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GUIDELINES FOR TRAINING PERSONNEL IN DEVELOPING COUNTRIES FOR PROSTHETIC AND ORTHOTIC SERVICES

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LIST OF CONTENTS

INTRODUCTION

There is an enormous need in developing countries for braces and artificial limbs. The need for braces is particularly acute in areas where polio still affects many children each year. Despite the efforts to eradicate polio, as many as two million children may still get polio before the year 2000. The vast majority of these children can remain free of deformities and able to walk if they are provided with braces. War and natural disasters have left many people with amputated limbs. These people can be active members of their families and communities if they are provided with artificial limbs. In order to provide these orthotic and prosthetic appliances to the people who need them, personnel must be trained to produce the appliances.

A World Health Organization Consultation on the training of personnel for prosthetic and orthotic services in developing countries took place at the Eastern Mediterranean Regional Office, Alexandria, Egypt, in June 1990. The purpose of the Consultation was to prepare a general description of the work done by personnel who make artificial limbs and braces, and a guide for training them based on the work they must perform. The Temporary Advisers who attended the Consultation were from seven schools in developing countries which prepare personnel for prosthetics and orthotics, and from five organizations that have been involved in the development and support of training programmes for personnel in prosthetics and orthotics in developing countries. (See Annex J for the list of participants in the Consultation.)

This document presents the tasks for various types of personnel and the guidelines for their training which were prepared at the Consultation. In addition, the document presents information on issues related to training, such as the distribution of prosthetic and orthotic services and personnel and the systems used for the production of appliances.

NEED FOR PERSONNEL FOR PROSTHETICS AND ORTHOTICS

The estimated number of people who need artificial limbs or braces is 0.5% of a population. This may be a conservative estimate, particularly where polio still affects many children each year. By the year 2000 the combined population of Africa, Asia and Latin America will be approximately 4 billion, so there will be 20 million people in need of orthopaedic appliances. Twenty thousand trained personnel are needed in order to have one person available for each 1000 people in need of services. (A more ideal figure for services is one trained person for every 500 people who need appliances.) The present number of adequately trained personnel in developing countries is not known, but it is estimated to be less than 2,000, or 1 for every 20,000 people who will need services. At least 18,000 additional personnel would be needed to provide a ratio of one for each 1,000 individuals in need of services.

There are approximately twelve recognized schools in developing countries which train personnel qualified to fit, fabricate and assess the biomechanical function of orthopaedic appliances. They prepare an average of 15 graduates per year, or a total of 180 for all developing

countries. If the number of trainees doubles to 360 per year, it will take 50 years to train 18,000 people.

These global figures may initially overwhelm planners of health care services. However, each country must consider the needs for its own population, along with the number of personnel who may already be trained. Some countries will find that they are close to achieving a ratio of one trained person for 1,000 people in need of appliances. If so, these countries can plan for training and expansion of services to reach the more desirable ratio of 1 trained person for every 500 people who need services.

The chart below presents examples of target numbers of personnel based on different populations.

Population	Number needing appliances (0.5% of the population)	Number of personnel needed 1/1,000	1/500
100,000,000	500,000	500	1,000
20,000,000	100,000	100	200
5,000,000	25,000	25	50

These general estimates for need of trained personnel must also be considered along with the types of disabilities most common within a country, the system for the production of appliances, and the number of workers who will be available to assist the trained personnel in the production of appliances. Population density must also be considered. In low density areas, where the population is spread over a large area, it may be necessary to have a higher ratio of personnel for the population in order to establish workshops in locations that are accessible.

TYPES OF PERSONNEL

The figures presented above referred to the number of personnel trained to fit, fabricate and assess the biomechanical function of prostheses and orthoses. This category of personnel is essential for the provision of properly fitted and aligned appliances. However, this level of personnel is assisted by others who are skilled in the manual labour and can produce components, assemble the appliance, and provide the finished, cosmetically acceptable appliance. Some countries have another level of personnel who are engaged in teaching and research in prosthetics and orthotics.

The terminology used to identify different types of personnel varies among countries and regions. The chart below presents two sets of names which are commonly used, but individual countries may use other names. This document will use the names of personnel that are commonly used in Asia and Latin America.

Major responsibilities of different types of personnel	Names of personnel used in Asia and Latin America	Names of personnel used in Africa, the Middle East and ISPO*
Teaching, research and management of the service system	Prosthetic/orthotic engineer	Prosthetist/orthotist
Fitting, fabricating and assessing orthopaedic appliances and management of the workshop	Prosthetist/orthotist	Orthopaedic technologist
Fitting, fabricating and assessing one type of orthopaedic appliance and management of the workshop related to that type of appliance.	Prosthetic or orthotic assistant**	Prosthetic or orthotic assistant**
Assembling of orthopaedic appliances and production of components	Technician	Technician

* International Society for Prosthetics and Orthotics

** This category was defined at the Consultation held in Alexandria in June 1990. Countries may name this category of personnel according to a system used within their other professional groups. The name Prosthetic or Orthothic Assistant was recommended by the Consultation and will be used in this document.

In this document the name prosthetist/orthotist is used to refer to the person who has primary responsibility for the production of prostheses and orthoses. This is done in order to emphasize the person's role in the production of prostheses and orthoses and to avoid confusion with other orthopaedic work, such as surgical procedures for correction of deformity or replacement of joints. The name prosthetic/orthotic engineer is used to refer to the person who is responsible for teaching, research, management of a national system for services, and the production of complicated appliances.

This document refers to all categories of personnel as "he". This is done because the vast majority of workers in prosthetics and orthotics are men. However, women can also participate in this work, and it is hoped that more women will be trained in all categories.

TASKS OF PERSONNEL

Before describing the training of various types of personnel, it is important to identify the tasks they are expected to perform. The training should then provide them with the knowledge and skills required for the tasks.

The **prosthetist/orthotist** is responsible for direct patient services and management of the orthopaedic workshop. A detailed list of the tasks of the prosthetist/orthotist are presented in Annex A. These tasks are divided into four categories: patient care, management and supervision, training and education, and community services. As indicated in the distribution of tasks, the major role of the prosthetist/orthotist is in patient care. The P/O has the ability to advise on the selection of an appropriate appliance to meet the needs of an individual patient, to prepare the appliance with the assistance of skilled workmen, and to do a biomechanical analysis of the appliance on the patient. His level of training is sufficient to enable the P/O to assess the fit and function of an appliance so that proper revisions can be made when necessary for the patient.

The management tasks of the prosthetist/orthotist focus on the management of his workshop. This includes the supervision of the technicians who assist him in the production of appliances. In addition, he may participate in the planning and implementation of the national system for the distribution of orthopaedic appliances. He may also have responsibility in the practical training of technicians and student prosthetists/orthotists. The services provided by the prosthetist/orthotist should be a part of system of services for disabled people which includes physical, occupational and speech therapies. As such, the P/O must interact with other rehabilitation professionals and workers, including those who deliver services at the community level.

Some countries have special situations which require the production of an unusual number of orthotic or prosthetic appliances. For example, a country may have many children with polio who need braces, or many amputees from war or natural disasters who need artificial limbs. In such cases, personnel may be trained for work with only one type of appliance, such as lower limb orthotics or lower limb prosthetics. Because this person's training and work is limited to a special need within the total prosthetic and orthotic services of a country, he may be referred to as a **prosthetic or orthotic assistant.**

The responsibilities of this category of personnel is the same as the fully trained prosthetist/orthotist, but with reference to the production and management of one type of orthopaedic appliance. A description of the tasks of a prosthetic or orthotic assistant is given in Annex C. As suggested, this person may be trained for lower limb orthotics, for lower limb prosthetics, or for upper limb prosthetics and orthotics and spinal orthotics. P/O Assistants who are trained for lower limb orthotics, for example, may later become fully qualified prosthetists/ orthotists by completing the training for the production of the other appliances.

Some countries may also choose to train personnel fully for only prosthetics or only orthotics. Many countries have chosen to train one person for both services because a great deal of the theoretical training is the same, so the investment in training of one person can provide services for both artificial limbs and braces. Nonetheless, countries with a much larger demand for one type of appliance may wish to fully train some people only as prosthetists or only as orthotists.

The **technician** has an important role in the production of the appliances, but does not have direct patient contact. The tasks of the technician are listed in Annex E. He fabricates and assembles the appliance. He does not do the measurements for fitting of an appliance, nor can he analyze the function of an appliance in order to adjust it to the individual patient. The ratio of technicians to P/O varies, with countries using between three and eight technicians for each prosthetist/orthotist. If the components for appliances (e.g., knee joints and feet for prostheses, and uprights and joints for braces) are mass produced in factories, the technicians do not have to make these items. In countries where each workshop makes its own components, this responsibility may take the majority of the technicians' time, and a higher ratio of technicians to prosthetists/orthotists is needed.

The **prosthetic/orthotic engineer** has responsibilities in education, research, and management of a system for the delivery of orthopaedic appliances. He also has responsibilities in the production of appliances which are used infrequently, or which are complicated. A complete list of tasks for the P/O engineer is provided in Annex G. This category of personnel is needed in schools for prosthetists/orthotists or in large hospitals which provide special services. In addition, he has an important role to play in the research needed to identify appropriate materials for orthopaedic appliances, to test standard designs in new materials, and to develop new designs. Small countries, where it is not appropriate to establish a school only for training nationals, may not have this level of personnel. Countries which have a regional school, or larger countries which establish national schools, will have a need for this type of personnel. Through research, the prosthetic/orthotic engineer can also make a contribution to a region where similar materials are available for use in appliances. This person also has more knowledge and skills than the prosthetist/orthotist for fitting and aligning appliances. The P/O engineer is trained to make all types of appliances, including, for example, the unique ones required by congenital amputees.

TRAINING OF PERSONNEL

The primary objective of this document is to provide guidelines for training of personnel based on their tasks in prosthetic and orthotic work. A secondary objective is to discuss the training of personnel with regard to national planning for services and the means of producing components, which may vary from country to country. The guidelines present recommendations for theoretical and practical instruction which will provide each category of worker with the knowledge and skills needed to perform the required tasks. Specific curricula are not presented. In order to develop a training programme, qualified teachers should prepare a specific curriculum to meet the needs of the country or region where students will be trained.

The time period for training of personnel varies from one country to another. A major consideration is the length of training needed for the production of components. However, other factors may also influence the amount of time needed for training. If the entry level of the students is not

as high as the one desired, more time may be needed to prepare students for the more difficult theoretical courses. If few workshops are available for students to do their clinical practice, more time may be needed in order to provide each student with adequate supervised experience.

The length of training is a consideration in determining the type of recognition the different categories of personnel will have at the end of the training period. Each country should compare the content and the length of training for prosthetists/orthotists with that of other health care personnel. Undoubtedly, the training will be comparable to the training of other health care professionals, such as nurses and therapists. It is important that prosthetists/orthotists receive comparable recognition educationally and in the posts to which they are assigned.

A guideline for training **prosthetists/orthotists** is presented in Annex B. The majority of the courses recommended for theoretical training, and all of those recommended for practical training, are intended to provide the knowledge and skills needed for patient care, the primary responsibility of the prosthetists/orthotists. Theoretical training is provided for management and teaching.

The recommended length of the training programme is two to three years. The recommended entry level requirement is O-Level or the equivalent, i.e., 11 to 12 years of education. The length of time needed for training will depend on the amount of training the P/O will have in the manufacture of components. If there is a central production of components within the country, it is not necessary to train the P/O to develop the mechanical skills required for the production of components, but only to understand how they are made and how they function. If each workshop must make its own components, the prosthetist/orthotist must have the necessary skills to produce components so that he can teach and supervise technicians in the production of all types of components that will be used in artificial limbs and braces.

The training of a **prosthetic or orthotic assistant** is based on the training of the prosthetist/orthotist, but is limited to a specific type of appliance. The entry level requirement should be the same as it is for the prosthetist/orthotist, i.e., O-Level or the equivalent. The training of an assistant could include preparation of approximately one third of the appliances which would be produced by the fully trained prosthetist/ orthotist. For example, training could be for one of the following types of appliances:

Lower limb prosthetics
Lower limb orthotics
Upper limb prosthetics and orthotics and spinal orthoses.

The period of training should be at least one third of the training period for the prosthetist/orthotist. The same time consideration must be given for the production of components for the type of appliance the assistant will produce. If he must make components or train technicians to do so, the training period will be longer than if he will be able to get components from a central supply.

A guideline for training the P/O assistant is presented in Annex D. The recommended theoretical courses are the same as those for the fully trained prosthetist/orthotist, but some of them would be limited only to the type of appliance which the assistant will produce. For the practical instruction, the guideline presents an example of training for an assistant who will be responsible only for lower limb orthotics. Since some personnel trained in this manner may work independently in regions of the country where there are special needs, it is important that their training is adequate for them to fit, fabricate and analyze the individual needs of their patients.

Training programmes for prosthetists/orthotists and for P/O assistants should provide opportunities for assistants already working to return for further training which will enable them to produce more types of appliances. Assistants who complete training in all aspects of prosthetics and orthotics can qualify as a prosthetists/orthotists. A long term aim of raising the level of education and training of all assistants to that of prosthetist/orthotist will aid in the expansion of services because personnel in all parts of the country will be able to provide all types of prosthetic/orthotic services

Most countries do not have formal training programmes for **technicians.** Their training is done on the job and one worker is trained to do only one aspect of the total work needed to produce an appliance. For example, one worker may do all of the leather work, while another does only metal work, and someone else assembles appliances. Sometimes local craftsmen are employed because they can apply the skills they already have to the production of appliances, and hence they require less training. A guideline for training technicians on the job or in a formal course is presented in Annex F. It is recommended that technicians complete primary school before beginning any training in prosthetics and orthotics. However, a person already skilled in a craft would not have to meet this requirement.

The system for the production of components influences the period of time needed for training technicians, as well as the number of technicians needed within a workshop. If a workshop has to produce its own components, the technicians must also be trained for this work. The training of new technicians for component making can take a great deal of the prosthetist/orthotist's time. Eventually technicians should be fully responsible for the production of components and the training of other technicians. This allows the prosthetist/orthotist or assistant to use his time for direct patient care.

Training programmes for **prosthetic/orthotic engineers** are not established in developing countries. At the present time, advanced technical training and the training for research and teaching are available at a few centres in Europe or North America. Most of these training programmes have university level entry requirements and provide training for 3 to 4 years. Some prosthetists/orthotist in developing countries should have this level of training in order to teach and to do research for improved use of materials and appliance designs in their own country. Some prosthetists/orthotists may be able to obtain training in engineering within their own countries that can be pertinent to their needs for research

in materials and design. For training in the production of complicated designs, they may be able to take short courses relevant to the needs within their countries. These additional segments of training can meet local needs until a country is able to train and employ a core of prosthetic/orthotic engineers.

When a country is preparing plans for the training of personnel, consideration should also be given to people in the country who may have had some training in the work of prosthetics and orthotics, but who are not fully qualified to provide complete patient services. This would include personnel who may have been trained many years ago, or who were trained in an emergency situation following war or a natural disaster. Some of these people are still working in the production of artificial limbs or braces, either under the supervision of a qualified prosthetist/orthotist, or independently. Since these people are not fully trained, they rarely obtain government posts. This may be one reason why some of these workers have left prosthetics and orthotics for work which provides more income. Some of these previously trained people can be upgraded to qualified prosthetists/orthotists or to assistants who can produce properly fitted and aligned appliances. The use of these workers following upgrading could be very helpful in meeting the need for services. These personnel may be particularly useful for meeting special needs, such as producing braces for the children with polio.

There is a need for more training programmes for prosthetists/ orthotists in developing countries. Large countries need national training programmes to develop and maintain the personnel needed just for themselves. Small countries can request a larger country in the same region to accept some students each year for training. Small countries within a region may also join together to develop one regional training programme which will prepare personnel for all of the countries involved.

When a training programme is established, provision should be made not only for the initial costs of setting up the school, but for the long-term maintenance of the programme. A list of resources needed for a school is presented in Annex H. This is merely a guide to the major items which must be considered. Planning a school requires a more detailed analysis done by people within the country where the school will be located. Prosthetists/orthotists must be involved in the planning, particularly for the laboratory facilities, equipment and materials.

DISTRIBUTION OF PERSONNEL AND SERVICES

In developing countries services for prosthetics and orthotics have often been limited to the capital and perhaps a few other large cities. This has resulted in very limited services to people in smaller urban or rural areas. Those who do travel to the major cities to obtain appliances usually receive inadequate services. Appliances are produced quickly and given to the patients without adequate training in how to use them.

In the case of prostheses, patients who come to the city for services rarely have their stumps prepared properly for the sockets. In many instances this results in shrinkage of the stump as soon as the new prostheses is

used, so the socket no longer fits. The patient from the rural area discovers this after he has returned home. Few patients can afford to return to the city for adjustment of the socket. Many may not realize that they can have a well-fitted socket. Often the prostheses are not used.

The lack of braces in rural areas is most evident among the populations where polio still exists. Families may bring their children with disabilities to the city to obtain a brace. However, children quickly outgrow their braces, which must be adjusted or replaced. Families cannot afford to go to the city each year, so the children stop wearing the braces and experience the well-known consequences.

These people who do not benefit from the services they seek are perhaps the minority in rural areas. The majority who need services do not seek them, many for economic reasons and some because of lack of awareness about possible services. These conditions are acknowledged for rural areas, but they exist also in urban areas, particularly among the poor.

A national plan for the distribution of prosthetic and orthotic services should begin by establishing services at the provincial level (or the next level of health services which are below the national level). Countries that are already providing services at this level should plan for further distribution of services to the district level (or to a level which serves a smaller segment of the population). The patterns of distribution will vary among countries depending on the size of their populations.

Personnel

The chart below presents an example of an ideal distribution of personnel at national, provincial and district levels. The sample country has a population of 20 million people. There are five provincial health care centres, and 100 district level centers.

1 National Centre

Population: 20,000,000
Serves the entire country for the production of uncommon or complicated appliances.

Type of Personnel:

P/O Engineers.....2
P/O.....3
Technicians.....25

(The ratio of technicians for each P/O or Engineer is 5 to 1.)

5 Provincial Centres

Population: 4,000,000
Serves patients who attend the provincial level health services and those living in the area near the provincial centre.

Type of Personnel:

P/O.....3 for each centre X 5...15
Technicians...15 for each centre X 5...75

100 District Centres

Population: 200,000
Serves patients living in the district, and in near-by districts which do not have prosthetic/orthotic services.

Type of Personnel:

P/O.....2 for each centre X 95.....190
Technicians...10 for each centre X 100...1000

(Five districts are included in the five provincial level services. Hence the figures are for 95 centres.)

Total number of personnel employed by the country:

P/O Engineers 2
Prosthetists/orthotists.....208
Technicians.....1100

Since such an ideal condition cannot be achieved by most developing countries in the near future, it is necessary to set realistic goals for the development of services which will be available to as many people in as many areas of the country as possible. The chart below uses the example of the country with a population of 20 million. Assuming that the country has 3 qualified prosthetists/orthotists in a major hospital in the capital city, the plan will be to train and post 10 more P/O at provincial level and 30

P/O and P/O assistants at district level. The assistants would be trained to produce the type of appliance which would meet the majority of needs. The majority would probably be trained for lower limb orthotic services. The professionals will need the help of technicians, who may number three to each P/O or assistant. This means 129 technicians would be employed to provide the manual labour for the professionals, who would then be able to fit more patients with prosthetic and orthotic appliances.

1 National Centre

P/O.....3
Technicians.....9

5 Provincial Centres

P/O.....2 for each centre X 5.....10
Technicians....6 for each centre X 5.....30

100 District Centres

P/O or P/O Assistants....1 in each of 30 centres.....30
Technicians.....3 in each of 30 centres.....90

If this plan was implemented over 5 years, it would require the posting of 8 P/O or P/O Assistants each year, along with the technicians needed to assist in the work. Since the assistants have a shorter training, they could be placed more quickly, first in the provincial centres, and when they were staffed with P/O, in the district centres.

If the plan was implemented over 10 years, it would require the posting of 4 P/O or P/O Assistants each year, along with the technicians needed to assist in the work.

Within the plan, the selection of centres for the services should consider both geographic distribution and the number of people concentrated in particular areas of the country.

Within the plan, the people trained as prosthetists/orthotists could be chosen from the assistants, which would provide upgrading for the assistants.

The training of the technicians could be on-the-job training, so there would not be training costs involved in the provision of this category of personnel.

The above plan could be considered a short-term plan with respect to a long term plan to distribute personnel and to deliver services throughout the country. Within either the short or the long-term plan, the preparation of prosthetic/orthotic engineers may be included. They will be needed if training is to be done within the country. If personnel are to be trained in

another country, the services of the P/O engineer are still valuable for research and for the provision of complicated appliances.

Services

This document focuses on the training of personnel for the distribution of prosthetic and orthotic services. It is not intended to be a guide for all aspects of the development of services. Nonetheless, some aspects of the services should be mentioned because they also relate to the development of personnel.

Throughout the presentation of tasks and guidelines for training, reference has been made to the production of components for artificial limbs or braces. The means by which components are obtained influences all aspects of national planning for services. Some countries have been dependent on industrialized nations for components, particularly for prostheses. In most cases this dependency on imports has meant costly components, which kept the price of appliances high, and the distribution of services low. In some countries the orthopaedic workshops each produce the components which they need for their patients. This is a labour-intensive, time-consuming process which is usually carried out by technicians. Other countries have developed a system for a central production of components which are then distributed to all workshops. This factory production of components is less time consuming and can promote a high standard of production which provides well-made components throughout the country. Central production requires a reliable system for the delivery of components to all workshops. If the delivery system does not function well, workshops may at times find themselves without components, and hence without the ability to produce appliances. This can be less efficient than producing the components in each workshop.

National plans should be made carefully with regard to the supply of components. Few countries have the financial resources to use imported items for all of the appliances which are needed in the country. Local materials should be identified and used for the production of components whenever possible. A central manufacturing service should be set up only if there is a guaranteed system for delivery of the components. If delivery is uncertain, components should be produced locally and the necessary staff of technicians should be provided.

It should be noted that the planning of services to be located throughout the country must consider the cost of setting up workshops. This cost will vary greatly depending on the materials used and the machines needed to produce appliances in the particular materials. For example, it is more costly to set up a workshop to produce prostheses made from wood than to have one which produces plastic prostheses. However, the plastic materials may not be available locally. Imported materials, like components, can greatly affect the cost of the appliances.

Services for people who need artificial limbs and braces should include not only the provision of the appliances, but education and training regarding the care of their limbs, the prevention of deformities and the use of their appliances. When appliances are provided for children, their parents

should receive this training. If these services are not available from physical therapists or rehabilitation assistants, they may have to be provided by the prosthetist/orthotist and the P/O assistant. If this is necessary, the training of the P/O and the P/O assistant should include preparation for these responsibilities.

If rehabilitation services are available at the community level, referral should be made by the P/O or P/O assistant to the community rehabilitation worker with clear instructions regarding the training that the person with a new appliance needs. The community worker should also be taught how to recognize problems with the fit of appliances so that advice can be given to people with appliances to return to the workshop for repairs or replacements.

The distribution of personnel and services for people with disabilities is needed throughout most developing countries. With a view to the long-term goal of serving all people, short-term goals should be set for the development of the necessary personnel and services. Over the relatively short span of ten years, a great impact could be made by meeting short-term goals each year.

Annex A

TASKS FOR PROSTHETIST/ORTHOTIST (Orthopaedic Technologist)

PATIENT CARE

Clinic Team

1. Participates as full member of the clinic team; takes part in the prescription; and advises on the design of the prosthetic/orthotic device, including the socket or body/device interface, suspension and selection of the proper components.
2. Assists and advises in pre-surgical and post surgical management of individuals requiring complicated prosthetic/orthotic devices.
3. Records and reports any pertinent information regarding patient and patients' families.

Fitting and fabrication

4. Formulates a range of prosthetic or orthotic designs as specified in the curriculum guidelines. This includes model and pattern making and selection of materials, components and additional aids.
5. Makes all necessary casts and measurements of patients required for proper fabrication and fitting.
6. Modifies positive and negative models and/or lays out design in order to obtain optimal fit and alignment.
7. Performs fitting as well as static and dynamic alignment of devices on patients.
8. Performs and/or supervises fabrication of the appliance, including component parts, sockets, suspension systems.
9. Performs and/or supervises finishing operations on prostheses and orthoses, including the use of alignment transfer tools and equipment.

Evaluation and follow-up

10. May take part in initial check-out and in preliminary training of patient in the use of the device.
11. Advises the team and participates directly in the evaluation of the final product including fit, function and cosmesis.
12. Instructs the patient or family in the use and care of the device.
13. Takes part in follow-up procedures as well as maintenance, repair and replacement of the appliance.

MANAGEMENT AND SUPERVISION

1. Supervises the activity of supporting staff as appropriate.
2. Manages clinical and laboratory/workshop activities assigned to him, including
   - use and maintenance of tools and equipment;
   - maintenance of safe environment;
   - inventory and stock control;
   - personnel matters;
   - financial matters;
   - ensures appropriate record keeping.
3. Devises improved job methods for increasing efficiency.
4. Interacts with professional groups as well as governmental and non-governmental agencies.
5. Takes part in planning and implementation of technical orthopaedic care system.

TRAINING AND EDUCATION

1. May supervise practical education for technologists and technicians.
2. May lecture and demonstrate to colleagues in his profession and other professionals concerned with prosthetics/orthotics and also to community and other interested groups.
3. Keeps abreast of all new developments concerning prosthetics/orthotics and teaching techniques.

COMMUNITY SERVICES

1. Takes part in community rehabilitation programmes.

Annex B

GUIDELINE FOR TRAINING PROSTHETIST/ORTHOTIST (Orthopaedic Technologist)

THEORETICAL INSTRUCTION

The following provides useful guidance but not a specific, detailed curriculum. This does not preclude desirable variations within the general principles outlined. Items of particular importance are identified for inclusion in each subject. The listing does not imply any sequential order of presentation.

SCIENCE	ITEMS OF PARTICULAR IMPORTANCE FOR INCLUSION IN THE COURSES
Physical and Applied Sciences	
Chemistry	Chemistry of prosthetics/orthotics materials.
Physics	Electricity, electronics and instrumentation, hydrostatics.
Mathematics	Elements of algebra, trigonometry.
Mechanics	Classical applied mechanics theory.
Materials	An appreciation of the properties of prosthetics/orthotics materials under varying loading conditions and working environments.
Life Sciences	
Biology and division	The characteristics of living organisms, cell structure Structure and function of body tissues.
Human Physiology and Anatomy	An appreciation of the structure and function of the principal body systems and also surface anatomy related to prosthetics and orthotics.
Pathology	Diseases and disabilities amenable to prosthetic/orthotic management and other relevant conditions such as leprosy.
Medical and Surgical Management	An appreciation of surgical, medical and rehabilitation procedures normally utilized in all stages of the management of patients receiving prosthetic/orthotic treatment. Orthopaedic examination and evaluation of the patient.
Psychology	An introduction to basic principles of psychological adjustment

PROFESSIONAL COURSES

Biomechanics	Body-tissue mechanics, locomotion and upper-limb and spinal use and function
Technical drawing	Drawing, interpretation and construction.
Workshop technology	The use of the materials, tools and production and repair processes used in prosthetic/orthotic practice.
Theory of prosthetic and orthotic techniques	The biomechanical principles, "patho-mechanics", fitting procedures and fabrication techniques of the range of prosthetic/ orthotic and other related appliances.
Management	Organization of health service programmes. Workshop organization.
Teaching	Introduction to instruction techniques.

PRACTICAL INSTRUCTION

Introductory Prosthetic/Orthotic Workshop Techniques

Clinical and workshop techniques for the following types of appliances, including where appropriate component fabrication:

Orthoses (of limited complexity)*

Upper Limb
- Hand
- Wrist
- Elbow

Lower Limb
- Hip Knee ankle foot
- Knee ankle foot
- Ankle foot
- Orthopaedic shoes

Cervical/Spinal
Thoraco-Lumbar
Lumbar
Lumbo Sacral

Prostheses (of limited complexity)*

Upper Limb
- Above-elbow
- Through-elbow
- Below-elbow
- Wrist disarticulation
- Partial hand

Lower Limb
- Above-knee
- Through knee
- Below knee
- Through ankle
- Partial foot

Other Related Devices

Mobility Aids

Ambulation Aids

Clinical Experience

A widely based clinical experience in approved prosthetic/orthotic centres with generalized case loads should be an integral part of any curriculum. Internship of six months is recommended. During this period, exposure should be arranged to the solution of the socio-economic aspects of patient care.

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*Practical demonstration may be given of more complex appliances.

Annex C

TASKS FOR PROSTHETIC OR ORTHOTIC ASSISTANT

1. Participates in clinics.
2. Advises on the design of the prosthetic or orthotic appliance.
3. Records and reports pertinent information.
4. Formulates a limited range of prosthetic or orthotic designs.
5. Makes all necessary casts/measurements.
6. Makes the choice of components and materials.
7. Performs or supervises the assembly of the prosthetic or orthotic components and the bench alignment.
8. Looks for the most appropriate technology. If the necessary components are not locally available, he should be able to supervise their production by a technician or to make them himself.
9. Performs the static and dynamic alignment and fitting to the patient.
10. Performs or supervises the finishing of the prosthesis or orthosis.
11. Gives the patient all needed information about use, maintenance and replacement times of the prosthesis or orthosis.
12. Does all necessary repair work and indicated corrective management of the prosthesis or orthosis.
13. Instructs the family of the patient in the use and care of the appliance.
14. Makes adaptive devices, such as walking aids.
15. Takes part in community services.
16. Supervises the activity of supporting staff as appropriate.
17. Manages workshop activities as necessary.

Annex D

GUIDELINE FOR TRAINING PROSTHETIC OR ORTHOTIC ASSISTANT

THEORETICAL INSTRUCTION

The courses are the same as those recommended for the prosthetist/orthotist. However they should contain only the information relevant to the type of appliances the Assistant will produce. The theoretical segment of the training should form approximately 35% of the total training period.

Science Courses

Physical and Applied Sciences	**Life Sciences**
Chemistry	Biology
Physics	Physiology and Anatomy
Mathematics	Pathology
Mechanics	Medical/Surgical
Management	
Materials	Psychology

Professional Courses

Biomechanics
Technical Drawing
Workshop Technology
Theory of prosthetic and orthotic techniques
Management
Teaching

PRACTICAL INSTRUCTION

This includes clinical and workshop techniques for the type of appliances which the Assistant will produce, along with the appropriate component fabrication. This segment of the training should be about 65% of the total training period.

The following is an example of the types of appliances and components which an Assistant for Lower Limb Orthotics would be trained to make.

Component/joint fabrication
- 2 sets of knee joints
- 2 sets of ankle joints

Lower Limb Orthotics
- 2 KAFO with knee lock plastic brace
- 3 AFO
- 4 other callipers/splints, appropriate for the country

Clinical Experience

Clinical experience under the supervision of qualified prosthetists/ orthotists is required.

Annex E

TASKS FOR TECHNICIAN

In direct assistance to the prosthetist/orthotist or orthopaedic technologist:

1. fabricates and assembles prosthetic/orthotic devices, including component parts, sockets, suspension systems as designed by the prosthetist/orthotist;
2. performs bench alignment of the device to the specifications of the prosthetist/orthotist;
3. as directed, assists the prosthetist/orthotist in the fitting and aligning activities with patients;
4. as directed, performs finishing operations on prostheses and orthoses, including the use of alignment transfer tools and equipment;
5. reports any pertinent information regarding the device or the patient to the prosthetist/orthotist.

In general:

1. keeps abreast of new developments in materials, tools, equipment and processes which apply to his duties in the laboratory;
2. offers suggestions for improvement in job methods in the laboratory;
3. repairs prostheses or orthoses as assigned and directed by the prosthetist/orthotist;
4. is responsible for the conduct of the "on the job" and apprenticeship training programmes for technician trainees as assigned by the prosthetist/orthotist;
5. reports to the prosthetist/orthotist on special needs regarding laboratory materials, equipment and tools;
6. is responsible for the care and economical use of laboratory materials, equipment and tools;
7. may supervise a group of other technicians with related administrative and management duties.

Annex F

GUIDELINE FOR TRAINING TECHNICIANS

The technician's job description may encompass all of the tasks identified or only a limited number of them.

The technician may already be a trained craftsman and may only require supplementary training to allow him to apply his skills in prosthetics/orthotics.

If the technician is required to fulfil all of the specified tasks, his training might be:

a. On the job training of about 4 years duration
b. A full-time structured course of 18 months

Normally the technician will perform a limited number of tasks and his training will be shortened accordingly.

An example of a curriculum for a full-time structured course of 18 months is as follows:

Curriculum for Prosthetic/Orthotic Technicians.

If one considers a formal course, the following should be considered:

1. Laboratory training should include general workshop procedures, woodwork, leather work, metal work, plaster work, plastics, assembly of components, assembly of prosthetic and orthotic appliances, and acting as an aide to the prosthetist/orthotist.

2. Academic training should include practical demonstration and laboratory practice in the following subjects:

   Technology of materials
   Safety measures in workshop practice
   Technical drawing (at this level of training means an ability to read a blueprint)
   Uses of special machinery
   Workshop technology

The duration of the training should be approximately 18 months and the ratio between laboratory practice and academic subjects should be approximately 7:1.

Annex G

TASKS FOR PROSTHETIC/ORTHOTIC ENGINEER (Prosthetist/Orthotist)

TRAINING AND EDUCATION

1. Supervises practical education for technologists and technicians.
2. Lectures and demonstrates to colleagues in his profession and other professionals concerned with prosthetics/orthotics and also to community and other interested groups.
3. Keeps abreast of all new developments concerning prosthetics/orthotics and teaching techniques.

RESEARCH AND DEVELOPMENT

1. Conducts continuing evaluation of his activities.
2. Participates in formal evaluation and research programmes.
3. Participates in scientific/professional meetings and contributes papers to scientific/professional journals.

PATIENT CARE

Clinic Team

1. Participates as full member of the clinic team; takes part in the prescription; and advises on the design of the prosthetic/orthotic device, including the socket or body/device interface, suspension and selection of the proper components.
2. Assists and advises in pre-surgical and post surgical management of individuals requiring complicated prosthetic/orthotic devices.
3. Records and reports any pertinent information regarding patients and patients' families.

Fitting and Fabrication

4. Supervises the activities of the orthopaedic technician in his fitting and fabrication.
5. Formulates prosthetic or orthotic designs, including model and pattern making and selection of materials, components and additional aids.
6. Makes all necessary casts and measurements of patients required for proper fabrication and fitting.
7. Modifies positive and negative models and/or layout of design in order to obtain optimal fit and alignment.
8. Performs fitting as well as static and dynamic alignment of devices on patients.
9. Performs and/or supervises fabrication of the appliance, including component parts, sockets, suspension systems.

Evaluation and Follow-up

10. Performs and/or supervises finishing operations on prosthesis and orthosis, including the use of alignment transfer tools and equipment.
11. Takes part in initial check-out and in preliminary training of patient in the use of the device.
12. Advises the team and participates directly in the evaluation of the final product including fit, function and cosmesis.
13. Instructs the patient or family in the use and care of the device.
14. Takes part in follow-up procedures as well as maintenance, repairs and replacement of the appliance.

MANAGEMENT AND SUPERVISION

1. Supervises the activity of supporting staff as appropriate.
2. Manages clinical and laboratory/workshop activities assigned to him, including
   - use and maintenance of tools and equipment;
   - maintenance of safe environment;
   - inventory and stock control;
   - personnel matters;
   - financial matters;
   - ensures appropriate record keeping.
3. Devises improved job methods for increasing efficiency.
4. Interacts with professional groups.
5. Takes part in planning and implementation of technical orthopaedic care system.

Annex H

RESOURCES NEEDED FOR A SCHOOL FOR PROSTHETISTS/ORTHOTISTS (Orthopaedic Technologists)

1. Faculty
   - Prosthetists/Orthotists (Orthopaedic technologists)
   - Physicians, scientists
   - Engineers
   - In practical sessions and clinical experience, the teacher/student ratio should be 1/8 to 10.

2. Facilities
   - Lecture rooms with audio-visual facilities
   - Laboratory for practical work
   - Clinical teaching facilities
   - Library
   - Common room, cloakroom and other supporting facilities

3. Laboratory Equipment
   - Appropriate machine tools, work benches, hand tools, casting aids and adequate environmental control equipment.

4. Materials
   - Raw materials: (a) metals (b) wood (c) fabric (d) plastics (e) leathers (f) plaster of paris (g) other local material
   - Components—prosthetic and orthotic
   - Pre-manufactured items, such as boots, riblets, etc.

5. Books and Manuals
   - Appropriate manuals - existing material may be utilized for preparing these manuals.
   - Books - standard text books related to the curriculum.
   - Journals—major prosthetic and orthotic journals.

6. Audio-Visual Aids
   - Projection equipment - slide projector, overhead projector, film projection
   - V.C.R. and television
   - Video cameras wherever feasible
   - Sound equipment

7. Other
   - Office equipment such as typing, photo-copying machine, duplicators, telephone.
   - Hostel and kitchen facilities may be required.

8. Funds
   - Adequate funds should be made available for the items listed above, as well as for replacement of equipment and purchase of consumable materials.

Annex J

PARTICIPANTS IN CONSULTATION ON TRAINING OF PERSONNEL IN DEVELOPING COUNTRIES FOR PROSTHETICS AND ORTHOTICS

Eastern Mediterranean Regional Office
Alexandria, Egypt
17-22 June 1990

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