FELLOWSHIP REPORT

Summary of work activities

Fanny CHEREAU
Intervention Epidemiology path (EPIET)
Cohort 2016

Background

The ECDC Fellowship Training Programme 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 curriculum paths are part of the ECDC fellowship programme that provides competency based training and practical experience using the 'learning by doing' approach in acknowledged training sites across the European Union (EU) and European Economic Area (EEA) Member States.

Intervention Epidemiology path (EPIET)

Field epidemiology aims to apply epidemiologic methods in day to day public health field conditions in order to generate new knowledge and scientific evidence for public health decision making. The context is often complex and difficult to control, which challenges study design and interpretation of study results. However, often in Public Health we lack the opportunity to perform controlled trials and we are faced with the need to design observational studies as best as we can. Field epidemiologists use epidemiology as a tool to design, evaluate or improve interventions to protect the health of a population.

The European Programme for Intervention Epidemiology Training (EPIET) was created in 1995. Its purpose is to create a network of highly trained field epidemiologists in the European Union, thereby strengthening the public health epidemiology workforce at Member State and EU/EEA level. Current EPIET alumni are providing expertise in response activities and strengthening capacity for communicable disease surveillance and control inside and beyond the EU. In 2006 EPIET was integrated into the core activities of ECDC.

The objectives of the ECDC Fellowship - EPIET path are:

- To strengthen the surveillance of infectious diseases and other public health issues in Member States and at EU level;
- To develop response capacity for effective field investigation and control at national and community level to meet public health threats;

This portfolio does not represent a diploma. Fellows receive a certificate acknowledging the 2-year training and listing the theoretical modules attended. Additionally, if all training objectives have been met, they receive a diploma.

Stockholm, July 2017

- To develop a European network of public health epidemiologists who use standard methods and share common objectives;
- To contribute to the development of the community network for the surveillance and control of communicable diseases.

Fellows develop core competencies in field epidemiology mainly through project or activity work, but also partly through participation in training modules. Outputs are presented in accordance with the EPIET competency domains, as set out in the EPIET scientific guide[1].

Pre-fellowship short biography

Fanny has a PhD in biology (Paris 6 University, France), and a specialized master of public health (Pasteur-Cnam School of Public Health, France). Before EPIET, she worked as a research epidemiologist in France. She studied HIV natural history among HIV patients in a European cohort, and colonization with antibiotic-resistant bacteria in the community in Madagascar.

Fellowship assignment: Intervention Epidemiology path (EPIET)

On September 15, 2016, Fanny Chereau started her EPIET fellowship at the Public Health Agency of Sweden, Stockholm, Sweden, under the supervision of Anders Wallensten. This report summarizes the work performed during the fellowship.

Fellowship portfolio

This portfolio presents a summary of all work activities (unless restricted due to confidentiality regulations) conducted by the fellow during the ECDC Fellowship, EPIET path. These activities include various projects, and theoretical training modules.

Projects included epidemiological contributions to public health event detection and investigation (surveillance and outbreaks); applied epidemiology field research; teaching epidemiology; summarising and communicating scientific evidence and activities with a specific epidemiology focus. The outcomes include publications, presentations, posters, reports and teaching materials prepared by the fellow.

This portfolio also includes a reflection from the fellow on the field epidemiology competencies developed during the 2-year training, a reflection from the supervisor on the added value of engaging in the training of the fellow, as well as a reflection by the programme coordinator on the development of the fellow's competencies.

Fellowship projects

1. Surveillance

Use of surveillance data to document a large national outbreak of domestic Campylobacter infections in 2016-2017 in Sweden

Supervisor: Cecilia Jernberg

The surveillance of human C*ampylobacter* infections in Sweden is comprehensive and passive. Domestically-acquired campylobacteriosis is endemic and seasonal in Sweden: the notifications peak in July-August, and diminish in February-March. From September 2016 to May 2017, a greater number of cases were notified compared to previous years, activating outbreak signals at The Public Health Agency of Sweden. Laboratory investigation identified broilers produced in Sweden as the probable source of the outbreak, but no description of the duration and the magnitude of the outbreak were available to appreciate the burden of cases in human

[1] European Centre for Disease Prevention and Control. European public health training programme. Stockholm: ECDC; 2013. Available from: http://ecdc.europa.eu/en/epiet/Documents/Scientific%20guides/EPIET%20Scientific%20Guide_C2015.pdf

population. The aim of this study was to use surveillance data to estimate the burden of the outbreak, and investigate changes in demographics of the cases during the outbreak compared to endemic period.

Using time series analysis methodology, we defined the endemic baseline of domestic cases in Sweden by modeling data from the endemic period 2009-2013. The model was used to predict the monthly number of domestic cases for 2014-2017.

By comparing observed and predicted cases, we identified that the outbreak lasted from August 2016 until May 2017, and produced 5147 excess cases (range: 4230-6063). A higher proportion of women were affected and cases were older during the outbreak period compared to endemic period.

Investigations conducted by the National Veterinary Institute following this outbreak reported a series of incidents along the broilers production in Sweden, which led to high colonization rates among broilers, and most probably to the outbreak observed in human population. After the implementation of control measures along the broilers production chain, the number of human cases dropped to the expected baseline. Our results illustrate the importance of maintaining good standards on levels of campylobacter colonization for broilers production, in order to avoid similar outbreaks with high consequences on public health.

Role: *principal investigator*

Fanny wrote the protocol, analysed surveillance data, developed the time series analysis model, presented the results to the Swedish Zoonosis Council Meeting (8), and will present a poster at ESCAIDE 2018. A manuscript is under preparation.

Design of a national surveillance system for diabetes mellitus in Sweden

Supervisor: Camilla Olofsson

Diabetes is a chronic disease associated with high morbidity and mortality, and high socio-economic costs. In a study conducted in Sweden in 2013, prevalence and incidence of diabetes were estimated to be 6.8% and 4.4 per 1000 inhabitants. The burden of type 1 diabetes is particularly worrying among children, with a steady increase in incidence observed over the over the period 1990-2007. There are thus indications that prevalence is high and incidence is likely increasing in Sweden. However, there is no national surveillance of diabetes performed with a public health perspective. As it is in the mandate of The Public Health Agency of Sweden to monitor the health status of Swedish population and support health promotion, the Public Health Agency of Sweden allocated resources for the design and implementation of a surveillance system for diabetes. A working group was created in order to inform the surveillance system design.

The working group defined that the surveillance system should aim to provide epidemiological description of trends in incidence, prevalence and mortality of type 1 and type 2 diabetes in the population by time, place and socio-demographic characteristics, in order to prioritise health resources and target prevention activities. The following elements of a surveillance system were defined: objectives of the surveillance system, population under surveillance and case definitions. A preliminary strengths, weaknesses, opportunities and threats analysis of the existing register-based data on diabetic patients was conducted to identify the primary data source for case identification. The data sources for socio-economic characteristics and mortality of cases were identified. Data management and analysis were considered to fulfill the objectives of surveillance. Data collection, transmission and storage were designed to ensure security of patient information.

A proposal for the surveillance system was submitted to the Public Heath Agency, and implementation is planned for 2019.

Role: *co-investigator*

As a member of the working group, Fanny led discussions on the key elements of a surveillance system according to EPIET guidelines, defined the objectives of the surveillance system, conducted a SWOT (strengths, weaknesses, opportunities and threats) analysis to identify primary data source, defined the methods to analyse surveillance data in order to fulfil the objectives stated, wrote the proposal for the design of the surveillance system for diabetes in Sweden (2).

Evaluation of rubella surveillance in a context of elimination in Sweden, January 2013 – August 2018

Supervisor: Hélène Englund

After an import-related outbreak of rubella in 2012, no endemic cases have been notified from January 2013 - August 2018 in Sweden. However, the absence of notified cases can only be considered as a zero-case reporting if the surveillance system can ensure the detection of all sporadic rubella cases. In the absence of reported cases in a context of elimination, WHO has established a list of standard performance indicators and associated targets to measure the performance of rubella surveillance. The aim of this work was to evaluate whether the Swedish rubella surveillance system meets the objectives stated by WHO relating to two key elements of the indicators: rate of suspected cases of rubella (i.e. clinical suspicion) investigated and discarded as non-rubella cases using laboratory testing; and proficiency of laboratories performing diagnostic confirmation, over the period 2013-2018.

Diagnostic capacity for acute rubella is available throughout Sweden, according to information collected from all medical laboratories. However, we identified two main limitations of the system: 1) few suspected rubella cases are captured by the surveillance system and the rate of suspected cases is below the WHO associated target, suggesting that suspected cases may not be identified by the physicians and 2) no evaluation of the laboratories performing acute rubella diagnostic in Sweden has been performed to ensure quality of the methods and reliability of the results for surveillance purposes.

We recommend to the Public Health Agency of Sweden:

-To use laboratory data of patients whose specimens were tested for anti-rubella IgM as an alternative data source to identify those with suspicion of rubella or rubella-like illnesses, in order to ensure that suspected cases are identified and subsequently managed toward laboratory investigation, even if not notified.

-To assess quality and performance of diagnostic methods for acute rubella and CRS in the laboratories in Sweden.

Role: *principal investigator*

Fanny wrote the protocol, collected, analysed and interpreted data from medical laboratories, developed recommendations and wrote a report (3).

2. Outbreak investigations

Suspected Norovirus outbreak at the Public Health Agency of Sweden, November 2016

Supervisor: Moa Rehn

An outbreak of gastrointestinal illness occurred among employees of the Public Health Agency of Sweden from Tuesday 15 November to Thursday 17 November, 2016. A cohort study was conducted in order to confirm the outbreak and determine its burden, identify the source of the outbreak and implement control measures.

The investigation identified 28 cases among the 254 employees included in the cohort (attack rate of 11%). In univariate analysis, those who had lunch at the canteen on Tuesday 15 November were 6 times more likely to be ill compared to those who did not, and those who had lunch at the canteen on Wednesday 16 November were 2.5 times more likely to be ill than those who did not. In stratified analysis, having had lunch at the canteen on Wednesday (but not on Tuesday), and having had lunch on Tuesday (but not on Wednesday) were both associated with illness. These results suggested that either there were 2 distinct sources at the canteen or that the source was continuous for these 2 days. No food item or specific dish from the canteen could be identified with certainty as the source of transmission thought the epidemiological investigation, although our investigation suggested that lentil salad served at the salad bar on both days may have been the source. No food items were sampled for testing.

The canteen manager did not report any sick employee in the week of the outbreak or on the previous week. An inspection of the canteen kitchen conducted by the environment Department of Solna City Council on 23 November did not report any malpractices or mismanagement. No specific recommendations or prevention and control measures were implemented during or after this outbreak.

Role: *principal investigator*

Fanny designed the study, wrote the protocol, developped the questionnaire, performed the statistical analysis, interpreted the results, and wrote an internal report (4).

Salmonella outbreak among elderly and hospitalized people in Sweden, October 2017-March 2018

Supervisors: Cecilia Jernberg and Anna Lindqvist Angervall

On 20 October, the Public Health Agency of Sweden raised an alert of an outbreak of *Salmonella Kentucky*, with five cases in Västra Götaland County and one case in Uppsala County. As the outbreak affected several counties, an outbreak investigation was initiated under the coordination of the Public Health Agency of Sweden in order to identify the source of the outbreak and implement control measures.

The outbreak affected 65 people in 6 counties: median age of cases was 85 years; 43 cases (68%) were women. The first specimen was provided on 05 October 2017 and the last on 12 March 2018, and *Salmonella* Kentucky was first isolated from 33 fecal, 25 urine, 3 blood, 1 wound, and 1 sputum samples. Many cases had either no gastrointestinal symptoms, or no identifiable gastrointestinal illness onset date. All cases had an epidemiological link with hospitals (hospitalized for long periods for underlying diseases, or employees), nursing homes or elderly homes, whose kitchens were all supplied by the same distributor. In Västra Götaland County, the most affected county, the same menus are offered in all hospitals, and the menu is identical every 6 weeks. The time distribution of cases in Västra Götaland County supported the hypothesis that the source of the outbreak came from the distributor. The description of ordered meals and food supplies led to testing of several food items: more than 80 samples were taken but none tested positive for Salmonella. The source of the outbreak could not be identified.

Most Salmonella outbreaks in Sweden are limited in duration and to a small number of cases, with mild symptoms. This outbreak affected a vulnerable population and cases were notified for over six months. The source of the outbreak could not be identified, but control measures were implemented in the kitchens of hospitals to strengthen food safety.

Role: *co-investigator*

Fanny participated in the field investigation in Västra Götaland County, described the cases, refined hypotheses on source of the outbreak, discussed possible control measures, and wrote an internal report (5).

Outbreak of Legionella non-pneumophila species associated with usage of commercial bagged soil in Sweden, 2018

Supervisor: Adam Roth

In June 2018, the Public Health Agency of Sweden was notified of an unusually high number of domestic cases of *Legionella* non-*pneumophila* subspecies. *Legionella longbeachae*, often found in soil, was identified from case specimens. An outbreak investigation was initiated to identify the source and exposures.

A case-control study was implemented on cases of *Legionella* non-*pneumophila spp.* with symptom onset after 14 May, with controls matched for sex, age, and county selected from a national survey panel. We surveyed water exposures, gardening, and soil handling, and computed matched odds ratios (mORE) using conditional logistic regression. Cases specimens and soil samples from gardens of cases were analysed for *Legionella* spp and genetic linkage by WGS.

To September 7th 2018, 42 cases (median age 70, 48% women) from six counties were reported. Thirty cases were laboratory confirmed with *Legionella longbeachae*. Symptom onset ranged from 3 April to 23 August. Twenty-five cases answered the survey and were matched to 170 controls. In univariate analysis, cases were more likely

than controls to have gardened (mOR=6.7, p=0.02) and to have used commercial bagged soil (CBS) (mOR=3.2, p=0.04). When looking at specific usage of CSB, the association between using a water hose/spray onto CBS (mOR=10.6, p=0.005) or using CBS in a greenhouse (mOR=10.3, p=0.05), compared to having not used CBS, and disease was even higher. Soil samples were found polyclonal for legionella species, but none clustered with related case isolates. No common water-related souce exposure was associated with disease.

We report the largest outbreak of sporadic *Legionella longbeachae* infection in Europe. While investigations are ongoing regarding soil, it appears that specific risk behaviours, such as spraying or hosing CBS, or using it in a greenhouse, are associated with increased risk of disease and may help inform public health recommendations.

Role: *co-lead investigator*

Fanny designed the study, wrote the study protocol and developed the questionnaire, analysed preliminary data, prepared an abstract for ESCAIDE 2018 (late breaker).

3. Applied epidemiology research

Wild and domestic bird faeces a likely source of psittacosis transmission – a case-control study in Sweden, 2014-2016

Supervisors: Anders Wallensten and Moa Rehn

Psittacosis is a zoonotic disease transmitted by birds; in Sweden, psittacosis is notifiable but rare. In 2013, an unusual increase of domestically-acquired human psittacosis cases was associated with exposure to wild birds, but specific risk behaviors could not be identified. We conducted a case-control study to identify specific risk behaviors for sporadic psittacosis.

Domestically-acquired psittacosis cases reported from December 2014 to April 2016 were matched to population controls. Cases and controls completed a questionnaire investigating detailed exposures to wild and tame birds.

Thirty-one domestically acquired cases were reported during the study period, all cases lived in southern Sweden and 26 cases had onset of illness between November and April. Twenty-six cases were men, median age was 67. Disease was associated with contact with bird faeces, especially when cleaning contaminated surfaces including domestic bird cages, or wild bird feeders, particularly those with a design allowing faeces accumulation. Two risk factors were independently associated with psittacosis infection in multivariate analysis: cleaning a wild bird feeder (amOR=18.95; 95%CI:2.11–170.03) and owning domestic birds (amOR=5.55, 95%CI:1.16–26.61).

This study was the first to identify exposure to tame birds as a risk factor for psittacosis in Sweden. In January 2017, The Public Health Agency of Sweden updated its recommendations for reducing the risk of human psittacosis infection, by encouraging the use of bird feeders with a design limiting faeces accumulation. The recommendations also reiterated good practices for cleaning surfaces contaminated with bird faeces (both wild and tame) to avoid the production of dust from dried faeces. Since then, 38 cases of psittacosis were reported in Sweden from November 2016 to end of April 2017: this suggests that human psittacosis is becoming more common, or that clinicians are now testing for *C. psittaci* in cases of atypical pneumonia.

Role: *co-investigator*

Fanny analysed the data, presented a poster at ESCAIDE 2016, wrote and submitted a manuscript to a peer-reviewed journal (1).

Burden (severity and cost) of a large outbreak of domestic campylobacteriosis in Sweden in 2016/2017

Supervisors: Anders Wallensten and Sharon Kühlmann-Berenzon

Domestically-acquired campylobacteriosis is endemic in Sweden. However, from August 2016 to May 2017, a large national outbreak of domestic campylobacteriosis affected Sweden. Using time series analysis, the number of cases related to the outbreak had been estimated to be 5147. Concomitantly to this increase in number of notifications,

several regional Public Health offices reported concerns of an increased severity of illness among campylobacteriosis cases, but the available surveillance data did not allow conclusions about this matter.

In order to inform stakeholders of the consequences of the outbreak in Sweden in 2016-17, the objectives of the study were:

(1) To investigate an increase in severity of domestically-acquired campylobacteriosis during the outbreak period compared to endemic period (2009-2013) by looking at:
    a. proportion of notified cases hospitalized,
    b. duration of hospitalization,
    c. rate of complications (GBS, sepsis),
    d. standardized mortality ratios (SMR).

(2) To estimate the burden of the outbreak in DALYs and cost.

For the endemic period and the outbreak, the SMR showed that campylobacteriosis cases had a significantly higher risk to die within 31 days after onset compared to the standard population, but the risk was similar for both periods (2.3 [95%CI:1.5-3.5] and 2.2 [95%CI:1.1-3.8]).

No increased mortality following illness was observed during the outbreak. Hospitalization data were requested to finalize the investigation on severity, and to calculate burden in DALYs and cost. This two metrics are amenable to sharing with stakeholders and decision-makers to communicate the consequences of the outbreak in human domestic campylobacteriosis that occurred in 2016-17. Investigations conducted during this outbreak reported a series of incidents along the broilers production in Sweden, which led to high colonization rates among broilers, and most probably to the human outbreak. Our results will be used to advocate on the importance to maintaining good standards on levels of campylobacter colonization for broilers production.

Role: *co-investigator*

Fanny designed the study, wrote the protocol, submitted an ethical application to the ethical committee, requested register-based data, and analysed mortality data.

Parents' socioeconomic characteristics associated with daughters' HPV vaccination uptake in school-based vaccination program in Sweden, 2013-2015

Supervisors: Adam Roth and Pär Sparen (Karolinska University)

HPV (human papillomavirus virus) vaccination was introduced into the Swedish national program in 2012 as a school-based vaccination for girls aged 10-12 years. Coverage for initiation of vaccination (at least one dose) among girls born in 2002 and 2003 was around 80%, but decreased to 75% for girls born in 2004. This participation rate is considerably lower than coverage for other childhood vaccines. Low socioeconomic status has been associated with lower HPV vaccination uptake, higher incidence, and lower survival from cervical cancer in Denmark. In Sweden, HPV-unvaccinated women are less likely to attend cervical cancer screening: there is a risk of increase in social inequalities in HPV-related cancer burden. The objective of the study was to compare parents' socioeconomic and demographic characteristics, according to their daughter´s HPV vaccination status, in order to identify groups at risk for lower uptake.

Girls born in 2002 and 2003 and their parents were identified from population registries. Socioeconomic characteristics were obtained from population Registries, and HPV vaccination status from the National Vaccination Registries.

Among the 98,993 eligible girls, 80,110 (80.9%) initiated HPV vaccine. Factors associated with lower initiation of vaccination included girls born outside of Sweden; low parental education; family income below the median; at least one parent receiving social benefits; and unemployment of on parent.

Although the HPV vaccine is available free of charge, these results highlight social inequalities in the initiation of HPV vaccination. Equal access to health among the Swedish population is a priority objective for the Public Health Agency of Sweden. This study will be continued, to include girls born in 2004. Identifying and describing the parents of girls who do not access HPV vaccination will help to target qualitative studies, and provide evidence to improve vaccination uptake and cervical cancer outcomes.

Role: *co-investigator*

Fanny designed the study, wrote the protocol, and conducted preliminary analysis.

4. Communications

Publications

1. Chereau F, Rehn M, Pini A, et al. Wild and domestic bird faeces likely source of psittacosis transmission — A case–control study in Sweden, 2014–2016. *Zoonoses Public Health*. 2018;00:1–8. https://doi.org/10.1111/zph.12492.

Reports

2. Chereau F. Proposal for a surveillance system for diabetes in Sweden, august 2018.
3. Chereau F. Rubella surveillance in Sweden in the context of verification of elimination, 2013-2018.
4. Chereau F. Suspected norovirus outbreak at Folkhäslomyndigheten, November 2016.
5. Chereau F and Löf M. Outbreak of Salmonella Kentucky among elderly home residents or hospitalized patients in Sweden, October 2017 - April 2018.

Conference presentations

6. Pini A, Chereau F et al. Cleaning wild bird droppings was associated with sporadic psittacosis cases notified in Sweden, 2014-2016. European Scientific Conference on Applied Infectious Disease Epidemiology, 2016.
7. Chereau F et al. Large outbreak of human campylobacteriosis linked to domestic chicken production, Sweden 2016-2017. European Scientific Conference on Applied Infectious Disease Epidemiology, 2018.

Other presentations

8. Documenting the burden of the outbreak of human domestic campylobacteriosis in Sweden, 2016/2017. Swedish Zoonosis Council Meeting, 3 May 2018.

Other

9. Supporting the response to the plague outbreak in Madagascar. Postcard from the field, 25 July 2018. https://ecdc.europa.eu/en/news-events/supporting-response-plague-outbreak-madagascar.
10. Story from the field: Fanny Chereau – Plague in Madagascar. EAN Newsletter, July 2018. http://epietalumni.net/wp-content/uploads/2018/07/EAN-Newsletter-Summer-2018.pdf.

5. Teaching and pedagogy

IDEA course (International Course of Applied Epidemiology), Rennes, France

From 26 to 30 March 2018, I facilitated in the International Course of Applied Epidemiology (IDEA) in Rennes, France. IDEA is a 3-week introductory course to applied epidemiology; participants included 34 French public health students and experienced professionals. Most lectures are conducted during the 1st week, while the 2nd and 3rd weeks focus on a field survey entirely conducted by the participants. Case studies are conducted thoughout the 3 weeks. I facilitated during the second week.

I facilitated two case-studies, "Outbreak of Haemorrhagic fever in Africa, 1976" and "SARS ".

The main objective of the second week of the training was to set up and conduct a survey on the determinants of physical activity in Rennes, France. The learning objectives of the different workshops were to be able to construct a protocol with objectives and data analysis plan, develop a questionnaire, collect data in the field, analyse and interpret the data and communicate the results. I facilitated these workshops, including the field supervision.

Course on surveillance activities and outbreak investigations, Stockholm, Sweden

In December 2016, I delivered two 45-minute lectures on (1) surveillance activities and (2) outbreak investigation for students in 1st year of a Master of Communicable Disease Control at Södertörn University. I facilitated a 2-hour case study: "Outbreak of gastrointestinal illness in 2010 in Sweden". The audience consisted of 12 Master students with diverse backgrounds (microbiologist, MDs, phamacists, communication, public health).

I adapted content from the EPIET introductory course and previous teaching presentations by former EPIET fellows. I also used examples from EPIET/EUPHEM case-studies and from my own datasets to illustrate specific points (epi-curve, maps). For the case study, I adapted a case study prepared by previous EPIET fellows, based on a gastrointestinal illness outbreak in 2010, in Sweden. I added questions and updated the case study conclusion using an article that was published in 2014, and expanded the facilitator guide (discussion for the choice of study design, interpretation of the results).

I developed the evaluation questionnaire: 9/10 respondents were satisfied with the content of the lecture, the level of the case study and the quality of the facilitation during the case study.

Facilitation of a case study, Uppsala, Sweden

In January 2017, I facilitated a case study, "Outbreak of trichinosis in France in 1985", for a group of 7 veterinary students. Participants were in the last year of the veterinary curriculum and had received basic epidemiology courses on study design and measures of association in their second year. I encouraged discussions among the students and provided guidance during the session, which lasted three hours.

No formal evaluation was admnistered, but students shared positive comments on the facilitation with the main organizer.

Reflection

Through these teaching activities, I discovered the pleasure of sharing my knowledge in epidemiology to various audience. By updating and improving a case study, I had the opportunity to reflect on the learning process. These experiences made me realize the importance of adapted teaching methods to reach different audience with specific learning needs, and the difficulties to ensure each participant's understanding of key concepts. Evaluations of my teaching activities helped me to identify points for improvement, which will allow me to progress in my ability to convey public health concepts. In the future, I will ensure that my teaching abilities are constantly be improved and adapted.

6. Other activities

GOARN deployment for support in the response to the plague outbreak in Madagascar, October-November 2017

An outbreak of plague in Madagascar started in August 2017, and was notified to WHO in September. Soon after, WHO classified the event as a Grade 2 emergency, and GOARN issued a request for assistance from international partners. I was deployed on October 10th, for 6 weeks.

I was involved in the epidemiological response and the laboratory support. During the first week of deployment, I joined the surveillance platform and worked with national and international field epidemiologists to develop and adapt tools for contact tracing and case investigation. We organized training sessions for healthcare and

community workers. The priority at that early stage of the outbreak was to identify and break the transmission chains. For the following weeks, I supported the laboratory response, in team with a WHO laboratory logistician. Rapid laboratory diagnosis with good performance is essential, particularly because the clinical picture for pneumonic plague is not specific at early stages of the disease. We evaluated the national capacity and capability for plague diagnosis in the context of the outbreak, and identified how WHO could support improvements. We implemented a system to ensure fast and safe transportation of cases' specimens, and promoted laboratory capacities (equipment, human resources).

During this mission, I learned about crisis management, emergency response, and coordination with national authorities, political bodies and with representatives from international NGOs, in a setting where resources were limited and team members had to use all their skills and knowledge. Working across disciplines to tackle a critical public health emergency is a valuable experience that I will carry with me in my future role as an epidemiologist. I also learnt how to be an effective and diplomatic player in international and multidisciplinary teams responding to complex emergencies situations. I got acquainted with the role and operational approach of the UN system.

Site visit to the Epidemic Intelligence and Response unit, April 2018, ECDC, Sweden

Fellows of cohort 2016 and 2017 hosted at the Public Health Agency of Sweden participated in a 1-week site visit at the Epidemic Intelligence and Response unit at ECDC, from 23 to 27 April 2018. The objective of the site visit was to be presented with epidemic intelligence procedures, response, FWD, EVD and RT meetings.

During the visit, we were explained the guiding principles of epidemic intelligence and response, and the process of rapid risk assessment. We were training on epidemic intelligence tools and procedures used at ECDC. On the last two days, we actively participated in the screening and shadowing of potential health threats, and their verification, assessment and investigation according to ECDC criteria. We also participated in the round table meetings of ECDC every day of the week. We could see how health threats identified by the Epidemic Intelligence and Response Unit are communicated within ECDC, and to external partners.

This site visit was a unique opportunity to learn and practice epidemic intelligence at European level. I learnt about the complexity of epidemic intelligence process and the importance of methods and guidelines to orientate each step of the process, in order to speed up the detection of potential health threats, and promote a timely response.

7. EPIET/EUPHEM modules attended

1. *Introductory course, 26th September to 14th October 2016, Spetses, Greece.*
2. *Outbreak investigation module, 5th to 9th December 2016, Berlin, Germany.*
3. *Multivariable analysis module, 13th to 17th March 2017, Zagreb, Croatia.*
4. *Rapid assessment and survey methods module, 8th to 13th May 2017, Athens, Greece.*
5. *Project review module, 28th August to 1st September 2017, Lisbon, Portugal.*
6. *Time series analysis module, 20th to 24th November 2017, Bristol, United Kingdom.*
7. *Management, leadership and communication module, 12th to 16th February 2018, Stockholm, Sweden.*
8. *Vaccinology module, 11th to 15th June 2018, Cardiff, United Kingdom.*
9. *Project review module, 27th August to 31st August 2018, Lisbon, Portugal*

Supervisor's conclusions

It has been a true pleasure to have Fanny working with us for two years. Not only has she been very productive, she has also been an appreciated colleague who have contributed to the agency with her kind personality. She was already knowledgeable in many areas of public health when she started working with us, but has since then increased her capacity by being exposed to areas that were new to her. When summing up all the projects and reports she has

participated in during her time at the agency it is clear that the range is very wide in terms of variety of pathogens, methodologies and public health problems.

We are very grateful for all the hard labour she has put in as well as her sharp observations. Fanny has actively helped the agency in the work with challenging and not very straight forward surveillance projects in the fields of Campylobacter, Diabetes mellitus and Rubella. She has been a very valuable resource during outbreak investigations on Norovirus, Salmonella and Legionella and has both helped finished projects started by other fellows and started her own on the subjects of campylobacter, HPV vaccination and rubella. All these projects have been priorities at the agency and having had access to a well-trained EPIET-fellow such as Fanny has been very valuable.

In summary Fanny is a very good epidemiologist and a joy to work with. I am convinced she will have a bright future and make valuable contributions to the field of public health in Europe and elsewhere.

Coordinator's conclusions

It has been a pleasure to work with Fanny, on both a personal and professional level. Fanny entered the fellowship with a strong scientific and analytical background and has really developed her competencies in applying epidemiology to urgent and complex public health problems. She has benefitted from a supportive training site by engaging in diverse projects, including the opportunity to develop a new surveillance system for a recognized public health issue. Fanny has demonstrated her ability and willingness to collaborate with her peers and build relationships between practitioners with diverse technical backgrounds. She has shown constant enthusiasm for learning new things and finding valuable lessons from challenging projects. Fanny emerges from the fellowship as a well-rounded intervention epidemiologist with a commitment to sharing her skills and knowledge with others.

Personal conclusions of fellow

The fellowship gave me the opportunity to be exposed to a variety of public health topics, which I had not been exposed to in the past. I broadened my knowledge of food- and water-borne diseases and vaccine-preventable diseases. The program provided me with the unique opportunity to learn new tools of teaching, to come upon new statistical methods and deepen my analytic skills, improve my scientific reporting and writing, and practice new software programs. I was exposed to several outbreak investigations, from which I learnt the importance of each of the 10 steps and the necessity to work closely with the laboratory. I could achieve my personal learning objectives: acquiring expertise in surveillance and independently conducting outbreak investigations.

My previous professional experiences in research were focused on very specific topics. Through the fellowship, I developed my organizational skills and my multi-tasking abilities. I also learned how to work as an effective and constructive team member. I also acquired experience in teaching public health to professionals and public health workers and became enthusiastic about sharing my knowledge and experience with others.

My international assignment with GOARN was an invaluable experience, personally and professionally. I learned about crisis management, emergency response, and coordination with national authorities, political bodies and with representatives from international NGOs. Working across disciplines to tackle a critical public health emergency is a valuable experience that I will carry with me in my future role as an epidemiologist.

EPIET has been a big professional and career leap for me, as it opened many possibilities for my future carrer which will be devoted to intervention epidemiology. I value to be part of a network of skilled epidemiologists and microbiologists trained by EPIET programme.

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