



ECDC Fellowship Programme

Public Health Training Section

Core competencies for training of public health microbiologists

For use by fellows, coordinators, and training site supervisors

EUPHEM

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1 Background: 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.

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.

The list of core competencies is intended to be used as a reference document for training EUPHEM but can be used by any training programme related to PHM. It will be updated periodically by EUPHEM forum and in collaboration with the potential users (NMFPs, training programmes, etc). The list is not exhaustive. They should also be an important tool during the assessments done in the country visits, to identify areas of work or expertise that should be strengthened.

Important uses include:

- Evaluation of training needs: for recruitment and 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;
- Potential users are not only public health institutes and training programmes, but also individual professionals and trainees;

In order to cover the scope of EUPHEM, seven core competencies were agreed together with the EUPHEM forum and discussion with NMFPs in November 2011 and was endorsed from September 2012.

2 Main domains and activities of Public Health Microbiology Core Competencies in EUPHEM training

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 skill/s and abilities which allows the function of the competency. Sub-domains are set of activities within a particular domain which allows the function of the domain. Activities are performance which leads to skills, abilities or competencies.

Core competencies listed in this document are defined for mid-career and above professionals. 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. As a baseline the term 'core' indicates that the competencies should be a minimum

pre-requisite for all public health microbiologists, regardless of the administrative level (international, national, sub-national, local, etc) he/she occupies in the public health system. They should be common to all professionals in this field.

Mid-career is defined as at least three years of 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 in order to facilitate the process.

2.1 Core competencies in the public health microbiology training programme:

1. Public health microbiology management and communication
2. Applied microbiology and laboratory investigations
3. Epidemiological investigations (surveillance and outbreak investigation)
4. Biorisk management
5. Quality management
6. Applied public health microbiology research
7. Teaching and pedagogy

The core competencies in this document are composed of crosscutting 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 independently (intermediate).

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

2.1.1 Public Health Microbiology Management and Communication

Public health microbiology management is defined as the capacity to identify and prevent/control threats to the health of the public caused by microorganisms or their products (e.g. toxins), and to construct evidence for 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 is aimed at training the fellow at different and distinct management levels as outlined below:

Public health management

General

- 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;
- Develop community partnerships to support epidemiological and 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 issues

- Integrate with the ethical rules related to their work;
- Adhere to 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 skills

Communication skills here include diverse levels of communications (national and international). Communication of public health microbiology information is a crucial task for appropriate public health action. During the two-year programme, EUPHEM fellows should:

- Submit abstracts to the European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) conference or similar international conferences;
- Prepare a scientific report/paper (one or more of the following):
 - Field investigation (outbreak);
 - Short article/s in microbiology/epidemiological bulletin/ journal;
 - Scientific paper for a peer-reviewed journal (as first author);
 - Make scientific oral and poster presentation at an international conference;
 - Appraise a scientific abstract/article;

Other optional activities include:

- 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.

2.1.2 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 the criteria for microbiological input and evaluation;

Establish microbiological criteria and assessment;

- Design and conduct laboratory investigations in accordance with the documented 'risk assessments;'

Collect data

- Create a data entry scheme;
- Record using appropriate IT 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 principle/s:
 - 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

Fellows are expected to learn different laboratory methods and analysis. The list below offers some examples but is not comprehensive.

Knowledge of phylogenetics

- understand principles of multiple alignment;
- Construct and interpret of a simple multiple alignment;

- Phylogenetic analyses techniques;
- Create and query a local basic local alignment search tool (BLAST) database;
- Evaluate the software and troubleshooting;

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;
- Run serological methods;
- Evaluate the software and handle troubleshooting;
- 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 in order to gather data necessary for understanding the epidemiology of communicable diseases. Fellows are expected to identify criteria for input of microbiological data and supply this data to epidemiological investigations.

2.1.3 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 systems activities, or evaluate surveillance systems. Outbreak investigations represent one of the most stimulating and also challenging activities. Time constraints, media attention, and the need for adequate methodology place the professionals under pressure when the need for rapid action conflicts with the need for accurate and valid investigation and results.

Surveillance

Design and implement, analyse or evaluate a surveillance system

The pedagogical objective of this activity is to acquire competencies in the planning and implementation process of a new system or/and managing data analysis or evaluation of a disease surveillance system.

New 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;
- If the findings of the surveillance system indicate the need for prevention or control measures, or further investigation, make appropriate recommendations;

- Develop a framework to evaluate the surveillance system using standard criteria;

Day-to-day surveillance activities

- Check incoming surveillance reports for acceptability 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;
- Make appropriate recommendations for the improvement of the surveillance system (such as new questionnaires) If the findings of the surveillance system indicate the need for prevention or control measures, or further investigation;

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;
- identify areas for improvement and their feasibility;
- Provide a written recommendations for improving or discontinuing the surveillance system;
- Assist with implementing improvements to the existing surveillance system;

Outbreak investigations

The training objectives are to gain knowledge and skills of the administrative, managerial, operational and methodological aspects of outbreak investigations. The following classical approach (ten steps) to outbreak investigation can be used as a guide and a basis for evaluating the acquisition of skills in outbreak investigation for PH microbiologists:

- Obtain preliminary information:
- Describe public health problem, how it was discovered;
- Gather epidemiological information;
- Address nature of problem and urgency of it;
- 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;
- Construct or 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

2.1.4 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

- Review international 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)
- 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 & EU and national directives.

2.1.5. 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 the patients, the health-care system and consequently for the health of the public. To ensure reliability, reproducibility and relevance of laboratory test results, quality management programmes are essential.

External quality assessment (EQA) and internal quality control (IQC) are complimentary components of a laboratory quality management programme. EQA is used to identify the degree of concurrence between one laboratory's results with established reference results or/and those obtained by other centres. IQC 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.

The EUPHEM programme will train the fellows to learn and apply standards in their daily work, participate in quality assurance activities, and if necessary, develop guidelines.

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;

Review international quality guidelines/standards

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

Internal quality control

Contribute to audit

Within a laboratory setting, the quality of results is influenced by different factors. Fellows are expected to contribute when appropriate to the audit of laboratory procedures as outlined below:

- Appropriate specimen collection and handling;
- Selection of suitable techniques and 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;
- Adequate records;
- Reporting system for results;

Accreditation Procedure

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

2.1.6 Applied Public Health Microbiology Research

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

This should enable fellows to relate microbiology to public health. The pedagogical objective of this activity is to acquire the skills necessary to plan, conduct and analyse a public health microbiology study and to interpret and communicate its results.

The research project is chosen in collaboration with the training institute supervisor and should be part of the usual work carried out by the training institute. It should be necessary and useful for the training institute, and not merely an academic exercise.

It is recommended that fellows participate in all stages of the research project -- from planning to write a scientific paper -- as this offers the best opportunity to acquire public health research competency. Although this may not always be possible within two years, the fellow should attempt to contribute to as many stages as possible:

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;

Method identification

- Identify relevant methods by literature review/discussion with supervisors and colleagues
 - 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;

Seek financial support if necessary

- Design and write an application;

Conduct a pilot study and, if necessary, make modifications

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;

All reports in the public domain are disseminated to the different training institutes and electronic copies stored in the ECDC virtual academy. They are an important way of demonstrating the achievements of the programme. If the findings are judged to be of sufficient importance to the public health or the scientific community, a paper should be prepared for publication in a medical/biomedical journal.

2.1.7 Teaching and Pedagogical Skills

Teaching is one of the most effective ways to transfer competencies. By training the fellows to teach, they perform different activities that help them to improve their ability to communicate with a professional audience and learn current concepts of teaching and learning at a higher level in the same time that cascade their competencies. 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.

During the two-year programme, fellows should participate in the teaching of public health microbiology both at teaching institutions and in the field.

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

Give lectures

- Give lectures (with discussion, etc.);
- Communicate and train a range of health-care professionals;
- Define learning objectives;
- Assess own performance through feedback assessments;
- Re-evaluate delivery and content;

Moderate case studies

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

Plan and organise 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;

Pedagogical teaching

- Use interactive teaching and learning methods such as:

- problem based learning (PBL), case studies, panel of experts, cooperative learning, brainstorming, etc.;
- manage adult groups;
- design case studies;
- prepare presentations;

Give and direct a seminar

- Deliver a seminar to multidisciplinary audience;