EUPHEM

EUPHEM REPORT

Summary of work activities

Orla Condell

European Public Health Microbiology Training Programme (EUPHEM), 2013 cohort

Background

According to the European Centre for Disease Prevention and Control (ECDC) Advisory Group on Public Health Microbiology ('national microbiology focal points'), public health microbiology is a cross-cutting area that spans the fields of human, animal, food, water, and environmental microbiology, with a focus on human population health and disease. Its primary function is to improve health in collaboration with other public health disciplines, in particular epidemiology. Public health microbiology laboratories play a central role in detection, monitoring, outbreak response and the provision of scientific evidence to prevent and control infectious diseases.

European preparedness for responding to new infectious disease threats requires a sustainable infrastructure capable of detecting, diagnosing, and controlling infectious disease problems, including the design of control strategies for the prevention and treatment of infections. A broad range of expertise, particularly in the fields of epidemiology and public health microbiology, is necessary to fulfil these requirements. Public health microbiology is required to provide access to experts in all relevant communicable diseases at the regional, national and international level in order to mount rapid responses to emerging health threats, plan appropriate prevention strategies, assess existing prevention disciplines, develop microbiological guidelines, evaluate/produce new diagnostic tools, arbitrate on risks from microbes or their products and provide pertinent information to policy makers related from a microbiological perspective.

According to Articles 5 and 9 of ECDC's founding regulation (EC No 851/2004) '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'.

Moreover, Article 47 of the Lisbon Treaty states that 'Member States shall, within the framework of a joint programme, encourage the exchange of young workers.' Therefore, ECDC initiated the two-year EUPHEM training programme in 2008. EUPHEM is closely linked to the European Programme for Intervention Epidemiology Training (EPIET). Both EUPHEM and EPIET are considered 'specialist pathways' of the two-year ECDC fellowship programme for applied disease prevention and control.

Stockholm, September 2015

This report summarises the work activities undertaken by Orla Condell, cohort 2013 of the European Public Health Microbiology Training Programme (EUPHEM) at Statens Serum Institut (SSI), Copenhagen, Denmark.

All EUPHEM activities aim to address different aspects of public health microbiology and underline the various roles of public health laboratory scientists within public health systems. Orla Condell is a microbiologist from Ireland. Prior to EUPHEM she was working as a post-doctoral researcher at the Centre for Food Safety, University College Dublin, studying the emergence of biocide tolerance and the development of antimicrobial resistance along the food chain.

Methods

This report accompanies a portfolio demonstrating the competencies acquired during the EUPHEM fellowship by participating in specific projects, activities and theoretical training modules.

Specific projects included epidemiological investigations (outbreaks and surveillance); applied public health research; applied public health microbiology and laboratory investigation; biorisk management; quality management; teaching and public health microbiology management; summarising and communicating scientific evidence and activities with a specific microbiological focus.

The outcomes include publications, presentations, posters, reports and teaching materials prepared by the fellow. The portfolio presents a summary of all work activities conducted by the fellow, unless prohibited for reasons of confidentiality.

Results

The objectives of these core competency domains were achieved partly through project/activity work and partly through participation in the modules. Results are presented in accordance with the EUPHEM core competencies, as set out in the EUPHEM scientific guide[1].

1. Epidemiological investigations

1.1. Outbreak investigations

Ebola Viral Disease, West Africa 2014

Supervisors: Aftab Jasir

Following a request for assistance in July 2014 for the Ebola outbreak in West-Africa, the fellow was deployed to Monrovia, Liberia in August 2014 together with a German FETP. The fellow had several tasks relating to outbreak investigation and data analysis. It was clear on arrival in Montserrado County that the sources and methods of data collection, merging, reporting, storage and analysis were not completely clear. The fellow was assigned to Montserrado County together with a German FETP fellow, and later to the national epi-surveillance teams to clarify these issues. Through field visits fellows were asked to determine the sources, flow and dissemination of data collection in Montserrado County. They were later requested by the Ministry of Health and Social Welfare to produce an epidemiological description of the EVD outbreak in Liberia; case counts and a description of the outbreak in terms of time, place and person. The fellow also participated in field visits to several Ebola diagnostic laboratories and assisted in entering laboratory results for cases into the national database. The fellow also contributed to training the data entry staff on how to interoperate such results. Assistance was also provided in the preparation of reports and presentations for the Ministry of Health. Fellows produced World Health Organization (WHO) daily and weekly epidemiological descriptions of the outbreak for internal WHO dissemination. This included identifying infection hotspots, to guide the social mobilisation and infection control teams with resource allocation and improvement of data quality, and preparing data cleaning scripts and SOPs. At the end of the mission ECDC asked the fellows to debrief the EU delegation in Monrovia on their work and the status of the outbreak.

Modules

The EPIET/EUPHEM introductory course trained participants in the principles, techniques and logistical aspects of outbreak investigations. This course familiarised participants with the ten steps of an outbreak investigation, the principles of intervention epidemiology and the function and importance of public health microbiology. The module 'Computer tools in outbreak investigations' taught participants how to apply this knowledge in practice using various software packages. Fellows were taught essential data management skills including data entry, validation

[1] http://ecdc.europa.eu/en/publications/Publications/microbiology-public-health-training-programme.pdf

and cleaning as well as dataset management. They were also given practical training in how to perform analytical studies for an outbreak investigation, including descriptive, cohort and case control studies and stratified analyses.

Educational outcome: Member of an outbreak team in a complex emergency situation, participation in a multidisciplinary-outbreak team, participation in outbreak meetings, field visits, teleconferences and interagency cooperation. Interoperation of laboratory results and epidemiological data, preparation of reports and presentations and provision of recommendations.

1.2. Surveillance

A. Surveillance of blood- and tissue-dwelling parasites in Denmark, semi-national data from an eight-year period, 2005–2012

Supervisor: Henrik Vedel Nielsen

Blood- and tissue-dwelling parasites cause diseases which have a significant effect on public health. The project consolidated data on the number of people tested and positively identified as having an infection with blood- or tissue-dwelling parasites over an eight-year period, namely *Plasmodium*, *Schistosoma*, *Leishmania*, *Trypanosoma*, *Echinococcus* and *Taenia*. An epidemiological description of all those tested positive was carried out and trends over time were analysed and compared to the preceding time period. The results of this study indicated that the levels of blood parasite exposure in the population remained low in all regions of Denmark and that there was no deviation from trends seen prior to 2005. Data from this study will be used to provide feedback to medical professionals with regard to the occurrence of blood- and tissue-dwelling parasitic diseases in Denmark. The fellow contributed to data cleaning, data analysis, and communication of the results (report) to the relevant stakeholders.

B. Assessment and evaluation of the laboratory surveillance system for enteroviruses in Denmark

Supervisors: Sofie Midgley, Thea Kølsen Fischer

The current armed conflict in Syria has left many children unvaccinated. The refugee influx to European Union Member States calls for increased awareness in order to detect and respond to poliovirus-transmission in a timely manner. This study aimed to evaluate the enterovirus (EV) laboratory surveillance system in Denmark based on cultivation, typing and sequencing of clinical samples, and to generate recommendations on how to strengthen the system.

The surveillance system was analysed for completeness of human EV-positive clinical samples submitted for characterisation, from primary diagnostic laboratories to the National WHO Poliovirus Reference Laboratory (NRL) and completeness of the detailed clinical information collected. The timeliness of specimen collection, laboratory results and reporting of clinical information was also assessed. Stakeholder interviews were conducted to map the laboratory data reporting structure for Denmark. Of 23 720 specimens screened, 2 202 were EV-positive. Submission of cerebral spinal fluid and stool specimens from primary diagnostic laboratories to the NRL was 79.5% complete (845/1 063), and varied by patient age (p-value <0.001) and the laboratory of primary diagnostics (p-value <0.001); completeness by laboratory varied from 44 to 94%. EV sub-types were successfully determined in 68.5% (979/1 430) of cases, and clinical information available for 63.1% (903/1 430). Primary diagnostic results were available after a median of 1.4 days, typing results after 17 days, and detailed clinical information, collected using a paper-based system, after a median of 33 days. The large number of samples tested for EV demonstrated the monitoring of EV-infections diagnosed in Denmark over the test period. The system could be improved in several ways: increasing participation of primary diagnostic laboratories, improving laboratory typing-methodology to reduce the number of non-typeable enteroviruses (representativeness) and reporting clinical information electronically (timeliness). National guidelines will be updated to address these issues. The fellow evaluated the surveillance system, communicated the results to regional laboratories and authorities and formulated a recommendation for improving the surveillance system.

C. Inventory of national surveillance system for food-and-waterborne parasitic diseases in the EU/EEA

Supervisors: Lara Tavoshi, Polya Rosin, Johanna Takkinen, Aftab Jasir

The objectives for ECDC's Food- and Waterborne Diseases (FWD) programme included carrying out surveillance of FWD at the European level in order to promote early detection and enhance control of multinational foodborne outbreaks; facilitating investigation and/or coordination of cross-border clusters/outbreaks and strengthening public health microbiology capacity for FWD. The surveillance of food- and waterborne parasitic diseases at the EU level is particularly variable, subject to apparent gross under-ascertainment and non-reporting. This results in EU-level surveillance being of limited use for communicable disease prevention and environmental health policy, both at the EU and Member State level. The reasons for these limitations are not known for all Member States and neither are their priorities in the field of food- and waterborne parasitic diseases. The ECDC project was conducted

in collaboration with the EUPHEM fellow at ISCIII and experts from the Member States. The aim was to understand existing challenges to food- and waterborne parasitic disease surveillance data in order to identify areas for improvement, including possible revision of the ECDC food- and waterborne parasitic disease programme, case definitions and variables for data collection at EU-level.

A questionnaire was administered to all Member States in order to evaluate perceived barriers to reporting of food- and waterborne parasitic diseases at the national level and European level and laboratory practices for diagnosis and identification of food- and waterborne parasitic diseases were also assessed. Finally, the questionnaire assessed Member States' perceived priorities with regard to food- and waterborne parasitic diseases. The results of this study highlighted a number of factors perceived as being associated with under-ascertainment and reporting at the national level, in particular clinician awareness and issues concerning primary diagnostics. In addition, factors associated with under-reporting at EU level were clear from the results. There was no mandatory reporting at national level, TESSy variables were not a component of the national surveillance system and there were staff and organisational issues. The questionnaires also confirmed that laboratory practices vary throughout the EU and there is scope for improving quality assurance with regard to food- and waterborne parasitic diseases in the EU. These facts may limit the interoperation of laboratory data at EU level and highlight the need to understand the characteristics of laboratory practices in order to assure the validity of data for public health action. Finally, it also became apparent that the parasites perceived by the Member States as being highest priority are those coming under the EU mandate for surveillance. From this work a number of recommendations and areas of improvement for FWPD became clear, resulting in a number of actions for ECDC to strengthen surveillance in this area. These include a recommendation to organise or support EQA schemes currently not available for certain parasites; revision of the surveillance objectives and variables for reporting in TESSy for these parasites at EU-level and advice to Member States on the need to train clinicians in relation to food- and waterborne parasitic diseases. The results of this study will be shared with the EU Member States in an ECDC report. The fellow played a leading role in designing the questionnaire, collating and analysing the data, participating in Member State expert consultations and summarising the conclusions.

D. Modules

The EPIET/EUPHEM introductory course familiarised participants with many aspects and concepts associated with surveillance, including the principles of surveillance and how to develop, validate, evaluate and operate a surveillance system. In addition to this course, the Vaccinology module taught participants how to approach the surveillance of vaccine-preventable diseases, including the surveillance of vaccine coverage and efficacy. The rapid assessment module introduced techniques for surveillance in complex emergencies, including morbidity and mortality surveys.

Educational outcome: Participation in disease-specific networks at the European level; analysis of national and European level surveillance systems; questionnaire design; evaluation of a laboratory-based surveillance system; understanding the challenges and limitations; authorities and responsibilities of those involved in surveillance; formulation of specific public health recommendations; presentation of results and writing of scientific articles.

2. Applied public health microbiology research

A. HAIBA: Validation and refinement of case definitions for the surveillance of urinary tract infections

Supervisors: Sophie Gubbels, Kåre Mølbak, Brian Kristiansen, Robert Skov

Approximately 8–10% of all hospitalised patients in Denmark acquire an infection that requires treatment while in the hospital. The Hospital Acquired Infections Database (HAIBA) is an automated surveillance system for monitoring five of the most common hospital-acquired infections (HAIs) in Denmark, including urinary tract infections (UTIs). The purpose of HAIBA is to detect and monitor HAIs in Denmark and to improve the evidence base for reducing the incidence of preventable HAIs. This study outlines the case definitions for HA-UTI and describes the surveillance data from 2010 to 2014. Secondly, this study compares a sub-set of the surveillance data to two Point Prevalent Surveys (PPS) in order to evaluate the performance of the HAIBA case definitions relative to the current method for monitoring HA-UTI and identify any discrepancies between them.

The UTI algorithm begins with the submission of a urine culture ≥48 h before admission and <48 h post-discharge, then including criteria for a laboratory-diagnosed algorithm (a urine culture positive for no more than two organisms with at least one at $\geq 10^4$ CFU/ml) and a probable algorithm with a relevant diagnosis code or antibiotic treatment. Incidence of HA-UTI was calculated as the number of cases over the number of risk days. For validation, prevalence was calculated for each day and compared to PPS data. HAIBA detected an incidence rate of 43.0 laboratory diagnosed HA-UTI, per 10 000 risk days, with an increasing trend noted. Compared to the PPS, the laboratory-diagnosed algorithm had a sensitivity of 72.9% (35/48) and specificity of 97.7% (2016/2063) and the probable and laboratory-diagnosed algorithms together had a sensitivity of 75.0% (36/48) and specificity of 96.5%

(1991/2063). HAIBA detected cases for which laboratory results were unavailable during the survey, but did not detect cases without a laboratory confirmed results. Currently HAIBA cannot reliably detect whether cases have an indwelling catheter, which is a limitation of the system. However, in the future urine samples could be coded to differentiate urine from an indwelling catheter. HAIBA HA-UTI algorithms were found to be valid, sensitive and specific compared to PPV. They have numerous advantages in that they cover the whole population and allow continuous standardised monitoring of HA-UTI. The fellow's role was to perform the study, communicate the results to the regional laboratories and authorities and summarise the outcome.

B. Modules

The EPIET/EUPHEM introductory course included training on how to develop a study protocol and taught strategies for the presentation of results and the writing of a manuscript. The module 'Initial management in public health microbiology' focussed on other aspects of research, including time and stress management, communication and team work.

Educational outcome: Preparation of a study protocol, management, analysis and interoperation of data, working with a large dataset, gaining expertise on data analysis with STATA, writing of scientific articles, scientific presentation at a conference, adherence to ethical principles.

3. Applied public health microbiology and laboratory investigations

A. Optimisation and comparison of Sanger and Illumina MySeq methodologies for the whole-genome characterisation of influenza

Supervisors: Ramona Trebbien, Thea Kølsen Fischer

The molecular surveillance of circulating influenza subtypes is critical for monitoring flu season activity and viral evolution in order to inform the production of annual flu vaccines. Whole genome sequencing can be used as a component of the influenza surveillance system and is advantageous over other typing techniques as it provides comprehensive information on the relatedness between viruses and genetic variation over time. Whole genome sequencing therefore can better our understanding of viral evolution and the emergence of new strains as well as improving accuracy in the design of preventive vaccines. The genetic surveillance of influenza A virus has typically been carried out by Sager sequencing. Alternatively, a next-generation sequencing approach could be used, which would give the added advantage of allowing the determination of genetic variation within patient samples and a quicker detection of variants. This study compared the two sequencing approaches with regard to influenza typing.

Primers were designed for multiple overlapping fragments of each of the eight segments of the influenza genome; general primers for PB1, PB2, PA, NP, M and NS segments and HA and NA specific for H1N1 and H3N2. PCRs were set-up and optimised. PCR products were validated with both a Sanger and next-generation (Illumina MySeq) approach. The whole genome of four clinical Influenza A isolates could be assembled by overlapping multiple fragments from each of the eight viral genome segments, from both Sanger and MiSeq sequencing methodologies.

From the same PCR product samples, the MiSeq approach resulted in a much higher coverage and quality of sequence data than the Sanger technique. Sequence data could be obtained from samples with a lower concentration of PCR product with the MiSeq method. Based on this work a recommendation was made to use a next generation sequencing approach for influenza A genetic surveillance in Denmark. This approach has an added public health value over the Sanger system; revealing genetic variation among different virus particles in the same sample, allowing for better monitoring of viral evolution in the host and detection of even low-abundance drug resistance mutations.

This technique will be used for the surveillance influenza A in Denmark; to monitor the circulation and evolution as well as vaccine effectiveness and resistance to antiviral drugs. The role of the fellow was to conduct the laboratory work, analyse data and communicate results.

B. Development and validation of a sero-diagnostic test for *Mycoplasma genitalium*

Supervisor: Jørgen Skov Jensen

M. genitalium is an emerging pathogen, first identified in the 1980s. It is thought to have a prevalence in the general population between that of *Chlamydia trachomatis* and *Neisseria gonorrhoeae*: causing approximately 20% of non-nongonococcal urethritis and approximately 30% of recurrent or persistent urethritis. *Mycoplasma genitalium* is a sexually-transmitted infection that causes urethritis in men and urethritis, cervicitis and infections of the upper genital tract in women. A serological test would be a valuable tool in investigating the long-term effects

of *M. genitalium*. However, the close relation between *M. genitalium* and *M. pneumoniae* hampers the specificity of such assays due to cross-reactivity between the two species.

An immunogenic protein encoded by the *M. genitalium* gene *mg075* has recently been identified and preliminary studies have indicated Mg075 as immunogenic, without any cross reactivity with the *M. pneumoniae* homologue. However, work to-date has demonstrated that recombinant Mg075 forms inclusion bodies in *E. coli* expression vectors and this precludes an efficient assay design, preferably in an ELISA format. This project investigated the potential for the development of a serological assay from smaller, epitope-containing and soluble fragments of the Mg075 protein.

Six overlapping fragments of the *mg075* gene were amplified and cloned into a vector system and propagated. The plasmid was isolated and transformed into an expression *E. coli* system. The protein was extracted, solubilised and purified using a His-tag and anion exchange methodologies. Five of the six fragments could be expressed and purified. Analysis of all five fragments on western blot gave a strong reaction for sera from patients with documented *M. genitalium* infections. All fragments also gave a reaction with sera from patients with documented *M. pneumonia infections,* however for two of these fragments the reaction with the *M. pneumonia* patient sera was weaker. These fragments show great potential for the development of a *M. genitalum* serodiagnostic test and development of an in-house ELISA with these fragments is currently underway. The prevalence of *M. genitalium* in the population and its association with sequelae, including tubal factor infertility and ectopic pregnancy is not definitively determined. In addition, the link between *M. genitalium* and salpingitis, epididymitis, prostatitis and sexually-acquired arthritis has not been firmly established. The development of a serodiagnostic test would be a valuable tool in investigating *M. genitalium* infection and its consequences and would provide a better understanding of this emerging pathogen. The fellow conducted all stages of the research project; designing, planning, conducting the laboratory work and analysing the results.

Educational outcome: Application of virology, bacteriology, and immunology concepts to the discipline of public health discipline; understanding the use and limitations of diagnostic and typing methods and their interpretation; familiarity with bioinformatics software and techniques; development and assessment of laboratory methods to improve surveillance procedures; application of national rules and regulations regarding biosafety and biosecurity

4. Biorisk management

A. Biosafety for genetically modified organisms

Training was completed for laboratory work in biorisk class II laboratories for genetically modified organisms. All work on genetically modified organisms was carried out in this laboratory following SOPs and waste management procedures for dealing with genetically-modified microorganisms.

B. Ebola Viral Disease mission

Appropriate biosafety measures were followed during the mission to Liberia. Proper hygiene, PPE (gloves), sanitisation techniques and social distancing were conducted during all field visits, including case investigations and visits to Ebola treatment units.

C. Biorisk management module, ECDC, Sweden

A five-day module focusing on biorisk/biosafety assessment and mitigation was completed. The module included WHO recommendations on biosafety management in laboratories and international regulations for the transportation of dangerous goods, as determined by ICAO (International Civil Aviation Organization).

Educational outcome: Understanding the processes associated with BSL2/BSL3/BSL4 laboratories, gaining experience of different types of personal protective equipment, understanding and applying the principles and practices of biorisk management; biorisk assessment and biorisk mitigation.

5. Quality management

A. Sixth external quality assessment scheme for typing of verocytotoxin-producing *Escherichia coli* (VTEC)

Supervisors: Susanne Schjørring, Flemming Schutz

For the past 10 years, annual EQA rounds for the national reference laboratories in the EU/EEA and non-EU countries on serotyping and virulence typing for VTEC have been administered by WHO's Collaborating Centre for Reference and Research on Escherichia and Klebsiella at Denmark's Statens Serum Institut. For EU/EEA countries this is an ECDC-funded project. The project included self-funded countries and involved the administration,

evaluation and reporting of results for the 2014–2015 VTEC EQA. The EQA was be conducted according to the International Standard ISO/IEC 17043:2010 and assessed the following methods; Pulsed Field Gel Electrophoresis (PFGE) using the PulseNet international protocol, Serotyping O:H, genotyping of virulence genes: *vtx1*, *vtx2*, *eae*, *aaiC, aggR,* subtyping of *vtx1* and *vtx2* (*vtx2a* to *vtx2g*) and phenotypic testing for the production of Verocytotoxin/Shiga toxin (VT), Extended Spectrum Beta Lactamases (ESBL), β-glucuronidase, enterohaemolysin and fermentation of sorbitol. Twenty-four public health national reference laboratories from 16 countries signed up for the EQA.

The number of participating laboratories this year was encouraging. An individual report was sent to all participants with a full evaluation of their results, feedback on strategies and technical issues for the improvement of the quality of laboratory results was given individually to each laboratory, where required. External quality assurance (EQA) is an important aspect of quality management systems. An EQA allows for comparison among different test sites, provides an early warning for systematic problems and objective evidence of testing quality and identifies areas for improvement and specific training needs among participants. The fellow was responsible for administration of the EQA, analysis of the results, completing a personal evaluation report for each participant and compiling a final EQA report.

B. Influenza EQA

The fellow part-took in the Quality Control for Molecular Diagnostics (QCMD) 2014 influenza virus A and B RNA EQA programme and assisted in the isolation of viral RNA, initial identification of influenza A and B, multiplex PCR, typing of influenza B by monomix PCR and typing of influenza A by monomix PCR. The laboratory performed well in the EQA and was correct in the typing of all but one of the test isolates.

Educational outcome: Use of appropriate shipment procedures, understanding and applying the principles and practices of quality assurance, administering, analysing and reporting the results of an external quality assurance scheme, understanding local and European accreditation procedures.

6. Teaching and pedagogy

A. STATA course

The fellow participated in the planning and preparation of teaching materials for a six-week STATA course for Statens Serum Institut's department of epidemiology. The fellow facilitated two of the sessions and prepared teaching materials, slides and exercises for the course.

B. Workshop 'Vaccine immunology', ECDC summer school, Stockholm, Sweden

Supervisor: Aftab Jasir, Androulla Efstratiou

The fellow participated in the planning and preparation of teaching materials for a two-day vaccine immunology workshop and the 2014 ECDC summer school in Stockholm together with another EUPHEM fellow based in the Czech Republic. The fellows also lectured at and facilitated the workshop. The workshop was designed for public health professionals with various backgrounds and consisted of a mixture of lectures and practical exercises. The workshop will be developed as an online e-learning tool in a modified version.

Educational outcome: Planning and organising a workshop for public health professionals, defining learning objectives, preparing lecture material and exercises, delivering and teaching the defined learning objectives by giving interactive lectures and facilitating group exercises, working in a team with other fellows (face-to-face, teleconferences and during the workshop), course evaluation.

7. Public health microbiology management

A. 'Initial management in public health microbiology', ECDC, Stockholm, Sweden

Fellows completed a one-week module that focused on principles of management, with particular emphasis on understanding roles and responsibilities in public health management. Topics included time management, how to identify and apply different management styles, team work and team evolution, delegation of tasks, provision of structured feedback and strategies for stress management.

B. Public health microbiology management components as part of regular projects

The managerial aspect of public health microbiology was a component of all projects and activities throughout the fellowship.

During an international mission to West Africa during the Ebola outbreak the fellow communicated effectively with people from a variety of backgrounds, including different cultural backgrounds, in an international context. During the mission the fellow worked in a worked in a multidisciplinary team with other microbiologists, physicians, epidemiologists, statisticians, public health officers and logisticians. The fellow worked under-pressure and was a contributing team member in a highly-stressful and complex situation. The fellow also communicated with the authorities, addressed Liberian government officials and de-briefed the EU delegation in Liberia. For numerous projects in Denmark the fellow communicated with regional laboratories and worked on politically sensitive topics with regional collaborators. The fellow took ethical considerations into account for numerous projects and completed an official data request process.

Throughout the fellowship the fellow practiced effective time management, organised and participated in meetings, communicated through scientific writing and presentations, and gave and accepted feedback.

Educational outcome: Working in a multidisciplinary public health team; understanding team management; planning, scheduling and organising public health research projects.

8. Communication

A. Publications

1. Condell O, Midgley S, Bohn Christiansen C, Chen M, Chen Nielsen X, Ellerman-Eriksen S, et al. Evaluation of enterovirus laboratory surveillance system in Denmark, 2010 to 2013. (Submitted to Eurosurveillance)
2. Condell O, Gubbels S, Nielsen J, Espenhain L, Frimodt-Møller N, Engberg J, et al. An automated surveillance system for hospital-acquired urinary tract infections in Denmark. (Submitted to Journal of Hospital Infection)
3. Surveillance of foodborne parasites in the European Union: current practices and perceived barriers (in final preparation)
4. Perceived Priorities and Burden of Food- and waterborne Parasitic Diseases in the EU (in final preparation)
5. Condell O, Trebbien R, Kølsen Fischer T. Whole genome sequencing of influenza A, comparison of Sanger and MiSeq platforms (in final preparation for submission to PlosOne)

B. Reports and protocols

1. Inventory of national surveillance systems for food- and waterborne parasitic diseases in the EU/EEA: working document for expert panel meeting 2014, prepared with another EUPHEM fellow.
2. Inventory of national surveillance systems for food- and waterborne parasitic diseases in the EU/EEA, data summary: working document for expert panel meeting 2015, prepared with another EUPHEM fellow.
3. Hospital-acquired infections database (HAIBA): study protocol for the validation and refinement of case definitions for the surveillance of urinary tract infections
4. Ebola viral disease field visits reports for WHO Montserrado epi-surveillance team, prepared with a German FETP.
5. Ebola viral disease weekly internal epi-surveillance report, prepared with WHO national epi-surveillance team
6. Ebola viral disease daily internal epi-surveillance report, prepared with WHO national epi-surveillance team.

C. Teaching materials

Lectures, exercises and other materials for a two-day workshop on basic vaccine immunology for public health professionals at the ECDC summer school in Stockholm, Sweden, 2014.

D. Conference presentations

1. Condell O, Midgley S, Andersen P, Kølsen Fischer T. Evaluation of the enterovirus laboratory surveillance system in Denmark, 2010 to 2013. (Accepted for poster presentation at ESCAIDE 2015).
2. Condell O, Bangert M, Rosin P, Tavoshi L, Jasir A, Takkinen J. Surveillance of foodborne parasites in the European Union: current practice, barriers and perceived priorities. Tenth Workshop of National Reference Laboratories for Parasites, 14–15 May 2015, Rome, Italy.
3. Condell O, Gubbels S, Nielsen J, Voldstedlund M, Skov R, Kristensen B. Evaluation of a new automated surveillance tool for hospital-acquired urinary tract infections in Denmark. ESCAIDE, 4–7 November, 2014.

E. Selection of other presentations

1. Outbreak investigations – interpretation of laboratory results. Outbreak module, Berlin.
2. Surveillance of haemoparasites in Denmark, semi-national data from an eight-year period, 2005–2012, Initial PHM management and leadership/teamwork module, Stockholm, Sweden.
3. HAIBA UTIs case definition and potential collaborations, Urinary Tract Infections section of the Capitol Region Task Force, Rigshospitalet Diagnostic Centre, Copenhagen, Denmark.
4. HAIBA: validation and refinement of case definitions for the surveillance of urinary tract infections, Nordic mini-module, Oslo, Norway.
5. HAIBA: Validation of HAIBA case definitions for urinary tract infections, Faglig følgegruppemøde (expert group meeting), Copenhagen, Denmark.
6. Inventory of national surveillance systems for food- and waterborne parasitic diseases in the EU/EEA: data collection: questionnaire outline, FWD parasitic diseases expert panel, ECDC, Stockholm, Sweden.
7. Ebola Viral Disease epidemiological situation in Liberia, EU delegation in Liberia, Monrovia, Liberia.
8. Epidemiological description of the outbreak in Liberia as of October 2014, Health Service Executive Ireland, Registrars Training Day, Cork, Ireland.
9. The Ebola epidemic in Liberia- surveillance and outbreak response, Statens Serum Institut, Polymorfien, Copenhagen, Denmark.
10. Inventory of national surveillance systems for food- and waterborne parasitic diseases in the EU/EEA, discussion of data analysis strategy, Nordic mini-module, Copenhagen, Denmark.
11. Food- and waterborne parasitic diseases, ECDC EU questionnaire 2014–15; Data processing and analysis, FWD Parasitic Diseases Expert Panel, ECDC, Stockholm.

9. International missions

Supervisors: Aftab Jasir

A. Ebola Viral Disease, West Africa, 2014

The World Health Organization (WHO) was notified of an outbreak of Ebola virus disease (EVD) in Guinea in March 2014 and declared the epidemic to be a 'public health emergency of international concern' in August 2014. By late August the numbers of reported cases were still increasing steadily, despite a multi-national and multi-organisation effort to control the outbreak. The epidemic grew to such an extent that Guinea, Liberia, and Sierra Leone, the three most affected countries faced enormous challenges in providing care for those infected and in implementing the control measures required to stop transmission of the virus. In July 2014, a GOARN request for assistance was released – Ebola Outbreak West Africa – and the fellow was deployed to Monrovia, Liberia in August 2014 in response. The fellow worked as part of the Montserrado team and later with the national epi-surveillance team. The team consisted of between three and six international staff and worked closely with the Liberian Ministry of Health and Social Welfare. The team was responsible for analysis of surveillance data, compiling reports, da`ta validation and liaising with the Liberian Ministry of Health. The mission lasted six weeks.

Educational outcome: Collaboration with international partners at a regional and national level, communication with authorities, experience in a complex emergency situation, writing reports.

10. EPIET/EUPHEM modules attended

- EPIET/EUPHEM introductory course, Spetses, Greece (three weeks)
- Computer tools in outbreak investigations, Robert Koch Institute, Berlin, Germany (one week)
- Initial management in public health microbiology, ECDC, Stockholm, Sweden (one week)
- Biorisk and quality management module, ECDC, Stockholm, Sweden (one week)
- Nordic mini module, Oslo, Norway (two days)
- Vaccinology, Public Health England, London, United Kingdom (one week)
- Rapid assessment and sampling module, Athens, Greece (one week)
- Project review module, ECDC, Stockholm, Sweden (one weeks)
- Nordic mini module, Copenhagen, Denmark (two days)

11. Other courses

Intestinal pathogen course: detection, identification and serotyping of common diarrhoeagenic bacteria: a laboratory course. Discussion of new techniques and possible projects. Statens Serum Institut, Copenhagen, Denmark.

Detection and identification of toxoplasmosis: Overview of the epidemiology, clinical features and serological diagnostics of *toxoplasmosis*, Statens Serum Institut, Copenhagen, Denmark.

Discussion

Coordinator's conclusions

Dr Orla Condell started her fellowship as the youngest fellow of EUPHEM since the programme has been in existence. Despite her young age she showed a very mature attitude and was an effective team player at the training site and within the EUPHEM network. The projects described in this portfolio represent the breadth and depth of public health microbiology. Surveillance activities ranged from national to EU level. Analysis of national databases, such as the assessment and evaluation of the laboratory surveillance system for enteroviruses in Denmark, was an excellent example of 'learning by doing' where Orla was directly involved in the evaluation process of the surveillance system and made recommendations based upon her findings for improvement of the system. This was also the case for the inventory of the national surveillance system for food- and waterborne parasitic diseases in the EU/EEA, where a joint collaborative study with ECDC was undertaken to determine the barriers encountered by Member States for case ascertainment and reporting of these diseases in conjunction with their laboratory practices and capabilities. She also gained experience in international crisis response during her international assignment in response to Ebola in West Africa where a key learning activity was her participation and contribution within a multidisciplinary outbreak team, working with Ministry of Health and communicating with different authorities. Additionally, Orla's portfolio comprised both laboratory and epidemiological projects that covered bacterial, viral and parasitic pathogens across a variety of disease programmes, such as vector-borne diseases, sexually-transmitted diseases, food- and waterborne diseases, respiratory tract infections, vaccine-preventable diseases and antimicrobial resistance. Projects involved different professional groups, such as physicians, laboratory technicians, epidemiologists, statisticians, government officials, public health officers and logisticians, strengthening the fellow's ability to work in a multidisciplinary team. All activities were in line with the 'learning by doing' and 'in–service' approach of the EUPHEM programme and followed the core competency domains described for professionals in mid-career and above. Projects had clear public health outcomes, with results communicated to public health authorities, in scientific journals and at conferences.

The EUPHEM coordinator team concludes that the fellow has succeeded in performing all her tasks to a very high standard and with a professional attitude. This included her leadership abilities and social competencies. The contributions made by this EUPHEM fellow in Liberia as with all the others have highlighted the need to further develop a future critical mass of highly skilled field public health microbiologists within MS, to contribute capacity to national preparedness as well as being available for international response in the interest of the EU.

Supervisor's conclusions

During the two-year fellowship at Statens Serum Institut, Orla Condell has been involved in a variety of public health activities as described in the core competencies of the EUPHEM programme and also took part in an international mission to Liberia during the Ebola outbreak. The fellow has developed both personally and professionally during the fellowship and has solved the given tasks in a highly competent manner, with a great degree of independence, while seeking assistance where appropriate. The fellow has experienced several challenges in the research arena, such as difficulties in interactions between national and regional public health agency actors/representatives and well as sensitive challenges related to authorship. She has demonstrated an impressive degree of patience and diplomacy throughout the various struggles, indicating her potential as a strong and respectful manager in the field of public health. A positive attitude to challenges and an open mind towards colleagues makes the fellow a very competent team player.

Orla's projects and activities have all come within the scope of Statens Serum Institut's strategy and core activities. She has generated new information that will improve surveillance of infectious diseases in Denmark, as described by the projects. The knowledge generated has been implemented as a scientific background for improved advice and targeted public health interventions. It is our clear conclusion that the EUPHEM programme in general, and Orla's efforts specifically, have enriched the departments and strengthened collaboration between the microbiology laboratories and the Department of Epidemiology.

Personal conclusions of fellow

The EUPHEM programme has been a great opportunity to gain knowledge and practical experience in numerous projects across a broad range of departments and pathogens, within a two-year period. The programme served as excellent training in the field of public health microbiology and provides fellows with practical experience in epidemiology. A major strength of the EUPHEM fellowship is its broad public health training, allowing fellows to work on laboratory-based projects as well as data-analysis and field work. From this fellowship structure I have gained experience in working as part of multidisciplinary teams and consequently have a better understanding of public health within and beyond the laboratory. The EUPHEM programme has been a unique opportunity to participate in practical 'learning-by-doing' training as well as attending courses, being supervised by disease specialists and gaining international experience. The EUPHEM fellowship structure enables and encourages a

network of European public health laboratories and is contributing to the growing field of public health microbiology. Finally, the programme is also building strong ties, together with the EPIET programme, between microbiologists and epidemiologists in Europe, emphasising the need for close collaboration in order to benefit public health.

Acknowledgements of fellow

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