Summary of work activities

Jeanette Stålcrantz

The ECDC Fellowship Programme

Field Epidemiology path (EPIET), 2020 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 Jeanette Stålcrantz, Cohort 2020 of the Intervention Epidemiology path (EPIET) at the Norwegian Institute of Public Health (Folkehelseinstituttet, NIPH).

Pre-fellowship short biography

Before the EPIET fellowship, Jeanette Stålcrantz was working as a senior advisor at the Department of Infection Control and Vaccines at the Norwegian Institute of Public Health (NIPH) since 2008. She has a background in nursing (University of Sydney, Australia) and holds an intermediate-level degree in social anthropology from the University of Oslo. Shecompleted her Master of Philosophy in International Community Health at the University of Oslo in 2005. She worked for a few years at the infectious disease department at the Oslo University Hospital (OUS), Ullevål, Oslo before starting her work at NIPH.

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

Stockholm, May 2023

At NIPH, she worked with different aspects related to vaccines and vaccine-preventable diseases, mainly with the counselling of healthcare personnel as well as communication and surveillance of the childhood immunisation programme. Her interest in a wider field of public health, such as data analysis, outbreak investigations and surveillance of infectious diseases increased through this work. She wanted to improve her knowledge in field epidemiology and infectious disease control and eagerly took up the opportunity to join the EPIET fellowship programme.

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 Manual[1].

1. Epidemiological investigations

1.1 Outbreak investigations

1.1.1 Salmonella Blockley outbreak in Norway 2021–2022

Supervisors: Heidi Lange (Senior Advisor, Department of Infection Control and Preparedness, NIPH), and Lin Brandal (Senior Researcher, Department of Infection Control and Preparedness, NIPH)

In December 2021, the National Reference Laboratory (NRL) for enteropathogenic bacteria at NIPH was notified of four possible local cases of *Salmonella* Blockley by a laboratory in a hospital in Mid-Norway. The samples were whole genome sequenced at the NIPH, and identical *Salmonella* Blockley (*S.* Blockley) bacteria (sequence type (ST) 52 and cluster type (CT) 9583) were detected. The first cases were from three different municipalities in the county of Trøndelag, but later several cases were reported from seven counties. The cases had become sick (onset of symptoms) from November 2021 to January 2022.

An outbreak investigation was initiated and coordinated by NIPH in close collaboration with relevant stakeholders, such as municipal chief physicians, the Norwegian Veterinary Institute (VI), the Norwegian Food Safety Authority's (NFSA) head office, regional offices, and local departments. The outbreak group at NIPH was continuously informed by the NRL about new suspected and confirmed cases of *S.* Blockley. The NFSA assisted NIPH in conducting interviews of the cases. As of March 2022, there were 21 confirmed cases with eight (37%) men and 13 (65%) women, and age ranging from 1–80 years (median age 38 years). The cases were resident in seven counties: Trøndelag (7), Troms and Finnmark (3), Viken (3), Nordland (3), Vestland (3), Møre and Romsdal (1) and Rogaland (1). Thirteen (62) out of the 21 cases were hospitalised. One case was in Spain before infection, while the remaining cases did not have a travel history prior to infection.

A total of 17 cases were interviewed using a hypothesis-generating *Salmonella* specific questionnaire. A compilation of data from the patient interviews, additional interviews and product tracing did not indicate a probable cause of this outbreak. Vegetables were suspected as the probable cause, and different kinds of salads and vegetables were investigated with product tracing. However, not enough information was available to be able to determine the source with certainty.

Role: Jeanette participated in the local outbreak investigation team, participating in meetings with stakeholders and was involved in framing the case definition, collecting information, preparing news items [18], and monitoring the situation. She performed descriptive data analysis, drafted the outbreak report [4], and presented the results from the outbreak at the NIPH internal EPIET/EUPHEM meeting [12] for the Nordic Mini Project Review Module 2022 [13].

[1] European Centre for Disease Prevention and Control. European public health training programme. Stockholm: ECDC; 2023. Available at: https://www.ecdc.europa.eu/en/publications-data/ecdc-fellowship-programme-manual

1.1.2 Cases of hepatitis of unknown origin among children, Norway 2022

Supervisor: Heidi Lange (Senior Advisor, Department of Infection Control and Preparedness, NIPH)

Hepatitis is an inflammatory condition of the liver that can be caused by infections, toxication, or conditions such as auto-immune or chronic disease. In the multi-country outbreak of acute hepatitis among children under the age of 16, the leading hypothesis (per 25 November 2022) was that the disease is associated with infection with adenovirus type 2 (AAV2), possibly in connection with another adenovirus infection with either a known or a new variant.

On 5 April 2022, the World Health Organization (WHO) was notified of an increase in cases of severe acute hepatitis of unknown cause among previously healthy children under the age of 10 in Scotland, where hepatitis types A, B, C, D and E had been ruled out. On 19 April 2022, the Norwegian Institute of Public Health (NIPH), received the first notification of two suspected cases from two different counties in Norway. By 11 November 2022, seven cases residing in four different counties were reported in Norway.

Due to the increase of cases reported in Norway during April and May 2022 and many children hospitalised globally, NIPH decided to initiate an outbreak investigation in line with internal routines. The investigation was performed in close cooperation with the clinicians, pediatricians, and municipal doctors.

The case definition was similar to the one defined by ECDC and used in Europe as well as by the WHO for reporting to The European Surveillance System (TESSy) as of 1 December 2022. NIPH collected epidemiological and microbiological data on the cases. In addition, NIPH collected relevant data to be able to create a baseline of relevant diagnoses for the number of cases per year, related to acute hepatitis of causes other than hepatitis A, B, C, D and E. NIPH had limited data on the background incidence of acute hepatitis of unknown cause among children in Norway, but the available data did not give any clear indication of any increase of cases during the period of international outbreak for the relevant age group in Norway. However, the data had to be interpreted with caution due to variations in reporting.

There were seven cases in Norway that met the criteria of the case definition for a possible case. The onset of symptoms was between 1 December 2021 and 29 October 2022. Four of the cases became ill in March and April 2022. The cases were two (29%) boys and five (71%) girls aged 0–5 years, from four different counties: Oslo (n=2), Viken (n=2), Møre and Romsdal (n=2), and Finnmark (n=1). All seven cases were hospitalised, of which two were admitted to an intensive care unit. Four of the cases had no travel history abroad, and travel history was unknown for three cases. None of the cases had contact with other cases (no epilink to other cases). All cases recovered. The results from the microbiological investigations showed that for three of the cases, adenovirus (F41) was detected in the blood, and for one case adenovirus was detected in the airways. The last case was notified in November 2022, after a period of no cases notified since July 2022. A decision was then made to end the outbreak investigation.

Internationally, the current leading hypothesis is that the increase of acute hepatitis in children was associated with adenoviruses F41 and AAV2 as both these viruses were found in samples from many of the children. Due to the stabilisation of the situation and a decreasing trend in new cases, a message was sent out on 31 January 2023 by the Acute Hepatitis in Children Response teams from ECDC and World Health Organization Regional Office for Europe (WHO/Europe) that reporting to TESSy should end.

Role: Jeanette participated in the local outbreak investigation team and participated in establishing a baseline of hepatitis cases <20 years (causes other than hepatitis A, B, C, D, E) and adenovirus for surveillance of the situation in Norway [appendix in reference 5]. She drafted and finalised a data protection impact assessment (DPIA) for collecting and handling the data from the Norwegian patient registry (NPR) in order to establish a baseline for hepatitis-related diagnosis for exceedance analysis in Norway. However, due to legal constrains and few cases in Norway, it was decided that the investigation be terminated. Jeanette described the outbreak in an outbreak report [5].

1.1.3 Outbreak of Serratia Marcescens, Norway

Supervisor: Thale Cathrine Berg (Senior Advisor, Department of Infection Control and Preparedness, NIPH)

In October 2022, the Norwegian Institute of Public Health (NIPH) received a notification from the Regional Centre for Infection Prevention and Control (RKS) in the central part of Norway about an outbreak of seven cases of *Serratia marcescens*, complex type (kt) 755. *Serratia marcescens* is a common bacterium that thrives in water and moist environments, as well as hospital environments. It rarely causes illness in healthy people but can cause serious illness in immunocompromised patients.

The cases occurred in two different hospital trusts in the period between May to September 2022. On 3 November 2022, a total of 12 outbreak cases (kt 755) were detected in two health regions, and a national outbreak was declared. NIPH coordinated the outbreak investigation, and a central outbreak group consisting of representatives from all four health regions, NIPH, the Norwegian Food Safety Authority, and the Norwegian Medicines Agency was established. Retrospective sequencing of all blood culture isolates from 2021 and 2022 were performed, in addition to prospective sequencing of all sample materials of new cases.

The Central Norway Regional Health Authority also uncovered another cluster of *Serratia marcescens*, kt 281. Eventually, cases of both complex types were detected in all health regions.

The epidemiological investigations included the collection and analysis of data from patients' hospital records on risk factors and history of hospitalisation. Further, hypothesis-generating interviews of 15 cases were conducted. A survey on the use of cosmetic products, medicines, and medical technical equipment within the hospitals to investigate whether a common source of infection could be identified was also considered. A questionnaire was prepared and piloted, but this was not implemented as it was considered that there was a high probability that the source of infection was not entirely nosocomial.

A total of 74 cases of *Serratia marcescens* (kt 755) were detected in 33 hospitals in all four health regions in Norway, including three cases that were detected in the primary healthcare service. The cases resided in 11 different counties. Females accounted for 46% (n=34) of the cases, and males accounted for 54% (n= 40). Their ages ranged from one month to 97 years (median age was 76 years) in the outbreak population. Most of the patients had many comorbidities and a longer medical history before the outbreak strain was detected. A total of 57% (n=42) had the bacteria detected in blood culture, 43% (n=32) in other sample materials. In the five cases that died, *Serratia marcescens* infection was reported as the main cause of death.

Furthermore, 26 cases of *Serratia marcescens* (kt 281) were detected in a total of 13 hospitals, in all four health regions. Females accounted for 54% (n=14) of the cases, and males accounted for 46% (n=12) of the cases. Their ages ranged from 26 years to 83 years (median age 69 years). The cases lived in 10 different counties. A total of 35% (n=9) had the bacteria detected in blood culture, 65% (n=17) in other sample materials. None of the cases that died had *Serratia marcescens* infection reported as the main cause of death.

The results from the epidemiological investigations showed few common features in exposures both in the interviews that were carried out, as well as mapping of possible risk factors in terms of medicines, cosmetics, and medical technical equipment that had been used in patients who had been hospitalised. The source of infection in this outbreak was not identified. However, the results indicate that the source of infection was probably not in the hospitals. As the cases appeared to decline in 2023, the outbreak investigation was ended on 17 February 2023.

Role: Jeanette participated in the outbreak response teams and participated in meetings with external stakeholders. She was responsible for compiling and analysing the data from trawling questionnaires. She also participated in descriptive analysis of the cases and the risk factors of the patients. She drafted parts of an outbreak report [6].

Training modules related to assignment/projects

The EPIET/EUPHEM Introductory Course provided an introduction to intervention epidemiology and introduced the concept of the steps of an outbreak investigation, risk assessment methodology and the use of the statistical tool Stata in performing epidemiological analysis. The course provided practical examples of important elements of outbreak investigations and the skills needed when investigating outbreaks through group work with case studies.

The Outbreak Investigation Module provided further epidemiological knowledge and basic skills of analytical epidemiology through lectures. Case studies and active discussions during these sessions provided both conceptual framework and practical training in epidemiological investigation combined with microbiological investigation.

The Multivariable Analysis Module provided an insight on statistical analysis and skills needed in analytical epidemiology, such as the use of multivariable analysis in outbreak investigations.

The RAS module and the **Management, Leadership and Communication in public health module** provided knowledge and practical skills in risk communication to different target groups.

Educational outcome

In the course of the three outbreak investigations which the fellow was involved in during her fellowship, she gained experience in working through the 10 steps of an outbreak investigation and developed her epidemiological skills. The activities performed by the fellow included collecting and compiling epidemiological and microbiological information, developing case definitions, documenting in line list, compiling information collected in trawling questionnaires to identify possible sources, creating epi-curves, and descriptive and analytical statistical analysis in Stata. She also participated in internal and external outbreak meetings, writing minutes of meetings, news items for the webpage, and outbreak reports. She gained experience and insight in different kinds of outbreaks that will enable her to participate more independently in her future work.

2. Surveillance

2.1 Development of an analysis plan for the COVID-19 vaccination coverage monitoring

Supervisors: Pawel Stefanoff (Scientific Coordinator, ECDC; former Senior Advisor, Department of Infection Control and Preparedness, NIPH), and Hilde Kløvstad (Section Leader, Department of Infection Control and Vaccines, NIPH)

As part of the COVID-19 response, vaccines were available in Norway from January 2021. COVID-19 vaccination was organised as a national programme, with municipalities offering vaccination for their residents. The programme involved various stakeholders with different duties and responsibilities, such as defining prioritised groups for vaccination, distribution of equipment and vaccines, surveillance of vaccine coverage and adverse events, vaccine efficacy and so on. NIPH was responsible for surveillance of vaccination uptake and estimating the effect of vaccination on the pandemic progression overall and in vulnerable populations.

An analysis plan was developed to prepare for COVID-19 vaccination programme monitoring, aiming for a weekly publication of performance indicators. The emergency preparedness register was used for COVID-19 (Beredt C-19) that linked data from the Norwegian Immunisation Registry (SYSVAK), Norwegian Surveillance System for Communicable Diseases (MSIS), the Norwegian Patient Registry (NPR), the Norwegian Intensive Care and Pandemic Registry (NIPaR), and the national MSIS laboratory database. The pandemic register was also linked to the population register and other civil registers containing data on occupation, all registers being linked by a unique personal number.

The analysis plan was developed using the following steps:

- Development of a list of objectives and relevant indicators addressing these objectives.
- Discussion with experts and stakeholders at the NIPH, including the feasibility and usefulness of the suggested indicators.
- Drafting daily templates and weekly reports with dummy tables and graphs aimed for different audiences.

Following the accepted analysis plan, an R code was set up in collaboration with colleagues which automatically compiled the most current datasets and calculated indicators on a daily and weekly basis. During the implementation phase, the reports were regularly revised, based on changing needs of various audiences, different stages of the vaccination programme implementation, and the changing epidemiological situation.

Role: Jeanette developed an analysis plan with the main indicators and dummy tables for presentation and presented it for feedback to colleagues at NIPH before the analysis plan was finalised [17]. A template report for the weekly monitoring of the vaccination programme was developed, and she was responsible for the weekly reporting of the relevant indicators and their development until June 2021 [20].

2.2 Weekly surveillance of the epidemiological situation of COVID-19 in the counties in Norway

Supervisors: Robert Whittaker (Researcher, Department of Infection Control and Vaccines, NIPH), and Hilde Kløvstad (Section Leader, Department of Infection Control and Vaccines, NIPH)

The NIPH compiled, assessed, and shared weekly data of the epidemiological situation in each county. The assessment provided a description of major outbreaks, and indicators (including epidemiological threshold, incidence in different groups, test activity and vaccination coverage) linked with an assessment of risk levels for each county. The aim of the report, together with other information, was to inform each county of the epidemiological situation to ensure the efficient and adequate implementation of prevention and control measures.

Role: Jeanette participated in writing the weekly COVID-19 situation reports for the counties in Norway [23]. She compiled relevant epidemiological data in the counties in this report that were shared with the county officials to provide an ongoing overview of the situation.

2.3 Surveillance of hospitalisations due to COVID-19 in Norway

Supervisors: Robert Whittaker (Researcher, Department of Infection Control and Vaccines, NIPH), Elina Seppälä (Senior Advisor, Department of Infection Control and Vaccines, NIPH), and Hilde Kløvstad (Section Leader, Department of Infection Control and Vaccines, NIPH)

An important indicator in the routine surveillance of severe illness is new admissions to hospital and intensive care units (ICU) due to COVID-19. For this surveillance, individual-level data from several national health, clinical and administrative registries were collected and analysed on a daily basis using the Norwegian emergency preparedness register for COVID-19 (Beredt C-19).

The data on new admissions to hospital and ICU were primarily based on data from the Norwegian Intensive Care and Pandemic Registry (NIPaR). Important additional patient and virological characteristics in this surveillance have included age, sex, vaccination status (including vaccine type, intervals between doses, and date of last vaccine dose), comorbidities, and virus variant.

Additional data were available through a linkage in Beredt C-19 with the Norwegian Patient Registry (NPR) and the Norwegian Surveillance System for Communicable Diseases (MSIS). The data was cleaned and compiled into separate patient trajectories using Beredt C-19.

The various key indicators used in the surveillance were:

- The number of new patients admitted to hospitals with SARS-CoV-2 (until January 2022), per day and per week, in total and per age group.
- The number of new patients admitted to hospitals where COVID-19 was the main reason for admission per day and per week, in total and per age group.
- The number of new patients admitted to the intensive care units with confirmed SARS-CoV-2, per day and per week, in total and per age group.
- The length of hospital stay, and/or stay in the ICU.

The results have been published in diverse forms, such as in daily interactive dashboards, weekly national routine surveillance reports, risk assessments, and peer-reviewed articles.

As part of this surveillance, a cohort study was performed to estimate differences in the length of hospital stay, and risk of admission to an ICU and in-hospital deaths among patients infected with the Omicron variant of SARS-CoV-2, compared with patients infected with the Delta variant in Norway. The patients who were hospitalised with COVID-19 as the main cause between December 2021 and February 2022 were included, with 409 (38%) infected with Omicron and 666 (62%) infected with Delta. Using a Cox proportional hazards model, results showed that Omicron patients had a 48% lower risk of ICU admission (adjusted hazard ratios (aHR): 0.52, 95% confidence interval (CI): 0.34–0.80) and a 56% lower risk of in-hospital death (aHR: 0.44, 95% CI: 0.24–0.79) compared with Delta patients. Omicron patients had a shorter length of stay (with or without ICU stay) compared with Delta patients in the age groups from 18–79 years and those who had at least completed their primary vaccination. This supported the growing evidence of reduced disease severity among hospitalised Omicron patients compared with Delta patients.

Role: Jeanette contributed to the ongoing running and development of the routine surveillance of hospitalisations and ICU admissions due to COVID-19 in Norway, including data cleaning, linkage, analysis, and publication. She developed a surveillance protocol [15] describing the need and the use of such surveillance. She contributed to the weekly national COVID-19 report [19] and performed several ad-hoc analyses upon request. For the cohort study described above, she contributed to the data cleaning and analysis, drafted the manuscript as the first author, coordinated the work between the co-authors and presented the study at ESCAIDE as a poster [8]. An article was published [1], and she co-authored another article on hospitalisations [2].

2.4 Evaluation of the surveillance of hospitalisations due to COVID-19 in Norway

Supervisors: Elina Seppälä (Senior Advisor, Department of Infection Control and Vaccines, NIPH), Hilde Kløvstad (Section Leader, Department of Infection Control and Vaccines, NIPH)

As described in Section 2.3, surveillance of patients admitted to hospitals and intensive care units (ICU) with COVID-19 is a key indicator for monitoring the severity of the pandemic. This surveillance was carried out by a small group of employees using the emergency preparedness register for COVID-19 (Beredt C-19). As part of an overall evaluation of the COVID-19 surveillance in Norway, an evaluation of the system provided an overview of the surveillance system used for monitoring hospitalisations and assessed the following surveillance system attributes: acceptability, simplicity, representativeness, timeliness, completeness, and stability.

Timeliness, the median time from admission to registration in the register, was regularly calculated when the data were published to monitor timeliness. This was relatively stable throughout the pandemic period until spring 2022. During spring 2022, the median time increased as the reporting deadline was extended from 24 hours to seven days, resulting in a greater time lag than previously. Also, in order to determine the completeness of the registry, there was a comparison between data from this system and data from the NPR to assess whether the NPR could replace this monitoring system in the future to save resources in the hospitals by reducing manual registration. The results showed that NIPaR and NPR gave a similar picture (>90%) of the number of new patients admitted to hospitals with COVID-19, showing high completeness until the start of 2022 (i.e. with the same diagnosis code for confirmed COVID-19). After this, the results showed that the proportion of hospitalisations that could be linked had reduced, indicating that the two registries started to measure differently over time, thereby, reducing the completeness.

The conclusion of the evaluation was that this was a stable, high-quality surveillance system that has contributed to both routine monitoring and ad-hoc analyses. The surveillance system could be used in future crises, given that sufficient resources for data collection and the digital infrastructure for receiving and linking data at the NIPH are in place.

This evaluation was done in June 2022. Due to changes in the epidemiological situation and registration in the hospitals, a similar evaluation would give different results if it was performed at a later point in time.

Role: Jeanette was an active part of the surveillance team of hospitalisations as described in Section 2.3. As part of an overall evaluation of the surveillance of COVID-19 in Norway, she drafted the chapter regarding hospital surveillance [7]. She collected and compiled inputs from colleagues and relevant stakeholders.

2.5 Surveillance of influenza-like illness (ILI) in Norway

Supervisors: Trine Hessevik Paulsen (Medical Officer, Department of Infection Control and Vaccines, NIPH), and Elina Seppälä (Senior Advisor, Department of Infection Control and Vaccines, NIPH)

The ILI-surveillance in Norway is registry-based, using data from primary healthcare. The data include diagnostic codes (ICPC-2) that follow doctors' claims to central health authorities for reimbursement through the Norwegian Control and Payment of Health Reimbursements Database (KUHR). The ILI-surveillance uses the diagnostic code 'R80 Influenza' to follow trends in consultations due to influenza-like illness during the influenza season.

Jeanette received training and took responsibility for this part of influenza surveillance during her fellowship, including weekly monitoring and reporting of the situation for ILI-surveillance in Norway, which was published in the weekly report written by NIPH on the epidemiological situation of COVID-19, influenza and other respiratory infections. With assistance from colleagues on coding a script in Stata, the surveillance was modernised and automated under the planning and coordination of the fellow.

Role: Jeanette became an active part of the surveillance team of influenza and other respiratory illnesses during her fellowship, both with collecting and evaluating surveillance data and contributing to weekly national reporting [22], as well as to different internal (NIPH) and external stakeholders (such as The European Surveillance System – TESSy and the Influenza Virological and Epidemiological season report prepared for the WHO Consultation on the Composition of Influenza Virus Vaccines for the Northern Hemisphere 2023/2024) [23].

Training modules related to assignment/projects

The EPIET/EUPHEM introductory course introduces the basic concepts of surveillance, different ways of surveillance, how to analyse and interpret surveillance data of infectious diseases. A brief introduction of the use of STATA was provided.

The Multivariable Analysis module provided a better understanding of how to use different descriptive statistical methods in the analysis and different multivariable models for analysis. Further practical training in univariable and multivariable regression analysis were provided.

The RAS-module also provided practical training through case studies.

The Outbreak Investigation Module also provided knowledge on methods used for setting up and evaluating surveillance systems, and the need for evaluation and use of baseline data in decisions regarding outbreak management.

The TSA module provided knowledge in the use and analysis of time series data used in surveillance.

Educational outcome

The fellow learnt how to plan surveillance activities and define relevant indicators using available data sources. Her participation in the routine surveillance work on COVID-19 and influenza gave her valuable experience in how this surveillance is performed, interpreting different types of surveillance data, and also some of the challenges of surveillance. Writing a surveillance protocol, participating in the weekly reporting and writing an evaluation of the surveillance introduced her to different aspects of the surveillance and how the surveillance of hospitalisations was designed in Norway. She also gained experience in writing reports and communicating the results, as well as learning the importance of using surveillance data for public health action.

The fellow learnt to use the basics of Stata, and increased her skills in data analysis, including the skills of univariable and multivariable analysis. Also, using large databases such as Beredt C-19 taught her a lot about data management.

3. Applied public health research

3.1 Mapping community exposures of COVID-19 in Oslo

Supervisor: Pawel Stefanoff (Scientific Coordinator, ECDC; former Senior Advisor at the Norwegian Institute of Public Health)

In March 2021, the municipality of Oslo experienced a sharp increase in COVID-19 cases and several major outbreaks, due to the introduction and rapid domination of the more contagious Alpha virus variant B.1.1.7 in Norway. To support the routine disease-tracing work and to implement infection control measures in Oslo, the NIPH in collaboration with the Oslo municipality, investigated the probable community exposures to COVID-19 during this period. Throughout the pandemic, household infection was dominant, but limited information on community exposures was a challenge for an effective contact-tracing strategy with efficient and targeted testing of suspected cases, isolation of confirmed cases, and tracing and quarantining close contacts of confirmed cases. These depend on the knowledge of where the infection usually occurred.

A case-control study was conducted in March 2021, and the study population were inhabitants of Oslo aged 18–70 years. Cases were identified through routine disease tracing, and controls were randomly selected from the Norwegian population registry. Participants were interviewed using computer-assisted telephone interviews (CATI). The chance (odds) of exposure among the cases and controls were compared using logistic regression, including demographic characteristics, protective behaviors, and community exposures. The final multivariable model included exposures identified in univariable analysis and potential confounders.

The total number of cases and controls recruited were 346, and 700 respectively. Adjusted Odds Ratios (aOR) were presented. Reporting a close contact with a confirmed COVID-19 case was associated with the highest chance of being infected (aOR: 12.2, 95% CI: 7.4–20.1) after adjusting for other factors.
The chance of infection was higher in the age group 18–29 years, compared to those aged 60–70 years (aOR: 2.7, 95% CI: 1.0–7.4). Compared with living alone, the chance of infection increased when living with 4–6 people (aOR: 1.7, 95 % CI: 1.1–2.6) and with seven or more cohabitants (aOR: 2.4, 95% CI: 1.3–4.5).

The number of close contacts outside the household did not seem to increase the chance of being infected. Visiting a café, restaurant or bar and eating at a table increased the chance of infection (aOR: 3.2, 95% CI: 1.5–6.6). Furthermore, it was found that attending a private party or gathering with less than 10 participants did not increase the chance of infection, but consuming alcohol at such a party did (aOR: 1.7, 95% CI: 0.9–3.1).

The findings indicated that poor compliance with infection control advice (such as always wearing a face mask where it is difficult to keep one metre distance from others, and poor hand hygiene) could increase the chance of infection (low vs. high compliance with measures, OR 1.7, 95% CI: 1.0–2.6). Not having the possibility to work or study from home also led to an increased chance of being infected (OR 1.5, 95% CI: 1.0–2.4).

The results indicated that approximately 40% of infections among adults in Oslo in February–March 2021 occurred in their own household. Having been in close contact with a confirmed infected person significantly increased the probability of infection. Furthermore, it seemed that participating in outdoor activities and meeting people in itself did not increase the chance of infection, but poor compliance with infection control advice was harmful. The types of activities that increased the chance of infection were, eating out at restaurants or bars, and consumption of alcohol at parties. Inclusion of standard questions that map probable sites or situations throughout the incubation period (up to 10–14 days before the onset of symptoms) in those cases where the site or situation was unknown, could improve routine disease tracing.

Role: Jeanette was the project coordinator for this project. She contributed to drafting the study protocol [16] and seeking study permission from the ethics committee. She coordinated the data collection between NIPH and the marketing analysis company performing the interviews. She assisted with the data management, data analysis, and started drafting the report [3], which was subsequently finalised by colleagues.

Training modules related to assignment/projects

The EPIET/EUPHEM Introductory courses provided an introduction to statistical tools and operational research.

The Operational Research Training provided knowledge on how to write a research protocol.

The Outbreak Investigation Module provided information about data collection, data cleaning and data analysis using Stata.

The Multivariable Analysis Module further provided methods on more complex analysis, the use of multivariable models, and gave possibilities to practise the building and usage of such models.

In the research project, the fellow was able to gain practical experience with logistic regression using Stata, and further develop the skills gained in the course of the module.

Educational outcome

The fellow gained and expanded her knowledge on carrying out a research project, including planning the project and its data collection, writing a study protocol, handling legal aspects, conducting data cleaning, and analysing and reporting the results in a report.

4. Teaching and pedagogy

4.1 Management of food-borne and waterborne diseases: 10 steps of an outbreak investigation

The fellow gave a lecture for students attending the course, 'Management of Food-borne and Waterborne Diseases' at the University of Oslo on 18 May 2022. The lecture focused on the 10 steps of an outbreak investigation [24]. The target audience was master's students attending the course, 'INTHE4121 – Water and Food in a Global Health Perspective'. The fellow revised and updated a presentation previously developed by Emily MacDonald, NIPH, and prepared questions related to the lecture to be used in the home exam after the course [25]. The questions were related to interpretation of epidemiological curves and initial data collection when suspecting an outbreak. She also prepared questions for the evaluation, and wrote a reflection note.

4.2 The Nordic Mini Project Review Module 2022

The Nordic Mini Project Review Module (NMPRM) was organised by NIPH in 2022, and the fellow was a member of the organising team together with Ragnhild Tønnessen, Lèa Franconeri, Andreas Rohringer and Ettore Amato. The aim of the module was to network with co-fellows, as well as present and discuss projects that the EPIET and EUPHEM fellows (cohorts 2020–2021) from the Nordic countries were working on. A hybrid meeting was arranged on 7–8 March 2022. The fellow was involved in planning and organising the meeting. She was involved in the evaluation of the meeting and wrote a reflection note together with her co-fellows. She also gave a presentation on one of her outbreak projects [13].

Training modules related to assignment/projects

The EPIET/EUPHEM Introductory Course introduced the basic concepts of communication and different types of learning styles and techniques, as well as how to develop a message for different target audiences. The project review modules provided an opportunity to practise presentations and receiving feedback.

Educational outcome

Teaching was a new field for the fellow. She gained experience in this during the fellowship by giving this lecture, especially by developing and revising presentations/lectures, presenting orally, creating exam questions, and receiving feedback/evaluation on her work.

5. Communication

5.1 Publications related to the EPIET fellowship

1. **Stålcrantz J**, Kristoffersen AB, Bøås H, Veneti L, Seppälä E, Aasand N, Hungnes O, Kvåle R, Bragstad K, Buanes EA, Whittaker R. Milder disease trajectory among COVID-19 patients hospitalised with the SARS-CoV-2 Omicron variant compared with the Delta variant in Norway. Scand J Public Health. 2022 Aug;50(6):676-682. doi: 10.1177/14034948221108548. Epub 2022 Jul 7. PMID: 35799474.

2. Veneti Lamprini, Bøås Håkon, Bråthen Kristoffersen Anja, **Stålcrantz Jeanette**, Bragstad Karoline, Hungnes Olav, Storm Margrethe Larsdatter, Aasand Nina, Rø Gunnar, Starrfelt Jostein, Seppälä Elina, Kvåle Reidar, Vold Line, Nygård Karin, Buanes Eirik Alnes, Whittaker Robert. Reduced risk of hospitalisation among reported COVID-19 cases infected with the SARS-CoV-2 Omicron BA.1 variant compared with the Delta variant, Norway, December 2021 to January 2022. Euro Surveill. 2022;27(4):pii=2200077. https://doi.org/10.2807/1560-7917.ES.2022.27.4.2200077

5.2 Reports

3. **Stålcrantz J**, Madslien EH, Madsen C, Sørreime B, Stefanoff P. "Kartlegging av smittesteder for covid-19 i Oslo - resultater fra en kasus-kontroll-undersøkelse". [Mapping of community exposures for covid-19 in Oslo – results of a case-control investigation] Rapport 2021. Oslo: Folkehelseinstituttet, Juni 2021. Available from: https://www.fhi.no/publ/2021/kartlegging-av-smittesteder-for-covid-19-i-oslo/

4. **Stålcrantz J**, Brandal L, Ødeskaug L, Lange H. Outbreak report: Outbreak of *Salmonella* Blockley outbreak in Norway, December 2021- January 2022 [internal report]
5. **Stålcrantz J**, Heen E, Greve-Isdahl M, Lange H. Outbreak report: Outbreak of acute hepatitis of unknown cause among children, in Norway, 2021- 2022 [internal report]
6. Berg T, Ødeskaug L, Taxt A, **Stålcrantz J**, Bentele H, Eldholm V et al. Outbreak report: National outbreak of *Serratia marcesens*, in Norway, October 2022- February 2023 [internal report]
7. **Stålcrantz J**, Whittaker R, Ree O, Seppälä E. Evaluation of surveillance of hospitalisations due to COVID-19 in Norway [internal report]

5.3 Conference presentations

8. **Stålcrantz J**, Kristoffersen AB, Bøås H, Veneti L, Seppälä E, Aasand N, Hungnes O, Kvåle R, Bragstad K, Buanes EA, Whittaker R. Milder disease trajectory among COVID-19 patients hospitalised with the SARS-CoV-2 Omicron variant compared with the Delta variant in Norway. ESCAIDE 2022. [Poster presentation].

5.4 Other presentations

9. Presentation at a professional meeting at NIPH: 'Implications of COVID-19 on the childhood immunisation - globally and in Norway' 18 November 2022.
10. Presentation at the ECDC COVID-19 Think Thank entitled, 'COVID-19 vaccination in Norway: Status and possibilities for future analysis on vaccination data'. 19 April 2021
11. Mapping community exposures of COVID-19 in Oslo, Project Review module, 23 August 2021, online
12. Outbreak of *Salmonella* Blockley in Norway, December 2021 – January 2022, EPIET/EUPHEM meeting, 27 October 2022, NIPH
13. Outbreak of *Salmonella* Blockley in Norway, December 2021 – January 2022, Nordic Project Review Mini Module, 7 March 2022, NIPH
14. Milder disease trajectory among COVID-19 patients hospitalised with the SARS-CoV-2 Omicron variant compared with the Delta variant in Norway. Project Review module, 29 August 2022, Lisbon

5.5 Other activities

15. Protocol: Surveillance of hospitalisations due to COVID-19 in Norway, December 2021 – March 2022
16. Research protocol: Mapping of community exposures for COVID-19 in Oslo, November 2020
17. Analysis plan for surveillance of the COVID-19 vaccination programme 17 December 2021 [internal report]
18. News item on *Salmonella* Blockley outbreak, published 14 January 2022, NIPH webpages
19. Writing the chapter on hospitalisations due to COVID-19 in the NIPH weekly report on COVID-19, influenza and other respiratory diseases, weekly from December 2021 ongoing. Available at: https://www.fhi.no/publ/2020/koronavirus-ukerapporter/#alle-ukerapporter-2020202120222023-
20. Writing the chapter on COVID-19 vaccination coverage in the NIPH weekly report on COVID-19, influenza and other respiratory diseases, weekly from January 2021 – August 2021. Available at: https://www.fhi.no/publ/2020/koronavirus-ukerapporter/#alle-ukerapporter-2020202120222023-
21. Writing the chapter on surveillance of influenza-like illness (ILI) in the Influenza Virological and Epidemiological season report prepared for the 'WHO consultation on the Composition of Influenza Virus Vaccines for the Northern Hemisphere 2023/2024'. Available at: https://www.fhi.no/publ/2023/influenza-virological-and-epidemiological-season-report-2023/
22. Wrote the chapter on surveillance of influenza-like illness (ILI) in the NIPH weekly report on COVID-19, influenza and other respiratory diseases, weekly from October 2022 – ongoing. Available at: https://www.fhi.no/publ/2020/koronavirus-ukerapporter/#alle-ukerapporter-2020202120222023-
23. Writing the Epidemiological situational reports on COVID-19 for the counties in Norway, weekly from December 2020 – august 2021. Available at: https://www.fhi.no/publ/2020/koronavirus-ukerapporter/#alle-ukerapporter-2020202120222023-
24. Lecture on 'Ten steps of an outbreak investigation', University of Oslo, 18 May 2022.
25. Preparing home exam questions for the master's students who attended the lecture on 'Ten steps of an outbreak investigation', University of Oslo, 18 May 2022 [24].

7. Other activities

Epidemic Intelligence

Supervisor: Emily MacDonald (Senior Advisor, Department of Infection Control and Preparedness, NIPH)

Epidemic Intelligence is the process of detecting, verifying, analysing, assessing and investigating public health events that may represent a threat to public health. It encompasses activities related to early warning signals, integrated event- and indicator-based surveillance and signal assessment, and outbreak investigation. In Norway, epidemic intelligence is established on both event-based and indicator-based surveillance. NIPH is the national focal point for International Health Regulations (IHR) for WHO and Early Warning and Response System (EWRS) for the EU.

Role: Jeanette participated regularly in the epidemic intelligence operated by NIPH during her fellowship. She was a member of the national epidemic intelligence group and was included as part of the NIPH core group by the end of her fellowship. She participated in weekly Epidemic Intelligence meetings where national and international epidemic intelligence relevant for Norway were discussed. Jeanette was on the roster in the group responsible for the monitoring and follow-up of notifications on outbreaks and events received through utbrudd@fhi.no. This is the epidemic intelligence system operated by NIPH, where alerts from the Norwegian outbreak reporting system (VESUV), the international surveillance network communication (EWRS/IHR), media surveillance are handled and distributed to relevant employees. Part of this task is to write weekly reports to be presented at the weekly Epidemic Intelligence meetings.

8. EPIET/EUPHEM modules attended

1. Fellowship Introductory Course, 28.9.2020 – 16.10.2020, online
2. Inject days on Operational Research, 9.11.2020 – 10.11.2020, online
3. Outbreak Investigation Module, 7.12.2020 – 11.12.2020, online
4. Multivariable Analysis Module, 15.2.2021 – 19.2.2021, online
5. Inject day on Multivariable Analysis Module, 18.3.2021, online
6. Introduction Course part III, 26.4.2021 – 30.4.2021; 4.5.2021 and 7.5.2021, online
7. Rapid Assessment and Survey Methods Module, 5.5.2021 – 6.5.2021, online
8. Vaccinology Module, 14.2.2022 – 18.2.2022, online
9. Time Series Analysis Module, 3.4.2022 – 8.4.2022, Rome, Italy
10. Management, Leadership and Communication in Public Health, 13.6.2022 – 17.6.2022, Stockholm, Sweden
11. Project Review Module, 29.8.2022 – 2.9.2022, Lisbon, Portugal,

9. Other training

1. Nordic Mini Project Review Module, 23.3.2021 – 24.3.2021, online
2. Nordic Mini Project Review Module, 7.3.2022 – 8.3.2022, Oslo, Norway
3. ESCAIDE, 24.11.2020 – 27.11.2020, online
4. ESCAIDE, 16.11.2021 – 19.11.2021, online
5. ESCAIDE, 23.11.2022 – 25.11.2022, Stockholm, Sweden

Discussion

Coordinator's conclusions

Jeanette started her fellowship with a background in nursing and public health. During her fellowship, she was involved in five surveillance projects, three outbreak investigations, and one applied research project. Through her dedication, enthusiasm and commitment, she has achieved all the EPIET objectives and produced high quality outputs. One highlight of her fellowship was a publication demonstrating the differences in disease trajectories between Delta and Omicron COVID-19 variants. She has been very active in the training and teaching activities during the fellowship. She has further developed many of her competencies, and has a wide range of skills in outbreak and surveillance, including working in multi-stakeholder teams and developing communication strategies for media and different audiences. She has been independent during her fellowship and has been able to organise and complete her work effectively with excellent supervision from her site supervisor. Due to the timing of her fellowship, she was understandably involved in a lot of work on COVID-19, but the site gave her the opportunity to be involved in a range of projects that enabled her to develop a diverse portfolio. She has worked in a professional manner and has strong competencies to continue a career in epidemiological and public health-related work. I wish her success in her future career.

Supervisor's conclusions

Before joining the EPIET programme, Jeanette had a long experience working in the field of vaccination, especially with the childhood immunisation programme. She has strong management skills as well as extensive experience in communication and guidance around vaccination.

Jeanette is proactive and positive, and actively sought out activities through her fellowship with a broad range of epidemiological learning opportunities. Being part of the COVID-19 surveillance team and working on routine surveillance activities has given Jeanette significant training in data handling, data analysis and the use of STATA. She has made great progress and has worked independently in analysis and presentation of data. Jeanette has also been responsible for surveillance and research projects using advanced statistical methods. Although some of the analyses have been done by a statistician, Jeanette has a good understanding of the results, and her interpretation and communication of the same have been on point.

Throughout the fellowship, Jeanette has been part of the NIPH outbreak response team and has had the opportunity to take part in different types of outbreak investigations. She has been involved in the routine epidemic intelligence work at NIPH and has taken part in all the 10 steps of outbreak investigation. She has been responsible for the collection of data, data handling, analyses, and writing of reports.

Jeanette is not afraid of taking on new tasks and responsibilities. She has strong communication skills, and the interpretation and communication of results is her forte. Always focused on impact on public health and lessons learnt, Jeanette has had remarkable development through her fellowship. She gradually took on more responsibilities as her epidemiological competence level increased. She has definitely met the different learning objectives set by the programme and significantly increased her competency level. It has been a pleasure being Jeanette's training site supervisor, watching her steadily grow as an epidemiologist in our department. I wish Jeanette all the best in her future epidemiological career!

Personal conclusions of fellow

Joining the EPIET programme has been a great opportunity and experience for me, both in terms of expanding my knowledge in field epidemiology, and also by getting to know my co-fellows of cohort 2020 as well as various colleagues and experts in the professional networks through the projects I have been involved in during my fellowship. Through my daily work, I navigated events that required extensive knowledge in the field of public health, data analysis and surveillance of infectious diseases and vaccine coverage. For this reason, it has been important and motivating for me to improve my knowledge in field epidemiology and infectious disease control. The EPIET training has given me the opportunity to strengthen my epidemiological skills, gain experience with data analysis and different epidemiological tools that will enable me to take on new and more complex tasks in the future. I particularly appreciated having an opportunity to learn and practise surveillance in different kinds of surveillance projects, and be involved in all the steps of an outbreak investigation.

Also, doing this training during the COVID-19 pandemic gave me the opportunity to closely follow and contribute to the pandemic response effort at the NIPH. This gave me insights on surveillance, management and communication during a public health crisis. It also provided many opportunities of getting involved in data management through both surveillance and research projects. However, it was challenging to have most of the modules online and it felt sad not to be able to spend more time with my co-fellows. However, in general, I think the modules and the projects I was involved in have provided me with new competencies, and a professional skillset that will be valuable for my work in the future.

Acknowledgements of fellow

I would like to thank my training site supervisor, Hilde Kløvstad, for her insight, support and guidance during my fellowship, and for being very proactive in involving me with a range of different projects and tasks, and providing me with many learning opportunities. Further, I would like to thank my workplace, NIPH, for giving me the opportunity to join the EPIET fellowship, and my colleagues at NIPH who have acted as supervisors and/or have served as supportive colleagues and mentors in different projects and new tasks which I had taken on during my fellowship. I am grateful to all the internal and external collaborators who have shared their knowledge and experience with me during the fellowship. I wish to thank my frontline coordinators, Zaida Herrador and Katie Palmer, for their support and guidance during my fellowship. I also wish to thank the whole EPIET/EUPHEM fellowship team at ECDC and for all the coordinators and supervisors and others involved in the modules.

I thank Ettore Amato and Pawel Stefanoff for coordinating the EPIET/EUPHEM activities and meetings at NIPH during this period. I would like to thank my co-fellows in cohort 2020 for their collaboration, friendship and support, especially my co-fellows at NIPH – Ragnhild Tønnessen, Andreas Rohringer and Lèa Franconeri. It has been great to get to know you and to work with all of you. Finally, thank you to my family for your support, love and patience.