



TECHNICAL DOCUMENT

European public health microbiology training programme

ECDC TECHNICAL DOCUMENT

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This report of the European Centre for Disease Prevention and Control (ECDC) was coordinated by Aftab Jasir.

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Abbreviations

BLAST	Basic local alignment search tool
BSL	Biosafety level
DG	Disease groups
ECDC	European Centre for Disease Prevention and Control
EPIET	European programme for intervention epidemiology training
EU	European Union
EUPHEM	European public health microbiology training programme
EQA	External quality assessment
IATA	International air transport association
ICaO	International civil aviation organization
IQC	Internal quality control
NMFP	ECDC National microbiology focal points
PHM	Public health microbiology
PPE	Personal protective equipment
WHO	World Health Organization
VNTR	Variable number tandem repeat

1. Background

1.1 What is public health microbiology?

ECDC National Microbiology Focal Points¹ (NMFP) define 'Public Health Microbiology' (PHM) as a cross-cutting area that spans the fields of human, animal, food, water, and environmental microbiology, with a focus on human health and disease. The primary work function is to use microbiology to improve the health of populations in collaboration with other public health disciplines, in particular with epidemiologists.

European preparedness for responding to the infectious disease threats requires a sustainable infrastructure of public health microbiology laboratories that play a central role in detection, monitoring, and outbreak response, and that provide scientific evidence to prevent and control infectious diseases. A range of expertise is necessary to fulfil these requirements including epidemiology and public health microbiology. Public health microbiology is required to provide access to experts with expertise/experience in important communicable diseases at the regional, national and international level and to mount a rapid response to emerging health threats. Organisational laboratory network models and expert professionals serving these public health microbiology functions differ widely across EU Member States. Thus, there is an opportunity to define common objectives and foster exchange of best practices to enhance operational capabilities.²

According to articles five and nine of the founding regulation of the European Centre for Disease Prevention and Control (ECDC) (EC No 851/2004)³, 'the Centre shall, encourage cooperation between expert and reference laboratories, foster the development of sufficient capacity within the community for the diagnosis, detection, identification and characterisation of infectious agents which may threaten public health and as appropriate, support and coordinate training programmes in order to assist Member States and the Commission to have sufficient numbers of trained specialists, in particular in epidemiological surveillance and field investigations, and to have a capability to define health measures to control disease outbreaks'.

Past experiences in outbreak investigations and surveillance suggest that the public health microbiology speciality is in short supply. As a consequence, ECDC has initiated a two-year European Union public health microbiology training programme (EUPHEM) closely linked to the European Programme for Intervention Epidemiology Training (EPIET). Both EUPHEM and EPIET are considered as 'specialist pathways' of the two-year ECDC fellowship programme for applied disease prevention and control. This scientific guide describes EUPHEM training core competencies, training objectives, training content, supervision and coordination of the training. It is a starting point for expert and public opinion necessary for future endorsement.

1.2 Development process for the core competencies in the public health microbiology training programme:

Literature review and first list of competencies

In 2010, on request of the EUPHEM training site forum and in discussion with national microbiology focal points (NMFPs), the chief coordinator of EUPHEM prepared a list of the competencies to be presented as a starting point for developing and agreeing on core competencies for the PHM training programme. At this stage different documents and published papers were reviewed to propose a list that could be in alignment with the definition of the NMFPs. Special attention was given to the documents/publications presented in the reference part of in this document.

¹ http://ecdc.europa.eu/en/publications/Publications/1006_TER_Core_functions_of_reference_labs.pdf

² http://ecdc.europa.eu/en/publications/Publications/1012_TER_Fostering_collaboration.pdf

³ Regulation (EC) No 851/2004 of the European Parliament and of the Council of 21 April 2004 establishing a European Centre for disease prevention and control. Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004R0851:EN:HTML>

Expert review and consultations

A list of competencies was gathered after discussion during the NMFP meeting in 2010.

The list was presented for the EUPHEM forum. The forum agreed provisionally on 12 core competencies. The list was presented for NMFP, and after discussions nine of the core competencies were agreed upon.

In May 2011, the EUPHEM forum discussed the nine core competencies and agreed to further consolidate them as seven core competencies.

The chief coordinator was given the mission to prepare a comprehensive proposal of domains, sub-domains activities/performance within the competencies by comprising proposals from the EUPHEM forum members.

This proposal was sent to the forum members and NMFPs (in October 2011) for review and

comments/suggestions. In November 2011 during a two-day meeting of EUPHEM forum members and supervisors, the chief EPIET and EUPHEM coordinators and head of PH training sections discussed the contents of the proposal (already commented upon by NMFPs) and agreed on the contents as a working document. The document was sent to microbiology cooperation at ECDC for comments/ suggestions. In February 2012 the document was available to NMFPs on the ECDC extranet for consultation (suggestions/comments).

1.3 Core competencies in public health microbiology and their use in context of the EUPHEM training

The structure of the core competencies in this document is arbitrary and proposed for easy reference.

A competency is a combination of knowledge, skills and abilities/attitude that are critical to perform a task effectively.

The domain of a core competency is the set of all possible knowledge, skill/s and ability titles that allows the function of the competency.

Sub-domains are a set of activity titles within a particular domain that allows the function of the domain.

Activities are performance that leads to knowledge skills or abilities.

Core competencies listed in this document are defined for mid-career and above professionals based on the definition of public health microbiology by NMFPs. These core competencies are either well-established and in use by other programmes/ disciplines or specifically developed for the EUPHEM programme.

Mid-career is defined as at least three years experience in the area of microbiology after post-graduate studies (Master or equivalent) or having a PhD in microbiology or equivalent (clinical microbiology specialisation).

An example of a professional profile after training would be that of a head of a laboratory within a public health microbiology institute (e.g. reference diagnostics, surveillance, preparedness, response activities, etc.). Despite the risk of creating artificial categories, this approach was chosen to facilitate the process.

Core competencies in the public health microbiology training programme:

- Public health microbiology management and communication
- Applied microbiology and laboratory investigations
- Epidemiological investigations (surveillance and outbreak investigation)
- Biorisk management
- Quality management
- Applied public health microbiology research
- Teaching and pedagogy

Fellows should be trained in all main domains and their respective sub-domains. However, not all listed activities will need to be covered. Fellows will be assessed on an individual basis regarding the acquired competencies compared to the initial competency assessment. The core competencies in this document are composed of cross-cutting and discipline specific domains, sub-domains and activities, and are presented as three levels. The level of expectations (minimum requirements) for EUPHEM fellows are indicated in front of each learning objective using the following levels.

Aware: Individuals are able to identify the concept but have limited ability to perform the skill independently (basic).

Skilled: Individuals are able to apply the skills (intermediate).

Competent: Individuals are able to synthesise, critique or teach the skills (advanced).

1.4 Users and uses of this document

The document is intended to be used as a reference document for the EUPHEM training programme but can be used by any training programme related to public health microbiology. Other potential users are not only public health institutes and training programmes, but also individual professionals and trainees.

The EUPHEM chief coordinator will take advice from the EUPHEM forum and other potential users (e.g. national microbiology focal points, training programmes, etc) to update this document annually. The list is not exhaustive.

This document, including core competencies, can also be a useful tool during the assessments done during country visits, helping to identify areas of work or expertise that should be strengthened.

Other uses include:

- Evaluation of training needs, at the time of recruitment or later, to assess the status in the learning process as achievements against competencies. Sub-competencies, considered as the ability to perform specific tasks, may be more suitable for this purpose;
- Curriculum development and instructional design;
- Accreditation of training programmes: Competencies and curricula of training programmes should be assessed as part of any accreditation process.
- Reference to the seven core competencies for public health microbiologists that were agreed together with the EUPHEM forum and discussion with national microbiology focal points.

The use and users description is in alignment with core competencies for public health epidemiologists working in the area of communicable disease surveillance and response, in the European Union⁴.

⁴ Available at:

http://ecdc.europa.eu/en/publications/Publications/0801_TED_Core_Competencies_for_Public_Health_Epidemiologists.pdf.

2. Programme content and learning objectives

2.1 Long-term mission of EUPHEM

The long-term mission of EUPHEM is to:

- strengthen communicable disease surveillance in the European Union through integrated public health microbiology field epidemiology networks
- support outbreak detection, investigation and response nationally and internationally
- develop a European network of public health microbiologists
- develop a response capacity for public health microbiology together with other disciplines inside and beyond the European Union
- foster future leaders in public health microbiology in Europe.

2.2 Training content

The training primarily consists of learning by doing and practising through service. Modules and courses are additional training opportunities. The fellows start with a three-week EPIET/EUPHEM introductory training course that takes place at the end of September each year. In total, each fellow must participate in ten module weeks, of which nine are compulsory and one is optional. Additional training courses are chosen depending on the skills assessment of the fellows. Sites should provide these courses or facilitate participation of the fellows to the courses when other training needs have been identified by the skills assessment. Fellows participate in some of the mandatory epidemiology (EPIET/EUPHEM) training modules. Modules more tailored to the laboratory background are also offered.

2.3 Learning objectives of EUPHEM fellowship within each core competency

Public health microbiology management and communication (aware/skilled)

- Design/organise/manage a public health microbiology laboratory
- Assess risks to respond to a potential health threat
- Apply the roles and responsibilities of local, national and international organisations involved in infectious disease control
- Coordinate response using communication mechanisms and other tools
- Communicate effectively with persons from a multidisciplinary background, authorities, the public and the media in the form of publications, reports, interviews, and oral presentations.

Applied microbiology and laboratory investigations (competent)

- Apply concepts of virology, bacteriology, parasitology/mycology and immunology to the public health disciplines
- Identify the use and limitation of diagnostic and typing methods and their interpretation in patient diagnosis, outbreak investigations, surveillance and epidemiological studies
- Recognise the specific issues with the use of laboratory and epidemiological methods in investigations of rare and emerging diseases
- Design and apply safe specimen sampling strategies for disease surveillance and for outbreak detection and control, both in humans and animals

Epidemiological investigations, including surveillance and outbreak investigation (skilled)

- Set up surveillance systems (combined syndromic and laboratory based or only laboratory-based)
- Analyse combined syndromic and laboratory or laboratory surveillance data
- Evaluate an existing surveillance system
- Operate microbiological support on surveillance systems
- Apply combined microbiological and epidemiological knowledge in outbreaks, surveillance, or unusual events
- Participate in an outbreak investigation with having one or more PH microbiology tasks.

Applied public health microbiology research (competent)

- Conduct all stages of a PHM research project, from planning to writing a scientific paper.

Quality management (skilled/competent)

- Describe quality assurance
- Assess and experience different standards
- Apply the concepts of external quality assurance (EQA)
- Perform, evaluate or analyse results of an EQA.

Biorisk management (skilled)

- Apply national, European and World Health Organization (WHO) rules and regulations regarding biosafety and biosecurity and understand how these may influence response to an outbreak
- Use appropriate decontamination strategies/personal protection and their applicability in field situations
- Determine the need for quality management, biosecurity management, and crisis response as core elements of management of a public health microbiological laboratory.

Teaching (skilled/competent)

- Identify training needs, planning and organising courses
- Moderate case studies, give lectures and perform pedagogical teaching
- Design/create a case study.

2.4 Core competencies, main domains, sub-domains and activities

2.4.1 Public health microbiology management and communication

Public health microbiology management

Public health microbiology management is defined as the capacity to identify and prevent/control threats to the health of the population caused by microorganisms or their products (e.g. toxins), and to construct policies and strategies that support improvement of the population's health.

Public health microbiology management in this context comprises different disciplines. These include all areas of microbiology (bacteriology, virology, and parasitology/mycology) within different disciplines (medical, veterinary, environmental, food), as well as epidemiology. Public health microbiology management includes public health, laboratory and communication management.

There are different levels of public health microbiology management. The EUPHEM management core competency refers to different and distinct management levels outlined below:

General PHM management

- Describe the added value of public health microbiology for public health
- Apply principles of scientific communication to peers, stakeholders and media/public
- Identify public health priorities in complex emergency situations
- Recognise security issues
- Know the role of different agencies
- Identify elements of stress management.

Knowledge of planning outbreak responses at national and international level

- Identify interdisciplinary needs between health-care professionals and front-line responders
- Implement lessons learned from planned exercises.

Infection control

- Plan and implement infection control processes within field studies.

Response to epidemics of a severe nature

- Identify key elements of social mobilisation
- Identify basic laboratory requirements in the field.

Rapid assessment techniques

- Use rapid assessment in the early phase
- Use relevant indicators to monitor intervention.

Team building and negotiation

- Be an effective team member, adopting the role needed to contribute constructively to the accomplishment of tasks by the group
- Promote collaborations, partnerships and team building to accomplish public health microbiology programme objectives
- Build up multidisciplinary partnerships to support microbiological investigations
- Mutually identify those interests that are shared, opposed or different with the other party to achieve good collaboration and conflict management.

Ethics and integrity

Public health microbiologists are expected to integrate with the ethical rules related to their work. There are organisational ethics, as well as other ethical codes binding the person to the principle of collaboration, publication ethics, and personal integrity.

- Respect and adhere to ethical principles regarding human welfare when planning studies, conducting research, and collecting, disseminating and analysing data
- Apply relevant laws to data collection, management, dissemination and use of information
- Adhere to ethical principles regarding data protection and confidentiality regarding any information obtained as part of professional activity
- Handle conflicts of interests.

Laboratory management

This includes simple daily bench work to more advanced planning for management of teamwork, laboratory networking (both internally and externally), and project management.

Identify and apply best laboratory techniques

- Apply appropriate sampling strategies
- Apply appropriate laboratory investigations and sampling preparation techniques.

Specimen transportation

- Review and report on the international regulations and the role of stakeholders;(i.e. International Air transport Association (IATA), International Civil Aviation Organization (ICAO), customs,) in movement of infectious materials across national borders
- Outline field microbiology needs and design packaging and transportation protocols.

Rapid assessment techniques

- Identify methods for detection of pathogen/cause of unusual events
- Design a protocol to gather the laboratory results.

Communication

Communication skills include diverse levels of communications, national and international. Communication of public health microbiology information is a crucial task for appropriate public health action. A number of different activities are vital to gain skills and abilities in communication.

Written communications

- Submit abstracts to a scientific conference within applied infectious disease
- Prepare a scientific report/paper (one or more of the following):
 - Field investigation (outbreak) report
 - Short article in a microbiology/epidemiological bulletin
 - Scientific paper for a peer-reviewed journal (as first author)
 - Appraise a scientific article

Oral communications

- Make oral scientific presentation at a national, European or international conference.
- Give scientific seminars to different professionals

Media communications;

- Communicate with the media
 - be involved in the preparation of a press release
 - respond to journalists' interview requests (newspaper, radio or TV) if appropriate
 - prepare a question and answer briefing (frequently asked questions) document.

2.4.2 Applied microbiology and laboratory investigation

Applied microbiology is the understanding of the basis and limitations of laboratory methods and the application of these methods in a public health setting (e.g., outbreaks, surveillance, complex emergency situations, and unusual events). This includes general microbiology, laboratory investigation, laboratory methods and analysis.

General microbiology

Microbiology knowledge

- Outline and describe the role of the laboratory in surveillance, outbreak investigation, applied research
- Understand the principles and practices of bioinformatics and phylogeny
- Define the type of analysis depending on the study design
- Establish criteria for microbiological input and evaluation
- Establish microbiological criteria and assessment
- Design and conduct laboratory investigations in accordance with the documented 'risk assessments'.

Data collection

- Create a data entry scheme
- Record using appropriate information technology support.

Analyse the data

- Identify and use appropriate analytical and statistical techniques.

Laboratory investigation

Conduct an investigation

- Undertake a laboratory investigation in a public health setting including the following steps:
 - knowledge of principles
 - development of a microbiological case definition
 - sampling strategies
 - laboratory techniques
 - incident team coordination
 - environmental procedures
 - environmental contacts.

Engage in interaction between different disciplines

- Identify needs and objectives of clinicians, laboratory, veterinary and environmental agencies in the public and private sector
- Give advice in pre-sampling, sampling, analysis, reporting, documentation, feedback.

Specimen collection

- Define a sampling strategy including number of needed specimens
- Collect, label, package and transport samples appropriately and safely.

Specimen transportation

- Review and report on the international regulations and the role of stakeholders (i.e. IATA, IACO, customs,) in movement of infectious materials across national borders
- Outline field microbiology needs and design packaging and transportation protocols.

Laboratory methods and analysis

Knowledge of phylogenetics

- Understand principles of multiple alignment
- Construct and interpret a simple multiple alignment;
- Conduct phylogenetic analyses techniques
- Create and query a local basic local alignment search tool (BLAST) database
- Evaluate the software and troubleshoot.

Sequencing technologies and non-sequencing typing methodology

- Prepare and run automated sequencing systems
- Design and interpret variable number tandem repeat (VNTR) assay
- Run Pulse Field Gel Electrophoresis
- Run serological methods
- Evaluate the software and troubleshoot
- Produce and interpret data.

Database systems

- Retrieve sequence
- Manage simple sequence entry
- Create a database using different software
- Complex sequence entry: trace data from automated sequencers
- Edit sequences by using editing programs (e.g. Bioedit)
- Analyse sequences by using sequence databases.

Laboratory methods

- Identify key laboratory investigations relevant to selected symptoms and/or suspected pathogens
- Identify situations where genetic typing methods should be used
- Perform evaluation studies of diagnostic test accuracy (sensitivity, specificity, positive and negative predictive value).

Establish the criteria for microbiological input to epidemiological investigations

Collaboration between epidemiologists and laboratories are of immense importance to gather the data necessary to understand the epidemiology of communicable diseases

- Collaborate with epidemiologist to established criteria for microbiological input.

2.4.3 Epidemiological investigations: surveillance and outbreak investigation

Surveillance systems and outbreak investigations within communicable disease are dependent on laboratory results as well as epidemiological investigations. Public health microbiologists need to be able to set up and/or manage day to day surveillance laboratory systems activities, or to evaluate such surveillance systems. Outbreak investigations represent one of the most exciting and challenging activities. Time constraints, media attention, and the need for adequate methodology place the professional under pressure when the need for rapid action conflicts with the need for accurate and valid investigation and results.

Surveillance

New surveillance system

- Design the surveillance system (public health importance, action/intervention available, objectives of the system, case definition, indicators, data collection, source of information, transmission of information, software and hardware, data analysis, feedback procedures, recipients, use of information)
- Develop a case report form and obtain clearance from appropriate individuals or offices
- Obtain support for the surveillance system from the individuals who will be responsible for ensuring that the system is implemented
- Conduct a pilot study if necessary
- Supervise data collection and collation
- Analyse the data, selecting appropriate methods
- Provide the results of the analysis to appropriate individuals choosing the appropriate mode of communication
- indicate the need for prevention or control measures, or further investigation, make appropriate recommendations if the findings of the surveillance system indicates it
- Develop a framework to evaluate the surveillance system using standard criteria.

Day-to-day surveillance activities

- Check incoming surveillance reports for plausibility and collection of missing information
- Conduct regular data analysis of surveillance data
- Interpret current trends in the surveillance data and develop corresponding recommendations
- Participate in regular feedback of surveillance data to stakeholders
- Write a scientific report using the analysed data

Evaluation of an existing surveillance system

Criteria to be used to assess the system:

- Describe the public health importance of the health event, and the public health strategy
- Describe the system:
 - list the objectives
 - describe the health event
 - state the case definition
 - draw a flow chart of the system
 - describe the components and operational modes of the system
 - assess usefulness by indicating action taken as a result of the data from the surveillance system
- Evaluate the system for each of the following criteria: simplicity, flexibility, acceptability, sensitivity, positive predictive value, representativeness, timeliness
- Describe the resources used to operate the system
- List conclusions and recommendations.

On the basis of the assessment,

- Identify areas for improvement and their feasibility
- Provide stakeholders and other appropriate individuals with written recommendations for improving or discontinuing the surveillance system
- Assist with implementing improvements to the existing surveillance system if requested

Outbreak investigations

The following classical approach to outbreak investigation can be used as a guide and a basis for evaluating the acquisition of skills in outbreak investigation for PH microbiologists who will participate in an outbreak investigation with specific microbiological tasks:

Classical approach to outbreak investigation

- Obtain preliminary information
- Describe public health problem, how it was discovered
- Gather epidemiological information
- Address nature and urgency of the problem
- Plan for future action
- Establish what level of control or investigation is necessary
 - major emphasis on control, minor emphasis on investigation
 - emphasis both on investigation and control
 - more emphasis on investigation than control
 - emphasis on investigation (research purposes)
- Make a site visit if requested and agreed
- Take part in the establishment of the outbreak control team
- Conduct an on-site investigation
- Confirm the outbreak, diagnosis, case definition
- Count cases and orient the data according to time, place and person characteristics
- Develop a hypothesis compatible with descriptive data and with the suspected source and the vehicle
- Test hypothesis, verify biological plausibility and compatibility of epidemiological results with other information
- Develop recommendations for preventive and control measures, verify that control measures are effective
- Write a report and communicate results and recommendations. If appropriate, write a scientific article.

2.4.4 Biorisk management

The scope of biorisk management is to apply requirements necessary to control risks associated with the handling, storage and disposal of biological agents and toxins in laboratories and facilities. Biorisk management results in controlling or minimising the risk to acceptable levels in relation to employees, the community, and others as well as the environment which could be directly or indirectly exposed to biological agents or toxins.

Biosafety

International biosafety guidelines

- apply the principles and practices of biosafety according to those outlined by WHO and EU directives

Personal protective equipment (PPE)

- describe variation and efficacy of PPE strategies
- assess and experience different PPE systems
- apply the concepts of 'operational protection factors'

Decontamination and waste control strategies

- understand the principles and practices regarding decontamination processes associated with infection control, equipment decontamination etc.
- plan and produce decontamination and waste disposal protocols

Biosafety level3 (BSL) and BSL4 biorisk management

- understand processes associated with BSL3 and BSL4 laboratories
- plan and produce decontamination in BSL3 and/or BSL4 laboratories.

Biosecurity

Understand the principles and practices of biosecurity according to those outlined by WHO, the EU and national directives.

Laboratory biosecurity

- understand principles of biosecurity
- follow WHO and EU laboratory biosecurity guidance

2.4.5 Quality management

In laboratory medicine, control measures are essential for diagnosis, risk assessment, examination and treatment of patients. Methods applied in diagnostic approaches must be accurate, precise, specific and comparable among laboratories. Insufficient or incorrect analytical performance has consequences for patients, the healthcare system and consequently for public health. Quality management programmes are essential to ensure reliability, reproducibility and relevance of laboratory test results.

External quality assessment (EQA) and internal quality control (IQC) are complimentary components of a laboratory quality management programme. External quality assessment is used to identify the degree of concurrence between one laboratory's results with established reference results or/and those obtained by other centres. Internal quality control is used to find whether a series of techniques and procedures are performing consistently over a period of time. It is organised to ensure day-to-day laboratory consistency.

Laboratory quality management

External quality assessment

- Describe efficacy of quality assurance
- Assess and experience different standards
- Apply the concepts of EQA
- Perform, evaluate or analyse results of an EQA

Preparing an external quality assessment

- Collect set of isolates/specimens for EQA
- Write protocols
- Identify related International Organisation for Standardization standards

Collecting data

- Design template for collecting data
- Integrate collected data
- Interpret integrated data

Preparing a report

- Create tables and figures
- Draft the EQA report
- Make conclusions and recommendations

Reviewing international quality guidelines/standards

- Understand the principles and practices of quality assurance according to those outlined by international and EU directives

Internal quality control

- Control within a laboratory setting, different factors influence the quality of results
- Appropriate specimen collection and handling
- Selection of suitable techniques
- Maintenance of an up-to-date manual of standard operational procedures
- Use of reliable reagents and reference materials
- Selection of suitable automation and adequate maintenance
- Maintain adequate records
- Reporting system for results

Accreditation**Audit**

- Understand and apply local and European accreditation procedures
- Contribute to audit of the accreditation

2.4.6 Applied public health microbiology research

Applied public health microbiology research is correlating basic science with clinical practice through addressing public health questions.

This should relate microbiology to public health.

Theoretical methods**Study design**

- Identify a problem of public health importance
- Review literature
- Identify and write study question and the hypothesis to be tested
- Design the study

Study protocol/relevant questions

- Identify critical questions
- Design protocols
- Exercise realistic timelines
- Identify limitations
- Evaluate possible risks and delays

Empirical methods**Method identification**

- Identify relevant methods by literature review/discussion with supervisors and colleagues to:
 - choose appropriate methodology
 - develop a plan of analysis
 - write a detailed protocol

Knowledge and skills of relevant methods

- Identify usefulness of the methods in a particular research study
- Apply relevant laboratory methods
- Implement new methods in a study

Application for financial support if necessary

- Design and write an application

Constitute and brief the study team

- Inform the team on ethical procedures and requirements, obtain ethical approval

Drafting results

- Collect and analyse data
- Interpret the results
- Disseminate and communicate the information
- Write a scientific report and/or a scientific article

2.4.7 Teaching and pedagogical skills

Teaching is one of the most effective ways to transfer knowledge and skills, and allows the performance of different activities that help to improve the ability to communicate with a professional audience and learn current concepts of teaching and learning at a higher level. The focus will be on the role of the teacher and his/her professional development, learning as a cognitive process, different teaching methods and their effect on learning, evaluation at different levels, and communication and pedagogical qualifications.

The pedagogical objective of this participation in training other individuals is to acquire the following skills and abilities/attitude:

Teaching

Giving lectures

- Give lectures (with discussion, etc.)
- Communication and training for a range of health-care professionals
- Assess own performance through feedback assessments
- Re-evaluate delivery and content

Moderating case studies

- Moderate a case study
- Guide participants to the answer
- Explain epidemiological/microbiological/clinical concepts surrounding a disease or an outbreak

Pedagogical Skills

Planning and organising a course

- Define course objectives
- Outline learning outcomes, describe core competences
- Develop curriculum
- Identify teaching and assessment methodologies
- Adopt training tools
- Develop a reflective learning strategy
- Create an assessment survey
- Use interactive teaching and learning methods such as:
 - problem based learning (PBL), case studies, panel of experts, cooperative learning, manage adult groups
 - design case studies
 - prepare presentations

Giving or directing a seminar

- Deliver a seminar to a multidisciplinary audience
- Record reflective learning

2.5. Modules

EUPHEM compulsory modules:

- EPIET/EUPHEM introductory course (three weeks)
- Outbreak investigation module (five days)
- Vaccinology (five days)
- Biorisk and quality control/quality management (five days)
- Initial PHM management and leadership/teamwork (five days)
- Project review (five days, twice)

Current optional modules:

- Multivariable analysis (five days)
- Rapid assessment of complex emergency situations and mass gathering (five days)
- Communication and scientific writing (five days)

2.6. Matrix and portfolio of the training

Throughout the two-year fellowship, when possible, projects will be selected that cover a range of technical aspects and infectious disease subjects. A matrix will be used to build the portfolio (summary of the work of the fellow during two years). Each new project is described in a short, two-page proposal, stating background, objectives, learning objectives addressed, work plan, and proposed learning outcomes. This proposal also states the specific supervision for each project. Protocols and draft reports should be shared with local supervisors, scientific programme co-ordinators and the ECDC training liaison person.

The matrix of two years training is planned both vertically and horizontally (table1) so that fellows can acquire core competencies through exposure to several disease groups.

Table1. Matrix portfolio of the projects and activities

DG	Outbreak investigation	Surveillance	PHM research	PHM management and com.	Biorisk management	Quality management	Applied PHM and lab investigation	Teaching	Others
1. VPD									
2. EIVD									
3. STD, Hepatitis and HIV									
4. RD inc. Flu and TB									
5. FWD									
6. HAI-AMR									

1. VPD: Vaccine preventable disease

2. EIVD: Emerging Imported Vector borne diseases

3. STD: Sexually transmitted diseases

4. RD: Respiratory diseases

5. FWD: Food and Waterborne diseases

6. HAI-AMR: Health care associated infectious and antimicrobial resistance

Horizontally, the matrix displays the seven core competencies and its eight domains. Vertically, the matrix presents different disease groups (DG). The fellow must complete at least four projects. Three must cover (1) outbreak investigation, (2) surveillance and (3) research. The fourth one can be selected in any other competency domain (i.e. applied PH microbiology and laboratory investigation, biorisk management and quality management). These projects should be in different DG. However, since outbreaks are unpredictable, a fellow may have an outbreak investigation project in the same DG as another project. Public health microbiology management and teaching can also be addressed in any field without blocking additional projects in the same DG. Beside projects, fellows will have activities that can be allocated in any DG. However, to develop more skills/abilities in different disease programmes, it is recommended to avoid more than one activity within the same DG. Each project and activity should result in an output in the form of a manuscript or a report. If the fellow has previously worked in one disease group, this group should not be chosen for the projects of the fellowship. However, fellows should make their skills available for special needs when requested (e.g., outbreak investigation).

3. Diploma

3.1 Requirements for completion of fellowship

Scientific coordinators will examine the portfolio (summary of the all work of the fellow) presented by the fellows in view of evaluation for the graduation. Minimum requirements are:

- Performing four projects (three compulsory and one optional) in subjects as below:
 - Conducting surveillance projects with responsibility for one or more specific tasks relevant for EUPHEM training as indicated in the objectives and portfolio matrix
 - Participation in an outbreak investigation, with responsibility for one or more specific microbiology tasks relevant for EUPHEM training and write an outbreak report
 - Plan, develop and conduct and report a laboratory based research study addressing a public health problem
 - Conduct projects or activities relevant to microbiological techniques or with laboratory based surveillance or outbreak investigations
- Develop a course or workshop in collaboration with epidemiologist/s (laboratory sciences for epidemiologists or similar) and teach specific aspects of public health microbiology to epidemiologists
- Submit a written report on one of the topics above for publication as first author
- Present a project at a scientific meeting (oral presentation or poster)
- Be involved in at least 10 hours of teaching (including preparation time, 3h each lecture preparation) and/or preparation of a teaching material
- Participate in 10 weeks of training modules according to this document.

4. Programme organisation

4.1 General

EUPHEM and EPIET are both pathways of the same two-year EU fellowship programme coordinated and funded by ECDC. The programme scientific coordinator coordinates the governance of the programme with close involvement of the EUPHEM forum.

4.2 EUPHEM governance

A multidisciplinary approach governs EUPHEM:

EUPHEM scientific coordination

ECDC manages the scientific coordination of the programme. The EUPHEM chief coordinator based at ECDC manages scientific aspects of the programme, in collaboration with the EPIET chief coordinator. The chief coordinator delegates certain tasks to other programme coordinators (stated at ECDC and the member states), according to the profile described.

The role of the coordinator is to have regular contact with fellows and supervisors and together oversee that fellows are attaining their objectives. The coordinators are also responsible for ensuring that core competencies and public health relevance of the projects are followed.

The EUPHEM chief coordinator chairs the selection committee, identifies new potential training sites and organises initial site appraisals. S/he organises regular site visits to existing EUPHEM training sites.

The EUPHEM chief coordinator facilitates opportunities for EUPHEM fellows to partake in international assignments and monitors their progress during the assignment.

The EUPHEM chief coordinator organises or co-organises training modules for EUPHEM fellows. The EUPHEM coordinator will take a moderating role in case of conflicts between the fellow and the site supervisor. The chief coordinator and the supervisor sign the diploma of the fellows.

Programme coordinators

The broad pedagogical activities of the EUPHEM training programme coordinators include:

- organising and developing of training programme content and methods, including training the trainers and seeking out-of-station assignments for fellows
- monitoring progress, advising and counselling fellows
- providing distance-tutoring for fellows
- promoting and advocating the programme
- maintaining contact with alumni

In particular, these activities encompass the following areas:

- Define and develop EUPHEM training objectives
 - develop and update documents describing training objectives related to the core competency
 - collaborate with each training site supervisor and fellow to ensure that individual training objectives are developed and reviewed regularly during the 23-month assignment
- Promote EU-wide participation of national institutes in training collaboration:
 - systematically involve senior microbiologists from collaborating institutes in the various EUPHEM training sessions
 - promote the development and hosting of EUPHEM training modules in collaborating institutes
 - promote collaboration with other training organisations (e.g. field epidemiology training programmes, universities, public health schools)
 - facilitate links between EUPHEM and EPIET and other European public health programmes
 - represent EUPHEM in relevant meetings and conferences
 - update EUPHEM information on the website
- Organise courses and training modules, and their subsequent evaluation:
 - plan, co-ordinate and evaluate the EPIET/EUPHEM introductory course
 - help and support collaborating training institutes in planning and organising specific modules
 - develop, implement and evaluate each module

- Identify, assess and promote additional training opportunities and assignments:
 - identify suitable EU-wide investigations or research projects, and negotiate the participation of the fellows
 - identify potential international assignments offering experience appropriate to the training objectives, and negotiate participation of the fellows
 - establish and maintain contacts with other public health microbiology training worldwide in order to exchange training material, trainees and trainers
- Monitor and promote EUPHEM training site developments
 - disseminate information about EUPHEM to all potential training sites
 - identify potential training sites, and conduct initial site visits
 - regularly perform training site appraisals in each training institute
 - involve training site supervisors as facilitators in the various training modules;
- Develop training skills and techniques among actual and potential trainers at training sites, and among fellows
 - regularly organise and improve training the trainers modules
 - use all EPIET/EUPHEM courses and modules as opportunities to strengthen the training skills of the fellows and training institute's supervisors
- Provide pedagogical support/tutoring to the fellows
 - review initial competency assessment
 - review specific training objectives as needed (midterm review and exit interview)
 - review protocols, reports, manuscripts, presentations as needed
 - help identify and provide relevant literature when needed
- Facilitate exchanges of information between EUPHEM and EPIET and EPIET Associated programmes (EAP) fellows
 - respond or identify appropriate responses to queries from the fellows
 - review fellows project during the project review module
- Identify and develop training materials for coursework and for distance learning
 - identify and review material developed by groups involved in distance learning
 - identify new relevant training material (case studies, video, computerised exercises) used in other training programmes
 - encourage the development of new training material by training institutes
 - promote and supervise the development of new training material by fellows

Training forum

The EUPHEM training site forum includes representatives from the EUPHEM training sites. The chief coordinators of EUPHEM and EPIET, and the head of the ECDC training section participate in the meetings of the forum as counterparts. The training forum advises ECDC on operational, technical and pedagogical issues regarding EUPHEM. Any major changes to the programme is discussed with the training forum, the national microbiology focal points and the ECDC chief microbiologist.

Regular EUPHEM forum teleconferences

Regular EUPHEM forum teleconferences constitute a mechanism to discuss issues related to the programme. All forum members book a day each month in their calendar for the teleconference. The teleconference is used for making decisions regarding fellows' progress, programme contents and also selection of candidates for interview.

4.3 Supervision

Fellows are placed under the responsibility of a main supervisor who is experienced in public health microbiology at one of the EUPHEM training sites. An assigned co-supervisor will assist the main supervisor in scientific and practical issues. Besides the supervisor and the co-supervisor, other scientists are available to guide the fellow on selected projects. When the main supervisor does not have the experience or does not wish to provide supervision for epidemiology, a dedicated epidemiology supervisor is assigned to help and supervise the fellows with epidemiological core competencies.

Supervision process

The fellows will be assigned to a senior laboratory staff member of one of the hosting institutes as main supervisor and primary contact. The supervisor must guide and closely follow the fellow during his/her fellowship, acting as his/her mentor. The main supervisor will monitor the progress according to the programme objectives, and will be the contact person for the ECDC office and the EUPHEM forum. A co-supervisor will follow the day-to-day work of the fellow in agreement with the main supervisor. The co-supervisor is also responsible for communication with project supervisors if the main supervisor is not available. The co-supervisor functions also as an alternate main supervisor at the forum in case of absence or leave and s/he helps the fellow with administration issues when the main supervisor is not available. The epidemiology supervisor will help the fellow acquiring the epidemiology core competency (i.e., outbreak investigation and surveillance), facilitate participation of the fellow in outbreak investigations, and review the epidemiology output of the fellow. S/he will also link the EUPHEM fellow with EPIET fellow(s), and link the microbiology department with the epidemiology department.

The training site should ensure the fellow receives at least four hours per week of supervision. This time can be used for discussion and guidance through the fellows' projects.

- The fellow will do a competency assessment at the start of the programme to assess competencies and training needs. Both the main supervisor and EUPHEM coordinator assist the fellow in this assessment.
- Developing a curriculum and plans for projects will be discussed and evaluated together with the EUPHEM scientific coordinator on a regular basis.
- Weekly meetings will be held with the local supervisor to monitor progress, with a longer meeting on a quarterly basis coinciding with the quarterly report and presentations on the annual EUPHEM meeting (combined with the European Scientific Conference on Applied Infectious Disease Epidemiology). ECDC and a training forum representative will conduct the reciprocal mid-term interview and final evaluation.

The training site supervisor is responsible for planning mentoring and following up of the progress of the fellow. This includes:

- performing a detailed initial competency assessment of the fellow, to identify projects and training activities that address the training needs before the introductory course
- repeating the competency assessment at the end of the first year and before the end of the fellowship to assess the acquired competencies and what training needs remain
- agreeing with the fellow and the coordinators on the choice of the optional module
- formulating a specific work plan to facilitate the choice of activities and subsequent training programme evaluation
- regularly reviewing the fellow's progress towards the training objectives
- reviewing the fellow's protocols and any type of oral or written communication
- supervising the development of any project, investigation, evaluation or data analysis the fellow is conducting

For day-to-day supervision the co-supervisor may assist the main supervisor in activities performed by the fellows.

The supervisor and the director of the training institute assume legal responsibility for the work carried out by the fellows. Thus, all activities of the fellows must comply with host country administrative regulations and codes of conduct. The supervisor needs to ensure that all the training objectives are addressed within the two-year period.

The supervisor must immediately notify the EUPHEM coordinator of any significant incidents occurring during the fellowship (in particular absences, sicknesses, accidents, unprofessional behavior, or interruption of the fellowship), which come to his/her attention, or of which the fellow has informed him/her.

Monitoring progress

The EUPHEM /EPIET coordinators monitor and advise on the content and conduct of the local training activities. Their tasks include:

- check the progress of fellow's achievement of learning objectives;
- provide the fellows and trainers with additional methodological support, if needed;
- offer support by reviewing protocols, reports and scientific articles or presentations made by fellows and to monitor their progress.

Incremental progress report

For monitoring and information purposes, fellows are required to regularly update an incremental progress report discussed with the supervisors. The incremental progress report helps to document and monitor the progress of individual fellows in achieving the EUPHEM training objectives and to share this information with other fellows, training supervisors and the programme coordinators. Incremental progress reports may also be used for administrative purposes such as justifying the release of funds for the EUPHEM programme.

The specific objectives of the reports include:

- help training site supervisors and programme coordinators to monitor the progress of each fellow towards achieving the EUPHEM training objectives, and to define future objectives
- inform all EUPHEM training site supervisors of the training activities in other training sites
- provide documentation that may inform internal EUPHEM training site appraisals, and future external evaluation of the programme

The report should reflect the results of regular meetings held between the fellow and the training site supervisor to review the fellow's progress against a detailed set of specific training objectives. The incremental progress report should be updated (1) when a new activity has been started, (2) when a major progress has been achieved or (3) at least every two months. The fellow should send the incremental progress report to all coordinators and his/her training site supervisor.

Mid-term interview

The EUPHEM chief scientific coordinator conducts a mid-term review after the first year of the fellowship followed by a telephone conference or during a site visit with each fellow and his/her supervisor. The mid-term review summarises the achievements of the first year and identifies existing training needs for the second year.

Short site visits to each training site are organised by the programme coordinators every two years or more, if needed. Site visits are intended to support fellows and trainers through a detailed formal appraisal of the local training site. The objectives of the site visits are to review:

- EUPHEM training environment, including logistical and administrative aspects
- Supervision of the fellow on-site and at the programme office level
- Training objectives and outputs for the fellow

Exit interview

The EUPHEM and EPIET coordinators conduct an exit interview with the fellows a few weeks before the end of the scheduled training period. During this interview, the coordinators evaluate whether all training objectives have been achieved and review the training of the last two years. The content of the exit interview is confidential (it may contain sensitive information about site or supervisor) to allow for open feedback about the programme. However coordinators might give some general feedback to the site in an appropriate way to facilitate improvements.

5. Selection

5.1 Selection of fellows

The EUPHEM training is aimed at citizens of EU or EEA countries who meet the following criteria:

- post-secondary education (diploma) in microbiology or a related subject (medicine, veterinary, pharmacology, biomedicine etc.), with at least three years of experience of microbiology (any microbiology disciplines) or
- post-secondary education (diploma) and a PhD degree in microbiology or equivalent (clinical microbiology specialist)
- previous experience in public health and epidemiology is a plus

Fellows are selected from nationals of Member States of the EU and the EEA countries. They are selected based on selection criteria regarding professional and personal characteristics/interpersonal skills defined by ECDC (with advice from the EUPHEM training forum) and included in the call for application. A call for applications advertises the fellowship on the ECDC website. The director of ECDC appoints a EUPHEM selection panel that is chaired by the EUPHEM chief coordinator, and includes an EPIET coordinator, a representative of the current training sites (chair and co-chair of the forum). The EUPHEM chief coordinator is in charge of the selection procedure.

6. Training sites

6.1 Selection criteria for the proposed training sites

- A proven track record of continuous professional development programme, including the ability to deliver high quality training, comparable with international recognised standards.
- A documented track record of addressing the seven major EUPHEM activities during the 24 month training period:
 - management according to the description of the core competency
 - surveillance activities: laboratory surveillance, data analysis, development of new surveillance systems and evaluation of surveillance systems
 - outbreak investigations from a microbiologist's perspective: diagnostic, molecular methods for outbreak investigation etc.
 - plan, develop and conduct a laboratory based research study addressing a wide range of public health issues and perform/facilitate work in a Biosafety Level 3 laboratory
 - conduct quality management and assurance according to EU/international regulations or equivalent;
 - communicate effectively (e.g. presentations, report writing, publications)
 - teaching

See also the learning objectives of the EUPHEM programme (section 2).

In the appraisal of new sites, ECDC will require an overview of publications in the last five years in the areas of interest as mentioned above.

The proposed training sites should have a structured supervisory team and have the time and capacity for training the fellows for a minimum of four hours per week. A local supervision review should be structured to include a formal introduction of the fellows into the host institute, host country language training, participation in internal seminars/workshops, regular monitoring of the fellows' training plan and completion of assignments.

There should be a capacity to propose projects of high scientific quality that have a multi-disciplinary approach relevant for public health. All projects undertaken by EUPHEM fellows must be part of the daily work carried out by the host institutes.

Necessary microbiological infrastructure, facilities and equipment for laboratory training should be compliant with current European biosafety and biosecurity standards, adequate office space, information technology support, and library facilities.

EUPHEM coordinators and training forum select and evaluate the training sites using written and agreed standards. The following criteria apply.

Laboratories should:

- be public health laboratories or laboratories with a demonstrated public health focus (motivation letter together with recent (five years) publications from the institute)
- be located in EU countries and have staff proficient in English
- have expertise in a range of topics covering most of the major infectious-disease related public health themes (sexually transmitted diseases, food- and water-borne diseases, vaccine-preventable diseases, respiratory diseases, emerging diseases and zoonoses, antimicrobial resistance, health-care associated infections)
- have established close links/collaboration with epidemiology groups/training programmes
- have senior supervisor staff with experience in public health microbiology

Requirement for application: potential training sites should provide a motivation for the application as a training site that describes:

- the laboratory and its focus
- possible project proposals
- supervision structure and name of supervisor

Selection procedure

- review of letter of application by ECDC
- site visit (before the start of the training) by ECDC representatives and preferably one representative from the training forum

Bibliography

World Health Organization. WHO International Health regulation 2007. Available at: http://apps.who.int/iris/bitstream/10665/43883/1/9789241580410_eng.pdf and <http://www.who.int/ihr/finalversion9Nov07.pdf> with special focus on areas 2,3,4, and5.

World Health Organization. WHO Biorisk management. 2006. Available at: http://www.who.int/csr/resources/publications/biosafety/WHO_CDS_EPR_2006_6.pdf

World Health Organization. Laboratory biosafety manual. 2004. Available at: <http://apps.who.int/iris/bitstream/10665/42981/1/9241546506.pdf>

World Health Organization. Guidelines for the collection of clinical specimens during field investigation of outbreaks. 2004. Available at: <http://www.who.int/csr/resources/publications/surveillance/whocdscsredc2004.pdf>

World Health Organization, Policy and Procedures of the WHO/NICD microbiology External Quality Assessment Programme Years 1 to 4,2002–2006. Available at: http://apps.who.int/iris/bitstream/10665/69696/1/WHO_CDS_EPR_LYO_2007.3_eng.pdf

European Centre for Disease Prevention and Control. Core competencies for public health epidemiologists working in the area of communicable disease surveillance and response, in the European Union. 2008. Available at: http://ecdc.europa.eu/en/publications/Publications/0801_TED_Core_Competencies_for_Public_Health_Epidemiologists.pdf

Shears P. Public Health Microbiology and Disease Surveillance systems; from Pasteur to Web 2. Sudanese Journal of Public Health. 2010 April 5 (2). Available at: <http://www.sjph.net.sd/files/vol5i1/SJPH-vol5i1-p15-21.pdf>

Biggs, J.B. What the student does: Teaching for quality learning at university. Buckingham: Open University Press. 1999.

Bloom BS. Taxonomy of educational objectives, handbook I: the cognitive domain. New York, NY: David McKay Co Inc.; 1956.

Uppsala University. Biggs, J. Aligning teaching and assessment to curriculum objectives. 2003. Available at: http://www.pu.uu.se/pu-wiki/mediawiki/images/5/5c/Aligning_teaching_and_assessment_to_curriculum_objectives.pdf

Biggs, J.B. Teaching for quality learning at university. Buckingham: The Open University Press. 2003.

The Council of Linkages between Academia and Public Practice. Core Competencies for Public Health Professionals. 2010. Available at: http://www.phf.org/resourcestools/Documents/Core_Competencies_for_Public_Health_Professionals_2010May.pdf

EDUCARE. The Development of Core Competencies at Higher Education: A Suggestion Model for Universities in Indonesia, International Journal for Educational Studies, 3(1) 2010

Columbia School of Nursing Center for Health Policy. Competency-To-Curriculum Toolkit, Association for Prevention Teaching and Research. 2008. Available at: <http://www.asph.org/userfiles/Competency-to-Curriculum-Toolkit08.pdf>

Council on Linkages between Academia and Public Health Practice. Core competencies for public health professionals. Washington, DC: Public Health Foundation; 2010. Available at http://www.phf.org/resourcestools/Pages/Core_Public_Health_Competencies.aspx

Annex 1

Core competencies, main domains, sub-domains and activities of public health microbiology training programme

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
Public health microbiology management and communication	Public health microbiology management	General PHM management	Describe the added value of public health microbiology for public health;
			Apply principles of scientific communication to peers, stakeholders and media/public;
			Identify public health priorities in complex emergency situations;
			Recognise security issues;
			Know the role of different agencies;
			Identify elements of stress management
		Knowledge of planning outbreak responses at national and international level	Identify interdisciplinary needs between health-care professionals and front-line responders
			Implement lessons learned from planned exercises
		Infection control	Plan and implement infection control processes within field studies
		Response to epidemics of severe nature	Identify key elements of social mobilisation
			Identify basic laboratory requirements in the field
		Rapid assessment techniques	Use rapid assessment in the early phase
			Use relevant indicators to monitor intervention
	Team building and negotiation		Be an effective team member, adopting the role needed to contribute constructively to the accomplishment of tasks by the group
			Promote collaborations, partnerships and team building to accomplish public health microbiology programme objectives
			Build up multidisciplinary partnerships to support microbiological investigations
			Mutually identify those interests that are shared, opposed or different with the other party to achieve good collaborations and conflict management
	Ethics and integrity		Respect and adhere to ethical principles regarding human welfare when planning studies, conducting research, and collecting, disseminating and analysing data
			Apply relevant laws to data collection, management, dissemination and use of information
			Adhere to ethical principles regarding data protection and confidentiality regarding any information obtained as part of professional activity
	Laboratory management	Identify and apply best laboratory techniques	Handle conflicts of interests
			Apply appropriate sampling strategies

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
			Apply appropriate laboratory investigations and sampling preparation techniques
		Specimen transportation	Review and report on the international regulations and the role of stakeholders;(i.e. International Air transport Association (IATA), International Civil Aviation Organization (ICAO), customs,) in movement of infectious materials across national borders
			Outline field microbiology needs and design packaging and transportation protocols
		Rapid assessment techniques	Identify methods for detection of pathogen/cause of unusual events
			Design a protocol to gather the laboratory results
	Communication	Written communications	Submit abstracts to a Scientific Conference within applied infectious disease
			Prepare a scientific report/paper
			Write a short article in a microbiology/epidemiological bulletin
			Write a field investigation (outbreak) report
			Write a scientific paper for a peer-reviewed journal (as first author)
			Appraise a scientific article
		Oral communications	Make oral scientific presentation at a national, European or international conference
			Give scientific seminars to different professionals
		Media communications	Communicate with the media; • be involved in the preparation of a press release; • respond to journalists' interview requests (newspaper, radio or TV) if appropriate; • prepare a question and answer briefing (frequently asked questions) document.
Applied microbiology and laboratory investigation	General microbiology	Microbiology knowledge	Outline and describe the role of the laboratory in surveillance, outbreak investigation, applied research
			Understand the principles and practices of bioinformatics and phylogeny;
			Define the type of analysis depending on the study design.
			Establish criteria for microbiological input and evaluation
			Establish microbiological criteria and assessment Design and conduct laboratory investigations in accordance with the documented 'risk assessments'.

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
		Data collection	Create a data entry scheme;
			Record using appropriate information technology support.
		Analyse the data	Identify and use appropriate analytical and statistical techniques.
	Laboratory investigation	Conduct an investigation	Undertake a laboratory investigation in a public health setting including the following steps: • Knowledge of principles; • development of a microbiological case definition; • sampling strategies; • laboratory techniques; • incident team coordination; • environmental procedures; • environmental contacts.
		Engage in interaction between different disciplines	Identify needs and objectives of clinicians, laboratory, veterinary and environmental agencies in the public and private sector;
			Give advice in pre-sampling, sampling, analysis, reporting, documentation, feedback.
		Specimen collection	Define a sampling strategy including number of needed specimens;
			Collect, label, package and transport samples appropriately and safely.
		Specimen transportation	Review and report on the international regulations and the role of stakeholders (i.e. IATA, IACO, customs,) in movement of infectious materials across national borders;
			Outline field microbiology needs and design packaging and transportation protocols
	Laboratory methods and analysis	Knowledge of phylogenetics	Understand principles of multiple alignment;
			Construct and interpret of a simple multiple alignment;
			Conduct phylogenetic analyses techniques;
			Create and query a local basic local alignment search tool (BLAST) database;
			Evaluate the software and troubleshoot.
		Sequencing technologies and non-sequencing typing methodology	
			Prepare and run of automated sequencing systems
			Design and interpret variable number tandem repeat (VNTR) assay
			Run Pulse Field Gel Electrophoresis
			Evaluate the software and troubleshoot
			Produce and interpret data
			Run serological methods

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
		Database systems	Retrieve sequence
			Manage simple sequence entry;
			Create a database using different software;
			Trace data from automated sequencers
			Edit sequences by using editing programs (e.g. Bioedit)
			Analyse sequences by using sequence databases.
		Laboratory methods	Identify key laboratory investigations relevant to selected symptoms and/or suspected pathogens
			Identify situations where genetic typing methods should be used
			Perform evaluation studies of diagnostic test accuracy (sensitivity, specificity, positive and negative predictive value)
		Establish the criteria for microbiological input to epidemiological investigations	Collaborate with epidemiologist to established criteria for microbiological input
Epidemiological investigations: Surveillance and outbreak investigation	Surveillance	New surveillance system	Obtain support for the surveillance system from the individuals who will be responsible for ensuring that the system is implemented
			Develop a case report form and obtain clearance from appropriate individuals or offices
			Design the surveillance system (public health importance, action/intervention available, objectives of the system, case definition, indicators, data collection, source of information, transmission of information, software and hardware, data analysis, feedback procedures, recipients, use of information)
			Conduct a pilot study if necessary
			Supervise data collection and collation
			Analyse the data, selecting appropriate methods
			Provide the results of the analysis to appropriate individuals choosing the appropriate mode of communication
			indicate the need for prevention or control measures, or further investigation, make appropriate recommendations; If the findings of the surveillance system indicates
			Develop a framework to evaluate the surveillance system using standard criteria

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
		Day-to-day surveillance activities	Check incoming surveillance reports for plausibility and collection of missing information
			Conduct regular data analysis of surveillance data
			Interpret current trends in the surveillance data and develop corresponding recommendations
			Participate in regular feedback of surveillance data to stakeholders
			Write a scientific report using the analysed data
		Evaluation of an existing surveillance system	Describe the public health importance of the health event, and the public health strategy
			Describe the system: - list the objectives; - describe the health event; - state the case definition; - draw a flow chart of the system; - describe the components and operational modes of the system; - assess usefulness by indicating action taken as a result of the data from the surveillance system
			Evaluate the system for each of the following criteria: simplicity, flexibility, acceptability, sensitivity, positive predictive value, representativeness, timeliness
			Describe the resources used to operate the system
			List conclusions and recommendations
			Identify areas for improvement and their feasibility
			Provide stakeholders and other appropriate individuals with written recommendations for improving or discontinuing the surveillance system
			Assist with implementing improvements to the existing surveillance system if requested
	Outbreak investigations	Classical approach to outbreak investigation	Obtain preliminary information
			Describe public health problem, how it was discovered
			Gather epidemiological information

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
			Address nature and urgency of the problem
			Plan for future action;
			Establish what level of control or investigation is necessary
			Make a site visit if requested and agreed
			Take part in the establishment of the outbreak control team
			Conduct an on-site investigation
			Confirm the outbreak, diagnosis, case definition
			Count cases and orient the data according to time, place and person characteristics
			Develop a hypothesis compatible with descriptive data and with the suspected source and the vehicle
			Test hypothesis, verify biological plausibility and compatibility of epidemiological results with other information
			Develop recommendations for preventive and control measures, verify that control measures are effective
			Write a report and communicate results and recommendations. If appropriate, write a scientific article
Biorisk management	Biosafety	national biosafety guidelines	apply the principles and practices of biosafety according to those outlined by WHO & EU directives
		personal protective equipment (PPE)	describe variation and efficacy of PPE strategies
			assess and experience different PPE systems
			apply the concepts of 'Operational protection factors' (OPF)
		contamination and waste control strategies	Understand the principles and practices regarding decontamination processes associated with infection control, equipment decontamination etc
			Plan and produce decontamination and waste disposal protocols
		safety level3 (BSL) and BSL4 biorisk management	Understand processes associated with BSL3 and BSL4 laboratories
			Plan and produce decontamination in BSL3 and / or BSL4 laboratories
	Biosecurity	Laboratory biosecurity	Understand principles of biosecurity
			Follow WHO & EU laboratory biosecurity guidance

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
Quality management	Laboratory quality management	External quality assessment (EQA)	Describe efficacy of quality assurance
			Assess and experience different standards
			Apply the concepts of EQA
			Perform, evaluate or analyse results of an EQA
		Preparing an external quality assessment	Collect set of isolates/specimens for EQA
			Write protocols;
			Identify related ISO standards
		Collecting Data	Design template for collecting data;
			Integrate collected data
			Interpret integrated data
		Preparing a report	Create tables and figures
			Draft the EQA report
			Make conclusions and recommendations
		Reviewing international quality guidelines/standards	Understand the principles and practices of quality assurance according to those outlined by international and EU directives
		Internal quality control	Control within a laboratory setting, different factors influence the quality of results including • Selection of suitable techniques; • Maintenance of an up-to-date manual of standard operational procedures; • Use of reliable reagents and reference materials; • Selection of suitable automation and adequate maintenance; • Maintain adequate records; • Reporting system for results
	Accreditation	Audit	Understand and apply local and European accreditation procedures.
			Contribute to audit of the accreditation
Applied public health microbiology research	Theoretical methods	Study design	Identify a problem of public health importance
			Review literature
			Identify and write study question and the hypothesis to be tested
		Study protocol/ relevant questions	Design the study
			Identify critical questions
			Design protocols
			Exercise realistic timelines

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
			Identify limitations
			Evaluate possible risks and delays
	Empirical methods	Method identification	Identify relevant methods by literature review/discussion with supervisors and colleagues to: • choose appropriate methodology, • develop a plan of analysis, • write a detailed protocol
		Knowledge and skills of relevant methods	Identify usefulness of the methods in a particular research study
			Apply relevant laboratory methods implement new methods in a study
		Applying for financial support if necessary	Design and write an application
		Constitute and briefing the study team	Inform the team on ethical procedures and requirements, obtain ethical approval;
		Drafting results	Collect and analyse data
			Interpret the results;
			Disseminate and communicate the information
			write a scientific report and/or a scientific article
Teaching and pedagogical skills	Teaching	Giving lectures	Give lectures (with discussion, etc.)
			Communication and training for a range of health-care professionals;
			Assess own performance through feedback assessments
			Re-evaluate delivery and content
		Moderating case studies	Moderate a case study
			Guide participants to the answer
			Explain epidemiological/microbiological/clinical concepts surrounding a disease or an outbreak
	Pedagogical Skills	Planning and organising a course	Outline learning outcomes, describe core competences
			Develop curriculum

Title of the core competency	Main domains of core competency	Sub-domains	Performance (activities)
			Identify teaching and assessment methodologies
			Adopt training tools
			Develop a reflective learning strategy
			Create an assessment survey
			Use interactive teaching and learning methods such as • problem based learning (PBL), case studies, panel of experts, cooperative learning, manage adult groups • design case studies • prepare presentations
		Giving or directing a seminar	Deliver a seminar to multidisciplinary audience
			Record reflective learning