

Summary of work activities

Charlotte Christiane Hammer

Intervention Epidemiology path (EPIET), 2019 cohort

Background

The ECDC Fellowship Programme is a two-year competency-based training with two paths: the field epidemiology path (EPIET) and the public health microbiology path (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 provide 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.

According to Articles 5 and 9 of ECDC's founding regulation (EC No 851/2004) 'the Centre shall, encourage cooperation between expert and reference laboratories, foster the development of sufficient capacity within the community for the diagnosis, detection, identification and characterisation of infectious agents which may threaten public health' and 'as appropriate, support and coordinate training programmes in order to assist Member States and the Commission to have sufficient numbers of trained specialists, in particular in epidemiological surveillance and field investigations, and to have a capability to define health measures to control disease outbreaks'.

Moreover, Article 47 of the Lisbon Treaty states that 'Member States shall, within the framework of a joint programme, encourage the exchange of young workers.' Therefore, ECDC initiated the two-year EUPHEM training programme in 2008. EUPHEM is closely linked to the European Programme for Intervention Epidemiology Training (EPIET). Both EUPHEM and EPIET are considered 'specialist pathways' of the two-year ECDC fellowship programme for applied disease prevention and control.

This report summarises the work activities undertaken by Charlotte Christiane Hammer, cohort 2019 of the Intervention Epidemiology path (EPIET) at the Finnish Institute for Health and Welfare (Terveyden ja hyvinvoinnin laitos, THL).

Pre-fellowship short biography

Prior to starting the fellowship, Dr Charlotte Christiane Hammer was working as a researcher in international health protection with a particular interest in humanitarian outbreak response and One Health. In 2019, she obtained her PhD from the University of East Anglia for which she completed her doctoral research as part of the Health Protection Research Unit in Emergency Preparedness at King's College London in collaboration with Public Health England. Her thesis focused on drivers of outbreak risk and rapid risk assessment in humanitarian emergencies. After her PhD, she worked as a senior research associate at Norwich Medical School on risk factors and disease control for Cryptosporidiosis. Charlotte holds Master's degrees in risk and security (2013, with distinction) from

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Durham University and in public health (2017, with distinction) from the University of Manchester, where she specialised in communicable diseases epidemiology and control.

Methods

This report accompanies a portfolio that demonstrates the competencies acquired during the EPIET fellowship 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 ECDC Fellowship Manual¹.

1. Epidemiological investigations

Outbreak investigations

1.1 Hepatitis E outbreak in Finland, 2019-2020

We identified a cluster of Hepatitis E (HEV) linked to an outbreak strain through sequencing in the National Infectious Diseases Register (NIDR). Additionally, we noticed a slight increase in the incidence of HEV. Cases were located across Finland and not obviously connected. We defined a confirmed case as any person diagnosed with HEV with the laboratory-confirmed outbreak strain (HEV-3e) between 1 August 2019, and 31 March 2020 in Finland. A possible case was defined as any person diagnosed with HEV on or after 1 August 2019, in Finland, excluding those with laboratory-confirmed different strains of HEV (up to 31 March 2020). Cases were sought via the NIDR, by requesting typing of HEV cases entered into the NIDR. Out of the 35 HEV notifications for the time period under investigation, 14 were types, including nine confirmed and five non-cases. The remaining 21 non-typed HEV cases were considered possible cases. We were unable to identify common exposures and are lacking sufficient typing results to properly distinguish between cases and non-cases to conduct an analytical study. The main resulting recommendation is therefore to type any further cases of HEV notified in Finland to facilitate the further investigation of this outbreak and to allow for an analytical study to identify the most likely exposure.

Role: Charlotte was the principal investigator during this outbreak and wrote the outbreak report.

1.2 Ebola Virus Disease Epidemic, Democratic Republic of the Congo 2018-2020: Analysis of deaths outside Ebola treatment units, daily and weekly epidemiological monitoring, and other ad-hoc analyses (GOARN deployment)

Supervisors: Marie-Amelie Degail Chabrat, Brett Archer

On 1 August 2018, the Ministry of Health of the Democratic Republic of the Congo (DRC) declared the 10th Ebola Virus Disease (EVD) outbreak following the investigation and laboratory confirmation of a cluster of viral haemorrhagic fever in North Kivu Province. The outbreak progressed to become the largest recorded EVD outbreak in DRC and the second-largest globally after the 2014–2016 outbreak in West Africa. One of the main tasks during this deployment was the analysis of deaths outside Ebola treatment units (ETUs) up to 9 April 2020. Out of the 2 211 deaths, 49% occurred in specialised ETUs. The remaining 1 131 deaths (corresponding to 30% of all confirmed cases) occurred outside of ETUs including 145 probable cases that died in the community. Deaths outside of ETUs are of particular epidemiological concern as they represent cases not isolated with potential community transmission while also negatively impacting the understanding of the overall outbreak dynamics. Additional day-by-day analyses included: analyses of alerts by health zone and for particularly affected areas, analysis of the development of the case fatality rate for all confirmed cases and confirmed cases admitted to an ETUs and a retrospective analysis of alerts throughout the outbreak for Beni sub-coordination.

¹ European Centre for Disease Prevention and Control. European public health training programme. Stockholm: ECDC; 2020. Available from: <https://www.ecdc.europa.eu/en/publications-data/ecdc-fellowship-programme-manual-cohort-2021>

Role: Charlotte was responsible for the analysis of deaths outside of Ebola treatment units. She performed data analysis, wrote briefings and contributed to a manuscript for a peer-reviewed journal (not submitted). She wrote a final report on the deployment and analysis of deaths outside Ebola treatment units.

SARS-CoV-2/COVID-19 outbreak preparedness and response in care homes and other communal living settings in Cologne, April – May 2020

Charlotte undertook a one-week visitation in the Task Force Vulnerable Population Groups at the Cologne Public Health Department (Gesundheitsamt). The task force works with social care providers and care homes, refugee shelters and other residential institutions affected or expected to be affected by COVID-19. Communal living settings, in general, have a high risk of being sites of COVID-19 outbreaks. Due to the age profile of their residents, elderly care homes additionally have a higher proportion of severe illness. Day-to-day activities include biomonitoring and testing of all staff and residents in care homes with a confirmed or suspected COVID-19 case among residents or staff, hygiene inspections and advice for care homes with a special emphasis on COVID-19, daily monitoring of cases and reporting of these to the crisis management team and coordination of other COVID-19-related activities in care homes and other residential institutions.

Role: Charlotte assisted during advisory and inspection sessions at care and communal homes and provided advice on improvements to data entry and data management.

SARS-CoV-2/COVID-19 outbreak in a partially-vaccinated nursing care home in Helsinki, January – February 2020: A cohort study

Supervisors: Outi Lyytikäinen, Timothée Dub

On 6 February 2021, a COVID-19 cluster of five residents (including two deaths and one hospitalisation) and seven healthcare workers (HCW) was identified in a nursing home in Helsinki, including samples positive with B.1.1.7. All residents had received one dose of Comirnaty on 19.1.2021 while 17% of the HCWs were fully vaccinated and 50% once vaccinated with either Comirnaty or Vaxzevria in January or February 2021. Confirmatory nasopharyngeal specimens from previously PCR-negative residents were collected as well as serum specimens from all participants for fluorescent microsphere immunoassay testing (FMIA) to identify cases that had not been detected by PCR or not been tested and to study immune response to SARS-CoV-2 nucleoprotein, receptor binding domain (RBD) and full-length spike (SFL). A case was defined as a participant with a positive PCR test and/or SARS-CoV-2 nucleoprotein antibodies. All residents (n=22), and 24/31 HCWs including two of the seven PCR-confirmed cases were enrolled. The first cases were among HCWs. Respectively, one and three additional cases were detected by FMIA testing among residents and HCWs. The attack rate among residents was 27.3%. For once-vaccinated non-cases, IgG levels to spike protein antigens were lower among residents (geometric mean, GM RBD 5.16 95%CI 2.08-12.84, SFL GM 6.42 95%CI 2.45-16.81) than among HCWs (GM RBD 16.56 95%CI 5.93-46.26, SFL GM 22.25 95%CI 9.25-53.53). The limited visitor policy and the first cases among HCWs point to an introduction by an HCW, making addressing the low vaccine coverage among HCWs a priority. Additionally, a single dose of vaccination induced lower antibody concentrations among residents, and only provided partial protection. A reversion of the extension of the interval between vaccine doses might be advisable in such settings. Other prevention measures should be maintained.

Role: Charlotte was the principal investigator during this outbreak. She developed the questionnaire, developed the data entry mask and was responsible for data management. She conducted the study and wrote an outbreak report and abstract for ESCAIDE 2021. Additionally, the data from this investigation will be combined with data from another nursing home outbreak for a manuscript to be submitted to a peer-reviewed journal for which Charlotte will be second author.

Training modules related to assignment/projects

EPIET/EUPHEM Introductory Course – The EPIET/EUPHEM Introductory Course introduced the main concepts of outbreak investigations, study designs and analysis. The fellows were able to familiarise themselves with the 10 steps of outbreak investigations and to practice outbreak investigations and analysis of data from outbreaks in case studies.

Outbreak Investigation Module – The Outbreak Investigation Module was the main module to prepare fellows for outbreak investigations. It built on the EPIET/EUPHEM Introductory Course and deepened the fellows' understanding of outbreak investigations. A core component of the course is a multi-day case study on a cohort study for an outbreak of gastroenteritis.

Multivariable Analysis Module – The Multivariable Analysis Module builds on the EPIET/EUPHEM Introductory Course and deepened the fellows' statistical skills. The module also provided added benefits for outbreak investigations as it allowed for a more in-depth analysis of any analytical studies done during outbreak investigations.

Rapid Assessment and Survey Methods (RAS) module – The Rapid Assessment and Survey Methods (RAS) module covers aspects of (survey) sampling including spatial sampling, surveillance and response in (complex) emergencies risk assessment and risk communications. As such the module provides valuable skills and knowledge for outbreak investigations, particularly for outbreak investigations in emergency settings.

Educational outcome

During the five outbreak investigations/outbreak response activities the fellow was able to gain insights into outbreak management at the local, national and international level in both high- and low-resource settings. Charlotte led two of the five outbreak investigations, including a cohort study and apart from the technical skills in epidemiology, including study design, data management and statistical analysis, also gained leadership skills and insights into laboratory methods.

2. Surveillance

2.1 SARS-CoV-2/COVID-19 response in Papua New Guinea (GOARN deployment)

Supervisors: Anna Maalsen

Charlotte deployed to Papua New Guinea through the Global Outbreak Alert and Response Network of the WHO. The WHO response to COVID-19 in Papua New Guinea is situated within the National COVID-19 Control Centre (NCC). During this deployment, Charlotte took the role of WHO COVID-19 Surveillance Pillar Lead. She supervised the daily and weekly data analysis and conducted the weekly transmission stage assessment for the WHO Western Pacific Region Regional Office. Charlotte also advised on and performed additional epidemiological analyses such as time series analysis for a province of particular concern and wrote the analysis plan for a national death audit. As a second role, Charlotte also supported the national rollout of Go.data in Papua New Guinea. For this, she advised on the possible use cases and implementation of Go.data and trained national and provincial surveillance officers in the use of the system. Additional analytical and administrative duties were performed on an ad hoc basis.

Role: Charlotte was the surveillance pillar lead for the WHO side of the COVID-19 response as well as serving as an advisor and trainer for the national go.data rollout. She wrote and end of mission report.

2.2 Is clinical primary care surveillance for tularaemia a useful addition to laboratory surveillance? An analysis of notification data for Finland, 2013 to 2019

Supervisors: Jussi Sane, Timothée Dub

In Finland, surveillance of tularaemia relies on laboratory-confirmed case notifications to the National Infectious Diseases Register (NIDR). This project investigated whether the addition of primary healthcare notifications from the Avohilmo register could improve tularaemia surveillance in Finland. NIDR tularaemia surveillance and primary healthcare clinically-diagnosed tularaemia cases data in Finland between 2013 and 2019 were retrieved. Incidences, demographic distributions and seasonal trends were compared between the two data sources. Between 2013 and 2019, the median annual incidence was 0.6 (range 0.1-12.7) and 0.8 (range 0.6-7.2) per 100,000 for NIDR notifications and primary healthcare notifications, respectively. NIDR reported cases were slightly older than primary healthcare reported cases (median 53 years compared to 50 years, $p=0.04$), but had similar sex distribution. Seasonal peaks differed between systems, both in magnitude and in timing. On average, primary healthcare notifications peaked three weeks before NIDR. However, peaks in NIDR were more pronounced, for example, in 2017, monthly incidence per 100 000 of NIDR notifications peaked at 12.7 cases in September while primary healthcare notifications peaked at 7.2 (1.8 ratio) in August. Clinically-diagnosed cases provide a valuable additional data source for surveillance of tularaemia in Finland. A primary healthcare-based system would allow for earlier detection of increasing incidences and thereby for early warning of outbreaks. This is crucial to implement targeted control and prevention measures as early as possible.

Role: Charlotte was the principal investigator. She wrote the protocol and designed the study, conducted the data analysis and wrote the manuscript for publication.

2.3 Analysis of primary care and laboratory notification data for Lyme disease in Finland, 2014-2019

Supervisors: Jussi Sane, Timothée Dub

Lyme disease (LD) is a tick-borne disease caused by bacteria of the *Borrelia burgdorferi sensu lato* (s.l.) species complex. It is the most common tick-borne infectious disease in Eurasia and North America. The aim of this study was to describe the epidemiology of LD in Finland, to inform prevention and control policy. The objectives of this study were to describe the epidemiology of LD between 2014 and 2019 in Finland by time, person, and place and to describe the surveillance system used for LD in Finland with regards to the surveillance scenarios developed by Wijngaard et al. 2017. All 20 mainland healthcare districts and the Åland Islands were included and data were retrieved from the National Infectious Diseases Registry (NIDR) for laboratory-confirmed cases and from Avohilmo for clinically diagnosed cases. It was determined that the system in Finland follows surveillance scenario three according to the classification of Wijngaard. Descriptive data analysis was augmented by time series analysis using both a negative binomial model and a multi-level model to account for potential differences across regions.

There was significant seasonality in both systems with peaks in July (Avohilmo) and August (NIDR) and an increase of 33.5% over the study period in NIDR using the multi-level model (no significant trend in Avohilmo). Furthermore, the data suggested that there is a shift from primary healthcare notifications to more laboratory-confirmed cases. However, based on the data it is not possible to see how much the cases in the two registries overlap, hence a future register-linkage study is recommended.

Role: Charlotte was the principal investigator. She wrote the protocol and designed the study, conducted the data analysis and wrote the report.

2.4 COVID-19 epidemic intelligence, Finland, 2020

Supervisors: Timothée Dub

COVID-19 emerged in December 2019 in China. The first case of the coronavirus disease 2019 (COVID-19) in Finland was confirmed on 29 January 2020 and the first autochthonous COVID-19 case was reported a month later. The first restrictions on people's lives were applied in March leading to the state emergency announcement on 16 March. The first death from COVID-19 was reported on 21 March. At the beginning of February, Charlotte got involved in the preparation of a daily COVID-19 situation report, which included collation of information gathered on case counts, deaths and recoveries inside and outside of China, new recommendations and risk assessments by the World Health Organization, ECDC, the Centers for Disease Control and Prevention and other public health agencies, new findings emerging from research in form of peer-reviewed and pre-print articles, scanning of the Twitter feed and reviewing news reports from around the globe. The information was summarised and forwarded to the heads of the Department of Health Security at THL and the COVID-19 emergency response team members to inform the operational outbreak team in Finland.

Role: Charlotte conducted the epidemic intelligence activities in a rotation system together with the other fellows.

Training modules related to assignment/projects

EPIET/EUPHEM introductory course – The EPIET/EUPHEM introductory course familiarised the fellows with the core concepts in surveillance. It covered the development and evaluation of a surveillance system as well as key aspects of the analysis of surveillance data.

Time Series Analysis module – The Time Series Analysis module built on the EPIET/EUPHEM introductory course and the Multivariable Analysis Module. It was a cornerstone in preparing the fellows for a more in-depth analysis of surveillance data. The module was particularly useful in the context of the project on Lyme disease which included a time series analysis of notification data.

Multivariable Analysis Module – The Multivariable Analysis Module builds on the EPIET/EUPHEM Introductory Course and deepened the fellows' statistical skills. The module introduced a variety of regression methods that can be applied for surveillance data analysis and it also provided the basis on which the Time Series Analysis module could build.

Educational outcome

Charlotte designed and conducted two main surveillance projects on vector-borne diseases. She also contributed to ad hoc surveillance in the form of epidemic intelligence for a novel health threat with regards to COVID-19 during the beginning of the pandemic. She was able to gain valuable insights into the surveillance system in Finland and to utilise skills acquired and deepened mainly in the Multivariable Analysis Module and the Time Series Analysis module.

3. Applied public health research

3.1 High influenza vaccination coverage among healthcare workers in acute care hospitals in Finland, 2017-2020

Supervisors: Outi Lyytikäinen, Hanna Nohynek

Influenza vaccination is widely recommended for healthcare workers (HCWs) in European countries, but the coverage is not always satisfactory. In Finland, a new act was introduced in 2017, according to which it is the employer's responsibility to use only vaccinated HCWs for servicing vulnerable patients. The aim of this project was to determine the influenza vaccination coverage among HCWs in Finnish acute care hospitals in the seasons 2017/18, 2018/19 and 2019/20. Data was collected by a web-based survey sent annually to all Finnish acute care hospitals and described the influenza vaccination coverage among HCWs during seasons 2017/18, 2018/19 and 2019/20. Mean coverage per healthcare district and season was calculated. In season 2017/2018, 38/39 hospitals, in 2018/19, 35/36 hospitals and in 2018/2019 31/33 hospitals provided data. The mean coverage was 83.7% (range: 65.5-95.0) in season 2017/18, 90.8% (range: 57.0-98.0) in 2018/19, and 87.6% (range: 72.0-99.3) in season 2019/20. There was no significant increase or decrease of mean coverage across the three seasons. The differences between districts were only significant in 2018/19 ($p < 0.005$). The coverage of influenza vaccinated HCWs in Finnish hospitals was high in all three seasons and the current legal situation (semi-mandatory system) in

Finland seems to provide a good background for this. HCW influenza vaccination coverage surveillance remains important and should be continued.

Role: Charlotte was the principal investigator. She wrote the protocol and designed the study, conducted the data analysis and wrote the manuscript for publication.

3.2 Risk factors for Lyme disease in Finland: a population-based case-control study

Supervisors: Jussi Sane, Timothée Dub

Lyme disease (LD) is a tick-borne disease caused by bacteria of the *Borrelia burgdorferi sensu lato* (s.l.) species complex. It is the most common tick-borne disease in Eurasia and North America. Risk factors for LD include peri-domestic and community-wide landscape risk factors and personal behavioural factors. Protective factors include certain landscape modifications and personal protective and hygiene measures. So far, risk factors for LD have not been studied specifically in the Finnish context. The objectives of the project were 1) to conduct a population-based case-control study to identify risk factors for LD in Finland and 2) to develop targeted risk communication materials based on the results of the empirical analysis and to provide recommendations for risk reduction. Cases were planned to be identified from the national registries and population controls to be drawn from the Population Registry. Simple random sampling from the Finnish National Registration System and frequency matching for hospital districts, age, and sex was planned for 123 cases and 368 controls (assuming a minimum odds ratio of 2.0 and an exposure among controls of 20 % and using two controls per case; adjusted for 50% non-response to 246 cases and 736 controls). For the risk factors, odds ratios were to be calculated with additional multivariable analysis depending on initial results.

Role: Charlotte was the principal investigator. She wrote the protocol and designed the study. Due to the COVID-19 pandemic, the project was de-prioritised. The group on vector-borne diseases is looking into continuing the study in the future.

3.3 Risk factors for Lyme disease: a systematic review and meta-analysis

Supervisors: Jussi Sane, Timothée Dub

Lyme disease (LD) is a tick-borne disease caused by bacteria of the *Borrelia burgdorferi sensu lato* (s.l.) species complex. It is the most common tick-borne disease in Eurasia and North America. To date, no systematic review and/or meta-analysis has been done on risk factors for LD. The objective of this project was to conduct a systematic review and meta-analysis of LD risk factors. The following databases were searched: Embase/Medline, PubMed, International Bibliography of the Social Sciences (IBSS) and Scopus. Search terms for Lyme disease AND the study design (case-control or cohort) were used. Only articles in English, Finnish, Swedish, German and French were included for practical reasons. Titles and abstracts were extracted and checked against the inclusion criteria; in case of uncertainty, the whole text was evaluated. This was done independently by two researchers. Any case of disagreement between the researchers was resolved by discussion. Afterwards, the whole text was reviewed for all included studies and for all included full-text studies quality assessment was conducted. After de-duplication, 520 abstracts were screened and 23 manuscripts were deemed to be eligible for full-text retrieval. After further exclusion of 11 studies that did not meet the inclusion criteria or were not available, eight case-control and four cohort studies were included and quality assessed using CASP guidelines. Next steps: included articles will be checked for inclusion in a meta-analysis. If measures are available that can be included in a meta-analysis (odds ratios, risk ratios, or other suitable and comparable measures in several articles), a meta-analysis will be performed to produce a pooled measure, the specific details and methods for this will depend on the measures reported and if even enough articles report such measures. All other information will be summarised in a narrative analysis. If no comparable quantitative measure is available and the entire systematic review will have to be qualitative, a thematic synthesis will be considered rather than a narrative synthesis in this case. PRISMA guidelines were followed.

Role: Charlotte was the principal investigator. She wrote the protocol and designed the study, extracted and screened the abstracts for inclusion, developed the data extraction mechanism, performed the quality appraisal and began the data analysis. The group on vector-borne diseases is looking into continuing the study in the future.

3.4 Qualitative insights into reasons for missed opportunities for vaccination in health facilities in Zimbabwe

Supervisors: Laura Nic Lochlainn

Globally more than one in ten children miss out on vaccinations, leaving them vulnerable to vaccine-preventable diseases. In Zimbabwe, the Expanded Programme on Immunization and its partners conducted a missed opportunities for vaccination (MOV) assessment to explore why children experience MOV, and thus inform improvements to increase immunization coverage and equity. Using the World Health Organization MOV strategy, focus group discussions (FGDs) and key-informant interviews (KIIs) with both caregivers and healthcare workers were conducted. Topics included health and vaccination services in the community, attitudes toward vaccination and vaccination compliance, reasons for missing vaccination and suggestions for improvement. The data were analysed using a grounded theory approach.

Issues and suggestions raised by caregivers and healthcare workers across all three data sources overlapped considerably. The main takeaways from both groups were the emphasis on the importance of caregiver health education, outreach, the vaccination card as well as the removal of logistical barriers. Healthcare workers were generally highly aware of the local barriers to vaccination and could be empowered to address these with the right tools. Strategies to address MOV should be included in long-term immunisation plans and community-driven, to ensure that gains in immunisation coverage and equity are sustainable. Empowering the community and ensuring there is good collaboration and trust between caregivers and healthcare workers is key to attaining high-quality vaccination. In the end, the objective is to make every health facility visit an opportunity for vaccination.

Role: Charlotte was the principal investigator. She developed the data extraction mechanism, adapted the methodology to the specific context and analysed the data. Charlotte wrote the manuscript for publication.

3.5 The Åland Islands' COVID-19 population cohort: a longitudinal study of epidemiology, experiences and behaviours

Supervisors: Jussi Sane, Knut Lönnroth

Åland, a self-governed, Swedish-speaking island region of Finland with a population of approximately 30 000 reported less than 100 cases of SARS-CoV-2 in 2020. Åland is in a unique position in between two countries (Finland and Sweden) with different COVID-19 control strategies. It is imperative to understand the specifics of this context to better adapt and communicate measures. This may also translate to other (semi-) autonomous regions, especially those with close ties to another country. The project consisted of a prospective cohort study in Åland investigating both seroprevalence and knowledge, attitudes and practices (KAP) towards COVID-19. A random sample representative of the adult Åland population for age and sex of 100 individuals in the seroprevalence and 103 in the KAP part of the study was enrolled for this study. As expected, based on the low numbers of COVID-19 in Åland, during the first round of the seroprevalence survey all participants were seronegative. Three months later nine participants were seropositive, however, all of them were among the group that had already received at least one dose of a vaccine against COVID-19, highlighting that despite the region having experienced a large COVID-19 outbreak in spring 2021, the overall case numbers were still very low. Results of the KAP study showed that vaccine acceptance on Åland was very high with 84% of the participants at least somewhat agreeing to accept a COVID-19 vaccine when one will be offered to them. Persons identifying more strongly with Finland were more likely to accept additional control measures. If a person identified more strongly with Finland or was neutral (identified with Åland) had no impact on their level of overall agreement with the COVID-19 control strategy on Åland. The Finnish strategy to control COVID-19 is generally seen positively, while the Swedish strategy is seen negatively. This is also reflected in support for the restriction of travel from Sweden.

Role: Charlotte was the principal investigator. She wrote the protocol and designed the study, conducted the data analysis and wrote two manuscripts for publication and several (visual) reports.

3.6 Monitoring knowledge, risk perceptions, preventive behaviours, and public trust in the current coronavirus outbreak in Finland

Supervisors: Jonas Sivelä, Timothée Dub

During the COVID-19 pandemic insights into knowledge, attitudes and practices were of critical importance. Knowledge about what drives behaviour and awareness of changes, misinformation, stigmatisation or herd behaviour needed to be monitored to identify sources and try to address them. National authorities and other stakeholders, such as the media, were able to gain valuable insights into information needs and deliver target messages. The COVID-19 Snapshot Monitoring (COSMO Standard): monitoring knowledge, risk perceptions, preventive behaviours and public trust in the current coronavirus outbreak - WHO standard protocol was adapted to design a brief (approximately 10 minutes) online survey, using seven-point response scales or closed-ended questions. Five iterative, randomly-selected groups of approximately 1 000 participants, representative of the Finnish population in age groups, gender and place of residence were invited to respond to items assessing risk perceptions, worries, fears, trust and information-seeking behaviour. Most people surveyed believe that they are not highly susceptible to COVID-19, and if contracted, the disease would not be severe. Trust remained stable over the 12-month period and worries were expressed in different areas. Across the whole study, information-seeking behaviour shifted from searching information multiple times a day to several times a week. Vaccine acceptance declined from 70% in April to 64% in December 2020 but rose again to 74% in April 2021. Complacency and worry about side effects were main reasons against vaccination while concern about severe disease was a strong motive for vaccination. Convenience of vaccination and recommendations by healthcare workers were identified as enablers for vaccination among those aged under 50 years. Understanding barriers and enablers behind vaccine acceptance is decisive in ensuring a successful implementation of COVID-19 vaccination programmes, which will be key to ending the pandemic. Based on continuing data collection and analysis, this tool has made it possible for public authorities to react quickly to emerging misinformation or sudden increases in risk perceptions that could foment panic.

Role: Charlotte was the principal investigator. This was a long-run project, initially started by another fellow and handed over to her after round three of data collection. Charlotte conducted the data analysis and wrote two manuscripts for publication and several (visual) reports.

3.7 Time series analysis of Database searches on coronavirus and smell/taste disorders and their relation to COVID-19 cases in Finland: Analysis of online information-seeking behaviours

Supervisors: Otto Helve, Timothée Dub

Finland has two primary medical databases, the Health Library (HL) which is aimed at the general public and the Physicians' Database (PD) aimed at clinicians. Over the course of the COVID-19 pandemic, both of those were used by their respective audiences to gain information on COVID-19 including unusual symptoms such as smell and taste disorders. The aims of this study were 1) to assess whether citizens' and professionals' searches for smell/taste disorders and coronavirus relate to epidemiological data on COVID-19 cases, and 2) to assess if the case numbers could explain some of the dynamics of searches when plotting internet searches using negative binomial regression models. Coronavirus searches drastically increased in HL (0 to 744,113) and in PD (4 to 5,375) prior to the first wave of COVID-19 cases during December 2019 and March 2020. Searches for smell disorders in HL doubled from the end of December 2019 to the end of March 2020 (2,148 to 4,195), and searches for taste disorders in HL increased from mid-May to the end of November (0 to 1,980). Case numbers were significantly associated with searches for smell disorders in HL (p -value < 0.001), and with coronavirus searches (p -value < 0.001) in PD. No other significant associations between case numbers and searches in either database could be identified.

Role: Charlotte supported the first author. She was the principal investigator for the time series analysis element of this study. The manuscript has been submitted to a peer-reviewed journal.

Training modules related to assignment/projects

EPIET/EUPHEM introductory course – The EPIET/EUPHEM introductory course familiarised the fellows with the core concepts of operational and applied. It covered the development of study protocols and the drafting of aims and objectives relevant to a national public health institute as well as data analysis and presentation for the other modules to build on.

Time Series Analysis module – The Time Series Analysis module built on the EPIET/EUPHEM introductory course and the Multivariable Analysis Module. It was a cornerstone in preparing the fellows for more in-depth data analysis.

Multivariable Analysis Module – The Multivariable Analysis Module builds on the EPIET/EUPHEM Introductory Course and deepened the fellows' statistical skills. The module introduced a variety of regression methods that can be applied for data analysis and it also provided the basis on which the Time Series Analysis module could build.

Educational outcome:

Charlotte was able to contribute to, design and conduct a wide variety of operational research projects. She was able to deepen her understanding of quantitative data analysis, particularly in R and also contribute her previous expertise in qualitative data analysis to one of her projects. Charlotte was able to cover a wide range of topics and epidemiological methods including a prospective cohort study that she was able to implement from scratch.

4. Teaching and pedagogy

4.1 Essentials of Infectious Disease Epidemiology, Tampere University

Charlotte taught a one-week intensive course for postgraduate (Master's and PhD) students at Tampere University together with two other fellows. She gave a full lecture as well as a short morning recap lecture and facilitated several case studies. For this, she both developed training materials and adapted existing materials. Together with the other fellows, she conducted an evaluation of the course, which was very positive.

4.2 Essentials of Infectious Disease Epidemiology, Cologne Public Health Authority & Fire Department

During her involvement with the Task Force Vulnerable Population Groups at the Cologne Public Health Department, Charlotte taught several small seminars mainly for temporary staff at the Public Health Department and members of the Cologne Fire Department on surveillance and essentials of infectious disease epidemiology. She developed ad-hoc teaching materials in the form of whiteboard outlines. No formal evaluation was performed but verbal feedback was very positive.

Outbreak Investigation Module, EPIET/EUPHEM/PAE, online

Charlotte facilitated a multi-day cases study for R users during the Outbreak Investigation Module for cohort 2020. Formal evaluations were conducted by the module coordinators for the module as a whole as well as individual case studies. Evaluations were positive.

Go.data, Outbreak Response and Surveillance, National COVID-19 Control Centre (NCC), Port Moresby, Papua New Guinea

During her GOARN deployment in Papua New Guinea, Charlotte taught several sessions on the basics of infectious disease epidemiology, outbreak investigations and surveillance to new NCC surveillance staff. She developed teaching materials based on previous materials. She also taught NCC staff as well as provincial staff on the use of go.data. For this, she adapted WHO training materials to the Papua New Guinean use case. No formal evaluation was performed but verbal feedback was very positive.

Training modules related to assignment/projects

EPIET/EUPHEM Introductory Course – The EPIET/EUPHEM Introductory Course provided training in adult education. The skills acquired during the EPIET/EUPHEM Introductory Course were particularly applicable to teaching case studies

Educational outcome:

Charlotte engaged with a wide range of audiences during her teaching assignments from health and safety professionals to postgraduate students and also fellows of the fellowship programme. She was able to strengthen her skills in the subjects she taught as well as further develop her teaching experience beyond just academic audiences. Her teaching assignments included lectures, seminars and case study facilitation.

5. Communication

Published or accepted peer-reviewed articles related to the EPIET fellowship

1. Hammer CC, Cristea V, Dub T, Sivelä J. Update on: High but slightly declining COVID-19 vaccine acceptance and reasons for vaccine acceptance, Finland April to December 2020. *Epidemiology and Infection*. Cambridge University Press; 2021.
2. Hammer CC, Cristea V, Dub T, Sivelä J. High but slightly declining COVID-19 vaccine acceptance and reasons for vaccine acceptance, Finland April to December 2020. *Epidemiology and Infection*. Cambridge University Press; 2021;149:e123.
3. Hammer CC, Boender TS, Thomas DRTh. Social media for field epidemiologists (#SoMe4epi): How to use Twitter during the #COVID19. *International Journal of Infectious Diseases*; 2021; ISSN 1201-9712; <https://doi.org/10.1016/j.ijid.2021.05.035>.
4. Hammer CC, Dub T, Luomala O, Sane J. Is clinical primary care surveillance for tularaemia a useful addition to laboratory surveillance? An analysis of notification data for Finland, 2013 to 2019. *Eurosurveillance*. [accepted]

Manuscripts under review (submitted to peer-reviewed journals) related to the EPIET fellowship

5. Hammer CC, Lyytikäinen O, Arifulla D, Toura S, Nohynek H. High influenza vaccination coverage among healthcare workers in acute care hospitals in Finland, 2017-2020. *Eurosurveillance*.
6. Mukka M, Hammer CC, Pesälä S, Mustonen P, Jormanainen V, Pelttari H, Kaila M, Helve O. Database searches on coronavirus and smell/taste disorders and their relation to COVID-19 cases in Finland: Analysis of online information-seeking behaviours. *JMIR Public Health and Surveillance*.

Manuscripts in preparation for submission to peer-reviewed journals related to the EPIET fellowship

7. Obach, C, Hammer, CC, et al. SARS-CoV-2 outbreaks in (partially) vaccinated care homes in Helsinki: Insights into epidemiology and immunology.
8. Hammer CC, Rupfutse M, Shendale S, Machekanyanga Z, Makwabarara E, Pampaka D, Ogbuanu I, Marembo J, Chigodo C, Lochlainn LN. Qualitative Insights into Reasons for Missed Opportunities for Vaccination in Health Facilities in Zimbabwe, 2017.
9. CC Hammer, Boman E, Grunér M, Nordberg M, Sane J, Lönnroth K. Seroprevalence of SARS-CoV-2 December 2020 to May 2021 on the Åland Islands, a “cold spot”.

10. Hammer CC, Cristea V, Dub T, Sivelä J. Results from the Finnish COSMO COVID-19 behavioural insights study, April 2020 to April 2021.

Reports

11. Nation-wide outbreak of Hepatitis E in Finland August 2019 to March 2020
12. Outbreak of SARS-CoV-2 variant of concern B.1.1.7 in a long-term nursing care ward in Helsinki: A cohort study
13. Ebola Virus Disease Epidemic Democratic Republic of the Congo 2018-2020, Report of EPIET International Assignment with the Global Outbreak Alert and Response Network, March to April 2020
14. Reflective report: SARS-CoV-2/COVID-19 outbreak preparedness and response in care homes and other communal living settings in Cologne, April to May 2020
15. Global COVID-19 Response, Papua New Guinea, Global Outbreak Alert and Response Network End of Mission Report, May to July 2021
16. Clinically-diagnosed and laboratory-confirmed Lyme disease, Finland 2014 – 2019
17. Reflective report: COVID-19 epidemic intelligence and situation reports
18. Prospective cohort study of seroprevalence of SARS-CoV-2 on the Åland Islands, December 2020 to May 2021
19. Knowledge, attitudes and practices regarding COVID-19 on Åland, December 2020 to February 2021
20. COSMO: Results of the Perceptions, Concerns and Attitudes survey [wave 4, English]
21. COSMO: Perceptions regarding the current development of a vaccine for coronavirus [wave 4, English]
22. COSMO: Käsitykset, huolet ja asenteet -kyselytutkimuksen tulokset [kyselykierros 4, Suomi]
23. COSMO: Rokotteisiin ja rokottautumiseen liittyvät käsitykset [kyselykierros 4, Suomi]
24. COSMO: Results of the Perceptions, Concerns and Attitudes survey [wave 5, English]
25. COSMO: Perceptions regarding the current development of a vaccine for coronavirus [wave 5, English]
26. COSMO: Käsitykset, huolet ja asenteet -kyselytutkimuksen tulokset [kyselykierros 5, Suomi]
27. COSMO: Rokotteisiin ja rokottautumiseen liittyvät käsitykset [kyselykierros 5, Suomi]
28. COVID queries Time series analysis of database searches on coronavirus and smell/taste disorders and their relation to COVID-19 cases in Finland: Analysis of online information-seeking behaviours

Protocols

29. Study protocol: Tularaemia in Finland between 2013 and 2019
30. Study protocol: Lyme disease in Finland between 2014 and 2019
31. Study protocol: Influenza vaccination coverage among Finnish health care workers
32. Study protocol: Risk factors for Lyme disease in Finland
33. Study protocol: The Åland Islands' COVID-19 population cohort: a longitudinal study of epidemiology, experiences and behaviours/ Ålands covid-19 populationskohort - en longitudinell epidemiologisk studie och kartläggning av befolkningens erfarenheter och beteenden.

Conference presentations

34. Hammer, CC, Lyytikäinen, O, Arifulla, D, Toura, S, Nohynek, H. High influenza vaccination coverage among healthcare workers in acute care hospitals in Finland, 2017-2020. ESCAIDE. 2021. Poster [accepted].
35. Hammer CC, Cristea V, Dub T, Sivelä J. Monitoring of COVID-19 vaccine acceptance and reasons for vaccine acceptance in Finland, Finland April to April 2021. FETP International Nights. 2021. Oral Presentation.
36. Hammer CC, Rupfutse M, Shendale S, Machekanyanga Z, Makwabarara E, Pampaka D, Ogbuanu I, Marambo J, Chigodo C, Lochlainn LN. A qualitative analysis of caregivers' opinions about childhood vaccination and vaccination services from a Missed Opportunities for Vaccination assessment in Zimbabwe. ESCAIDE. 2020. Poster.
37. Mäkelä H, Laurila P, Tuutti E, Pihlajasaari A, Hammer CC, Summa M, Rimhanen-Finnea R. Kokemuksia Hepatiitti E-seurannasta ja selvityksestä. Valmis. 2020. Poster [presented by H Mäkelä].

Other presentations

38. Drivers of risk for communicable disease outbreaks in humanitarian emergencies. THL EPIET and EUPHEM meeting. 21.11.2019.
39. Influenza vaccination coverage among healthcare workers during the first two seasons of data collection, Finland, 2017-2019. THL EPIET and EUPHEM meeting. 05.12.2019.
40. Influenza vaccination coverage among healthcare workers during the first two seasons of data collection, Finland, 2017-2019. PAE. 17.01.2020.
41. The 10th Ebola outbreak in the Democratic Republic of Congo, epidemiological support for WHO, presentation of GOARN deployment. THL EPIET and EUPHEM meeting. 04.06.2020.
42. Syndromic surveillance for Tularaemia in Finland: Comparison of laboratory and primary healthcare notification data between 2013 and 2019. THL EPIET and EUPHEM meeting. 16.06.2020.
43. The end of the 10th Ebola outbreak in the Democratic Republic of Congo. PAE. 25.06.2020.

44. Syndromic surveillance for Tularaemia in Finland: Comparison of laboratory and primary healthcare notification data between 2013 and 2019. PAE. 13.08.2020.
45. A qualitative analysis of caregivers' opinions about childhood vaccination and vaccination services from a Missed Opportunities for Vaccination assessment in Zimbabwe. Project Review Module. 25.08.2020.
46. The Åland Islands' COVID-19 population cohort: a longitudinal study of epidemiology, experiences and behaviours. THL EPIET and EUPHEM meeting. 22.10.2020.
47. Monitoring knowledge, risk perceptions, preventive behaviours, and public trust in the current coronavirus outbreak in Finland, COSMO study: Selected results, round 4 (November-December 2020). THL EPIET and EUPHEM meeting. 14.01.2021.
48. Monitoring knowledge, risk perceptions, preventive behaviours, and public trust in the current coronavirus outbreak in Finland, COSMO study: Selected results, round 4 (November-December 2020). PAE. 11.02.2021.
49. Outbreak of SARS-CoV-2 in a care home in Helsinki, initial analysis. THL EPIET and EUPHEM meeting. 11.03.2021.
50. Monitoring knowledge, risk perceptions, preventive behaviours, and public trust in the current coronavirus outbreak. Nordic Mini Project Review Module. 23.03.2021.
51. Reasons and solutions for Missed Opportunities for Vaccination in Zimbabwe: A qualitative analysis of caregivers' and healthcare workers' opinions and perceptions. Nordic Mini Project Review Module. 24.03.2021.
52. Outbreak of SARS-CoV-2 in a care home in Helsinki, update. THL EPIET and EUPHEM meeting. 31.03.2021.
53. Outbreak of SARS-CoV-2 in a care home in Helsinki, update. THL EPIET and EUPHEM meeting. 22.04.2021.
54. Outbreak of SARS-CoV-2 in a care home in Helsinki, final results. THL EPIET and EUPHEM meeting. 10.05.2021.
55. Monitoring knowledge, risk perceptions, preventive behaviours, and public trust in the current coronavirus outbreak in Finland. Vaccinology Module. 17.06.2021.
56. High influenza vaccination coverage among healthcare workers in acute care hospitals in Finland, 2017-2020. Project Review Module. 23.08.2021.

6. Other activities

Cohort representative activities

Charlotte was the cohort 2019 representative for the EPIET (field epidemiology track fellows). The cohort representatives' role is to address fellow's issues and concerns to the fellowship programme. Together with the other representatives of her cohort and those of the parallel cohorts (cohort 2018 and cohort 2020), Charlotte co-organised quarterly teleconferences with the ECDC Fellowship office and scientific head of fellowship, as well as with the EAN. Together with the other cohort representatives from her cohort, she organised the 2021 fellows' survey.

Activities of the PAE (German FETP) and Master of Science in Applied Epidemiology

Charlotte took part in the activities of the PAE (German FETP) on a regular basis and completed the Master of Science in Applied Epidemiology at the Charité in Berlin. She contributed to the weekly PAE meetings by giving presentations and engaging in discussion. She also attended a two-day laboratory training and a visitation at a local German public health department as part of this. Finally, in addition to this portfolio, she also completed a master's dissertation based on the results of her projects.

Women in Global Health Finland Advisory Board

During the second year of her fellowship, Charlotte was part of the advisory board for the Women in Global Health chapter in Finland. Together with the other board members she advised on the strategy of Women in Global Health Finland and developed the first member survey to write a participatory mission statement.

THL EPIET and EUPHEM meetings

THL runs bi-weekly EPIET and EUPHEM meetings during which the current fellows present their project proposals and results to the wider department. Charlotte has actively contributed to these meetings throughout her fellowship and has presented most of her projects during the meetings.

Science communication

Charlotte engaged in several science communication activities during her fellowship. Most notably, she authored a manuscript on the use of Twitter by field epidemiologists together with Sonia Boender and Daniel Thomas which has been published in the International Journal of Infectious Diseases in a special supplement for the first World Field Epidemiology Day 2021 in collaboration with TEPHINET. For the same event, she was also involved in making a video about the activities of EPIET and EUPHEM fellows.

Additionally, she has contributed to the Blog of her previous university with a perspective on the pandemic in 2020, to a podcast by the University of Manitoba and to an online expert panel on the use of technology during the COVID-19 pandemic organised by the Centre for the Study of Existential Risk at the University of Cambridge in 2021.

7. EPIET/EUPHEM modules attended

1. Introductory Course, 3 weeks, Septses, Greece
2. Outbreak Investigation Module, 5 days, Nicosia, Cyprus
3. Multivariable Analysis, 6 days, online
4. Project Review Module 202, 5 days, online
5. Time Series Analysis, 5 days, online
6. Rapid Assessments and Survey Methods, 3 days, online
7. Vaccinology, 5 days, online
8. Project Review Module 2021, 4 days, online

8. Other training

1. Outbreak Analytics in R, 2 days, Stockholm, Sweden
2. Global Outbreak Alert and Response, Network Tier 1.5 Training, 2 days, online
3. Nordic Mini-Project Review Module 2021, 2 days, online
4. PAE Laboratory Module, 2021, 2 days, online
5. Master of Applied Epidemiology at the Charité - Universtätsmedizin & Berlin School of Public Health; integrated into the EPIET training programme.

Discussion

Coordinator's conclusions

I have only been Charlotte's frontline co-ordinator for the second year of her fellowship, by which time she had already achieved almost all that was required for graduation and had participated in an international mission. Charlotte was already a skilled public health researcher at the start of the fellowship, able to work independently and effectively; however, she was still eager to learn and improve both in her existing skills and in areas that she had less experience. During her fellowship, Charlotte has worked effectively across all competency domains. She has taken full advantage of the range of project opportunities that the THL has to offer and has also contributed to the response to the Covid-19 pandemic in this country. Charlotte's undiscussed capacities for applied research and enthusiasm has brought her to engage in a diverse and wide range of projects within the fellowship, expanding her knowledge on various disease groups (vector-borne diseases, influenza, COVID-19), keep her qualitative skills sharp and acquiring new quantitative analytical skills such as programming in R, TSA and multilevel analysis. Charlotte has succeeded in performing all her tasks to a high standard and with a very good and critical professional attitude. I wish her every success in her future career.

Supervisor's conclusions

Supervision team: Outi Lyytikäinen, Hanna Nohynek, Lotta Siira, Jussi Sane, Timothee Dub

During her two-year fellowship at THL, Charlotte has been actively involved in a variety of Public Health activities including surveillance, outbreak investigations, descriptive and analytical epidemiology and research as well as communication and teaching. The outcome of her work has been excellent, benefiting the Department of Health Security at THL as well as the national and international community. She has contributed to the development of Finnish surveillance systems for tularemia and Lyme disease. Charlotte was also involved in a very diverse set of outbreak investigation and response projects, both in Finland, Germany and through international assignments. Her research projects increased our knowledge on vaccine uptake (Influenza) and/or hesitancy (COVID-19) in Finland. Her participation in the daily work of the department has made it possible for the supervisors to carry out projects that would otherwise have been difficult or impossible to accomplish. The fellow developed both personally and professionally during the fellowship and solved the given tasks in a highly competent way with a high and increasing degree of independence, but at the same time seeking assistance when necessary. This two-year experience at THL also helped Charlotte develop as an epidemiologist, supported by her experience in social science which proved to be useful in several projects, making her a public health professional with a wide range of skills from qualitative research to advanced statistics. Charlotte worked independently but also proved to be a great team player, a quality that was highly appreciated by her co-fellows and colleagues. We would highly recommend her for any kind of public health work.

Personal conclusions of fellow

During my time as an EPIET fellow, I had the opportunity to get involved in a large number of diverse projects. I was able to strengthen my skills across all areas of applied epidemiology on a wide range of issues and diseases. After learning the methods during the modules and gaining proficiency in applying them during the vast variety of projects that THL has been able to offer me, I had the pleasure to complete two deployments with the Global Outbreak Alert and Response Network (GOARN) first in the Ebola response 2020 and then in 2021 in the global COVID-19 response. Combining this with insights gained from taking part in some areas of the German PAE has resulted in an ability to reflect on the differences and similarities between the Finnish context, the German context and non-European contexts which has helped me consolidate my learning across the core competencies and beyond. Doing this fellowship during a pandemic has been both a challenge but also a backdrop for learning rapidly and working on immediately meaningful projects. However, while all the skills I deepened and learned during the modules and during my field assignments are beyond valuable, it is the network that EPIET and EUPHEM fellows share that will be my most cherished gain from these two years. I am grateful that this community continues beyond just the two years of the fellowship and look forward to continuing to be an active part of it.

Acknowledgements of fellow

I have had a wide range of project supervisors at THL and beyond who have guided me on my journey through the fellowship – and what a journey it has been! I would like to thank all of them profoundly for their insights, support and feedback, particularly Outi, Jussi and Lotta. However, Tim has taken supervision to the next level, thank you for not despairing with any weird questions and always being there with support and knowledge but most of all thank you for being a friend as well as a supervisor. I am also very grateful to have had not one but two wonderful frontline scientific coordinators, thank you Daniel and Zaida. The EAN board were a source of support and mentoring and gave me the reassuring feeling that the fellowship is really only the beginning of a life-long community.

My co-fellows at THL have been an amazing team, thank you, Veronica, Marius, Dorothée, Dafni and Sohvi. Particularly Sohvi thank you for always being our link to anything Finnish and for tirelessly translating and explaining THL policy for us. Over the last two years, I have had the pleasure of working with a great team of cohort representatives. Thank you, Alberto, Andreas, Kamelia, Sonia, Max, Ettore, Katja, Joaquin, Daniela and Diana. Thank you for bearing with me when I was my most rebellious and for working tirelessly to improve all fellows' experiences.

This fellowship would not have been possible without the support from the ECDC fellowship team, all coordinators and supervisors and those involved in delivering the modules.

Finally, but most importantly, thank you, to all the other fellows of cohort 2019, you have been wonderful!