EUPHEM

EUPHEM REPORT

Summary of work activities

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European Public Health Microbiology Training Programme (EUPHEM), 2014 cohort

Background

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'.

The ECDC Fellowship Training Programme therefore includes two distinct curricular pathways: Intervention Epidemiology Training (EPIET) and Public Health Microbiology Training (EUPHEM). After the two-year training EPIET and EUPHEM graduates are considered experts in applying epidemiological or microbiological methods to provide evidence to guide public health interventions for communicable disease prevention and control. Both paths that provide competency based training and practical experience using the 'learning by doing' approach in acknowledged training sites across European Union (EU) and European Economic Area (EEA) Member States.

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 from a microbiological perspective.

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.

Stockholm, November 2016

This report summarises the work activities undertaken by Susanne Schjørring, cohort 2014 of the European Public Health Microbiology Training Programme (EUPHEM) at the Statens Serum Institut, 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.

Pre-fellowship short biography

Susanne completed her Ph.D within microbiology from the Faculty of Health and Medical Sciences at the University of Copenhagen in 2008, building upon her Masters in Molecular Biotechnology from the Technical University of Denmark, 2004. During her Ph.D she worked on transfer of antimicrobial resistance gene between bacteria in the intestine. From 2008 to 2012, she was the microbiology expert and project manager at Statens Serum Institut (SSI) of the microbiological part of an Asthma research project in collaboration with the Professor Hans Bisgaard at the Danish Pediatric Asthma Centre. Since 2012, she has been working in the department of foodborne infections at SSI as the External Quality Assessment coordinator of molecular typing of foodborne pathogens (*Salmonella*, *Escherichia coli* (VTEC) and *Listeria f*or all participating European national reference laboratories. (ECDC tender).

Fellowship assignment: Public health Microbiology (EUPHEM) path

Methods

This report accompanies a portfolio that demonstrates the competencies acquired during the EUPHEM fellowship by working on various projects, activities and theoretical training modules.

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 outputs 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 due to confidentiality regulations.

Results

The objectives of the core competency domains were achieved partly through project or activity work and partly through participation in the training 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

A. Cluster of Verotoxin producing Escherichia coli (VTEC) O103:H2, Denmark 2014

Supervisors: Epidemiologist Charlotte Kjelsø and Senior Researcher Flemming Scheutz

The national reference laboratory for *Escherichia coli and Klebsiella* reported three cases of Verotoxin producing *Escherichia coli* (VTEC) serotype O103:H2 in August 2014. In order to prevent larger outbreaks all VTEC positive patients were interviewed using a trawling questionnaire and the isolates were typed by Pulsed field gel electrophoresis (PFGE). The PFGE profile of the isolates were indistinguishable; however, no apparent connection could be identified between the patients or any vehicle/food items and the patients. In the following weeks, no new cases of O103 were reported and the outbreak was closed. In week 38 (mid-September) one new case of O103 with the same identical PFGE profile was identified and the outbreak was re-opened. The fellow interviewed the new patient and made the PFGE comparisons by the PFGE analysing software BioNumerics. Additionally nine other O103:H2 isolates were observed during the following ten weeks. All patients were interviewed. However, based on the PFGE analysis only five had same profile and were considered to be a part of a cluster. Despite the trawling questionnaire data, no food item could be identified. The fellow summarized the PFGE typing details and the descriptive epidemiology in an outbreak report (in Danish), which were communicated to the Danish national outbreak group. In addition the data were included in the Danish Annual Zoonosis report 2014.

[1] European Centre for Disease Prevention and Control. European public health training programme. Stockholm: ECDC; 2013. Available from: http://ecdc.europa.eu/en/publications/Publications/microbiology-public-health-training-programme.pdf

B. Legionnaires' disease – North Zealand, Denmark 2014 – A suspected outbreak

Supervisors: Senior Researcher Søren Uldum and Epidemiologist Charlotte Kjelsø

Fifteen community-acquired cases of Legionnaires' disease (LD) were diagnosed from July to November 2014 in the northern Zealand region in Denmark. The relatively high number of cases in a restricted time and geographical area, together with the detection of *Legionella pneumophila* serogroup 1, subgroup Allentown/France, sequence type (ST) 82 in four of the cases, pointed to a potential outbreak of LD. An investigation was initiated and the fellow participated in the conduction of interviews, sampling of environmental samples from the patients' homes and one work place as well as analysing data from standard typing methods and whole-genome sequencing (WGS) of the isolates. Out of the fifteen cases fitting the case definition, five cases could be excluded from the outbreak as being non-ST82. No ST82 isolates were found in the environmental samples and no external source was recognised. The WGS analysis showed that one of the four ST82 isolates was 16-21 Single nucleotide polymorphisms (SNPs) different to the other ST82 isolates after recombined regions were excluded, suggesting that the case was unrelated. The other three ST82 isolates clustered closely together (<5 SNPs), suggesting the possibility of a common source. Interestingly though, isolates from two of these three cases clustered even more closely with epidemiologically unrelated isolates sampled many years apart in Denmark and the United Kingdom than with the third case. This study confirms that recombination plays a major role in *L. pneumophila* evolution and is a very important factor to consider in outbreak investigations. Secondly, it shows that strains belonging to the same ST can be highly similar with only a few SNP differences observed between isolates sampled over both large timespans (years) and geographic distances (countries), a finding which also complicates outbreak investigations. Despite these challenges, WGS data produce unparalleled information compared with current gold standard epidemiological typing methods such as the sequence based typing. The details and descriptive epidemiology was summarized in an outbreak report (in English) for the EUPHEM program and internal use at SSI. This outbreak investigation is the first at SSI where WGS of *Legionella* was implemented. The data contribute to the worldwide discussion on how *L. pneumophila* outbreaks should be interpreted using WGS data and contribute to the knowledge about the diversity within *L. pneumophila.* The fellow have therefore summarized the data into a manuscript accepted by Eurosurveillance.

C. Outbreak of gastroenteritis in a canteen in the Copenhagen area, Denmark 2015

Supervisors: Senior Researcher Steen Ethelberg and Epidemiologist Luise Müller

On 26 January 2015, the chef of the canteen in a large company in the Copenhagen area, Company X, notified the Veterinary and Food Administration about an outbreak of gastroenteritis in the company. The Veterinary and Food Administration contacted SSI for assistance to conduct an investigation. The canteen served two different menus per day to about 500 employees. The fellow conducted a cohort study, including an online questionnaire asking the employees if they had had food from the canteen between 17-23 January and if they became ill with stomach problems afterwards. Furthermore, they were asked which food items from the menu they had consumed on 22 and 23 January. A total of 259 respondents were included in the final analysis. Four responders submitted a faecal sample to SSI, none of them were from the suspected kitchen personnel. Norovirus were identified in the faecal samples of the patients and both the symptoms and the histogram of the responders corresponded to a norovirus outbreak. In addition, the data analysis could explain 78 out of the 80 cases by presence in the canteen in week 5, without excluding prior or later date of onset. The main exposure were on Friday, 23 January 2015. After calculation of food-specific attack rates, no single food item could be identified as the outbreak vehicle. The fellow prepared the reports including the descriptive and statistical analysis (in English) for the Veterinary and Food Administration. The report was included in the National Food outbreak database (FUD) and for internal use at SSI. The Veterinary and Food Administration did not find any critical issues upon their visit and because no single food item could be identified the recommendations were general reminders.

Training modules

The EPIET/EUPHEM introductory course, Outbreak module and the Multivariable analysis module 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 outbreak module taught the participants how to apply this knowledge in practice using various software packages (STATA and EPI info). Fellows were taught essential data management skills including data entry, validation 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: The fellow participated in a multidisciplinary-outbreak team. She was involved in all steps during the investigation of the outbreaks and applied her microbiological and epidemiological knowledge, both during the on-site visit. The fellow participated in case definitions, planning future actions and she conducted telephone interviews with patients, designed questionnaires, testing the hypothesis by evaluated laboratory data and conducted epidemiological analyses as well as prepared reports and presentations, wrote scientific article and provided recommendations.

1.2. Surveillance

A. Day-to-day surveillance of foodborne pathogens, fall 2014

Supervisors: Outbreak team at SSI (Unit of foodborne infections and the division of Epidemiology and Disease surveillance)

In order to fully understand the day-to-day surveillance of foodborne infections and the collaboration between the foodborne infection unit and the epidemiology department, the fellow was included in all activities related to surveillance of foodborne infections during a 3-month-period. The fellow participated both in the meetings on the laboratory side, in weekly meetings between laboratory and the epidemiology department and the meetings within the epidemiology department. The fellow contributed to the investigation of several ongoing outbreaks within this period (see Epidemiological Investigation). The fellow learned about the various surveillance systems, the notification systems, and how foodborne outbreaks based on typing can be detected by the laboratory surveillance systems at SSI. In addition, the analysis of surveillance data in general also increased the fellow's understanding of the complexity of the collaboration between SSI and the Danish Departments of Clinical Microbiology (DCMs) with regard to Public Health surveillance. Submission of isolates within some species from the DMCs to SSI is based on good will and is not mandatory so good collaboration and net-working is essential. This training was essential for the fellow if she would be included in the outbreak and surveillance of foodborne infections after the EUPHEM fellowship.

B. Semi-automated Linelist

Supervisors: Senior Researcher Steen Ethelberg and Senior Researcher Eva Møller Nielsen

The overall aim of the project was to map the current information (surveillance data) flow between the lab unit of foodborne infections and the epidemiology unit of foodborne infections during an outbreak situation in order to optimize the data flow and obtain a less person-dependent procedure. The Linelist is the backbone of any outbreak investigation; therefore it is crucial that any new information is added timely, and the Linelist should be simple, but contain all valuable information. Often unstructured excel sheets emailed between the departments (but person to person dependent) or updates by phone or by personal email were used. Excel files differed for every outbreak, both the variable fieldnames and their position in the sheet. Some of the foodborne related outbreaks begin with a laboratory detection of a cluster based on typing data. Therefore firstly, a BioNumerics (BN) script was developed to get a standardized export of typing data regardless of bacterial species. Secondly, a semi-automated Linelist in an excel format was developed. The excel file contained 12 sheets: Linelist, Typing data, Address, Case definition, Gender and age, Epi-curve, Map, Food isolates, Assessment and Conclusion, Log, Address Export and a helping sheet. The Danish civil registry number (CPR-no.) was used as a unique identification and the Bionumerics key for isolate identification. As part of the excel file, a macro was developed (in visual basic) to compare new data entered with already existing data thus ensuring less manual comparison of data. Additionally, age calculation, gender determination, premade Epi-curve and easy Export of Address for mapping were included. The lab unit of foodborne infections will use the new BN script in order to standardise their export of typing data. Cluster IDs and outbreak (FUD) nos. were also added to the BN species databases which will be routinely updated. The fellow produced a more standardised way to exchange data between the two units with help from Jonas Torgny Björkman (BN script) and Stefan Schytte Olsen (Excel macro). The semi-automatic Linelist ensures less manual labour (minimising typing errors and the need to re-organise data). The more standardized export of typing data also ensures fewer person to person dependent procedures and less communication between the laboratory and epidemiology unit of foodborne infections. This will not only have a positive impact on the collaboration between the two units but also have a positive impact on future outbreak investigations with less wasted time.

C. Rickettsia infections in Denmark 2008-2015

Supervisors: Professor Karen A. Krogfelt and Senior Researcher Palle Valentiner-Branth

The overall aim was to describe the number of samples and patients analysed for Rickettsia in Denmark in the period from 2008 to 2015 in order to obtain data for promoting surveillance and obtaining knowledge on the occurrence of rickettsia infections. In Denmark, only a limited number of studies have evaluated the potential risk of rickettsiosis as a tick-borne disease. *Rickettsia helvetica* (belonging to the Spotted Fever group) has been found to be one of the most common pathogens in the tick *Ixodes ricinus* isolated from domestic dogs in Denmark (Stensvold *et al.*,2015; Kantsø *et al.*, 2010). In 2004, patients exposed to ticks in North Jutland with borreliosis were screened for Rickettsia. Among them 12.5% were found seropositive for *Rickettsia* spp. (Nielsen *et al*, 2004). Rickettsiosis is not notifiable in DK, however, diagnosis of rickettsia is primarily performed at SSI. Samples are submitted to SSI for diagnostic testing by Focus Diagnostics Indirect Immunofluorescence assay (IFA) or for detection of *Rickettsia* spp. DNA by

PCR (using primers described by Stenos *et al.*, 2005). Serological detection of IgG and IgM for *R. rickettsii* (spotted fever group) or *R. typhi* (typhoid fever group) with positive cut-off values of IgG ≥ 1:512 and IgM ≥1:64 was based on evaluation when compared with Danish blood donors (Kantsø *et al.*, 2009). The fellow extracted data from the SSI laboratory database and conducted data cleaning and data analysis. From 2008 to 2015, 27% (769/2819) of the samples were positive for *Rickettsia* spp. either by serology (95%) IgG or/and IgM or by PCR (5%). The 769 positive samples represented 591 patients. Fifty-one percent (299/591 patients) were males and 55% were in the age group of >30-60 years. The limited clinical information suggests 10% were travel related infections, and 5% reported tick/insect bite. Antibodies for the spotted fever group were detected in 86% (486/561), 7% (40/561) for the typhoid fever group and 7% (37/561) were inconclusive. In consequence, further studies are being planned to gain knowledge about symptoms and travel anamnesis, among others to improve our ability to differentiate between infections acquired abroad and in Denmark. Nevertheless this is the first time that the diagnostic data have been analysed and the recommendation is that both clinical data and specific travel exposure should be included when implementing a future surveillance system of *Rickettsia* infections in order to gain the necessary knowledge of the situation in Denmark. The fellow performed that data analysis and presented the data at the international European Congress of Clinical Microbiology and Infectious Diseases (ECCMID) conference and communicated the results in an EPI-news for the Danish medical professionals to increase awareness of Rickettsia infections and the diagnostics. A manuscript by the fellow is also in preparation for submission to "Emerging infectious diseases".

D. PCR positive gonococcus reports and lack of specimens for culture

Supervisors: Senior Researcher Steen Hoffmann, Senior Researcher Susan Cowen and Researcher Laura Espenhain

In Denmark, clinical notification of gonorrhoea is mandatory. The National Board of Health recommends that a gonorrhoea diagnosed by PCR is always followed up by additional specimens for culture in order to perform antimicrobial resistance (AMR) testing. The testing is important for both the patient's treatment and the national surveillance of AMR in *gonococci*. In recent years, an increase has been seen in the number of clinically notified cases of gonorrhoea, however, in only approx. 25% of the cases do the health care providers send additional specimens for culture and AMR testing. The overall aim of the project were to elucidate if the phrasing of the comments included in the PCR positive gonococcus (GC) reports issued by the departments of clinical microbiology (DCMs) to general practitioners (GPs) has an impact on whether additional specimens are sent for culture. All results from all DCMs are copied into the Microbiology Data Bank (MiBa). The study population was patients with a GC positive sample by PCR in 2015. All eleven DCMs had to some degree standard phrasings; however, most of the sentences were very long. The various comment contents were divided into groups of words (recommending additionally culture, additional swab sample, sample for resistance profile, confirmation testing, screening test, notification etc.). The number of specimens sent for culture after a PCR positive sample was lowest if the words screening test, notification and/or confirmation test were used. The number of samples sent for culture were highest if the sentence included the words resistance profile or additional sample and for culture. The DCM with the lowest number of submitted samples for culture had both the word screening test. Nevertheless, the data suggest that specific words influence whether the GP's submit additional specimens for culture. Disclosing improper communication between DCMs and the GPs might be the key factor for ensuring a high coverage of culture samples for AMR testing which leads to accurate treatment of the infection and valid AMR data for national surveillance of GC. A higher coverage is the only way to ensure valid surveillance data for early interventions in the future. Therefore, it is important to focus on better communicative phrases between the DCMs and the GPs. The fellow prepared an interne report of the data analysis, and in the annual EPI-News on gonorrhoea 2015 for the Danish medical professionals, SSI highlighted for the GPs/DCMs the possibilities for misunderstandings especially when using words like screening test or confirmation. On the basis of this analysis, a more intensive investigation will be conducted including sending questionnaires to the GPs with the lowest culture follow-up rate (after a GC PCR positive sample).

Training 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 data from 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. Whole genome analysis of Clostridium difficile CD027

Supervisors: Senior Researcher Søren Persson, Researcher Mie B. Frid Jensen and Bioinformatician Kristoffer Kiil

The overall aim is to demonstration the genomic variation of *Clostridium difficile* isolated from patients, by using WGS and SNP analysis, in order to distinguish between relapse and re-infection. Guidelines suggest, a time dependent "8-week cut-off period"; whereby recurrence within 8 weeks of a previous infection is likely to be a relapse resulting from treatment failure, while recurrence, >8 weeks after a previous infection, is expected to be a re-infection with a new strain (Cohen *et al*. 2010, McDonald *et al*. 2007). However, the nature of multiple recurrences and the diversity of subtypes within patients during consecutive infections is not completely understood.
Genomic DNA of 20 CD027 isolated from three patients with recurrent infections in 2012-2013 were WGS using the Illumina MiSeq platform in order to obtain 251-bp paired-end reads according to the manufacturer's instructions. Identification of SNP variants was performed using in-house pipeline by aligning sequence reads from the isolates against the reference chromosome of CD630. The analysis showed one SNP difference between the two isolates from the same patient, and 1-2 SNP between isolates from different patients. However, the analysis also showed 0 SNP between samples from the recurrent group and two random surveillance isolates from 2016 (from Greenland and Esbjerg). In conclusion, the *C. difficile* isolates included in the analysis could be considered clonal. In addition, during the analysis additional nine CD027 isolates (from 2008 to 2016) were also included in the analysis and, unexpectedly, the SNP analysis categorised all the isolates into two major clusters (A and B). The two clusters could also be separated based on their resistance profiles as well as being isolated during high/low prevalence regions. The current Danish National surveillance of *C. difficile* is only based on TRST type and toxin genes. However, this study suggests that isolates within the same TRST type possess different epidemiologically potential and including antibiotic resistance data into the surveillance of *C. difficile* in Denmark would enhance the surveillance dramatically in order to fully understand the diversity and the clonal spread of *C. difficile*. This project were the first WGS analysis of *C. difficile* at SSI, the fellow were part of the group which developed the SOP for WGS for *C. difficile* both the purification, the DNA preparation and the bioinformatics analysis.

B. Enterovirus and their role in respiratory illness in Denmark, 2009-2015

Supervisors: Senior Researcher Sofie E. Midgley and Professor Thea Kølsen Fischer and Senior Researcher Peter HS Andersen

The overall aim were to investigate the extend of respiratory disease caused by Enteroviruses (EVs) and describe which EV genotypes are associated with this illnesses in order show the added value of including typing of positive respiratory EV samples in the EV surveillance-system. EVs are a common cause of both hand-foot-and-mouth disease and meningitis and is globally monitored using EV screening of cerebrospinal fluids and stools. However, the extensive EV-D68 outbreak in USA/Canada in the fall of 2014, increased the awareness on respiratory EVs.
All respiratory samples (5607), which were submitted for viral diagnostic testing at SSI, from all regions of Denmark, were included in the study. Samples were tested using reverse transcriptase-PCR and subsequently sequenced followed by BLAST analysis against the NCBI/SSI-EV databases. During 2009-2015, 905 (16%) respiratory samples tested positive for EV, representing 745 disease episodes. Of these, 399 episodes (54%) occurred in males and 390 episodes (52%) occurred in children aged <5 years. The identified EV species included rhinovirus (RV), which was detected in 390 episodes (52%), followed by EV-A (11%) and EV-B (8%). For EV species A-D; 28 different EV genotypes were detected. The most frequent were Coxsackievirus A6 (12%), EV-D68 (4%), and Coxsackievirus A16 (4%). Notably, new emerging EV genotypes C104, C109 and C117 were identified in three individual cases. Of the 745 episodes, 240 (32%) were admitted to the hospital and available data suggest that 34% had underlying conditions such as cancer, transplantation, immunological defects or chronic lung disease. These findings are the first to demonstrate that EVs constitute a major burden of viral respiratory disease among Danish patients. Furthermore, the project also documented a large variety of EV genotypes in respiratory specimens, of which some (EV-D68, EV-C104, EV-C109 and EV-C117) are not detectable in stools. In order to detect novel and emerging EVs, and allow for timely intervention in the event of outbreaks such as EV-D68, the existing EV surveillance-system should be enhanced to include typing of EV positive respiratory samples. The fellow conducted the data analysis and data will be presented as an oral communication at ESCAIDE, the manuscript is in preparation.

Training modules

The EPIET/EUPHEM introductory course included training on how to develop a study protocol and teaching 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 interpretation 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. Development of Real time multiplex PCR for Enterovirus

Supervisors: Senior Researcher Sofie E. Midgley and Professor Thea Kølsen Fischer

The overall aim were to develop a multiplex real time RT-PCR to distinguish between enterovirus species EV-A, EV-B, EV-C and EV-D (Part I) as well as develop a specific VP1 region PCR for each species (Part II) in order to improve surveillance of EV.
Approx. 2.200 test are found positive /year (39/100.000 persons) in Denmark. The enterovirus genus can be divided into 12 species, with seven being associated with infections in humans (EV-A, EV-B, EV-C, EV-D, HRV-A, HRV-B, and HRV-C). EV species A-D can further be classified into 114 different genotypes, including polio. Therefore, all enterovirus positive faecal samples are cultured in polio optimal cell lines. In order to cover all 114 subtypes the primers are degenerate, leading to lower specificity and making it difficult to amplify all genotypes from all sample material types. Previous work has been performed by EUPHEM fellow Lieke Van Alphen in 2013; construction of two single-plex PCRs for species EVA1, EV-C and EV-B. However, the PCRs were only tested on a small number of samples/virus types, and additional optimization was needed. Despite repeated test-runs the set-up only worked on the samples with very high viral load, and several genotypes did not give any results. Therefore the focus was put on part II (see below).
The aim of part II of the project, was to develop four more specific single-plex RT-PCRs for A-VP1, B-VP1, C-VP1 and D-VP1 PCRs to enhance the sensitivity and specificity of the genotyping. The fellow conducted sequence alignment and primer design. In total, 20 primer sequences were ordered and multiple combinations of primers and different annealing temperatures were tested. Several? Combinations resulted in positive outcomes however, never for genotypes within one EV species. In conclusion, it was not possible to develop a single-plex PCR targeting all genotypes. However, the work is ongoing and based on the results the VOF group afterwards continued working on developing one PCR for some of the most important (EV C-104, 105, 109, 117, 118) emerging E Enterovirus genotypes within species C. The existing EV surveillance-system is enhanced by introducing new PCRs for genotyping and hereby allow for timely intervention in the event of outbreaks.

B. Evaluate if a kit can be used to separate M. chimaera from other nontuberculous species

Supervisors: Senior Researcher Michael Rasmussen and Senior Researcher Erik Svensson

Mycobacterium chimaera has been associated with contaminated heater-cooler units in Switzerland, Germany and the Netherlands. Here in Denmark, *M. chimaera* has been identified in 18 out of 21 units. As such, samples are frequently analysed at Statens Serum Institut (SSI). The current procedure is to use in-house PCR followed by sequencing of the 16S rDNA and Internal Transcribed Spacer DNA (ITS) to distinguish *M. chimaera* and *M. intracellulare*. Therefore, the aim of the project were to evaluate if a kit "A" could identify and differentiate relevant species in order to reduce the time and processes in the laboratory. The kit were able to correctly identify the four different reference isolates (*M. abscessus* subsp. *massiliense, M. abscessus* subsp. *bolletii, M. intracellulare*, *M. chimaera),* eleven different clinical isolates (*M. intracellulare, M. chimaera, M. avium, M. chelonae),* and add subspecies identification of four clinical isolates. Only three out of the 19 tests were inconclusive, and should, therefore, be re-tested. During the evaluation process of the kit the fellow were trained in all BSL3 procedures and protocols at the International Reference Laboratory of Mycobacteriology (BSL3 laboratory) at SSI. The fellow conducted the evaluation of the kit and prepared an internal report. Recommending that by implementing the kit, SSI can obtain a faster response rate compared to currently methods (PCR and sequencing) which allow for timely intervention in case of a contamination is found in a heater-cooler units. In addition, the kit will also enhance surveillance on *M. abscessus* subspecies (*abscessus, massiliense and bolletii).*
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 level 3

Supervisors: Senior Researcher Michael Rasmussen and Senior Researcher Erik Svensson

The fellow was during the laboratory investigation of the *Mycobacterium* kit trained in all general Biosafety level 3 (BSL3) procedures and protocols. Eight weeks before the project started the fellow received the Bacillus Calmette–Guérin (BCG) vaccine. All relevant SOPs on laboratory behaviour, waste disposal and routine experiments were studied and signed in order to authorize the presence in the laboratory. The procedure in case of an accident or fire were thoroughly explained. In the BSL3 laboratory, there is lower pressure in all inner rooms compared to the outer rooms. The fellow were instructed in the procedure of redressing in the locker room before entering the restricted area. The fellow was tested for latent *M. tuberculosis* infection on day one. During the stay the fellow was trained in the phenotypic methods used to identify and characterize different species of *Mycobacterium* including sample pre-treatment, staining of clinical specimens and positive cultures, resistance detection, Mycobacteria Growth Indicator Tubes, DNA extraction, Mycobacteria identification by TbcID and the assay to differentiate between *Mycobacterium tuberculosis* complex. Species determination of Non-Tuberculous Mycobacteria by GenoType CM/AS (Common Mycobacteria/Additional Species Assay) where explained in detail.

Training modules

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). The module also included a short visit to Biosafety Level 4 Laboratory at the Karolinska Instuitut, which allowed the fellow to observe the special conditions needed when working with highly virulent pathogens. After the module the fellow prepared a small report on a mitigation exercise and made an audit of the VOF laboratory at SSI. Evaluating both process management and quality control as well as the documentation.

Educational outcome: Understanding the processes associated with BSL2/BSL3/BSL4 laboratories, gaining experience in 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. External quality assurance for molecular typing of Listeria, Salmonella and VTEC (ECDC funded)

Contributions to the training site as an expert

During the first year of the EUPHEM fellowship the fellow maintained the coordinator responsibilities for the three molecular typing External Quality Assurance (EQA) for *Listeria*, *Salmonella* and VTEC funded by an ECDC contract for all national reference laboratories (NRL) within European union/European Economic Area. During the second year, the fellow trained the replacement as EQA coordinator Mie B. F. Jensen (See teaching section).

The three typing EQAs all contains Pulsed Field Gel Electrophoresis (PFGE) as the main part. In addition the *Listeria* EQA contained serotyping, the *Salmonella* contained Multiple-Locus Variable number of tandem repeats Analysis (MLVA) of *S.* Typhimurium and VTEC contained both serotyping, genotyping (including subtyping) and phenotypic testing (verocytotoxin/Shiga toxin, Extended Spectrum Beta Lactamases (ESBL), β-glucuronidase, enterohaemolysin and sorbitol).

The main part of the EQA were the PFGE typing which were evaluated on both the quality of the gel by seven parameters, but also the performance using the specialised analysing tool BioNumerics were evaluated in five parameters. The evaluation lead to an overall conclusion, if the gel can be used for inter laboratory comparisons. Additionally recommendation for improvements were described. The serotyping, MLVA and all additional test in VTEC are evaluated by a correct or incorrect result. All participants receive a participation certificate and an individual report of all the parts they participated in. All data from each species EQA were each year summarised in a detailed ECDC report, three reports per year, which is published on ECDC website (see reference list). General an improvement of the quality of the PFGE profiles is observed over the years, however the main issues is still in the two parameters 'Image Acquisition and Running Condition' and 'Bands' within all three species. Yearly, SSI encourage new participant experiencing technical problems to use the EQA program for troubleshoot and optimize their PFGE procedure. Each laboratory were given individually evaluation of their results, feedback on strategies and technical issues for the improvement. In addition all others methods were also evaluated, however not described here.

These ECDC funded molecular typing EQAs is highly important for improving the quality of across border surveillance for foodborne infections. An EQA is an essential aspect of quality management systems and allows for comparison among different test sites. It can give an early warning for systematic problems and objective evidence of testing quality and identifies areas for improvement and specific training needs among participants. Enhancing the gel quality across EU will have impact in future outbreak investigations across borders. The fellow had the overall responsibility for organising the EQAs, supervising the analysis of all the results accumulating into the individual evaluation reports for each participant and into the final ECDC EQA report within each species (2015) and supervising Mie B. F. Jensen (2016).

B. Internal audit

Supervisor: Laboratory technicians Susanne Jespersen and Pia Møller Hansen

The fellow part-took in an internal audit at SSI, in the pre-diagnostic centre (PDC) together with Susanne Jespersen and Pia Møller Hansen. Prior to the audit, we discussed the focus of the equipment audit and selected equipment to be inspected and the documentation they should provide. The selected equipment were room refrigerator, centrifuge, scales, fume hood and incubators. Every standard operation procedure were checked, everything from cleaning dates, calibrations notes and approval procedures were inspected. Seven minor recommendations were suggested in the final report.

Training modules

During the five-day module focusing on biorisk/biosafety assessment and mitigation the different aspects of Quality management were also introduced.

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 and the importance of audits and accreditation.

6. Teaching and pedagogy

A. Ph.D course on Infection epidemiology

Supervisor: Head of department of epidemiology infections Kåre Mølbak

All EUPHEM and EPIET fellows at SSI participated in the planning and preparation of teaching materials for a 3 days Ph.D course for Copenhagen University on Infection epidemiology. The course will be at Statens Serum Institut's department of epidemiology scheduled at week 43 2016. The course gives an introduction to the application of epidemiology to the field of infectious diseases. Main topics will be the current global challenges as to communicable diseases and what can be done to respond to them. What makes a good surveillance system and how can its data be used as information for taking action. How outbreaks of communicable disease are discovered, handled and learned from – on a global and on a local basis. The form the course will include a combination of lectures and group work based on real life case studies. The fellow will present Molecular typing methods together with EUPHEM Andreas Petersen and Celine Barnadas Cohort 2015 and facilitate three of the exercise sessions. The course will enhance the knowledge among future researcher/medical doctors on Infection epidemiology.

B. Development of Case-study Listeria monocytogenes ST224 outbreak

Supervisor: Senior Researcher Steen Ethelberg and Senior Researcher Jonas Torgny Björkman

In collaboration with EUPHEM Fellow Andreas Petersen Cohort 2015, the Danish outbreak of *Listeria monocytogenes* ST224 from 2014 were re-written into a case study for EUPHEM/EPIET fellows at the introductory course. The case study covers: The ten step of an outbreak investigation, the importance of collaboration of different disciplines (epidemiology, microbiology and bioinformatics) and different authorities (Food and Human), WGS analysis, similarities and differences in *Listeria monocytogenes* outbreaks compared to other food borne outbreaks, new guidelines within the public health sector might be the result of a solved outbreak and the complexity of trace-back/forward procedures.

C. External quality assurance (EQA) for molecular typing of VTEC (ECDC and Self-funded)

Contributions to the training site as an expert

The Fellow trained both her EQA coordination replacement and EUPHEM fellows at SSI in molecular typing EQAs. Mie were coordinator for the ECDC funded participants both in the *Listeria*, *Salmonella* and VTEC EQA. The EUPHEM fellows (Orla Condell Cohort 2013 (trained 2015), and Celine Barnadas and Andreas Petersen Cohort 2015 (trained 2016) was trained in evaluating the self-funded participants results in EQA of VTEC. The self-funded participants were evaluated using the same parameters as the ECDC funded and the participants got a participation certificate and an individual report. The basis of organising an EQA is the administration and documentation part, which is of great importance. Every deadline needs to be meet in order for the process to be optimal. All tasks are of equally importance, because they are subsequently. Invitation, registration, evaluation results of test strains, communication with own laboratory technician, preparation of strains and method to submit results, shipping of strains, communicate with laboratories within EU (ECDC funded) and worldwide (self-funded), trouble shouting on lab issues or submission issues, evaluation of results, feedback to the participants and report writing.
The fellow particularly liked that her actions and ambitions could motivate others. However the progress from teaching newbees with need supervision into the step of letting go of the "strict control" didn't come naturally. The fellow have recognised that teaching is 1/3 knowledge, 1/3 personal relationships and 1/3 communication skills. The fellow find both the knowledge and the relationships part easy, however the communication part have improved from speaking a lot, repeating the process in 2-3 different ways into being really specific and direct.

D. Lecture on External Quality Assessment for EUPHEM Cohort 2014

Supervisor: Aftab Jasir

During the EUPHEM module BQM 2015, the fellow gave a lecture on External Quality Assessment (EQA), which specified advantages and disadvantages of the different methods: Proficiency testing, Rechecking /retesting and on-site evaluation. The fellow prepared teaching materials, slides and exercises for the lecture (1h).

Educational outcome: Identify training needs, planning and organising courses for health-care professionals, working in a multidisciplinary public health team, outline learning outcomes, describe core competences, give lectures and perform pedagogical teaching.

7. Public health microbiology management

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

For numerous of projects the fellow communicated with different supervisors and other collaborators both within SSI, DCMs and Veterinary and Food Administration. The fellow also communicated with patients during the collection of water samples from patient's homes as well as communicated with the chef and kitchen staff in an outbreak affected canteen. All which require sensitive approach and ethical considerations. In addition, the Ebola preparedness

presentation at ECDC, were a great experience, to encounter the in some degree hard questions from the head of ECDC, to defend Denmark's decisions. 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. In addition, the physical movement between departments within SSI, also gave the fellow insight to different leading strategies.

Training modules

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 management styles.

Educational outcome: Describe the added value of public health microbiology for public health, working in a multidisciplinary public health team, understanding team management, team building and negotiation, ethics and integrity issues, planning, scheduling and organize research projects, understanding laboratory management, communicating with authorities.

8. Communication

A. Publications

1. Schjørring S, Niskanen T, Björkman JT, Torpdahl M, Nielsen EM. Evaluation of molecular typing of foodborne pathogens in European reference laboratories in 2012-2013; Accepted by Eurosurveillance 06-09-2016.
2. Schjørring S, Stegger M, Kjelsø C, Lilje B, Bangsborg JM, Petersen RF, David S, Uldum SA and on behalf of the ESCMID Study Group for Legionella Infections (ESGLI). Genomic investigation of a suspected outbreak of *Legionella pneumophila* ST82 in Denmark reveals heterogeneity masked by the present gold-standard methods.; Accepted by Eurosurveillance 16-09-2016.
3. Schjørring S, Valentiner-Branth P, Jørgensen CS, Petersen RF and Krogfelt KA. Diagnose of rickettsia infections in Denmark 2008-2015; in final preparation for submission to Emerging infectious diseases; 2016
4. Schjørring S, Fischer TK, Andersen PHS, Nielsen J, Poulsen MW, Andersen B and Midgley SE, Detected enterovirus (EV) genotypes in respiratory secretions from patients with respiratory illness in 2009-2015 in Denmark; submitted to Eurosurveillance november 2016.

B. Reports

1. Schjørring S, Kjelsø C, Müller L, VTEC O103 outbreak report, (in Danish), Epidemiology outbreak archive at SSI.
2. Schjørring S and Ethelberg S, Norovirus Outbreak report 2015, Epidemiology outbreak archive at SSI.
3. Schjørring S, Uldum SA, Bangsborg JM, Stegger M, Andersen PS, Petersen RF and Kjelsø C, Legionella ST82 outbreak report, Zealand 2014, Epidemiology outbreak archive at SSI.
4. European Centre for Disease Prevention and Control. Third External quality assurance scheme for *Listeria monocytogenes* typing Stockholm: ECDC; 2015. http://www.google.dk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiTlrGE5efPAhXGVywKHS_xDOgQFggbMAA&url=http%3A%2F%2Fecdc.europa.eu%2Fen%2Fpublications%2Fpublications%2Flisteria-eqa-4-2015-2016.pdf&usg=AFQjCNGtl5ThwJV_Nihd1jbNzRZ0i3-h0A&sig2=2J8maWUkekpZ4GKxzFqg8w
5. European Centre for Disease Prevention and Control. Sixth external quality assessment scheme for *Salmonella* typing. Stockholm: ECDC; 2015. http://ecdc.europa.eu/en/publications/Publications/salmonella-EQA-sixth.pdf.
6. European Centre for Disease Prevention and Control. Sixth external quality assessment scheme for typing of verocytotoxin-producing *E. coli* (VTEC). Stockholm: ECDC; 2015. http://ecdc.europa.eu/en/publications/Publications/VTEC-EQA-2015.pdf.
7. Jespersen S, Hansen PM, Schjørring S, Internal audit at SSI, PDC: Audit rapport nr 29534 (in Danish).
8. Schjørring S, Jørgensen CS, Kantsø B, Petersen RF, Valentiner-Branth P and Krogfelt K, Epi-news, Rickettsia diagnostic in Denmark 2008-2015. (http://www.ssi.dk/English/News/EPI-NEWS/2016/No%2025%20-%202016.aspx) English and Danish.
9. European Centre for Disease Prevention and Control. Fourth External quality assessment scheme for *Listeria monocytogenes* typing Stockholm: ECDC; 2016. http://ecdc.europa.eu/en/publications/Publications/listeria-eqa-4-2015-2016.pdf
10. European Centre for Disease Prevention and Control. Seventh external quality assessment scheme for *Salmonella* typing. Stockholm: ECDC; 2016. http://ecdc.europa.eu/en/publications/Publications/salmonella-typing-seventh-external-quality-assessment.pdf
11. European Centre for Disease Prevention and Control. Sixth external quality assessment scheme for typing of verocytotoxin-producing *E. coli* (VTEC). Stockholm: ECDC; 2016. (final revision at ECDC).
12. Schjørring S, Gil H, and Tryfinopoulou K, Biosecurity mitigation high MDR-TB report (EUPHEM homework, BQM).
13. Schjørring S, Audit report, Process Management and Quality Control and Documentation, VOF, SSI (EUPHEM homework BQM).
14. Condell O, Schjørring S Jensen MBF and Scheutz F. External quality assessment scheme for typing of verocytotoxin-producing *E. coli* (VTEC), self-funded participants 2014-15 (sent to Participants and published

on SSI´s homepage.
http://www.ssi.dk/~/media/Indhold/EN%20-%20engelsk/Public%20Health/National%20Reference%20Laboratories/EQA%20for%20typing%20of%20verocytotoxinproducing%20E%20coli%20VTEC%20selffunded%20participants%20201420155.ashx

15. Petersen A, Barnadas C, Schjørring S and Scheutz F. External quality assessment scheme for typing of verocytotoxin-producing E. coli (VTEC), self-funded participants 2015-16 (in preparation).
16. Schjørring S and Hoffmann S, internal SSI report, PCR positive gonococcus reports and lack of specimens for culture.
17. Schjørring S and Michael Rasmussen, internal SSI report, Evaluate if a kit can be used to separate *M. chimaera* from other nontuberculous species.

C. Conference presentations

1. Uldum SA, Stegger M, Bangsborg JM, Schjørring S, Andersen PS, Petersen RF, Kjelsø C, "Was it a cluster/outbreak of *L. pneumophila* serogroup 1 subgroup Allentow/France ST82 infection?" (Accepted for an oral presented at ESGIL 2015, by Søren Uldum).
2. Midgley SE, Trebbien R, Schjørring S, Christiansen CB, Poulsen MW and Fischer TK, Diversity of enteroviruses in respiratory samples: Challenges for entero- and rhinovirus diagnostics and genotyping (Accepted for poster presentation at ESCV, Edinburg 2015).
3. Schjørring S, Jørgensen CS, Kantsø B, Petersen RF, Valentiner-Branth P and Krogfelt K, Trends of Rickettsiaosis in Denmark 2008-2015 (Accepted for poster presentation at ECCMID 2016).
4. Schjørring S, Jørgensen CS, Kantsø B, Petersen RF, Valentiner-Branth P and Krogfelt K, Rickettsia infections in Denmark 2008-2015 (Accepted for poster presentation at Nordic Tick conference 2016).
5. Schjørring S, Fischer TK, Andersen PHS, Nielsen J, Poulsen MW, Andersen B and Midgley SE, Enterovirus (EV) and their role in respiratory illness in Denmark, 2009-2015. (Approved for oral communication at ESCAIDE 2016).
6. Schjørring S, Jensen MBF, Joensen KG, Krill K, Persson S and Nielsen EM, Two major subtypes of *Clostridium difficile* 027 are circulating in Denmark (Submitted for ESCAIDE 2016).

A. Other presentations

1. EPIET/EUPHEM forum: Denmark´s Preparedness for Ebola.
2. EPIET/EUPHEM forum: Outline of process of the Legionella outbreak and feedback on proposed approaches.
3. EPIET/EUPHEM forum: Outline of process of the Norovirus outbreak in a Canteen in Copenhagen and feedback on proposed approaches.
4. EPIET/EUPHEM forum: Outline the rickettsia project.
5. EPIET/EUPHEM forum: Journal club, Measles outbreak at the Faroe Islands 1846.
6. Department of Microbiology & Infection Control: What is a EUPHEM?
7. Department of Microbiology & Infection Control: EQA of Molecular typing.
8. Presentation on Horizontal gene transfer (IC).
9. Presentation on Denmark´s Preparedness for Ebola, the ECDC board (IMMPH).
10. Lecture on Quality assurance, teaching objective, (BQM).
11. Presentation on *Streptococcus* group B, vaccine development, (VAC).
12. Presentation on prevalence of enterovirus genotypes in Denmark in the period 2009-15, (PRM).
13. Presentation on Enterovirus typing methods: Development of a multiplex real time RT - PCR to distinguish enterovirus species (Nordic Mini Module, DK).
14. Presentation on Rickettsia in Denmark in the period 2008-15, (Nordic Mini Module, SW).
15. EUPHEM fellowship 2014-2016 by Susanne Schjørring, Statens Serum Institut department meeting.

9. EPIET/EUPHEM modules attended

1. Introductory course (IC), Spetses, Greece, 2014 (three weeks).
2. Outbreak module, Berlin, Germany, 2014 (one week).
3. Initial management PHM and leadership/teamwork (IMPHM), Stockholm, Sweden, 2015 (one week).
4. Biorisk and quality control/quality management (BQM), Stockholm, Sweden, 2015 (one week).
5. Multivariable analysis module (MVA), Vienna, Austria, 2015 (one week).
6. Nordic Mini Module, Copenhagen, Denmark, 2015 (1.5 days).
7. Vaccinology Module (VAC), Krakow, Poland, 2015 (one week).
8. Rapid Assessment and Survey methods (RAS), Athens, Greece, 2015 (one week).
9. Project review module (PRM), Lisbon, Portugal, 2015 (one week).
10. Bioinformatic & Phylogeny (BIP), Stockholm, Sweden, 2015 (one week).
11. Nordic Mini Module, Stockholm, Sweden, 2016 (1.5 days).
12. Project review module (PRM), Lisbon, Portugal, 2016 (one week).

Discussion

Coordinator's conclusions

One of the main goals of the EUPHEM programme is to expose fellows to diverse and multidisciplinary public health experiences and activities, thus enabling them to work across different disciplines. This report summarises all activities and projects conducted by Susanne Schjørring during her two-year EUPHEM fellowship (cohort 2014) as a member state track fellow at the Staten Serum Institut in Denmark. Susanne is the first appointed MS track EUPHEM fellow in Denmark. The projects described in this portfolio demonstrate the breadth of public health microbiology. Outbreak and surveillance activities extended from regional to national and outbreaks with excellent public health outputs in terms of formulation of recommendations, analysis of national databases and contribution towards disease specific networks at the national level. The outbreak investigations conducted incorporated all ten step steps of an outbreak investigation and were diverse, ranging from foodborne, and respiratory diseases investigations. The laboratory and epidemiologically based projects covered a range of disease programmes involving multidisciplinary working and teamwork on all levels such as physicians, laboratory technicians, epidemiologists, statisticians, government officials and public health officers, strengthening the fellow's ability to work within such an environment. The contributions made by this EUPHEM fellow towards public health in Denmark and also within Europe as with other fellows in particular her work with quality management has highlighted the importance of developing a future critical mass of highly competent field public health microbiologists within Member States to contribute towards national preparedness as well as being available for international responses in the interest of the EU. The EUPHEM Coordinator Team concludes that the fellow has succeeded in performing all her objectives to a high standard and with a professional attitude. We wish the fellow every success in her future career as a public health microbiologist.

Supervisor's conclusions

During the two-year fellowship at SSI, Susanne Schjørring has been involved in a variety of public health activities as described in the core competencies of the EUPHEM program.
The fellow has during the fellowship solved the tasks in a highly competent manner. She has worked independently but appropriately seeked assistance where appropriate. There have been challenges in the projects, and also in the status implied in being Denmark's first member state fellow. Susanne has coped well with both the challenges and has managed to pave the way for following MS-Tracks fellows. Susanne has during the program developed both personally and professionally. As a person Susanne is positive to challenges, caring about the well-being of colleagues and a very good team player. However, Susanne is a perfectionist and has learned during her EUPHEM-Training with many deadlines and red-lines to meet that sometimes "almost perfect" is acceptable. As a future leader this might well be a very important leaning point for her. Susanne's projects has been within the institute's strategy and core activities. She has generated new information that will improve surveillance of infectious diseases in Denmark, as described by all 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 Susanne´s efforts specifically, have enriched the departments and strengthened collaboration between the microbiology laboratories and the Department of Epidemiology and will continue to after the EUPHEM fellowship have ended.

Personal conclusions of fellow

The EUPHEM programme has been a great opportunity to gain skills and practical experience in Public health projects across a broad range of departments and pathogens at SSI. 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 opportunity of field work. 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 at the modules. 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 not only at SSI but across EU.

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