Johanna Young

The European Programme for Intervention Epidemiology Training (EPIET), Cohort 2022

STATENS SERUM INSTITUT (SSI), Denmark

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. The Administrative Decisions ECDC/AD/2023/23 and ECDC/AD/2023/06 govern the EU-track and MS-track, respectively, of the ECDC Fellowship Programme, field epidemiology path (EPIET) and public health microbiology path (EUPHEM).

Both curriculum paths provide training and practical experience using the 'learning by doing' approach at acknowledged training sites across the European Union/European Economic Area (EU/EEA). This final report describes the experiences and competencies the fellow acquired by working on various projects, activities, theoretical fellowship training modules, other modules or trainings, and international assignments or exchanges during the fellowship.

Pre-fellowship short biography

With a background in biomedical sciences and a research master's degree in Global Health, Johanna Young has worked in national and international public health institutes in several European countries and has had brief international assignments in several countries in Africa. Prior to starting the EPIET fellowship, Johanna gained experience in surveillance and outbreak response for several infectious diseases.

Results

The objectives of these core competency domains were achieved partly through project and activity work and partly by participating in the training modules. Results are presented in accordance with the EPIET core competencies, as set out in the ECDC Fellowship Manual[1].

[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

Stockholm, November 2024

1. Epidemiological investigations

1.1. Outbreak investigations

Investigations of Campylobacter *outbreaks in Denmark, September 2022–August 2023*

Supervisors: Luise Müller, Guido Benedetti and Katrine Grimstrup Joensen, Steen Ethelberg and Stine Nielsen

Category: Food- and waterborne diseases

Aim: The aim of this outbreak investigation was to identify and trace sources of *Campylobacter jejuni* and *C. coli* infections in Denmark using whole genome sequencing (WGS).

Method: In Denmark, WGS is used to detect and trace *Campylobacter jejuni* and *C. coli* outbreaks linked to food sources. Outbreaks are defined by five or more genetically-related clinical isolates within three months, using a threshold of four allelic differences, with or without a linked food isolate.

Results: From September 2022 to August 2023, 16 genetic *Campylobacter* clusters met the outbreak criteria, involving 294 cases, averaging 25 cases per outbreak. Cases were dispersed across Denmark with no consistent epidemiological pattern. The average age of cases was 44 years, with 39.7% being women. Among the outbreaks, 11 out of 17 clinical isolates matched food/animal origins: 47 from chicken, two from poultry, and one from cattle. Interviews were conducted in 15 out of 16 outbreaks, with an average of three cases per outbreak, consistently reporting chicken consumption.

Public health implications: WGS has proven effective in detecting *Campylobacter* outbreaks, with chicken identified as the primary source for most outbreaks during this period.

Role: Johanna was the lead investigator in these *Campylobacter* outbreak investigations from the epidemiology side. Her responsilbilities involved creating and updating the linelists and performing descriptive analysis for all outbreaks. She collaborated with colleagues from the microbiological department to consolidate genomic findings from the animal and food side and communicated these in outbreak meetings. Johanna took the initiative to critically review the outbreak management procedures of *Campylobacter* outbreaks and presented these results in a 12-minute oral presentation during the Congress of the European Society of Clinical Microbiology and Infectious Diseases (ESCMID Global 2024) in Barcelona (see 4.2).

Outbreak of Enteroinvasive Escherichia coli *(EIEC) O124 in Denmark, July 2023*

Supervisor: Luise Müller

Category: Food- and waterborne diseases

Aim: to identify the source of an Enteroinvasive *Escherichia coli* (EIEC) O124 outbreak in Denmark.

Method: In June 2023, the Statens Serum Insititut was informed about a localised EIEC O124 outbreak initially involving around 20 cases. Interviews were conducted by the Food and Drug Administation.

Results: Results of the interviews showed that most affected individuals had eaten lunch in their workplace canteen. Additionaly, six seperate cases of EIEC O124 were reported; further investigation linked five of those to the original outbreak, while the remaining case had travelled abroad and was likely affected overseas. Unfortunately, epidemiological and microbiological investigations did not identify a specific contaminated food item, leaving the source unresolved.

Public health implication: the investigation highlighted the difficulties in identifying sources in EIEC outbreaks and underscored the need for prompt response and robust food safety practices.

Role: Johanna participated in the investigation of this outbreak, analysing interview data to identify patterns and contributing to updated discussions at outbreak meetings. She also played a role in creating a case definition for the outbreak to ensure consistency and accuracy in case identification, and supported the maintainenance of the linelist. Johanna also prepared a descriptive outbreak report.

Investigation of an increase in cases of Salmonella *Enteritidis in Denmark, July 2023*

Supervisor: Luise Müller

Category: Food- and waterborne diseases

Aim: To identify the cause of the increase in cases of Salmonella *Enteritidis* in Denmark.

Method: From April to June 2023, an increase in cases of *Salmonella* Enteritidis was observed compared to 2016–2019 and 2022. This increase triggered early outbreak investigations and patients were interviewed to identify common food sources.

Results: The cases were geographically spread across Denmark and were not travel-related. WGS of the samples showed that the cases were part of different outbreaks. Overall, the number of cases of *Salmonella* Enteritidis increased dramatically in 2023, with 384 cases reported compared to 251 in 2022. Additionally, the number of distinct outbreaks rose significantly, from 1–3 per year between 2017 and 2022 to 10 outbreaks in 2023.

Public health implications: This increase highlights the need to communicate general hygiene advice, including washing hands, separating raw meat from other foods, avoiding tasting raw meat, and thoroughly cooking food.

Role: Johanna supported the analysis of patient interview data and produced graphs of potential cases of *Salmonella* Enteritidis when an increase in cases was observed. She supported the analysis of patient interviews and produced epidemiological outputs to help interpret the dynamics of the increase.

Investigation of an outbreak of Salmonella *Enteritidis (ST11) in Denmark, May and June 2023*

Supervisor: Luise Müller

Category: Food- and waterborne diseases

Aim: To identify the source of a *Salmonella* Enteritidis (ST11) outbreak in Denmark.

Method: In May 2023, a signal of nine cases of *Salmonella* Enteritidis was reported by the laboratory to the epidemiology department at the Statens Serum Institut (SSI). Patients interviews were conducted to investigate the source of the outbreak.

Results: The cases were reported between 12 May and 14 June 2023. Six of the cases were female and the median age was 38 years. Although all cases were interviewed, no specific common food source was identified.

Public health implication: The absence of a common food source highlights the challenges of identifying the source of *Salmonella* Enteritidis outbreaks. Educational efforts should focus on food safety practices to raise awareness and prevent future infections.

Role: Johanna prepared a linelist detailing the cases associated with the outbreak, compiling essential information for further analysis and outbreak investigation. She also supported the production of a descriptive epidemiological report, which provided insights into the characteristics and patterns of the outbreak. She helped in recoding the interview data to identify potential sources of infection.

Investigation of a localised Norovirus outbreak in Copenhagen, Denmark, February 2023

Supervisor: Luise Müller

Category: Food- and waterborne diseases

Aim: To investigate an outbreak of illness suspected to be linked to oysters consumed in a restaurant in Copenhagen.

Method: In early February 2023, Statens Serum Institut (SSI) was contacted by the local Food Inspection Unit in Copenhagen about an outbreak of sick people who had eaten at a specific restaurant in Copenhagen. A field visit to the restaurant was conducted and the kitchen and restaurant managers were interviewed and cleaning practices were observed.

Results: Approximately 25 people were affected by the outbreak. Initial reports from the local Food Inspection Unit linked the outbreak to oysters served around the time the cases reported to be ill. Subsequent investigation revealed additional cases across the country linked to oysters from the same distributor. Cases developed symptoms within 24–48 hours of consumption, with most individuals having consumed a specific menu at the restaurant. Several hypotheses were formulated, but laboratory testing confirmed norovirus contamination in oysters sourced from the distributor, identifying them as the likely origin of the outbreak, despite initial suspicions surrounding a staff member working at the restaurant.

Public health implications: This outbreak underscores the importance of stringent food safety practices in handling and serving shellfish. Public health authorities should enhance monitoring of food sources and educate consumers about the risks associated with consuming raw or undercooked oysters.

Role: Together with an MS-track EPIET fellow, Johanna joined the local Food Inspection Unit in Copenhagen for a site visit to the restaurant. They observed and followed the processes of the local Food Inspection Unit in handling outbreaks. Johanna wrote an internal report on the field visit and the outbreak, together with her EPIET colleague.

Educational outcome

Through her involvement in various outbreak investigations, Johanna gained comprehensive experience in all steps of the outbreak investigation process. She developed a thorough understanding of the importance of collaborating with different stakeholders and sectors, including the department of Microbiology as well as the Danish Veterinary and Food Administration. She also learnt about the challenges of investigating national-level food- and waterborne

disease outbreaks and the fact that even after substantial investigation efforts, the outbreak source may not be found. Through her involvement in the outbreak team, she learnt to interpret microbiological data in the context of food- and waterborne disease outbreaks and obtained a detailed overview of the routines around signals and outbreaks.

1.2. Surveillance

An evaluation of the risk assessments methodology at Statens Serum Institut, Denmark, 2022–2023

Supervisors: Maarten Nauta and Hanne Rosenquist

Category: Evaluating a surveillance system

Aim: To identify the needs and further develop the risk assessments methodology at SSI based on existing methodologies.

Methods: Risk assessments are important in the early stages of events with potential public health impact, which often require rapid initial assessments with limited information. More comprehensive risk assessments, including systematic reviews, are often carried out at a later stage when more information is available. It is important that all risk assessments are based on the best scientific evidence available at the time and should be reviewed regularly [2]. Several European Union (EU) agencies have developed tools on risk assessments methodology. The ECDC rapid risk assessment operational tool facilitates the conduct of harmonised and well-structured risk assessments of communicable disease threats in Europe. However, in some national case studies we found that modifications to the ECDC guidance can increase the transparency of the risk assessment and strengthen the risk analysis process.

Results: The developed alternative approach emphasises defining clear risk questions and quantitatively assessing both the probability of disease introduction and its impact on population health. This alternative approach uses numerical intervals to express uncertainty, thereby increasing the clarity and effectiveness of risk assessment, and has been successfully implemented at SSI.

Public health implications: This approach is particularly benificial for addressing populations within specific geographical region and provides an evidence-based foundation for public health measures. Our revised methodology could facilitate other national public health institutes in their risk assessment development and support preparedness activities across Europe.

Role: Johanna organised meetings with internal SSI stakeholders and set up an internal working group. She also coordinated meetings with experts from ECDC and the European Food Safety Authority (EFSA) to review risk assessment methodologies, prepared an abstract for the European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2023, and co-authored a scientific paper submitted to a peer-reviewed journal.

Surveillance of human salmonellosis in Denmark: setting up an operational reporting system of epidemiological information, 2023–2024

Supervisors: Steen Ethelberg and Guido Benedetti

Category: Setting up a surveillance system

Aim: To introduce a tool to facilitate routine epidemiological analysis for human salmonellosis in Denmark and develop a sustainable surveillance system that provides timely, accessible data for public health decision-making.

Methods: In Denmark, *Salmonella* infections are recorded through indicator-based surveillance. Such systems play an important role in monitoring disease, identifying outbreaks, and providing insights into the epidemiological trends. To effectively realise this role, continuous analysis of the data is essential. Regular analysis does not only support the monitoring of trends but also facilitates the early detection of clusters. While cases which are part of outbreak investigations (based on genetic links) are routinely assessed and aggregated data are available on SSI's homepage, there are no regular interpretations of the epidemiological situation of *Salmonella* i.e. production of regular epidemiological surveillance outputs.

Results: An R Shiny application was developed to structure and automate epidemiological reporting outputs in an interactive format for *Salmonella* surveillance. It summarises the burden, trends and exceedances of *Salmonella* infections in Denmark. Users can select and visually inspect various parameters, including descriptive epidemiological indicators, travel, regions, laboratories, and serotypes.

Public health implications: This tool enhances the capacity for timely epidemiological analysis, facilitating improved monitoring and response to *Salmonella* infections. By providing accessible and interpretable data, it supports public health decision-making and resource allocation, ultimately contributing to more effective disease control strategies.

Role: Johanna developed a surveillance protocol and analysed the *Salmonella* data. She maintained a data log, prepared R scripts and prepared standard operating procedures. She collaborated with the Department of Microbiology at SSI to enhance the routine surveillance and actively participated in bi-weekly surveillance meetings.

Educational outcome

Involvement in these surveillance projects significantly enhanced Johanna's skills in writing surveillance protocols and reports, as well as managing and coordinating high-level project activities. She advanced her data analysis capabilities and gained valuable experience collaborating with a wide range of national and international stakeholders. These activities emphasised the importance of multidisciplinary collaboration and provided her with experience in presenting research findings and contributing to scientific publications.

Improving the automated data analysis and reporting systems for the routine surveillance of national food- and waterborne disease outbreaks in Denmark, 2022–2024

Supervisors: Stine Nielsen and Luise Müller

Category: Analysing data from a surveillance system

Aim: To improve the processes for investigating food- and waterborne outbreaks for the Outbreak Investigation Unit at SSI, in collaboration with the Danish Veterinary and Food Administration and the National Food Institute.

Methods: The unit investigates the epidemiology of outbreaks, conducts hypothesis-generating interviews, identifies patterns and coordinates with laboratories and authorities to identify outbreak sources. This work was previously done manually, but upgradations have been initiated recently. Johanna's work has continued these efforts and further contributed to the improvement of the efficiency and effectiveness of national outbreak surveillance and management in Denmark.

Results: R scripts were further developed to automate various processes, allowing for direct data extraction and minimising the need for manual interventions. This automation streamlines the outbreak investigation workflow and enhances data accuracy and efficiency.

Public health implication: Enhancing automation in outbreak investigations will lead to quicker responses and more effective management of food- and waterborne outbreaks.

Role: Johanna continued the evaluation of outbreak investigation processes, working on the further development of R scripts, creating automated procedures and working with colleagues within the unit to identify best practices.

Educational outcome

Involvement in these surveillance projects significantly enhanced Johanna's skills in writing surveillance protocols and reports, as well as managing and coordinating high-level project activities. She advanced her data analysis capabilities and gained valuable experience collaborating with a wide range of national and international stakeholders. These activities emphasised the importance of multidisciplinary collaborations and provided her with experience in presenting research findings and contributing to scientific publications.

2. Applied public health research

Impact of the COVID-19 pandemic on five food- and waterborne diseases in six European countries, 2016–2021

Supervisor: Steen Ethelberg

The COVID-19 pandemic required a shift in healthcare and public health focus and led to numerous public health measures also affecting food- and waterborne diseases (FWD). This study aimed to describe the impact of the pandemic using the number of confirmed domestically acquired and travel-related cases of campylobacteriosis, salmonellosis, hepatitis A, shigellosis and listeriosis notified to ECDC between 2016 and 2021 by Czechia, Denmark, Greece, the Netherlands, Norway and Sweden. This study emphasises the substantial differences in transmission routes, surveillance, notification and detection methodologies, as well as testing and sampling practices of these diseases across different countries. Despite these variations, the overall recorded case numbers for most of the five FWDs decreased during the pandemic (March 2020 to December 2021), except for the more severe disease – listeriosis – suggesting that healthcare-seeking behaviour and healthcare access played a role in the decline of FWDs with milder symptoms. The proportion of travel-associated cases decreased for most diseases in all countries, particularly for campylobacteriosis and salmonellosis, likely due to the travel-restrictions. Declines were also observed in the number of domestically acquired cases. An improved understanding of healthcare-seeking behaviour and testing rates during the pandemic can provide insights into the extent of under-diagnosis in the reduction of cases.

Role: Johanna, as the lead investigator in this study, managed and analysed data for the study, collaborating with European FWD experts. She wrote an abstract for submission to ESCAIDE 2023, presented findings at the European Food-and Waterborne Diseases and Zoonoses Network meeting in Helsinki (see 4.3), and authored a scientific article submitted to a peer-reviewed journal (see 4.1.1).

An exploratory retrospective case–control study to identify potential risk factors associated with the emerging methicillin-resistant Staphylococcus aureus *t4549 lineage in Denmark, 2022–2023*

Supervisors: Andreas Petersen and Jesper Larsen

Methicillin-resistant *Staphylococcus aureus* (MRSA) spa type t4549 first appeared in Denmark in 2012 and has become one of the most prevalent lineages, with its source still unknown and infections rising. A nationwide case–case study in 2024 aimed to identify predictors of this infection, comparing cases of MRSA t4549 to cases of MRSA with other spa types (t002, t008, t127, t223) from January 2022 to November 2023. An online questionnaire was distributed, receiving responses from 64 cases (52.9%) and 103 controls (42.6%). Foot and toe infections were significantly more common in cases ($p<0.001$). Animal contact with dogs, cats, and pheasants was noted, with dogs being most common among cases (60.2% vs. 42.7%). Cases reported more involvement in team sports, especially indoor (10.9% vs. 1.9%, $p=0.02$) and outdoor (18.8% vs. 7.8%, $p=0.06$), and particularly football (15.6% vs. 6.8%). Water sports (48.4% vs. 19.4%, $p<0.001$) and swimming (42.2% vs. 17.5%, $p<0.001$) were significantly more common in cases, with cases having four times higher odds of swimming (OR 4.18). Most swimming occurred in pools (92.6%) and the sea (44.4%). Cases also had higher odds of reporting indoor team sports (OR 7.99). Although the small number of cases must be interpreted with caution, these findings highlight the need to emphasise the potential implementation of preventive measures at both individual and sport facility level.

Role: Johanna co-led a case–control study, wrote the research protocol and designed the study with her fellow EPIET colleague (C21). She developed the questionnaire, conducted a pilot study, organised data collection and analysed the data. She submitted an abstract to and presented a poster at ESCMID Global 2024 in Barcelona, Spain. Johanna collaborated closely with colleagues in the Department of Microbiology and was involved in the ethical application for the study. She is currently finalising a scientific manuscript to be co-authored with her colleague.

Campylobacter*-associated hospitalisations in Denmark, 2019–2024*

Supervisors: Steen Ethelberg, Guido Benedetti and Katrine Grimstrup Joensen

Campylobacteriosis is the most frequently reported gastrointestinal illness in the EU/EEA, with 129,960 confirmed cases in 2021. It primarily results from consuming contaminated poultry products. Symptoms typically include diarrhoea, abdominal pain, fever, headache, nausea, and vomiting, though severe cases can lead to conditions like Guillain–Barré syndrome. Most cases are sporadic rather than part of outbreaks, and in Denmark, genetic analysis reveals *C. jejuni*'s diversity, with strains like ST-22 and ST-677 linked to more severe infections. The study aimed to investigate the severity of these infections in Denmark by examining hospitalisation data from 2019 to 2023. By linking severity to genetically identified clusters, the aim was to shed light on high-risk strains and facilitate the development of more effective intervention strategies.

Role: Johanna worked with colleagues to formulate the research question and design the study, including case definitions. She is currently carrying out the data analysis for this project.

Educational outcome

Through the above projects, Johanna significantly improved her skills in data management and data analysis using R. She developed her analytical skills through multivariable regression analysis and non-parametric rank tests. In addition, Johanna gained valuable experience in building positive working relationships with European experts and collaborating outside of Denmark. Her work also deepened her understanding of data protection and compliance requirements. Presenting research findings at external conferences further enhanced her ability to communicate complex data to diverse audiences.

3. Teaching and pedagogy

Teaching GenEpi-BioTrain, Copenhagen, 27 September 2023

This teaching assignment was on epidemic curves as part of the 'Fundamentals of MRSA, CRE, and C. difficile genomic epidemiology' course for skilled bioinformaticians and molecular biologists from eastern and southern Europe. The course, held at SSI on 27 September 2023, aimed to build capacity in using whole genome sequencing for outbreak investigations under the GenEpi-BioTrain project. Johanna's session included a lecture, exercises, and discussions to ensure understanding of epidemic curves and outbreak spread analysis.

Teaching Infectious Disease Epidemiology, University of Gothenburg, Sweden, 28 February–3 March 2023

This week-long teaching assignment was part of the Infectious Disease Epidemiology course at the University of Gothenburg for nurses from Sweden, Norway, and Denmark, as part of a Nordic Master's programme. Johanna gave lectures on chance, bias, confounding, and effect modification, and assisted with lecture preparation on interpreting epidemiological findings. Johanna also updated practical exercises on disease transmission, descriptive epidemiology, case–control and cohort studies, and facilitated these exercises in plenary sessions, ensuring participant support and engagement throughout the course.

Organisation of the Nordic Mini Project Review Module 13–14 March 2023, Copenhagen, Denmark

Together with two SSI EPIET Fellows, Johanna organised the annual Nordic Mini Project Review Module at SSI in Copenhagen on 13–14 March 2023, attended by 13 Fellows and 16 facilitators from the Nordic countries. The aim of the module was to guide and facilitate discussions on the Fellows' projects and to promote inter-institutional learning. Over two days, they facilitated 13 sessions, planning, organising and evaluating the event and producing an evaluation report. They also promoted the event online and prepared a detailed handover for 2024.

Educational outcome

Johanna's involvement in various educational activities throughout the fellowship contributed significantly to her development towards the training and teaching of public health professionals. The various experiences honed her ability to effectively communicate complex epidemiological concepts, as well as deepened her understanding and adaptability in teaching diverse, complex epidemiological topics to an international audience. Organising the Nordic Mini Project Review Module further developed her organisational and administrative skills. These activities collectively enhanced Johanna's competencies in teaching, curriculum development, event organisation and evaluation, and strengthened her role as an educator and facilitator in the field of epidemiology.

4. Communication

4.1 Publications related to the EPIET fellowship

4.1.1 Manuscripts published in peer-reviewed journals

Young JJ, Grosos Aabye M, Daniel O, Špačková M, Sideroglou T, Mellou K, Chrysostomou A, Friesema IHM, Franz E, Lange H, Lyngstad TM, Brandal LT, Karamehmedovic N, Dryselius R, Ethelberg S, Westrell T. Impact of the COVID-19 pandemic on five food- and waterborne diseases in six European countries, 2016-2021. European Journal for Public Health. [Manuscript submitted for publication].

Maarten Nauta, Lasse Engbo Christiansen, Stine Kjær Lefèvre, Charlotte Louise Munkstrup, **Johanna J. Young**, Hanne Rosenquist. An alternative approach to ECDC's rapid risk assessment of communicable diseases - redefining probability and impact. Epidemiology and Infection. [Manuscript submitted for publication].

Young JJ, Funk T, Ravnholt Urth T, Larsen J, Petersen A. First indications that swimming may be linked to the emerging methicillin-resistant Staphylococcus aureus t4549 lineage in Denmark. [Manuscript in production].

Young, JJ, et al. In the One Health and whole genome sequencing era: what is the role of epidemiological investigations in human Campylobacter outbreaks in Denmark? [Manuscript submitted for publication].

4.1.2 Other reports

Investigation of a localised Norovirus outbreak in Copenhagen, Denmark, February 2023. [Internal report]

An evaluation of the risk assessments methodology at Statens Serum Institut, Denmark. [Internal report]

Outbreak investigation report: outbreaks of food-and waterborne diseases in Denmark, September 2022 to August 2023. [Internal report]

Surveillance of human salmonellosis in Denmark: setting up an operational reporting system of epidemiological information. [Internal report]

End of Mission Report. International Assignment supporting the Greater Horn of Africa Drought, Food Insecurity, and Health Response, WHO Emergency Hub, Kenya, Nairobi 2024. [Internal report]

4.2 Conference presentations

Young, JJ, et al. ESCMID Global 2024, 28 April 2024, Barcelona, Spain. In the One Health and whole genome sequencing era: what is the role of epidemiological investigations in human *Campylobacter* outbreaks in Denmark? Oral presentation.

Young, JJ, et al. ESCMID Global 2024, 29 April 2024, Barcelona, Spain. First indications that swimming may be linked to the emerging methicillin-resistant *Staphylococcus aureus* t4549 lineage in Denmark. Poster presentation

4.3 Other presentations

Tirsdagsmøde: EPIET and EUPHEM – Learn about the European training programs in field epidemiology and public health microbiology including a WHO mission to Kenya with SSI's EPIET/EUPHEM fellows, 18 June 2024, Statens Serum Institut, Copenhagen, Denmark.

Seasonal influenza as an example to apply the newly developed risk assessments methodology in Denmark, Statens Serum Institut Seminar on Risk Assessments, 4 October 2023, Statens Serum Institut, Denmark, Copenhagen.

The effect of the COVID-19 pandemic on food- and waterborne diseases in six European countries, 12th European Food-and Waterborne Diseases and Zoonoses Network (FWD-Net) meeting, 18 September 2023, Helsinki, Finland.

An exploratory retrospective case-control study to identify potential risk factors associated with the emerging methicillin-resistant Staphylococcus aureus t4549 lineage in Denmark, Nordic Mini Project Review Module 2023, 13 March 2023, Copenhagen, Denmark.

Chance, bias, and confounding, Prevention and Control of Communicable Diseases and Health Care-Associated Infections Master's Programme, 2 March 2023, Gothenburg, Sweden.

5. EPIET/EUPHEM modules attended

- Introductory Course, 26 September–14 October 2022, Spetses, Greece
- Outbreak Investigation, 5–9 December 2022, Berlin, Germany
- European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2022, 23–25 November 2022, Stockholm, Sweden
- Multivariable Analysis, 22–26 May 2023, Frankfurt, Germany
- Rapid Assessment and Survey Methods, 19–23 June 2023, Stockholm, Sweden
- Project Review Module 2023, 28 August–1 September 2023, Lisbon, Portugal
- European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2023, 22–24 November 2023, Barcelona, Spain
- Time Series Analysis, 11–15 December 2023, Rome, Italy
- European Congress of Clinical Microbiology and Infectious Diseases (ECCMID) 2024, 27–30 April 2024, Barcelona, Spain
- Management, Leadership and Communication in Public Health, 24–28 June 2024, Stockholm, Sweden
- Project Review Module 2024, 26–30 August 2024, Lisbon, Portugal

6. Other training

- One Health EJP Continuing Professional Development Module Rapid diagnostics and harmonisation of diagnostic tests, 2–4 November 2022, Copenhagen, Denmark
- ESCAIDE Conference, dates, 23–25 November 2022, Stockholm, Sweden
- Fundamentals of R for public health by Applied Epi, 1 December 2022, online
- ECDC Rapid Risk Assessment e-Learning course, 31 March 2023, online

- BSAFE - security awareness training by UNDSS, 16 June 2023, online
- ESCAIDE Conference, 22–24 November 2023, Barcelona, Spain
- Is it the same strain? Defining genomic epidemiology thresholds tailored to individual outbreaks, ESCMID webinar, 30 November 2023, online
- United to Respect: Preventing Sexual Harassment and Other Prohibited Conduct, 8 January 2024, WHO, Geneva, Switzerland (e-learning)
- WHO's New Policy and Strategy on Preventing and Addressing Sexual Misconduct, 9 January 2024, WHO, Geneva, Switzerland (e-learning)
- Prevention and Sexual Exploitation and Abuse (PSEA), 9 January 2024, WHO, Geneva, Switzerland (e-learning)
- WHO Ethics Empowerment, 10 January 2024, WHO, Geneva, Switzerland (e-learning)
- ESCMID Global, 26–30 April 2024, Barcelona, Spain
- Danish language courses and lessons (acquired level: A2)

7. International assignments

GOARN (Global Outbreak Alert and Response Network) deployment (epidemiologist), WHO Regional Emergency Hub, Nairobi, Kenya, 16 January 2024–14 March 2024

As an epidemiologist based in the WHO Regional Emergency Hub, Nairobi, Kenya, Johanna supported the Greater Horn of Africa Drought, Food Insecurity, and Health Grade 3 Emergency Response. In collaboration with partners, she focused on countering malnutrition, monitoring disease outbreaks, and supporting access to essential health services across Djibouti, South Sudan, Sudan, Ethiopia, Somalia, Kenya, and Uganda. Key responsibilities included monitoring health and nutrition, providing technical and epidemiological support, and contributing to information product development for the ongoing response efforts.

Johanna prepared an End of Mission Report summarising the response activities and made short-, medium- and long-term recommendations (see 4.1.2). She also prepared comprehensive handover notes to her successor to ensure maintenance of ongoing reporting activities.

8. Other activities

- Organisation of the weekly SSI EPIET and EUPHEM Forum meetings
- Active participation in bi-monthly section surveillance meetings

Acknowledgements

During my fellowship at SSI, I have had the pleasure of working with many knowledgeable supervisors and colleagues. I would like to thank them all for sharing their expertise, advice and support over the past two years. It has been a pleasure to work on such a wide range of topics and I have learnt so much from all of you.

I would especially like to thank Steen Ethelberg and Guido Benedetti for their constant support and valuable input, and Tjede Funk for our great discussions during our fellowship and beyond.

Special thanks to the outbreak team. It was great to learn about outbreak investigations and enjoy your friendly working atmosphere.

Thank you to my frontline coordinators, Lynn Meurs and Andreea Badache, for supporting me throughout the fellowship.

Finally, a big thank you to my kind office colleagues; it wouldn't have been the same without you.