional basis. Further, more qualified staff are also considered to be essential at workshops, to ensure all equipment is functioning and continuously reliable.

Tip

- If your health service provider organization is going through a restructuring programme (a common process in developing countries), it is important to ensure the staff required for the HTM Service are adequately reflected in the plans.

It is important that HTM Teams have sufficient technical staff with the necessary qualifications, otherwise staff will be over-stretched since they will be forced to undertake the work of others. However, there are no rules that dictate the number of staff you must employ. *Boxes 28–30* summarize advice from various sources (see *Annex 2*).

Box 28 presents suggestions for **likely minimum requirements** from international agencies with many years of experience in this field. The numbers quoted reflect the knowledge that health service providers find it difficult to hire large numbers of technical staff and must start with a small pool of staff whose skills are used for many facilities. As *Section 3* shows, the probable workload makes this possible.

BOX 28: GTZ and WHO's Suggestions for Minimum Staff Requirements at Different Levels of the HTM Service

Location	Label	Level of training	Number of staff
Ministry	Chief Engineer / Manager	Masters (MSc)	1, as head of the HTM Service
	Engineer	Degree (BSc) or Higher National Diploma (HND)	2 – 4
Regional level	Engineer	BSc or HND holder	1, as head of the HTM Team
	Technologist	Diploma holder	2 per every 100 beds in the regional hospital (from a mix of disciplines)
	Technician, artisan, handyman	Certificate holder, trade test holder, informal training	3 per every 100 beds in the regional hospital (from a mix of disciplines)
District level	Technologist	Diploma holder	1, as head of the HTM Team
	Technician (polyvalent)	Certificate holder	2 per every 100 beds at the district hospital
	Artisan, handyman	Trade test holder, informal training	3 per every 100 beds at the district hospital (from a mix of disciplines)
Health centre	General health staff	Informal training	Several appointed as maintenance officers

Box 29 is the result of input from hospital technicians and engineers from many West and East African church hospitals who, having already established HTM Services, wished to increase staff levels to maximize what they could achieve. Thus *Box 29* reflects suggestions for **staff development needs** for technical personnel over time.

BOX 29: Suggestions for Staff Development Needs According to Hospital Size from a FAKT International Seminar

Label	Level of training	Number of staff per hospital type				
		1000 plus beds	500 plus beds	200 – 300 beds	100 plus beds	30 plus beds
Engineer	BSc or HND holder	2 minimum	2	1	0	0
Technologist	Diploma holder	10	5 – 7	2 – 4	2 minimum	0
Technician	Certificate holder	20	10	4	2 – 4	1 minimum
Artisans:						
electrician	Trade test holder or informal training	6 plus	3 – 6	2 – 3	1 – 2	
plumber		6 plus	3 – 6	2 – 3	1 – 2	
carpenter		5 plus	3 – 5	1 – 3	1	
mason		3 plus	2 – 3	0 – 1	0	
painter		2 plus	1 – 3	0 – 1	2	
car mechanic		3 plus	2 – 3	1 – 2	0	
Support staff	Relevant test certificate or informal training	2	1	1	1	

Box 30 presents advice from different countries on strategies to consider when determining staffing levels.

BOX 30: Suggestions from Various Countries of Staff Requirements

Different countries suggest a number of alternative approaches:

i. The number of staff required depends upon:
   - how sophisticated your equipment is (see analysis in *Section 3.1*), and
   - how much equipment you have.

   For example, only having five pieces of equipment requiring maintenance at skill level 3 (high-level tasks) does not merit an engineer at that location.

ii. The number of staff required will vary depending upon:
   - the value of your equipment inventory (advice on calculating the value of your stock of equipment is provided in *Guide 2* on planning and budgeting)
   - the time it takes to attend to faults; and
   - the number of equipment items not working (advice on keeping these statistics is provided in *Guide 5* on maintenance management).

Continued overleaf

BOX 30: Suggestions from Various Countries of Staff Requirements (continued)

iii. Ensure staff with special skills also have basic common skills so that when they are not carrying out specialized tasks they can be busy helping with routine work. Specialists should be spread around your HTM Service and organization or country, in order to make the most of their skills. If specialized staff do not use their skills regularly, they will lose them. Thus they need to be at a place of work that presents them with enough specialized jobs to retain their expertise. For example, if you have four regions, spread your specialists around the regions so that each is serving several or all regions – region one might have the only radiotherapy team, regions two and four might have renal dialysis teams, and regions one and three have X-ray teams, etc.

iv. Whatever type (or qualification) of staff, you will have those who are experienced and those who are new young recruits. It is a common mistake to suppose that as the size of the HTM Team decreases (towards the smaller institutions) the experience of the staff should decrease. In an efficient HTM Service there will always be new staff with limited ability, but they should be placed in the larger teams to gain experience on-the-job, and not in the small two- or three-person teams where a high level of all-round ability is essential.

v. Start with small numbers of staff and expand slowly based on how productive the staff can be (see *Section 3.3.2* and *Guide 6* for discussions on and calculations for productivity).

vi. It may be difficult to find suitable technical staff and provide them with the correct training in physiology and anatomy so that they can deal with medical equipment. So some developing countries have employed doctors in their HTM Service, and trained them in the necessary electronics or engineering subjects instead.

vii. Try to encourage more women to become maintainers – there is a vast pool of women in the health service already working with equipment who may be encouraged to take a greater role in keeping the equipment stock functioning.

6.3 ESTABLISHMENT POSTS AND CAREER PROGRESSION

Establishment Posts

It is very important that your organization creates suitable establishment posts for the members of the HTM Service. These are required so that suitable staff can be recruited, hired, and placed in post from the outset. A well thought-out structure of posts, with different entry points, qualification requirements, and salaries will also help with career progression.

Many countries just starting to develop their HTM Service face great difficulties because they need technical staff but have no suitable posts. This can lead to the following difficulties:

- If technical staff are hired against other posts (such as a doctor's or laboratory technician's post), the health facility cannot have its full complement of doctors or laboratory technicians, for example.

- If technical staff are hired against posts lower than their own, their salaries may be correspondingly low. For instance, if hired against a cleaner's post, they may only receive the salary of a cleaner.
- If technical staff are placed against a nurse's post, their subsequent training qualifications might not make them eligible for promotion according to the nurse's salary scale.

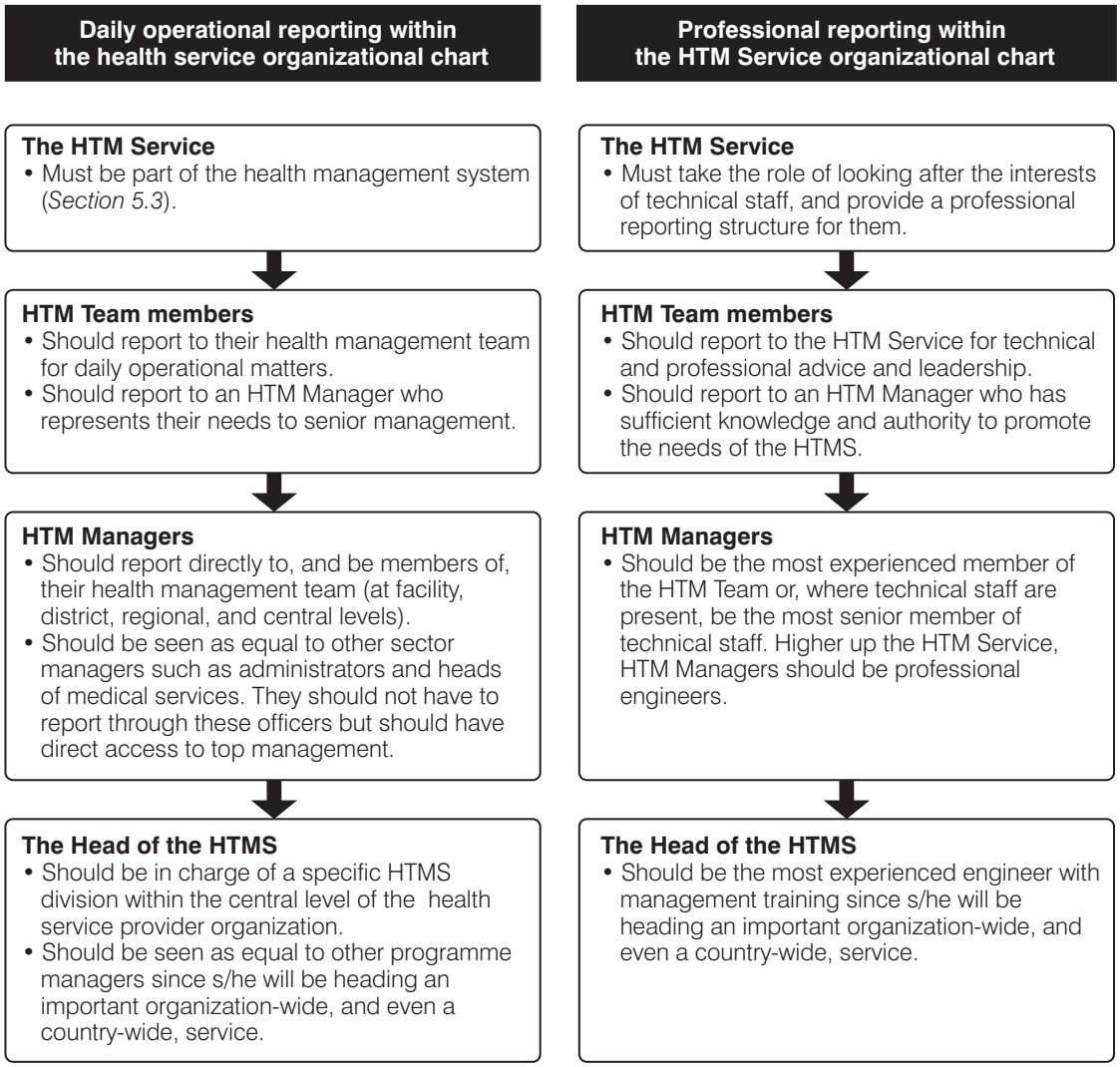
The ability to develop posts for all the different types of staff required for the HTM Service (*Section 6.1*) is dependent on negotiations with certain bodies. For example, in the government sector a body like the Public Service Commission is involved. Similarly in the non-government or private sectors, the Personnel Division or a department dealing with the structure of the health service provider organization will be involved.

When hiring and promoting staff, you must follow the guidelines and procedures set by these bodies concerning suitable entry points, salary scales, and routes for career progression. Public service rules often define the entry categories based on pre-service qualifications. These may limit your ability to attract skilled workers that may already be in short supply in the job market. Thus if there are insufficient or unsuitable posts for the HTM Service, you will have to lobby your health service provider to establish a suitable structure. We recognize however, that some developing countries face temporary problems of posts being frozen.

A Suitable Reporting Structure

It is important that the establishment posts for HTM staff ensure they are properly placed within the organizational chart for the health service as a whole, and have an effective reporting structure for daily operational matters. Also the HTM Service organizational chart (*Section 5.2*) should provide HTM staff with suitable professional support. *Figure 11* shows the reporting structures required within both the health service and HTM Service organizational charts.

Figure 11: Daily Operational and Professional Reporting Structures for HTM Staff



If technical staff in your organization are not adequately represented on management bodies, and have no professional service to take care of their needs, it will be very difficult for them to be effective in their jobs. In this case, you should lobby your health service provider to consider the role of technical staff and develop a suitable position for them within the health service.

Career Development

Ideally the HTMS will be able to pursue strategies to:

- motivate their staff
- evaluate staff performance
- use staff appraisal as a positive tool to help develop staff skills and enable career progression; and
- discipline staff when necessary.

However, their ability to achieve these goals will depend on the type of human resource policies and procedures developed by your health service provider organization.

As *Section 6.1* shows, a wide-ranging training plan for HTM Team members is essential in order to:

- enable the ongoing development of technical skills
- respond to the rapid changes in equipment designs
- provide the possibility of career progression.

Therefore, the central level of your health service provider should play a significant role in activities such as: developing and financing training plans, organizing and providing training scholarships, and approaching external support agencies to finance training programmes. The health service provider also needs to develop a clear policy on what form of 'bonding' conditions to impose, both in terms of rewards for staying and liabilities for leaving, in order to ensure that a member of staff sent for training remains with the health service on their return. Where staff receive additional training, there need to be mechanisms in place to ensure such training is recognized and to identify opportunities for promotion for technical staff.

Guides 4 and 5 provide details of the skills required for equipment users and maintainers, as well as suggestions for staff appraisals. The development of an Equipment Training Plan is covered in *Guide 2* of this Series.

6.4 TERMS AND CONDITIONS OF EMPLOYMENT

Terms of employment are essential for attracting the right technical staff to your organization. Good working conditions are also important if you want to retain staff, once recruited. One key factor is to ensure you have sufficient resources for staff to do their work, otherwise they will quickly become frustrated and demoralized.

Terms and Conditions

Reasonable salaries and other conditions of employment (such as number of days holiday, illness entitlements, and overtime payments) are the basic precondition for retaining good quality staff, and maintaining morale amongst the workforce. Poor terms and conditions of employment could lead to the loss of valuable and qualified staff. This would mean the loss of valuable knowledge of the health service's equipment and systems, which cannot be replaced even if new staff are immediately appointed. Your organization will therefore need to offer adequate salaries and recruitment packages to ensure that technical staff can be retained in employment, and may even have to help with accommodation depending on the location of their posting.

The same regulating bodies that determine establishment posts, such as the Public Service Commission in the government sector, also set the salary scales that are linked to the posts. As technical staff within health services represent a fairly new profession, the salary scales they have been placed in may not be suitable for attracting and keeping the sorts of technical staff you need. In such cases, your health service provider must negotiate with the regulating body about finding appropriate salary scales for personnel with the qualifications of HTM Team members. One great advantage of using staff who have obtained nationally recognized qualifications (*Section 6.1*) is that the salary scales for them will be fairly standard countrywide.

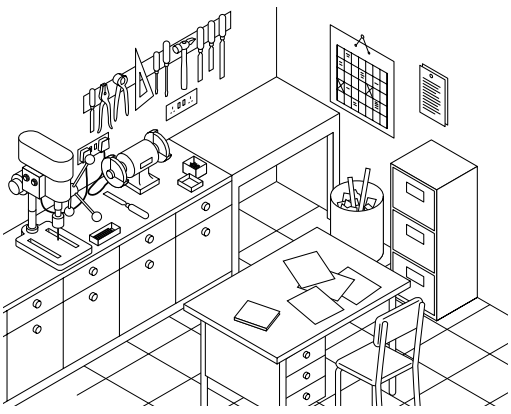
Your organization's strength with managing staff and developing their careers will depend upon its Human Resources policies and strategies. Employment conditions are important, but so are other factors such as supportive supervision, suitable tools, and other resources to undertake the work required. There should also be opportunities for staff to attend meetings and conferences to obtain further skills.

Resource Availability

Figure 5 (*Section 2.4*) shows the sort of inputs required for the HTM Service (*Guide 5* on maintenance management discusses these inputs in more detail). For HTM Teams to carry out their work effectively it is important that your health service provider ensures the provision of the following facilities and resources:

- sufficient secure workshop facilities (or maintenance rooms) equipped with suitable tools and test equipment
- adequate supplies of maintenance materials and spare parts stocked in suitably located stores
- office space including adequate filing facilities and space for record-keeping
- adequate supplies of stationery for record-keeping
- adequate technical reference material and access to information
- adequate access to transport for HTM staff so that they can carry out their tasks
- adequate funding for both the equipment stock and HTM activities.

Tip • It will be very difficult to undertake the necessary HTM work if this full range of resources is not available.



The work of the HTM Teams can only go ahead and be effective if adequate budgets are planned and allocated by your health service provider for the running of the HTM Service. Such budgets need to guarantee, as far as possible, the continuing employment of suitable staff. They also need to cover all HTM expenditure requirements, including external contracts and the supply of spare parts, tools, and other materials. *Guide 2* of this Series provides advice on how your health service provider can plan and budget for healthcare technology management.

Depending on your health service provider and country, the HTM Service may be able to generate income by charging for the services it provides. Whether this income can be used to improve the HTM Service further, thereby encouraging HTM staff, will depend on the accounting policies of the responsible finance authority (such as the treasury in the government sector, or a central finance office). *Guide 6* of this Series provides advice on how to manage the finances of the HTM Service, including the possibilities for generating income.

Box 31 outlines the issues to consider if you wish to improve the human resources available for HTM in your organization.

BOX 31: A Checklist for Improving Your Human Resources

Check whether the human resources available for HTM in your organization meet the following requirements:

- What types of staff exist in your HTM organization, and what are their qualifications?
- How many of each type of staff do you have?
- What sort of in-service training (or re-training) have you provided, to adapt the staff for HTM work?
- What establishment posts are available for technical staff?
- What is the reporting structure for HTM staff within the organizational chart of your health service?
- Does the HTM Service provide an adequate professional support structure for HTM staff?
- Does your health service provider have positive human resource policies and procedures which encourage staff and aid their career progression?
- What training plans exist for HTM staff?
- Are the terms and conditions for technical staff suitable for attracting and retaining technical staff?
- Are there sufficient resources available to enable HTM staff to do their work?

Box 32 provides a summary of the issues covered in this Section.

BOX 32: Summary of Issues in Section 6 on Determining your Human Resource Requirements

Staff Types	**Health Service Providers**	◆ develop the full range of skilled personnel within the HTM Service ◆ use job descriptions to identify suitably qualified personnel to provide the skills required ◆ establish in-service training (or re-training) programmes to adapt HTM staff to their HTM work ◆ investigate sources of appropriate training in the country or geographical region
Staff Numbers	**Health Service Providers**	◆ develop an HTM Service with at least the minimum number of staff to maintain full control of equipment and HTM work within the health service, whether in-house staff undertake the work or not ◆ preferably develop the HTM Service with enough in-house personnel to ensure that equipment is functioning and continuously reliable ◆ spread limited technical personnel around the HTM Service in order to make the best use of their skills ◆ use available advice for determining where staff are required and a variety of strategies for placing staff around the HTM Service
Posts/Promotion	**Health Service Providers**	◆ negotiate with the appropriate regulatory body (such as a Public Service Commission) to ensure sufficient establishment posts for the HTM Service ◆ ensure the establishment posts have appropriate entry points, salaries, and career progression opportunities for the needs of technical staff
	Health Service Providers, Health Management Teams, and senior HTM staff	◆ develop a suitable reporting structure for HTM staff within the organizational chart of the health service for daily operational matters ◆ develop the HTM Service so that it provides an adequate professional support structure for HTM staff ◆ pursue human resource strategies (such as a positive staff appraisal system) in order to guarantee career development for HTM staff ◆ ensure technical staff: - are adequately included in any health service training plans - have access to training scholarships - have suitable bonding conditions - have their training recognized for promotional purposes
Conditions	**Health Service Providers and Health Management Teams**	◆ establish suitable terms and conditions of employment to attract and retain technical staff ◆ provide sufficient resources for the HTM Service so that staff can carry out their work ◆ provide sufficient finances to guarantee the continuing employment of technical staff and the resource requirements for HTM

7. HOW TO SET YOURSELF GOALS AND MONITOR PROGRESS

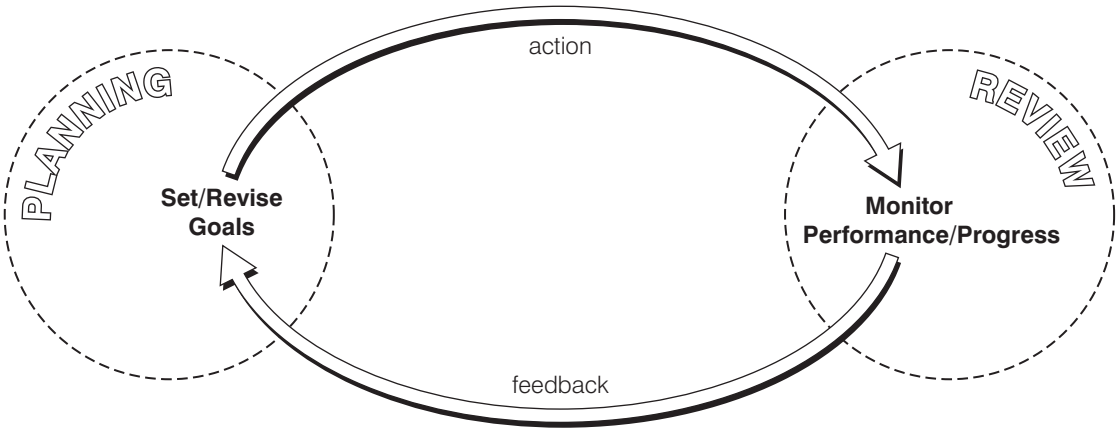
Why is This Important?

Managing the development of an HTM Service, as described in this Guide, will involve a cycle of actions.

You need to monitor your performance, and set yourself goals so that you can improve. Then you monitor your progress, revise your goals, and review your progress again – thus undertaking a continuous cycle of planning and review.

Such evaluation helps you to ensure the quality of your work. This is one element of quality management – an important goal for managers.

Figure 12: The Planning and Review Cycle



The planning and review activities are interlinked in a cycle as shown in *Figure 12*, but it is necessary to start the discussion at some point in the cycle. This Section discusses:

- the planning process (setting goals) in *Section 7.1*
- the review process (monitoring progress) in *Section 7.2*.

As your HTM Service may be new, you may have little data for monitoring, therefore this Section also discusses:

- how to gather data in *Section 7.3*.

The main outcome of the planning and review process is that you are able to evaluate your performance. This is important for ensuring the quality of your work (quality assurance), which is an essential component of quality management.

Aims of Quality Management

- client satisfaction
- cost efficiency
- compliance with laws

We recommend that quality management is introduced into the health management systems of all the decentralized levels of the health service. This can help to improve staff attitudes, and this, in turn, will enable staff to handle the challenges connected with the many reforms and new management tasks they face (such as those described in this Guide). Important elements of quality management are:

- a management team approach
- supervision and evaluation
- participative leadership
- methods for encouraging staff
- individual responsibility and initiative
- control measures, such as performance measurements and impact analysis
- community participation.

Who is Responsible for Setting Goals and Monitoring Progress?

Preference

All staff involved in developing the HTM Service should be involved in planning and reviewing their progress with this work.

Who?		Takes what action?
Policy-makers Health Management Teams Existing technical staff	→	Are responsible for planning and monitoring progress with the establishment of a new system of HTM
Health Management Teams HTM Teams HTM Working Groups	→	Are responsible for planning and monitoring progress with the ongoing development of an existing system of HTM
Which level?		**Takes what action?**
Every service level involved	→	Needs to plan and monitor progress with the system of HTM.

Tip

- The purpose of planning is to break down the large task of creating an HTM Service into smaller, more manageable, components. Monitoring progress will also provide you with evidence with which to apply for more assistance and resources.
- If you have already taken some steps towards organizing a system of healthcare technology management, evaluating what has been achieved so far will help you to determine what to do next.

7.1 SETTING GOALS FOR ORGANIZING A SYSTEM OF HTM

Purpose

Each health facility and service level needs to have goals and plans which set out activities in order of priority. The goals and plans must be clearly defined so that they guide the work of:

- health facilities
- service levels
- their staff
- the health service as a whole.

The goals and plans also enable staff and managers to monitor their own performance and progress with regard to organizing a system of HTM. This is an opportunity for the members of each team or group to agree the range of activities (initiatives and changes) they want to implement, because they believe the activities will improve:

- their working environment
- their performance
- the service they provide.

The planning process, and the plans themselves, should be clear and straightforward. This assists participation and produces goals that can be understood and used by all staff. Staff who are involved in setting goals and preparing plans are more likely to be committed to carrying them out. Thus, the planning process should incorporate representatives of all different types of staff, from all relevant disciplines involved in the HTM system.

The main purpose is to establish an **annual planning cycle** which:

- reviews past performance, problems, and needs
- identifies solutions and sets specific goals for the year
- prepares an annual action plan for delivering improvements in the coming year
- monitors implementation
- starts back at the beginning again with another review the following year.

Guides 2 – 6 of this Series have advice on how to implement an annual action planning process, with details relevant to the area of HTM activities covered in each Guide.

Setting Goals

Three types of goals are required: targets, recommendations, and longer-term objectives.

i. Targets

Targets guide the work of departments, committees (such as an HTM Working Group), and teams (such as an HTM Team) during the following year. They help to improve services and make sure that the most important work gets done. Targets are one of the best tools for judging progress and work performance. We suggest that each team/group should have between five and 10 targets, following the 'SMART' target-setting process:

Specific	state **what** should be done and **who** will do it
Measurable	easy to measure, or easy to decide that the target has been achieved or if progress is being made
Achievable	possible to carry out with **existing** staff, equipment and money
Relevant	cover a priority problem or improvement
Time-bound	state when the activity should be completed by.

It will be clearer if targets are written down using the following headings, which can be used when the final plans are produced:

Target	By whom	How to measure	How to achieve	Timetable
Actions agreed, listed in order of priority	Names of persons who will be responsible	How progress will be determined (see indicators below)	Resources required	Time-frame for start and completion

ii. Recommendations

You will discover that some important problems cannot be overcome or improvements achieved unless extra supplies, staff, or funds are provided, or unless assistance is obtained from outside. In such cases, recommendations are required. These should be:

Specifically addressed:	to the person, official, department, organization, etc that is able to carry out the recommendation.
Reasonable:	there is no point in asking for the impossible, such as ten times more staff.
Essential:	there should be no easy way for the HTM Team to achieve the same results on their own.

iii. Longer-term objectives

You will also discover some problems which cannot be solved in one year. Maybe they need large amounts of money, longer preparation, or plenty of time to achieve. Or maybe it is simply not possible to do everything at once. In such cases, longer-term objectives are required which will be carried forward to the next year, or for implementation later on.

How to Measure the Goals

Each goal must be easily measured, so that you can see if it has been achieved or if progress is being made:

- You need a way of determining if you are moving towards your goal – this is called an *indicator*. There will always be several possible indicators for each goal, and more than one way of measuring them.
- You need to know where you are starting from, (in other words, what the situation is now) – this is called the *baseline data*. The data chosen must be relevant to the indicator.

Tip • Many developing countries have little hard information, if any, to use as baseline data, since attention has only recently been focused on the management of healthcare technology. If this is your situation, you will need to start gathering data – advice on this is given in *Section 7.3*.

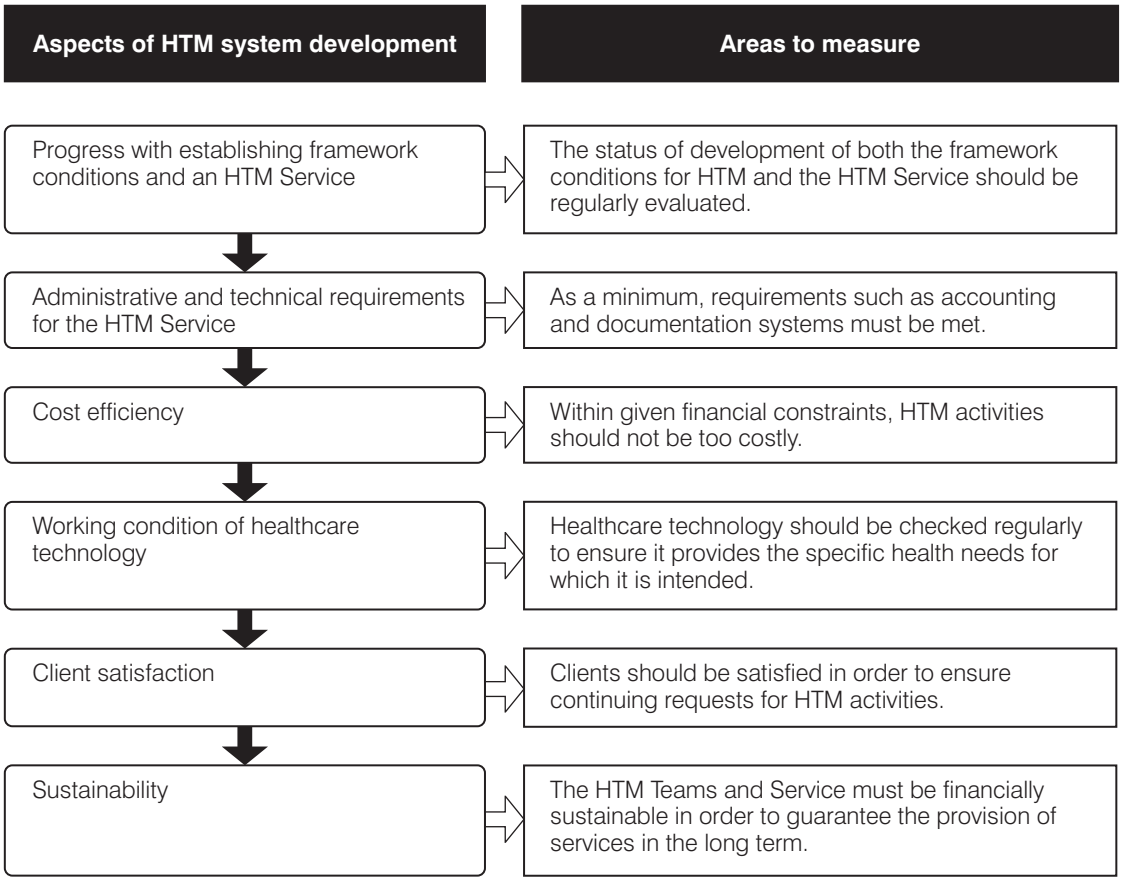
Box 33 provides an example of measuring a goal, using an indicator and baseline data.

BOX 33: Example of How to Measure a Goal

Goal:	Let's ensure that our levels of staffing for the HTM Service are as close to full as possible
An indicator:	Percentage of HTM Service staff posts filled
Calculation required:	Some staff posts will be full-time and some may be part-time. So all posts need to be calculated in terms of hours: Percentage of staff hours per week budgeted for which are actually filled $= \frac{\text{Number of staff hours filled}}{\text{Number of staff hours per week budgeted for}} \times 100\ \%$
Baseline data:	You have 20 full-time and 10 part-time posts that between them fill 1,075 hours per week. However, you only have enough staff to work 752.5 hours per week. Therefore your baseline data is 70%. Your aim is to improve this situation, and increase this percentage by 10% over the next six months.

It is necessary to choose suitable indicators that are specific to all your goals. There are many possible indicators for Health Management Teams at the centralized and decentralized levels and in health facilities, and for HTM Teams and HTM Working Groups. Thus, staff and managers should decide upon the most important activities (or statistics and results) to measure. HTM systems should be measured according to set criteria. As a guideline, *Figure 13* shows the main areas to measure. These are discussed in more detail in *Section 7.2*.

Figure 13: Main Areas to Measure when Developing a System of HTM



Tip

- You may wish to wait until your HTM system is fairly well established before setting quantitative targets, in order to avoid creating unrealistic expectations.
- To begin with, you should consider what you want to achieve at each of the health facilities assisted by the HTM Service. You can then go about the process of gathering information for each of these areas. On the basis of this data collection, you will soon be able to determine the goals to set.

The teams and groups involved in organizing the system of HTM should meet to agree on a few suitable indicators each, that can be measured easily and quickly (if possible). Positive indicators are preferable as they motivate staff. Sometimes it is useful to use common indicators for different teams, groups, and staff, so that their progress can be compared.

Once the indicators have been agreed, they need regular measuring and charting. The relevant Health Management Team will need to decide:

- how records of these indicators will be kept, for example, in a register, with a form, or on a chart
- who will be responsible for keeping them
- how regularly the results will be summarized (each month, for example)
- what form of charts and displays you will use to display the monthly summarized results (so that it is easy for people to see how they are progressing).

7.2 MONITORING PROGRESS

Purpose

Monitoring progress against goals is one of the best ways that staff, managers, and the health service provider can judge their work performance, and identify problems and needs. Therefore, it is necessary to follow up the goals you set (*Section 7.1*), in order to ensure that they are put into practice. If this is not done, there is the danger that your goals will not be followed, and all the time you spent on planning will have been wasted.

The results of such monitoring are also useful for providing feedback to staff, Health Management Teams, and the Healthcare Technology Management Service. This feedback is beneficial as it enables you to learn from your actions, and incorporate the lessons learnt into the next round of planning. By receiving feedback on their activities and answers to their queries, staff benefit from experience, and feel a part of the system as a whole.

In this way staff:

- will be informed
- can obtain support
- will feel involved and empowered
- can be encouraged to take responsibility.

During each year, and definitely at the end of each year, it is essential to review and carefully analyze the results achieved on all the team/group goals. This review should take place before starting to develop the Annual Action Plan for the following year (see *Guide 4 or 5* on running an annual action planning seminar). This step is the most important – to review results on a regular basis **with the people who are doing the work**.

This is the time to give praise for good progress, or to find out what might be causing shortcomings or problems, and then seek a solution. If solutions are quite impossible it may be necessary to change the plans. If common indicators were used for different teams, groups, and staff, it will be possible to compare their progress.

How To Monitor Progress

As we saw in *Figure 13*, there are many aspects of your development plans for an HTM system which need to be monitored. This Section discusses these aspects, and provides different indicators with which to measure performance and achievements. You can then choose those which best fit your own HTM system and adapt them to suit you own individual situation. This should help you to consider the full range of possible objectives and the alternative ways to measure them.

Once you have established your HTM system, the full range of different HTM activities you undertake will also need regular, ongoing, planning and monitoring. Indicators for these activities are covered in *Guides 2 – 6* of this Series.

Establishing Framework Conditions and an HTM Service

In the previous Sections of this Guide, we provided checklists that enable you to measure your progress in establishing HTM systems. Use these checklists to monitor progress with:

- Existence of a regulatory framework for quality health services (*Box 5, Section 2.1*).
- Adoption of standards for health services and healthcare technology in particular (*Box 7, Section 2.2*).
- Development of an HTM policy (*Box 9, Section 2.3*).
- Recognition of the importance of HTM in your country and organization (*Box 12, Section 2.4*).
- Managing change (*Box 13, Section 2.5*).

- Determining the technical requirements of your health facilities (*Box 20, Section 3*).
- Choosing a model for providing HTM and incorporating it into the health management system (*Box 22, Section 4*).
- Establishing an organizational structure for your HTM Service at different levels of the health service (*Box 24, Section 5.2*).
- Determining responsibilities at different levels of the HTM Service (*Box 25, Section 5.3*).
- Obtaining qualified staff for the HTM Service (*Box 31, Section 6*).
- Providing appropriate conditions and funding for HTM staff and their work (*Box 31, Section 6*).
- Planning and monitoring capabilities (*Box 34, Section 7*).

Administrative and Technical Requirements

Reviewing your development of the administrative and technical requirements for the HTM Service is also important. You need to evaluate factors such as:

- How are various forms used for interventions with equipment (e.g. the maintenance record system – see *Guide 5* on maintenance management)?
- Does an inventory exist (see *Guide 2* on planning and budgeting)?
- What form does your financial planning take (see *Guide 2*)?
- Is an adequate accounting system in place for the HTM Service (see *Guide 6* on financial management)?
- Are the required human resources available for HTM (*Section 6*)?
- Are all the necessary tools and safety testing equipment available to do HTM work (see *Guides 4 and 5*)?
- Are sufficient equipment consumables, accessories, spare parts, and maintenance materials provided regularly (see *Guides 4 and 5*)?
- Have different documents and guidelines been prepared to ensure good quality equipment, such as specifications and regulations for donors that supply equipment (see *Guides 2 and 3*).

Cost Efficiency

Another important area is the cost efficiency of the HTM Service. There are a number of key ways of evaluating this:

- By checking in the accounting system of the HTM Service – for example, you could look at overhead costs per unit of income, or compare how costs per unit of income develop over time.
- By measuring efficiency at the client's health facility – for example, you could compare the maintenance costs of a specific piece of equipment with the savings achieved through not having to replace the equipment so quickly (*Box 11, Section 2.4*).

- By looking at income generation set by the HTM Service – for example, you could compare the time paid for HTM activities with the time used by the staff to complete them.
- By looking at the productivity of HTM Teams – for example, you could compare how long it took to undertake specific maintenance or repair jobs with the time targeted for those jobs.

For more details on these indicators see *Guide 6* on financial management.

Working Condition of Healthcare Technology

To measure the working condition of your equipment, you should check the functioning of a representative sample of vital equipment. It makes sense for managers to regularly change this sample without informing the staff responsible for its maintenance, in order to avoid concentrating on certain forms of equipment while omitting others. There are two ways to measure the working condition of your equipment:

- If the client health facilities keep good records of their equipment, you can simply count the days per year in which your chosen set of equipment is working.
- If such records do not exist, you will need to make regular, unannounced, visits to check the working condition of the equipment. In this case, you would look at the percentage of your chosen set of equipment that is working.

Client Satisfaction

The clients of the HTM Service are people such as:

- equipment users
- health facility managers
- patients
- senior officers in the HTM Service
- decentralized health authorities
- the health service provider.

You can measure client satisfaction using standardized questionnaires. These would look at a number of different areas, including:

- promptness of intervention
- down-time of equipment
- competence of service staff
- friendliness of staff.

Sustainability

Once the HTM Service is performing adequately, you will want to sustain this good level of work.

Before measuring the sustainability of the HTM Service, you will need to agree on which area of sustainability you are looking at. It is sensible to measure the sustainability of the institution (the HTM Service and its Teams) separately from the financial sustainability of HTM activities. For more guidance on these topics see *Guide 6* on financial management.

To measure institutional sustainability, you could consider factors such as:

- percentage of management and key staff posts filled by local employees
- dependence on external assistance or contracts (days of external assistance or contracts used per year).

To measure financial sustainability, you could consider factors such as:

- percentage of costs covered by own income
- improvement of cost coverage over time
- decrease in financial assistance from external agencies, measured in local currency or as percentage of income.

Experience in Jordan

In Jordan, the Department of Biomedical Engineering is supervising 15 biomedical workshops serving 28 hospitals. In order to ensure satisfactory quality and efficiency of services, they have developed an elaborate set of forms which allows them to monitor:

- *the satisfaction of the users with the maintenance service*
- *the timeliness of the service provided*
- *the quality control of the equipment*
- *the timely ordering and the supply of spare parts*
- *the time utilization of the workshop staff*
- *the documentation process used by the workshops.*

The Department of Biomedical Engineering analyzes the forms received and organizes monthly meetings with the workshops. On the basis of the information on the forms, these meetings are used to discuss proposals for improvement and to provide feedback on past work and performance.

7.3 GATHERING DATA

Regular monitoring of activities and services is essential for improving the quality of healthcare. Management need access to such data in order to plan effectively, and to assess how equipment-related activities are carried out. Thus, it is important to have some method of collecting information.

For the development of HTM systems, monitoring of costs and performance is indispensable. It ensures you are able to correct any problems, especially during the early phases of establishing HTM systems, and helps to keep decision-makers motivated. It may be possible to incorporate this data-gathering into any existing Health Management Information System (HMIS).

Many health service providers have a HMIS to gather data regularly about all aspects of their health service. This is used to calculate statistics for factors such as the incidence of disease, and attendance at health facilities. Similarly, data-gathering and monitoring about healthcare technology should form an integral part of an information system for Healthcare Technology Management. Thus you could create a Healthcare Technology Management Information System (HTM-IS) – or, for maintenance, a Maintenance Information System (MIS). This would be designed as a sub-system of the HMIS, especially at the district level, and would enable 'evidence-based' planning to take place.

An HTM Information System (or Maintenance Information System) should be based on a few simple forms or data-sets such as the equipment inventory – see *Guide 2*, and the maintenance record system – see *Guide 5*. At a district level, this should be paper-based, in order to make it as easy as possible for the data to be gathered, otherwise staff may not do it. It should involve computer software programmes for processing the data at a higher service level (see *Annex 2*). The information gathered should record, among other things, the nature and effect of HTM interventions and the material and personnel costs involved. You can then consolidate these data and compare them with the potential losses in equipment purchase value if no HTM occurred, to provide an economical justification for undertaking HTM.

Many developing countries have little hard information to use as baseline data, since attention has only recently been focused on the management of healthcare technology. If this is your situation, there are useful resources, such as the PAD Method, for appraising the management of physical assets in healthcare (see *Annex 2*). Standardized sets of checklists are used for the various management areas, which provide a semi-quantitative and quick method of data gathering. The results can serve as a baseline for measuring project progress over several years by describing system effects rather than single technological indicators, thus are suitable for assessing mid- to long-term changes.

Box 34 outlines the issues to consider if you wish to improve your planning and monitoring capabilities in your organization.

BOX 34: A Checklist for Improving your Planning and Monitoring Capabilities

Check whether your planning and monitoring system meets the following requirements:

- Do you undertake a regular planning and review cycle of your progress with organizing an HTM system?
- Are the people who undertake HTM activities involved in the planning and review process?
- Have you set a number of goals for organizing an HTM system, which you want to achieve?
- Have you decided which indicators would show a satisfactory achievement of the different goals?
- Have you found useful and easy ways of measuring the indicators?
- Have you gathered sufficient baseline data?
- Which areas of the HTM system are you monitoring with the indicators?
- Is the monitoring of the HTM system part of your Health Management Information System?

Box 35 contains a summary of the issues covered in this Section.

BOX 35: Summary of Issues in Section 7 on Setting Goals and Monitoring Progress

Setting Goals	**Health Service Providers**	◆ ensure there is a regular and annual action planning process for organizing an HTM system, involving staff who undertake HTM activities
	Health Management Teams, HTM Teams, and HTM Working Groups	◆ set targets, recommendations, and longer-term objectives each year, in order to improve their performance with organizing an HTM system (after reviewing the previous year's performance) ◆ develop suitable measurement indicators for these goals ◆ gather baseline data
Monitor Progress	**Health Management Teams, HTM Teams, and HTM Working Groups**	◆ ensure progress against goals is monitored, displayed, and used to provide feedback to group/team staff, as well as to develop improved goals for the following year
	Health Service Providers	◆ ensure that progress against any goals (annual or regular) is used to prompt the correct response, such as training, better budgets, different contractors, career progression, etc
Gather Data	**Health Service Providers**	◆ ensure adequate baseline data for healthcare technology are gathered as a starting point, using some form of available quick appraisal method based on standardized checklists ◆ ensure the Health Management Information System is developed to include a subsystem that gathers data on healthcare technology management issues (an HTM-IS), to measure progress over the long-term.

ANNEX 1: GLOSSARY

Administrative level:	See decentralized authorities.
Artisan:	A skilled person who works with their hands; someone with craft skills such as a plumber, carpenter, and electrician. An artisan is the most experienced form of craftsperson, holding trade tests at various levels.
Autonomous:	Self-governing or independent.
Bonding:	Mechanisms to ensure staff sent for training remain with the health service on their return; conditions which impose incentives for staying and liabilities for leaving employment.
Central level:	Highest authority of your health service provider, such as Ministry of Health or Board.
Chargeable:	Services rendered, goods supplied, or activities undertaken for which an amount can be demanded as a price.
Commissioning:	A series of tests and adjustments performed to check whether, and ensure that, new equipment is functioning correctly and safely.
Communication equipment:	Any equipment that is used for sending or receiving information, such as telephones, two-way radios, nurse-call systems, paging systems.
Cost centre:	A unit of an organization that generates expenses and has no responsibility for generating revenue (income); its goal is to adhere to expense budgets, which are tailored to meet certain objectives. Which type of unit (health authority, facility, division, or department) acts as a cost centre depends on whether it is at a level that has the independence and responsibility to be allocated money, spend it, and account for the expenditure.
Craftsperson:	A skilled person who works with their hands; someone with craft skills such as a plumber, carpenter, and electrician. This ranges from someone with informal training (such as a handyman) to trade test holders at various levels (known as artisans – see above).
Decentralized authorities:	Local units of an organization which have had authority transferred to them from the central level of the organization. For example, district, regional, provincial or diocesan health authority.
Donor:	See external support agency.
Electrical safety:	The guidelines, practices and procedures to ensure that people are protected from the fatal electrical risks posed by electrical supplies, installations, and equipment.
Energy sources:	A source of energy or power, such as generating sets, solar panels or transformers.
Engineer:	Someone qualified in a branch of engineering such as electrical, mechanical, or electronics, with advanced academic knowledge of controlling, designing, and building equipment, and using their skills to develop original ideas. This ranges from someone with a higher national diploma from a technical college to someone with a bachelor degree in engineering.

Equipment-related supplies:	Items which are essential for equipment use, such as consumables, accessories, spare parts and maintenance materials used with equipment.
Equipment users:	All staff involved in use of equipment, such as clinical staff (e.g. doctors and nurses), paramedical staff (such as radiographers and physiotherapists) and support services' staff (such as laundry and kitchen workers).
Establishment posts:	Available jobs within an organization that staff can be appointed to.
External support agency:	A body responsible for providing money, equipment, or technical support to developing countries on various terms, such as international donors, technical agencies of foreign governments, non-governmental organizations, private institutions, financial institutions, faith organizations.
External support agency staff:	People working for external support agencies that health workers come into contact with, such as a country representative, desk officer, consultant, coordinating agency, director.
Fabric of the building:	Items which are part of the integral structure or framework of a building, such as doors, windows or roofs.
Facility:	See health facility.
Fire fighting equipment:	Equipment used to put out fires, such as fire blankets, buckets, extinguishers, hose and sprinkler systems.
Fixtures built into the building:	Items which are not part of the integral structure of a building but are installed into the fabric of the building, such as a ceiling-mounted operating theatre lights, scrub-up sinks and fume cupboards.
Handyman:	A skilled person who works with their hands; someone with craft skills such as a plumber, carpenter, or electrician; the least experienced type of craftsperson, with informal training only.
Head of section:	Departmental managers, such as head of department, group leader, officer in-charge, senior operator.
Health centre:	Small health facility with a few beds (for deliveries and overnight observation) and a handful of staff; a rural clinic, an urban clinic.
Health facility:	Buildings where healthcare is delivered, ranging from small units (clinics, health centres), and small hospitals (rural, district, diocesan), to large hospitals (regional, referral).
Health facility furniture:	Furniture with a specific clinical use in health facilities, such as beds, cots, trolleys, infusion stands.
Health management team:	Health management body, such as facility management committee, district/regional/diocesan/central health management team, Board.
Health post:	The smallest type of health facility with no beds and only a couple of staff; a dispensary, a first-aid post.
Health service provider:	A provider of health services, such as Ministry of Health or Defence, non-governmental organization, private institution, employer organization or corporation (for example, mine), faith organization.
Health system:	Comprises all organizations, institutions, and resources devoted to health actions (defined as any effort, in personal or public health services or through inter-sectoral action), whose primary purpose is to improve people's health. (Source: WHO).

HTM Manager:	Head of the HTM Team; ranging from a general member of health staff with some management skills in the smallest HTM Teams, to an engineering manager in the highest level HTM Teams.
HTMS:	Healthcare technology management service made up of a network of HTM Teams and HTM Working Groups.
HTM Team:	A body responsible for management of equipment, such as, equipment management team, maintenance management team, physical assets management team; part of the HTM Service.
HTM Working Group:	A working group, or standing committee responsible for making decisions on healthcare technology management issues; part of the HTM Service.
Income:	Money received, usually generating from work done or investments made; revenue.
Indicator:	Something that will provide information which shows whether progress is being made towards achieving a goal.
In-house:	Activities undertaken by staff already employed by the health service provider organization (rather than using temporary hired labour or external contractors).
Installation:	The process of fixing equipment into place; can range from building equipment into the fabric of a room, to simply plugging it into an electric socket.
Inventory:	A systematic listing of stock (or assets) held. An *annual inventory* is prepared at the end of each year following a physical inspection and count of all items owned by an organization. The list gives details, such as location, reference number, description, condition, cost and the date the inventory was taken.
Laundry and kitchen equipment:	Equipment required for kitchen or laundry activities, such as cookers, cold rooms, washing machines, hydro-extractors, roller-ironers.
Lifetime:	Lifespan, life expectancy. For equipment, the likely length of time that an item will work effectively, dependant on the type of technology and parts used in its manufacture.
Maintainers:	See maintenance staff.
Maintenance staff:	Staff responsible for maintenance of equipment, such as craftspeople, artisans, technicians, technologists, engineers.
Manager:	Any staff involved in the management of equipment-related activities. This could include administrator, nurse-in-charge, medical superintendent, chief executive, director, health secretary, medical practitioner, maintenance manager, policy-maker.
Medical electrical safety:	The guidelines, practices and procedures to ensure that people are protected from the fatal electrical risks posed by medical equipment. There are stricter requirements than for electrical safety as medical equipment comes into direct contact with patients' bodies.
Medical equipment:	Equipment used for medical purposes, including X-ray units, diathermy units, suction pumps, foetal doppler, scales, autoclaves, infant incubators, centrifuges.

Office equipment:	Equipment used in an office, such as computers, photocopiers, calculators, record systems.
Office furniture:	Furniture used in an office, such as desks, chairs or filing cabinets.
Percentage efficiency:	The proportion of available working hours that staff spend working productively (carrying out tasks for their employer).
Plant, general:	Machinery such as boilers, lifts, air-conditioners, water pumps or compressors.
Polyvalent technician:	Technician with skills that cover a range of engineering disciplines.
Productivity:	A comparative measure that links outputs to a single unit of inputs, thus if one worker using the same tools can produce more goods than another, he or she is said to be more productive. Linked to efficiency since a more efficient organization will produce the same outputs at lower cost, and linked to effectiveness since an effective organization will be more productive (produce more outputs for the same cost).
Profit centre:	A unit of an organization that generates both revenue and expenses; its goal is to have revenue exceed expenses.
Quality control:	A system of maintaining standards; testing a sample against specifications.
Service supply installations:	Supply installations such as electrical installations, water and sewage pipelines, gas supplies.
Standard:	A required or agreed level of quality or attainment set by a recognized authority, used as a measure, norm, or model for all aspects of health services and healthcare technology.
Standardization:	Rationalization, normalization, and harmonization. In other words, reducing the range of makes and models of equipment available in stock, by purchasing particular or named makes and models.
Stock:	In stores, this is the goods held by an organization for its own use. The 'equipment stock' is all the equipment assets owned by an organization.
Support staff:	Additional types of support staff in the health service besides medical personnel, such as planner, finance officer, procurement officer, stores controller, human resource officer.
Technician:	Someone skilled in a craft such as plumbing, carpentry, electricity with academic knowledge of how to put the science of their skills into practice; ranges from someone with a craft certificate at various levels from a vocational training college, to someone with a basic-level technical diploma from a technical college.
Technologist:	Someone highly skilled in a craft such as mechanics, refrigeration, or electricity, with considerable academic knowledge of how to put the science of their skills into practice; someone with a technical diploma at various levels from a technical college.
Training equipment:	Equipment required when running a training course, such as overhead and slide projectors, video and tape recorders.
Users:	See equipment users.
Vehicles:	Any conveyance used for transporting people, goods, or supplies in the health service, such as ambulances, cold-chain motorbikes, mobile workshops, lorries, buses.

Walking aids:	Items used to aid mobility, such as wheelchairs, zimmer frames, crutches.
Waste treatment plant:	Any plant used to treat waste, including incinerators, septic tanks or biogas units.
Working group:	A group of people set up to be responsible for a particular subject area, such as a standing committee, select committee, sub-committee.
Workshop equipment:	Equipment used in a workshop, such as hand tools, bench tools or test instruments.
Your organization:	See health service provider.

BOX 36: WHO's Definition of the Technology Management Hierarchy

Equipment support:	undertaking maintenance and repair.
Equipment management:	using the equipment database (inventory and maintenance history) to help you make decisions for improving equipment support.
Asset management:	including cost and utilization information (life-cycle cost analysis) in the equipment database to help you make decisions on replacement and acquisition.
Technology assessment:	reviewing past, current, and future technologies to determine their efficacy and effectiveness, and to help you make decisions for capital planning and acquisition.
Technology management:	using: equipment equipment support equipment management asset management technology assessment to manage technology in health care from conception to retirement.

Source: Department of Health Service Provision, World Health Organization, 2000

ANNEX 2: REFERENCE MATERIALS AND CONTACTS

This Annex is in two parts, and provides information about:

Part i. Books, guidelines, databases, and websites

Part ii. Organizations, sources of publications in part i, resource and information centres, and training institutes.

i. Books, Guidelines, Databases, and Websites

The following books, guidelines, databases, and websites are listed in subject categories according to the topics found in Sections of this Guide. For each publication, a brief description of the content and the main source(s) are included. Contact details for the source organizations are included in *Part ii*. Readers should note that many of the publications are available at low cost. In some countries it may also be possible to obtain these publications from local bookstores, as publishers and distributors increase efforts to ensure wider availability. Published prices may be flexible depending on the order size, discounts available and distribution method.

Tip

- Many books and documents cover a variety of topics that apply to several Sections of this Guide. The first time they appear in this list they are described in full. For each subsequent entry only the basic details are provided.

Healthcare Technology Management Framework Issues

This material covers issues in *Sections 1 and 2*, such as health service definitions, the place of HTM in health systems, policy issues, regulation, standards, and literature that discusses many aspects of HTM. It is listed alphabetically by title. A great deal of this material is aimed at senior planners within health service provider organizations.

Health sector development

Draft final report of the informal consultation on physical infrastructure, technology and sustainable health systems
WHO, Health Systems Department (1998)
This report provides an overview of the important role of physical infrastructure in health systems, and the increasing challenges that health service providers will face in the future.
Available from: WHO

Health and disease in developing countries
Lankinen K et al (eds) (1994). MacMillan Press. ISBN: 0 333 58900 9
This comprehensive book covers health and disease from the wider perspective of development in general. It is of particular interest to medical and other professionals working in developing countries or for international cooperation agencies. It is a valuable resource for district medical officers, and students taking courses in public health and tropical medicine. Besides sections on: society, economy and health; infectious diseases; and challenges for health care, there is a section on health services to meet the challenges. This section contains chapters of particular relevance to equipment, such as:

1. **Medical equipment management.** Temple-Bird C, Chapter 52
2. **Essential laboratory services.** Willcox W, Chapter 51

Available from: book suppliers

Health in the commonwealth: Challenges and solutions 1998/1999
Commonwealth Secretariat (1999). Kensington Publications Ltd, London
This digest of articles covers a wide range of health issues, such as: resources and planning; equity of access; medical technology and equipment; health promotion; mother and child health; community health; communicable and non-communicable diseases, etc. The content is aimed at policy-makers and planners. There is a range of technology articles on equipment, telemedicine, hospital design, sanitation, vector control, water and air supplies, such as:
1. **Managing healthcare technology.** Temple-Bird C, pp 57-60
Available from: Commonwealth Secretariat

Public and private roles in health: Theory and financing patterns
Musgrove P (1996), World Bank, Washington, USA. ISBN: 0 8213 3710 6
This book looks at the complex nature of the appropriate role for the state in health. State action is recognized for public services, to address poverty and inequality, and failings in insurance markets for health care. The insurance domain presents the most costly and difficult problems, and explains why governments tend to finance an increasing share of health care as incomes rise. The book discusses regulation, mandates and provision of information that are crucial public instruments.
Available from: www-wds.worldbank.org

Service and maintenance in developing countries
Issakov A (1994). In *Medical Devices: International Perspectives on Health and Safety*, Gruting C W D van (ed), Elsevier Science, Amsterdam, The Netherlands
This document presents a problem analysis to explain why so many health sectors are facing difficulties with the widespread introduction of healthcare technology. It also presents an overview of the strategies required for a healthcare technical service and policy, physical and human resources, and training.
Available from: WHO,

The world health report 2000: Health systems – Improving performance
WHO (2000). ISBN: 92 4 156198 X
Drawing from a range of experiences and analytical tools, this book traces the evolution of health systems, explores their diverse characteristics, and uncovers a unifying framework of shared goals and functions. The book presents three fundamental goals for health services, and shows that the achievement of these goals depends on the ability of each health system to carry out four main functions. It aims to stimulate debate about better ways of measuring health system performance and thus finding a successful new direction for health systems to follow.
Available from: WHO

World development report 1993: Investing in health
World Bank (1993). Oxford University Press, New York, USA. ISBN: 0 19 520889 7
This report examines the controversial questions surrounding health care and health policy, and advocates a threefold approach for governments in developing countries and those in transition. First, to foster an economic environment that will enable households to improve their own health. Second, to redirect spending away from specialized care and toward low-cost and highly effective activities, by adopting packages of public health measures and essential clinical care described in the report. Third, to encourage greater diversity and competition in the provision of health services.
Available from: World Bank

Developing healthcare technology policy

Examples of Policies

A number of health service providers have already developed their own healthcare technology policies, as well as implementation guidelines to go with them. For more information, contact:

- Dr P Asman, Biomedical Engineering Unit, Ministry of Health (Room 33, MOH Building), PO Box M-44, Accra, Ghana. Email: nchtm@africaonline.com.gh
- Ministry of Health, PO Box 7272, Kampala, Uganda. Email: info@health.go.ug, website: www.health.go.ug/support_system.htm
- Dr N Forster, Under Secretary: Health and Social Welfare Policy, Ministry of Health and Social Services, Private Bag 13198, Windhoek, Namibia. Email: nforster@mhss.gov.na
- Director of Health, Lusaka Urban District Health Board, PO Box 50827, Makishi Road, Lusaka, Zambia. Email: msinkala@lycos.com
- Department of Hospital Services, Ministry of Health, 151-153 Kampuchea Krom Boulevard, Phnom Penh, Kingdom of Cambodia. Email: procure.pcu@bigpond.com.kh, website: www.moh.gov.kh

Health care technology management No.1: Health care technology policy framework
Kwankam Y, Heimann P, El-Nageh M, and M Belhocine (2001). WHO Regional Publications, Eastern Mediterranean Series 24. ISBN: 92 9021 280 2
This booklet is the first in a series of four titles. It introduces the ideas of and behind health care technology management, defines terms relating to and sets objectives for health care technology management policy. It examines what should go in to such a policy, and the national policy framework and organization. Capacity-building and human resources issues are considered, as well as economic and financial implications. Attention is also given to legislation, safety issues, cooperation nationally and between countries, implementation, monitoring, and evaluation.
Available from: WHO

Health care technology management No.2: Eastern mediterranean regional strategy for appropriate health care technology.
Kwankam Y, Heimann P, El-Nageh M, and A Issakov (2001). WHO Regional Publications, Eastern Mediterranean Series 24. ISBN: 92 9021 283 7
This booklet in the Series looks at the development of a regional strategy for health care technology management. It examines the social and economic justifications for such a strategy, and addresses the key issues and expected results. It considers human resource development, operational research, implementation of a regional strategy, and criteria for success.
Available from: WHO

Health care technology management No.3: Health care technology policy formulation and implementation
Schmitt R, Cheng M, Heimann P, and M El-Nageh (2001). WHO Regional Publications, Eastern Mediterranean Series 24. ISBN: 92 9021 281 0
This booklet in the Series looks at national policy formulation and implementation. It identifies the important players in the process, and outlines the procedures to be followed and bodies to be set up as the policy is developed and implemented. The importance of public participation in emphasized. Convenient checklists are provided, breaking down the policy formulation and implementation process.
Available from: WHO

Health care technology management No.4: Country situation analysis
Porter D, Morris R, Heimann P (2001). WHO Regional Publications, Eastern Mediterranean Series 24. ISBN: 92 9021 282 9
This booklet in the Series outlines guidelines for conducting a country situation analysis for health care technology management purposes. It summarizes the thinking behind and the need for country situation analyses, and sets out objectives for such projects. Guidelines and handy checklists are provided so that countries can carry out their own situation analyses of health care technology management status.
Available from: WHO

Interregional meeting on the maintenance and repair of health care equipment: Nicosia, Cyprus, 24–28 November 1986
WHO (1987). WHO/SHS/NHP/87.5
This document provides a comprehensive discussion of the problem of non-functioning equipment and of proposed solutions. The major policies, recommendations, and strategies proposed by the conference on the issue of maintenance and repair of health care equipment are presented. It includes four Working Papers that cover in detail: maintenance and management of equipment, the proposed health care technical service, manpower development, and training.
Available from: WHO

Management of equipment
DHSS, UK (1982). Health Equipment Information No. 98
The aim of this booklet is to recommend a system of equipment management that, if fully implemented, would ensure that all equipment used in the British National Health Service was suitable for its purpose, was maintained in a safe and reliable condition, and was understood by its users. Its recommendations and procedures are structured into sections on equipment selection, acceptance procedures, training, servicing (maintenance, repair, and modification), and replacement policy.
Available from: Her Majesty's Stationery Office (HMSO).

Medical equipment in sub-Saharan Africa: A framework for policy formulation
Bloom G H, and C L Temple-Bird. (1988). IDS Research Report Rr19, and WHO publication WHO/SHS/NHP/90.7. ISBN: 0 903354 79 9
This book provides a good overview of the situation of medical equipment in Africa. Its approach to the analysis is to unpackage medical equipment technology into its component activities, such as planning, allocating resources, procurement, commissioning, operation, maintenance, training, etc. It provides good general policy formulation strategies to address the problems discussed.
Available from: WHO

Practical steps for developing health care technology policy: A manual for policy-makers and health service managers in developing countries
Temple-Bird, C L (2000). Institute of Development Studies (IDS), UK. ISBN: 1 85864 291 4
This book is a practical step-by-step guide for developing health care technology policy. It can be used by health service providers, regional and district health authorities, health facility managers, and external support agencies. It describes a process for developing health care technology policy which is collaborative, participatory, iterative, and involves community stakeholders. Guidance is provided on underlying management concepts, undertaking a situation analysis, running a ideas workshop, formulating policy, developing an implementation plan and procedures manual, as well as the resources required to complete these tasks.
Available from: Ziken International Consultants Ltd

Strategic medical technology planning and policy development
Raab M (1999). Swiss Centre for International Health. August 1999.
This paper discusses the challenge of the fast expansion in technologies, and the choices that have to be made in manage them. It looks at healthcare technology assessment, the elements and formulation of a healthcare technology policy, and the strategic planning process required.
Available from: SCIH

Understanding healthcare technology management

International seminar for hospital technicians/engineers: February 1998, Moshi, Tanzania
Clauss J (ed) (1998). FAKT
This document reports the results of intensive work by 38 national and international experts brought together from faith, public, and private agencies to strengthen equipment management measures in the health sector. It includes papers, with country examples, on healthcare technology management, financing maintenance, cash control, equipment standardization, networking, structures of health care technical services (including MBEHOMA), and training.
Available from: FAKT

International workshop on healthcare technology management: 2-6 October 2000, Catholic Pastoral Centre, Bamenda, Cameroon
Clauss, J (ed) (2000). FAKT
This document reports the results of intensive work by 35 national and international experts involved in setting up and operating systems for the sustainable management of healthcare technology. It includes papers, with country examples, on healthcare technology management, the role of stakeholders, public/private partnerships for providing HTM, cost-effective maintenance and repair services, and acquisition and utilisation of healthcare technology.
Available from: FAKT

Medical equipment in Botswana: A framework for management development
Temple-Bird C L, Mhiti R, and G H Bloom (1995), WHO publication WHO/SHS/NHP/95.1
This book reports on the results of a study of the healthcare technology sector in Botswana, and the lessons learnt are of relevance to many other countries. The study was undertaken by unpackaging the sector into its component activities, such as planning, allocating resources, procurement, commissioning, operation, maintenance, training, etc. In this way the book provides good general healthcare technology managment strategies to address the problems discussed. This book also describes how technical staff obtain their basic technical qualifications either as artisans at local Trade Testing Centres, or as technicians at the local Polytechnic, and provides an understanding of how such systems and qualifications work.
Available from: WHO

Medical technology management
David Y, and T Judd. (1993) BioPhysical Measurement Series, SpaceLabs Medical Inc.
ISBN: 0 9627449 6 4
This book looks at the appropriate management tools needed to make technology's role more clinically effective and cost-effective (based on the healthcare delivery system in the USA). It focuses on strategic technology planning principles, and how they contribute to improved patient outcomes. It defines many common terms, and the role of useful committees, procedures, and forms.
Available from: SpaceLabs Medical Inc.

Physical assets management and maintenance in district health management
Halbwachs H (2000). GTZ document
This paper provides practical guidance to health workers involved in district health systems concerning health technology – one of the critical areas in managing health service delivery at district level. It presents the physical assets management approach, and elaborates on key strategies for maintenance, financing, quality control, monitoring indicators, and a basic paper-based maintenance information system.
Available from: GTZ

The effective management of medical equipment in developing countries: A series of five papers
Bastiaan Remmelzwaal (1997). FAKT, Project Number 390
This document is aimed at the health workers, administrators, maintainers, and overseas aid workers who are involved in medical equipment management in developing countries. It examines the variation in performance with management of medical equipment in different countries, with the objective of identifying successful approaches. It addresses some of the managerial issues related to the conservation of equipment; allocation of human, financial and material resources; and acquisition and use. It looks at the structure for the HTM Service, and the HTM cycle.
Available from: FAKT

Regulations and standards

A guide for the development of medical device regulations
Cheng M (2002). Essential Drugs and Technology Programme, Division of Health Systems and Services Development, PAHO. ISBN: 92 75 12372 1
This publication has been prepared to guide regulatory authorities in all countries of the Region of the Americas in ensuring the safety, efficacy and quality of medical devices. It aims to provide guidelines for countries seeking to develop a regulation program for medical devices, at all stages in their life. It is based on, and provides an overview of, the regulatory methods in Canada, the USA, and the European Union.
Available from: PAHO, WHO

ANSI website: www.ansi.org
American National Standards Institute, which administers and coordinates US voluntary consensus standards and conformity assessment systems. The site contains catalogues of American Standards, as well as IEC and ISO standards.

CEN website: www.cenorm.be
European Committee for Standardization, which prepares European Standards in specific sectors of activity and promotes technical harmonisation in Europe. The site contains a catalogue of European Standards, many of which cover a wide range of healthcare technology.

CENELEC website: www.cenelec.org
European Committee for Electrotechnical Standardization, which develops European electrotechnical standards adopted from the international bodies such as the IEC and ISO. The site includes an online catalogue of European and international standards, many of which cover a wide range of healthcare technology.

Emergency Care Research Institute (ECRI, USA) products
This organization produces a variety of products on healthcare technology. They are available as hard copy and as software regularly renewed by subscription, with special rates for developing countries. They cover various issues, such as:

- **Healthcare product comparison system**
- **Health devices source book**
- **Health devices system**
- **Health technology monitor newsletter**
- **Health devices alerts database**
- **Inspection and preventive maintenance system**

Available from: ECRI

European Union's Directorate General 3 (Enterprise) website: http://dg3.eudra.org
The EU website providing information on pharmaceuticals, biotechnology, and medicines.

IEC website: www.iec.ch
International Electrotechnical Committee, which sets standards for the safe manufacture of electrical healthcare technology. There is a wide range of specific standards for medical electrical equipment falling under the standard numbers IEC 60101–1,2, and 3.

ISO website: www.iso.ch
International Organization for Standardization, which is a worldwide federation of national standard bodies responsible for the development of international standards and related activities. The standards most frequently referred to are those in the ISO 9000 range covering quality management for businesses.

Medicines and Healthcare Regulatory Agency (MHRA, UK) products
This agency of the UK government (formerly the Medical Device Agency) ensures medical devices and equipment meet appropriate standards of safety, quality, performance, and effectiveness, are used safely, and that they comply with relevant Directives of the European Union. The MHRA produces a variety of publications, such as:

- **Medical device alerts** (replacing former hazard notices, safety notices, device alerts, advice notices, etc.)
- **Device bulletins** (replacing former evaluation reports)
- **Device evaluations**
- **Advice on a wide variety of safety topics** (visit the website, click on contacts, then medical devices, then search under a subject area such as decontamination, or laundry for example).

Available from: MHRA

NICE website: www.nice.org.uk
National Institute of Clinical Excellence, which provides guidance to the UK National Health Service (NHS) on current best practice covering both health technologies (from medicines to diagnostic techniques) and the clinical management of specific conditions.

Regulating relationships with external support agencies that provide equipment

Guidelines for health care equipment donations
WHO (1997). WHO document WHO/ARA/97.3
This document presents guidelines that aim to improve the quality of equipment donations, not to hinder them. They are not an international regulation, but intended to serve as a basis for national or institutional guidelines, to be reviewed, adapted and implemented by governments and organizations dealing with health care equipment donations. They provide detailed guidance and checklists for both the potential donor and recipient. The guidelines are based on extensive field experience and consultations with many experts internationally. They also merge together several earlier documents, including the two listed below.
Available from: WHO

Guidelines on medical equipment donations
Churches' Action for Health (1994). World Council of Churches' publication
This paper is a guide for those accepting and making donations, and is also useful for those planning to buy equipment. It clearly lays out in point form the responsibilities of the recipient and the responsibilities of the donor.
Available from: WCC

Policy position: Donating and selling used medical equipment
International Medical Device Group (1992). pp 295-296 in *Health Devices*, Vol 21(9)
This paper discusses the pitfalls in the donation or sale of used medical equipment, ending with three recommendations for donors and recipients.
Available from: ECRI

Technical Requirements and Benefits

This material covers issues in *Section 2.4* on the financial benefits of maintenance, and *Section 3* on determining technical requirements. It is listed alphabetically by title.

Cost-benefit calculation models for optimizing technology management in healthcare facilities
Raab M (1999). Swiss Centre for International Health
This paper presents a set of tools for evaluating the costs related to clinical engineering services (whether in-house, externally contracted, or a mixture of both). These costs are balanced against the benefits reaped by the health service provider. The method of analysis used has been tested in a number of countries (mainly those in transition).
Available from: SCIH

Essential equipment for district health facilities in developing countries
Halbwachs H, and A Issakov (eds.) (1994). GTZ, Eschborn, Germany
This book describes the types of equipment required at different levels within the district health services – at health post level (sub-health centre without beds), at health centre or small district hospital level (with 1–75 beds), and at district or provincial hospital level (with 76–250 beds). It also provides guidance on the maintenance skill levels required for each equipment type.
Available from: GTZ, WHO

Hospital facilities: Assets and maintenance case histories
Porter D (1993). West of Scotland Health Boards
This paper looks at features of assets management and maintenance services in various countries. It draws on quantitative information obtained in several African countries, and for reference compares it to Greater Glasgow Health Board. It presents how analysis of the data enables estimates of the anticipated maintenance and repair workload in a facility can be made, from knowledge of a few basic parameters relating to how large and how busy the facility is.
Available from: David Porter

Interregional meeting on the maintenance and repair of health care equipment: Nicosia, Cyprus, 24-28 November 1986
WHO (1987). WHO/SHS/NHP/87.5

International seminar for hospital technicians/engineers: February 1998, Moshi, Tanzania
Clauss J (ed) (1998). FAKT

La maintenance dans les systemes de santé/ Maintenance for health systems: 4th GTZ Workshop, Dakar, Senegal, September 1993
Halbwachs H, and R Schmitt (eds) (1994). GTZ
This document reports the results of intensive work by 67 national and international experts brought together from health services and support agencies to strengthen equipment maintenance measures in the health sector. It includes papers, with country examples, on the benefits of maintenance, the place of maintenance in the district health system, maintenance management and organization, energy management, photovoltaic systems, networking and computers, and training.
Available from: GTZ

Maintenance and the life expectancy of healthcare equipment in developing economies
Halbwachs H (2000). pp 26-31 in *Health Estate Journal*, Vol 54, No. 2, March 2000, Portsmouth UK
This paper puts forward a way to estimate the benefit of maintenance, by comparing the input for maintenance with the savings achieved by extending the useful life of physical assets. The data comes from many different countries, and the analysis uses equations. The results are presented in tables that provide a range of life expectancies for 16 different types of healthcare technology.
Available from: GTZ

Maintenance strategies
Raab M (1999), Swiss Centre for International Health
This paper discusses the main factors that can optimize maintenance strategies and gives some guidelines and examples from different countries, mainly those in transition. It looks at models and structures for providing HTM, and staff skill and workload requirements.
Available from: SCIH

Reflections on the economy of maintenance: Presentation at the summit conference of the African Federation for Technology in Healthcare, Harare, Zimbabwe, 1998
Riha J, Mangenot L, Halbwachs H, and G Attemené. (1998). GTZ
This paper aims to provide convenient quantitative guidelines for engineers, administrators and decision makers on the cost implications of maintenance approaches. It explores how to define an annual maintenance cost ceiling by relating maintenance cost to the expected increase in equipment lifetime. This is achieved though the use of various equations with worked examples.
Available from: GTZ

The importance of maintenance and repair in health facilities of developing economies
Halbwachs H (1999). GTZ
This paper describes, with country examples, the consequences of a lack of maintenance and repair, and how the introduction of planned preventive maintenance can benefit the health service by providing a positive economic impact.
Available from: GTZ

WHO Interregional meeting on manpower development and training for health care equipment management, maintenance and repair: Campinas, Brazil, November 1989
WHO (1989). WHO document WHO/SHS/NHP/90.4
This document provides a comprehensive discussion of the complexities of manpower development and training for healthcare technology maintenance and management, as well as proposed strategies. It uses reports from countries, participating institutions and organizations regarding skill development for healthcare technical services. It discusses the needs, professional development, use of an equipment survey to determine manpower requirements, certification, and job descriptions.
Available from: WHO

A Model and Organizational Structure for HTM

This material covers issues in *Section 4* on models for providing HTM and its place in the health system, and *Section 5* on the organizational structure for HTM. It is listed alphabetically by title.

Healthcare equipment management
Halbwachs H. (1994). pp 14-20 in *Health Estate Journal*, December 1994, Portsmouth UK
This paper first discusses elements of an equipment management system including selection, inventories, user training, and maintenance services, as well as issues concerning energy, waste, and hygiene. It then discusses establishing an HTM system including the organizational structure, personnel requirements, and costs.
Available from: GTZ

Healthcare technical services – maintenance organizations in health systems: Models for institution building
FAKT Concept paper
This paper discusses different models for providing healthcare technical service, such as expanding existing services to cover the needs of other health service providers, establishing a separate agency run by a board, and forming an association of health facilities. The paper describes the steps involved, and provides advice on, the institutional development needed to form these new models.
Available from : FAKT

International seminar for hospital technicians/engineers: February 1998, Moshi, Tanzania
Clauss J (ed) (1998). FAKT

International workshop on healthcare technology management: 2-6 October 2000, Catholic Pastoral Centre, Bamenda, Cameroon
Clauss, J (ed) (2000). FAKT

Interregional meeting on the maintenance and repair of health care equipment: Nicosia, Cyprus, 24-28 November 1986
WHO (1987). WHO/SHS/NHP/87.5

La maintenance dans les systemes de santé/ Maintenance for health systems: 4th GTZ Workshop, Dakar, Senegal, September 1993
Halbwachs H, and R Schmitt (eds) (1994). GTZ

Maintenance strategies
Raab M (1999). Swiss Centre for International Health

Physical assets management and maintenance in district health management
Halbwachs H (2000). GTZ document

The Madagascar experience
Halbwachs H (1992). In Berche T, *The district hospital: WHO-IMT-GTZ workshop report*, Yaounde, Cameroon.
This paper discusses the implementation and success of the initiative in Madagascar of creating a first (simplest/lowest) level of their HTM Service from general staff at facility level.
Available from: GTZ

Developing Skills, Managing Change, and Monitoring Progress

This material covers issues in *Section 2.5* on managing change, *Section 6* on human resource requirements, development, and training, as well as *Section 7* on target-setting and monitoring progress. It is listed alphabetically by title.

District health care: Challenges for planning, organisation and evaluation in developing countries (2nd edition**)**
Amonoo-Larston R, Ebrahim G, Lovel H, and J Rankeen (1996). MacMillan
ISBN: 0 333 57349 8
This book contains practical support and advice intended for those in the planning, management and evaluation of health services at district level. It covers a wide range of topics based on country experience, including: staff motivation, teamwork, developing management skills, managing change, managing conflicts, and staff development; managing finances; monitoring and evaluation; as well as district health needs, plans, organization and management.
Available from: TALC

Economics for health sector analysis: Concepts and cases
Over AM (1991) World Bank, Washington, USA. ISBN: 0 8213 1335 5. SKU 11335
This training manual is designed to introduce students, especially those from developing countries, to simple economic tools in the analysis of health-sector projects. The manual can be used to supplement a course on the economics of health sectors in developing countries.
Available from: http://publications.worldbank.org/ecommerce

Healthcare equipment management
Halbwachs H. (1994). pp 14-20 in *Health Estate Journal*, December 1994, Portsmouth UK

International seminar for hospital technicians/engineers: February 1998, Moshi, Tanzania
Clauss J (ed) (1998). FAKT

La maintenance dans les systemes de santé/ Maintenance for health systems: 4th GTZ Workshop, Dakar, Senegal, September 1993
Halbwachs H, and R Schmitt (eds) (1994). GTZ

Management support for primary health care: A practical guide to management for health centres and local projects
Johnstone, P, and J Ranken, (1994). FSG Communications Ltd, Cambridge, UK
ISBN: 1 87118 02 4
This practical user-friendly book gives support and guidance to leaders in health centres and other local projects to help stimulate and maintain primary health care (PHC) in their surrounding communities. Aid workers, and others unfamiliar with PHC and basic management techniques may also benefit. Includes sections which will assist with staff motivation, such as teamwork and team effectiveness; managing oneself, others and tasks; and managing change, as well as sections on planning and monitoring progress.
Available from: TALC

Maintenance strategies for public health facilities in developing countries: Report of a workshop held in March 1989 in Nairobi by GTZ
Halbwachs H, and R Korte (1990). WHO/SHS/NHP/90.2
This report presents the results of a workshop attended by 60 participants from 18 countries including project staff and counterparts from GTZ projects in various countries, representatives of various donor agencies, and resource persons. The papers included address the different types of personnel required in maintenance services, the training they require, experiences of establishing national training courses in hospital maintenance, and ways to monitor progress with maintenance and training.
Available from: GTZ, WHO

Medical administration for frontline doctors: A practical guide to the management of district-level hospitals in the public service or in the private sector (2nd edition**)**
Pearson C (1990). FSG Communications Ltd, Cambridge, UK. ISBN: 1 871188 03 2
This book provides information for doctors who combine wide clinical responsibilities with administration and support for primary health care services. It covers a wide range of topics, with country examples, including: management structures; infrastructure and maintenance; buildings, support services, and equipment; hospital supplies; training; outreach programmes; and wider responsibilities in the district and above.
Available from: TALC

Medical equipment in Botswana: A framework for management development
Temple-Bird C L, Mhiti R, and G H Bloom (1995), WHO publication WHO/SHS/NHP/95.1
See this book's details for a description of training artisans at Trade Testing Centres and training technicians at Polytechnics.

On being in charge: A guide to management in primary health care (2nd edition**)**
McMahon R, Barton E, and M Piot (1992)
This practical guide aims to improve the managerial skills of middle level health workers. The text is reinforced with practical examples, questionnaires and illustrations that help relate the information to health workers' own experiences. Topics include identifying health problems, assigning priorities to their solution, planning and implementing programmes, and evaluating results. Also serves both as a training and reference guide, covering all aspects of primary health care management including equipment and drugs.
Available from: WHO

Results of the international survey of clinical engineering departments
Frize M (2000). IFMBE
This paper discusses how clinical engineering departments vary globally. In terms of staffing they discuss where most departments are located, how that relates to hospital size, if the departments employ more technicians than engineers, and the ongoing training provided.
Available from: www.ifmbe-news.iee.org/ifmbe-news/may2000/survey.html

Technology in health care: GTZ concepts and experience
Halbwachs H (1997). pp70-73 in *Technologie Sante*, No.31, November 1997
This paper describes the involvement of GTZ in healthcare technology management projects around the world. It describes GTZ support for the development of training courses in healthcare technology maintenance and management in various countries. The courses in Kenya and Senegal are well established, open to students from the region, and are described in *Part ii*. There is a course in Jordan, modular courses in El Salvador, a series of seminars in the Philippines, and new course developments in Chile and Peru – for more information contact Friedeger Stierle of the GTZ.
Available from: GTZ

Transfer of learning: A guide for strengthening the performance of health care workers
Intrah/PRIME II/JHPIEGO (March 2002)
This book is for healthcare workers involved in training and learning interventions and enables them to transfer their newly acquired knowledge and skills to their jobs, resulting in a higher level of performance and sustained improvement in the quality of services at their facilities.
Available from: free online at http://www.prime2.org/prime2/section/70.html

WHO Interregional meeting on manpower development and training for health care equipment management, maintenance and repair: Campinas, Brazil, November 1989
WHO (1989). WHO document WHO/SHS/NHP/90.4

See *Part ii* for regional and international training institutes, and *Guide 4* for more information on training in equipment operation.

Health management information systems

Healthcare technology information system: The case study of Mozambique with an eye on a global approach for developing and in-transition countries
Nunziata E, et al (2002). In *Report of the 2nd IEE Seminar on Appropriate Medical Technology for Developing Countries,* IEE Healthcare Technologies Professional Network
This paper describes the development of an information system for HTM and the lessons learnt. They are developing it to become a generic software tool for use in developing countries. For further information on its progress and availability, contact: Enrico Nunziata on email: engbio@botte.net.
Available from: IEE, Enrico Nunziata

PAD: Protocols for the appraisal of physical assets management in health services in developing economies
Halbwachs H (1996). GTZ
This document presents the PAD Method for appraising the management of physical assets in healthcare through the collection of hard information to use as baseline data. It contains standardized sets of checklists for various management areas that provide a semi-quantitative and quick method of data gathering. The results can serve as a baseline for measuring project progress over several years by describing system effects rather than single technological indicators, and are therefore suitable for assessing mid- to long-term changes.
Available from: GTZ

Physical assets management and maintenance in district health management
Halbwachs H (2000). GTZ document

Research into health information systems processes and technologies
Lilongwe Central Hospital and Baobab Health Partnership (2001). Project report submitted under the *DFID's Knowledge and Research programme on disability and healthcare technology*.
This paper discusses the development of an information system for health management in general, and the lessons learnt when computerizing it. For further information contact Gerry Douglas, email: gdouglas@baobabhealth.org.
Available from: KAR website

Accessing Information

These websites are sources of information concerning many aspects of health service delivery. They are locations where there is, or may be, information about healthcare technology management and organizing a system of HTM.

Africa online health website: http://bamako.africaonline.com/afol/index.php
Provides links to health information sites related to Africa. The links are organized into the following categories: health information, health news, events, African organizations, international organizations, schools and hospitals in Africa, projects, publications and health services

AFRO-NETS (African networks for health research and development) website: www.afronets.org
Forum for exchanging health research information in and between East and Southern Africa.

AJOL (African journals online) website: www.inasp.org.uk/ajol
Offers free online access to tables of contents and abstracts of over 70 journals published in Africa.

FIN: Free International Newsletters: www.healthlink.org.uk
Healthlink produces this publication that lists over 130 print and electronic health-related newsletters and magazines which are available free to readers in developing countries.

GATE (German Appropriate Technology Exchange): www5.gtz.de/gate/
The GATE Information Service seeks to improve the technological knowledge of organizations and individuals involved in poverty alleviation projects and to develop information and knowledge management systems of organizations.

Health exchange website: www.healthcomms.org
Explores issues, ideas and practical approaches to health improvement in developing countries and provides a forum for health workers and others to share viewpoints and experiences in this area.

HIF-net at WHO discussion group
Discussion list dedicated to issues of improving access to reliable health information in resource-poor settings. To join, email your name, affiliation and professional interests to: health@inasp.info

HINARI (Health inter-network access to research initiative) website: www.healthinternetwork.net
WHO initiative offering free/discounted access to journals from six leading publishers.

HNP flash website: www.worldbank.org/hnpflash
A free monthly electronic newsletter dedicated to sharing knowledge regarding the latest technical developments in the fields of health, nutrition, population, and reproductive health.

ID21 health website: www.id21.org/health
An internet based development research reporting service for health policy makers and development practitioners on global health issues. Latest research summaries are provided on a searchable website, by email and in a quarterly publication

IEE healthcare technologies professional network website: www.iee.org/pn/healthtech
The Institution of Electrical Engineers of the UK provides internet sites for a wide variety of engineering professions, with the aim of enabling people to communicate with their peers around the world and access the latest global industry news and key information sources. One of their professional networks focuses on healthcare technologies. It has also hosted a series of seminars on **Appropriate medical technology for developing countries**, and their reports can be obtained from the IEE.

INFRATECH discussion group
WHO forum for global exchange of information on infrastructure and health care technology issues
To subscribe send an email to LISTSERV@LISTSERV.PAHO.ORG enter in text: subscribe infratech 'your full name'.

KAR (Knowledge and research programme on disability and healthcare technology) website: www.kar-dht.org, and for the latest projects being funded use website:www.disabilitykar.net/
This is the Knowledge and Research Programme on disability and healthcare technology of the UK government's Department for International Development (DFID). It supports a range of projects on development and use of appropriate disability and healthcare technologies in developing countries. The website also provides links to:

- **Disability and healthcare technology newsletter** produced every six months describing the progress and findings of the projects funded
- **KaR global database** on healthcare technology publications, organizations, manufacturers, training institutions, etc.

Sphere project: www.sphereproject.org
Seeks to develop a set of universal minimum standards in core areas (water supply and sanitation, nutrition, food aid, shelter and site planning and health services) of humanitarian assistance in disaster response.

The manager's electronic resource center website: http://erc.msh.org
The ERC website is an electronic information resource and communication service for health managers, containing more than 150 ready-to-use management tools in various languages. A key feature is:

- **The health manager's toolkit**, includes spreadsheet templates, forms for gathering and analyzing data, checklists, guidelines for improving organizational performance, and self-assessment tools that allow managers to evaluate their organizations. Tools cover areas such as strategic planning, developing information systems, cost and revenue analysis, and sustainability.

WHO: Management of health services (MAKER) website: www.who.int/management
This WHO site provides information, publications, and country experiences on all types of management issues for health services, such as facility management, resource management, and district management.

ii. Organizations, Sources of Publications in Part i, Resource and Information Centres, and Training Institutes

For the following institutions we have included the name, address, contact details, a brief description of the various services they offer, and additional contact details for further relevant activities.

AfriAfya
AMREF Building, PO Box 30125, Nairobi, Kenya
Tel: 254 2 609520, fax: 254 2 609518, email: info@afriafya.org, website: www.afriafya.org
Established by Kenya-based health agencies, AfriAfya provides community access to relevant and appropriate health knowledge and information in an interactive manner. As well as a section on HIV/AIDS there is a news centre, message board and discussion forum on their website.

AFTH (African Federation of Technology in Healthcare)
PO Box 19070, Tygerberg 7505, South Africa
Email contacts: ykwankam@cht.uninet.cm, and pheimann@mweb.co.za
Professional body for those working in the healthcare technology field in Africa. Members can be both individuals and organizations. For information use website: http://ifmbe-news.iee.org/ifmbe-news/may1998/mrc.html, and look up the South African Medical Research Council (SA MRC).

AIME (Association of Institutions concerned with Medical Engineering)
Website: www.aime.org.uk

Amazon Bookshop
PO Box 81226, Seattle, Washington 98108-1226, USA
Website: www.amazon.com or www.amazon.co.uk
Internet bookshop

American College of Clinical Engineering (ACCE)
5200 Butler Pike, Plymouth Meeting, Pennsylvania PA 19462, USA
Tel: 1 610 825 6067, website: www.accenet.org
The ACCE is an organization of clinical engineers experienced in the management and support of medical devices and technology. The purpose of the ACCE is to establish a standard of competence and to promote excellence in the practice of clinical engineering in the United States and around the world. Many ACCE members are based in overseas facilities or have broad international experience. Their International Committee is able to offer training and consultation worldwide (write to the Chairperson of the International Committee at ACCE or email: icchair@accenet.org).

American Hospital Association (AHA)
Clinical Engineering Section, 840 North Lake Shore Drive, Chicago, Illinois 60611,USA
Website: http://aharc.library.net/
Their documents are published by HealthForum, use website: www.ahaonlinestore.com

AMREF International (African Medical and Research Foundation)
Resource Centre, AMREF Headquarters, Langata Road, PO Box 00506 – 27691, Nairobi, Kenya
Tel: 254 2 501301/2/3, fax: 254 2 609518, e-mail: amref.info@amref.org, website: www.amref.org
Publishes practical books, journals and other literature for health workers, and provides advice on primary health care. Runs training courses and seminars.

BOND (British Overseas NGO's for Development)
Website: www.bond.org.uk
A network of more than 260 UK based voluntary organizations working in international development and development education. BOND works to promote the exchange of experience, ideas and information by acting as a broker for a variety of relationships and by collating and distributing information.

Commonwealth Secretariat
Marlborough House, Pall Mall, London SW1Y 5HX, UK
Tel: 44 207 747 6500, fax: 44 207 930 0827, website:
www.thecommonwealth.org/publications/html/contactus.asp
This website provides access to the publications produced by the Commonwealth Secretariat.

David Porter
DCPB Overseas Support, South Glasgow University Hospital NHS Trusts, 1345 Givan Road, Glasgow, G51 4TF, UK

DFID (Department for International Development)
Website: www.dfid.gov.uk
UK government's department for international development assistance.

ECHO International Health Services Ltd
ECHO International Health Services is no longer trading as it used to. Its services can be accessed as follows:

i. the charitable foundation can be contacted at:
   ECHO, Ullswater Crescent, Coulsdon, Surrey, CR5 2HR, UK
   Tel: 44 208 6602220, fax: 44 208 6680751, website: www.echohealth.org.uk/intro2.html
ii. the trading branch of the business (wholesale providers of medical supplies and equipment) is now:
   Durbin PLC, 180 Northholt Road, South Harrow, Middlesex, HA2 0LT, UK
   Tel: 44 208 8696500, fax: 44 208 8696565, email: cataloguesales@durbin.co.uk, website: www.durbin.co.uk
iii. ECHO publications are still available from TALC (see below).

ECRI (Emergency Care Research Institute)
5200 Butler Pike, Plymouth Meeting, Pennsylvania 19462-1298, USA
Tel: 1 610 825 6000 ext 5368, fax: 1 610 834 1275, website: www.ecri.org
Offers guidance and advice on health care technology, planning, procurement and management; and health technology assessment and assistance.

Elsevier Health Science
Elsevier Books Customer Services, Linacre House, Jordan Hill, Oxford, OX2 8DP, UK
Tel: 44 1865 474110, fax: 44 1865 474111, email: eurobkinfo@elsevier.com
website: www.us.elsevierhealth.com
Books published by WB Saunders, Mosby, Churchill Livingstone, and Butterworth-Heinemann are now all members of the Elsevier Science, Health Sciences Division.

European Union (EU)
http://europa.eu.int/comm/development/index_en.htm
EU site for international development and aid.

FAKT (Consultancy for Management, Training, and Technologies)
Gansheidestrasse 43, D-70184 Stuttgart, Germany
Tel: 49 711 21095/0, fax: 49 711 21095/55, email: fakt@fakt-consult.de, website: www.fakt-consult.de
Non-profit consultancy firm, that provides information on appropriate hospital and medical equipment and training in healthcare technologies. FAKT is not a supply organization.

Global Directory of Health Information Resource Centres
Health Information for Development (HID) Project, PO Box 40, Petersfield, Hants, GU32 2YH, UK
Tel: 44 1730 301297, fax: 44 1730 265398, email: iwsp@payson.tulane.edu,
website: www.iwsp.org/directory
This is a directory of health information resource centres that is arranged alphabetically by country. Between January 2000 and May 2001, Health Information for Development (HID) compiled a Global Directory of Health Information Resource Centres (HIRCs). This is available from their website. The Directory is updated on an ongoing basis.

GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit – German government technical aid agency)
Division of Health and Education, PO Box 5180, D-6236, Eschborn, Germany
Tel: 49 6196 791265, fax: 49 6196 797104, email: Friedeger.Stierle@gtz.de
Website: www.gtz.de/de/4030.htm
Friedeger Stierle is the contact for the GTZ's healthcare technology management programme, and any articles or documents on HTM.

Healthlink Worldwide
Cityside, 40 Adler Street, London, E1 1EE, UK
Tel: 44 20 7539 1570, fax: 44 20 7539 1580, email: info@healthlink.org.uk,
website: www.healthlink.org.uk
Publishes a range of free and low-cost newsletters, resource lists, briefing papers and manuals about health and disability.

HEART Consultancy
Quadenoord 2, 6871 NG Renkum, The Netherlands
Tel: 31 317 450468, fax: 31 317 450469, email: jh@heartware.nl, website: www.heartware.nl/
Consultancy firm working in all aspects of healthcare technology management in developing countries. It also produces and supplies the PLAMAHS software package for managing the inventory, model lists, maintenance, and procurement needs for your healthcare technology stock.

Institute of Healthcare Engineering and Estate Management (IHEEM)
2 Abingdon House, Cumberland Business Centre, Northumberland Road, Portsmouth, Hants PO5 1DS, UK
Tel: 44 23 92 823186, fax: 44 23 92 815927, email: office@iheem.org.uk, website: www.iheem.org.uk/index.php
IHEEM is the learned society and professional body licensed by the Engineering Council for all those working in healthcare engineering, estates and facilities management in the UK. Membership is applicable to architects, builders, engineers, estate managers, surveyors, medical engineers and other related professionals. The Institute aims to advance research, education and training in healthcare engineering and estate management. They produce the **Health estate journal**.

Institute of Physics and Engineering in Medicine (IPEM)
Fairmount House, 230 Tadcaster Road, York, YO24 1ES, UK
Tel: 44 1904 610821, fax: 44 1904 612279, email: office@ipem.ac.uk, website: www.ipem.ac.uk
Professional body for personnel working in the field of physics and engineering in medicine, both for the UK and overseas affiliates. It produces a range of publications and has information on a wide variety of medical equipment areas.

Institution of Electrical Engineers (IEE)
Savoy Place, London WC2R 0BL, UK
Tel: 44 207 240 1871, Fax: 44 207 240 7735, email: postmaster@iee.org, website: www.iee.org.uk
Largest professional engineering society in Europe with worldwide membership for those working in electronics, electrical, manufacturing and IT professions. Produces a wide range of publications, is a source of a wide range of information, and has a Healthcare Technologies Professional Network. Copies of their publications are available from IEE Publication Sales Department, Michael Faraday House, Six Mills Way, Stevenage, Herts SG1 2AY, UK
Tel: 44 1438 767 328, fax: 44 1438 742 792, email: sales@iee.org.uk

International Atomic Energy Agency (IAEA)
Wagramerstrasse 5, PO Box 100, A-1400, Vienna, Austria
Tel: 43 222 2360, fax: 43 222 230 184, website: www.iaea.org/
Offers regionally-based training courses in the field of nuclear medicine.

International Electrotechnical Commission (IEC)
IEC Central Office, 3, Rue de Varembé, PO Box 131, CH - 1211 GENEVA 20, Switzerland
Tel: 41 22 919 02 11, fax: 41 22 919 03 00, email: info@iec.ch, website: www.iec.ch/
Sets the standards for the safe manufacture of medical equipment.

International Federation of Hospital Engineering
Website: http://home.enter.vg/ifhe/main.html
This body enables national engineering professional organizations to join in a worldwide federation. It encourages and facilitates exchange of information and experience in the broad field of hospital and healthcare facility design, construction, engineering, commissioning, maintenance, and estate management. It arranges an International Congress every two years at different locations, in conjunction with a healthcare trade exhibition. It publishes a newsletter.

International Federation for Medical and Biological Engineering (IFMBE)
IFMBE Secretariat, Croatia
Tel: 385 1 6129 938, fax: 385 1 6129 652, e-mail: office@ifmbe.org, website: www.ifmbe.org/
Professional body for clinical engineers and technicians. IFMBE also produces the **Medical and biological engineering and computing journal** as well as the subscription newsletters **MBEC news** and **Clinical engineering update** which discuss pertinent issues and news concerning clinical engineers and equipment from around the world. Available from: Subscription Offices, Medical and Biological Engineering and Computing, Peter Peregrinus Ltd, Station House, Nightingale Road, Hitchin, Herts, SG5 1SA, UK.

Management Sciences for Health (MSH)
Development Office, and/or Publications Office, 165 Allandale Road, Boston MA 02130-3400, USA
Tel: 1 617 524 7799, fax: 1 617 524 2825, email: development@msh.org, website: www.msh.org
MSH undertakes consultancies with health care policy-makers, managers, providers, and clients to seek to increase the effectiveness, efficiency, and sustainability of health services by improving their management. MSH also publishes and distributes practical, experience-based books and tools in multiple languages for health and development professionals, managers and policy makers. Email: bookstore@msh.org, website: www.msh.org/publications

Medical Research Council South Africa (MRC-SA)
PO Box 19070, 7505 Tygerberg, South Africa
Tel: 27 21 9380911, fax: 27 21 9380200, email:info@mrc.ac.za, website: www.mrc.ac.za
The MRC-SA's mission is to improve the nation's health status and quality of life through relevant and excellent health research aimed at promoting equity and development. They have a WHO Collaborating Centre for Essential Technologies in Health, at website: www.mrc.ac.za/innovation/whocollaborating.htm

Medicines and Healthcare Regulatory Agency (MHRA)
Hannibal House, Elephant and Castle, London, SE1 6TQ, UK
Tel: 44 0207 972 8000, email: devices@mhra.gsi.gov.uk, website: www.mhra.gov.uk
Offers guidance, advice, and regulations on medical device quality, safety, performance, use, and standards.

PAHO (Pan American Health Organization)
Pan American Sanitary Bureau, Regional Office of the World Health Organization, 525 Twenty-third Street, N.W.Washington, D.C. 20037, USA
Tel: 1 202 974-3000, fax: 1 202 974-3663, website: www.paho.org/
The Pan American Health Organization (PAHO) is an international public health agency working to improve health and living standards of the countries of the Americas. It also serves as the Regional Office for the Americas of the World Health Organization. Antonio Hernandez is the contact for healthcare technology issues, email: 1hernana@paho.org

Quality Assurance Research and Policy Development Group (QARPDG)
Philippine Health Insurance Corporation (PhilHealth), CityState Center, 709 Shaw Blvd., Brgy. Oranbo, 1600 Pasig City, Philippines
Fax: 632 637 9693, emailmadz_valera@yahoo.com, contact: Dr. Madeleine Valera (Vice President)
PhilHealth is a government owned and controlled corporation that was the main organizer of the 3rd Asian Regional Health Technology Assessment Conference in 2004, and is the source for the conference proceedings.

SpaceLabs Medical Inc
15220 N.E. 40th Street, Redmond, WA 98052, USA
Tel: 1 206 882 3700, website: www.spacelabs.com/
Spacelabs Medical is a leading global provider of patient monitoring and clinical information systems. Their educational service produces a Biophysical Measurement Book Series for biomedical and clinical professionals

Source (International Information Support Centre)
The Wellcome Trust Building, Institute of Child Health, 30 Guildford Street, London, WC1N 1EH, UK
Tel: 44 20 7242 9789 ext 8698, fax: 44 20 7404 2062, email: source@ich.ucl.ac.uk,
website: www.asksource.info
The Source Centre has a unique collection of over 20,000 health and disability related information resources. These include books, manuals, reports, posters, videos, and CD-Roms. Many materials are from developing countries and include both published and unpublished literature.

Swiss Centre for International Health (SCIH)
Swiss Tropical Institute, Socinstrasse 57, PO Box, CH-4002 Basle, Switzerland
Tel: 41 61 284 82 79, fax: 41 61 271 86 54, email: martin.raab@unibas.ch,
website: www.sti.ch/francais/scih/scih.htm
Undertakes consultancies in healthcare technology management in developing countries and countries in transition.

TALC (Teaching Aids at Low Cost)
PO Box 49, St. Albans, Herts, AL1 5TX, UK
Tel: 44 1727 853869, fax: 44 1727 846852, email: talc@talcuk.org website: www.talcuk.org
UK registered non-profit charity specializing in supplying affordable books, slides and teaching aids on health and community issues in developing countries, with a particular focus on materials for primary health care and district levels.

Third World Network
Email: twnet@po.jaring.my, website: www.twnside.org.sg
The Third World Network is an independent non-profit international network of organizations and individuals involved in development issues. Its website offers articles and position papers on a variety of subjects related to developing countries, including trade, health, biotechnology and bio-safety.

Transaid (Transport for Life)
137 Euston Road, London, NW1 2AA, UK
Tel: 44 20 7387 8136, fax: 44 20 7287 2669, email: info@transaid.org website: www.transaid.org
A charity working in the field of international transport management. Thus unique organization works with many sectors, including health, to ensure that transport resources are efficiently and effectively used. Their aim is to develop local capacity in transport and logistics management. They produce a newsletter **Hub and spoke**, and have developed the **Transaid transport management handbook**.

Voluntary Service Overseas (VSO), and **VSO Books**
317 Putney Bridge Road, London, SW15 2PN, UK
Tel: 44 20 8780 2266, email: webteam@vso.org.uk, website: www.vso.org.uk
A UK-based charity with worldwide experience of providing skilled volunteers for work overseas, including workers in the fields of medicine, hospital engineering, and associated technical services. VSO Books publishes practical books about specific areas of development, using the professional experience of volunteers.

World Bank (WB)
Website: www.worldbank.org
One of the world's largest sources of development assistance including health, nutrition and population projects

World Council of Churches (WCC)
PO Box 2100, 1211 Geneva, Switzerland
Tel: 41 22 791 6111, fax: 41 22 791 0361, email: info@wcc-coe.org, website: www.wcc-coe.org
International fellowship of churches that produces publications and newsletters. Recent publications include **Guidelines on medical equipment donations**.

World Health Organization (WHO)
20 Avenue Appia, CH-1211 Geneva 27, Switzerland
Tel: 41 22 791 2476 or 2477, fax: 41 22 791 4857, website: http://www.who.int/en/
WHO offers advice, and undertakes programmes, on all aspects of health care. Contact your regional or field office for advice on all aspects of health care and WHO materials – the addresses of the regional offices worldwide are available on the website.

- WHO has programmes and literature on many aspects of healthcare technology management. Andrei Issakov, Coordinator of Health Technology and Facilities Planning and Management, is the contact, and source of WHO literature on healthcare technology management that is not available as published documents, email: issakova@who.int.
- WHO produces and distributes books, manuals, journals, practical guidelines and technical documents, several include aspects of healthcare technology management. The Distribution and Sales Office is the contact point for information on WHO publications, email: publications@who.ch, website: www.who.int/publications/en/. To order WHO publications use email: bookorders@who.int.
- WHO has a comprehensive library and information service on international public health literature. Contact email: library@who.int. The WHO library catalogue has electronic access to more than 4000 technical documents, use website: www.who.int/library.
- WHO produces many newsletters, for a list contact website: www.who.int/library/reference/information/newsletters/index.en.shtml

Ziken International Consultants Ltd
Causeway House, 46 Malling Street, Lewes, E.Sussex, BN7 2RH, UK
Tel: 44 1273 477474, fax: 44 1273 478466, email: info@ziken.co.uk, website: www.ziken.co.uk
A consultancy organization working worldwide in many aspects of health care development, including healthcare technology management.

Training Institutes

This section lists some of the regional and international institutions that offer a range of courses for technical staff in healthcare technology maintenance at various levels. Some of the courses also offer a training component in healthcare technology management. These institutions are known to train staff from developing countries or aim their training at students from developing countries.

American College of Clinical Engineering (ACCE)
5200 Butler Pike, Plymouth Meeting, Pennsylvania PA 19462, USA
Tel: 1 610 825 6067, website: www.accenet.org
Courses offered:

- short tailor-made advanced healthcare technology management/clinical engineering workshops run jointly by ACCE, PAHO and WHO four to five times a year in all WHO regions (contact the International Committee, email: icchair@accenet.org).

British Columbia Institute for Technology (Canada)
School of Health Sciences, 3700 Willingdon Avenue, Burnaby, British Columbia, Canada, V5G 3H2
Tel: 1 604 434 5734, email: anthony_chan@bcit.ca, website: www.bcit.ca, contact: Anthony Chan (Program Head)
Courses offered:

- 2-year full-time diploma of technology in biomedical engineering (for high school graduates with qualifications in specific subjects)
- web-based continuing education course in medical technology management
- web-based continuing education course in medical device development and standards
- extra courses, seminars, and workshops in assorted medical technology subjects run on campus.

Campinas University (UNICAMP), Brazil
Email: calil@ceb.unicamp.br, website: www.deb.fee.unicamp.br/ec
Contact: Saide Jorge Calil, (Course Coordinator)
Course offered:

- 18-month part-time post-graduate clinical engineering specialization course.

The course is run for Portuguese-speaking students, and is aimed at those wishing to work as clinical engineers in the health sector, whether industrial, government or other hospitals.

Catalan Agency for Health Technology Assessment and Research (CAHTA)
30 Esteve Terradas, Edifici Mestral (1a planta), Recinte Sanitari Parc Pere Virgili,
08023 Barcelona, Spain
Tel: 34 93 259 42 00, fax: 34 93 259 42 01, email: direccio@aatrm.catsalut.net
Website: www.aatrm.net/html/en/dir395/index.html, contact: Dr Emília Sánchez
Courses offered:

- 4-month part-time assessment of health care services course (website: www.uoc.edu/masters/esp/sanidad/sanidad/servicios_sanitarios.html)
- 4-month part-time information management for decision making course (website: www.uoc.edu/masters/esp/sanidad/sanidad/habilidades_informacionales.html)

This agency also participates in two modules of the International Masters Degree in Health Technology Assessment and Management, at the University of Barcelona.

Centre National de Formation de Techniciens en Maintenance Hospitalière, (Ministry of Health, Senegal)

Diourbel BP 16, Senegal
Tel: 221 971 13 42, fax: 221 971 13 42, website: www.cnftmh.sn, contact: Mr. Saliou Dione (Director)
Courses offered:

- 3-year 'Brevet de Technicien' certificate course in hospital maintenance, which includes maintenance management
- 1-year hospital maintenance course for secondary school certificate holders
- ongoing training courses from 1 week to 5 months in electronics, medical equipment, sterilization, power generation, air conditioning, laboratory equipment, etc.

All courses are in French, can be tailored for the different qualifications of candidates (vocational training, middle certificates, professionals, etc), and are open to French-speaking students from the region. The Diorbel Centre is a WHO Collaborating Centre for equipment/maintenance issues.

Department of Clinical Physics and Bioengineering Overseas, (West of Scotland Health Board, UK)
South Glasgow University Hospitals NHS Division, 135 Govan Road, Glasgow, G51 4TF, Scotland, UK
Tel: 44 141 201 1889/1888, fax: 44 141 201 1891, email: dporter41@tesco.net, or dr_david_porter@hotmail.com
Website: www.show.scot.nhs.uk/sguht/professionals/dcpbo.htm, contact: Dr David Porter (Overseas Projects Manager)
Courses offered:

- tailor-made courses in healthcare technology operation, maintenance, and management for overseas students
- 3-year degree course in physics with medical technology (with Paisley University)
- Masters degree and Doctorate in medical technology
- on-the-job work experience training for staff working towards qualifications for their professional body (IPEM)

The Department also undertakes consultancies in developing countries through its Overseas Training and Support Group.

Eastwood Park Training and Conference Centre, UK
Falfield, Wotton-under-Edge, Glos, GL12 8DA, UK
Tel: 44 1454 262777, fax: 44 1454 260622, email: training@ eastwoodpark.co.uk,
website: www.eastwoodpark.co.uk
Courses offered:

- a wide range of scheduled and tailor-made short courses in healthcare engineering, estates and facilities, at certificate level accredited with known bodies (such as BTEC, City and Guilds).
- specific equipment courses, such as sterilization technology courses.

Health Technology Assessment Unit (Ministry of Health, Malaysia)
Health Technology Assessment Unit, Medical Development Division, Ministry of Health, Malaysia, Level 4, Block E1, Govt. Office Complex, Precinct 1, 62250 Putrajaya, Malaysia
Tel: 60 3 8883 1228, fax: 60 3 8883 1045, email: sivalal@hotmail.com and sivalal2001@yahoo.com
Contact: Dr S Sivalal (Head, Health Technology Assessment Unit)
Courses offered:

- annual 4-day HTA training course
- two systematic review workshops aimed mostly at physicians involved in formulating clinical practice guidelines
- HTA seminars for other health personnel like allied health professionals
- an occasional supply chain management seminar focusing on the different components of technology management
- a module on health technology management run for students of the Masters in Public Health programme at the University of Malaya.

Institut International Superieur de Formation des Cadres de Santé (IISFCS)
Hôpitaux de Lyon-162, Avenue Lacassagne-69424, Lyon, France
Tel: 33 4 72115105, fax: 33 4 72115122, email: marie-jo.pachtem@chu-lyon.fr
Contact: Maryjo Pachtem (Technical Director)
Courses offered:

- 12-month multidisciplinary training certificate in hospital maintenance for senior technicians
- 5-month specialized training certificate in the maintenance of medical imaging for senior specialized technicians
- 5-month specialized training certificate in laboratory maintenance for senior specialized technicians

All students come from French-speaking developing countries and must have as a minimum a higher-level technical diploma. Professional experience in the field is desirable but not a prerequisite.
The Lyon Institute is a WHO Collaborating Centre for training in hospital maintenance training

Mombasa Polytechnic, Kenya
Department of Medical Engineering, Mombasa Polytechnic, PO Box 90420, Mombasa, Kenya
Tel: 254 41 492222/3/4, 490571, email: msapo1y@africaonline.co.ke, msapoly@kenyaweb.com
Website: www.mombsapoly.ac.ke, contact: The Chief Principal or The Head of Department of Medical Engineering
Courses offered:

- three-year diploma in medical engineering, with one-term field attachment
- a certificate in medical engineering services
- a number of specialized courses offered occasionally on request, covering specific aspects of medical equipment or hospital facilities. They are aimed at professionals already working in the field, and last from one to four weeks.

The courses are open to English-speaking students from the region.
The Department is a WHO Collaborating Centre for training in hospital maintenance.

Tshwane University of Technology, South Africa
Department of Biomedical Sciences, Faculty of Health Sciences, Technikon Pretoria, PB X680, Pretoria 0001, South Africa
Tel: 27 12 3186267, fax: 27 12 3186262, email: dtoitd@techpta.ac.za,
Website: http://intranet.tut.ac.za or www.techpta.ac.za, contact: Prof. D du Toit (Head of Department)
Courses offered:

- Bachelor's degrees, Masters degrees and Doctorates in biomedical technology, clinical technology, and diagnostic radiography.

Various institutions have merged to become the Tshwane University of Technology, the Department of Biomedical Sciences is still on the Pretoria Technikon site.

Université de Technologie de Compiègne, France
BP 60319-60203, Compiègne Cedex, France
Tel: 33 3 44 234423, fax: 33 3 44 234300, website: www.utc.fr
Courses offered:

- postgraduate level courses in clinical engineering for French-speaking students.

Université Montpellier II, France
Place Eugène Bataillon, 34095 Montpellier Cedex 5, France
Tel: 33 4 67 143030, fax: 33 4 67 143031, website: www.univ-montp2.fr
Courses offered:

- postgraduate level courses in clinical engineering for French-speaking students.

University of Cape Town, South Africa
Dept. of Human Biology, UCT Faculty of Health Sciences, Anzio Road, Observatory 7925, South Africa
Tel: 27 21 406 6545, fax: 27 21 448 3291, email: poluta@cormack.uct.ac.za, website: sizanani.uct.ac.za
Contact: Mladen Poluta (Programme Convenor)
Courses offered:

- 18-month postgraduate diploma in healthcare technology management
- 12- to 24-month MSc in biomedical engineering
- 12- to 18-month MPhil programme in biomedical engineering

The courses are open to English-speaking students from the region.
The department is a participating centre in the Medical Research Council-South Africa/WHO Collaborating Centre for essential technologies in health.

Training in General
In addition to the institutions listed above, there are many others that provide training in subject areas such as biomedical engineering, clinical engineering, etc that are aimed at home students, but overseas students can apply. These can be found in any part of the world by searching on the internet stating the type of course required and the geographical region. For example:

- for courses in the United States of America, see website: www.collegesurfing.com or www.Degree-Finder.com
- for courses in biomedical engineering in the UK and Ireland at institutions which wished to be on this website, see website: www.gradschools.com/listings/UK/bimed_eng_UK.html
- for B.Tech and degree courses in biomedical engineering in India, see this report from The Hindu newspaper website: www.hindu.com/edu/2005/04/19/stories/2005041900290300.htm.

ANNEX 3: SAMPLE JOB DESCRIPTIONS

1. Job Title: Health Service Craftsperson

I. Job Outline

The craftsperson works with their hands to employ craft skills in a specific area, such as plumbing, carpentry, or building. The craftsperson uses these skills to undertake basic tasks for the well-being of all or some of a range of the equipment, plant, service installations, furniture, vehicles, and buildings of their employing health facility or operational zone of the Healthcare Technology Management Service. Performs basic tasks under supervision.

II. Duties and Responsibilities

Performs and documents basic planned preventive maintenance, performance checks, and corrective repairs on the types of new and existing healthcare technology s/he has received training on, according to guidelines written by engineering professionals.

Performs other HTM activities such as planning and costing his/her work, keeping a record of work, reading manuals and drawings, and training equipment users of relevance to their craft skill area.

Determines the need for, and assists in the purchasing of, spare parts and maintenance materials necessary to accomplish preventive maintenance and repair.

Applies relevant codes and standards related to the health environment and safety.

In the performance of his/her duties, works closely with engineering and medical personnel. Communicates orally with medical, administrative and engineering professionals.

Applies conventional technical principles to modify, install, and correct malfunctions on basic healthcare technology in their craft skill area.

III. Reporting Status

The job-holder works under supervision, usually receiving specific and detailed instructions. Work will be checked during regular visits by senior members of the District or Regional HTM Team and is reviewed for accuracy. The only supervisory responsibilities will occur if they have an assistant in their craft skill area.

IV. Working Conditions

The working conditions require occasional lifting and exertion for short periods. The work site is within the employing health facility or zone and includes patient areas where the employee may be exposed to sick patients and to research projects.

V. Qualifications

Ranges:

- from an entry-level of some schooling and informal training (such as a handyman)
- with promotion for various levels of formal trade tests from a national trade-testing scheme (known as an artisans)
- to the highest post with the highest level of trade test in their chosen craft skill area.

Must be able to use conventional troubleshooting instruments and mechanical maintenance and fabrication equipment suited to their craft skill area, such as standard hand tools, drilling machine, welder, grinder.

Must possess or be able to acquire fundamental knowledge of the techniques, theories and characteristics of basic electricity, mechanics, pneumatics and working materials of relevance to their role, in conjunction with any necessary anatomy, physiology and health facility procedures (offered as in-service training).

Must be willing to learn any relevant management skills necessary for their role, on-the-job from supervising managers.

Must be aware of relevant codes and standards related to the health environment and safety.

Must be willing to work towards becoming an artisan with a higher level of trade-test qualification.

2. Job Title: Health Service Technician

I. Job Outline

The technician has craft skills in a specific area, such as mechanics, refrigeration, or electricity, and the academic knowledge to put the science of their skills into practice. Or, if a polyvalent technician, has craft skills in a range of engineering disciplines. S/he possesses education and experience beyond that of the health service artisan. The technician uses these skills to care for the working condition of all or some of a range of the equipment, plant, service installations, furniture, vehicles, and buildings of their employing health facility or operational zone of the Healthcare Technology Management Service. Performs skilled work of routine difficulty under supervision.

II. Duties and Responsibilities

Performs and documents planned preventive first-line maintenance, performance checks, and corrective maintenance on new and existing healthcare technology according to guidelines written by engineering professionals.

Is responsible for calibration and performance of essential healthcare technology, the failure of which could directly affect the operation of essential services of the health facility.

Performs other HTM activities such as planning and costing his/her work, keeping a record of work, training equipment users of relevance to their craft skill area, reading manuals and drawings, monitoring contracts with private sector artisans, and assisting with installing and commissioning projects.

Determines the need for, and assists in the purchase of, equipment, consumables, accessories, spare parts, and maintenance materials of relevance to their craft skill area, necessary for accomplishing their duties.

Applies relevant codes and standards related to the health environment and safety.

In the performance of their duties, works closely with engineering and medical personnel. Communicates orally and in writing with medical, administrative and engineering professionals.

Applies conventional technical principles to modify, install, and correct malfunctions on basic healthcare technology.

III. Reporting Status

The job-holder works under supervision, usually receiving specific and detailed instructions. Work will be checked during regular visits by senior members of the Regional HTM Team, and is reviewed for accuracy. The technician may supervise the work of craftspeople from the same craft skill area, in their team.

IV. Working Conditions

The working conditions require occasional lifting and exertion for short periods. The work site is within the employing health facility or zone and includes patient areas where the employee may be exposed to sick patients and to research projects.

V. Qualifications

Ranges:

- from an entry-level of form four level (secondary school graduate) and an ability to use conventional hand and bench tools;
- with promotion for increasing levels of craft certificates obtained from a vocational training college
- to the highest post with a basic-level technical diploma from a technical college.

Must be able to use conventional troubleshooting instruments and mechanical maintenance and fabrication equipment such as standard hand tools, drilling machine, press, grinder.

Must possess or be able to acquire fundamental knowledge of the techniques, theories and characteristics of basic electricity, mechanics, optics, pneumatics and working materials in conjunction with anatomy, physiology, and health facility procedures (offered as in-service training).

Must be willing to learn management skills on-the-job from supervising managers.

Must be aware of relevant codes and standards related to the health environment and safety.

Must be willing to work towards becoming a technician with a higher level of qualification.

3. Job Title: Health Service Technologist

I. Job Outline

The technologist is highly-skilled in a craft such as electronics, electricity, or refrigeration, with considerable academic knowledge of putting the science of their skills into practice. S/he possesses education and experience beyond that of the health service technician. The technologist uses these skills to care for the working condition of all or some of a range of the equipment, plant, service installations, furniture, vehicles, and buildings of their employing health facility or operational zone of the Healthcare Technology Management Service. The job-holder's education and experience enable him/her to analyze standard healthcare technology problems and identify solutions. S/he is also involved in the healthcare technology management process by participating in the HTM system development, implementation, and modification.

II. Duties and Responsibilities

Analyzes standard healthcare technology for purposes of affecting corrective repairs, developing appropriate preventive maintenance or performance assurance protocols, and designing and implementing modifications which permit enhanced operational capability.

Often supervises maintenance and modifications performed by others.

Applies the relevant codes and standards related to the health environment and safety.

Is responsible for calibration and performance of standard healthcare technology, the failure of which could directly affect the reliable operation of standard services of the health facility.

Performs and documents scheduled preventive maintenance, performance assurance, corrective repairs, and modifications on new and existing healthcare technology.

Utilizes various measurement techniques to obtain optimum operational efficiency.

Performs other HTM activities such as planning and costing work, training equipment users and health service technicians and artisans, managing the equipment inventory and database, financial management, keeping statistics, installing and commissioning basic- and medium-level equipment, and monitoring contracts.

Determines the need for, and assists in the purchase of equipment, tools, consumables, accessories, spare parts, and materials necessary to accomplish this range of tasks.

In the performance of his/her duties, works closely with engineering and medical personnel. Communicates orally and in writing with medical, administrative and engineering professionals. Develops written procedures and recommendations for administrative and technical personnel.

Should be willing to provide technical support to peripheral healthcare facilities covered by the facility s/he is normally assigned to.

III. Reporting Status

The job-holder may function in a 'lead' capacity for a zonal HTM Team, often training, supervising, or directing the work of other technicians and artisans. Reports to more senior managers in the HTM Service and to the relevant Health Management Team.

IV. Working Conditions

The working conditions require occasional lifting and exertion for short periods. The work site is within the employing health facility or the operational zone of the Healthcare Technology Management Service and includes patient areas where the employee may be exposed to sick patients and to research projects.

V. Qualifications

Ranges:

- from an entry-level with a low level of technical diploma obtained from a technical college
- with promotion for increased levels of diplomas in general technical subjects or in biomedical engineering, up to Ordinary National Diploma level
- to the highest post requiring at least four years experience as a health service equipment maintenance technologist, with at least two of which in a progressively responsible supervisory capacity.

Must be able to use conventional electronic troubleshooting instruments such as multimeters and oscilloscopes. Must also be able to use conventional hand tools and machine shop equipment such as drilling machine, grinder and welding equipment.

Must possess or be able to acquire a knowledge of the techniques, theories and characteristics of electronics and electricity, mechanics, optics, pneumatics and working materials in conjunction with physics, chemistry, anatomy, physiology and health facility procedures (offered as in-service training).

Must possess or be able to acquire some management skills and business knowledge that enable him/her to participate in budgeting, cost accounting, personnel management, use of computers, and be able to instruct others (offered as in-service training)

Must know the relevant codes and standards related to the health environment and safety.

Must be willing to work towards becoming a specialist technologist with a higher level qualification in a particular technical field.

4. Job Title: Health Service Engineer

I. Job Outline

The engineer is qualified in a branch of engineering such as electrical, mechanical, or electronics, with advanced academic knowledge of controlling, designing, and building equipment, and can use his/her skills to develop original ideas. The engineer uses these skills to manage the care of all healthcare technology of their employing health facility or operational zone of the Healthcare Technology Management Service, and acts in a management capacity for HTM Teams. The job-holder's education and experience enable him/her to analyze complex healthcare technology problems and identify solutions. The engineer works with nursing and medical staff to analyze new healthcare technology needs and their acquisition. S/he designs or directs any necessary equipment modifications. S/he is also involved in the healthcare technology management process by taking a lead role in the HTM system development, implementation, and modification.

II. Duties and Responsibilities

Works with medical and nursing staff in the development of technical and performance standards, specifications, and standardization strategies for healthcare technology required in health facilities.

Once equipment is specified and procured, plans and supervises its installation and generates appropriate testing of the new equipment.

Carries out complete performance analysis on complex medical equipment and other complex types of healthcare technology. Summarizes results in brief, concise and communicable terms for purposes of recommending corrective action, or developing appropriate preventive maintenance and performance assurance protocols.

Designs and implements modifications that permit enhanced operational capability. May supervise the maintenance or modification when performed by others.

Applies the relevant codes and standards related to the health environment, safety, and performance assurance activities.

Responsible for obtaining the engineering specifications (system definition) for systems considered unusual or one-of-a-kind that are not commercially available.

Supervises, trains, and coordinates in-service technologists, technicians, and craftspeople on codes and standards and on preventive maintenance, performance assurance, corrective repairs, and modification requirements on new and existing healthcare technology.

Supervises supply and procurement activities for equipment, consumables, accessories, spare parts, and maintenance materials, and develops corresponding policies and procedures.

Sets department or institutional goals and develops budgets and policy, manages the equipment database, prepares and analyzes management reports to monitor department activity, and manages and organizes the department or institution to implement them.

Teaches measurement, calibration and standardized techniques that promote optimum performance.

In the performance of his/her duties, works closely with management, technical, and medical personnel. Communicates orally and in writing with medical, administrative, managerial, as well as maintenance professionals. Develops written procedures and recommendations for administrative and technical personnel.

Supervises and coordinates activities in all healthcare facilities under the jurisdiction of his/her normally assigned facility or operational zone of the HTM Service.

III. Reporting Status

The job-holder functions with minimum supervision, often training, supervising or directing the work of technologist, technicians, artisans, and contractors. The job-holder may function in a 'lead' capacity for a zonal or central HTM Team. Reports to more senior managers in the HTM Service and to the relevant Health Management Team.

IV. Working Conditions

The working conditions require occasional lifting and exertion for short periods. The work site is within the employing health facility or the operational zone of the Healthcare Technology Management Service and includes patient areas where the employee may be exposed to sick patients and to research projects.

V. Qualifications

Ranges:

- from an entry-level with a Higher National Diploma from a technical College, or a 3-4 year first engineering degree, in electrical/electronic or equivalent (preferably with a clinical/biomedical option)
- with promotion for a minimum of three years experience as a health service engineer and two years in a progressively responsible supervisory capacity
- to the highest post with a Masters degree as the Head of the HTM Service

Must have some management skills and business knowledge that enable him/her to participate in budgeting, cost accounting, personnel management, including behavioural counselling, job description development and interviewing for hiring or staff evaluation. Knowledge and experience in the use of computers, word-processing and spreadsheets is desirable and will be considered as an additional advantage. Must have skills in teaching others that enable him/her to prepare and conduct training courses for technicians and users and to design relevant training materials. For expatriates: knowledge of English language (or other main language of the country) compulsory, willingness to integrate him/herself into existing social and cultural structures, receptiveness to new ideas and skilled in the development of conceptual structures.

Must possess or be able to acquire a knowledge of the techniques, theories and characteristics of electronics and electricity, mechanics, optics, pneumatics and working materials in conjunction with physics, chemistry, anatomy, physiology and hospital procedures (offered as in-service training). Must also be able to use conventional electronic troubleshooting instruments such as multimeters and oscilloscopes. Must be able to use conventional hand tools and machine shop equipment such as drilling machine, grinder, lathes and welding equipment.

Applies the relevant codes and standards related to the health environment, safety, and performance assurance activities.

Must be willing to work towards becoming a chartered clinical engineer and/or registering with a professional engineering association.

ANNEX 4: SOURCE MATERIAL/BIBLIOGRAPHY

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