EUPHEM

EUPHEM REPORT

Summary of work activities

Pieter W. Smit

European Public Health Microbiology Training Programme (EUPHEM), 2012 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 2014

This report summarises the work activities undertaken by Pieter Smit, cohort 2012 of the European Public Health Microbiology Training Programme (EUPHEM) at the National Institute for Health and Welfare (THL), Helsinki, Finland.

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.

Material and methods

This report accompanies a portfolio detailing the various activities conducted during the EUPHEM fellowship. The activities comprised specific projects, investigations 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 due to confidentiality regulations.

Results

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

Supervisors: Hanna Soini, Ruska Rimhanen-Finne, Markku Kuusi, Francis Drobniewsky, Outi Lyytikäinen

A. Tuberculosis outbreak investigation, Turku, Finland 2012-2014

An outbreak of tuberculosis (TB) occurred in November 2012 among school-age adolescents. For the outbreak investigation, 14 TB cases were identified, over 600 close contacts were interviewed and screened and 219 close contacts were tested with Interferon Gamma Release Assay for latent TB infection. In order to understand and describe the transmission dynamics at a higher resolution, 12 *M.tuberculosis* cultures were sequenced using whole genome sequencing. Social network analysis and transmission dynamics revealed that the outbreak was larger than expected and transmission to casual contacts had occurred. The use of whole genome sequencing therefore had a direct public health impact that led to preventive and educational action.

B. Norovirus outbreak in a hotel, Espoo, Finland, May 2013

An outbreak of gastrointestinal disease among hotel guests was reported to the National Institute for Health and Welfare (THL) in May 2013. Questionnaires were sent by mail to the visitors of the hotel, environmental and laboratory investigations were conducted to characterise the outbreak and recommend control measures. Cases were defined as visitors who developed symptoms of diarrhoea or vomiting within 72 hours after visiting the hotel in May 2013. From the 355 persons interviewed, 172 met the case definition (49%). Investigations confirmed that drinking water was significantly associated (1.84 95% CI 1.3-2.2) with illness. Microbiological investigations of clinical and environmental samples identified norovirus as the causative agent. After thorough cleaning of the well by a professional cleaning company and cleaning of the premises, no new gastroenteritis cases were identified at the hotel.

C. Hepatitis A outbreak among travellers returning from Egypt

This investigation involved a multistate outbreak of hepatitis A virus (HAV) among European travellers returning from Egypt between November 2012 and April 2013. Common exposures and details of the cases' vaccinations were assessed using trawling questionnaires and case-control studies. HAV sequencing was performed to determine the relatedness of strains isolated from cases. Responding cases (n=43) were interviewed using questionnaires developed by the international outbreak investigation team. Overall, 14 EU-EFTA countries reported 107 cases returning from Egypt. Cases were clustered around all-inclusive hotels in the Red Sea area. Twenty-one genotyped cases from six countries had sub-genotype IB and shared identical RNA sequences, suggesting a

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

common source outbreak. The case-control study found cases associated with exposure to strawberries or mango (multivariable analysis P value 0.04). No cases had been vaccinated. The most common reasons for not being vaccinated were not knowing that HAV vaccination was recommended (23/43, 53.5%) and perceiving the infection risk as low at an all-inclusive luxury resort (19/43, 44.2 %). Vaccination had not been recommended to five of the six cases who sought travel medical advice before travelling. Public health authorities should strongly reiterate to travellers, travel agencies and healthcare providers the importance of vaccination prior to visiting HAV-endemic areas, including Egypt.

D. Modules

The EPIET/EUPHEM introductory course familiarised participants with the methods and logistical aspects of outbreak investigations. The module 'Computer tools in outbreak investigations' taught essential data management skills (entering, validating and cleansing data), dataset management and how to perform case-control studies (descriptive and cohort studies, including stratified analyses).

Educational outcome: Participation in outbreak team meetings and teleconferences, involvement in outbreak investigations (case definitions, active case-finding, data collection, data analysis, on-site visits), writing of reports and scientific articles, implementation of prevention measures.

1.2. Surveillance

Carita Savolainen–Kopra, Hanna Soini, Petri Ruutu, Outi Lyytikäinen, Jaana Vuopio, Mika Salminen, Jari Jalava

A. Surveillance of Group A Streptococcus in Finland 2008—2013

Surveillance data on invasive Group A *Streptococcus* (*S. pyogenes*) infections and microbiological characterisation data of corresponding isolates was analysed to assess epidemiological trends of invasive Group A *Streptococcus* in Finland during the period 2008-2013. A total of 1 165 cases with invasive Group A *Streptococcus* were reported: 54% were males and 50% of all cases were >55 years of age. The annual incidence rates varied 3.15—4.13 per 100 000 inhabitants (p:< 0.003) but there was no noticeable trend over the study period (P>0.05). A total of 1 121 invasive GAS isolates (96%) were analysed by *emm* typing; 73 different *emm* types including subtypes were found, the most common were *emm*28 (297 isolates, 26%), *emm*89 (193 isolates, 12%), and *emm*1 (132 isolates, 12%). An *emm* type 'uncommon' to Finland - *emm*33 - was detected in 2012 (5/207 cases, 2%) in southern Finland and also found in three other regions (West, Central and East) during 2013 (13/176, 7%). All the 18 *emm33* isolates were macrolide and clindamycin resistant due to *erm*(TR) genes. In addition, PFGE analysis of the *emm*33 isolates showed a 100% identical PFGE pattern.

The overall rate of invasive Group A *Streptococcus* infections in Finland remained relatively high although an increasing trend was not observed. The study identified clonal spread of a macrolide-resistant invasive emm Group A *Streptococcus* type. This emm type was novel, suggesting its recent introduction into Finland. As macrolide resistance is uncommon (~2-6%) in Finland, it is important that national guidelines and antibiotic policies adequately respond to the emergence of macrolide-resistant strains in order to maintain low resistance rates and prevent treatment failures. This study underlined the necessity of monitoring the spread of invasive Group A *Streptococcus* infections and the emergence of novel invasive clones.

B. Evaluation of the environmental polio surveillance system in Finland

Since 1961, an environmental polio surveillance system has been in use in Finland. Due to the current global polio situation and outbreaks in Somalia and Syria, the Finnish polio surveillance system needed to be evaluated. The usefulness of the surveillance system and attributes such as flexibility, stability, acceptability, and simplicity of the surveillance system were assessed. The evaluation identified many strong points and was able to pinpoint aspects for improvement, such as the database, adjustments necessary at the specimen collection sites and more specific aims and objectives for the surveillance system. Following the evaluation, guidelines were written to improve the locations where the environmental samples are collected, structure the process of selecting sites and help determine how many samples are needed.

D. Modules

The EPIET/EUPHEM introductory course familiarised participants with the development, evaluation and analysis of surveillance systems. Building on this course, the module on 'multivariable analysis' demonstrated the principles, application and interpretation of multivariable analysis and its role in field epidemiology.

Educational outcome: Participation in disease-specific networks at the national and European levels; analysis of laboratory-based surveillance systems at hospital, country and European level; familiarity with multivariable analysis; phylogenetic analysis in order to provide surveillance systems with microbiological support; scientific articles and the formulation of specific public health recommendations.

2. Applied public health microbiology research

Supervisors: Hanna Soini, Petri Ruutu, Nalin Rastogi, Outi Lyytikäinen

A. Genotypic characterisation and historical perspective of Mycobacterium tuberculosis among older and younger Finns, 2008–2011

The *Mycobacterium tuberculosis* genotypes obtained from older Finns were assessed and compared to those obtained from younger Finns to comprehend the epidemiology of tuberculosis (TB) in Finland. From 2008–2011, a total of 1 021 *M. tuberculosis* isolates were characterised by spoligotyping and MIRU-VNTR-15. In total, 733 Finnish-born cases were included in the study, of which 466 (64%) were born before 1945 (elderly Finns). Younger Finns were significantly more likely to be clustered (56% vs. 27%, p<.001), have pulmonary TB (87% vs. 71%, p<.001) and to be sputum-smear-positive (57% vs. 48% p<0.05), indicating that the risk of TB transmission from younger Finns is likely to be greater than from elderly Finns. *M. tuberculosis* isolates from elderly Finns were associated with dominant lineages of the early 20th century and differed from the heterogeneous lineages found among younger TB patients. Awareness among clinicians of TB among younger Finns needs to be increased in the country.

B. Modules

While the EPIET/EUPHEM introductory course focused on the development and presentation of study protocols, the module 'Initial management in public health microbiology' focussed on laboratory aspects, time management and collaboration as a team.

Educational outcome: Preparation of study protocols; questionnaire design; organisation of a multicentre study; interpretation of typing results; data analysis; writing of scientific articles; scientific presentation at a conference.

3. Applied public health microbiology and laboratory investigations

Supervisors: Jaana Vuopio, Jari Jalava, Hanna Soini, Maija Toropainen, Satu Kurkela, Olli Vapalahti, Markku Kuusi

A. Molecular epidemiology of tuberculosis in Finland, 2008–2011

In industrialised countries the majority of tuberculosis cases are linked to immigration. In Finland, most cases are still Finnish born but the number of foreign-born cases is steadily increasing. In this four-year population-based study, the TB situation in Finland was characterised by a genotypic analysis of *Mycobacterium tuberculosis* isolates. A total of 1 048 *M. tuberculosis* isolates (representing 99.4% of all culture-positive cases) were analysed by spoligotyping and MIRU. Spoligotype lineages belonging to the Euro-American family were predominant among the Finnish isolates, particularly T (n=346, 33.0%) and Haarlem (n=237, 22.6%) strains. The lineage signature was unknown for 130 (12.4%) isolates. In total, 23 new SIT designations were given and 51 orphan strains were found, of which 58 patterns were unique to Finland. When compared to neighbouring countries, phylogeographical TB mapping showed that the population structure in Finland most closely resembled that observed in Sweden. In conclusion, a large proportion of the *M. tuberculosis* isolates were from Finnish-born elderly patients. Moreover, many previously unidentified spoligotype profiles and isolates belonging to unknown lineages were encountered.

B. Sudden increase of invasive Haemophilus influenzae cases, Finland 2013

In 2013, the reference laboratory observed an increase in invasive *H.influenzae* cases. The Finnish national infectious disease registry was analysed to assess the geographical spread and patient characteristics compared to previous years. The epidemiological investigation revealed no difference in time, place and person, although an increase in non-capsulated *H.influenzae* was observed. As current typing methods in Finland are unable to genotype this type of *H.influenzae* strain, the increase could not be assessed in greater detail. To be prepared for a further increase of invasive cases in the future, training was undertaken on Multi Locus Sequence Typing in the Netherlands and the method was set up for use in Finland. Although the sudden increase in invasive *H.influenzae* cases came to an end a few months later, in the future the reference laboratory will be able to assess sudden increases in the number of invasive *H.influenzae* cases in greater detail.

C. Evaluation of Lyme borrelia rapid diagnostic tests

The diagnosis of Lyme disease is complicated and no single diagnostic method can rule out infection. We assessed the performance of two commercially available *Borrelia burgdorferi* rapid diagnostic tests (RDT) compared to multiple laboratory-based diagnostic assays, using specimens with a gradually increasing probability of *Borrelia* infection. Based on 200 samples, the sensitivity for detecting Lyme Borrelia cases using Lyme rapid diagnostic tests and Borreliose rapid diagnostic tests was low (26% and 32% respectively). However, the specificity was reasonably good (85% and 88%). Based on this evaluation, these rapid diagnostic tests are not recommended for diagnostic purposes and should not be used in clinical settings or relied upon by the general public.

Educational outcome: Application of laboratory methods to analyse and interpret resistance mechanisms; understand the limitations of laboratory methods; analyse laboratory, drug resistance and national surveillance data; make scientific presentations at conferences and write scientific articles.

4. Biorisk management

A. Biorisk management module, ECDC, Sweden

This five-day module provided techniques for biorisk/biosafety assessment and mitigation, including WHO recommendations on biosafety management in laboratories. One day focused on international regulations for the transportation of dangerous goods, as determined by ICAO (International Civil Aviation Organization).

B. Theoretical and practical biosafety level 3 (BSL3) training, National Institute for Health and Welfare, Finland

The training consisted of a two-day theoretical part and a practical part that was incorporated into one of the projects and took place at the BSL3 laboratory of Finland's national mycobacterial reference centre.

Educational outcome: Understand processes associated with BSL3/BSL4 laboratories; experience different personal protective equipment; understand the principles and practices of biorisk management; biorisk assessment and biorisk mitigation.

5. Quality management

Supervisors: Aftab Jasir, Heidi Hochstenbach

A. Proposal for quality assurance methods for rapid diagnostic tests, Chad

Rapid diagnostic tests (RDT) are offering developing countries improved accessibility and quality of care for the diagnosis of patients within minutes. Given that these tests can be used with minimal training, quality assurance is complicated but essential when they are used in warm climates. As Médecines sans Frontières provide RDTs for their own clinics and Ministry of Health clinics, it was necessary to develop a quality assurance system. A proposal was written that included proficiency panel testing, standardised kit lot testing, setting up a central point of distribution and procedure for distribution of known positive and negative samples for weekly testing at the clinics.

Educational outcome: Evaluation of shipment procedures and their potential to affect the quality of RDTs, development of a detailed protocol, understanding and applying the principles and practices of biorisk management, quality assurance and quality control.

6. Teaching and pedagogy

A. Global health course

Lecture within the global health course for international students, National Institute for Health and Welfare, Finland.

B. Epidemiology course

Case studies and lecture for medical students at Tampere University, Finland

C. The use of Whole Genome sequencing in infectious disease outbreaks

Lecture for medical students at Turku University, Finland.

Educational outcome: Planning and organisation of lectures; guiding of case studies, defining learning objectives and teaching laboratory and microbiology topics to epidemiologists.

7. Public health microbiology management

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

This one-week module focused on understanding roles and responsibilities in public health management. Topics included the identification of different management styles, team roles and team evolution, the delegation of tasks and the provision of structured feedback.

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

Public health microbiology management was an integral component of all projects and activities during the fellowship. This included laboratory management, ethical and integrity considerations, team building and coordination, research collaboration, time management, management of cultural differences in international contexts and working in a multidisciplinary team with microbiologists, physicians, laboratory technicians, epidemiologists, statisticians, government officials, public health officers and logisticians.

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

8. Communication

A. Publications

1. Smit PW, Haanperä M, Rantala P, Couvin D, Lyytikäinen O, Rastogi N, et al. Molecular epidemiology of tuberculosis in Finland, 2008-2011. PLoS One. 2013 Dec 26;8(12):e85027
2. PW, Haanperä M, Rantala P, Couvin D, Lyytikäinen O, Rastogi N, et al. Genotypic characterization and historical perspective of *Mycobacterium tuberculosis* among older and younger Finns, 2008–2011. Clinical Microbiology and Infection, 2014 July
3. Smit PW, Kurkela S, Kuusi M, Vapalahti O. Retrospective evaluation of two commercially available rapid diagnostic tests for Lyme Borrelia. European Journal of Clinical Microbiology & infectious Diseases, July 2014
4. Smit PW, Vasankari T, Aaltonen H, Haanperä M, Casali N, Marttila H. Tuberculosis Outbreak Investigation Using Whole Genome Sequencing and Interferon Gamma Release Assay. Submitted to European Respiratory Journal 2014
5. Soini J, Smit PW, Huusko S, Sälke S, Ollikka J, Hemminki K, et al. Norovirus outbreak in hotel, Finland, 2013. (In preparation).
6. Smit PW, Lindholm L, Jalava J, Lyytikäinen O, Pätäri-Sampo A, Sihvonen R. Epidemiology and emm types of invasive Group A Streptococcal infections in Finland. (In preparation).

B. Reports

1. Pieter W. Smit. Epidemiological and Microbiological investigation of increase of *Haemophilus influenzae,* National Institute for Health and Welfare, 2012
2. Pieter W. Smit. Outbreak investigation of a norovirus outbreak in a hotel in Finland, National Institute for Health and Welfare, 2013
3. Pieter W. Smit. Evaluation of the Finnish polio environmental surveillance system, National Institute for Health and Welfare, 2014

C. Teaching materials

Case study on the investigation of an outbreak of tuberculosis in Turku, Finland (2014) for the 22th EPIET/EUPHEM introductory course.

D. Conference presentations

1. Smit PW, Haanperä M, Lyytikäinen O, Rastogi N, Soini H. Molecular epidemiology of tuberculosis in Finland, 2008–2011. National infectious disease day, Helsinki ,Finland 2013.
2. Smit PW, Haanperä M, Lyytikäinen O, Rastogi N, Soini H. Cluster analysis of tuberculosis cases in Finland 2008–2011. ESCAIDE, Stockholm, Sweden, 2013.
3. Smit PW, Lyytikäinen O, Vasankari, T, Casali N, Soini H. Tuberculosis outbreak investigation using whole genome sequencing, ESM, Vienna, Austria
4. Smit PW, Lyytikäinen O, Vasankari, T, Casali N, Soini H. Tuberculosis outbreak investigation using whole genome sequencing and interferon gamma release assay. ESCAIDE, Stockholm, Sweden, 2014.
5. Epidemiology of invasive *S. pyogenes* infections in Finland 2008–2013; clonal spread of a newly-introduced invasive *Streptococcus pyogenes emm* type 33.0. 2014. Lancefield International Symposium on *Streptococci* and Streptococcal Diseases, Buenos Aires, Argentina

F. Selection of other presentations

1. Smit PW. The use of dried blood spots as a novel tool for epidemiological investigations, 2013, National Institute for Health and Welfare, Finland
2. Smit PW, Lyytikäinen O, Vasankari, T, Casali N, Soini H. Tuberculosis outbreak investigation using novel techniques, FILHA, Stockholm, Sweden, 2014.

9. International missions

Supervisors: Aftab Jasir, Ruby Siddiqui

A. Epidemiological support to the Médecins sans Frontières (MSF) emergency malaria team in Am Timan, Chad

Several regions In Chad experienced the start of a large malaria outbreak in 2013. The fellow was assigned to organise a 'Knowledge, Attitudes and Practises' survey on the use of bed nets. This involved managing the study, organising a two-day training course and supervising data collection by 12 interviewers. Additionally, the fellow was part of the emergency malaria response team which focused on expanding the MSF malaria response activities to villages where no care was yet being provided yet MSF. The fellow was responsible for providing intellectual and strategic input to the team. The team consisted of three foreign and nine national staff. Mortality and malaria outbreak reports were distributed on a weekly basis to the Chad Ministry of Health and MSF headquarters. The mission lasted six weeks in total.

Educational outcome: Coordination of surveillance and active case-finding activities; coordinating and performing KAP study; analysis of surveillance databases; writing of surveillance reports and study report; development of training programme; collaboration with emergency response team.

10. EPIET/EUPHEM modules attended

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

11. Other courses

STATA course (seven sessions), National Institute for Health and Welfare, Finland
Theoretical biosafety level 3 (BSL3) training, National Institute for Health and Welfare, Finland (two days)
Design of diagnostic studies, (four weeks) online course, Freiburg, Germany

Discussion

Coordinator's conclusions

One of the main goals of the EUPHEM programme is to expose the fellows to different public health experiences and activities, thus enabling them to work across various disciplines.

This report summarises all activities and projects conducted by Pieter Smit during his two-year EUPHEM fellowship (cohort 2012) at the National Institute for Health and Welfare (THL), Finland.

The projects described here show the breadth of public health microbiology. Outbreak and surveillance activities ranged from small, local-community and hotel outbreaks to the analysis of national databases. Outside of Europe, international missions to Chad contributed to the understanding of important international public health issues. Laboratory and epidemiological projects 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 disease 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.

Activities were in line with the 'learning by doing' and 'on-the-job' training service approach of the EUPHEM programme and followed the core competency domains described professionals in mid-career and above. Activities were complimented by nine training modules providing theoretical knowledge. Projects had a clear educational outcome, with results communicated in scientific journals and at conferences.

The EUPHEM coordinator team concludes that the fellow has succeeded in performing all his tasks to a very high standard and with a professional attitude. This included his leadership abilities and social competencies.

Supervisor's conclusions

Dr Pieter Smit was the first EUPHEM fellow based at the National Institute for Health and Welfare. This two-year training programme has turned out to be very successful for a number of reasons. For the host institution, it gives the opportunity to build new bridges and strengthen collaboration between the different sectors in the field (such as various disciplines of public health microbiology, epidemiology and clinical medicine). At the same time it has also allowed us to evaluate and improve our internal laboratory practices. As the fellow visits the different units and discusses his/her projects and results with the local experts, knowledge of public health microbiology eventually spreads. As Pieter Smit was a smart and quick learner and a skilful writer, we were also able to produce several useful reports and other papers during this period. He also presented his findings at various national meetings (with very positive feedback from the audience), which further strengthens the output of his fellowship.

For Finland, hosting a EUPHEM fellow was a great pleasure, and we highly appreciate the training and public health microbiology (PHM) achievements gained.

C. Personal conclusions of fellow

The EUPHEM programme presents the unique opportunity to work in diverse projects across various departments, thus covering the entire field of public health microbiology in a two-year period. The fellowship successfully bridges the gap between microbiology and epidemiology by maintaining a close connection to the European Programme for Intervention Epidemiology Training (EPIET) network. EUPHEM fellows benefit from the fact that they are not restricted to conducting laboratory-based research, but instead learn to conduct field studies with the help of a multidisciplinary team. Based on the various courses that are given during the two years in combination with considerate supervision and guidance, essential public health skills are strengthened and knowledge of public health microbiology is increased. The EUPHEM programme strongly contributes to the growing public health microbiology community, enabling the fellows to establish personal networks between European public health laboratories.

Acknowledgements of fellow

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