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Education and training in occupational health, safety and ergonomics

Eighth Report of the Joint
ILO/WHO Committee on
Occupational Health



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Geneva, 2-10 March 1981

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EDUCATION AND TRAINING IN OCCUPATIONAL HEALTH, SAFETY, AND ERGONOMICS

Eighth Report of the Joint ILO/WHO Committee on Occupational Health¹

1. INTRODUCTION

The Joint ILO/WHO Committee on Occupational Health met in Geneva from 2 to 9 March 1981 to discuss education and training in occupational health, safety, and ergonomics. Dr Ch'en Wen-chieh, Assistant Director-General of WHO, opened the meeting on behalf of the Directors-General of both ILO and WHO. Referring to the WHO target of "health for all by the year 2000", he drew attention to WHO's long-term objective and activities in regard to workers' health: "to make available to all workers, including those employed in remote areas, preventive health care based on convenient and appropriate technology and workers' participation". The ILO, on the other hand, launched in 1976 the International Programme for the Improvement of Working Conditions and Environment (PIACT) which has occupational safety and health as one of its central features. In particular, Dr Ch'en said, training and education in the occupational health and safety fields were among the main objectives of the two organizations and it was therefore essential to harmonize their approaches and to undertake complementary activities in these fields.

The subject of education and training had been selected for discussion by the Committee in view of the following:

- (a) there is a marked shortage of occupational health and safety personnel in many countries, particularly in developing countries;
- (b) health personnel in industry and agriculture should be made aware of the primary health care approach and the principles of epidemiology so that they may carry out more responsible functions in dealing with workers' health;

¹The second, third, fourth, fifth, and sixth reports were published as, respectively No. 66, 135, 246, 354, and 415 in the WHO Technical Report Series. The seventh report was published as No. 34 in the ILO Occupational Safety and Health Series. The first report was issued as an unpublished document.

(c) there is a need to introduce educational material on occupational health and safety for primary health care workers who are called upon to provide services in agriculture and small industries and other groups of underserved working populations;

(d) there is a need to educate workers so that they may participate in occupational health and safety programmes and there is also a need to increase the awareness of employers in this field.

The main objectives of the meeting were therefore:

- to assess the needs for education and training at different levels,
- to develop policies in education and training,
- to determine education and training objectives in occupational health and safety, and
- to advise on methodology and programmes for education and training.

At a meeting of the Joint ILO/WHO Committee on Occupational Health held in 1950, the aim of occupational health was described as follows:

the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations, the prevention among workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological equipment, and to summarize: the adaptation of work to man and of each man to his job.

Within these broad objectives the practice of occupational health and safety, and consequently the need and content of education and training, varies widely from country to country and even from industry to industry. The primary concern of occupational health and safety is the dynamic interrelationship between work and health and the attainment of the best balance between them. According to the circumstances of the work, the approach may call for expertise in medical, engineering, and other sciences in order to prevent accidents and disease and to promote health. Furthermore, it is necessary that those concerned with the technology of work should constantly bear in mind its impact on people, while those primarily concerned with health should be fully aware of the nature and content of work.

Many people are involved in the organization of work, for example, designers, engineers, chemists, administrators, managers, personnel officers, supervisors, and foremen. Only in a few cases are they specifically concerned with the effect of work on safety and health, e.g.,

factory inspectors, safety engineers, physicians, ergonomists, hygienists, and nurses. Equally, many people are concerned with the management of health—e.g., health administrators, physicians of all kinds (from general practitioners to specialists in a variety of disciplines) and nurses of a similarly diverse character. In only a few cases are they specialists in occupational health, yet they must all recognize that, even if the condition under treatment is not related to work, it may affect to some extent the possibility and time of return to work.

The challenge therefore is to provide for each participant in the work–health complex the necessary education or training to enable him to fulfil his role in achieving the object of ensuring protection of workers against risk and the maintenance of an economically and socially productive life.

2. NEEDS FOR EDUCATION AND TRAINING IN OCCUPATIONAL HEALTH, SAFETY, AND ERGONOMICS

A number of factors point to the need for education and training in occupational health, safety, and ergonomics. The first is the lack of trained personnel in many countries. Secondly, even where trained people exist, facilities are often lacking to provide additional training (18). Thirdly, in spite of the efforts of the international organizations to provide help in the form of fellowships and institutes in developing countries, there are still many gaps to be filled and more effective coordination of international effort is necessary. Finally, there is a great need for intercountry cooperation in the field of education and training.

The Committee found that the need for education and training concerns all persons involved in any way in occupational health, safety, and ergonomics. Recognizing that there are wide differences between countries in the ability to fulfil these needs, it was generally accepted that three levels of education and training are required: (1) awareness; (2) training for specific tasks; (3) specialization.

It was stressed that these levels are not separate compartments, but components of a continuum. Any person may require access to all three levels (6).

2.1 Awareness

This is the basic level of education, aimed at providing an understanding of the principles of occupational health and safety in order to promote correct attitudes at work and to permit intelligent participation in discussions of any action to be taken. The main target groups are:

(a) *Legislators and policy-makers.* Those concerned with decision-making and administration have a central role to play in defining the needs. They must therefore be fully aware of the true situation at the local level and should be in a position to indicate the level of priority that should be accorded to health and safety. Obviously, those employed in positions concerned with occupational health and safety legislation should have an adequate degree of awareness.

(b) *Managers.* Every member of the management team, from director to supervisor, should recognize the area of his responsibility in health and safety. He should be sensitive to the need for improvement and should know where and how to get expert help, either within his own industry or through his trade association or elsewhere. He should understand the health and safety problems of the workers under his supervision and be able to communicate with them on such matters, both formally and informally, e.g., in health and safety committees and day by day on the shop floor. According to his position in the hierarchy of management and the nature of the processes concerned, his required level of awareness will vary. Top management would be expected to know when they need expert help in the long-term decision-making process. The personnel manager would be expected to have a high level of awareness of job profiles. So too would the supervisor in charge of a potentially hazardous process, though he might also need specific training.

(c) *Workers.* Workers' organizations should be fully aware of the hazards faced by their members, from the top level of the trade union organization down to the local level. They should have access to all relevant information and should be able to call on expert help where necessary. Every worker should be familiar with the main hazards of his job and how these are controlled. He should have a knowledge of the safety and health organization of his workplace, so that he knows where to get any necessary information and help. He should be taught that the right way to do a job is the safe way, and to practise occupational health and safety at all times.

2.2 Training for specific tasks

The aim of training for specific tasks, either formally or on the job, is to provide the individual with the ability to carry out specific tasks in the occupational health and safety field, either on a part-time or on a full-time basis. The range of persons and the appropriate level of training is wide but the following are examples:

(a) *Administrators*. Those engaged in the administration of the law on occupational safety and health (e.g., factory and other inspectors, social security officers) need training. This is sometimes given on the job, but should be supplemented by special courses and refresher courses to keep pace with technological developments.

(b) *Managers*. According to the circumstances of the particular industry, some members of the management team need more than awareness of the problems. They should be familiar with the legislation and safety standards and play an active part in health and safety committees. Some of them may acquire knowledge by interest, experience, and practice, but specially designed courses, often in association with workers' representatives, are desirable.

(c) *Workers*. Many workers serve as safety representatives or as members of health and safety committees. They need a more intensive course of training complete with on-the-job supervision, supplemented by periodic refresher courses, to enable them to fulfil their duties effectively. They may also be trained to use appropriate instruments for environmental measurements.

(d) *Architects and designers*. As indicated above, awareness of human problems is necessary, but in many cases this is not enough. There is a real need to integrate the human factors of the disciplines with technical and professional training.

(e) *Medical and paramedical personnel*

(i) *Physicians and nurses*. Even at the undergraduate level there is a need for more than just awareness of occupational problems. Special efforts should be made to include occupational health and safety in the basic medical and nursing courses as an essential part of the education and training of physicians and nurses (16). Unfortunately, this need is recognized all too rarely.

After qualifying, most physicians and nurses work in hospitals or community services, either as specialists or in community practice. The more they know of the nature of their patients' jobs the more likely they are to provide effective treatment and rehabilitation. Training and refresher courses in occupational health and safety are

therefore desirable. In some cases these courses can stimulate the person to go on to specialized training in these subjects.

(ii) *First-aid workers.* The man or woman who is concerned with treating emergencies has very often an acute appreciation of the causes. Many organizations are concerned with formal training in first aid and such training is essential for mine rescue teams and others. The first-aid worker is a valuable member of the health and safety team and consideration should be given to his further training.

(iii) *Primary health care by nonphysicians.* In many countries where no occupational health services are available, such as in rural areas or remote industrial settings, nonphysician primary health care workers will have to deliver occupational health care. These workers need appropriate training to deal with problems that may occur, for example, in agricultural work where hazardous chemicals and potentially dangerous machines are used.

(f) *Chemists and engineers.* Inevitably these professionals will be concerned with handling potentially dangerous substances and hazardous equipment, so it is essential that their training courses should include a significant component of health and safety. As with the architects and designers, health and safety should be integrated into their training, rather than being merely incidental areas of concern. With the right kind of teacher and the right kind of teaching, there is a possibility that chemists and engineers may specialize later in toxicology, occupational hygiene, or safety and health engineering.

(g) *Occupational health and safety technicians.* In practice, health and safety measures depend very much on technically trained people who are not graduates, but within a narrow range are often more expert than professionals. Much of their training is on the job, but many of them can attend specialist training courses.

2.3 Specialization

The occupational health and safety professionals are usually employed fulltime in the exercise of their specialty. They obtain their expertise by undergraduate or postgraduate courses and experience. In such areas as occupational medicine, occupational health nursing, occupational hygiene, occupational safety, health physics, and ergonomics the usual route is by postgraduate qualification. In the case of the safety officer, it is only recently that formal courses leading to a postgraduate qualification have been established. Safety officers throughout the world are seeking recognition of their specialist status.

3. POLICY IN EDUCATION AND TRAINING IN OCCUPATIONAL HEALTH AND SAFETY

3.1 General principles

One of the main objectives of the Committee was to contribute to the harmonization of general policies in education and training in occupational health and safety, particularly in international work in this field.

Prevention of occupational accidents and ill health caused by harmful factors at the workplace, as well as creation of working conditions and a working environment that maintain and promote the health of workers, are integral parts of national development policies. This is true also of education and training in occupational health and safety.

Safety at work and prevention of occupational accidents and diseases should be ensured at all levels of working activity. The principles of safety, hygiene, and ergonomics must be applied as early as at the stage of planning, designing, and constructing machines, working procedures, or buildings. Human factors in accidents must be considered in such a way that safe behaviour is ensured. Safety and protective devices must be designed, applied and used. Workers and employers must be motivated in the prevention of occupational accidents and diseases. Work must be organized in such a way as to adjust work to man. There must be a system of specialized services and institutions to carry out research and supervision of workers' health, working conditions and environment, and safety at work.

Hence the policy in education and training in occupational health and safety must cover all the categories of personnel involved, in order to enhance their awareness of health and safety measures, their ability to fulfil specific tasks, or their specialized knowledge and skill.

Any preparation of decision-making in education and training policy in occupational safety and health should start with an analysis of national and global needs and constraints. The analysis is the first step in elaboration of a plan for training activities. The plan should be practical to meet immediate needs, but also dynamic enough to cope with further needs that may rise with future development.

Policy depends largely on national or local economic, social, cultural, political, and other conditions. That is why the education and training plans and processes should be formulated primarily by the countries themselves.

3.2 National level

The training and educational policy will cover many different types of information, education and training and its formulation should be participated in by a wide range of interests within the country, especially those on whom the policy will have its main impact. The policy will, of necessity, reflect the technological, economic, political, social, and cultural background of the nation for whom the policy is being developed. This will be true regardless of the model that is followed in the development of the policy. The policy should reflect not only the occupational health and safety needs of the country but also the current agreements that the country has with others in the international community. The policy should cover the concerns of employers' and workers' organizations; labour administration, health services, and education. Representatives of each sector should fully participate in its formulation.

The Committee discussed different levels of participation in the formulation and implementation of the national education and training policy.

The *government* should particularly assess and analyse the country's needs in education and training, formulate adequate policy, support it by appropriate regulations and planning, and coordinate the activities of different institutions and organizations involved. This coordination is indispensable in view of the multidisciplinary character of education and training in occupational health and safety.

The policy should reflect conditions within the country or area for which it is designed, should involve employers' and workers' participation, and should provide training of its people as early as possible in life, preferably when they commence primary school; it should involve team work and a multidisciplinary approach and should relate closely to all those elements of the government and private sector that will be required to play a role in ensuring the success of the policy. The policy should provide for the primary health care system (a multi-purpose activity) as part of a global health activity focusing on those individuals who frequently do not have ready access to occupational health facilities, such as workers in agriculture, forestry, small-scale industry, urban informal sector, and migrant labourers.

The policy should take into full consideration the requirements and methods for the provision of physical facilities to train a cadre of instructors, and the preparation of the entire instructional support system, including training materials.

In the implementation of a policy through regulations and legislation, it should be remembered that nothing may be accomplished unless those in policy-making positions can be convinced of the need for and adequacy of the design of the proposed programmes. Thus, it is vital that the legislators and policy-makers should be involved in the process as far as possible.

Educational systems should incorporate educational and training programmes in occupational health and safety into their regular curricula. In the pre-employment stage, education should start as early as possible to foster appropriate habits from childhood. The programmes for students or apprentices should cover health and safety aspects in general, as well as those related especially to their future profession.

The Committee considered it very important that health and safety at work be taught as topics inseparable from the working process itself. Educational programmes in occupational health and safety should be integrated into workers' vocational training and training for production, especially for students and apprentices. Safe behaviour at work, the use of protective devices, and attention to personal hygiene should become an integral part of working habits and should be among the basic aims of educational policy.

The programmes of education and training of managerial staff, designers or production engineers should ensure that these specialists obtain a good knowledge of the principles of occupational health and safety and apply the principles of ergonomics in their specific functions.

Education of occupational health and safety staff should prepare them fully for their duties. Besides technical knowledge, special attention should be given to training in teamwork; as occupational health and safety is multidisciplinary, teamwork is indispensable.

Another aspect is the proper integration or coordination of public health and occupational health. A great deal of health supervision in occupational health will be carried out by public health services, as specialized occupational health services reach only a part of the working population. Thus, public health, and primary health care workers must be prepared in occupational health, too. The Declaration of Alma-Ata (23) gave advice on how to reach the basic underserved populations by primary health care. The Committee stressed, however, that the duties of the staff in occupational health services are never limited to occupational health; education in all aspects of health must form a part of the training for specialization in occupational health.

When appropriate, education and training in occupational safety and health should be taken into account in national legislation.

Workers' organizations. The policy of workers' organizations in the field of worker education is to provide their members with the necessary information to enable them to play their full part in safety committees, safety inspections and discussions with governments on intended legislation.

Trade unions can influence the policies of employers and governments. It should be the general rule that when trade unions provide courses for their members, these should be held during working hours and entail no loss of pay.

Employer associations. Conscious of their responsibilities to provide maximum protection to their workers, employer associations have been making substantial contributions to worker safety and health. These contributions have taken the form of increased concern for the design of equipment and industrial processes, the use of safe substitutes and less dangerous materials, and the training of various levels of management to ensure that the workplace is functioning at continually lower levels of risk. Management has increased its efforts to inform workers, to recruit specialists in occupational health and safety where necessary, to make full use of the research findings of scientific organizations, and to seek more ways to involve workers in safety and health programmes.

Voluntary organizations and professional societies concerned with occupational health and safety should participate in formulating and implementing national educational and training policy.

Mass media of information may have a large impact on occupational health and safety, giving—often unintentionally—good or bad examples of behaviour at work, etc.

3.3 International level

The Committee believes that harmonization of international policy in training and education in occupational health and safety is essential, particularly in the implementation of various training activities by ILO and WHO. A number of principles were considered by the Committee as appropriate bases for this policy:

(a) Training and education in occupational health, safety, and ergonomics should be a part of national development schemes and should relate to the sociocultural environment in the different coun-

tries, as well as being coordinated or integrated with educational efforts.

(b) Training and education in occupational safety and health should be carried out as much as possible within the country itself. In addition to minimizing the cost, this would ensure that the training provided would be most relevant to the conditions in the country and to the degree of development of its industry and other related services. Some countries do not have satisfactory resources to provide for training of their personnel, in which case it may be possible for ILO and WHO to organize national training courses with consultants from abroad, utilizing at every opportunity the resources available in neighbouring countries and activating technical cooperation among the developing countries.

(c) Regional and subregional institutions for training and education should be established and those already in existence should be given every support from national agencies. Regional training is the next best means of training to that carried out within the country. Training material relating to various fields of occupational safety and health, particularly the education and training of primary health care workers responsible for the health of underserved working populations, should become the high priority in the immediate future, in view of the fact that there is a great need for this material by many countries in the world.

(d) Emphasis should always be given to training of trainers in the field of occupational health and safety. Criteria for the selection of potential trainers, in addition to background qualifications, should include their ability to communicate, to teach, and to motivate trainees. A system should be developed for the selection of trainers and the international organizations should play as large a role as possible in stimulating and organizing courses for trainers.

(e) Granting of fellowships should be preceded by a thorough analysis of the functions of recipients of fellowships following their return to their countries. One of the principal reasons for granting fellowships is to ensure the development of a career structure to which such fellows will return to fulfil their new functions in their own countries. In many instances the value of fellowships is nullified by the absence of a corresponding career in the specialty in the country (12).

(f) There is a need for the coordination of initial efforts in education and training in occupational safety and health among various international agencies and between those agencies and efforts undertaken at the national level. This coordination should start at the plan-

ning level and agreement should be reached on goals and objectives. The Committee noted with satisfaction the increasing cooperation between WHO and ILO and recommended encouragement of this type of cooperation at the national level.

(g) International organizations such as ILO and WHO should continue to make use of the available resources in the most effective manner. There is a need to activate the efforts of voluntary organizations and professional societies dealing with various fields of occupational health and safety and to make use of their expertise in various countries in educational and training objectives.

(h) In view of the fact that occupational health personnel will often be required to carry out various responsibilities in public health affecting workers and their families and since there is a corresponding need to use peripheral health services to deal with occupational health problems of underserved working populations, occupational health officers need to be trained in public health duties and epidemiology, while rural and suburban health officers need to be trained in occupational health.

3.4 Planning as a part of education and training policy

Planning is the administrative instrument that provides a rational basis for decision-making. When aspirations exceed resources, choices must be made, and if decisions are to be made intelligently and productively they must be based on a careful assessment of options. Perhaps the most important contribution planning can make is in the allocation of scarce resources so as to ensure that health services are made available equitably. Planning involves:

- the identification and analysis of problems;
- the formulation of alternative options;
- the selection of the appropriate solution;
- the determination of the technical methods to be used, whether in the form of services or of physical changes;
- the definition of programme objectives and of the future action to be taken (13).

The identification and analysis of training and education needs in occupational health and safety will result in the determination of priorities, with major consideration being given to the allocation of resources to those areas where the greatest numbers of workers are exposed to risk and where a high level of risk exists.

In selecting the appropriate solution, and in determining the technical methods to be used, the availability of resources and the constraints existing must be taken into account.

The Committee defined the following *resources* as those that should be employed to develop the manpower required:

- the primary and secondary school system (to ensure that appropriate inputs of safety and health are integrated into, or coordinated with, appropriate subject matter);
- industrial arts and vocational training;
- technical institutes and universities;
- research institutes;
- trade unions;
- employer organizations;
- industry, and departments of occupational health and safety, whether located within ministries of health or labour, or elsewhere.

Likewise, the Committee identified the following examples of *constraints* that exist in some countries and that should be considered by those formulating national policy in training and education in occupational health and safety:

- the lack of training and education infrastructure (e.g., physical facilities, instructors, training materials and the like);
- language barriers (i.e., lack of ability by migrant workers to speak the language of the host nation, and low reading comprehension levels that hinder a worker in understanding labels, signs, and instructions);
- failure to consider the entire labour force as including the white collar worker as well as the blue collar worker, the worker in the urban informal sector, in agriculture, the employee of the small enterprise, the migrant labourer, and many other categories of workers.

Perhaps as important as or more important than any of the above are lack of coordination in the planning of training and educational efforts, lack of visible awareness of the problem, lack of incentives, and limitations in our knowledge about occupational health and safety.

The policy in education and training should be closely related to manpower needs in various categories. That is why educational planning should be related to planning of manpower. This is true of the education and training of the staff of occupational health and safety services as well as of that of all related workers. The educational capacity of a country and educational institutions in general, as well as the number of institutes and their staffing, should be developed to meet needs.

Despite the great variations between countries in the scope, methodology, and sophistication of manpower planning, several lessons have emerged from experience that appear to have wide applicability (13):

(1) planning is unlikely to be effective if due account is not taken of the social, economic and, especially, political circumstances in which it takes place;

(2) health manpower planning is an integral part of comprehensive health planning and should not become an independent activity;

(3) the three components of the health manpower development process—planning, production, and management—must be brought into closer and more functional relationship with each other and with health services development if an effective manpower policy is to be implemented;

(4) manpower studies or reports of commissions, however sophisticated, do not necessarily lead to the development, much less to the implementation of a plan, or to an integrated process of health manpower development unless the necessary social, economic, and political conditions and a definite national political will are present.

The Committee agreed largely with the analysis made by the Joint ILO/WHO Conference on Teaching of Occupational Health and Safety (9). Manpower planning in occupational health and safety is essential for the development of occupational health and safety services and as a basis for the planning of a rational education and training programme. National surveys of the needs for occupational health and safety manpower should be carried out and such needs continuously reviewed.

Different types of work and industries will call for different planning and will have different needs for occupational health and safety services. Such factors as population, morbidity, economy, and type of production of a country or region may change over a period of time. It will therefore be necessary to revise the manpower planning continually and to plan for specific periods. It is helpful also to have short-term and long-term plans.

When a system of manpower planning in occupational health and safety has not been established, certain definite drawbacks may result, including a haphazard distribution of available resources.

In manpower planning for occupational health and safety services the following factors should be considered. The needs of occupational health and safety services can be expressed in ratios of occupational health and safety personnel (physicians, nurses, engineers, etc.) to

numbers of workers to be supervised; or they may be expressed in terms of the time that needs to be expended by physicians, engineers, and nurses per worker per week. An analysis of the task to be performed should be carried out, and the functions of the personnel of the occupational health and safety team should be determined and specified in detail, as well as the distribution of responsibilities and tasks between the different members of the team.

When the functions of occupational health and safety service personnel are being determined, the possibility should be considered of delegating some routine tasks of professional personnel to others specially trained as technicians, medical aides, and safety technicians. In studying the need for an occupational health and safety service, the availability of public health services and medical care services outside industry should be taken into account, since the requirements for occupational health and safety services and their functions will depend very much on other services available outside industry or at other places of employment. If public health and general medical care services are well developed, there will be less load upon the occupational health services. If they do not exist, or are poorly developed, the load upon occupational health services will be greater and their functions may be different.

The need for personnel dealing with control of the work environment should be established and the functions of such personnel as occupational hygienists or labour and sanitary inspectors specified. Here, the relation between health, labour and factory inspectors and the occupational health and safety team should also be considered.

There is an increasing trend for personnel occupied with inspection and control duties, such as health, labour, or factory inspectors, not only to enforce labour legislation but also to study in more detail, and advise on, the work environment through industrial hygiene surveys, such as measuring concentrations of dusts, gases, or levels of noise. This trend will call for more extensive training of health, labour, and factory inspectors.

There are some difficulties in establishing occupational health and safety manpower standards. Morbidity data concerning occupational groups are sometimes not available, and it is also difficult to assess the effectiveness of occupational health and safety services and their influence upon the health of workers. Such data are essential for manpower planning, which should take account of growth of population and economic growth, as well as diversity in types of work in different countries and in different areas within countries. Therefore, it is not

possible to lay down a general rule for the requirements of occupational health and safety manpower for different countries; there will always be regional and national variations. Establishing future requirements calls for information on the number of personnel entering occupational health and safety fields, those being trained and gaining experience, and those who are transferred to other fields, or who leave or retire. There must then be a national policy that governs the distribution of available personnel to different health and safety activities.

It is important that people trained in occupational health and safety are used in this field afterwards, for occasionally it happens that those trained in occupational health move to other health fields. In countries with limited resources of educational personnel, training should be carried out at a variety of levels in order to meet the most urgent needs; priorities should be established and short-term and long-term plans developed.

4. OBJECTIVES OF EDUCATION AND TRAINING IN OCCUPATIONAL HEALTH AND SAFETY

4.1 General objectives

Educational or training objectives should be organized under three broad headings:

- (a) cognitive (knowledge);
- (b) psychomotor (professional skills); and
- (c) affective (attitudes and values).

Teachers should critically examine the learning experiences they offer and the test procedure whereby they judge their students' progress to determine whether they are appropriate to the desired level of learning. While problems cannot be solved without information, the evidence is clear that merely having information does not assure it can be used. On the other hand, learning experiences and evaluation procedures directed at problem-solving will also transmit information or test its acquisition. Attitudinal learning probably has a more profound influence upon future behaviour than the informational input, which has probably been overstressed in the usual educational programmes.

The development of a classification scheme for skills has proved very difficult, largely because of the wide spectrum of activities that fall under the general psychomotor heading and the problem of identi-

ifying common components in such varied skills relating, for example, to visual, tactile or motor activities (14).

The salient objective of education and training in occupational safety and health is to promote a general awareness of risks associated with work. Specific objectives are to train employers and workers in safe working practices and to train all personnel responsible for safety and health in enterprises to carry out the functions expected of them. The scope and level of training have to correspond to work hazards and to collective or individual responsibilities. A priority training area is the shop floor, where employers and workers are cooperating in maintaining safety and health at work.

The goals or overall objectives of education and training in occupational health and safety should be determined by a manpower planning process taking all requirements into account. The Committee emphasized that in most countries there are many shortcomings in occupational safety and health education and training. In some countries, there is little manpower planning, and educational programmes are not specifically designed to meet national needs. Often, occupational health and safety services are not organized to meet the health needs of the total national labour force, particularly as regards small industries, agriculture, mining, and industries in remote areas. Educational planning should take into account the need to train personnel for such underserved sectors. In order that educational and training programmes can be based on real needs and can meet the practical training needs of students assigned to work with occupational health teams, educational institutes should have close and continuous contact with field activities.

In determining the broad objectives of education and training systems for occupational health and safety, it should be stressed that the aim of occupational health and safety is not only to prevent occupational diseases and injuries but also to maintain and promote health. This implies the development in the social sectors of industry and in occupational health and safety personnel of new knowledge and technical capacities. They must be encouraged, *inter alia*, to devote more attention to early detection of health impairment, and greater emphasis must be placed on the psychological and sociological aspects of occupational health and safety.

Overall objectives of education and training in occupational health and safety may be expressed in terms of quantity and quality. The Committee gave the following examples of such objectives, expressed in terms of quantity:

- to increase the number of adequately trained occupational health professionals;
- to increase the contribution of intermediate staff to the efficiency of a service in view of the increasing responsibilities of services;
- to increase the number of educators and trainers and develop new training facilities and resources.

Objectives expressed in terms of quality would be, for example:

- to foster an awareness of occupational hazards and ways to contain them;
- to promote favourable attitudes towards a positive concept of health;
- to promote a team approach within occupational health and safety;
- to foster attitudes of cooperation among various medical and nonmedical personnel;
- to promote the use of effective investigative techniques, whether in laboratory work, in interviewing patients or groups of workers, or in evaluating data;
- to prepare teachers in new or inadequately developed occupational health aspects of fields such as administration, biochemistry, industrial psychology, nursing, and ergonomics;
- to integrate parts of education and training in occupational safety, health, and ergonomics with the basic education of physicians, engineers, chemists, nurses, and other safety and health personnel.

Educational objectives, both overall and instructional, are derived from various sources. Information on what is expected and required of services should be obtained from health statistics, from occupational health experts, occupational health physicians, hygiene and safety engineers, nurses, and factory inspectors. It is very important that the "consumers", such as employers' and workers' organizations, workers, foremen, technologists, and managers, should also be consulted. Epidemiological information, particularly on such factors as the incidence and prevalence of occupational diseases and accidents, their causes and prevention, must always be reflected in the objectives of courses.

4.2 Objectives by persons who require training

The categories of personnel to be trained include occupational physicians, occupational hygienists, safety engineers, health physicists (where appropriate), industrial psychologists, physiologists, ergo-

nomists, occupational nurses, social workers, factory and health inspectors, and nonphysician primary health care workers. Others less directly involved include clinical specialists, public health officers, and health education specialists. The need to train workers and line personnel in industry must also be emphasized. The Committee summarized the training objectives of some of these target groups as follows.

4.2.1 *Workers*

Workers must be informed about the work hazards to which they are exposed and the means of prevention. They must participate in the prevention of occupational accidents and diseases through the application of all protective measures, including the use of personal protective clothing and equipment. They have to be familiar with the procedures for reporting to internal safety committees, safety delegates, union representatives, and governmental inspectors on conditions of work that are considered as being unsafe. Where safety delegates are appointed, their very status calls for a more advanced level of knowledge on occupational hazards and their prevention.

4.2.2 *Supervisors and/or foremen*

These persons should receive appropriate education and training to carry out the workers' functions listed above, and:

- to recognize in detail all risks of accidents and occupational diseases to which their subordinates are exposed;
- to take active part in the activities of the internal safety committee, wherever it exists;
- to be in close contact with the occupational health personnel, the safety officers and all other professionals directly related to occupational health, safety, and ergonomics;
- to enforce on the workers the undertaking's safety rules through education and persuasion.

4.2.3 *Management personnel*

All levels of management should have an appropriate training in occupational safety and health. Special attention should be given to professionals who will be involved in the occupational health, safety, and ergonomics activities. For these professionals specific education and training objectives have to be established.

4.2.4 *Undergraduate medical students*

The Committee considered that there was a need to incorporate elements of occupational health at the level of undergraduate medical education. This measure will enable students to:

- appreciate how health is related to work;
- know how the impact of work on physical and mental health may be measured;
- understand the concept of hygiene in industry;
- be familiar with the most important occupational health problems in the country in which they are to work;
- be able to describe the main occupations in the country;
- be able to carry out appropriate examinations, diagnose, plan treatment, and carry out preventive procedures.

4.2.5 *Occupational health physicians*

To carry out their functions, occupational health physicians should enjoy the full professional and moral independence of both the employer and the workers. As appropriate, professional secrecy might have to be respected. Free access to all workplaces and information on industrial processes are essential prerequisites to enable the occupational health physician to advise management on the application of appropriate occupational health standards (5).

Requirements for postgraduate occupational health education might differ according to national objectives. Generally, occupational health physicians should be able to carry out the following tasks:

- to assess the incidence and prevalence of ill-health in relation to work conditions, and to recognize work conditions that contribute to subclinical and overt ill health and its short-term and long-term consequences; this requires special experience in such fields as toxicology, physiology, biostatistics, psychology and internal medicine, and knowledge of basic principles of technology and of specific technological hazards;
- to identify occupational health problems in the light of the general health of the working population;
- adequately to manage accidents and other emergencies (e.g., cardiovascular incidents, cases of intoxication); this management involves diagnosis, first-aid treatment and organization of a first-aid service and a disaster programme;

- to prepare and evaluate statistical records of sickness absences, to use such records to identify causes, and to propose measures to eliminate causes;
- to assess working capacity;
- to apply the legislation relating to occupational health in a specific industry;
- to build up and maintain good relationships with workers and management, and to educate management, heads of departments, foremen, and workers to understand the complex relationship between work and health, with special emphasis on specific hazards and methods of prevention;
- to understand the basic principles of occupational hygiene, and to build up and maintain effective collaboration with occupational hygienists;
- to understand the basic principles of ergonomics, to apply them to a proper adjustment of job to man, and to make use of available resources from various ergonomic disciplines;
- to use epidemiological and other methods to investigate occupational risk factors, the possibility of their prevention, and the means by which they may be prevented;
- to be conversant with the basic principles of safety management and to show willingness to cooperate with the safety programme.

4.2.6 Occupational health nurses

The traditional term "occupational health nurse" is used here, although different terms are used in different countries. The education and training objectives apply, however, to all personnel carrying out identical or similar activities. The Committee agreed that it is essential that some training in occupational health nursing should be given to trainee nurses. Specialist training of nurses wanting to follow a part-time or full-time career in occupational health nursing is essential. A nurse entering a manufacturing, commercial or agricultural enterprise for the first time has to adjust herself to a completely different environment and develop a new attitude of mind and new skills (19).

Examples of desirable objectives include the following (9):

- (a) Health supervision and rehabilitation:
 - to demonstrate the ability to carry out a health interview;
 - to show the ability to relate the findings of the interview to the work situation;

— to formulate health programmes to meet the health needs of groups at risk, such as young workers, women, disabled persons, persons needing rehabilitation programmes, those exposed to specific hazards at work, older workers and immigrants;

(b) Health education and counselling:

— to demonstrate ability in a teaching situation, whether giving instruction to individuals or to groups;

— to specify social agencies to which to refer patients in need of special help;

— to analyse, in a counselling situation, the needs of a patient;

(c) Treatment:

— to assess the clinical condition of a patient and make an appropriate nursing diagnosis;

— to initiate treatment in major emergency situations;

— to show a high degree of nursing skills, particularly in the treatment of injuries and eye and skin conditions;

(d) Cooperation:

— to demonstrate a knowledge of the organization of an enterprise;

— to construct a theoretical model to show with whom to cooperate in the interests of the patient's health, for example: within the factory—all other occupational health personnel, management, foremen, trade unions; outside the factory—personal health services, public health services, hospital services, other social agencies;

(e) Environmental control and accident prevention:

— to tell how to make a visit to a workplace;

— to enumerate the requisite observations;

— to compile a manual of the hazards of the factory;

(f) Administration of an occupational health department:

— to describe the layout and design of an ideal occupational health department;

— to select the equipment that would be needed in such a department;

— to plan and use a system of record keeping.

4.2.7 *Nonphysicians providing primary health care at the workplace*

In developing countries, the need to bring health care to where people live and work has led to the recognition of the importance of nonphysician primary health care workers. Their duties may vary from one country to another or from one locality to another within the same country. Basically they are health workers with 10–12 years of

basic general education followed by 2–3 years of technical training, which should enable them to recognize the most common diseases, to care for the simple ones, and to refer problem cases to the nearest health centre or hospital. They work under physicians' supervision in a variety of settings, such as in an outlying post, as members of a health team functioning in a health centre or other facility, or as a direct assistant to a physician. They are trained and used to meet the circumstances found in a particular country and not according to some international standard.

This description of the primary health care worker covers, in fact, only the central, dominant portion of a spectrum that in practice is considerably broader. At the lower end of the spectrum is a category better designated as "medical auxiliaries", which includes persons with primary education and a few months of practical training only, while the upper end includes those with part or complete university education plus several years of sophisticated technical training (4).

Among the examples of their roles, the following are related to occupational safety and health in agro-industrial settings:

- first aid in medical and surgical emergencies;
- diagnosis and outpatient treatment of common diseases and minor surgery in dispensaries and health centres;
- referral of emergencies and other cases requiring hospitalization to the nearest hospital;
- industrial hygiene;
- promotion of community development activities.

The Committee recommended that, whenever appropriate, non-physician primary health care workers should be trained to carry out their activities not only in residential situations, but in agricultural and industrial settings as well. Of primary importance is that they should carry out inspection visits in the workplace and submit reports regarding the work environment and the maintenance of personal hygiene and public health measures. They should propagate health education, cater for the proper use of protective equipment, and participate in immunization programmes.

4.2.8 *Occupational safety and health engineers or safety officers*

Regardless of the terminology used in different countries for persons carrying out similar or identical activities, the education and training objectives remain essentially the same. These officials perform the task of helping to create safe and healthy working conditions

and reduce accidents and diseases, mainly through engineering control measures. Their responsibilities cover a wide area of technical, hygienic, and ergonomic factors at work. For them, learning from experience is insufficient, even if they have an adequate training in technology. They need to undergo further specialized training in safety promotion and accident prevention.

The main objectives of education and training should make them able:

- to design and apply methods of controlling health hazards and accidents;
- to apply methods of accident prevention and ergonomics;
- to apply principles of plant layout and building and machine design from the health, safety, and ergonomic aspects;
- to keep records and, in particular, to analyse records on environmental stress and accidents;
- to use epidemiological methods to investigate the causes of accidents and their prevention;
- to collaborate and participate in team work in the field of occupational health, safety, and ergonomics;
- to apply rules and regulations on health and safety;
- to work effectively with the other members of the occupational health team;
- to assist in the education and training of workers and of supervisors in occupational health and safety.

4.2.9 Occupational hygienists

An *occupational hygienist* is a person with a university degree in engineering, physics, or chemistry, or an equivalent science degree (in some countries, medicine), and, in addition, with specialized training in recognition (identification of hazards and understanding of their effects on health of humans and their wellbeing), evaluation (characterization of hazards from qualitative and quantitative points of view), and control (preventive measures) of hazards that arise in or out of the workplace and may cause impaired health or significant discomfort among workers or inhabitants of the surrounding community.

An *occupational hygiene technician* is a person who, through special training, has proficiency in one or more aspects of occupational hygiene practice—e.g., noise measurements, evaluations of thermal environment, air sampling, dust counts, instrumentation—and who should perform such duties under the supervision of an occupational hygienist (10).

Occupational hygienists should be able to carry out the following tasks:

— to recognize the agents and factors in the work environment that may affect health and comfort; this requires knowledge and experience in such fields as basic principles of technology, industrial processes, raw materials, chemicals, products and by-products, principles of physiology, toxicology, and occupational diseases;

— to evaluate the health hazards arising in and out of the work environment; this requires knowledge of the measurement of physical agents (heat, noise, radiation, etc.), techniques of air sampling and analysis, instrumentation, statistical treatment of data, as well as an understanding of the conditions of exposure that can influence the health effects. In connexion with this activity, the occupational hygienist must have a sound knowledge of instrumentation (for physical measurements, air sampling and analysis) as well as of the organization and functioning of both occupational hygiene and analytical chemistry laboratories;

— to design, implement and periodically check environmental preventive measures (such as heat and noise control, industrial ventilation, and other engineering control measures), as well as personal preventive measures (such as the establishment of adequate work practices, the use of personal protective equipment, and other measures in collaboration with the medical staff) in order to control the health hazards in the work environment;

— to apply the legislation concerning occupational hygiene, that is, compliance with standards of exposure (for example, maximum permissible levels for occupational exposure to physical and chemical agents);

— to understand the basic principles of occupational medicine and nursing in order to build up and maintain effective collaboration with the medical staff within a spirit of team work and a multidisciplinary approach;

— to understand and to a certain extent apply the basic principles of occupational safety and ergonomics;

— to apply statistics both to environmental and health data, as well as to have an understanding of the basic principles of epidemiology;

— to know and apply the principles of work psychology, with a view to developing and/or collaborating with the medical staff in health education campaigns;

— to advise on plant design (building and lay-out);

- to have a basic knowledge of such matters as basic sanitation, water supply, waste disposal;
- to be familiar with, and eventually be responsible for, the control of air and water pollution.

4.2.10 *Educators and trainers*

The training of educators and trainers has two aspects: one, their training in occupational health and safety and in related specialized fields; and the other, their training in educational methodology.

It is essential that trainers and educators constantly improve their own qualifications through scientific work; active participation in conferences, congresses, and possibly short courses; exchange of information with other professionals in the fields of occupational health and safety; and continuous study of scientific and educational literature. The scientific and field work carried out in training institutes should be considered as an indispensable contribution to the education and training activities. It should be emphasized that this continuous updating of knowledge should focus not only on the scientific field of specialization but on education and training methodology as well.

Once a country develops a national plan for the specialization of various categories of personnel in occupational health, safety and ergonomics, a need is created for educators and trainers for the various disciplines of the specialization course. In this case, the role of the universities and training centres is essential.

5. TECHNOLOGY, METHODOLOGY, AND PROGRAMMES OF EDUCATION AND TRAINING

5.1 Education and training technology

The objectives of occupational health have been defined in an earlier report of the Joint ILO/WHO Committee on Occupational Health (21). However, its practice may vary from country to country, or even within the same country. Broadly, it is concerned with the best possible balance in the interrelationship between work and health; however, the emphasis may range from the solution of basic health problems of the workforce to highly sophisticated measures for the promotion of comfort, passing through the essential steps of preventing occupational diseases and accidents.

Therefore, the education and training of those specifically concerned with workers' health and safety (e.g., occupational physicians, nurses, hygienists, safety engineers, factory inspectors), as well as of others less directly involved in these questions (workers, managers and supervisors, administrators, architects and designers, production engineers, among others), will vary from country to country or from region to region if they are to meet real needs of the working population in question (11).

Education and training technology should not only be relevant to the country's needs but should also be feasible in terms of the country's situation, available resources, and existing structures (8). As pointed out at a consultation on "Organization of Occupational Health Training", held at the WHO Regional Office for Europe (Copenhagen) in December 1976, "one of the main points when planning a teaching programme is to relate the educational system to the health system of the country". In the same consultation it was considered that rather than standardized curricula, "a standardized approach to educational planning or, more especially, standardized objectives, would be more important". The starting-point of a standardized approach to educational planning for occupational health should be the identification of the basic competence of each member of the basic occupational health team.

5.1.1 *Education and training approaches*

Long-term education and training may be both at undergraduate level (e.g., safety engineering) and at postgraduate level (e.g., occupational medicine for physicians, occupational nursing for nurses, occupational hygiene for engineers, chemists, etc.; ergonomics for physicians, engineers, etc.; safety for engineers). Full university courses should ideally be available also on a part-time basis, in order to allow individuals who are employed to acquire a formal education. This is particularly true in occupational health and safety education and training; since many people who already have practical knowledge of working conditions and workers' health are employed, they would be the most suited to receive additional training in this field.

Short-term education and training, which covers a broader range of persons, may be at the following levels:

- medium level (technicians, supervisors);
- undergraduate level: basic information courses for physicians, nurses, engineers, administrators;

— graduate level: for persons with a basic degree and thus receiving some specialization in one of the occupational health disciplines—namely, occupational medicine, nursing, hygiene, safety, or ergonomics—in cases where lack of facilities, time, or financial support prevents full (long-term) specialization;

— joint labour management training programme: this type of activity is essential in the field of occupational safety and health; although short courses are suitable for this type of programme, other approaches (e.g., on-the-job training) might be used.

5.1.2 *Modular training programmes*

It is not always possible to rely on traditional and formal types of training and education. The need of flexibility in providing training and education for people with different backgrounds and in a variety of different ways must be balanced against the need to ensure a good and consistent standard of training.

It would seem that the development of a modular training programme would be one practical way of achieving this balance. With coordination from government employers and other agencies, it would be possible to ensure that training modules can be developed without duplicated effort. Training modules could be standardized to meet the level of the competent person defined in the appropriate safety and health legislation. WHO and ILO may play a role in establishing syllabuses of modular training for occupational health, safety and ergonomics.

5.1.3 *On-the-job training*

Whenever formal training is not feasible, or to complement its practical aspects, on-the-job training, under the supervision of an experienced professional may constitute an efficient solution. It can be carried out at different levels, but it should be envisaged as a complement of formal training rather than as a substitute for it.

In many instances, on-the-job training for auxiliary personnel (medical assistants, occupational hygiene technicians, safety personnel, etc.) has proved very successful.

5.1.4 *Continuing education*

Considering the dynamic nature of occupational health, safety, and related fields (toxicology, production and chemical engineering, analytical chemistry, control technology, etc.), there is need of activities aimed at a continuous updating of knowledge. Continuing education can be used as method to maintain the certification as a specialist in any occupational health and safety profession and international organizations may play an important role in this respect, since they have access to information in different parts of the world.

5.1.5 *Education and training techniques*

There are many techniques to be used in order to educate and train—namely, transfer of information through lectures and/or audiovisual materials, discussions, seminars, workshops, etc.

When designing an education and training programme, it is important to have advice from a manpower development specialist, since there are continuous developments in the field of education and training techniques. It is necessary to keep in mind the functions of the service for which the educational system is expected to produce adequate manpower, as well as such aspects as learning objectives, background of trainees and participants, geographical area, or cultural and social aspects.

The increased use of *audiovisual aids* in educational and training programmes in occupational health, safety, and ergonomics was strongly recommended by the Committee. The help of experts in the preparation and use of audiovisual materials and in educational technology as a whole should be obtained. It was pointed out that remarkable progress has been made in the making and utilization of these materials in recent years (1, 2, 22). An overview of the most appropriate films on occupational safety and health has been prepared by the ILO (7). The ILO Centre of Education in Turin has prepared documentation on the elaboration of the audiovisual aids.

Field work must necessarily form a substantial component of any training programme in occupational health, safety and ergonomics. It may coincide with complementary on-the-job training. The main objective of field work is to enable the professional to carry out practical work.

5.1.6 *Course content*

The Committee emphasized that occupational health and safety should be taught in conformity with the socioeconomic and cultural background of the community. Understanding the thought patterns of workers in the community is vital to the implementation of an occupational health or safety programme. This should include knowledge about local sociocultural patterns. Hence, training in occupational psychology, sociology, and related disciplines is important. Occupational health at all levels cannot be taught rationally without relating it to general health services and the community health situation in the country.

Traditionally, occupational health has often been regarded as a branch of public health and a subspecialty within environmental health. However, clinical training is of high importance should the physician wish to assess the effects of work on health (3). Whenever a physician will be working in remote areas, where medical facilities are often lacking, the curriculum should include sizable modules of teaching in those particular health problems that the occupational health physician might deal with (e.g., malaria, sanitation, etc.) besides instruction in occupational ailments in the narrow sense (occupational diseases, work injuries, etc.) (20).

Similarly, occupational safety cannot be taught effectively without relating it to general conditions of the particular industry, region, and country. Occupational safety does not mean safety at work only, but safe habits and general conditions of working life are also of immense importance, and hence the study of ergonomics becomes indispensable.

The investigation of occupational health and safety problems and their solutions should be firmly based on epidemiological principles: hence epidemiology and biostatistics should receive adequate emphasis. The related subjects of data processing and computing are useful and should be taught whenever facilities and opportunities permit.

The fundamentals of management science should be taught in courses for occupational physicians, occupational hygienists, safety officers and senior nursing personnel administering occupational health services. Not only would management techniques be useful in administering the occupational health team and facilities, but a knowledge of management science might lead to a better understanding of the thought and behaviour patterns of managers, who are often decisive factors in occupational health services at the enterprise level.

The art of communication is also essential in the repertoire of the skills of occupational health and safety practitioners. Often, excellent recommendations about improvements to the work environment are ignored solely because the message did not permeate the understanding of employers or workers. In addition to general training in communication techniques, occupational health and safety personnel should master the special techniques of health and safety education.

5.2 Education and training methodology and programmes

The Committee recommended the formulation of education and training programmes, curricula, and courses in occupational health and safety in each country, in order to:

- provide specialized teaching at universities, industrial training establishments, nursing schools, and vocational training institutes;
- promote awareness at secondary school and teacher-training institutions;
- educate employers, workers, and personnel concerned with safety and health in large-scale establishments (e.g., management personnel such as personnel managers, training managers, safety officers, physicians, nurses, primary health care workers);
- advise and educate managers and workers and provide necessary advice to small-scale entrepreneurs on how to modify processes, procedures, plant, and machinery so as to improve working conditions and environment;
- include in the education and training of engineers—particularly in those branches connected with industry—occupational health and safety components, so that they will be able to account for these aspects in their professional practice.

Educators and trainers in occupational safety and health should be used as practitioners and researchers and vice-versa so as to maximize the utilization of scarce specialist resources for improving teaching and inspection standards.

5.2.1 Pre-employment stage

If education in occupational health and safety is to form part of a general health and safety policy in all kinds of human activity, it should start as early as possible to create appropriate habits from childhood. The way in which parents behave in their jobs sets an example to their children. In many countries, schools have introduced into their cur-

ricula the teaching of traffic safety; it can be easily extended to basic education in the safe handling of chemicals, machinery, or apparatus now largely used in household or agriculture or industry. In subjects like physics and chemistry, emphasis should be placed on health and safety considerations whenever appropriate (risks of wounds, electrical injuries, toxicity of chemicals, etc.).

The programmes for students or apprentices should contain health and safety aspects: dangerous work habits; the hazards of tools, machinery and chemicals; safety rules; principles of occupational hygiene, e.g., requirements relating to climate, lighting, control techniques for health hazards, principles of ergonomics (working time, work load, work posture, lifting of weights, fatigue, etc.).

5.2.2 *Workers*

It is important that health and safety at work be taught as inseparable aspects of the working process itself. Educational programmes for workers (apprentices, students) should be integrated with vocational training and training for production. Safe behaviour at work, the use of protective devices and personal hygiene should become an integral part of working habits.

The programmes and technical means for education of workers should be prepared in adequate form and should contain appropriate amounts of information. They should not cause a feeling of anxiety at the workplace.

The basic information and training can efficiently be given by the workers's supervisor. If substantiated by the complicated matter of occupational health and safety in certain working conditions, education and training should be performed by a safety officer or occupational health personnel (nurse, physician). Finally, short safety courses may be organized.

It is to the worker's advantage if written instructions can be provided. They should describe the possible dangers connected with the work and what can be done to prevent them, general safety regulations, special safety rules for different types of work, personal protective devices and their use, emergencies.

The worker's knowledge of occupational health and safety should be regularly checked and refreshed. Furthermore, workers who serve as safety representatives or as members of health and safety committees need a more intensive course of training complete with supervision and periodic refresher courses to enable them to fulfil their

duties effectively (17). There is no reason why they should not be taught to use instruments for environmental measurement.

5.2.3 *Supervisors and managers*

There is great need to train supervisors and foremen in safety matters, so that they, in their turn, will train those for whom they are responsible. The supervision is the first line of defence. The training is best provided in short two- or three-day courses by experienced safety professionals.

Many managers have backgrounds in economics, law, and engineering. In economics and law there are seldom, if ever, any courses on occupational health and safety. Engineering courses may offer limited teaching of these subjects. Teaching curricula in schools preparing managerial staff should be revised in order to include occupational health, safety, and ergonomics.

Every effort should be made to impress upon managers and supervisors the importance of occupational health and safety, and they should understand that good working conditions and a good working environment are necessary for smooth production. The main topics included in educational programmes should be, among others: the role of management, the functions of safety officers and of the occupational health services, accident investigation, environmental factors, fire hazards, work load, ergonomics, productivity and health, legal requirements.

5.2.4 *Designer and production engineer*

The education of these specialists has two objectives: (a) to teach them to practise occupational health and safety in their own work, and (b) to give them a good knowledge of the principles of occupational health and safety and of ergonomics, to be applied in their functions of designer and producer. Whereas the former objective applies to the education of any worker, the latter deserves special attention. The curricula of technical schools should contain enough information about the properties of materials, procedures, or products to ensure the technological reliability of the production processes. However, such information will be insufficient unless appropriate emphasis is placed on the human link in the production chain. The importance of the human element may be easily demonstrated on tools or machines which do not respect ergonomic principles; on appa-

ratus or procedures which emit noxious dust or gases and vapours; on machinery exposing workers to noise and vibrations or causing accidents; on buildings with insufficient microclimatic conditions, ventilation or lighting.

The curricula of technical schools should include instruction on the use of ergonomics and on the prevention of accidents and exposure to occupational health hazards. If the designer wishes to keep in mind the need to adapt the means of production to man, he must have a knowledge of ergonomics, occupational safety and health hazards, and the technical means to prevent such hazards:

(a) Ergonomics: anatomical physiological, and psychosocial characteristics of man and the design of machines, equipment and tools. In this context the characteristics of individuals and groups in terms of height, weight, somatotype, and other relevant phenomena, e.g., lung functions, have to be taken into account. Differences in the organization and content of work must also be considered in view of the effect on productivity or health.

(b) Hygiene of work: factors of the working environment (temperature, air movement, humidity, lighting, etc.) and their effect on health; occupational safety and health hazards (noise, vibration, radiation, fibrogenic dust, toxic chemicals, etc.) and their effects; control measures.

(c) Safety or work: physical causes of accidents and their prevention; human factor in safety at work.

5.2.5 Occupational health and safety personnel

The following main subject areas should be taught:

— organization of occupational health and safety services, their activities, legislation and regulations;

— occupational medicine,

— occupational hygiene,

— occupational safety,

— work physiology and ergonomics, dealing particularly with the adaptation of work to man, but also with the readjustment of the handicapped to work.

— occupational psychology, sociology and health education.

According to the profile of the personnel, the educational programmes will go more or less deeply into different subjects to meet the demands of the respective professions, as discussed under the objectives of education.

5.2.6 *Physicians and nurses*

All medical students should be taught some occupational health. In some countries, there are separate courses; in others, occupational health is dealt with in such courses as physiology, pharmacology and toxicology, public health, social medicine, internal medicine. Nevertheless, they do not, as a rule, acquire sufficient knowledge and skill to allow them to practise occupational health independently, and some postgraduate training in occupational health and safety is necessary. For further specialization in occupational health (e.g., occupational diseases, or even more narrow fields, like occupational neurology, dermatology, etc.), postgraduate training programmes should be available.

For specialization in occupational health, the Committee considered the following as appropriate:

- introduction to the study of occupational safety, hygiene and medicine;
- methods of research/work;
- principles of administration;
- epidemiology;
- descriptive statistics;
- basic methods of analytical statistics;
- occupational toxicology;
- principles and organization of health care;
- occupational diseases;
- chronic diseases in the morbidity of industrial workers;
- legislation pertaining to occupational safety and health;
- evaluation and control of work environment;
- occupational physiology;
- occupational psychology;
- principles of occupational safety;
- principles of ergonomics;
- principles and organization of occupational health services;
- medical care of special types of workers;
- hygiene and social medicine.

For nurses active in occupational health services, both long-term and short-term courses need to be organized, depending on their range of activities.

5.2.7 *Nonphysician primary health care workers*

The nonphysician primary health care worker responsible for agricultural and industrial settings should know how to recognize and, if possible, prevent some occupational diseases. The Committee included the following factors for consideration.

(a) *Agricultural settings:*

- accidents with machinery and/or hand tools;
- infectious and parasitic diseases contracted directly or indirectly during the course of work, e.g., anthrax, tetanus, schistosomiasis;
- health risks of exposure to pesticides and other toxic chemicals used in agriculture;
- extremes of climatic conditions, e.g., temperature, humidity, and solar radiation;
- lung diseases, due to inhalation of vegetable dusts.

(b) *Industrial settings:*

- mass labour migration, causing complex psychosocial health problems;
- accidents with machinery and dangerous chemicals;
- health risks due to exposure to harmful agents occurring in workplaces supervised by primary health care workers;
- danger of accidents or diseases due to alcoholism, smoking, and/or taking of drugs;
- water and air pollution;
- any labour codes that exist to protect the worker.

(c) *Principles of prevention in occupational health and safety:*

- sanitation and hygiene: cleanliness, overcrowding; adequate heating, ventilation, and lighting; adequate sanitary facilities; use of protective devices; food hygiene in canteens;
- monitoring the environment for the basic health hazards, if simple methods are available (e.g., detection tubes for chemicals);
- provision and maintenance of adequate accident-prevention measures.

5.2.8 *Occupational hygienists*

The occupational hygienist should have an undergraduate training (e.g., engineering, chemistry, medicine) with strong emphasis on the basic sciences¹—mathematics (including statistics), physics (including

¹ Knowledge in any of these basic sciences may be acquired at the specialization level, should it not have been part of the undergraduate training.

acoustics, electricity and thermodynamics), chemistry (inorganic, organic and analytical), biology (including basic knowledge of human anatomy and physiology). In addition, he should have taken the following basic public health and occupational health courses:

- environmental health (basic sanitation, water supply, food hygiene, waste disposal, water and air pollution);
- principles of work physiology and toxicology;
- occupational diseases;
- occupational psychology and health education;
- biostatistics;
- principles of epidemiology;
- ergonomics and occupational safety.

For specialization in occupational hygiene, the Committee considered the following as fundamental subjects:

- introduction to occupational hygiene;
- recognition of occupational hazards; “walk-through” or preliminary surveys; industrial processes and associated health hazards;
- evaluation (measurement and interpretation of results) of physical agents, such as heat, noise, vibration, illumination, radiation, etc.;
- evaluation of air contaminants (assessment of exposure and interpretation of results), including: air sampling methodology; analytical chemistry applied to occupational hygiene; air analysis for gases and vapours; collection techniques and analysis (including particle sizing) for particulate matter; instrumentation (direct reading instruments, air sampling devices, analytical instrumentation); and statistical treatment of data;
- environmental preventive measures for physical, chemical and biological agents, including: noise and vibration control; control of the thermal environment; radiation control; illumination design; and industrial ventilation, among other engineering control measures;
- control measures related to the workers (in close collaboration with medical staff), including: work practices; personal protective equipment; and health education.

Two aspects that should not be overlooked in the training of occupational hygienists are knowledge of:

- administrative and legal requirements of the country practice;
- education and training methodology, for those involved in such activities.

5.2.9 *Safety and health engineers and safety officers*

Occupational safety is concerned with failures of materials, machines, processes and structures that may give rise to dangerous situations, including release of harmful agents. The aim is to enable students to foresee danger, both at the planning stage of projects and in existing situations, to quantify the danger, and to design measures to combat it. The training in occupational safety involves the student in a substantial study of selected topics from engineering and materials science, as related to mechanical, civil, chemical, electrical, and structural engineering.

Separate curricular units would be concerned, for example, with the structure and strength of materials, in mechanical engineering; with forces in structure, in civil engineering; with handling and transportation of chemicals, in chemical engineering; and with design standards, protective equipment and the theory of preventive maintenance, in electrical engineering and behaviour of strata in mining engineering.

The safety engineers, in addition to acquiring a basic knowledge, should also go through the special course. The Committee recommended the following subjects:

- introduction to the study of occupational safety, hygiene and medicine;
- introduction to occupational health hazards and occupational diseases;
- principles of occupational safety;
- principles of occupational physiology;
- occupational toxicology;
- radiation hygiene;
- principles of occupational hygiene and sanitation;
- principles of epidemiology;
- industrial ventilation, lighting, heat and humidity;
- protection against fire, explosion, inundation, harmful respirable dust and gases;
- introduction of ergonomics and occupational/industrial psychology;
- protection against noise and vibration;
- prevention of accidents due to the use of machines, electricity, compressed air, explosives and blasting, transport of products, men and material, both inside and outside the industry;
- safety legislation, prevention of accidents, accident analysis, and cost of accidents;

- organization of occupational safety and health (including emergency organization) at the various levels of the enterprise;
- introduction of occupational safety of systems.

5.2.10 *Ergonomists*

In addition to basic knowledge on anthropometry and anatomy, work physiology, occupational psychology, job design and equipment design, ergonomists should be able to deal with the following:

- anthropological data for the design of work stations;
- muscle strain, postural efforts and handling loads;
- heavy work and heat stress;
- mental load and vigilance;
- fatigue and boredom;
- man-machine systems and design of displays and controls;
- working time, work-rest schedules, and night and shift work;
- work performance in relation to physical working environment;
- psychosocial aspects of work;
- basic principles of occupational health and safety;
- ergonomic job analysis.

In practice, ergonomic improvement can be initiated and, to some extent, carried out by designers and production engineers, occupational health and safety personnel, as well as by managers and workers. Teamwork among people trained in applied ergonomics is essential. Also, organization of special courses on ergonomics for different target groups is very useful (15). Such training in ergonomics should impart basic ergonomic methods for assessing workplace conditions and the practical exercises. Examples of ergonomic improvements and practical ergonomic checklists may be effectively used. It is important to illustrate the relevance of ergonomic aspects to health, safety, and productivity of the workers.

5.2.11 *Occupational psychologists*

The following programme was recommended by the Committee for occupational psychologists.

- (a) Work analysis and design based on man-machine systems:
 - psychophysiology of information processing and design of displays;
 - design of strategies for standardization of problem-solving in work tasks;
 - design of machines.

- (b) Job analysis and personnel selection:
 - measurement of intellectual and emotional work load,
 - measurement of job demands and construction of job profiles,
 - measurement of vocational fitness.
- (c) Job satisfaction and effectiveness:
 - measurement of attitudes and job satisfaction;
 - process of learning and training;
 - theories of motivation for work;
 - theories of group dynamics related to industry;
 - measurement of job success and turnover.
- (d) Occupational health and safety:
 - elementary knowledge of occupational health,
 - knowledge of the effects of drugs and toxic agents,
 - analysis of accidents.

5.2.12 *Social workers in occupational health and safety*

Social workers may be useful members of the occupational health and safety team. The Committee considered some topics for their education:

- basic knowledge in occupational safety and health;
- knowledge of medicolegal aspects of occupational accidents and diseases and of social security and welfare legislation;
- information on vocational and educational institutions, leisure and sport activities, psychosocial health problems (alcohol, tobacco, drugs, etc.) and family relationships;
- some knowledge of statistics, epidemiology, and other methods of investigating social factors related to occupational safety and health problems.

5.2.13 *Special programmes*

Special attention should be given to the training of all the occupational health and safety personnel in *teamwork*. As occupational health and safety is multidisciplinary, teamwork is indispensable. Some problems are especially suitable for teamwork, e.g., surveys on health of workers and evaluation of the work environment.

Members of the team have the same goal. Efficient teamwork calls for good communication between team members and for understanding and appreciation of each others' work and achievements. Difficulties may arise because of poor definition of responsibilities in a formal

organization, or if there is no skill in teamwork. Formal training for teamwork should therefore be included in postgraduate educational programmes.

Following postgraduate education, various ways of promoting teamwork may be used as a form of continuing education: cooperation in committees, training in group seminars, joint research projects, etc.

Continuing education may be organized in many different ways. Self-instruction is an important form, which institutes can promote by making available learning resources and media. Refresher courses and conferences should be organized, usually dealing with selected special problems and recent results of research and progress.

National safety councils, other voluntary organizations concerned with occupational safety and health and improvement of working conditions, and environment and professional associations should be encouraged to prepare necessary teaching aids, materials, and programmes to suit local needs and priorities.

Mass media and mobile resources, such as vans equipped with teaching aids and materials, should be used for creating an awareness among the general public as well as in training rural, agricultural and industrial workers, those in small-scale industries and self-employed persons.

National seminars to create awareness and motivate decision-makers on improving working conditions and environment, as also workshops and training courses for middle management and supervisory staff are also important priorities.

6. RECOMMENDATIONS

1. National policies on education and training in occupational health, safety, and ergonomics should be formulated and carried out in consultation with national governments, employers and workers, and in accordance with the training policies of the education authorities in the same country.

2. The ILO and WHO are urged to promote the development of education and training policies in occupational health, safety, and ergonomics at both the national and workplace level and in all sectors of economic activity. The development of such policies should take into full consideration the needs for occupational health, safety, and ergonomics services in the particular country.

3. In accordance with the WHO target of "health for all by the year 2000", and the ILO International Programme for the Improvement of Working Conditions and Environment (PIACT), the ILO and WHO are urged to develop, in cooperation with national governments, the mechanisms and guidance to intensify participation by both employers and workers in projects concerning the health and safety of workers, through schemes of workers' health and safety education and increased awareness of employers.

4. National policies on education and training in occupational health, safety and ergonomics should give due consideration to underserved sectors of the working population, including agricultural workers and workers in small-scale enterprises. This requires, in particular, the development of primary health care workers to deal with the immediate health problems of the working population.

5. The ILO and WHO are urged to help in developing manuals and other publications for the education and training of primary health care workers in occupational health and safety activities, as it is felt that such workers would greatly strengthen the usually scanty manpower resources in occupational health and safety and would extend the reach of such services.

6. It is recommended that education and training programmes in occupational health, safety, and ergonomics should be based on modern methods of educational technology and that sufficient emphasis should be given to epidemiological principles and field work.

7. The ILO and WHO are urged to develop dynamic programmes for training of trainers in occupational health, safety, and ergonomics.

8. The ILO and WHO are urged to help in developing model curricula and manuals for the training of all categories of personnel in occupational health, safety, and ergonomics.

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