

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.