

Clinical immunology: guidelines for its organization, training and certification; relationships with allergology and other medical disciplines—a WHO/IUIS/IAACI report

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FOREWORD

This report was prepared during a meeting jointly organized in Geneva, 20–22 January 1992, by the World Health Organization (Microbiology and Immunology Support Services, WHO), the International Union of Immunological Societies (IUIS), and the International Association of Allergology and Clinical Immunology (IAACI). It is the result of extensive discussions among an international group of individuals interested in promoting the judicious use of immunology in clinical practice. It is the synthesis of their own perspectives as well as the ideas of many others whom they consulted. The report has been approved as an official document by the three international organizations who supported its formulation, but it is not meant to be the 'last word' on the subject with which it deals. With extraordinary speed, new knowledge is developing about the immune system, and about the immunopathological basis for an ever-growing number of diseases; there is a rapidly increasing availability of new reagents that may be useful for diagnosis, for monitoring disease activity, and for testing as therapeutic agents in clinical trials. Therefore, it would be presumptuous to think that 'clinical immunology', 'allergology' and the many other related fields can be finally defined, or that the training appropriate for their practice can be finalized. Therefore, this report should be viewed as a substantive, thoughtful basis both for considering actions now, as well as for a continuing dialogue. WHO, the IUIS and IAACI hope that it will be useful to the medical community, and we welcome comments that can be considered.

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INTRODUCTION

Immunologic conditions represent a broad spectrum of diseases that affect many organ systems. While the incidence of such diseases has been best documented in developed countries, some of these conditions have at least a comparable incidence in developing countries. When viewed collectively, these diseases may affect nearly 10–20% of the population and are steadily increasing. Although some immunologic conditions are fatal, most of these illnesses are clinically expressed through years of relentless morbidity and disability.

Allergic diseases and asthma represent a particularly large proportion of affected individuals. In the USA, for example, it is estimated that as many as 20 million individuals suffer from allergies, and as many as 9–12 million from asthma. The economic impact in the USA from asthma alone was estimated to be 4.5 billion US dollars in 1985.

AIDS is the result of an infection of the immune system with HIV, affecting an increasing number of individuals throughout the world, with a high mortality and considerable morbidity, particularly in developing countries. There are approximately 1 million HIV-affected individuals in the USA, and several

million in the rest of the world, particularly in the developing countries, with a devastating social and economic impact.

Autoimmune rheumatic diseases are estimated to affect 1–2% of the population. The economic impact in the USA of all rheumatic diseases combined was estimated to be 21 billion US dollars in 1980 alone. Autoimmune mechanisms are also important in endocrine, neurologic, ophthalmologic and cutaneous disorders. Autoimmune insulin-dependent diabetes mellitus may affect as many as one child for every 600 in the population under age 16, and as many as 7–30 persons per 100 000 population may be affected.

Infectious diseases affect a large segment of the world's population, especially in developing countries. Vaccination, which is an immune-based prophylactic measure, has been successful in the eradication of some of the most feared of these diseases and the control of many others. Understanding the immunopathogenesis of these disorders and utilizing newer methods of regulating the immune system with ever increasing precision will have a major impact on disease morbidity and mortality in the future.

The rapid development of the science of immunology during this century has made this field increasingly applicable clinically

to prevention, diagnosis, evaluation and management of a great number of diseases within various fields of medicine. Thus it has become increasingly important to define the contents and organization of clinical immunology and to outline criteria for education, training and certification. WHO 1972 [1] and IUIS 1976 [2] have produced reports mainly on the content and organization of clinical immunology, including allergy and the other principal medical fields where immunology is applicable. In addition, IUIS has provided a series of position papers on central themes within clinical immunology [3-7].

In the past 10-20 years, despite a common scientific basis, various patterns of the practice have emerged in different countries. The IUIS Clinical Immunology Committee decided to look at the existing position of clinical immunology in different countries and to draw up guidelines based on the nature of clinical immunology, the methods by which it could be integrated into health care systems, as well as model systems for training and certification of personnel involved in its practice. The IAACI Training and Education Committee, as well as several other organizations, have pursued similar endeavours in allergology [8,9].

The present document is a follow up of previous inquiries and a synthesis of the information available on the practice of clinical immunology under its various aspects. Since allergology encompasses several of the major groups of diseases within the field of clinical immunology, a joint endeavour was undertaken between IUIS, IAACI and the WHO to provide guidelines for teaching and education in these fields of medicine. On the basis of this and previous documents about clinical immunology, IUIS/WHO are thus prepared to help and advise other international clinical societies to outline the clinical immunological components in education, training and certification for their disciplines.

DEFINITIONS

Clinical immunology

The first objective of this document is to achieve a common definition of clinical immunology, as follows:

'Clinical immunology is a clinical and laboratory discipline dealing with the study, diagnosis and management of patients with diseases or disease processes resulting from disordered immunological mechanisms, and conditions in which immunological manipulations form an important part of therapy and/or prevention'.

Clinical immunology includes diseases in which immune mechanisms fail to act appropriately for genetic or acquired reasons (Immunodeficiency, including AIDS), or because of neoplastic transformation of lymphoid and other immune cells (lymphoid malignancy), or where the action of specific antibodies and/or specifically sensitized lymphocytes, either directly or through various associated effector systems, results in host tissue injury (allergy and autoimmunity). It also includes conditions in which such injury may result from the action of the immune system in defence against micro-organisms (infection and immunity), or during the rejection of allografts (transplantation and transfusion immunology). Finally, it includes the applications of immunogenetics and of immune-based therapies in clinical practice.

Medical practice of clinical immunology

The immune system is the specific organ system, comprising the bone marrow, peripheral blood, thymus, spleen, lymph nodes and lymphoid cells, mast cells/macrophages/monocytes/histocytes and other inflammatory cells in all organs of the body. Its functions and malfunctions are the areas of interest and expertise for the clinical immunologist. Only recently has it been possible to evaluate this lymphoid organ by quantitative techniques. Furthermore, disorders of immune function impact on other organ systems. Thus, clinical immunologists are now practising as immunologists within a defined organ speciality, e.g. in pulmonary medicine, gastroenterology, immunohaematology, or more generally, as clinical immunologists dealing with disorders that affect a number of organ systems, e.g. autoimmunity and rheumatic diseases, immunodeficiency and infectious diseases, oncology. The pattern of practice varies in different countries, depending primarily on the organization of health care, and the perceived need by the medical and lay community for such specialists.

As is apparent from the above, clinical immunology is a discipline which is based on the science of immunology, but may be practised in different medical specialities, and in which the laboratory component is variable but essential.

Allergology

Allergology encompasses a large part of the practice of clinical immunology, since allergic diseases affect a large proportion of the population. Allergology is already a recognized speciality or subspeciality in many countries, and has an established place in the health care system. Allergy deals with the diagnosis and management of patients with diseases resulting from hypersensitivity reactions primarily due to environmental agents. It involves a basic understanding of immunology, the immunological basis of allergy, medical ecology, the pharmacotherapeutics of allergic diseases and specific allergen immunotherapy, allergic and pseudo-allergic reactions to drugs, as well as environmental and industrial medicine.

Laboratory immunology

In all countries, there is an accepted laboratory-based component to clinical immunology, since laboratory evaluations employing the new techniques and concepts of immunology are essential for the management of patients with immunological disorders. One of the debates that has occurred over the years is the extent to which the subject is a clinical one, involving patient care and management (in the way that cardiology is a clinical speciality), or purely a laboratory discipline providing immunological tests and evaluation available to physicians in all disciplines. In most countries, both types of clinical immunologist (patient care and laboratory based) are recognized. In some countries, this may be the same person who can do both functions, in others it can only be one or the other.

OFFICIAL STATUS OF CLINICAL IMMUNOLOGY AND/OR ALLERGOLOGY

In some of the developed countries, clinical immunology is a separate speciality, well established with Government-backed status and with training programmes and job opportunities in both teaching and non-teaching establishments. In several countries, it is established in association with allergology with

Table 1. Main examples of immunologic disorders and therapies within the scope of clinical immunology

<i>Immunodeficiency diseases</i>	<i>Immunologic diseases involving the haematopoietic system</i>
Congenital immunodeficiencies	Autoimmune haemolytic anaemia
HIV infection	Idiopathic thrombocytopenic purpura
Secondary immunodeficiencies (cancer, leukaemia, malnutrition, organ and bone marrow transplantation)	Pernicious anaemia
	Plasma cell disorders
	Amyloidosis
<i>Allergic diseases</i>	<i>Immunologic diseases involving the nervous system</i>
Allergies to pollens, moulds, animal danders, insects, food, drugs, other environmental allergens	Multiple sclerosis
	Guillain Barré syndrome
<i>Immunologic diseases involving the respiratory system</i>	Myasthenia gravis
Allergic rhinitis, hay fever	
Asthma	<i>Neoplastic disease and the immune system</i>
Hypersensitivity pneumonitis	Leukaemia lymphomas
Pulmonary fibrosis and related disorders	Neoplasia associated with immune deficiencies
<i>Collagen vascular and skeletal connective tissue diseases</i>	<i>Immunologic diseases involving other organ systems</i>
Vasculitis syndromes, including Wegener's granulomatosis	Eczema/allergic dermatitis and other immunologically mediated dermatoses
Systemic lupus erythematosus	Immunologically mediated renal diseases
Cutaneous lupus	Immunologically mediated gastro-intestinal diseases
Rheumatoid arthritis	Immune complex diseases
Ankylosing spondylitis	
Scleroderma	Cancer immunotherapy
Eosinophilic fasciitis	Organ and bone-marrow transplantation
Panniculitis	
Dermatomyositis/polymyositis	
Sjögren's syndrome	
<i>Immune endocrinopathies</i>	
Autoimmune thyroiditis	
Autoimmune diabetes mellitus (type 1)	
Autoimmune primary adrenal insufficiency	
Autoimmune polyendocrinopathy	

approved training programmes, including laboratory immunology and clinical allergology. For example, in the USA, the speciality of allergy developed alongside the discipline of immunology, and both are now combined in the speciality of allergy and immunology. In other countries, clinical immunology is not well established as a clinical speciality involving the care and management of patients, although accepted as a laboratory discipline. In many countries where the subject is emerging, its practice is largely confined to teaching institutions. In others, the subject has little or no recognized place in the national official health care system.

In some countries, allergology alone or allergology and clinical immunology are recognized subspecialties, but with little formal training in immunology, a state which should be corrected in the future, in the light of the present recommendations.

RESEARCH

Considerable research in clinical immunology and allergology is undertaken, by all categories of medical specialists and scientists, in formally constituted departments and institutions of immunology, clinical immunology and/or allergology, as well as in other departments of medical science. The IUIS and IAACI Committees are encouraged by and wish to foster research in the basic and applied aspects of immunology. It is not the intention of this document to define or prescribe the need for research in clinical immunology.

SCOPE OF CLINICAL IMMUNOLOGY

Diseases included in clinical immunology

A representative list of diseases in which clinical immunology can be said to play a part is shown in Table 1. Clinical immunology also involves the investigation of environmental agents (toxins) that modify the immune system, and the immunological evaluation of various immune-based therapies.

Special forms of treatment/prophylaxis used in clinical immunology

Clinical Immunologists employ:

- Immune suppression
- Immune stimulation
- Replacement therapy
- Desensitization or hyposensitization
- Vaccination/immunization.

Laboratory procedures involved

The spectrum of tests performed in clinical immunology laboratories reflects the advances in the subject in recent years. These advances derive from the basic research, from better understanding of the immunological basis of disease processes, and from empirical observations in patient groups.

Because of the inter-relationship with other laboratory disciplines such as biochemistry, microbiology, haematology, blood transfusion and histopathology, there is frequent overlap

Table 2

Laboratory tests in clinical immunology (principal procedures)*Measurement of specific antibodies to:*

Microbial antigens, auto-antigens, alloantigens, allergens

Immunochemistry

Qualitative and quantitative estimation of immunoglobulins, immunoglobulin fragments and immune complexes in plasma and body fluids

Measurement of cytokines and soluble cytokine receptors in plasma and body fluids

Measurement of products of immune effector cells and inflammatory reactions

Assessment of functional and immunochemical complement components

Measurement of acute phase proteins

Measurement of other relevant proteins, e.g. β_2 -microglobulin

Cellular studies

Lymphocyte subsets and phenotypic markers of immune change

Determination of the clonality of lymphoid cells

Lymphocyte function, proliferative responses *in vitro*, immunoglobulin production, etc.

Functional cytotoxicity of lymphoid and other immune effector cells

Functional assessment of macrophages and neutrophils

Functional assessment of mast cells, basophils and eosinophils

*Immunohistology**Immunogenetics*

HLA typing by serological and molecular biology techniques

Phenotypic and genotypic determination of serum protein allotypes

Prenatal diagnosis and inheritance of genetically determined immune disorders

with these disciplines in respect to the immunological procedures offered in any one institution or clinical setting.

Table 2 is a list of those procedures that are properly the concern of clinical immunologists and that form part of the work of clinical immunologists in many parts of the world. Variations occur to suit local interests and expertise. As examples, the serological diagnosis of infectious diseases may in some countries be the responsibility of departments of microbiology, the quantification and assessment of immunoglobulins may be carried out by departments of clinical chemistry, HLA typing by blood transfusion centres, the management of lymphoid malignancy by departments of haematology, and the immunopathological diagnosis of renal disease by departments of histopathology. An essential role of the clinical laboratory immunologist is to lead in the development of clinical laboratory investigations and their interpretation in the evaluation of immunological diseases.

Quality control programmes are beginning to be applied to immunological laboratory tests, and in a few countries they are well established. As they spread, and as reference standards in immunology and allergology become available through the efforts of WHO, IUIS and IAACI, the importance of defined and standardized clinical immunology laboratory services will increase.

PERSONNEL EMPLOYED IN CLINICAL IMMUNOLOGY

In all countries where clinical immunology has become established, medical doctors and technologists are found working in the subject. Non-medical scientists (PhDs) are widely involved in basic and applied research in immunology. Only in a few countries are there opportunities for such scientists in clinical immunology service laboratories.

Clinical care specialists

In most countries where clinical immunology is recognized as a clinical discipline, it is practised in association with allergology or with other clinical disciplines (rheumatology, infectious disease, haematology, nephrology, etc.). Patient referrals are often from other doctors, usually a family physician or general practitioner, but in some countries the main source of patient referrals is from other specialists. Self-referral by patients to clinical immunologists is limited in most countries by the lack of awareness by the general public of the subject and its practitioners. In countries where allergology or allergology and clinical immunology are well recognized specialities or subspecialities, allergologists are involved in primary medical care.

Laboratory-based medical specialist

In countries in which clinical immunology has become established as an identifiable laboratory discipline, medical doctors are responsible for providing immunology laboratory services. They may in addition have limited clinical commitments, seeing patients or advising other colleagues on their investigations and management. Dual responsibilities for patient care and laboratory management are common in many countries, such as the USA, Australia and most Western European countries.

Non-medical scientists (PhDs)

In countries where non-medical scientists (PhDs) are employed in clinical immunology laboratories, their role is to develop and apply new types of tests, and to maintain quality control. They often act as supervisors of a particular aspect of the service in which they have strong research interests. They do not under usual circumstances have contact with patients, although they may be consulted by clinicians on the interpretation of the tests performed under their direction.

Table 3. Basic immunology training programme in clinical immunology, common core programme

A. Knowledge of the immune system

I. Anatomy and cellular elements of the immune system

- a. Primary and secondary lymphoid organs: anatomy and functions including the mucosal associated immune system
- b. Specific cells: ontogeny, structure, phenotype, function, and activation markers/receptors

II. Immune responses

- a. Antigens: types, structures, processing and presentation
- b. Major histocompatibility complex: structure, function and regulation
- c. Immunogenetics: polymorphisms, generation of diversity and rearranging gene families
- d. Immunoglobulins: structure, function and antigen binding
- e. T cell receptors: structure, function and antigen binding
- f. Receptor ligand interactions: adhesion molecules, complement receptors, Fc receptors and signal transduction
- g. Complement structure and function
- h. Non-specific: acute phase reactants and inflammation

III. Hypersensitivity mechanisms

- a. IgE mediated: acute and late phase reactions
- b. IgG-, IgA-, and IgM-mediated: opsonization, complement fixation, antibody-dependent, cell-mediated cytotoxicity, stimulation and blocking
- c. Immune complex mediated: physicochemical properties and clearance
- d. Cell-mediated: participating cells, effector mechanisms and granuloma formation
- e. Other: natural killer cells, lymphokine-activated killer cells and cutaneous basophil hypersensitivity

IV. Cytokines and immunomodulators

- a. Cytokines: for each cytokine, understand the origin, structure, effect, site(s) of action (receptor), metabolism, regulation and gene activation
- b. Inflammatory mediators (e.g. leukotrienes, prostaglandins and platelet-activating factor): for each mediator, understand the origin, structure, effect, site(s) of action (receptor), metabolism and regulation

V. Immunoregulation

- a. Tolerance: clonal selection, suppression and antigen paralysis
- b. Cell-cell interactions: help and suppression
- c. Idiotype networks: inhibition and stimulation
- d. Mechanisms of autoimmunity

VI. Transplantation immunology

- a. Histocompatibility: major and minor antigens and principles of cross-matching
- b. Allograft rejection: mechanisms
- c. Graft-versus-host reactions and their mechanisms

VII. Tumour immunology

- a. Tumour markers: leukaemias and lymphomas
- b. Principles of cancer immunotherapy
- c. Oncogenes: translocation and breakpoints

VIII. Immunotoxicology

- a. Mechanisms of adverse reactions to xenobiotics
- b. *In vivo* and *in vitro* evaluation of immunotoxic compounds
- c. Clinical aspects of immune disorders induced by drugs or environmental chemicals

IX. Immunotherapy

- a. Drugs
- b. Antibodies
- c. Recombinant molecules
- d. Others

B. Knowledge of and experience with immunological techniques and measurements

- I. Techniques, principles and methodology, particularly as they relate to measurement of immunoglobulin levels, immunoglobulin classes and subclasses, specific antibodies, T lymphocytes and their subsets, B lymphocytes, natural killer cells, null cells, cellular response to mitogens, cellular response to antigens, cytokines, immune complexes, cryoprecipitable proteins, total serum complement activity, complement components, and histocompatibility markers.**

- a. Serologic: ELISA, radioimmunoassay, radial diffusion, nephelometry, immunoblots, high-performance liquid chromatography, isoelectric focusing, immunoelectrophoresis, electroimmunodiffusion and protein electrophoresis
- b. Cellular: flow cytometry, chemotaxis, phagocytosis, killing assays and lymphocyte proliferation
- c. Immunohistochemistry
- d. Immunofluorescence
- e. Hybridomas and monoclonal antibodies
- f. Molecular biology: Northern blots, Southern blots; PCR (polymerase chain reaction)

- II. Test performance characteristics: principles of sensitivity, specificity and predictive value**

C. Research

All clinical immunologists should be actively involved in research both at the clinical level and in basic immunology. Clinical immunologists are urged to keep abreast of new techniques that could be applied to clinical investigations.

In some instances, a non-medical scientist may be the head of a laboratory service and assume a wider role in advising clinical colleagues. This occurs following years of experience, and sometimes after passing a certification exam, but opportunities for non-medical scientists in clinical immunology have generally been limited.

Their numbers vary from country to country and within geographical regions of a single country. Where they are employed in clinical immunology laboratories, it may be on the basis of 1–5 per department.

Technologists

Clinical immunology laboratory services rely heavily on technologists to carry out the majority of routine investigations. In laboratories where the service has developed distinct from other laboratory disciplines, the technical staff are likewise separately identified. They number in hundreds in many countries. The actual numbers reflect the size of the country and the development of its clinical immunology services. Their training and status are an essential component of clinical immunology services.

TRAINING OF MEDICAL DOCTORS IN CLINICAL IMMUNOLOGY

Immunology forms a variable part of undergraduate training in many countries, and in different medical schools within a country. For all doctors, the practice of immunology requires postgraduate qualification in a speciality. Training courses and programmes including immunology exist in a number of countries, and vary in length from 2 to 5 years, following which the doctor is accredited as a specialist in clinical immunology or, as in most countries, in clinical immunology and allergology.

Research in immunology has been a means of gaining such accreditation for some doctors in the past. However, most countries now require both research and practical clinical work as different but necessary aspects in the training of clinical immunologists.

Training programmes include: (i) acquisition of knowledge in basic immunology, immunodeficiency, allergy (including the environmental aspects of allergy and pharmacotherapeutics), autoimmunity, transplantation, lymphoproliferative malignancy, immune-based therapy and the immunology of organ system diseases; (ii) laboratory evaluation of patients with immune disorders; (iii) practical experience in one or more areas of clinical practice with a high content of immunology, such as clinical allergology, paediatrics, respiratory medicine, infectious diseases, nephrology, gastroenterology, clinical transplantation, haematology, and clinical oncology; (iv) research in aspects of basic or applied immunology is encouraged and some programmes expect a trainee to submit a thesis, but this is not universal. For those medical doctors who are intending to practise mainly in the laboratory, a longer period of laboratory experience is usual, and in some instances a PhD (or equivalent degree) is mandatory.

FUTURE PATTERNS—RECOMMENDATIONS

Future developments and changes already under way will influence the patterns of clinical immunology and of allergology practice. Clinical immunology is of increasing importance in all

clinical disciplines. New therapeutic strategies including immunoprevention are being developed. In addition, stronger interactions between clinical and fundamental immunology are essential for quality research, education and practice.

Recognition

The first step is for the subject to be recognized as a distinct medical discipline by the national health care authorities and their academic counterparts.

Appointments

In countries where the discipline is not yet formally recognized, existing senior staff who are practising as clinical immunologists should be designated as such to create a nucleus from which the discipline can grow. In developed countries, academic appointments should be made in Clinical Immunology. In less developed countries, opportunities for growth of the speciality should be encouraged, initially by one or two academic appointments in teaching centres. Such clinical immunologists may well have a role in another speciality. Designated centres should have links with academic Clinical Immunology departments in developed countries, to enable the exchange of personnel, and training opportunities.

Affiliations

Departments of Clinical Immunology should have strong links with (or include) basic immunology, as well as develop links with (or include) clinical units in related specialities such as allergy, rheumatology, internal medicine, paediatrics, infectious disease, nephrology and haematology.

Scale

The ratio of established clinical immunologists to the population base is difficult to define, but in a developed country it is not unreasonable to suggest there be at least two per million people, with academic clinical immunologists (as distinct from a basic immunologist who does some clinical teaching) in every medical school. This will obviously be less in a developing country, depending on the resources available for health care. In countries where allergology and clinical immunology is a recognized speciality or subspeciality, on the other hand, the number of practising allergologists is usually 10–15 allergologists per million people.

Pattern of practice

The work pattern of clinical immunologists should reflect the emergence of modern forms of immune-based therapies. They should be involved in the management of allergy, autoimmune and immune complex diseases, vasculitis, immunodeficiency, oncology, and in partnership with existing organ system specialists as appropriate. Their referrals should be principally from primary care physicians and from other specialists. In less developed countries, the scope of practice of clinical immunologists could be more extensive.

Laboratory procedures

Facilities for the comprehensive laboratory characterization of the immune system should be available in every clinical immunology centre. Facilities should be under the direction of a career immunologist, although some testing may for convenience or for historical reasons be carried out in other divisions

of laboratory medicine. The extent and complexity of the evaluation will depend on the health care resources of the country.

Scientists

Career opportunities for scientists should be created in clinical immunology laboratories. They should be seen as leading the development of different sections of the laboratory, e.g. immunochemistry, cell-mediated immunity, serology, tissue typing, and molecular biology, as well as participating in research.

Technologists

Proper recognition should be given to technologists for the work performed in maintaining clinical immunology services. Separate training and career positions in clinical immunology should be available after basic technical training, with emphasis on laboratory management and quality control as well as on the most recent immunological methodology. Suitable individuals should be encouraged to participate in the research and development aspects of their departments.

Training programmes

For all training programmes in clinical immunology there should be a common core programme in fundamental immunology, essentially as outlined in Table 3.

For medical graduates. Training programmes should be developed from academic centres, subject to central co-ordination and governed by an appropriate state or national body. The practice of clinical immunology requires knowledge and skills in clinical medicine, with a specialized expertise in clinical immunology. Thus, to be recognized as a specialist in clinical immunology, a medical graduate should have:

- Two to three years of training or certification in a primary medical discipline, e.g. internal medicine, or paediatrics.
- (i) Specialized training in clinical immunology, which can be carried out in several ways:
 - (a) In a 3-year training programme.
 - (b) As a 1-year added qualification to a clinical subspeciality such as allergology or rheumatology, where a substantial component is immunology.
 - (c) As a 2-year immunology programme in addition to clinical subspeciality training, in which immunology is not a substantial component.
- (ii) Included within clinical immunology training for the above pathways should be:
 - (a) A thorough review and update of the fundamental principles of immunology (6–12 months), or an immunology PhD research programme in lieu, which fulfils the IUIS programme recommendations for PhD programmes.
 - (b) An in depth training in the immunologic aspects of clinical disciplines such as allergology, rheumatology, nephrology, or transplant immunology. This should include practical experience in immunotherapeutic procedures, including immunosuppression, plasma exchange, immunoglobulin therapy, allergen immunotherapy, and treatment with cytokines and immunomodulation as they become established (12–18 months).
- (c) A period of attachment to a clinical immunology diagnostic laboratory (3–6 months).
- (d) Research in aspects of clinical and/or basic immunology (6–12 months).
- For those who are intending to practise mainly or exclusively in laboratory clinical immunology, the period of clinical attachment can be lessened, and the laboratory experience extended. Training with techniques of molecular biology is essential, as is training in quality control and laboratory management. For developing countries, greater emphasis should be placed on training those who can establish and run adequate clinical immunology laboratory services, since these form the foundation of satisfactory clinical immunology practice.
- For those who are intending to practise mainly or exclusively in allergology, it must be pointed out that a recommendation including less than 12 months of laboratory immunology in the training of specialists carrying the title 'Allergy and Clinical Immunology' is considered insufficient by some members of the expert group. On the other hand, there is agreement that the requirements set forth in Table 3 (see also *J Allergy Clin Immunol* 1990; **86**:411–14) for a basic immunology core programme must be met.

For other scientists. Training programmes for post-doctoral scientists in clinical immunology laboratory medicine should include attachment to a clinical immunology laboratory for at least 3 years, with opportunities to be in charge of a section of the department. Training courses aimed at improving their understanding of the clinical problems in immunology should be offered on a state or national basis, either short duration full time courses, or day or evening courses extending over the 3-year period. Courses in quality control and laboratory management are also necessary. Continued involvement in research and development is essential.

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REFERENCES

- 1 WHO Technical Report Series no. 496; Clin Immunol 1972.
- 2 IUIS Report of the Clinical Immunology Committee. Lancet 1976; 1:196.
- 3 IUIS/WHO Report. Use and abuse of laboratory tests in clinical immunology. WHO Bulletin 1981; 59(5):717-28.
- 4 IUIS/WHO Report. Appropriate uses of human immunoglobulin in clinical practice. Clin Exp Immunol 1983; 52:417.
- 5 IUIS/WHO Report on AIDS. Annals Intern Med 1987.
- 6 IUIS/WHO Report Laboratory Investigations in Clinical Immunology. Clin Exp Immunol 1988; 74:494-503.
- 7 IUIS/WHO Current Status of Allergen Immunotherapy. WHO Bull 67, 263-72, 1989; Lancet 1989; i:259.
- 8 Oehling A. Practice and training for allergology in Europe. Allergologie 1989; 12:224-6.
- 9 Immunotherapy. Position Papers of EAACI. Allergy 1988; 43(Suppl. 6):1-33.