FELLOWSHIP REPORT

Summary of work activities

Laura Espenhain
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 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 listing the theoretical modules attended and the 23-month training. Additionally, if all training objectives have been met, they receive a diploma.

Stockholm, September 2018

- 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.

Pre-fellowship short biography

Laura Espenhain has a bachelor and master's degree in Public Health from University of Copenhagen. After graduating, she worked for three years at Statens Serum Institut in Denmark, primarily with surveillance of infectious diseases.

Fellowship assignment: Intervention Epidemiology path (EPIET)

On 15.09.2016, Laura Espenhain started her EPIET fellowship at the Norwegian Institute of Public Health, Oslo, Norway, under the supervision of Thale Berg. Her EPIET frontline coordinator was Alicia Barrasa. This report summarizes the work performed during the fellowship.

Methods

This portfolio demonstrates the competencies acquired during the ECDC Fellowship, EPIET path, by working on various projects, activities 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. 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 EPIET core competencies, as set out in the EPIET scientific guide[1].

[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/.pdf

Fellowship projects

1. Surveillance

Supervisor: Thale Berg

Title: *Surgical site infection after coronary artery bypass grafting*

Surgical site infection (SSI) is a serious complication after coronary artery bypass grafting (CABG) and is associated with burden for both patients and health-care system. Hospital-specific incidence of SSI is a national quality indicator in Norway. The EuroSCORE (European System for Cardiac Operative Risk Evaluation), a method for predicting post-operative mortality for patients undergoing cardiac surgery, is included in the Norwegian surveillance system for Health Care-Associated Infections (NOIS). We aimed to determine whether EuroSCORE can predict risk of infection after isolated CABG and thus be useful for risk stratification

We carried out a register-based cohort study using data from NOIS. We included patients who underwent isolated CABG surgery between 2010 – 2017 in five hospitals that reported EuroSCORE. We expressed the incidence of general and deep SSI as the number of infections within 25 days after surgery over the total number of procedures. To evaluate the existence of a relationship between the EuroSCORE and risk of infection, we used ttest, logistic regression and ROC curves.

In total, 6069 patients were included in the study. A total of 312 (5.1%) SSIs were reported, ranging from 3.8–8.4%, including 68 (1.1%) deep infections. 1262 (21%) observations had missing EuroSCORE. There was no association between EuroSCORE and SSI and the ROC curve indicated that the EuroSCORE cannot predict SSI in general or deep infections after CABG (C-statistics=0.37 and 0.46).

The lack of association between EuroSCORE and risk of SSIs suggests that EuroSCORE is not useful for risk adjustment. We recommend exploring reasons for differing incidences between hospitals and active use of the data locally and nationally to improve patient safety.

Role: Wrote protocol, analysed surveillance data, wrote report, communicated with stakeholders, prepared manuscript, prepared abstract for ESCAIDE, submitted manuscript to peer-reviewed journal [1], prepare poster, will present poster at ESCAIDE 2018 [2].

Supervisors: Torunn Alberg, Øyunn Holen, and Thale Berg

Title: *Yearly report on antibiotic use and healthcare-associated infections in hospitals and long-term care facilities (LTCF), 2016*

Healthcare-associated infections are associated with prolonged hospital stay, and can lead to hospitalization of residents in LTCFs and increased use of antibiotics. Increased use, or inappropriate use, of antibiotics can contribute to the development of resistance of bacteria and this can in turn make treatment of infections more difficult. National guidelines for use of antibiotics in hospitals and primary care exists in Norway. In the Action plan against antibiotics resistance in the health services, the Norwegian Ministry of Health and Care Services set a goal to reduce the use of antibiotics in health care institutions, especially the use of broad-spectrum antibiotics, by 30% by the end of 2020. They have also set a target of a prevalence of healthcare-associated infections (HAI) in hospitals of less than 4.7% in 2016.

Information about HAI and use of antibiotics is monitored in bi-yearly point prevalence surveys carried out on Norwegian hospitals and long-term care facilities. We described results from 2016 and evaluated whether antibiotics were prescribed according to the national guidelines.

The prevalence of HAI in hospitals in 2016 was 4.5% in the survey carried out in the spring and 4.9% in the autumn of 2016. In LTCFs, the prevalence was 5.5% and 5.8% for spring and autumn respectively. The most frequently reported HAI in hospitals was surgical site infections, while urinary tract infections were most frequently reported in LTCFs.

Around 30% of patients in hospitals and 7% of residents in long-term care facilities received antibiotics on the two days of the prevalence surveys. Broad-spectrum antibiotics accounted for 33% of the prescriptions in hospitals and 7% in LTCFs.

The most common indication for prescribing antibiotics was treatment of lower respiratory tract infections in hospitals and prophylaxis or treatment of urinary tract infections in LTCFs.

The use of antibiotics in hospitals and LTCFs was to a large extend in accordance to the national guidelines. However, this assessment was limited by the fact that the indications in the guidelines are more detailed than the indication collected in the prevalence surveys. It is therefore recommended that each hospital and LTCFs evaluate locally whether their use of antibiotic is in accordance with the national guidelines.

Role: Analysed surveillance data, drafted report [3], responsible for the results section, contributed to methods and discussion section, developed semi-automated system for updating graphs for future yearly or bi-yearly reports in Stata.

Supervisors: Thale Berg, Oliver Kacelnik and Horst Bentele

Title: *Epidemiology and impact of norovirus outbreaks in Norwegian healthcare institutions, 2006-2018*

Although it is mandatory to report all outbreaks in Norwegian healthcare institutions (HCIs), the burden associated with norovirus outbreaks is unknown. The aim of this study was to describe the epidemiology and impact of norovirus outbreaks in HCI in Norway.

We carried out a descriptive analysis of all reported norovirus outbreaks in HCIs from week 27, 2005 to week 26, 2018. We analysed information about onset, symptoms, number of cases among personnel and patients.

A total of 20,623 cases, including 7,073 healthcare personnel were reported in 967 outbreaks; 740 from long term care facilities (LTCFs) and 227 from hospitals. Median number of cases per outbreak was 15, interquartile range [8-25] in LTCF and 17, interquartile range [10-28] in hospitals. All regions reported outbreaks, with 1/3 of the 422 Norwegian municipalities having at least one outbreak in LTCFs during the study period. The peak of outbreaks happened three weeks earlier in hospitals than LTCFs. The estimated average number of working days lost for healthcare personnel per year ranged from 1598 to 1953.

This is the first comprehensive description of Norwegian norovirus outbreaks in HCIs. Given that one third of all cases were healthcare professionals there is a need for further focus on infection control. Outbreaks affect all levels of healthcare and all regions. Our results suggest that hospitals, affected first, could alert LTCFs in the area in order to prevent further outbreaks.

Role: Defined objectives, extracted and analysed surveillance data, prepared abstract for ESCAIDE, prepared PowerPoint presentation and will be presented at ESCAIDE 2018 [4], prepared manuscript, submitted manuscript peer-reviewed journal [5].

Supervisor: Ruby Siddiqui, HQ Epidemiologist, MSF-UK

Title: *Epidemiologist in refugee settlement, Palorinya, North Uganda with Doctors without Borders (MSF)*

The conflict, that commenced in South Sudan in 2013, has driven large numbers of the population to flee internally or into neighbouring Uganda. In July 2016 fighting broke out in Juba and later spread into the state of Equatoria. By February 2017, more than 730,000 South Sudanese had fled into Uganda. MSF-OCA started operations in Palorinya refugee settlement in Northern Uganda in February 2017, providing health care in areas not covered by other actors, producing drinking water and performing community surveillance. In September 2017, paper-based community surveillance was expanded to the whole settlement. MSF-OCA handed over its operations in January 2018.

In October 2017, we aimed to establish and implement electronic community surveillance covering all 11 zones of Palorinya settlement using smart phones with the app KoboCollect. This entailed re-designing the questionnaire (based on the previously-used paper forms), training the community health workers (120) and their supervisors (5) in the use of the smartphones and electronic survey platforms, monitoring data collection, supervision and logistics of surveillance teams and analysis of the generated data. Weekly bulletins containing epidemiological summaries of surveillance and medical activities were produced.

Activities also included prioritising epidemiological questions before closure of the program. In addition to information collected routinely, we decided to add some questions concerning the health status of the population to the electronic surveillance questionnaire. By the end of October 2017, we had collected data on vaccination status for all children below 5 years of age in the settlement. This entailed also training of community health workers and their supervisors in vaccination policy in Uganda and South Sudan to help the parent remember vaccination status if the vaccination card was missing.

Other activities included support of the water and sanitation team to optimise the use of their data as well as mapping of water sources and population density using QGIS to identify areas with poor access.

Role: Project epidemiologist, establish and implement electronic community surveillance, design questionnaire, training of community healthcare workers, analysis of data, prioritisation of epidemiological activities, mapping water sources and population density.

Supervisors: Torunn Alberg, Øyunn Holen, and Thale Berg

Title: *Yearly report on antibiotic use and healthcare-associated infections in hospitals and long-term care facilities, 2017*

Healthcare-associated infections are associated with prolonged hospital stay, and can lead to hospitalization of residents in LTCFs and increased use of antibiotics. Increased use, or inappropriate use, of antibiotics can contribute to the development of resistance of bacteria and this can in turn make treatment of infections more difficult. National guidelines for use of antibiotics in hospitals and primary care exists in Norway.

Information about HAI and use of antibiotics is monitored in bi-yearly point prevalence surveys carried out on Norwegian hospitals and long-term care facilities. We described results from 2017 and evaluated whether antibiotics were prescribed according to the national guidelines.

The prevalence of HAI in hospitals in 2017 was 4.5% in the survey carried out in the spring and 4.7% in the autumn of 2017. In LTCFs, the prevalence was 5.2% and 4.9% for spring and autumn respectively. The most frequently reported HAI in hospitals was surgical site infections, while urinary tract infections were most frequently reported in LTCFs.

Around 30% of patients in hospitals and 6% of residents in long-term care facilities received antibiotics on the two days of the prevalence surveys. Broad-spectrum antibiotics accounted for 29% of the prescriptions in hospitals and 8% in LTCFs.

The most common indication for prescribing antibiotics was treatment of lower respiratory tract infections in hospitals and prophylaxis or treatment of urinary tract infections in LTCFs.

The use of antibiotics in hospitals and LTCFs was to a large extend in accordance to the national guidelines. However, this assessment was limited by the fact that the indications in the guidelines are more detailed than the indication collected in the prevalence surveys. It is therefore recommended that each hospital and LTCFs evaluate locally whether their use of antibiotic is in accordance with the national guidelines.

Role: Analysed surveillance data, drafted result section, contributed to methods and discussion section.

Supervisor: Karin Nygård

Title: *Epidemic Intelligence activities*

Epidemic Intelligence is the process to detect, verify, analyse, assess and investigate public health events that may represent a threat to public health. Epidemic intelligence provides early warning signals as one of the main objective of public health surveillance systems. In Norway epidemic intelligence is based on both event based and indicator based surveillance, and NIPH is the national focal point for International Health Regulations (IHR) for WHO and Early Warning and Response System (EWRS) for the EU.

Role: Member of Epidemic Intelligence group, did a total of 6x2 weeks of daily monitoring of main mailbox for incoming alerts from the outbreak reporting system (VESUV), the international surveillance network communication (EWRS/IHR), media surveillance, distribution of information to relevant employees, write weekly summary report to be presented at the weekly Epidemic Intelligence meeting.

2. Outbreak investigations

Supervisor: Katrine Borgen

Title: *Outbreak of gastroenteritis after a memorial service*

On Monday 19 December 2016, a local Norwegian food Safety Authority (NFSA) department reported 32 gastroenteritis cases among approximately 70 people that had lunch during a memorial service at restaurant venue on Friday 16 December. NFSA in collaboration with the Municipal Medical Officer and NIPH initiated an outbreak investigation to estimate the extent of the outbreak and identify the vehicle of transmission, in order to implement control measures and prevent further cases.

We conducted a retrospective cohort study among all individuals who consumed food served at the memorial service. A case was defined as a person who consumed food served at the memorial service and reported gastroenteritis symptoms with onset between 16 and 19 December. We collected data using a self-administered online questionnaire. NFSA collected specimens from ingredients used for preparation of the food and patients were encouraged to deliver stool samples. We calculated attack rates (AR) and risk ratios (RR).

Of all participants, 44 (60%) completed the questionnaire and 33 (75%) cases were identified; symptoms included nausea (97%), vomiting (94%), and diarrhoea (76%). Onset of symptoms was reported up to 18 December 12 am; the epidemic curve suggested a point source outbreak. The median duration of illness was two days (range 0-6 hours to 4 days). Those who consumed salmon sandwich had a 44% (RR 1.44; 95%CI 0.87-2.38) higher risk of illness compared with those who did not; 80% of cases ate salmon sandwich. Specimens from two patients were positive for norovirus. No pathogens were identified in the three tested food specimens.

Epidemiological data suggested a point source norovirus outbreak without conclusive results regarding the source and mode of transmission. Neither cross-contamination of food nor person-to-person transmission could be ruled out. We recommend adherence to the current guidelines to prevent norovirus outbreaks.

Role: Co-investigator: Collaboration and coordination with the food authorities, colleagues at FHI, EUPHEM, EPIET, to make a questionnaire in Norwegian in Questback to the guests, help in data analysis, review of outbreak report written by Lamprini Veneti, EPIET cohort 2015 [6].

Supervisor: Katrine Borgen

Title: *Outbreak after a company Christmas dinner*

On Monday 19. December 2016, the director of a high school, alerted the municipal doctor about a potential foodborne outbreak after a Christmas dinner party amongst the staff of the school on Friday 16 December. The food served at the dinner was made by Restaurant and Food Processing-students from the school. The food authorities were alerted and an investigation was initiated by the local food authorities and the municipal doctor.

A retrospective cohort study was carried out amongst the participants of the Christmas dinner. A case was defined as a person who participated in the dinner Friday 16 December and who developed vomiting and/or diarrhoea or at least two symptoms from fever, nausea and stomach aches, starting after 2 am on December 17 (six hours after the dinner started at 20).

Of 58 respondents, 21 met the case definition. The main symptoms were vomiting, diarrhoea, nausea and stomach aches. The mean incubation period was 37 hours (14-59 hours). It was not possible to show a clear and meaningful association between any of the 31 food served at the dinner and illness, but one dessert was weakly positively associated with illness.

The food authorities did an inspection of the premises on Monday 19. December with a focus on hygiene, routines around illness amongst staff, food storing temperature, cooling down of hot food and how food is served. No misconduct was observed but the food authorities recommended to log the process of cooling down of hot food and the temperature in the fridge and freezer in the bakery department.

The outbreak fulfils three out of four of the Kaplan criterion for Norovirus outbreak, but as no human or food specimens were collected, the cause of the outbreak remains unknown. The kitchen was washed down and disinfected and routines around gastro-symptoms amongst staff and hand washing was reviewed.

Role: Assisted the municipal doctor: The NIPH was only involved in a later stage of this outbreak investigation. The municipal doctor carried out the cohort study and only requested guidance and quality check of his work and results in January 2017. I assisted him: analysed the data he had collected, made a summary report, provided guidance on data and specimen collection and shared an Excel epi curve tool with him for future outbreaks. [7]

Supervisors: Thale Berg and Oliver Kacelnik

Title: *Klebsiella oxytoca at a neonatal intensive care unit at a hospital*

Klebsiella oxytoca is a gram negative bacteria in the *Enterobacteriaceae* family and is considered an opportunistic pathogen that causes bacterial infection, pneumonia, urinary tract infection and enterocolitis. In April and June 2016, there were two infections with *Klebsiella oxytoca* at a neonatal intensive care unit in a Norwegian hospital. In July same year, carriage of the same *Klebsiella oxytoca* were identified in two neonates in connection to a screening of faeces during another outbreak. In January 2017, after the introduction of routine screening of faeces on selective agar during the autumn of 2016, 20 cases with *Klebsiella oxytoca* had been identified including five infections and one death. In January 2017 the screening changed to a gen-based screening method.

The section of infection control at the hospital helped the unit with handling of the outbreak. Measures to prevent cross-contamination were main priority: Isolation and later cohorting of cases, increased attention and education about hand hygiene, cleaning, handling and disinfection of equipment.

Environmental samples were taken from 89 different sites from the intensive care unit and in other related departments. A case-control study was carried out to identify risk factors.

An overlap in time, except for four days in November 2016, was observed for admissions of all cases. The *Klebsiella oxytoca* outbreak strain was not identified in any environmental samples. The epidemiological and microbiological analyses did not suggest that donor-milk, milk from individual donors or particular rooms in the unit were implicated in the outbreak. Cases had had umbilical venous catheter and received total parenteral nutrition to a larger extent than controls, were younger at birth and had been admitted longer than controls. No cases has been identified since week 6 of 2017. Good collaboration, regular meetings and education has been crucial to succeed with implementing the measures to control the outbreak.

Role: Wrote protocol, developed line list, call for meetings, update log, keep track of information, collect data for describing the outbreak and for case control study. Held one teleconference and travelled to the hospital two times - supervisors were there on one more occasion while I was at a module. Responsible for writing the outbreak report (confidential) and getting microbiology and infection control's contributions to the report [8].

Supervisors: Heidi Lange

Title: *Outbreak of gastroenteritis at an accordion festival*

On Tuesday 17 January 2017, the Norwegian Food Safety Authority reported gastroenteritis cases among approximately 210 people who had attended an accordion festival at a hotel in Oppland during 13-15 January. We investigated to estimate the extent of the outbreak and identify the mode and vehicle of transmission, in order to implement control measures.

We conducted a retrospective cohort study among all individuals who consumed food served at the hotel during the festival. A case was defined as a person who consumed food served at the hotel and reported diarrhoea or vomiting with onset during 14-18 January. We conducted telephone interviews using a structured questionnaire. We inspected the premises including kitchen facilities. Patients were encouraged to provide stool samples. We calculated attack rates and adjusted risk ratios (aRR) using binomial regression.

Of all participants, 67 (32%) completed the questionnaire and 23 (31%) cases were identified; symptoms included nausea (68%), vomiting (64%), diarrhoea (75%), stomach pain (57%) and fever (17%). The epidemic curve suggested a point source outbreak. The median duration of illness was two days (range 0-6 hours to 7 days).

Those that consumed "spekemat" (aRR 2.03; 95%CI 1.25-3.32), "krepsehale" (aRR 2.25; 95%CI 01.38-3.68), and "safran gravet torsk" (aRR 3.05; 95%CI 2.10-4.43) had higher risk of illness compared with those who did not; 81% of cases had eaten at least one of the above three cold buffet dishes. One patient sample was tested and was positive for Norovirus. No irregularities in kitchen hygiene were identified. No food samples were available.

Epidemiological evidence suggested that the three cold buffet dishes consumed by the majority of cases may have been the vehicles of transmission. However, neither cross-contamination of food nor person-to-person transmission could be ruled out. We recommend adherence to the current guidelines to prevent norovirus outbreaks.

Role: Participated in status meetings. We decided on a cohort study, gave input on the questionnaire prepared by Lamprini Veneti, the 2nd year EPIET fellow, and carried out interviews with the participants by phone. Responsible for writing the outbreak report (Lamprini did the analyses) [9].

Supervisors: Heidi Lange and Emily MacDonald

Title: *Salmonella Typhimurium at a juice bar*

Alert concerning 7 identical Salmonella Typhimurium monophasic with an unusual MLVA profile was reported from the National reference laboratory for enteric bacteria. The isolates came from patients, 6 were female, from all over Norway. Coordination with the national, regional and local food authorities started and local food authorities interviewed the cases in their area with a trawling questionnaire developed by FHI.

Tuesday the first filled out questionnaire were sent to FHI. All had been to the same café in Oslo airport. A TC was arranged with all involved parties Wednesday and by then it became clear that 6/7 had been at the same café during the same period (18 – 21 august). The local food authorities inspected the café Wednesday afternoon and another TC was held Thursday. Friday an eighth identical isolate was identified at the reference laboratory. This person had also been at the café during the same period.

The food authorities went on from here.

Role: Took part in meetings, update linelist, made epicurve, write status summary to be shared with the food authorities and municipal doctors, briefed at TC.

3. Applied epidemiology research

Supervisors: Martin Steinbakk and Silje Bakken Jørgensen

Title: *Prevalence of Extended beta lactam producing E.coli and Klebsiella ssp. in Norway*

The prevalence of extended-spectrum beta-lactamase (ESBL)-producing *Enterobacteriaceae* has been increasing in Europe and ESBL has been seen in hospital outbreaks in Norway. We aimed to estimate the prevalence of fecal carriage of ESBL-producing *Enterobacteriaceae* in non-Intensive Care Unit (non-ICU) patients upon hospital admission and identify factors associated with carriage to guide screening recommendations.

Between October 2014 and December 2016, we recruited non-ICU patients admitted to five non-psychiatric departments for adults and one acute care department for children at a Norwegian university hospital. Upon admission, rectal swabs or stool samples were collected for screening for ESBL-producing *Enterobacteriaceae*. Isolates were characterized by phenotypic methods. Patients or parents of children completed a questionnaire covering possible risk factors for ESBL colonization. We calculated prevalence and adjusted prevalence ratios (aPR) using binomial regression.

Of 746 patients, 50 (6.7%) were colonized with ESBL-producing *Enterobacteriaceae*; 92% (46/50) with Escherichia coli and 14% (7/50) with Klebsiella pneumoniae. 43 (86%) patients had isolates with coresistance to ciprofloxacin. Prevalence of ESBL was higher among travellers to Asia (15/39; prevalence=38% compared with non-travelers to Asia (35/707; prevalence=5.0%; aPR=7.7; 95%CI 4.6-13; p<0.001). Previous hospitalization in Norway (aPR=0.81; 95%CI 0.45-1.5; p=0.47) or antimicrobial treatment 12 months prior to admission (aPR=1.4; 95%CI 0.85-2.3 p=0.18) was not associated with ESBL colonization.

The observed prevalence of ESBL colonization upon admission was lower than that reported in similar studies in Germany (9.5%) and the Netherlands (8.2%), but comparable with previous studies in Norway and Sweden. Consistent with other studies, travel to Asia was associated with ESBL colonization and needs to be included in the screening recommendations.

Role: Adjusted project protocol to this sub-project, quality checked and corrected data, analysed data, communicated with microbiologists, laboratory, participated in overall project-meetings at the hospital, presented results at ESCAIDE [10], prepared and submitted manuscript to peer-reviewed journal [11].

Supervisors: Karin Nygård, Heidi Lange, Lin Brandal

Title: ***Geographical determinants of domestically acquired human EHEC infections in Norway, 2009-2017***

Enterohemorrhagic *Escherichia coli* (EHEC) is a common causative agent of foodborne outbreaks globally. In Norway EHEC often causes sporadic infections, but has also been seen in outbreak. The geographical distribution of sporadic EHEC infections in Norway varies, and these geographical variations are not well described or understood. In an ecological study we will look at the incidence and spatial patterns of human EHEC infections in Norway and the relationship with environmental factors (agricultural, water-related, and climatic). This can give insight into the causes of transmission and possible risk factors, as well as give rise to research questions on individual-level. We will investigate environmental factors potentially contributing to the distribution of sporadic

EHEC cases in Norway as opposed to food products, which have frequently been well documented as EHEC risk factors in outbreak settings.

Role: Wrote protocol, gathered data from the statistical and metrological bureau, described data, made maps in R, and presented results at EPIET meetings.

4. Communication

Publications

1. Espenhain, L., et al., European System for Cardiac Operative Risk Evaluation does not predict surgical site infections after isolated coronary artery bypass grafting in Norway, a register-based cohort study, 2010 - 2017. **[Submitted]**.

5. Espenhain, L., et al., Epidemiology and impact of norovirus outbreaks in Norwegian healthcare institutions, 2005-2018. **[Submitted]**.

11. Espenhain, L., et al., Travel to Asia is a strong predictor for faecal carriage of cephalosporin resistant E. coli and Klebsiella spp. but is far from explaining everything. Prevalence study at a Norwegian hospital 2014-2016.. **[Submitted]**.

Reports

3. Espenhain, L., et al., Årsrapport 2016 - Helsetjenesteassosierte infeksjoner og antibiotikabruk i Norge. 2017, Norwegian Institute of Public Health.

6. Veneti, L., et al., A foodborne outbreak after a memorial service, Norway December 2016. 2017. **[Internal report, not for the public domain]**.

7. Bergkåsa, M., et al., Utbrudd av gastroenteritt, i Lillehammer, desember 2016. 2017. **[Internal report in Norwegian]**.

8. Espenhain, L., et al., Utbruddsrapport - Klebsiella oxytoca på en neonatalintensiv-avdelingen, 2016-2017. 2018. **[Internal report, not in the public domain]**.

9. Veneti, L., et al., An outbreak of gastroenteritis connected to Trekkspilltreff at Thon Fagernes hotel, Oppland, Norway January 2017. 2017. **[Internal report, not in the public domain].**

Conference presentations

2. Espenhain, L., et al., European System for Cardiac Operative Risk Evaluation does not predict surgical site infections after isolated coronary artery bypass grafting in Norway, a register-based cohort study, 2010 - 2017. ESCAIDE, 2018. **Poster presentation**.

4. Espenhain, L., et al., Epidemiology and impact of norovirus outbreaks in Norwegian healthcare institutions, 2005-2018. ESCAIDE, 2018. **Oral presentation**.

10. Espenhain, L., et al., Travel to Asia associated with colonization with extended-spectrum beta-lactamase-producing Enterobacteriaceae upon hospital admission, Norway, 2014-2016. ESCAIDE, 2017. **Oral presentation**.

5. Teaching and pedagogy

Title *Case study about outbreak investigation in hospital for infection prevention personnel*

NIPH had been encouraged to facilitate *outbreak management in healthcare setting* courses on numerous occasions. A good case study in a Norwegian context was needed. I developed and facilitated a new case study suitable for the Norwegian context together with three experienced colleagues. The **training objectives** covered the steps of an outbreak investigation, the roles and responsibilities of actors in a hospital setting in Norway, introduction to how to collect and systematise information in an outbreak setting. The course **target audience** was infection prevention and control personnel and healthcare personnel in hospitals and it was piloted amongst 23 participants during a course on outbreak investigation in a hospital setting in Trondheim and took approximately two hours. The course was conducted in one (of the four) health regions in Norway.

The course was evaluate via an online form sent to the participants after the course. The evaluation of the course showed that the participants were very content with the content, minor changes were done. As well the content was adjusted and translated into a Danish context to be used in a course about outbreak investigation in a hospital setting in Denmark during the autumn 2017, in a course for microbiologists in Norway later same year and during an outbreak course in a second health region in 2018.

Reflection

Being involved in the development of a case study allowed me to develop my skills within planning and targeting material for a specific audience and the discussion we had in the working group around developing the case study served as numerous table top exercises in **outbreak management** in a **hospital setting**. Being involved in the development of a case study also allowed me to learn more about the structure of the Norwegian healthcare system, the roles and responsibilities, and the surveillance systems for infectious diseases.

Title *Outbreak investigation course for municipal health doctors*

During a one-day training course on outbreak investigation I facilitated a two hours case study on an EHEC outbreak in a hotel in Norway. The **training objectives** were for the participants to a) be able to identify an outbreak, b) understand the different steps of an outbreak investigation and how epidemiological, microbiological and environmental investigations go hand in hand, c) apply a case definition, d) be able to describe an outbreak in time, place and person and interpret an epicurve, e) understand the importance of interdisciplinary cooperation during the investigation and implementation of control measures and f) to understand the importance of media-handling during an outbreak investigation. The course **targeted** municipal health officers and veterinarians working at the food safety authorities.

The course was evaluated in an open discussion immediately after the case study was done. Participants were content and found the case study helpful but could have wanted more time.

Reflection

Facilitating both case studies allowed me to improve my skill in **capacity building**, explaining epidemiological topics, encourage participation and gave me valuable insights in how the participants from different professions and healthcare or public health institutions see and have acted in outbreak situations.

6. EPIET/EUPHEM modules attended

1. *Intro course, 25/9-14/10-2016, Spetses, Greece*
2. *Outbreak investigation module, 5-9/12-2016, Berlin, Germany*
3. *Multivariable analysis module, 13-17/3-2017, Zagreb, Croatia*
4. *Rapid Assessment and Survey Methods, 8-13/5-2017, Athens, Greece*
5. *Time series analysis, 20-24/11-2017, Bristol, England*
6. *Vaccinology, 11-15/6-2018, Cardiff, Wales*

7. Other training

1. /Antimicrobial resistance - theory and methods, 5 week Coursera course by Technical University of Denmark (DTU)
2. *Nordic mini project review, 2017, Helsinki*
3. *Nordic mini project review, 2018, Oslo*

Discussion

Supervisor's conclusions

Laura Espenhain has completed a two-year fellowship at the Norwegian Institute of Public Health, in the department of antibiotic resistance and infection prevention. During her fellowship she has been engaged in a variety of national and international projects, through which she has developed a broad understanding of infectious disease epidemiology and public health, especially in the field of health care associated infections and antimicrobial resistance, but e.g. also in refugee camp settings. Laura has been involved in several outbreak investigations, both in the community and the hospital setting. Among her research projects is one performed in close collaboration with a university hospital, where her epidemiological and analytical skills and ability to move the project forward has been much valued. This work has added to the knowledge of the prevalence of AMR in the Norwegian population. Laura has made major contributions to the department's surveillance and research activities on outbreaks, health care associated infections and antimicrobial use, and her work will be useful for the department even in the future. As a teaching project, Laura has developed a case study on outbreak management in the hospital setting which has been a great success and already used in outbreak/infectious disease epidemiology courses on several occasions. In all projects, Laura's keen interest in learning, motivation, work capacity and analytical skills have been highly appreciated by her supervisors and co-workers. Laura settled in quickly in the department and has adjusted very well to life in Norway. She has made important contributions to the professional, but also to the social life of the department, as a key member of the social committee. Laura has been a great colleague, and we wish her the best of luck in her future career.

Coordinator's conclusions

Prior to this programme Laura had already professional experience in infectious diseases surveillance and good competencies in data analysis, skills that she put extensively in practice for her surveillance projects and outbreaks investigations. But she entered the programme with the clear objective of enhancing her analytical skills which I believe she did throughout all her projects and particularly in her applied research projects where she was very proactive, always thinking further on how to apply different techniques she learnt across these two years, and willing to learn how to do it in more extent than what was covered during modules.

Laura is a very independent professional open to constructive input, and a very good colleague always ready to give support and good scientific discussions. I definitively would recommend Laura for any kind of public health work.

Personal conclusions of fellow

Engaging in the EPIET programme has been an excellent opportunity for me to refine my skills within epidemiology - especially within applied research - , to broaden my horizon on how surveillance and response are organised in Norway and across Europe, and to expand my personal and professional network. It has been a great journey both professionally and personally and a privilege to be surrounded by such talented and engaged people, including facilitators, supervisors, and co-fellows.

Acknowledgements of fellow

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