



UNION EUROPÉENNE DES MÉDECINS SPÉCIALISTES EUROPEAN UNION OF MEDICAL SPECIALISTS

Association internationale sans but lucratif

International non-profit organisation

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Training Requirements for the Specialty of Medical Microbiology

European Standards of Postgraduate Medical Specialist Training

Preamble

The UEMS is a non-governmental organisation representing national associations of medical specialists at the European Level. With a current membership of 34 national associations and operating through 39 Specialist Sections and European Boards, the UEMS is committed to promote the free movement of medical specialists across Europe while ensuring the highest level of training which will pave the way to the improvement of quality of care for the benefit of all European citizens. The UEMS areas of expertise notably encompass Continuing Medical Education, Post Graduate Training and Quality Assurance.

It is the UEMS' conviction that the quality of medical care and expertise is directly linked to the quality of training provided to the medical professionals. Therefore the UEMS committed itself to contribute to the improvement of medical training at the European level through the development of European Standards in the different medical disciplines. No matter where doctors are trained, they should have at least the same core competencies.

In 1994, the UEMS adopted its Charter on Post Graduate Training aiming at providing the recommendations at the European level for good medical training. Made up of six chapters, this Charter set the basis for the European approach in the field of Post Graduate Training. With five chapters being common to all specialties, this Charter provided a sixth chapter, known as "Chapter 6", that each Specialist Section was to complete according to the specific needs of their discipline.

More than a decade after the introduction of this Charter, the UEMS Specialist Sections and European Boards have continued working on developing these European Standards in Medical training that reflects modern medical practice and current scientific findings. In doing so, the UEMS Specialist Sections and European Boards did not aimed to supersede the National Authorities' competence in defining the content of postgraduate training in their own State but rather to complement these and ensure that high quality training is provided across Europe.

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At the European level, the legal mechanism ensuring the free movement of doctors through the recognition of their qualifications was established back in the 1970s by the European Union. Sectorial Directives were adopted and one Directive addressed specifically the issue of medical Training at the European level. However, in 2005, the European Commission proposed to the European Parliament and Council to have a unique legal framework for the recognition of the Professional Qualifications to facilitate and improve the mobility of all workers throughout Europe. This Directive 2005/36/EC established the mechanism of automatic mutual recognition of qualifications for medical doctors according to training requirements within all Member States; this is based on the length of training in the Specialty and the title of qualification.

Given the long-standing experience of UEMS Specialist Sections and European Boards on the one hand and the European legal framework enabling Medical Specialists and Trainees to move from one country to another on the other hand, the UEMS is uniquely in position to provide specialty-based recommendations. The UEMS values professional competence as *“the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served”*¹. While professional activity is regulated by national law in EU Member States, it is the UEMS understanding that it has to comply with International treaties and UN declarations on Human Rights as well as the WMA International Code of Medical Ethics.

This document derives from the previous Chapter 6 of the Training Charter and provides definitions of specialist competencies and procedures as well as how to document and assess them. For the sake of transparency and coherence, it has been renamed as “Training Requirements for the Specialty of X”. This document aims to provide the basic Training Requirements for each specialty and should be regularly updated by UEMS Specialist Sections and European Boards to reflect scientific and medical progress. The three-part structure of this documents reflects the UEMS approach to have a coherent pragmatic document not only for medical specialists but also for decision-makers at the National and European level interested in knowing more about medical specialist training.

Introduction

Ideally every EU member state recognizing the specialty should have a professional specialist society of Medical Microbiology. Man power planning and forthcoming quantitative training facilities are the responsibility of the national medical association on the advice of the Medical Microbiology specialty group. The specialty of Medical Microbiology should be represented in the national medical association in each EU country.

The Central Monitoring Authority of the specialty of Medical Microbiology is the UEMS Section of Medical Microbiology which, in consultation with the Professional Affairs Committee of the European

¹ Defining and Assessing Professional Competence, Dr Ronald M. Epstein and Dr Edward M. Houndert, Journal of American Medical Association, January 9, 2002, Vol 287 No 2

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Society of Clinical Microbiology and Infectious Diseases (ESCMID: www.escmid.org), produces guidelines for training in the specialty and produces a training programme blueprint to be filled in with the specific aspects of the training, pertinent to the individual EC member states.

A revised core training programme and training programme for Medical Microbiology was published on the internet under auspices of the Medical Microbiology Commission of the UEMS Section of Medical Biopathology in 2007.

In 2008 a Section of Medical Microbiology was created within the UEMS. After the creation of a separate section it was decided to adopt the version of Chapter 6 of the UEMS Charter on Postgraduate Training for Medical Microbiology which was used when Medical Microbiology was still a part of Medical Biopathology as a basis for the further development and modernisation of specialist training. The current standard is again derived from this but has undergone certain changes.

It is recognised that the practice of Medical Microbiology differs across EU member states, ranging from a principally laboratory-based specialty in states where there is a legal obligation for all reports to be signed by a Medical Microbiologist, to a predominantly clinically-based service, particularly in those states where there are few infectious disease physicians. In the latter states, much of the diagnosis and management of patients with infection is directed by Medical Microbiologists.

Training centres are recommended to apply for the status of ESCMID Collaborative Centre, which will enable and promote the exchange of trainees within the European Union and UEMS member countries.

I. Training Requirements for Trainees

In order to become a trainee for the speciality Medical Microbiology the candidate has to be a qualified medical doctor. Procedures for recruiting medical doctors, who have fulfilled the requirements for basic medical training leading to an EC recognized medical diploma, must be transparent.

1. Content of training

a. Theoretical knowledge

The core of Medical Microbiology consists of the subjects bacteriology, virology, mycology and parasitology and includes in these fields the following knowledge: clinical advice/counselling: diagnosis, treatment and prevention, isolation identification of pathogens and diagnostics including serology, antibiotic and antifungal susceptibility testing, the use of molecular methods within these fields, antibiotic/antimicrobial (antibacterial, antiviral, antimycobacterial, antimycotic and antiparasitic) therapy, antibiotic stewardship. In addition laboratory management is an essential part of the abilities of a medical microbiologist, and includes quality control and quality assurance,

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economics/budgeting and leadership training. Medical microbiologists should also learn about public health and Infection control; consisting of counselling, auditing and accreditation, surveillance of pathogens, resistance and nosocomial infections, epidemiology, bioinformatics and molecular typing. In addition a specialist in Medical Microbiology should have relevant clinical practice in his/her training to be able to give informed clinical interpretation of test results and be able to give independent clinical interpretation of the patient in question. The field of Medical Microbiology covers almost all aspects of medicine and ranges from general practice to specialised hospital programmes (e.g. haematology and transplantations).

b. Practical skills

The specialist training should produce medical microbiologists able to provide specialist opinion in their clinical discipline and who should have developed the appropriate management skills to lead a department of Medical Microbiology, if required. The trained medical microbiologist should be competent to:

1. Give advice as a physician on the diagnosis, treatment and prevention of microbial diseases.
2. Provide a scientific basis for laboratory diagnosis; to set protocols and to maintain standards within the laboratory.
3. Undertake the management responsibilities required from the director of a Medical Microbiology laboratory.
4. Take charge of infection control in hospitals
5. Propose hospital policies on the control of antibiotic usage and on the prevention of hospital acquired infection
6. Collaborate with national surveillance organisations and public health authorities and to provide services for these organisations
7. Participate in the training programs for medical microbiologists, infection control doctors and other experts in the field of microbial diseases.
8. Undertake research and development in the specialty of Medical Microbiology

c. Professionalism

The abilities that are essential for a specialist in Medical Microbiology are: Being a medical expert, having good communication, academic, cooperative and, organisational/administrative abilities.

It is expected that the finished specialist during his/her education has acquired attitudes that promote a high professional and ethical standard and a positive collaboration with colleagues and other professional groups.

Relevant elements to obtain these qualifications are a recognition that Medical Microbiology primarily is to serve the patient. This requires a high degree of willingness for fast and good communication with clinical colleagues. A motivation for their own professional development includes, amongst others, participation in continued medical education. It is expected that specialists in Medical Microbiology have respect for colleagues and other professional groups working in the medical laboratories.

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Training in such attitudes comes first and foremost by model learning from supervisor and other senior doctors.

2. Organisation of training

a. Assessment and evaluation

The training programme should contain sufficient opportunities to check the trainee's proceedings by means of observations during critical practical situations, written proofs of critical assessments by the trainer and examinations of knowledge. The frequency of these tests is laid down in the training programme. Trainers and other staff members involved in the training process should be trained to be able to critically make an assessment of the trainee's knowledge, skills and attitude.

The section will not require that an examination should be passed but will leave the decision to have an examination or not to the medical associations in the individual member states. Nevertheless an assessment of the candidate should be made by the trainer based on theoretical knowledge, practical skills (amongst others based on the candidates log book or equivalent) and the candidates professionalism.

The section encourages the use of courses, both national and international, to train the candidates. Certain subjects might better be seen in an international course, e.g. parasitology courses on a European level, especially in countries with no institutes for tropical diseases.

b. Schedule of training

Specialisation in Medical Microbiology requires education within clinical medicine, microbiology, laboratory management, public health & infection control and science. The duration of the specialisation should be at least 60 months (5 years, including any compulsory periods in clinical medicine required for entry into formal Medical Microbiology training after obtaining a license to practice (authorisation). One or more of the subjects (laboratory management, public health & infection control and science) may be integrated within Medical Microbiology. In this case, documentation for acquired skills is required. Amendments or minor changes that may be necessary in single countries should on a European level comply with a mandatory minimum of five years of training for medical microbiologists.

The training period may be reduced when there is proof of experience in one or more of the major different themes as stated in the UEMS Section of Medical Microbiology training program (e.g. bacteriology, virology, mycology, parasitology, practical clinical training, and infection control). This experience should imply a period of more than twice the training period needed in the specific theme and the period in practice should not have taken place longer than 5 years before the training is started. The reduction shall not be more than half of the period required for training in the specific theme.

- Medical Microbiology (at least 24 months). The following subjects should be covered: Bacteriology, Virology, Mycology and Parasitology. The subjects (virology, parasitology and

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mycology) may be integrated into bacteriology/general microbiology where no separate department exists. In order to be able to cover the entire field of Medical Microbiology the approximate length of each sub-discipline should be: bacteriology - 12 months, virology - 8 months, mycology - 2 months and parasitology - 2 months.

- Laboratory Management (Up to 6 months)
- Public Health and Infection control (up to 12 months):
- Clinical Medicine (minimal 12 months)
and, either
- Science project (6 months): Projects should preferably be based on Medical Microbiology or translational, i.e. method-based studies within Medical Microbiology that include clinical information. Clinical epidemiological studies with limited laboratory involvement are discouraged. The project should lead to a publication: here defined as a presentation (article in peer reviewed journal, poster or oral presentation) at national or international level.
or
- Direct in-patient care and out-patient clinics in infectious diseases, HIV/AIDS, tuberculosis or related specialties (6 months).

II. Training Requirements for Trainers

a. Requested qualification and experience and core competencies

Every centre should have one recognised training leader but can have more trainers.

The recognised training leader should have been practising the specialty for at least 5 years after specialist accreditation. The training leader should be specialist in Medical Microbiology. The training leader should be supported by a trainer representative and there should be sufficient specialist medical staff to operate the daily department's activities. Ideally, the training leader should have academic qualifications.

The trainer should work out a training program for the trainee in accordance with the trainee's progress during the training and the possibilities of the institution, which also complies with national rules and EU directives and considers UEMS/European Board recommendations.

The ratio between the number of qualified specialists in the teaching staff and the number of trainees should provide a close personal monitoring of the trainee during his/her training and provide adequate exposure of the trainee to the training. Therefore this ratio should approximate one trainer to a maximum of 3 trainees.

b. Quality management for trainers

Evaluation of the training provided should be organized, e.g. evaluation of trainers by trainees.

III. Training Requirements for Training Institutions

1. Process for recognition as training centre

a. Requirement on clinical activities

All or part of the training can take place in a training centre that offers the full spectrum of facilities needed for training accordingly the essential themes in Medical Microbiology (University laboratories or laboratories covering nearly all aspects of Medical Microbiology). Parts of the 5 year training programme, no longer than 3 years, may be followed in a department with a lesser spectrum of facilities (small or peripheral laboratories). In any case, all training should take place in a department that is a recognised training centre. The section of Medical Microbiology encourages training in more than one institution (small and large) to be able to learn the full spectrum of the subject. The medical specialist responsible for the training programme, and the trainer representative, should be of sufficient scientific status, preferably at PhD level, and have at least 5 years of practical specialist experience in the field of Medical Microbiology.

Training institutions should be part of /or serving a medical centre, harbouring the main leading clinical specialties such as internal medicine, surgery, paediatrics and gynaecology/obstetrics. In addition, the trainee should gain experience in serving including clinical consulting in the field of clinical microbiology on Intensive Care Units and gain experience in the epidemiology of hospital acquired infections and antibiotic resistance. These main specialties should also be qualified to train specialists in their respective field.

b. Requirement on equipment, accommodation

The equipment should be of such standard that it meets the current standards of the speciality.

2. Quality Management within Training institutions

It should be aimed at a maximum of 3 trainees per member of the training group.

The quality of the training institution should be audited by an external team of specialists in Medical Microbiology, delegated by the national medical association or its equal. Audit should take place at regular intervals, preferably annually. The training institution and the clinical departments should be subject to auditing procedures according to national requirements for accreditation and certification.

Board, Section of Medical Microbiology

March 2013

Updated May 2013

UEMS - SECTION OF MEDICAL MICROBIOLOGY

CORE TRAINING PROGRAMME FOR MEDICAL MICROBIOLOGY

INTRODUCTION

This document sets out a curriculum for medical microbiologists which covers the scientific base of medical/clinical microbiology, as well as applied aspects, including related fields such as infectious disease and infection control. Some elements of medical microbiology training are common to the training in infectious diseases, e.g. infection control. The terms medical and clinical microbiology means the same and pertains to the scientific base of the study of diseases afflicted by contagious micro-organisms of any nature, be it viruses, bacteria, fungi (moulds and yeasts), parasites, or prions.

AIMS OF TRAINING

The main aim of training is competency in delivering specialist practice in Medical Microbiology.

The core training programme aims to provide the trainee with both the theoretical foundation and the practical, technical, clinical and managerial skills necessary for the independent specialist practice of medical microbiology in a clinical environment and for the advancement of the subject. It must be appreciated that laboratory work and clinical experience must be closely integrated; therefore laboratory associated clinical duties are an essential component of the training programme. At the end of their training a certain behaviour is expected, of which the most important is an enthusiastic approach to learning and application of knowledge.

SUPERVISION AND ASSESSMENT OF PROGRESS IN TRAINING

The requirements for the length spent on each part of Medical Microbiology, supervision, qualifications of supervisors and assessment of progress in training are set out in the documents "Training Requirements for the Specialty of Medical Microbiology" and "Minimal requirements for specialisation in Medical Microbiology in Europe". Both documents have been amended by the Sections annual meeting, and the "Training Requirements for the Specialty of Medical Microbiology" was formally accepted by UEMS in Paris in Sept. 2013. The matters covered in those documents will not be discussed any further in this document.

GENERAL AIM

To produce trained clinical microbiologists who can provide a specialist opinion in the discipline and who should have developed the appropriate management skills to lead a department, if required. The trained medical microbiologist should be competent to:

1. give advice as a physician on the diagnosis, treatment and prevention of microbial and parasitic diseases.

2. provide a scientific basis for laboratory diagnosis and management; to set protocols and to maintain standards within the laboratory.
3. undertake the management responsibilities required of the director of a clinical microbiology laboratory.
4. to provide expert specialist advice in relation to infection control and prevention in hospitals.
5. propose hospital policies on the control of antibiotic, antiviral, antimycotic and antiparasitic use.
6. collaborate with national surveillance organisations and public health authorities and provide services for these organisations
7. participate in education and training programs for medical microbiologists, infection control doctors, other medical doctors and experts in the field of infectious diseases. There may also be a role in public education, where relevant and feasible.
8. undertake research and development in the field of medical/clinical microbiology and infectious diseases.

These eight areas of competence include two (namely 4 and 5) in which additional courses and/or formal training may be required by law in some European countries. Points 7 and 8 apply mainly to medical microbiologists in academic institutions, but all microbiologists should have had training in these matters.

OBJECTIVES

Over a minimum 5-year period the trainee should acquire or develop:

- a) Good clinical care skills
 - i. History, examination, investigations, treatment (therapeutics) and communication (verbal and written).
 - ii. Management of infectious diseases.
 - iii. Time management and decision-making.
- b) Specialised factual knowledge of the natural history of infectious diseases.
- c) Interpretative skills so that a clinically useful opinion can be derived from laboratory data. Emphasis should be made on the importance of clinical training and multidisciplinary care.
- d) Technical knowledge, gained from familiarity with laboratory technology, so that methodology appropriate to a clinical problem can be chosen and so that quality control and quality assurance procedures can be implemented.
- e) Research and development experience. Original thought and critical assessment of published work are important to allow the trainee to contribute in a team, and individually, to the development of the service.
- f) The life-long habits of reading, literature-searches, consultation with colleagues, attendance at scientific meetings and the presentation of scientific work as part of continuing professional development (CPD).

- g) Data management skills to evaluate information derived from the population served and from the technical procedures applied in the laboratory. These skills should include familiarity with IT and the use of spread sheets, databases and statistical packages etc.
- h) Management skills.
The trainee is strongly recommended to gain experience, under supervision, in developing departmental policies and future strategies and to develop the leadership skills necessary to implement them. The trainee is strongly recommended to acquire a basic knowledge of healthcare economics.
- i) Presentation skills:
The trainee is required to become familiar with the preparation and delivery of oral presentations and written scientific reports and should deliver at least one scientific presentation during their training period. A presentation is defined as an article in peer reviewed journal, poster or oral presentation at national or international level. Publications in national or international medical journals should be encouraged.
- j) Familiarity with all aspects of health and safety requirements for laboratories.
- k) The communication skills required for the practice of microbiology. These include both informal verbal skills and formal skills such as at committee work and written work encompassing strategy documents, reports, letters, etc.
- l) An understanding of audit, leadership, governance and team working which underpin microbiology practice.
- m) Moral based competencies.
 - (i) Professional behaviour.
 - (ii) Ethics and legal issues.
 - (iii) Patient education and disease prevention.
- n) Teaching methods and skills.

CORE TRAINING PROGRAMME: CLINICAL MICROBIOLOGY

Specialisation in Medical Microbiology requires education within clinical medicine, medical microbiology, public health & infection control, laboratory management and science. The duration of the specialisation should be at least 60 months, and the training in bacteriology, virology, mycology and parasitology should be at least 24 months. In order to be able to cover the entire medical microbiology the approximate length of each sub-discipline should be: bacteriology - 12 months, virology - 8 months, mycology - 2 months and parasitology - 2 months. One or more of the subjects (e.g. laboratory management, public health & infection control, scientific basis of clinical microbiology and science) may be integrated within medical microbiology. In this case, documentation for acquired skills is required, and the length of the training in medical microbiology should be adjusted to include these subjects. The recommended length of training in laboratory management is - up to 6 months; public health and infection control - up to 12 months; clinical medicine - minimal 12 months and science project (6 months) .

The subjects virology, parasitology and mycology may be integrated into bacteriology/general microbiology where no separate department exists, but time in a specialised laboratory in these subdisciplines is advisable.

The following subjects should be covered:

GENERAL MICROBIOLOGY

Applies to all the sub-disciplines of medical microbiology (bacteriology, virology, mycology and parasitology)

Scientific basis of clinical microbiology

At the end of their training trainees should be able to:

- a) explain the basic microbial biology (structure, genetics, taxonomy, physiology, epidemiology, classification and typing) of major bacterial, viral, fungal and parasitic agents.
- b) use knowledge of basic biology to justify investigations, infection prevention and control procedures and interpretation of results
- c) explain the basis of genetic susceptibility to pathogens and disease.
- d) explain the basics of the immune response to infection, host defence mechanisms, the immune system and immunity to infection and immunodeficiency.
- e) compare and contrast cellular and humoral immunity
- f) explain the basis of how the immune response protects against infection, and how it may contribute to pathogenesis of infectious diseases
- g) explain the basis of different types of host–parasite relationships, e.g. symbiosis, viral latency, quasi-species evolution, etc.
- h) explain the types of immunodeficiency and how they affect susceptibility to and control of infectious diseases
- i) use knowledge of host–pathogen relationships to analyse clinical presentation of infections and justify investigations and interpretations of results
- j) explain microbial pathogenicity and genetic susceptibility to pathogens and diseases.
- k) explain epidemiology of infectious diseases - their surveillance and control.
- l) explain typing methods available: the principles, advantages and limitations of various phenotypic and genotypic methods and describe the role of typing in incident/outbreak investigations. And as a result, should be able to recommend appropriate typing methods for clinical and infection control situations and interpret the results.
- m) understand about antimicrobial agents, their mode of action and mechanisms of microbial resistance.
- n) explain the basis of how vaccines work

Laboratory safety

Prior to any "hands on" experience of laboratory work, the trainee should be instructed in basic safety requirements including correct laboratory dress and laboratory hygiene.

Instruction should also be given on the immediate handling and disposal of specimens and

contaminated articles (e.g. inoculating loops, pipettes) at the laboratory bench, the dangers of aerosols and the procedure for dealing with spillages.

The objective of the training is to obtain an in-depth understanding of health and safety issues both locally and nationally in order to practice safely in a laboratory and in a clinical or other setting and to advise on safe practice. The candidate should also obtain an understanding of risk assessment for dealing with category 3 and 4 pathogens and be familiar with the requirements for handling of such pathogens.

At the end of formal training, the microbiologist should be able to:

- a) explain the principles of standard precautions, hazard groups and containment levels.
- b) explain basic laboratory hazards and precautions against them
- c) work safely in a laboratory at appropriate containment level
- d) describe local procedures for the safe transport of specimens or cultures and also with national and international postal and packaging regulations for such material.
- e) work within and explain to others the current requirements and recommendations, including legislative framework, on safety in microbiological laboratories underpinning health and safety at work.
- f) explain the principles and operation of microbiological safety cabinets and the procedures for their decontamination and monitoring of air flow.
- g) perform an infection-prevention and control-oriented risk assessment when required for all procedures undertaken in the hospital, including the laboratory, for all categories of worker, including the pregnant and immunocompromised
- h) act in accordance with the principles of Good Medical Practice

Sterilisation and Disinfection

At the end of formal training, the microbiologist should understand the principles and uses of sterilisation and disinfection procedures for the preparation of media and instruments and for microbiological waste disposal. Trainees should be familiar with methods of monitoring and be capable of formulating a policy on the use of sterilisation and disinfection in the laboratory, hospital or community and the role of environmental cleaning and decontamination. They should also be aware of emerging technologies and their applications.

At the end of formal training, the microbiologist should be able to:

- a) describe the process for disinfection and sterilisation in the hospital and primary care settings including their indications advantages and limitations
- b) make an accurate risk assessment
- c) demonstrate when urgent action is required if disinfection and sterilisation fails

Handling of specimens

At the end of formal training, the microbiologist should:

- a) be aware and demonstrate that they are able to use this awareness, for each specimen type, of the optimal methods for collection, transport (including transport media),

storage, reception, identification and documentation, including the requirements and regulations for high-risk specimens

The trainee should develop a sense of the continuity of identification of specimens from collection, through culture and further testing to the issuing of a final report. He or she needs to be aware of critical points in processing where this continuity may fail and be able to minimise the risk of this

- b) be able to assess degrees of urgency for the processing of specimens, including the provision for an out of hours service and the communication of preliminary results as applicable
- c) be able to decide upon further testing or processing of a specimen as appropriate.
- d) be aware of existing reference facilities and their appropriate use
- e) understand the evidence base behind Standards of Practice (SOPs)
- f) be able to describe the indications for referral of specimens to reference facilities/centres/laboratories, both for diagnostic and surveillance purposes
- g) be able to refer specimens to reference lab appropriately

Data handling

At the end of formal training, the microbiologist should:

- a) have a basic understanding of information technology and in particular, computerised data handling. He or she should have an appreciation of the advantages and disadvantages of such systems and a basic understanding of the need for data protection
- b) be aware of available technologies for data broadcasting
- c) be aware of the developing issues prompted by computerised management of data in terms of confidentiality, data archiving, and report validation (electronic signature)
- d) be familiar with the fundamental aspects of computing- databases, spread sheets, word processing, internet and how these are used on a day to day basis

Results reporting

At the end of formal training, the microbiologist should:

- a) be able to report laboratory results interpretively to ensure the patient is appropriately treated
- b) be aware of the role of the laboratory report in antibiotic stewardship and infection control initiatives
- c) be able to liaise effectively with wards and primary care based doctors

Microscopy

At the end of formal training, the microbiologist should:

- a) understand the principles of light, fluorescent and electron microscopy and be able to set up a light microscope
- b) be able to perform routine staining techniques including fluorescent dyes
- c) be familiar with the appearance of stained preparations and be able to recognise artefacts and their possible origin

Serologic and antigen-based techniques

At the end of formal training, the microbiologist should:

- a. be able to describe the basis and clinical interpretation of results of basic serological test methods. E.g. latex agglutination, enzyme-linked immunosorbent assay (ELISA/EIA), immunofluorescence and the various controls
- b. be able to perform simple serological tests
- c. be able to provide clinical advice based on interpretation of the results of serology

Molecular microbiology and other emerging technologies

At the end of formal training, the microbiologist should:

- a) be able to describe and have a basic understanding of current used molecular and other new techniques available to diagnostic laboratories (e.g., DNA/RNA preparation, hybridisation, nucleic acid amplification techniques (NAT), MaldiTOF, etc.).
- b) have gained experience with (when available) and be able to describe the selection of appropriate diagnostic tests, both molecular and other emerging technologies, and their advantages and limitations
- c) be able to provide clinical advice based on interpretation of the results current used molecular and other new techniques available to diagnostic laboratories
- d) be able to describe automated, and rapid techniques available to medical/clinical microbiology
- e) be able to evaluate critically the need for emerging techniques within the laboratory, including cost effectiveness and effects on staffing levels and working practices
- f) be aware of the potential role of point of care testing, including quality assurance of these tests

BACTERIOLOGY

At the end of formal training, a microbiologist should be able to:

- a) describe basic diagnostic and screening methods in bacteriology. The methods should include culture methods, microscopy, serology and molecular methods
- b) process routine specimens received in the laboratory and carry out further tests necessary for full identification of pathogens. Certain tests will require specialist expertise for full identification, e.g. in house molecular tests. This implies that what is considered routine specimens will vary.
- c) interpret results from diagnostic methods to give clinical advice/counselling, for infection control purposes, and for the prevention of bacterial diseases
- d) explain about bacteriological policies in relation to health care workers, pregnancy, transplantation and immunisation
- e) refer to or request specialist expertise when appropriate
- f) perform and interpret antibiotic susceptibility testing
- g) recommend appropriate use of anti-bacterial agents, including agents against mycobacteria
- h) initiate and manage an antibiotic stewardship programme

More specific on culture methods

At the end of formal training, the microbiologist should be able to:

- a) describe the basic principles of the diversity of microbial metabolism

- b) choose and use correctly for diagnostic purposes from the wide range of selective, enrichment, inhibitory and chromogenic media available for general and specialised use and be able to choose relevant media in common use in medical laboratories
- c) correctly utilise the physical growth requirements of micro-organisms including atmosphere and optimal temperature and have an appreciation of the growth kinetics of both solid phase and broth cultures. It is important in this context to know those micro-organisms and clinical situations in which detectable growth may require prolonged incubation
- d) describe common growth media in use and have an understanding of internal quality control of such preparations. Trainees should at some stage in their training have taken part in the preparation of growth media
- e) process all common specimens, recognise potential pathogens from a mixture of colonies on culture plates and separate such colonies in order to achieve the pure growth necessary for further work
- f) perform tests leading to the identification of all common pathogens, for instance in house tests, MaldiTOF, molecular tests and commercially produced kits (e.g. kits for enzyme assays) and rapid diagnostic kits, ELISA, latex agglutination, etc.
- g) utilise the principles and methods of molecular identification and epidemiologic typing applied to diagnosis, outbreak investigation and epidemiological surveillance
- h) be aware of available reference facilities for further identification including serotyping and all other typing schemes, both phenotypic and genotypic

VIROLOGY

At the end of formal training, a microbiologist should be able to:

- a) describe the aetiology, risk factors and clinical presentation and treatment of viral infections
- b) use basic and advanced diagnostic and screening virology methodology, including serology and molecular methods
- c) describe methods available for antiviral susceptibility testing and their limitations
- d) describe basic antiviral susceptibility testing and interpret antiviral susceptibility testing results
- e) recognise when susceptibility testing is required for an individual patient
- f) describe the different anti-viral agents and the general principles of their mode of action
- g) recommend appropriate anti-viral agents and treatment strategies
- h) interpret test results to give clinical advice/counselling, for infection control purposes, and for prevention of viral diseases
- i) describe in detail the diagnosis and management of viral infections (e.g., rubella, varicella, parvovirus, CMV) in the context of pregnancy
- j) describe viral infections causing immunodeficiency (in particular HIV infection): epidemiology, clinical features, laboratory diagnosis, prevention strategies
- k) describe viral infections associated with severely immunocompromised patients: clinical features, laboratory diagnosis
- l) explain virology policies in relation to health care workers, pregnancy, transplantation and immunisation
- m) use reference facilities appropriately

MYCOLOGY

At the end of formal training, a microbiologist should be able to:

- a) describe the aetiology, risk factors and clinical presentation and treatment of both superficial (skin, hair, nails and mucous membranes) and systemic (e.g. candidosis, aspergillosis and cryptococcosis) fungal infections
- b) use basic diagnostic mycology methodology, including interpretation of serological tests for fungal antigens and antibodies and molecular methods (if not available the trainee should be able to explain the possibilities).
- c) interpret results to give clinical advice/counselling, for infection control purposes, and for prevention of fungal diseases.
- d) recognise and diagnose superficial and deep seated fungal infection.
- e) recognise special problems associated with the immune-compromised host.
- f) examine skin, hair, nails, etc. for presence of fungal elements
- g) describe methods available for antifungal susceptibility testing and their limitations
- h) to recognise when susceptibility testing is required for an individual patients
- i) describe the different anti-fungal agents and the general principles of their mode of action, and recommend anti-fungal treatment strategies.
- j) to use reference facilities appropriately

PARASITOLOGY

At the end of formal training, a microbiologist should be able to:

- a) describe the epidemiology and clinical features of important imported and endemic parasitic diseases likely to present in the country where the training took place (e.g. malaria, intestinal protozoa, intestinal helminths, leishmaniasis, trypanosomiasis, filariasis, schistosomiasis, toxoplasmosis, toxocariasis, giardiasis and hyatid disease – it will vary which are considered imported and which endemic)
- b) describe infections associated with severely immunocompromised patients: epidemiology, clinical features and laboratory diagnosis (e.g. microsporidiosis, cryptosporidiosis)
- c) describe in detail the diagnosis and management of toxoplasmosis in the context of pregnancy
- d) use basic diagnostic parasitology methodology: examine blood, stool and other tissues for the presence of protozoa and helminths.
- e) identify major parasitic species
- f) measure parasite size under the microscope
- g) plan and select appropriate diagnostics (microscopy and/or serology and/or molecular methods) for parasite infections
- h) interpret diagnostic results to give clinical advice/counselling, for infection control purposes, and for prevention of parasitic diseases.
- i) explain epidemiology and clinical features of important endemic and imported parasitic infections.
- j) recommend appropriate anti-parasitic drugs and treatment strategies.
- k) to use reference facilities appropriately

ANTIMICROBIALS

At the end of formal training, the microbiologist should:

- a. have a thorough understanding and knowledge of the range of therapies available for infectious disease, the clinical indications for their use and their side effect profile
- b. be able to explain the classification of antimicrobial agents and their modes of action
- c. be able to determine the antimicrobial susceptibilities of an isolate using common techniques and interpret the results using nationally or internationally approved breakpoints, including appropriate quality control
- d. be able to perform minimum inhibitory concentrations (MICs) and interpret the results using nationally or internationally approved breakpoints, including appropriate quality control
- e. be familiar with the strengths and weaknesses of automated susceptibility test methods
- f. have an understanding of the pharmacodynamics, pharmacokinetics and the therapeutic and toxic effects of antimicrobial drugs and be able to advise on appropriate dosage regimens
- g. understand the principles of interpretative reading of antibiograms and the use of expert system software for that purpose
- h. be familiar with clinically relevant natural and acquired resistance phenotypes of common bacterial pathogens, viruses, parasites and yeasts
- i. be familiar with the epidemiology of antimicrobial resistance at global and local level and of its clinical and financial implications as regards susceptibility testing, choice of therapy and control of hospital infection
- j. be able to explain the basic principles of prophylaxis, both with antimicrobials and with immune globulins
- k. be able to explain empiric and directed antimicrobial use
- l. be able to describe the means of prevention of emergence of antimicrobial resistance.
- m. be able to participate in the surveillance of antimicrobial resistance
- n. be able to describe existing vaccines and the schedules of immunisation

INFECTION CONTROL IN HOSPITAL AND COMMUNITY

At the end of formal training, the microbiologist should:

- a) have had first-hand experience of local infection control problems, including outbreaks of infection and their management
- b) be familiar with the workings of infection control meetings including local and regional infection control committees
- c) be aware of those areas of hospital and community health that require infection control policies
- d) have worked closely with the infection control nurse both in day to day duties and in the education of those involved with infection control issues
- e) have participated in visits to clinical and non-clinical areas to advise on infection control. These should include kitchen inspections, especially those conducted by environmental health officers, operating theatres and Central Sterilisation Services Departments (CSSDs). Relationships should be developed with key personnel in the CSSD, pharmacy and laundry
- f) be able to describe the principles of patient isolation and their application, including that of the febrile traveller

- g) be familiar with documentation relevant to infection control at local, national and super-national level and to have a knowledge of existing working party recommendations (e.g. MRSA, Shigella, Clostridium difficile, norovirus, avian influenza and SARS)
- h) have gained some experience of public health microbiology with secondment if necessary to a Public Health Laboratory
- i) have had experience of communicable disease control in the community by working with Environmental Health Officers
- j) become familiar with the physical and chemical agents used in hospital infection control.
- k) be able to describe the principles of notification and epidemiologic surveillance of infectious diseases and antimicrobial resistance and be aware of legal requirements for reporting communicable disease cases to public health authorities
- l) be aware of issues related to bioterrorism
- m) be able to describe routes of transmission and methods of preventing nosocomial spread of common and important infecting organisms (and Multi-drug resistant organisms (MDROs)), including but not limited to: methicillin-resistant and -sensitive Staphylococcus aureus, vancomycin-resistant enterococci, varicella zoster virus, enteric infections including viral diarrhoea, respiratory tract infections including TB, blood-borne viruses, extended-spectrum beta-lactamase-producing organisms (ESBLs), multiply-resistant Acinetobacter baumannii, Clostridium difficile associated diarrhoea
- n) be able to use knowledge of infection prevention and control in recommendation for the management of patients with infection
- o) be able to liaise effectively with Infection Prevention & Control Team and the clinicians and advise coordination infection prevention and control and public health management of patients
- p) recognise the need for confidentiality

Audit and clinical governance

At the end of formal training, the microbiologist should:

- a) have an understanding of the principles of audit
- b) have participated in microbiological audit both in the laboratory and the clinical setting
- c) understand the importance of clinical governance
- d) be aware of regional, national and international practice guidelines

CLINICAL MEDICINE

Clinical practice in departments where the trainee gains experience in the management of infection will be accepted e.g. Intensive care, Emergency, Surgery, Oncohematology, Infectious diseases and Paediatrics

At the end of formal training, trainees should:

- a) be able to take a relevant basic clinical/infection history and manage common clinical syndromes (see list below)
- b) be able to advise on diagnosis, treatment and prevention of common clinical problems (see list below)
- c) be able to explain results and clinical management plans simply and effectively to both clinicians and patients

- d) be able to assimilate clinical, laboratory and epidemiological information and use this to differentiate between infections and other conditions
- e) be able to select and interpret appropriate tests
- f) be able to analyse data to produce specific or differential diagnosis
- g) be able to liaise effectively with clinical colleagues through regular ward visits and participation in collaborative clinical activities. In particular, a close relationship is required with high dependency units (e.g. ICU, NICU) and specialist units (e.g. haematology, paediatrics, transplantation, infectious diseases, burns, etc.) where available.
- h) be able to liaise effectively with general practitioners
- i) have participated in on-call rotas (including weekends) with consultant cover and have acquired decision making skills and be capable of prioritisation
- j) have participated in postgraduate educational meetings such as Grand Rounds and lunchtime case presentations
- k) be able to provide informed advice on vaccination and immunisation with all products normally available
- l) have undergone clinical training, with experience in the management of patients with Infectious diseases
- m) be able to outline the principles of the epidemiology, presentation, assessment, diagnosis, management and follow-up of the following clinical syndromes:
 - urinary tract infection
 - respiratory tract infection
 - gastrointestinal infection
 - skin, soft tissue, bone- and joint infection
 - post-operative infection
 - encephalitis/meningitis
 - hepatitis, including test interpretation
 - patients with skin rashes and their contacts (pregnant and non-pregnant).
 - infections in pregnancy, including methods of diagnosis, and implications of infection for mother and fetus
 - congenital infection and infection acquired perinatally
 - genitourinary infection including sexually transmitted infections (STIs)
 - infections which constitute medical emergencies
 - occupational associated infection
 - food and water borne infection
 - systemic infections including blood stream infections (bacteraemia/septicaemia), vascular graft infections, endocarditis, etc.
 - eye infection
 - inoculation incident
 - brain abscess
 - infections in the immunocompromised (both with and without HIV infection) including basic understanding of how to make the diagnosis of infection and treatment options
 - common hospital acquired infection (e.g. device-associated infection)
 - infection in travellers (e.g. malaria)

- community-acquired and nosocomial infections in which environmental factors play a role (e.g., food, water, air)

LABORATORY MANAGEMENT

Management

At the end of formal training, the microbiologist should demonstrate awareness of important aspects of laboratory management including staffing (including personnel management, staff appraisal, team working and negotiation skills), financial issues (for instance budget control, departmental budgeting, preparation of a business plan, contracting processes and service level agreements), planning (e.g. strategic planning) and implementation of policies and rotas.

The trainee should:

- be able to establish a close rapport and understanding with laboratory staff
- respond constructively to change
- demonstrate appropriate behaviours in multidisciplinary team working
- recognise need for change, and principles involved
- be open minded

He/she should also understand the fundamentals of financial management in health-care facilities and the principles of medico-economic evaluation of laboratory tests. Ideally attendance at interview panels should be achieved as part of training.

The trainees should be encouraged to attend appropriate management courses in which the programme will be sustained by professional managers. Trainees may, as "colleagues", be permitted to sit in on departmental, directorate and other local committee meetings as observers. The aims and objectives of this should be to provide them with some experience of committee procedures, aspects of confidentiality, decision making at a local level and the importance of maintaining good inter-personal relationships

Quality control

At the end of formal training, the microbiologist should:

- a) be able to explain internal and external quality control systems and quality assurance.
- b) be able to process specimens, distributed by an organisation for external quality control and manage underperformance
- c) have an understanding of the existing external quality control schemes and be able to process data from these schemes
- d) be able to describe the importance and relevance of standards to good laboratory practice
- e) be able to explain the evidence base behind standard operating procedures (SOPs)/examination procedures (EPs) and the importance of audit and quality control to establish validity

Accreditation

At the end of formal training, the microbiologist should be aware of requirements of continuing professional development and be informed of any existing laboratory accreditation schemes and of the process whereby accreditation is conferred.

SCIENCE PROJECT

Science forms the basis of the future development of our field and the trainee should be encouraged to undertake research and development in the field of medical/clinical microbiology and infectious diseases during training. This to ensure they develop an understanding of how new knowledge is acquired.

Projects should preferably be based on medical microbiology or translational, i.e. method-based studies within medical microbiology that include clinical information. Clinical epidemiological studies with limited laboratory involvement are discouraged. The project should lead to a publication: here defined as a presentation (article in peer reviewed journal, poster or oral presentation) at national or international level.