

The section header "Summary of work activities" in a bold, white, sans-serif font, set against a blue background.

Horacio Gil

The main title of the report, "European Public Health Microbiology Training Programme (EUPHEM), 2014 cohort", in a white, sans-serif font, centered on a blue background.The section header "Background" in a bold, blue, sans-serif font.

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.

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Stockholm, November 2016

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This report summarises the work activities undertaken by Horacio Gil, cohort 2014 of the European Public Health Microbiology Training Programme (EUPHEM) at the Centro Nacional de Microbiología, Instituto de Salud Carlos III (CNM-ISCIII), Majadahonda, Madrid, Spain.

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

Horacio Gil is a Spanish bacteriologist with a veterinarian background, which has allowed him to develop his professional career in zoonotic diseases, especially in arthropod-borne bacteria and highly pathogenic microorganisms. During his PhD thesis, he evaluated the role of small mammals as reservoir hosts of *Borrelia burgdorferi* in the Basque Country (Spain), meanwhile in his post-doctoral period in the USA, he worked in the field of virulence factors of *Francisella tularensis*. Before EUPHEM, he was responsible for the research reference activities of *Bartonella* and *Leptospira* within the laboratory for Reference and Investigation in Special Pathogens, CNM-ISCIII.

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 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

The objectives of these 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 guide¹.

1. Epidemiological investigations

1.1. Outbreak investigations

A. Outbreak investigation of cholera in Ghana, 2014

Supervisors: Daniel Eibach & Silvia Herrera

Ghana is affected by regular cholera epidemics and an annual average of 3,066 cases since 2000. In 2014, this country experienced one of its largest cholera outbreaks within a decade with more than 20,000 notified infections. In order to attribute this rise in cases to a newly emerging strain or to multiple simultaneous outbreaks involving multi-clonal strains, outbreak isolates were characterized, subtyped and compared to previous epidemic strains from 2011 and 2012. The fellow performed the molecular identification of the *Vibrio cholerae* isolates and the initial characterization for detecting the presence of the cholera toxin in Ghana. In the laboratory of Reference and Investigation in Food and Waterborne Bacterial Diseases of the CNM-ISCIII (Spain), the fellow performed the phenotype characterization of 92 *V. cholerae* isolates by serotyping and determining the antibiotic susceptibility, and the genotype characterization by Pulse Field Gel Electrophoresis (PFGE). An increase of antimicrobial resistance was observed between 2011 and 2014. The analysis of the strains suggested that *V. cholerae* has an endemic reservoir in the environment and selection pressure results in a highly heterogeneous population of *V. cholerae*, with a few strains evolving into pathogenic clones during each outbreak period in Ghana. These results have been published recently in PLoS Neglected Tropical Diseases and presented at the German Society of Infectious Diseases and German society of Hygiene and Microbiology meetings. We recommended that public health authorities should be vigilant to prevent cholera transmission through aquatic reservoirs, particularly within

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>

urban agglomerations during the start of the rainy season, and a close monitoring of the emerging of the antibiotic resistance.

The fellow has shown in this project the public health importance of establishing laboratory based surveillance for cholera in Ghana to monitor the spread of multiresistant antimicrobial strains. The fellow has also provided data regarding the endemic strains which are circulating in the country. This allows the identification of non-endemic clones, which could be introduced into Ghana in the future, with potential dramatic consequences as has been experienced in the past other countries such as Haiti, if rapid and appropriate control measures are not implemented. In addition, the data obtained can be useful for detecting the spread of Ghanaian strains to other countries.

B. Analysis of a *Salmonella* outbreak signal in the Comunidad Autónoma Valenciana, Spain 2016

Supervisor: Silvia Herrera

Since 15th of January 2016, the laboratory of Reference and Investigation in Food and Waterborne Bacterial Diseases of the CNM-ISCIII had received nine isolates of the monophasic variant of *Salmonella enterica* serotype Typhimurium (4,5,12:i: -), which belonged to the phagotype 138 and showed resistance mechanisms to the betalactamics TEM-1 and CTX-M-9 (BLEE). The isolates came from the same region in Spain (Comunidad Autónoma Valenciana) and they were mostly isolated from children under 5 years (44%, 4 isolates). This unusual increase in this specific sero-phagotype suggested the existence of an outbreak. The fellow wrote a report on the descriptive epidemiology of the cases (time, place, person), thus informing the regional public health authorities in the "Comunidad Autónoma Valenciana" about the increasing incidence of this sero-phagotype, which triggered the outbreak investigation by the regional epidemiologist, identified the source of the infection and controlled the spread of the outbreak.

C. Analysis of a *Salmonella* Bovismorbificans outbreak in Spain, 2016

Supervisors: Silvia Herrera & Carmen Varela

From April 2015 to February 2016, the laboratory of Reference and Investigation in Food and Waterborne Bacterial Diseases of the CNM-ISCIII had detected an increase in the number of *Salmonella* serotype Bovismorbificans isolates compared to previous years. Most cases were women (58 %) and this serotype appeared prevalent in the age groups < 5 year old (16 %) and 50 y (48 %). The isolates were identified in 12 provinces of nine autonomous regions of Spain. The continuous detection of this infrequent serotype suggested a potential outbreak which was investigated further. The fellow in collaboration with Leonidas Georgalis (EPIET cohort 2014) sent from the Centro Nacional de Epidemiología (CNE-ISCIII) a request to the regional epidemiologists of the autonomous regions asking for case information. However, few additional data could be collected as they were old clinical cases. The laboratory of Reference and Investigation in Food and Waterborne Bacterial Diseases (CNM-ISCIII) performed the characterization of strains from 31 patients by PFGE (isolates from June 2015 to March 2016). The same pulsetype (XbaI.1474) was found in 14 patients from seven different regions in Spain. This pulsetype was also found in a strain isolated in June 2015 from a pig carcass. This isolate had been sent to the CNM-ISCIII for further characterization as part of the hygiene routine controls performed on meat carcasses in slaughterhouses. The fellow contacted the regional Public Health department where the isolate came from and the Food Spanish Agency for permission to share the information with the CNE-ISCIII and request additional data for tracing the origin of the pig. The obtained information traced the origin to three potential farms in three different provinces of Spain. No additional measures were taken, as the positive pig was identified nine months previously and no further cases were notified. For the identification of new cases and a more systematic collection of the information, a call to the regional laboratories was sent through the CNE-ISCIII and the regional epidemiologists, for submission of *Salmonella* serotype Bovismorbificans isolates to the CNM-ISCIII. The fellow and Leonidas Georgalis prepared a questionnaire to interview the new cases for collection of clinical and epidemiological data. The questionnaire asked for different food items, having a specific section for different pork products as it was the most likely source of the infection. No new cases were reported and the investigation could not proceed further.

Training modules

The EPIET/EUPHEM introductory course exposed fellows to the fundamentals of an outbreak investigation in several lectures and case studies. The outbreak module taught essential data management skills (entering, validating and cleaning data), dataset management, designing cohort and case-control studies and statistically analysis of the data using STATA. The multivariable analysis module showed the usefulness of this methodology in the identification of third factors such as effect modification or confounding, and its potential application in an outbreak investigation.

Educational outcome: involvement in the different steps of an outbreak investigation, including participation in the initial response to a suspected outbreak, integration of microbiological and epidemiological knowledge to investigate outbreaks, creating a questionnaire for an epidemiological investigation, tracing a potential contamination food item, performing laboratory testing in an outbreak investigation, formulating recommendations

based on the analysis of the laboratory data; understanding the complexity of the Spanish regional Public Health departments interactions in a national outbreak investigation; working in a multidisciplinary team; writing a report.

1.2. Surveillance

A- Virological and epidemiological surveillance of influenza in Spain

Supervisors: Francisco Pozo, Inmaculada Casas & Amparo Larrauri

This project assessed the methods used for virological and epidemiological surveillance of influenza activity in Spain during the 2014-15 influenza season. The project was performed in liaison with the Spanish Reference Influenza Laboratory at CNM-ISCI III and the Influenza Surveillance Unit at CNE-ISCI III.

In the Influenza Laboratory, the fellow identified and characterized types and subtypes of circulating strains of influenza viruses, assessed emergence of antiviral resistance, and analyzed strains to contribute towards the annual formulation/composition of the influenza vaccine content. The fellow in collaboration with Mathieu Bangert (EUPHEM cohort 2013) improved the Laboratory Information Management System (LIMS) in the unit, creating a script to merge several databases and preparing the weekly laboratory data to be submitted to the Global Initiative on Sharing All Influenza Data (GISAID) and to the CNE-ISCI III. The fellow also contributed to the national laboratory influenza surveillance by analyzing weekly data for reporting to the National Weekly Surveillance Report and contributed to international laboratory surveillance by uploading virological information to The European Surveillance System (TESSy).

In the Influenza Surveillance Unit (CNE-ISCI III), assessment of the intensity of influenza activity is currently estimated using historical data from the Spanish Influenza Sentinel Surveillance System (SISSS) using qualitative indicators from the European Influenza Surveillance Network. These indicators are subjective and prone to their own interpretation and cannot be compared amongst the different networks of the SISSS. The Moving Epidemic Method (MEM) has been proposed by ECDC for harmonizing the reporting of the intensity indicator, but the impact of implementing MEM within the SISSS has not been explored. To investigate the potential value of using MEM in the standardization of influenza reporting indicators among regions in Spain, the fellow in collaboration with Mathieu Bangert, applied the MEM method to the 2014-15 influenza season at the national and regional level within the SISSS. This pilot study suggested that implementing MEM will not create significant differences in reporting this indicator compared with the current method. A manuscript with the results from this pilot study has been accepted for publication in *Epidemiology and Infection*. These results were also presented in an oral communication at ESCAIDE. In addition, a report with the results of the pilot study was sent to the different networks of the SISSS, being MEM accepted and implemented in the influenza season 2015-2016 by the SISSS. In this project the fellow has contributed to the influenza surveillance system, which is a key for monitoring the seasonal influenza, a critical tool for taking decisions to control this disease, and consequently with an important impact in public health. First, the fellow has provided virological data to SISSS and has simplified the report of data to CNE-ISCI III and TESSy from the CNM-ISCI III; second he has contributed to implement MEM in SISSS for harmonizing the report of the influenza intensity at national and international level.

B- Measles surveillance in Spain, 2015

Supervisors: Josefa Masa

WHO/Europe placed a high priority on the elimination of measles and rubella from the European Region by 2015, where surveillance plays a central role. The fellow reviewed the measles cases reported during 2015 in the national surveillance database (SIVIES). This data will be used for preparing the 2015 annual measles report for WHO and for monitoring progress towards measles elimination in Spain. A total of 38 measles cases, 32 laboratory confirmed, were reported in the system. A total of 47% occurred in children under 5-years-old. Twenty nine cases were associated with five outbreaks, comprising two to 15 patients. Five were imported cases from European and Asian countries. The vaccination status was known in 30 cases, either as unvaccinated or incomplete vaccination. Seven cases were related to individuals who were not vaccinated for their beliefs. The small number of outbreaks without dissemination is characteristic of the elimination phase of the disease. We recommended the rapid notification of suspected cases in order to effectively reach the WHO goals for the elimination of Measles in Spain and the EURO zone.

In this project, the fellow has contributed towards the analysis of surveillance data for monitoring measles cases, which is needed to evaluate the measles control plan and particularly critical during the last stages of measles elimination, where we are currently.

Training modules

The EPIET/EUPHEM introductory course exposed fellows to the development, evaluation and analysis of surveillance systems. The module on 'Bioinformatics and phylogenetics' provided essential tools to interpret the microbiological data. The vaccinology module taught the use of data from the surveillance system for evaluation of vaccination programs. The rapid assessment and survey methods module showed how to set up a surveillance system and interpreted data generated in this system in the context of a complex emergency situation.

Educational outcome: Understanding of the need to integrate microbiological and epidemiological data in disease surveillance; identification of a common goal; performing data and phylogenetic analysis in order to provide surveillance systems with microbiological support; understanding in disease-specific networks at the

national and European levels; pilot a new system proposed by ECDC for harmonising the reporting of intensity and trend influenza indicators; understanding the importance of national and international surveillance in the plan for measles elimination; formulation of specific public health recommendations; multidisciplinary teamwork; preparing a scientific presentation at a conference; writing a report and a scientific article.

2. Applied public health microbiology research

A. HIV-1 transmission clusters in Spain: Role in the propagation of transmitted resistance mutations and the spread of the infection

Supervisors: Elena Delgado, María Teresa Cuevas, Miguel Thomson & Lucía Pérez

The success of antiretroviral treatment may be limited by the emergence of HIV drug resistance, which can be transmitted to newly infected individuals. The HIV Biology and Variability Unit (HBVU) at CNM-ISCIII routinely analyze samples for drug-resistance, providing information to clinicians to implement the appropriate antiretroviral treatment to patients. The fellow has improved the LIMS in the HBVU, cleaning its current local database, which had more than 17,000 registers, creating a user-friendly interface in Access and semi-automatizing the introduction of data and laboratory results, thus avoiding mistakes. The fellow in collaboration with Leonidas Georgalis compared the patient information in this database with notified cases in the national surveillance system to estimate the representability as the patients cannot be linked in both databases. In addition, they extracted information from the database for the HBVU annual report regarding laboratory results obtained in the samples received from the Basque Country (Spain). This report provides useful information for decision-makers in the implementation of control measures in this Spanish region.

HIV-1 strains which group phylogenetically in transmission clusters (TCs) and disseminate more rapidly than non-TCs strains. Moreover, propagation of transmitted drug resistance (TDR) within some TCs represents a serious public health problem. In this project, the fellow studied 625 individuals diagnosed during 2013-2015 in two regions of Spain (Basque Country and Galicia) to determine the role of TCs in the epidemiology of the infection. A total of 107 TCs were identified amongst the studied individuals by phylogenetic analysis. This analysis included the sequences from these 625 patients and 7,688 additional sequences from HIV-1 infected individuals from Spain (1999-2012) for assigning and sizing the TCs. Fifty five percent of the patients from the two studied Spanish regions diagnosed during 2013-2015 were included in TCs and six presented TDR associated with high resistance. The fellow in collaboration with Leonidas Georgalis studied the risk factors associated with individuals belonging to TCs. Men were more likely to belong to TCs than women. Men having sex with men (MSM) were more likely to belong to TCs than other risk groups such as heterosexuals or injecting-drug users. We recommended early detection of TCs and to focus upon effective measures for prevention of high risk transmission groups, especially amongst MSM, which will ultimately reduce HIV-1 infection TCs and the incidence of TDR within these regions. A manuscript with these results is under preparation. Also, several communications have been presented at the AIDS 2016 conference as well as at the Spanish Interdisciplinary AIDS Society.

The fellow has built a bridge between the HIV research groups in the CNM-ISCIII and the CNE-ISCIII for sharing data and collaborating in future projects. Also, improving LIMS in HBVU will provide a most accurate and valuable source of data for monitoring the evolution of the TCs, the TDRs and trends of HIV infections. In this project, the fellow has analyzed the role of TCs in the epidemiology in two regions of Spain. Knowledge of the populations which are involved in TC facilitates the design of prevention programs and public health interventions focusing on transmission chains, which could reduce the spread of the HIV infections and the TDR. The sequences from the virus identified in TCs are being deposited by the fellow in public databases, improving the HIV surveillance at national and international level, allowing the identification of TCs which could be spreading in different regions or countries.

B. Presence of zoonotic *Giardia* and *Cryptosporidium* in an animal shelter in Álava, Spain.

Supervisors: David Carmena & Isabel Fuentes

Protozoa of the genera *Cryptosporidium* and *Giardia* are enteropathogens that infect humans and other vertebrate animals. Both microorganisms are among the major causative agents of gastrointestinal disease in humans, leading to considerable morbidity and socioeconomic impact in developing and developed countries including Spain. Previous epidemiological studies in Álava (Basque Country, Spain) revealed that contact with pet animals (dogs and cats) tended to be associated with a higher prevalence of human cryptosporidiosis/giardiasis. To explore this finding a study on the prevalence of these enteric protozoa was launched, analyzing dogs and cats hosted in a shelter within this Spanish region. The fellow analyzed 125 stool samples from these animals by IFD and molecular methods for the detection and further characterization of positive samples. In addition, he has estimated the sensitivity of the used molecular methods. A total of 31% of the samples were positive as *Giardia duodenalis* while 1% were positive as *Cryptosporidium canis*. The characterization of the *Giardia* positive samples identified the sub-assemblages AII (n=7), BIV (n=5) and C (n=1). The sub-assemblage AII and BIV are known to cause disease in humans, providing molecular evidence that pet animals may be a potential source of zoonotic infection. We

recommended implementation of specific control measures in the pets to reduce the potential risk of these animals transmitting protozoan enteropathogens to humans. A manuscript with these results has been submitted to *Veterinary Parasitology*.

The fellow has contributed to the understanding of the molecular epidemiology of cryptosporidiosis/giardiasis and the transmission pathways that contribute to the disease burden for assessing the zoonotic potential of *Cryptosporidium* and *Giardia* in Spain. The potential role of pet animals in the maintenance of these pathogens observed in this study strongly emphasizes the inclusion of these animals in the plans for controlling the spread of the infection.

Training modules

During the EPIET/EUPHEM introductory course the fellows practiced the design of study protocols. The initial management in public health microbiology module focused on laboratory aspects, time management and collaboration as a team. The phylogenetic and bioinformatic module provided tools for the analysis of molecular data useful in public health research projects.

Educational outcome: Conducting all stages of a public health microbiology research project, from the preparation of study protocols to writing a manuscript; integration of microbiological and epidemiological data in a public health research project, including phylogenetic analysis and interpreting typing results, managing databases and analyzing data; formulating recommendations based on the results; understanding data protection; multidisciplinary teamwork; preparing a scientific presentation at a conference; writing a scientific article.

3. Applied public health microbiology and laboratory investigations

A. Antifungal resistance and strain characterization methods for the study of fungal infections in Spain

Supervisors: Ana Alastruey & Emilia Mellado

Short tandem repeats of *Aspergillus fumigatus* (STRAf) are widely accepted as the first choice for genotyping although the method is problematic and thus paves the way for the development of novel typing techniques. In this project, a combination of several surface coding genes that have hypervariable tandem repeats (TRESP) was proposed as a new strategy for genotyping of this pathogen. The fellow amplified and sequenced one of three TRESP included in the genotyping panel from 175 strains (susceptible and azole resistant strains), estimated the discriminatory power of this new typing method and the phylogenetic relations of the analyzed strains based on TRESP. As a result, a highly discriminatory and non-laborious molecular method was developed. This identified 111 genotypes and could thus be potentially useful for outbreak investigations. Interestingly, most of the azole resistant strains with the non-hospital-environment mutation TR34/L98H belonged only to a few specific types and were phylogenetically related, which suggested that these azole resistant strains could have evolved from a common ancestor. These results have been published in *PLoS One* and presented at the Trends in Medical Mycology conference.

Mutations in the target *cyp51A* are responsible for most azole resistance development in *A. fumigatus*. The rapid identification of these mutations can help clinicians to select the proper antifungal treatment. This project proposed the use of High Resolution Melting (HRM) analysis as a fast method for the identification of azole resistant isolates. The fellow collaborated in designing primers for the amplification of six regions of *cyp51A*, where most of the common mutations responsible for azole resistance are located, analyzing those using HRM, set up the conditions of the assay using 34 susceptible and azole resistant strains and finally, validating the method with a blind-80-strain panel. The method showed good efficiency and could distinguish all the azole resistant isolates from the susceptible strains. These results were presented in the Advance Against Aspergillosis conference and a manuscript has been submitted to the *Journal of Antimicrobial Chemotherapy*.

The new genotype method and the HRM resistant analysis will be included in the diagnostic tool repertory offered by the Reference Mycology Laboratory at CNM-ISCIII to the Spanish National Health System. These methods represent an important improvement for the investigation of *A. fumigatus* outbreaks and for the rapid implementation of appropriate antifungal treatment in patients.

B. Evaluation of new molecular targets for the efficient investigation of measles transmission chains

Supervisors: Aurora Fernández & Juan Emilio Echevarría.

The number of measles cases has decreased rapidly in the European region after several decades of vaccination. At this point, progress towards measles elimination must be monitored through an effective surveillance system. As part of this system, the genetic characterization of circulating viruses is essential and more discriminatory molecular targets are needed for the exhaustive investigation of the transmission chains. In this project, the utility of the intergenic region between the M and F protein (M-F UTR) was evaluated to identify transmission chains

during the large measles outbreaks that occurred in Spain in 2011-2012. These outbreaks were caused by measles virus (MeV) from the D4-Enfield lineage after several years with a low number of cases. The fellow amplified and sequenced 75 clinical samples and performed a phylogenetic analysis. As a result, 30 different haplotypes were identified using the M-F UTR target compared with the 17 haplotypes identified with the classical N450 target recommended by WHO for measles typing. Moreover, the sequence analysis identified indels in the M-F UTR region which were only specific to MeV from the D4-Enfield lineage. This genetic feature was not present in the other genotype D4 MeV thus far, neither in other measles genotypes. As this region was associated with regulatory functions, we hypothesized that this feature could have provided the virus with a biological advantage, providing as result a high capability of this lineage to disseminate amongst the population hence, causing large outbreaks. This study has been presented at the European Conference in Clinical Microbiology Infectious Diseases and a manuscript has been submitted to *Clinical and Microbiology Infection*.

The fellow has shown the usefulness of the M-F UTR for the MeV characterization. This complies with the WHO recommendations for the use of additional targets with higher discrimination power for the exhausted investigation of any transmission chain, especially during the last stage of measles elimination. The fellow has also proposed a potential explanation for the unexpected large outbreaks which occurred in Europe during 2008-2012, which advocates close surveillance of emerging atypical MeV strains with high capability of dissemination.

Educational outcome: Applied concepts of virology and mycology to the public health disciplines; interpreting laboratory results in the context of a public health problem; generating hypothesis; database management; preparing a scientific presentation at a conference; writing a scientific article.

4. Biorisk management

A. Shipment of *Vibrio cholerae* isolates from Ghana to Spain

Supervisor: Daniel Eibach & Silvia Herrera

A total of 94 *V. cholerae* isolates were sent to the laboratory of Reference and Investigation in Food and Waterborne Bacterial Diseases at CNM-ISCIII in Spain for a further investigation of the cholera outbreak in Ghana. The fellow organized the shipment, inoculated the isolates in a transport media, packed the parcel in compliance with the international regulations for sending category A infectious substances and filled the proper documents for the shipment.

Training Modules

The three-day biorisk management module provided techniques for biorisk/biosafety assessment and mitigation, including WHO recommendations on biosafety management in laboratories. The module also reviewed the international regulations for the transportation of infectious substances. A visit to the installation of Biosafety Laboratory 4 allowed the fellow to observe the special contention measures for working with highly virulent pathogens.

Educational outcome: Applying international regulations for the shipment of infectious substances, understanding the problems of shipment samples from Africa and solving logistic problems; understanding processes associated with BSL3/BSL4 laboratories; understanding the principles and practices of biorisk management, assessment and mitigation.

5. Quality management

A. Accreditation of two real time PCRs for the detection of *Bacillus anthracis* and *Yersinia pestis*

Supervisor: Raquel Escudero & Isabel Jado

An important requirement for laboratories is the ability to demonstrate the quality of their analytical results and the validity of the methods used. Increasingly, this is accomplished by certification and accreditation to the appropriate ISO Standards (including ISO 9001 setting out the criteria for a quality management system, ISO 17025 regarding the competence of testing and calibration laboratories or ISO 15189 setting out the requirements for quality and competence of medical laboratories). This is especially important in methods for the detection of pathogens which could be involved in a health alert such as *Bacillus anthracis* or *Yersinia pestis*. Thus, the laboratory of Reference and Investigation in Special Pathogens (CNM-ISCIII) was involved in the development and implementation of an internal quality control for the final accreditation of two Real Time PCRs for detecting these pathogens. The fellow was involved before and during the EUPHEM training in this project. Specific tasks included: 1) setting up the conditions of the real time PCRs ; 2) development of Standard Operation Procedures (SOPs); 3) record keeping of batch numbers of all laboratory reagents to improve traceability and troubleshooting; 4) use of reliable reagents and reference materials; 5) work in accordance with laboratory SOPs. As result, the method for detection of *B. anthracis* spores in environmental samples was accredited under the ISO 17025 and the method for detection of *Y. pestis* in clinical samples has been accredited under the ISO 15189 in 2015.

The fellow has participated in the accreditation of two diagnostic techniques which is a requirement of any Reference Laboratory, especially critical in pathogens involved in health alerts, such as those within this project.

B. Internal and external quality audits of the Reference and Investigation in Special Pathogens laboratory, CNM-ISCI III

Supervisors: Raquel Escudero & Isabel Jado

As part of the accreditation process an annual audit is conducted internally by the CNM-ISCI III's quality department prior to the external quality audit of the National Accreditation Agency (ENAC). The fellow participated as a member of the laboratory of Reference and Investigation in Special Pathogens (CNM-ISCI III) in both audits providing information, records, answering the questions and discussing doubts of the auditors. The fellow participated in the implementation of the measures to solve the non-conformities detected during both audits. This activity highlighted the challenges and importance of quality management and traceability in laboratories in order to ascertain good laboratory practice and detect systematic errors.

Training modules

The two-days quality management module gave an overview of quality concepts in diagnostic laboratories, according to the ISO 15189 standard. The module reviewed topics such as the internal and external quality controls, norms and accreditation, assessment and audits, documentation and record keeping, sample and equipment management, among other factors influencing quality in laboratories.

Educational outcome: Understanding and applying the principles and practices of biorisk management, quality assurance and quality control; implementing an internal quality control in the laboratory, practicing laboratory management; understanding the accreditation process.

6. Teaching and pedagogy

A. Training for cholera molecular diagnostic tools, Kumasi, Ghana

During the international mission, the fellow organized a two-day workshop for the laboratory staff at the Kumasi Center for Collaborative Research in Tropical Medicine in Ghana for the molecular diagnostic of cholera. The first day was theoretical describing PCR and the molecular methods used for *V. cholerae*, followed by a supervised practical exercise using DNA controls. For the second day, the participants tested blind samples without supervision.

B. Master in applied microbiology in Public Health and infectious disease research.

Supervisors: Silvia Herrera, Inmaculada Casas, Teresa Garate & Miguel Thomson

During the last two years this master was organized by the ISCI III and the Universidad de Alcalá de Henares and held at the National School of Public Health in Madrid, Spain. The fellow was involved in different aspects of the master:

- The fellow facilitated the Kalundborg norovirus outbreak case study, which belongs to the ECDC training material, in 2015 and 2016.
- The fellow held lectures on bartonellosis and leptospirosis in 2015 and 2016. This last lecture included a practical exercise with different scenarios where the participants had to review the concepts learned on leptospirosis, interpret laboratory results and define the consequences of them in public health.
- The fellow prepared and facilitated a practical session on bioinformatics tools for bacterial identification and characterization in 2016. Participants had to solve different scenarios and interpret the results, identifying their consequences in public health. The teaching material included exercises using 16S rRNA for bacterial identification, Multi-Locus Variable Number tandem Repeats Analysis (MLVA) for characterization of *Bartonella* and finally, using New Generation Sequencing data to investigate a *Streptococcus pyogenes* outbreak. This last exercise was adapted and translated into Spanish by the fellow from previous ECDC training material.

C. Organisation of the course "Epidemiology for microbiologists" (epi4micro)

Supervisors: Ana Alastruey and Silvia Herrera

Most microbiologists have a limited use of epidemiology. Although they know the basic concepts of this discipline, there is a lack of daily practice. This situation is frequently found in Spain. The fellow in collaboration with Leonidas Georgalis organized a 15-hour module on epidemiology topics for microbiologists as part of the internal training programme of the CNM-ISCI III. Both, were responsible for the planning, defining the learning objectives, preparing the programme and identifying the most appropriate teachers for the delivery of the lectures. In the course, the fellow gave a lecture on the most effective way to present data and facilitated a case study on the investigation of

a gastroenteritis outbreak after a Christening party. This case study was translated into Spanish by the fellow from previous ECDC training material. The fellow also designed and facilitated an exercise for analysing a large database based on a hypothetical measles outbreak.

Training modules

The introductory course gave an overview of pedagogical and teaching concepts. A practical session was devoted to organising a course where participants had to identify needs, define objectives and plan the method to evaluate and obtain feed-back from the students about the proposed course. In addition, an overview of different pedagogical methods was demonstrated, including case studies and a Problem Base Learning (PBL) exercise using an antimicrobial resistance transmission scenario in which the fellows participated for two days. An additional PBL was proposed during the vaccinology module. In this exercise, the difficulties in vaccine development for some pathogens were used as a scenario.

Educational outcome: Identified training needs, planning, organising and evaluating courses; moderate case studies and give lectures; practising new pedagogical methods; preparing teaching material.

7. Public health microbiology management

A. Med-Vet European Joint Programme (Med-Vet EJP) "One Health – Zoonoses Emerging Threats". Scientific Steering Board meeting. 2016. Paris. France.

This initiative is a CoFund action under the European Joint Programme instrument within the Horizon 2020 Framework Programme of the European Commission which involves a network of 40 partner organizations most of which are host reference laboratories in the fields of life sciences, medicine, public health, veterinary medicine, animal sciences and environmental sciences across 16 European countries. Med-Vet EJP aims to create a network that will focus on zoonoses with an emphasis on zoonotic food-borne infections, antimicrobial resistance and emerging threats. The fellow represented the CNM-ISCI III in the Scientific Steering Board (SSB), which is composed of the director or the head of department of the partner institutions. In this meeting, a ranking of topics selected by an expert panel in this field was validated by the SSB and a budget was assigned to them.

B. United Nations Secretary General's Mechanism (UNSGM) designated laboratories for investigation of alleged use of biological weapons workshop. 2016. Spiez. Switzerland.

The guidelines to the United Nations Secretary-General's Mechanism for Investigation of Alleged Use of Chemical and Biological Weapons indicate that UN may designate analytical laboratories for the analysis of samples in support of an investigation. Designated laboratories would be asked to analyze samples for the presence of chemical or biological agents and report their findings to the General Secretary. Recently, the CNM-ISCI III has been included in the roster of potential designated laboratories. Switzerland is organizing a series of expert workshops for this topic. These workshops will discuss the necessary steps to establish a functional laboratory network for investigations of alleged use of biological weapons conducted under the UNSGM. The attendants of this workshop included representatives from WHO, United Nations Office for Disarmament Affairs (UNODA), Organization from the Prohibition of Chemical Weapons (OPCW), Ministry of Defense and Ministry of Foreign Affairs from different countries and potential laboratories around the world which could be designated for this mission. The fellow represented the CNM-ISCI III in this workshop and participated in the discussions which were focused on the unambiguous identification of the agents, the aspects of the UN mandate for the analysis of the samples and the reporting criteria which the designated laboratories should fulfill. The workshop concluded with a visit to the BLS3/BLS4 facilities of the Spiez Laboratories.

C. Initial management in public health microbiology, ECDC, Sweden

This one-week module provided participants with a thorough understanding of what is required to successfully motivate and manage individuals and teams, applied specially in a public health environment. A crisis management situation exercise during an Ebola outbreak investigation focused on skills such as team building, stress management, logistical and communication management, negotiations and conflict solving. A presentation of the fellow regarding Ebola preparedness in Spain gave the opportunity to experience a debate with the director and the chief microbiologist at the ECDC.

D. 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. The different projects have allowed the fellow to incorporate within different teams, working in multidisciplinary environments and communicating with experts from different disciplines. During the international mission in Ghana, the fellow in collaboration with Daniel Eibach (EUPHEM Cohort 2011) met different actors to engage them in the study of the cholera outbreak, including the Head of the Department of Biological Environmental and Occupational Health in Accra, the Head of the National Public Health Reference Laboratory in

Accra, and the head of the Kumasi Center for Collaborative Research in Tropical Medicine (KCCR) in Kumasi, as well as to prepare and obtain the acceptance of the Material Transfer Agreement to establish the conditions of the collaboration between the National Public Health Reference Laboratory in Ghana and CNM-ISCIII to share the *V. cholera* strains of the outbreak. During the *Salmonella* Bovismorbificans outbreak investigation, the fellow contacted regional epidemiologist and the Spanish Food agency to trace the origin of the infection source. The fellow has improved LIMS in the Respiratory viruses and Influenza Unit and in the HIV Biology and Variability Unit (CNM-ISCIII). The fellow has intermediated between this last Unit and the epidemiologists of the CNE-ISCIII, establishing collaboration for sharing data and developing of future projects which didn't exist previously. In the laboratory of Reference and Investigation in Special Pathogens, where the fellow was working before starting EUPHEM, he has been involved in the process of accreditation which has included large laboratory management. The participation of the fellow in the measles and *Aspergillus* projects has provided the opportunity for exploring different systems of laboratory organization.

Educational outcome: Working in multidisciplinary public health teams; critical thinking in feedback and reporting; identifying public health interests, defending the priority topics of the fellow's institution; understanding the role of different EU agencies, the UN and the Secretary General's Mechanism; understanding the process of public health decision-making, including the role and responsibilities of managers and leaders in public health; understanding the importance of disease-specific networks; establishing national and international collaborations; understanding the principles of public health management, identifying team roles, team evolution and how to motivate teams, exploring and mastering how to delegate tasks effectively, identifying how to recognise and manage stress more effectively; exercising and applying communication skills with different audiences and giving feedback to higher authorities, public and media; understanding laboratory management; implementing and improving LIMS.

8. International missions

Cholera Outbreak, Ghana, October 2014

Supervisor: Silvia Herrera & Daniel Eibach

Ghana has experienced several major cholera outbreaks in the last three decades with 15,302 cases in 1983, 9,174 cases in 2011 and 9,566 cases in 2012. Between 10th of June 2014 and 21st of Sept 2014, 16,613 cases including 130 deaths (CFR: 0.8%) had been reported from 9 out of 10 regions in Ghana. Greater Accra Region was the most affected region, with La Dade Kotopon (AR =712.26/100,000 population with 5,558 cases and 45 deaths) being the most affected district. A mission for assisting in the investigation of the current cholera outbreak in Ghana was proposed by the Bernhard Nocht Institute for Tropical Diseases of Hamburg (Germany). The fellow was deployed in October 2014 in the field to assist in this mission during a month. The fellow participated in the meetings to convince the local stakeholders to collaborate in this project, performed the sub-culturing of the isolates in the National Reference laboratory of Public Health, in Accra (Ghana), set up the molecular methods for the detection and characterization of *V. cholerae* at KCCR in Kumasi (Ghana), applying these methodology in the 92 selected isolates.

Molecular diagnostic tools are essential in the diagnostic, surveillance and control of cholera outbreaks. During 2014, laboratories in Ghana were not implementing any of these detection methods. The fellow provided to KCCR with the reagents, DNA controls, protocols from the laboratory of Reference and Investigation in Food and Waterborne Bacterial Diseases (CNM-ISCIII) and training, creating the capability for the molecular diagnosis of cholera in Ghana.

Educational outcome: Understanding the limitations for working in a laboratory in Africa; Understanding the importance of being flexible for adapting to unexpected new situations in an international mission; solving technical problems; identifying diagnostic needs; creating laboratory capabilities; practicing public health management; writing a report.

9. Communication

A. Publications

- 1- Eibach D, Herrera-León S, Gil H, Hogan B, Ehlkes L, Adjabeng M, Kreuels B, Nagel M, Fobil JN, Opare D, May J. Molecular epidemiology and antibiotic susceptibility of *Vibrio cholerae* associated with a large cholera outbreak in Ghana in 2014. PLoS Neglected Tropical Diseases. 2016. 10(5): e0004751.
- 2- García-Rubio R, Gil H, Monteiro MC, Pelaez T, Mellado E. A new *Aspergillus fumigatus* typing method based on hypervariable tandem repeats located within exons of surface protein coding genes (TRESP). PLoS One. 2016. 11 (10): e0163869.
- 3- Bangert M†, Gil H†, Oliva J, Delgado C, Vega T, De Mateo S, Larrauri A and the Epidemiology Working Group of the Spanish Influenza Sentinel Surveillance System. Pilot study to harmonize the reported influenza intensity levels within the Spanish Influenza Sentinel Surveillance System (SISS) using the Moving Epidemic Method (MEM). Epidemiology and Infection (in press).

- 4- Gil H†, Fernández-García A†, Mosquera MM, Hübschen J, Castellanos A, Echevarría JE. Measles virus genotype D4 strains with non-standard genome lengths circulated during the large outbreaks in Spain in 2011-2012. 2016. (Submitted to Clinical and Microbiology Infection).
- 5- Bernal-Martínez L†, Gil H†, Rivero-Menéndez O, Mellado E, Cuenca-Estrella M, Gago S, Alastruey-Izquierdo A. Development and validation of a High Resolution Melting assay to detect azole resistance in *Aspergillus fumigatus*. 2016. (Submitted to Journal of Antimicrobial Chemotherapy).
- 6- Gil H†, Cano L†, de Lucio A, Bailo B, Hernández-de-Mingo M, Cardona GA, López-Molina N and Carmena D. Prevalence and molecular diversity of *Giardia duodenalis* and *Cryptosporidium* spp. in sheltered dogs and cats in the province of Álava, Northern Spain. 2016. (Submitted to Veterinary Parasitology).
- 7- Irisarri-Gutiérrez MJ, Hernández-de Mingo M, de Lucio A, Gil H, Morales L, Seguí R, Nacarapa E, Muñoz-Antoli C, Bornay-Llinares FJ, Guillermo-Esteban J, Carmena D. Association between enteric protozoan parasites and gastrointestinal illness in HIV- and tuberculosis-infected individuals in the Chowke district, southern Mozambique. 2016. (Submitted to Acta Tropica).
- 8- Gil H†, Delgado E†, Georgalis L, Cuevas MT, Fernández-García A, Montero V, Benito S, Sánchez M, Carrera C, García-Bodas E, Pérez-Álvarez, Thomson MM and Spanish Group for the Study of HIV-1 Antiretroviral Drug Resistance and Tropism. Role of transmission clusters in the epidemiology of HIV-1 infections in two regions of Spain (2013-2015). 2016. (in preparation)

† Authors have participated equally.

B. Reports

- Gil, H. International mission to assist in the outbreak investigation of cholera in Ghana. 2014.
- Surveillance flu group from the surveillance in public health Area. Centro Nacional de Epidemiología. (CNE-ISCIII). Estudio piloto para la armonización de los indicadores de intensidad y evolución de la actividad gripal dentro de Sistema centinela de vigilancia de la Gripe en España utilizando el método de epidemias móviles (MEM) (participation in this report).
- Gil, H. Epidemiology for microbiologists. Teaching report. 2015.
- HIV Biology and Variability Unit (CNM). Realización de un estudio de investigación y prevalencia de resistencias a los antirretrovirales y de subtipos No-B y recombinantes VIH-1 en el País Vasco. 2015 (participation in this report).
- Gil, H. Measles surveillance in Spain, 2015.
- Gil, H and Herrera, S. Alert of a potential outbreak of *Salmonella* in the Comunidad Autónoma Valenciana, Spain. 2016.
- Gil, H. Report of a potential outbreak of *Salmonella* Bovismorbificans, Spain. 2016.

C. Conference presentations

- Eibach D, Herrera S, Gil H, Hogan B, Ehlkes L, Adjabeng M, Kreuels B, Opare D, Fobil J and May J. Imported or endemic? Sources of the large *Vibrio cholerae* outbreak in Ghana, 2014. German Society of Infectious Diseases. 2015. Munich. Germany. (Poster presentation)
- Eibach D, Gil H, Herrera S, Hogan B, Adjabeng M, Nagel M, Fobil J, Opare D and May J. Molecular epidemiology and antibiotic susceptibility of *Vibrio cholerae* outbreak strains in Ghana, 2011-2014. Annual meeting of the German society of Hygiene and Microbiology. 2015. Munich. Germany. (Poster presentation)
- Gil H, Bangert M, Delgado C, De Mateo S, Larrauri A and Spanish Influenza Sentinel Surveillance System. Pilot study to harmonize the reported influenza intensity levels and trends within the Spanish Influenza Sentinel Surveillance System using the Moving Epidemic Method (MEM). ESCAIDE. 2015. Stockholm. Sweden. (Oral presentation)
- ‡García-Rubio R, Gil H, Monteiro M, Pelaez T and Mellado E. A new *Aspergillus fumigatus* typing method based on hypervariable tandem repeats located within exons of surface protein coding genes (TRESP). 7th Trends in Medical Micology. 2015. Lisbon. Portugal. (Poster presentation)
- †Bernal-Martínez L, Gil H, Rivero-Menéndez O, Mellado E, Cuenca-Estrella M, Gago Sara, Alastruey-Izquierdo A. Development and validation of a High Resolution Melting Assay to detect azole resistance in *Aspergillus fumigatus*. Advance Against Aspergillosis conference. 2016. Manchester. United Kingdom. (Poster presentation)
- Gil H, Fernández-García A, Mosquera MM, Hübschen JM, Castellanos A, de Ory F, Echevarría JE. D4 genotype measles virus with non-standard genome lengths circulated during the large outbreaks in Spain in 2011-2012. European Conference in Clinical Microbiology Infectious Diseases. 2016. Amsterdam. Netherlands. (Poster presentation)
- Delgado E, Gil H, Cuevas MT, Fernández-García A, Martínez-López J, Sintés M, Montero V, Sánchez M, Carrera C, García-Bodas E, Benito S, Pérez-Álvarez L, Thomson MM, and the Spanish Group for the Study of new HIV

Diagnoses. Diverse HIV-1 non-subtype B clusters are spreading among men who have sex with men in Spain. 21st International AIDS Conference. 2016. Durban. South Africa. (Poster presentation)

- Delgado E, Gil H, Cuevas MT, Fernández-García A, Montero V, Sánchez M, Carrera C, García-Bodas E, Benito S, Geogalis L, Pérez-Álvarez L, Thomson MM y Grupo para el Estudio de Resistencias a Antirretrovirales en Galicia y País Vasco. Spanish Interdisciplinary AIDS Society. 2016. Madrid. Spain. (Poster presentation)

- Cuevas MT, Sanchez-Martinez M, Mielu LM, Delgado E, Carrera C, Gil H,2, Pérez-Álvarez L y Thomson M. Caracterización de las envueltas de VIH-1 de pacientes implicados en clusters de transmisión de rápida expansión. Spanish Interdisciplinary AIDS Society. 2016. Madrid. Spain. (Poster presentation)

- Echevarría JE, Fernández-García A, Masa J, Saravia G, López-Perea N, Gil H, Castellanos A, Mosquera M, Gómez-Vecino A, Rueda A, Gavilán A, Torres MV, de Ory F. Nuevas herramientas moleculares para la investigación de brotes de sarampión y parotiditis. XXXIV Scientific Meeting of the Spanish Epidemiology Society. 2016. Sevilla. Spain. (Oral presentation)

‡ Presentation which was awarded during the conference

D. Abstracts accepted

- Geogalis L, Delgado E, Gil H, Cuevas MT, Pérez-Álvarez L, Thomson, MM, Martínez De Aragon MV and Spanish Group for the Study of HIV-1 Antiretroviral Drug Resistance and Tropism. Comparative analysis of molecular epidemiologic surveillance of HIV-1 infection in two regions of Spain, 2003-2015. ESCAIDE. 2016. Stockholm. Sweden.

- Delgado E, Gil H, Cuevas MT, Fernández-García A, Benito S, Montero V, García-Bodas E, Carrera C, Geogalis L, Pérez-Álvarez L, Thomson M, and the Spanish Group for the Study of HIV-1 Antiretroviral Drug Resistance in Galicia and Basque Country. Caracterización de clusters de transmisión de VIH-1 de reciente expansión en España (2015-2016). VIII National congress of the Study Group of AIDS (GESIDA). 2016. San Sebastian. Spain.

- Gil H, Cano L, de Lucio A, Bailo B, Hernández-de Mingo L, Cardona GA, Fernández-Basterra JA, Aramburu-Aguirre J, López-Molina N, Carmena D. Prevalencia y diversidad genética de *Giardia duodenalis* y *Cryptosporidium* spp. en perros y gatos en un centro de protección animal de la provincia de Álava. XXI Symposium of specialist veterinarians in laboratory diagnostics (AVEDILA). 2016. Murcia. Spain.

E. Other presentations

- International mission in Ghana to assist in the outbreak investigation of cholera. Outbreak module. Robert Koch Institute. Berlin. Germany. (2014)

- Ebola preparedness in Spain. Initial management in Public Health microbiology module. ECDC. Sweden. (2015)

- Laboratory considerations during complex emergency situations. Rapid assessment module. National school of Public Health. Athens. Greece. (2015) (presented in collaboration with Kyriaki Tryfinopoulou, EUPHEM Cohort 2014)

- Antifungal resistance and strain characterization methods for the study of fungal infections in Spain. CNM-ISCI. Madrid. Spain. (2015)

- Analysis of the measles outbreaks in Spain, 2015. CNE-ISCI. Madrid. Spain. (2015)

- Study of the circulation of the measles virus variant D4-Madrid (2011-2012). CNE-ISCI. Madrid. Spain. (2015)

- Tribulations and adventures of a EUPHEM traveller. CNM-ISCI. Madrid. Spain. (2016)

- Presence of zoonotic *Giardia* and *Cryptosporidium* in an animal shelter in Álava, Spain. CNM-ISCI. Madrid. Spain. (2016)

10. EPIET/EUPHEM modules attended

- EPIET/EUPHEM Introductory Course, Spetses, Greece (93 hours)

- EPIET/EUPHEM Outbreak module, Berlin, Germany (33,75 hours)

- Initial management in Public Health microbiology module, Stockholm, Sweden (35 hours)

- Biorisk and quality management module, Stockholm, Sweden (40 hours)

- EPIET/EUPHEM Multivariable analysis module, Vienna, Austria (37,5 hours)

- EPIET/EUPHEM Vaccinology module, Krakow, Poland (34 hours)

- EPIET/EUPHEM Rapid assessment and survey methods module, Athens, Greece (50 hours)

- EPIET/EUPHEM Project review module, Lisbon, Portugal in 2015 (40 hours)

- Bioinformatics and phylogenetics module, Stockholm, Sweden (24 hours)

- EPIET/EUPHEM Project review module, Lisbon, Portugal in 2016 (40 hours)

11. Other training

- International Transport of Infectious Substances. ECDC & WHO (included in the Biorisk and Quality Module).
- Basic Security in the field. United Nations Department of safety and Security (Online module).
- Advanced Security in the field. United Nations Department of safety and Security (Online module).

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 Horacio Gil during his two-year EUPHEM fellowship (cohort 2014) as a member state track fellow at the Centro Nacional de Microbiología, Instituto de Salud Carlos III (CNM-ISCI3), Majadahonda, Madrid, Spain. Horacio is the first appointed MS track EUPHEM fellow in Spain. The projects described in this portfolio demonstrate the breadth of public health microbiology. Outbreak and surveillance activities extended from regional, national and to international 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 and European level. The international mission undertaken to Ghana during a peak cholera epidemic was important to both the fellow, his organisation and on an international level with the establishment of laboratory based surveillance and molecular characterisation for multiresistant strains. The laboratory and epidemiologically based projects covered all diverse 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(s). Activities were in line with the 'learning by doing' and 'on the job training' ethos of the EUPHEM programme and fulfilled the core competency domains described for professionals in their mid-career and beyond. Activities were complimented by nine training modules providing theoretical knowledge. Projects had a clear outcome, with results communicated in scientific journals and at conferences. The contributions made by this EUPHEM fellow in Ghana as with all other fellows has highlighted the importance of developing a future critical mass of highly skilled 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 his tasks to a high standard and with a professional attitude. We wish the fellow every success in his future career as a public health microbiologist.

Supervisor's conclusions

Dr Horacio Gil was the first MS-EUPHEM fellow based at the National Centre for Microbiology (ISCI3). This two years training program have been very successful for both the fellow and the training site. Horacio has been an outstanding fellow accomplishing an extremely successful fellowship that has allowed our center to improve our public health capacities facilitating multidisciplinary projects through the collaboration between different stakeholders and generating remarkably useful knowledge in several areas of public health microbiology. His commitment with the program leads him to seek for new collaborations. As an example, the HIV research project has allowed the collaboration not only between the EPIET and EUPHEM fellows but also between the Nacional Center for Microbiology and the National Centre for Epidemiology. This collaboration is still going on with very fruitful results. Thus, our center has strengthened and generated several bridges between epidemiologist, microbiologist and clinical medicine. His international mission in Ghana has allowed the CNM for the first time to collaborate with the Bernhard Nocht Institute for Tropical Medicine in Germany and opened the possibilities to future common projects in other fields of public health importance. The course "Epidemiology for Microbiologists" he developed together with the EPIET fellow Leonidas Georgalis was one of the best examples of cascading within the Institute and actually a second edition is being prepared for this year due to the high demand. At personal level, he is an excellent team player highly appreciated by his colleagues, including EPIET and EU-EUPHEM fellows based at our Institute. All supervisors at the training sites have highlighted Horacio's commitment and responsibility, appreciated his hard work and emphasized the added value he has given back to their laboratories, accomplishing projects that would otherwise have been hard to achieve. For example he has developed or optimized together with the staff at the specific laboratories, new diagnostic/subtyping tools that will be incorporated to the set of services that the ISCI3 offers to the National Health System [e.x *Giardia* and *Cryptosporidium* (PCRs); *Aspergillus* hypervariable tandem repeats (TRESP)]. During the two-year fellowship, Horacio has developed both personally and professionally working in challenging projects that were out of his area of expertise. He has accomplished all assigned tasks in a highly competent manner, with great enthusiasm and a high degree of independence and accuracy, occasionally seeking advice and assistance from supervisors and co-workers. We are sure that the experience he has gained during these

two years will enhance his already promising future as a public health microbiologist and wish him every success for his career.

Personal conclusions of fellow

My background as a veterinarian has allowed me to develop my professional career in zoonotic diseases, especially in arthropod-borne bacterial diseases. Although I have had the opportunity to work on different aspects of zoonotic diseases, I had a limited knowledge of public health management and outbreak responses. I have always been interested in this angle as the ultimate objective of the activities we are performing in the laboratory. The EUPHEM programme has given me the opportunity to fill these gaps and to develop competencies and skills in different aspects of the public health microbiology that I could hardly have acquired in another way, and in this very short period of time. My background as microbiologist has been strengthened after working in projects which involved virus, fungus and parasites and different groups of diseases, different from the arthropod-borne bacterial diseases which were my professional field. I had learnt and experienced how disease prevention and control measures are developed at national and international level, working in surveillance projects and in outbreak investigations. During the programme I have had the experience of working in the field during an international mission, an opportunity that every public health microbiologist should have at least once in his/her life. The programme has been an incomparable platform for creating a network not only at national level with the colleagues from my institution but also at international level with the public health professionals from different disciplines I have collaborated. The valuable opportunity to work in projects with an important epidemiological component has opened me a new world of possibilities for maximising the impact of my research in public health. In summary, the experience acquired during the EUPHEM has broadened my view of public health microbiology.

Acknowledgements of fellow

I would like to thank my local supervisors Ana Alastruey and Silvia Herrera-León for their support during this intense two-year fellowship, not only for the scientific advises and the project opportunities which they have offered me, but also for encouraging and supporting me every time I have need it. Although I have been working in the CNM-ISCI III for more than ten years and I knew most of the supervisors I was working with, it has been an amazing experience to be part of their different research groups. I am more than grateful to my colleagues who have opened their laboratories to allow me to participate in their projects, working together and sharing the EUPHEM experience. Also, I would like to thank the staff-members of the labs which have helped me in each one of the rotations. I would like to extend the same gratitude to the project supervisors and their teams at the CNE-ISCI III for the opportunity to work with them, which it has been an enriched experience. Special thanks go to my EUPHEM coordinators Aftab Jasir (ECDC) and Androulla Efstratiou (Public Health England) for mentoring and guiding me into the programme. Last but not least, I would like to thank the Spanish EUPHEM and EPIET family which is growing year by year and my co-fellow EUPHEMs and EPIETs for all the moments we have shared and the support during the fellowship.