



FELLOWSHIP REPORT

Summary of work activities

Gudrun Freidl

Intervention Epidemiology path (EPIET)

Cohort 2015

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;

The views expressed in this publication do not necessarily reflect the views of the European Centre for Disease Prevention and Control (ECDC).

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.

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- 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 guide¹.

Pre-fellowship short biography

Gudrun studied veterinary medicine in Austria. Upon completion of her studies she worked at the Research Institute of Wildlife Ecology at the University of Veterinary Medicine, Vienna. In 2011, she moved to the Netherlands to pursue a PhD in Public Health Virology at the Erasmus Medical Center, Rotterdam and the National Institute for Public Health and the Environment (RIVM), Bilthoven. During that time, she also completed a Master's degree in Infectious Disease Epidemiology at Utrecht University, the Netherlands. In 2015, she gained experience in international missions by providing diagnostic support during the Ebola outbreak in Liberia.

Fellowship assignment: Intervention Epidemiology path (EPIET)

On September 14, 2015, Gudrun started her EPIET fellowship at the National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands under the supervision of Dr. Mirjam Knol. Dr. Chris Williams was her front-line coordinator. 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

Implementation of a surveillance system for Severe Acute Respiratory Infections (SARI) in Dutch paediatric intensive care units: Results from respiratory season 2016/17

During the 2009 influenza pandemic, insight into the epidemiology of severe cases was lacking, which hampered targeted provision of vaccine to high-risk groups. In response, the World Health Organization encouraged countries to implement surveillance for Severe Acute Respiratory Infections (SARI). We established a SARI surveillance system in Dutch paediatric intensive care units (PICU) to monitor SARI and provide early warning of serious respiratory infections.

Between week 42, 2016 and week 20, 2017, PICUs reported aggregated data weekly using an online platform. Reported data comprised number of patients on PICU, total number of SARI cases and number of newly admitted SARI cases by age group. For newly admitted SARI cases, PICUs also reported laboratory results.

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_C2016.pdf

Six of eight PICUs in Dutch hospitals participated, covering ~75% of the pediatric population. SARI burden in PICUs was highest in week 50, accounting for 49% of admissions (24/49). SARI incidence peaked in week 49 at 39 cases (1.4 per 100.000 children <18 years). The cumulative seasonal incidence was 11.8 cases per 100.000 (n=321), and 81% of SARI cases were 0-1 years old. Laboratory results were available for 254/321 SARI cases (79%). Respiratory syncytial virus (RSV) was identified earliest, and most often (64%), followed by rhino/enterovirus (25%), other respiratory viruses (20%) and influenza (7%).

PICU surveillance meets the objective to clarify the epidemiology of SARI in the Dutch pediatric population. Most pediatric SARI cases in 2016/17 were caused by RSV, corroborating the observation that the early start of the respiratory illness season in primary care was mainly attributable to RSV rather than influenza. Surveillance results can be useful for capacity planning on PICUs, and public health communications about respiratory virus circulation.

Role and outputs: principal investigator

Adapted an existing protocol, liaised with participating paediatric intensive care units (PICU), submitted to ethical committee, implemented surveillance system by creating data form within online platform for weekly reporting performed by PICUs, established syntax for weekly and monthly analysis, analysed surveillance data, responsible for weekly updates to the Dutch National Early Warning Committee and monthly reports for PICUs (1), evaluated the surveillance system (2), co-authored a chapter of the yearly report of the respiratory diseases group (3) and submitted an abstract to ESCAIDE (accepted for an oral presentation) (4). A manuscript is planned.

Supervisor: Anne Teirlinck

Routine national surveillance activities for measles, mumps and rubella 2015/16

Measles, mumps and rubella (MMR) are notifiable diseases in the Netherlands. The National Institute for Public Health and the Environment uses two sources for MMR surveillance purposes: (i) the registration system Osiris, in which municipal health services provide demographic, laboratory and epidemiological information about cases, and (ii) the virological weekly reports, in which a selection of medical laboratories report the numbers of positive virological tests per week. Municipal health services notify measles and rubella cases within one working day and mumps cases within three working days. The RIVM conducts surveillance for notified MMR cases on a weekly basis and shares results with the weekly infectious diseases Early Warning Meeting. Samples for genotyping are collected for all measles and rubella cases and a selection of mumps cases.

Between January 2015 and June 2016, only seven cases of measles were notified in Osiris. Cases were between 27 and 58 years old. All were imported or import-related. Five cases were not vaccinated, one case was vaccinated once and for another case vaccination history was unknown. During the same reporting period, only one rubella case occurred, which was a 31-year-old, unvaccinated male that became infected in Namibia. In 2015, 89 mumps cases were notified in Osiris. This figure was higher compared to the year 2014, during which 40 cases were reported. Of the cases reported in 2015, 53% were male and ages ranged from 7 to 65 years (mean age: 26). With respect to vaccination history, 60% were vaccinated twice, 11% once and 18% were not vaccinated. For 11%, vaccination status was unknown. Two epidemiological clusters could be identified, which comprised 13 and seven cases, respectively. Molecular typing showed that both clusters were caused by an identical mumps virus genotype G. During the first half of 2016, 45 mumps cases were reported. Among these, again two clusters were identified (n=8 and n=7, respectively) which were infected with a unique molecular cluster of genotype G.

In conclusion, for the reporting season January 2015 to June 2016 the number of measles and rubella cases was low and all cases were associated with infection outside the Netherlands. For mumps, the surveillance indicated endemic circulation between March and May 2015. Mumps incidence was low, but higher compared to the previous year. Genotype G was most often identified, which has been most prevalent in Dutch cases since 2010.

Role and outputs: principal investigator

Weekly analysis of data from the national surveillance system for measles, mumps and rubella and reporting results to Early Warning Committee. A summary of results of surveillance activities is given above (5).

Supervisor: Susan Hahné

Competencies developed:

Performing the routine national surveillance for measles, mumps and rubella helped me to develop more experience in conducting surveillance on a national level and to understand the different surveillance systems that are in place in

the Netherlands; for the virological weekly states, 21 medical molecular laboratories report positive laboratory tests for viruses. For the national surveillance system for notifiable diseases (Osiris), the municipal health services collate and report data. As part of my responsibilities, I was in regular contact with both the laboratories and municipal health services to ask additional information about reported cases. I also worked closely with the Early Warning Committee to which I submitted surveillance results on a weekly basis and provided clarifying information when needed.

The implementation and evaluation of the surveillance system for severe acute respiratory illness on paediatric intensive care units (PICU) allowed me to gain experience in how a surveillance system is set up and how it can be evaluated. By closely liaising with PICUs I learned to not only think in terms of what is relevant for public health purposes but also what kind of information can be feasibly collected from clinicians that might also be useful to improve clinical practice. I prepared documents for the assessment by the medical ethical committee. I learned how to use the online platform Questback to implement a user-friendly format for data submission via an online platform and worked closely with a statistician to establish an easily adaptable syntax for swift weekly and monthly analysis and automatic report generation in the statistical program R. I developed an evaluation form using various indicators to assess the performance of the surveillance system. I conducted evaluations with relevant stakeholders (PICU representatives, public health professionals from the epidemiology and laboratory department, as well as members of the Early Warning committee) and used the feedback to provide recommendations for improvement during the following respiratory season.

2. Outbreak investigations

National outbreak of *Salmonella* Typhimurium with a novel MLVA type linked to the consumption of raw and undercooked beef products distributed via a Dutch deboning plant, the Netherlands, October to December 2015: Tracing back the source

On October 23, 2015, a cluster of six cases with gastroenteritis notified the Netherlands Food and Consumer Product Safety Authority. Cases suspected *filet américain*, a raw beef spread, as the source of infection. Leftovers and stool samples tested positive for *Salmonella* Typhimurium. Multiple locus variable-number of tandem repeat analysis (MLVA) revealed a novel MLVA pattern (02-23-08-08-212), which had never been detected in the Netherlands before. Concomitantly, an increase of this MLVA type was observed in the national *Salmonella* surveillance, amounting to 47 cases between October 26 and December 22, 2015. To investigate whether *filet américain* or an alternative (related) source could also be linked to surveillance-reported cases, we sent questionnaires to surveillance-reported cases identified early in the outbreak and initiated source tracing to map the food supply chain from retail/catering premises to processors. In total, 24/29 respondents (83%) could be linked to beef products (predominantly *filet américain* and minced beef). Rapid interdisciplinary action resulted in identification of a contaminated 46-ton batch of beef distributed via a Dutch deboning plant as the likely source of infection. Repeated identification of raw meat products as a source of infection indicates that improved measures on product labeling, pre-treatment or product testing should be considered.

Role and outputs: *principal investigator*

Member of the outbreak management team, wrote protocol, developed data entry mask in Microsoft Access, performed data entry and data analysis, analysed outbreak data, wrote and submitted the manuscript to a peer-reviewed journal (6), provided update for National Dutch Early Warning Meeting Report (7).

Supervisor: *Ingrid Friesema*

Hepatitis A outbreak among men who have sex with men (MSM) predominantly linked with the Europride, the Netherlands, July 2016 – February 7, 2017

Between July 2016 and February 7, 2017, 48 male hepatitis A cases were notified in the Netherlands. Of these, 17 identified as men who have sex with men (MSM). Molecular analyses showed co-circulation of three distinct hepatitis A strains. Ten of the 14 cases (71%) for which sequencing information was available were infected with a strain linked with the Europride that took place in Amsterdam in 2016. The Europride strain is identical to a strain that has been causing a large outbreak among MSM in Taiwan.

Role and outputs: *principal investigator*

Member of the outbreak management team, wrote protocol, analysed outbreak data, wrote and submitted a manuscript to a peer-reviewed journal (8), developed a questionnaire and a data extraction form using Microsoft Access, developed data entry mask, performed data entry and data analysis. Wrote updates for meetings of the outbreak management team (9), provided two updates for National Dutch Early Warning Meeting report (10, 11) and

contributed to an alert (*inf@ct*) for Dutch public health professionals in which we raised awareness of the outbreak and provided recommendations with respect to prevention measures (12).

Supervisor: *Ingrid Friesema*

Hepatitis A outbreak affecting men who have sex with men (MSM) in Europe, June 1st 2016 – March 31st, 2017

Between June 2016 and March 2017, 13 European countries reported hepatitis A (HAV) cases among MSM, with three co-circulating HAV strains: VRD_521_2016, V16-25801 and RIVM-HAV16-090. We investigated the extent of this outbreak within Europe and described case characteristics to inform public health interventions across member states and prevent further transmission.

Confirmed cases were defined as EU/EEA residents with illness onset between June 1st 2016 and March 31st 2017, and laboratory-confirmed HAV with $\geq 99.3\%$ sequence homology to one of the three outbreak strains (VP1-2a region). Thirteen affected countries provided demographic, clinical and phylogenetic information on cases via their national surveillance system. Comparison of characteristics between clusters of the three outbreak strains was done using the Chi-square test.

597 confirmed cases were reported; 96% were male. VRD_521_2016 was detected in 57%, RIVM-HAV16-090 in 31% and V16-25801 in 12%. Strain distribution differed between countries. The epidemic curve indicates a persistent increase of cases since June 2016. 471/597 (79%) cases had linked genotyping and epidemiologic data. Among cases with available data, we found no difference between clusters: 74% were between 18-45 years ($p=0.57$), 81% were reported MSM ($p=0.42$), 47% were hospitalized ($p=0.23$) and 35% were HIV-positive ($p=0.42$). Among cases who were probably infected outside their country of residence, 43% reported travelling to Spain, 6% to Germany and 4% to Belgium.

Latest case reports suggest that this outbreak, which disproportionately affects MSM, has not yet peaked. In light of the World Pride Festival in Madrid in June-July 2017, all affected European countries were recommended to inform MSM about preventive measures, including HAV vaccination, personal hygiene and safer sexual practices.

Role and outputs: *co-investigator*

Contributed to writing the protocol (13) and developing a standardized EU questionnaire (14) based on the experience gained during investigations in the Netherlands, contributed to communication with EU member states, collated and submitted aggregated, descriptive and analytical data to principal investigator, co-authored an abstract for ESCAIDE (15) and submitted a manuscript to a peer-reviewed journal as a second author (16).

Supervisors: *Ettore Severi & Ingrid Friesema*

Competencies developed:

As the lead investigator in two national outbreak investigations and as a co-investigator in a European outbreak investigation, I consolidated my knowledge on the ten steps of outbreak investigation acquired during the outbreak module, and learned how to put the theoretical knowledge into practice. I established protocols and questionnaires, constructed case definitions, developed data entry masks, analysed data and compiled reports. I also produced regular situation updates for public health professionals. I expanded my knowledge on several disciplines by closely collaborating with public health professionals from the food safety authority, laboratory, national coordination centre for communicable disease control and municipal health services. For instance, during the Salmonella outbreak, besides evaluating epidemiological evidence, I improved my knowledge on food safety and tracing methods aimed at identifying the source of infection. I also periodically presented epidemiological findings in spoken word and in writing. During the hepatitis A outbreak I consolidated communication skills by translating epidemiological results into recommendations to risk groups to prevent further spread. By coordinating a team effort to write a rapid communication on the latter outbreak, I finalized and submitted a manuscript within one week.

As a co-investigator during the European outbreak investigation, I gained experience in how international investigations are coordinated and how challenges can be addressed. I also collected and contributed data from the Netherlands to the investigation and facilitated information exchange between participating countries and the ECDC.

3. Applied epidemiology research

Risk factors for pneumonia in an area of intensive animal farming in the Netherlands

Previous research conducted in 2009 found a significant positive association between living close to poultry and goat farms and pneumonia in humans. However, as this result might have been affected by the Q-fever epidemic that ended in 2010, the aim of this study was to re-test this association, now that the Q-fever incidence has fallen below 0.5/100,000.

In 2014/15, as part of the “Livestock Farming and Neighbouring Residents’ Health” project, 2494 adults (aged 20-72 years) living in a livestock-dense area in the Netherlands completed a questionnaire on respiratory health, lifestyle and other items. We retrieved additional information from electronic medical records (EMR) for 2,426/2,494 (97%) participants. The outcome was self-reported, physician-diagnosed pneumonia or pneumonia recorded in the EMR in the previous three years. We used livestock license data to determine exposure to livestock, including distance between residence and closest farm (at 500m intervals), and the number of animals (cattle, goats, horses, pigs, poultry, sheep) close to the home. We quantified associations between livestock exposures and pneumonia using odds ratios adjusted for participants’ demographics, behaviors and comorbidities (aOR).

The three-year cumulative attack rate was 186/2,426 (7.7%). Residents within 2000m of a farm with at least 50 goats had an increased risk of pneumonia, which increased the closer they lived to the farm (2000m aOR 1.9, 95% CI 1.4-2.6; 500m aOR 3.7, 95% CI 1.6-8.6). We found no significant associations between exposure to other farm animals and pneumonia.

Living close to goat farms is still a risk factor for pneumonia. We recommend identifying causes of pneumonia by using molecular diagnostics on cases exposed to farms, and investigating the role of non-infectious agents such as dust or endotoxins.

Role and outputs: principal investigator

Cleaned and analysed data, presented results in study group, presented this work at two international conferences (17, 18), wrote and submitted a manuscript to a peer-reviewed journal (19). Co-author on an abstract (20) and corresponding manuscript that is in the finalizing stage.

Supervisors: Rianne van Gageldonk and Wim van der Hoek

A matter of method – comparing influenza vaccine effectiveness using the screening method and the test-negative design for seasons 2010/11 to 2015/16 in the Netherlands

As part of the project I-MOVE (Influenza Monitoring Vaccine Effectiveness in Europe), we compared influenza vaccine effectiveness (VE) estimates retrieved through the screening method (SM) and the test-negative design (TND), to assess whether these methods could be used interchangeably.

Between 38-41 sentinel practices, covering 0.7% of the Dutch population, reported influenza-like illness (ILI) cases along with vaccination status for seasons 2010/11-2015/16. RIVM performed influenza testing. For the TND, we calculated one minus the odds ratio (adjusted for age and comorbidities) of vaccination for influenza-positive ILI cases versus those testing negative to determine VE. For the SM, we compared the proportion of vaccinated influenza-positive ILI cases to the vaccination coverage in a representative reference population.

We included 1,163 cases. Combining all seasons, the VE in the general population was 19% (95% CI: 5–31) with the SM and 41% (95% CI: 23–55) with the TND. Among those aged 65+, VE was -20% (95% CI: -89–24) with the SM and -18% (95% CI: -155–35) with the TND. Stratified by season, (sub)type and age groups, 71% of SM VE estimates were lower than TND estimates. For 61% of the VE estimates, the two methods differed by more than 30%, for 14% of the VE estimates by 10–30%, and 25% diverged by less than 10%.

Despite being easier to conduct when data are readily available, the SM more frequently resulted in lower VE estimates compared to TND. TND should be preferred when appropriate data is available, as it can minimize confounding by health-care-seeking behaviour. SM can be used alternatively to provide a crude indication of VE, but estimates should be interpreted with caution.

Role and outputs: principal investigator

Cleaned and analysed data, submitted an abstract to ESCAIDE (accepted as an oral presentation) (21), submission of a manuscript to a peer-reviewed journal is planned.

Supervisor: Frederika Dijkstra

To vaccinate or not to vaccinate – results from a serosurvey for nine vaccine-preventable diseases among adult refugees in the Netherlands in 2016

Refugees are vulnerable to contracting infectious diseases due to overcrowding. Outbreaks occur among children and adults. In the Netherlands, refugee children are offered vaccination according to the National Immunization Program. As little is known about adult refugee seroprotection, we aimed to assess their immunity against vaccine-preventable diseases (VPD) to identify groups that might benefit from additional vaccinations.

In 2016, we invited adult refugees in three Dutch centres, from Syria, Iran, Iraq, Afghanistan, Eritrea and Ethiopia, to participate in a serosurvey for VPD. Participants completed questionnaires (demographics, vaccination history) and provided blood samples. We measured prevalence of antibodies to measles, mumps, rubella, varicella, diphtheria, tetanus and hepatitis A and B, comparing them by originating country and age groups using chi-squared tests. For polio, results are pending.

We surveyed 622 refugees. The median age was 28 years (interquartile range: 23-35), 81% were male and 48% originated from Syria. Overall, seroprevalence was 88% for measles (range between countries: 83-93%), 91% for mumps (81-95%), 94% for rubella (84-98%), 96% for varicella (92-98%), 82% for diphtheria (65-88%), 98% for tetanus (86-100%), 84% (54-100%) for hepatitis A and 27% for hepatitis B (anti-HBs) (8-42%). Except for varicella and measles, seroprevalence differed between countries (p-values: <0.001-0.002). For measles and hepatitis A seroprevalence increased with age (p-values: 0.009 and <0.001).

Our results indicate insufficient protection against certain VPD. For all countries, measles seroprevalence was below the WHO-threshold of 95% required for elimination. In comparison, seroprevalence in the Dutch general population was 96% in 2006/07. Rubella seroprevalence was below 95% for Syria and Iraq. In outbreak situations, results of this study can help prioritizing vaccination of susceptible subgroups of adult refugees in Europe.

Role and outputs: principal investigator

Wrote the research protocol (22), analysed data, submitted an abstract to ESCAIDE (accepted as oral presentation) (23) and submitted a manuscript to a peer-reviewed journal (24), developed questionnaire or data extraction form, developed data entry mask, partly performed data entry, data analysis, submitted protocol to medical ethical committee, developed informed consent form, developed information brochure for participants, developed a workshop and trained interpreters that supported the study, liaised with laboratory and phlebotomists to organize supplies and plan availability. Co-authored two national publications (25, 26).

Supervisor: Irene Veldhuijzen

Competencies developed:

The experience gained in course of my research projects was very versatile. For the serosurvey among refugees I learned to write a concise research protocol and liaised with the medical ethical committee. In addition, I learned to plan, develop and deliver a workshop for interpreters, organized supplies and recruited phlebotomists. Together with the study team, I furthered my experience by implementing and executing the study in three different refugee centres. During this study, I build on prior experience by communicating in a culturally sensitive way with a vulnerable population. I learned to manage financial responsibilities by being in charge of accounting for the compensation participants received.

When I studied risk factors for pneumonia in a livestock-dense area and by comparing influenza-vaccine effectiveness, I consolidated my skills in data management by cleaning and analysing a large database consisting of various data sources. By regularly presenting findings to the study group, I improved my presentation and refined my analysis skills. I also broadened my data analysis skills using two different statistical programs for my research projects (SAS and Stata).

4. Communication

Publications in peer reviewed journals

2 publications in peer reviewed journals (8, 19)

Manuscripts submitted to peer reviewed journals (in review process)

- 2 manuscripts submitted as first author (Epidemiology and Infection; Vaccine) (6, 24)
- 1 manuscript submitted as second author (Eurosurveillance) (16)

Three additional manuscripts are planned (Comparison of influenza VE, PICU SARI surveillance) or are ongoing (pneumonia risk and GPS), in which I am involved as a co-author.

Conference presentations

- 1 poster presentation at ESCAIDE 2016, Stockholm, Sweden (17)
- 1 poster presentation at 4th International One Health Congress & 6th Biennial Congress of the International Association for Ecology & Health, Melbourne, Australia (18)
- 3 oral presentations at ESCAIDE 2017, Stockholm, Sweden (4, 21, 23)

Reports

- 6 monthly surveillance reports for paediatric ICUs [the final one is referenced here (1)],
- 1 evaluation report of the SARI surveillance system on PICUs (2)
- 1 chapter of the yearly report of the respiratory diseases group (3),
- 1 international mission report (27)

Other

- 4 epidemiological updates for outbreak investigation [one referenced here (9)],
- 3 contributions to the weekly Early Warning Meeting Report (7, 10, 11)
- 1 contribution to an Inf@ct message to inform public health professionals about ongoing outbreak and request action (12)
- 2 articles as a co-author in Dutch scientific journals (25, 26)

5. Teaching activities

a) Insights from the field – diagnostics and challenges during the Ebola outbreak in West Africa

As part of a course on infectious diseases, I gave a presentation about my experience in Liberia during the Ebola outbreak where I supported the Ebola response by working as a laboratory professional performing diagnostics for Ebola and Malaria. The audience were ~25 master students of the biomedical sciences track at the Radboud University Medical Center in Nijmegen, the Netherlands. I used Microsoft Powerpoint for the presentation, which lasted 45 minutes and I focused on the diagnostic aspects and the challenges that we faced in the field. I encouraged questions throughout the presentation and students showed great interest. At the end of my presentation, I also explained what the EPIET program is and answered immediate questions and follow-up e-mails of students that were interested in applying for the program.

The evaluation results showed the following: Students appreciated being taught by 'real experts in the field' and 'openness about career path', students also encouraged to integrate presentations of fellows who recently went on missions in the future course curriculum

Supervisor: Alma Tostman

b) Facilitation of a case study on an outbreak of trichinosis in France

As part of a course on Infectious Disease Epidemiology, I facilitated a case study for ~12 master students of the biomedical sciences track at the Radboud University Medical Center in Nijmegen, the Netherlands. I used pre-existing EPIET case study documents and used white boards to illustrate epidemiological concepts, e.g. the ten steps of outbreak investigations, or how to calculate odds ratios. I encouraged discussions among the students and provided guidance during the session, which lasted three hours.

The evaluation results of the session I taught in showed the following: 'great level of professionalism', 'well prepared', 'liked style of teaching'

Supervisor: Alma Tostmann

c) Lecture on information and selection bias

At the Netherlands School of Public and Occupational Health in Utrecht, the Netherlands, I delivered a lecture on information and selection bias. I used Microsoft Powerpoints and alternated introductory slides explaining the various forms of bias with illustrative examples. The lecture lasted for 45 minutes and was followed by 15 minutes of discussion. The target audience were ~20 doctors that were in training to become specialists in infectious disease control.

The lecture was well received and points for improvement were identified (specific feedback: speed could have been a little bit slower and more examples would have been appreciated).

Supervisor: Cecile de Ruijter

d) Workshop for interpreters who supported the project 'Serosurvey for nine vaccine-preventable diseases among adult refugees in the Netherlands in 2016'

At the RIVM, I developed a workshop to train 13 interpreters who supported the serosurvey for vaccine-preventable diseases among refugees (see research section). I prepared the agenda and delivered a presentation in Microsoft powerpoint outlining the history of the RIVM, the national immunisation programme and the background of the study. I supervised and commented on the presentation of an intern who provided support during the workshop and who outlined specific objectives for interpreters. Following the presentations, we divided interpreters into small groups based on the different languages (Arabic, Farsi, Tigrinya) and practiced how to explain study aims to participants and provide support with filling in the informed consent form and the questionnaire in an objective manner. We also prepared background documents (Q&A, abridged study protocol, copies of the questionnaire and informed consent form) for the interpreters to take home. The workshop lasted 2.5 hours and closed with a discussion section and reflection on what was learned during the workshop. No formal evaluation of the work shop was conducted.

Supervisor: Irene Veldhuijzen

e) Master class on outbreak investigation

At the RIVM, I gave a lecture on outbreak investigation together with Arnold Bosman, the former head of the ECDC training section, as part of our Master Class series. My part was to explain the ten steps of outbreak investigation, whereas Arnold elaborated on the challenges of outbreak investigations on the EU level. I used Microsoft Powerpoint to go through the theory of the ten steps, followed by various examples from real outbreak investigations and build in questions for the audience. The audience consisted of ~80 public health professionals from the RIVM ('Centre for Infectious Diseases, Epidemiology and Surveillance', 'Centre for Infectious Disease Research and Screening' and 'National Coordination Centre for Communicable Disease Control'). In total the lectures lasted 45 minutes, of which my part was 30 minutes and the session was ended by a 15-minute session for discussion.

Following the lecture, I sent an evaluation form using google forms; 25 participants responded and the evaluation. On a scale from 1 (too basic) to 5 (too advanced), the satisfaction with the content of the lecture was rated 2.8, which showed that the presentation was sufficiently balanced to meet the needs of the varied audience. Skills of the presenter were rated 4.2 (1: not at all skilled- 5: extremely skilled). The speed of the presentation was rated as just right (3.2; 1: too slow – 5: too fast), the presentation contained sufficient examples (3.8; 1: strongly disagree – 5: strongly agree) and the content of the slides was clear (4.5; 1: not at all clear- 5: very clear).

Supervisor: Mirjam Knol

f) Training for local staff aimed at improvement of data quality, Kamrangirchar Urban Slum, Dhaka, Bangladesh

During my mission to Bangladesh, I analysed a large database (see 'Other activities') during which I identified points for improvements regarding data quality. I had the opportunity to share these findings with a group of ~30 consisting of data managers, clinicians, nurses and outreach workers by giving a presentation using Microsoft Powerpoint. During this presentation, I pointed out suggestions to improve data quality, maintain a clean database, and facilitate data entry and data collection.

Supervisor: Grazia Caleo

Educational outcome:

By teaching various audiences in course of my fellowship, I learned to tailor the content of my presentations to the respective learning needs of the listeners. Evaluations of my teaching activities helped me to identify points for improvement, which allowed me to progress in my ability to explain public health concepts. I gained experience with various teaching formats through facilitating group discussions, lecturing, to delivering an interactive workshop. I strived to make my teaching interactive and stimulate discussions and questions by the audience by, for example, including quizzes in my presentations, which was overall well-received.

6. Other activities

Epidemiologist with Médecins Sans Frontières (MSF)/ Doctors Without Borders, Kamrangirchar Urban Slum Project, Dhaka, Bangladesh, May-June 2017

During this mission, I cleaned and analysed a large database comprising demographic, morbidity and exposure information of factory workers working in various industries in the urban slum Kamrangirchar in Dhaka, Bangladesh. The database spanned the years 2014 to 2017 and was collated by six MSF clinics providing – among others – occupational health care to factory workers. In addition, I analysed data from a factory hazard assessment, assessed data quality of all databases and developed and delivered training regarding data quality and completeness for national staff.

By working in this mission, I produced a report (27) in which I described the most prevalent health problems of factory workers in various industries and most common hazards identified in factories. Results of this report will be used to plan mitigation strategies in factories, improve working conditions for factory workers and serve as basis to guide medical activities. In addition, I trained local staff in ensuring data quality and made provided advice for improvement.

WHO GOARN Outbreak Response Training Course, Global Outbreak Alert and Response Network, July 9-14, 2017, Lisbon and Évora, Portugal

The training comprised a simulation of an international outbreak response that included role plays, intense group work and practical exercises, which helped me to hone my skill to work under pressure with limited information. As part of a team of eight public health professionals, in which I acted as epidemiologist and deputy team leader, I strengthened my ability to work as an effective team member during challenging operational and technical circumstances, in preparation for deployment for international missions with WHO GOARN.

7. EPIET/EUPHEM modules attended

1. Introductory course, September 28 to October 16, 2015, Spetses, Greece
2. Outbreak investigation module, December 7-11, 2015, Berlin, Germany
3. Multivariable analysis module, February 14-18, 2016, Vienna, Austria
4. Rapid assessment and sampling module, June 20-25, 2016, Athens, Greece
5. Project review module, August 22-16, 2016, Lisbon, Portugal
6. Time series analysis module, November 7-11, 2016, Bucharest, Romania
7. Project review module, August 28-September 1, 2017, Lisbon, Portugal

Supervisor's conclusions

Gudrun was very productive during her two-year EPIET fellowship at the RIVM. She published two peer-reviewed papers as first author, of which one was a rapid communication on an outbreak. Three other papers have been submitted to a peer review journal; Gudrun is the first author on two of these papers. She set up a new surveillance system for severe acute respiratory infections at paediatric intensive care units and evaluated it. Furthermore, Gudrun had numerous abstracts accepted as oral and poster presentations at international conferences. She performed several teaching activities and went on a mission with MSF to Bangladesh.

Regarding public health implications of her work, the SARI surveillance project gave us better insight into the problem of SARI at PICUs in the Netherlands, and there is now a system in place to be able to detect and respond quickly in case of an outbreak. The outbreak investigation on Salmonella showed us that rapid interdisciplinary action can result in identification of the likely source of infection. The Dutch and European ongoing outbreak investigation on hepatitis A among MSM is very important to describe the extent of the problem and guide preventive measures for MSM. The serosurvey among adult refugees showed suboptimal protection against vaccine-preventable diseases and helps to prioritize vaccination of adult refugees in case of outbreaks. The study on risk factors for pneumonia showed that living close to goat farms is still a risk factor for pneumonia, and that

also non-infectious agents such as dust and endotoxins should be investigated as potential causes for pneumonia. The comparison of methods for estimating influenza vaccine effectiveness showed that the screening method generally underestimated the influenza VE.

Because of the broad scope of the projects performed by Gudrun she shows to be a very versatile field epidemiologist with experience in writing protocols and medical ethics proposals, field work, data collection and analysis, and written and oral communication. Gudrun is very eager to learn new things and ready to accept challenges. She has a strong epidemiological background. She can work very independently, but is also keen on keeping persons within the project informed and updated. Lastly, she is a very pleasant person to work with because of her motivation, knowledge and attitude.

Coordinator's conclusions

Gudrun started her fellowship with a strong academic and research background, and had also conducted field work for the Ebola response. She took on several substantial field assignments, mainly in the research area, along with an outbreak investigation and a challenging new surveillance scheme. Through her excellent skills, diplomacy and high work-rate she has completed all of these, resulting in several publications already and further planned. Particular highlights are the setting up of the SARI surveillance required developing good working relationships with busy paediatricians; her support of another fellow in driving an EU-wide investigation into the Hepatitis A outbreak; and the conduct of the serosurvey research study from start to finish.

She is highly organised, intellectually able, and hard-working, but also (as per other comments) is a very friendly and helpful person to work with. Supported by good supervision and project availability at the site, hers has been a very successful fellowship. Her mission, later in the fellowship, added to her field experience in the practicalities of data capture in a low-income setting, and staff training.

I have personally very much enjoyed being Gudrun's front line co-ordinator due to her working style and the excellent and interesting projects she has been involved in. I hope she can take on a role that allows her more autonomy and a wider public health perspective in the future, as the profession will greatly benefit from her leadership.

Personal conclusions of fellow

The EPIET fellowship allowed me to learn from and collaborate with fantastic people who were also experts in the field. Within my projects I had the opportunity to be part of interdisciplinary teams both in national and international contexts, which I thoroughly enjoyed. Taking on challenges outside my primary area of expertise expanded my knowledge and helped me grow into a well-rounded epidemiologist. Working with MSF and contributing to local capacity building within my mission was an unforgettable experience. The RIVM constituted an excellent learning environment; I could easily achieve my main personal learning objectives: acquiring more in depth expertise in surveillance and independently conducting outbreak investigations. The fellowship also allowed me to establish valuable connections with public health professionals across Europe. I highly recommend the programme and am grateful to everyone involved at the ECDC for this great opportunity.

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References

1. G.S. Freidl, A. Teirlinck. *Maandelijks rapport - SARI surveillance op PICUs 2016/2017: week 42-20* (Monthly report - SARI surveillance on PICUs: week 42-20). Sent to paediatric ICUs on a monthly basis. 2017.
2. G.S. Freidl, A. Teirlinck. Evaluation Report on the Surveillance System for Severe Acute Respiratory Infections on Paediatric Intensive Care Units. National Institute for Public Health and the Environment (RIVM); 2017.
3. A. Teirlinck, G.S. Freidl. Chapter 2.4: Severe acute respiratory infections (SARI) in paediatric intensive care units (PICU). Bilthoven, the Netherlands: Annual Report - Surveillance of Influenza and Other Respiratory Infections in the Netherlands: Winter 2016/2017; National Institute for Public Health and the Environment (RIVM); 2017.
4. G.S. Freidl, C.N.M. Brouwer, M. de Jong, M. de Neef, D. Markhorst, E. Roodbol, et al. Implementation of a surveillance system for Severe Acute Respiratory Infections (SARI) in Dutch pediatric intensive care units: Results from respiratory season 2016/17. European Conference on Applied Infectious Disease Epidemiology (ESCAIDE); Stockholm, Sweden; 2017.
5. G.S. Freidl. Overview of results from routine surveillance activities for measles, mumps and rubella in the Netherlands - January 2015 – June 2016: Contributions to the Early Warning Meeting. National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands; 2016.
6. G.S. Freidl, S. Schoss, M.J.M. te Wierik, M.E.O.C. Heck, P.J.P. Tolsma, Urbanus A., et al. Tracing back the source of an outbreak of Salmonella Typhimurium: National outbreak linked to the consumption of raw and undercooked beef products, the Netherlands, October to December 2015. Submitted to 'Epidemiology and Infection'. 2017.
7. G.S. Freidl, I. Friesema. *Verheffing van Salmonella Typhimurium (vervolg)* | (Increase of Salmonella Typhimurium (follow-up). Section of Early Warning Meeting Report: National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands; 2015.
8. G.S. Freidl, G.J. Sonder, L.P. Bovee, I.H. Friesema, G.G. van Rijckevorsel, W.L.M. Ruijs, et al. Hepatitis A outbreak among men who have sex with men (MSM) predominantly linked with the EuroPride, the Netherlands, July 2016 to February 2017. *Eurosurveillance*. 2017;22(8).
9. G.S. Freidl. *Hepatitis A uitbraak onder mannen die seks hebben met mannen in Nederland, 4 juli 2016 tot en met 19 april 2017* (Hepatitis A outbreak among men who have sex with men, the Netherlands, July 4, 2016-April 19, 2017). RIVM internal report: National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands; 2017.
10. G.S. Freidl, I. Friesema, H. Ruijs, G. Sonder, H. Vennema. *Uitbraak van hepatitis A onder mannen die seks hebben met mannen - vervolg 1* (Hepatitis A outbreak among men who have sex with men - follow-up 2). Section of Early Warning Meeting Report: National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands; 2017.
11. G.S. Freidl, I. Friesema, H. Ruijs, G. Sonder, H. Vennema. *Uitbraak van hepatitis A onder mannen die seks hebben met mannen - vervolg 2* (Hepatitis A outbreak among men who have sex with men - follow-up 2). Section of the Early Warning Meeting Report: National Institute for Public Health and the Environment, Bilthoven, the Netherlands; 2017.
12. H. Ruijs, G.S. Freidl, G. Sonder, M. Petrignani, A. Meiberg, H. Vennema. *Inf@ct: Hepatitis A-uitbraak onder MSM* (Inf@ct report: Hepatitis A-outbreak among MSM). Bilthoven: National Institute for Public Health and the Environment (RIVM); February 16, 2016.
13. P. Ndumbi, G.S. Freidl. Outbreak protocol: Hepatitis A outbreak among men who have sex with men in Europe Instituto de Salud Carlos III, Madrid, Spain & National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands; 2017.

14. P. Ndumbi, G.S. Freidl. Questionnaire on risk factors associated with hepatitis A transmission among men who have sex with men. Instituto de Salud Carlos III, Madrid, Spain & National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands; 2017.
15. P. Ndumbi, G.S. Freidl, et.al. Hepatitis A outbreak affecting men who have sex with men (MSM) in the European Union and European Economic Area (EU/EEA), June 1st 2016 – March 31st 2017. European Conference on Applied Infectious Disease Epidemiology (ESCAIDE); Stockholm, Sweden 2017.
16. P. Ndumbi, G.S. Freidl, C. Varela, A Avellón, I Friesema, H Vennema, et al. Hepatitis A outbreak mostly affecting men who have sex with men (MSM) in the European Union and European Economic Area (EU/EEA), June 1st 2016 – May 31st 2017. Submitted to 'Eurosurveillance'. 2017.
17. G.S. Freidl, I.T. Spruijt, F. Borlée, L.A.M. Smit, R. van Gageldonk DH, J. Yzermans, C. van Dijk, K. Maassen, W. van der Hoek. Risk factors for pneumonia in an area of intensive animal farming in the Netherlands. European Conference on Applied Infectious Disease Epidemiology (ESCAIDE); Stockholm, Sweden 2016.
18. G.S. Freidl, I.T. Spruijt, F. Borlée, L.A.M., Smit, R. van Gageldonk, et al., editors. Risk factors for pneumonia in an area of intensive animal farming in the Netherlands. 4th International One Health Congress & 6th Biennial Congress of the International Association for Ecology & Health 2016; Melbourne, Australia.
19. G.S. Freidl, I.T. Spruijt, F. Borlée, L.A.M. Smit, A.B. van Gageldonk-Lafeber, D.J. Heederik, et al. Livestock-associated risk factors for pneumonia in an area of intensive animal farming in the Netherlands. PLoS one. 2017;12(3):e0174796.
20. G. Klous, L.A.M. Smit, G.S. Freidl, F. Borlée, W. van der Hoek, M.E.E. Kretzschmar, et al., editors. Pneumonia risk for people living close to intensive animal farms – taking GPS derived mobility patterns into account. 4th International One Health Congress & 6th Biennial Congress of the International Association for Ecology & Health 2016; Melbourne, Australia.
21. G.S. Freidl, S.J.A.M. Denissen, F. Dijkstra, M.M.A. de Lange, M. Hooiveld, G.A. Donker, et al. A matter of method – comparing influenza vaccine effectiveness using the screening method and the test-negative design for seasons 2010/11 to 2015/16 in the Netherlands. Stockholm, Sweden: European Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 2017.
22. G.S. Freidl. Research protocol: Serosurvey of vaccine-preventable diseases (VPD) among adult refugees. NL56277.094.16 / protocol ID EPI-290, *Medisch Ethische Toetsingscommissie (METC) Noord Holland* / (Medical Ethical Committee Noord Holland the Netherlands); 2016.
23. G.S. Freidl, A. Tostmann, M. Curvers, W.L.M. Ruijs, G. Smits, R. Schepp, et al. To vaccinate or not to vaccinate – results from a serosurvey for nine vaccine-preventable diseases among adult refugees in the Netherlands in 2016. European Conference on Applied Infectious Disease Epidemiology (ESCAIDE); Stockholm, Sweden; 2017.
24. G.S. Freidl, A. Tostmann, M. Curvers, W.L.M. Ruijs, G. Smits, R. Schepp, et al. Immunity against Measles, Mumps, Rubella, Varicella, Diphtheria, Tetanus, Polio, Hepatitis A and Hepatitis B among adult refugees in the Netherlands, 2016. Submitted to 'Vaccine'. 2017.
25. M. Curvers, A. Tostmann, J.L.A. Hautvast, W.L.M. Ruijs, H.E. de Melker, F. van der Klis, et al. *Bescherming tegen infectieziekten bij volwassen asielzoekers* (Protection against infectious diseases among adult refugees). *Infectieziekten Bulletin*. 2016;27(9).
26. M. Curvers, G.S. Freidl, J.L.A. Hautvast, W.L.M. Ruijs, H.E. de Melker, F. van der Klis, et al. Protection against vaccinepreventable diseases in adult asylum seekers in the Netherlands. *Bulletin of the Netherlands Society for Tropical Medicine and International Health*. 3 October 2016;54(3).
27. G.S. Freidl, S. Islam, R. Mahfuzullah, T. Arnab, M.I. Talukder, G.W. Bangs, et al. Occupational health of factory workers in Kamrangirchar, Dhaka, Bangladesh - July 2017: Morbidities and occupational risks of factory workers and analysis of a factory hazard assessment. *Médecins Sans Frontières (MSF) mission report*. 2017.