Ana Cristina González Pérez

The European Public Health Microbiology Training Programme (EUPHEM), Cohort 2022
Finnish Institute for Health and Welfare (THL), Finland

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

Ana Cristina González Pérez holds a bachelor's degree in biomedicine from the University of Alcalá de Henares, Madrid, Spain. She wrote her bachelor's thesis on cancer research at the De Duve Institute in Brussels, Belgium. Following that, she completed a master's degree in Public Health Microbiology and Infectious Disease Research at the Spanish National Institute of Health (Instituto de Salud Carlos III, Madrid).

In 2022, Cristina earned her PhD in Natural Science from the Helmholtz Centre for Infection Research in Germany, focusing on host-pathogen interactions and human herpesviruses. Motivated to broaden her expertise in public health microbiology and intervention epidemiology, Cristina joined the EUPHEM programme. Her ultimate goal was to expand and integrate her previous knowledge and virology competences, gain confidence in a broader spectrum of infectious diseases, and acquire the tools needed to address public health challenges.

Results

The objectives of the 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/EUPHEM core competencies, as set out in the ECDC Fellowship Manual[1].

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

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1. Epidemiological investigations

1.1. Outbreak investigations

1.1.1. Outbreak of Cryptosporidium parvum *in Helsinki, Finland, 2022*

Supervisors: Ruska Rimhanen-Finne (THL) and Anni Vainio (THL)

Category: Food- and waterborne diseases

Aim: To characterise the pathogen, identify the source and extent of the outbreak, and enhance control measures.

Methods: A retrospective cohort study was conducted using an online questionnaire. A case was defined as any person who attended meals served during the event and developed at least one of the following symptoms from 28 September to 18 October 2022: diarrhoea, stomach pain, or nausea. Food-specific relative risks (RR) and 95% confidence intervals (95% CI) were calculated.

Faecal specimens were collected for PCR and culture. *Cryptosporidium*-positive samples were characterised by species (RT-PCR) and *gp60* type (nested-PCR and Sanger Sequencing). No food or environmental samples were available for testing.

Results: Out of 85 participants, 66 (response rate 78%) completed the questionnaire, of whom 35 (53%) met the case definition. Among the cases, 97% (34/35) ate a ready-to-eat salad-mix during dinner on 26 September 2022, while among non-cases the proportion was 71% (22/31). A positive significant association was found between the consumption of this salad-mix and illness (RR: 6.0, 95% CI: 0.9–39.2, *p*-value: 0.005).

Out of 13 collected faecal samples, seven were tested for *Cryptosporidium* and four were positive. Two were identified as subtype *C. parvum* IIdA21G1, one as IIaA15G2R1, and one was not characterised further.

Public health implications: Green salad-mix was the suspected source of this *C. parvum* outbreak. It was recommended that testing for *Cryptosporidium* be emphasised in clinical settings and routine species determination and subtyping for outbreak detection be considered. Additionally, the existing recommendation of storing frozen food samples at restaurants for later testing should be strengthened. Risk management measures should be developed for producing ready-to-eat salads.

Role: Cristina was a co-investigator along with the EPIET fellow Wioleta Kitowska (cohort 2022); developed the analysis plan and supported the data analysis using RStudio; planned and led meetings with different members of the team; wrote the outbreak report together with Wioleta Kitowska (see 1, section 7.2), which was shared with stakeholders; submitted an abstract for an international conference as co-author (European Scientific Conference on Applied Infectious Disease Epidemiology – ESCAIDE 2023); and reviewed an e-poster for ESCAIDE 2023.

1.1.2. Outbreak of Salmonella enterica *serotype Mbandaka, multi-country, 2022–2023*

Supervisors: Ruska Rimhanen-Finne (THL) and Anni Vainio (THL)

Category: Food- and waterborne diseases

Aim: To investigate a widespread outbreak of *Salmonella* Mbandaka in the European Union and European Economic Area, Israel, and the United Kingdom; to identify the source, assess the extent of the outbreak, and implement control measures.

Methods: Data from trawling interviews, purchase records, and national food consumption were integrated. Traceback investigations and a case–case study were conducted. Whole genome sequencing (WGS) was performed for *S.* Mbandaka isolated throughout the outbreak of human (n=48) and food (n=1) origin, as well as cluster analysis (Ridom SeqSphere+).

Results: Between April 2022 and January 2023, Finland identified 97 cases of *Salmonella* Mbandaka, linking the outbreak to ready-to-eat (RTE) products containing chicken. In December 2022, *S.* Mbandaka was isolated from a suspected product. A case–case study pinpointed RTE containing chicken from EU Company A as the outbreak vehicle. WGS confirmed the link, revealing that the *S.* Mbandaka isolate from the food product shared only one allelic difference with the main outbreak cluster, which included strains from both Estonian and Finnish cases. The contaminated chicken meat was traced to a non-EU country and used by Company A in further processing. Following the discontinuation of the affected product batch and a supplier change by Company A, no new cases were reported.

Public health implications: The findings underscore the need to strengthen surveillance systems for timely outbreak detection and enhance food safety regulations and inspections. Furthermore, the success of cross-border collaboration emphasises the critical role of international cooperation and information sharing to respond to cross-border threats and protect public health in Europe.

Role: Cristina was the lead investigator, conducted the case–case study together with the EPIET fellow, Wioleta Kitowska (cohort 2022); contributed to development of the questionnaire; developed the analysis plan, R script, and performed data analysis; planned and led meetings with different members of the team; submitted an abstract for the international conference, ESCAIDE 2023; prepared an e-poster for ESCAIDE 2023; and wrote and submitted a manuscript to a peer-reviewed journal (see 1, section 7.1).

1.1.3. Outbreak of pneumococcal pneumonia in Turku, Finland, 2023

Supervisors: Lotta Siira (THL) and Timothée Dub (THL)

Category: Vaccine-preventable diseases

Aim: To identify risk factors associated with the shipyard setting to inform targeted control measures and recommendations for prevention of future outbreaks.

Methods: On 29 August 2023, THL was notified by the wellbeing services county of Southwest Finland (Varha), of a potential cluster of pneumococcal pneumonia among the employees of a shipyard in Turku, western Finland. A case–control study was conducted. Shipyard workers employed at least since 1 August 2023 were included in the analysis. In-person controls were recruited using a convenience sampling strategy during a field visit to the shipyard on 16 November 2023. All identified cases were invited for an interview over telephone. For risk factors of interest, odds ratios (OR) and 95% confidence intervals (95% CI) were calculated. Blood culture isolates were serotyped and whole genome sequenced at THL. Cluster analysis was done using multilocus sequence typing (MLST) and core genome MLST (cgMLST).

Results: 14 cases were identified between 19 August and 15 October 2023. Eleven cases and 67 controls were included in the study. Compared to controls, cases were more likely to be living in an apartment/studio (OR: 10.3, 95% CI: 1.3–458.94) or in a hotel/hostel (OR: Inf, 95% CI: 1.2–Inf). Cases were less likely to be living in houses (OR: 0.00, 95% CI: 0.00–0.46), living with family (OR: 0.15, 95% CI: 0.02–0.82), or to be working longer than one year at the shipyard (OR: 0.1, 95% CI: 0.0–0.7).

Two serotypes (4, 9V) representing three sequence types were identified: ST801 (serotype 4, n=5), ST2025 (9V, n=1), ST239 (9V, n=1). cgMLST revealed three distinct clusters, differing by over 900 alleles.

Public health implications: This was the second reported pneumococcal outbreak occurring in this shipyard within five years (the last one was in 2019). Microbiological typing confirmed a multi-strain outbreak, suggesting that shipyard conditions could be facilitating transmission and progression from carriage to severe disease. Longer tenure at the shipyard may imply prior vaccination post-2019 outbreak or earlier colonisation, potentially resulting in higher protective immunity. All employees working on ship construction and exposed to fumes, dust, or smoke merit vaccination against pneumococcal disease.

Role: Cristina was the co-investigator; supported in the design of questionnaires, including translations of materials; conducted interviews with cases; participated in and contributed to meetings as part of the outbreak investigation team; submitted an abstract for ESCAIDE 2024as co-author; contributed and reviewed a manuscript submitted to a peer-reviewed journal (see 2, section 7.1).

1.2. Surveillance

1.2.1. Evaluation of the genomic surveillance system for SARS-CoV-2

Supervisors: Erika Lindh (THL), Niko Tervo (THL), and Outi Lyytikäinen (THL)

Type of project: Evaluating a surveillance system

Aim: To describe and evaluate the SARS-CoV-2 genomic surveillance system in Finland to provide recommendations based on identified opportunities for improvement.

Methods: Data were sourced from the laboratory surveillance system (Milla), the Global Initiative on Sharing All Influenza Data (GISAID), and the National Infectious Disease Registry databases. Evaluation criteria included representativeness, data completeness, and timeliness. The system was evaluated using data from 1 January to 31 December 2023.

Results: The system is representative of national reported data, particularly capturing trends among older age groups, which aligns with public health strategies. Data completeness was generally good. However, laboratory compliance varied significantly, with most participating laboratories failing to meet the requested submission guidelines. Lastly, the system demonstrated effective performance with a median turnaround time of 15 days from sample collection to WGS results, and timely reporting to GISAID with a four-day delay from when the WGS results are obtained. Overall, the Finnish genomic surveillance system for SARS-CoV-2 is effective but could be improved by addressing the identified weaknesses. Future efforts should focus on enhancing laboratory compliance with guidelines and exploring the possibility of expanding sampling to underrepresented groups to strengthen surveillance, when needed.

Public health implications: The continuous monitoring of SARS-CoV-2 through genomic surveillance helps in the early detection of new variants or mutations, offering insights into the prevalence and characteristics of circulating strains and assessing the effectiveness of existing vaccines. Evaluating and improving these systems is crucial for informed decision-making, adapting public health responses, as well as preparing for future threats.

Role: Cristina developed the analysis plan; performed data analysis; planned and led meetings; presented the proposal and findings to various audiences; incorporated feedback; wrote an evaluation report (see 6, section 7.2).

1.2.2. Addressing infectious diseases (HIV and hepatitis) within the Prison Population Study in Finland, 2023

Supervisors: Henrikki Brummer-Korvenkontio (THL), Kirsi Liitsola (THL), and Mika Rautanen (Health Care Services for Prisoners, THL)

Type of project: Analysing data from a surveillance system (see the following section, 'Applied public health microbiology research and laboratory investigations').

2. Applied public health microbiology research and laboratory investigations

2.1. Nosocomial bloodstream infections (BSIs) caused by Escherichia coli *and* Klebsiella pneumoniae *non-susceptible to third-generation cephalosporins in Finland, 2014–2022*

Supervisors: Outi Lyytikäinen (THL), Kati Räisänen (THL), and Lotta Siira (THL)

Aim: To get an updated view on the epidemiology and resistance patterns of nosocomial BSIs caused by *E. coli* and *K. pneumoniae* non-susceptible to third-generation cephalosporins from 2014 to 2022 in Finland.

Methods: The study will employ a descriptive approach, using retrospectively collected hospital-wide surveillance data from approximately 20 Finnish hospitals. Two key objectives will be pursued. Firstly, this study aims to describe the clinical and demographic characteristics associated with these infections, offering insights into patient profiles and infection trends during the specified period. Secondly, the study will investigate, at genetic level, the current resistance genes to third-generation cephalosporins of *E. coli* and *K. pneumoniae* circulating in hospital settings across the country. For this, molecular microbiological investigations will be conducted using whole-genome sequencing (WGS) on isolates from 2022, offering detailed molecular insights into the mechanisms driving antibiotic resistance.

Results: Not applicable – the outputs will be taken by the next EUPHEM fellow at the training site, who will develop the project further.

Public health implications: The findings of this study will be of significant value for evaluating public health strategies and policies. By understanding the latest situation of these infections at a country-specific level, policymakers and healthcare professionals can develop targeted prevention and control efforts. Furthermore, this knowledge will inform risk assessment, facilitate coordinated actions at the European level, and ultimately, contribute significantly to the global fight against nosocomial bloodstream infections and antibiotic resistance.

Role: Cristina worked on the study design; wrote the study protocol; planned and led meetings with different members of the team and possible collaborators; prepared and submitted an ethical approval application (approved).

2.2. Addressing infectious diseases (HIV and hepatitis) within the Prison Population Study in Finland, 2023

Supervisors: Henrikki Brummer-Korvenkontio (THL), Kirsi Liitsola (THL), and Mika Rautanen (Health Care Services for Prisoners, THL)

Aim: To assess the status of infectious diseases, particularly HIV and hepatitis, among prison inmates in Finland, and to inform policy-making through gap identification and recommendations for implementing effective preventive measures in prison settings.

Methods: This was a cross-sectional study involving interviews, anonymous questionnaires, laboratory tests, and clinical examinations. A randomised sample included 403 males and 126 females from seven prisons (the Finnish daily prison population being approximately 2,300 inmates). Data encompassed demographics, risk behaviours, testing, and preventive measure awareness. Laboratory diagnostics assessed the hepatitis and HIV status of the participants. Statistical analyses included cross-tabulation, Pearson's chi-squared test, and ANOVA.

Results: Hepatitis C antibodies were detected in 40% of male and 53% of female inmates, with 35% (48/139) of those who tested positive for HCV antibodies being actively infected. HIV prevalence was 1%. A significant part of the inmates reported previous use of injecting drugs (55%) or fitness doping substances (34%). While incarcerated, 34% engaged in injecting drug use, and notably, 66% shared needles, intensifying the risk of transmission. Only 9% of positive inmates serving sentences under two years had access to hepatitis C treatment. Regarding preventive measures awareness, 13% reported easy condom access. Conversely, 83% deemed vaccines safe, with 61% vaccinated for hepatitis B and 44% exhibiting hepatitis A antibodies, indicating improved vaccine coverage.

Public health implications: The study underscored the elevated prevalence of hepatitis C infections among Finnish inmates compared to the general population, emphasising the urgent need for targeted interventions to mitigate health risks and reduce transmission within prisons. Key challenges identified include insufficient awareness, limited access to prevention measures, and high-risk behaviours such as needle sharing. To address these issues effectively, prisons should prioritise raising awareness of transmission routes, enhancing access to preventive tools like disinfectants and condoms, implementing regular testing and needle exchange programmes, promoting vaccinations, and considering on-site treatment initiatives to minimise infection transmission among short-term inmates. Within the first year after the study, some of these recommendations were implemented, including expanded availability of treatment and preventive tools like disinfectants.

Role: Cristina developed the analysis plan and reviewed and summarised the results; planned and led meetings; wrote a national report, published in Finnish and English (see 3 and 4, section 7.2); submitted an abstract for an international conference (European Society of Clinical Microbiology and Infectious Diseases – ESCMID 2024); presented the study at ESCMID 2024; started drafting a manuscript to be submitted to a peer-reviewed journal (see 3, section 7.1).

2.3. Verification of an updated NGS-based serotyping tool for surveillance of invasive pneumococcal disease in Finland, 2022

Supervisor: Lotta Siira (THL)

Aim: To verify the updated version of the WGS-based tool PneumoCaT, v1.2, for serotyping pneumococcal invasive isolates in the Expert Microbiology Unit of THL.

Methods: Selected strains were invasive pneumococcal isolates with available Next Generation Sequencing (NGS)-based whole genome sequences and previously serotyped using PneumoCaT v1.0. These sequences were run using PneumoCaT v1.2 and results were compared to those obtained with v1.0. For validation, a reference strain with confirmed serotype 22F and a negative control (a closely related species) were included. In addition, results from PneumoCaT v1.0 and v1.2 were compared with those from the traditional *Quellung* reaction, when available. Discrepancies between versions were resolved using *Quellung*.

Results: The sensitivity and specificity of PneumoCaT (v1.2) were determined to be 79% (compared to 99% with v1.0) and 78%, respectively, based on a subset of Finnish invasive pneumococcal isolates collected in 2022. The relatively lower sensitivity and specificity observed in the updated version is attributed to outcomes classified by v1.2 as 'mixed' (i.e. 19A, 19AF), 'failed', and 15A+ serotypes. Therefore, v1.2 should only be considered for routine use if these issues are satisfactorily resolved.

Public health implications: *S. pneumoniae* significantly contributes to morbidity and mortality globally, particularly in young children and the elderly. Continued surveillance and accurate serotype identification are crucial for monitoring disease epidemiology, evaluating pneumococcal vaccine efficacy, and assessing the impact of non-vaccine serotypes. For pneumococcal reference laboratories, quality and accreditation are paramount, influencing the choice of bioinformatics tools. The routine use of automated WGS-based serotyping tools like PneumoCaT enhances efficiency by reducing the need for phenotypic testing and enabling batch serotyping.

Role: Cristina designed and wrote a verification plan; run and analysed the sequencing data; performed data analysis; wrote a verification report (see 5, section 7.2); communicated the results to the stakeholders.

2.4. Evaluation of the One Health European Joint Programme (OHEJP) simulation exercise (SimEx)

Supervisors: Lotta Siira (THL) and Karin Artursson (Swedish Veterinary Agency)

Aim: To conduct an external evaluation of the OHEJP simulation exercise (SimEx), focusing on strategies for capacity and capability development in diverse European public health systems.

Methods: This study employed a qualitative research approach. Background documentation on SimEx planning, development, and execution was revised. Semi-structured interviews were conducted with 12 exercise leaders from four countries, selected by convenient sample to ensure sectorial and geographical representation. Interviews explored sector perceptions, needs for coordinated action plans, implementation efforts, lessons learned, and future perspectives. Thematic analysis was applied to interview data.

Results: Participants expressed overall satisfaction with SimEx, highlighting its role in facilitating cross-sectoral collaboration and discussions. The animal health sector emphasised the importance of establishing a surveillance system for broader involvement. Recommendations included demonstrating the value of the One-Health approach to enhance political support, engaging stakeholders at all levels, and disseminating lessons learnt. Future exercises should tailor scenarios to national contexts and conduct national after-action reviews. Participants demonstrated readiness to adopt the One-Health approach more extensively, stressing the need for institutional support and training to sustain partnerships and reinforce preparedness.

Public health implications: Simulation exercises, supported by adequate investment and institutional backing, offer opportunities to strengthen intersectoral collaboration, communication channels, and best practices during non-emergency periods. This approach enhances preparedness and resilience through prevention, contingency planning, and capacity building, ensuring sustained readiness across local, regional, and national levels.

Role: Cristina revised all background documentation on One Health EJP SimEx; conducted and wrote an external evaluation; communicated between different actors from different sectors and the EU/EEA countries involved; identified key information and actors to conduct interviews; developed a questionnaire for the semi-structured interviews; wrote an informed consent for participants; planned, conducted, and analysed the interviews; planned and led meetings; wrote a final report (see 2, section 7.2); communicated the results at the OHEJP final meeting (Paris, France).

3. Biorisk management

3.1. Biorisk assessments using the BioRAM tool as part of the Biorisk and Quality Management module exercise, 2023

Aim: To assess the biosafety and biosecurity risks associated with culturing Multi-Drug-Resistant Titan Blue (MDR-TB) for antibiotic susceptibility testing.

Methods: The BioRAM Lite tool was used to conduct this biorisk assessment. This tool employs a systematic scoring process to evaluate biosecurity and biosafety risks by considering various factors, including characteristics of the biological agent (e.g. modes of transmission and infectious dose), laboratory practices, and mitigation strategies. Participants worked through the assessment process, scoring each factor to determine the overall risk levels.

Results: The assessment indicated that this fictional pathogen had a moderate risk of inhalation (score: 2.71) and a low risk of ingestion (score: 1.89) for the individual performing in vitro work. For the community, the risk of inhalation for the surrounding community was moderate, while the risk of ingestion was low. Finally, both inhalation and ingestion risks for the animal community were identified as low.

Public health implications: The exercise highlighted the importance of understanding transmission risks to different populations and reinforced the need for tailored mitigation strategies to protect public health. Simulation exercises like this emphasise the significance of preparedness, informed policy-making, and improved laboratory practices to reduce the risk of exposure to hazardous pathogens.

Role: Cristina discussed with team members to analyse the biological risks associated with MDR-TB; contributed to the systematic scoring; filled out the BioRAM tool as part of the group work.

3.2. Biosafety Level 3 (BSL-3) training with isolation and cultivation of H5N1 avian influenza, Finland, 2024

Supervisors: Veera Avelin (THL) and Pamela Österlund (THL)

Aim: To visit the BSL-3 laboratory and premises at THL to a) review and compare the safety protocols required for BSL-3 laboratories with previous experiences in similar environments; and b) observe the isolation of the H5N1 avian influenza virus from mink brain tissue.

Methods: The training included both theoretical and practical sessions designed to enhance understanding and skills in handling high-risk pathogens. To do so, different topics were covered, including risk assessment for microorganisms at THL, laboratory safety protocols, and BSL-3 essentials.

Results: Working in the BSL-3 environment highlighted the need of adaptability and vigilance. This activity augmented the fellow's previous experience and will enhance her future work in high-containment laboratory settings. Participation in this activity reinforced Cristina's understanding of pathogen risk assessment and improved her practical skills in laboratory safety. It has been invaluable in emphasising the importance of continuous learning and adherence to safety protocols to effectively mitigate risks.

Public health implications: Training in BSL-3 environments is crucial for maintaining high standards of biosafety and biosecurity. Such training ensures that laboratory personnel are well-prepared to handle high-risk pathogens safely, which is essential for preventing laboratory-acquired infections and outbreaks. Continuous professional development in biosafety protocols contributes to the overall effectiveness of public health responses to emerging infectious diseases, enhancing both individual and collective preparedness.

Role: Cristina participated in the biosafety training; exercised the BSL-3 procedures used at THL; visited the laboratory under supervision; followed virus isolation and cultivation work; wrote a reflective note on the activity.

4. Quality management

4.1. Audit of the reference laboratory of poliovirus at THL, Finland, 2023

Supervisors: Soile Blomqvist (THL) and Niina Ikonen (THL)

Aim: To examine various indicators within process management, quality control, and documentation at the poliovirus laboratory of the Finnish Institute for Health and Welfare (THL).

Methods: The head of laboratory and other staff were interviewed to go through protocols, descriptions of methods, and workflows in the laboratory. The assessment focused on reviewing the implementation and adherence to standardised protocols in process management, quality control, and documentation. Specific indicators evaluated included pre-analytical processes, specimen management, and the use of standardised reporting formats.

Results: The results were highly satisfactory, indicating robust implementation of processes and quality controls. The laboratory's work is well documented and recorded. One indicator that did not achieve 100% was the standardised reporting format, where the times of sample receipt and report publication were not documented, although the date was recorded. This indicator was considered minor as samples are processed immediately upon receipt. In pre-analytical processes and specimen management, the address and origin of the patient were not documented but could be traced if needed.

Public health implications: Maintaining high standards in laboratory processes and documentation is critical for ensuring the reliability and accuracy of poliovirus testing, which is essential for public health surveillance and outbreak response. The positive outcomes from this evaluation underscored the importance of ongoing internal and external assessments to uphold quality standards. Continuous monitoring and improvement of laboratory practices contribute to effective disease control and prevention, thereby enhancing public health outcomes.

Role: Cristina applied the principles and practices of biosafety according to WHO and EU directives; applied the concepts of accreditation procedures and quality audits; conducted a laboratory audit; completed a quality evaluation report.

4.2. Periodic audit by the Finnish Accreditation Service to the bacteriology laboratory at THL, Finland, 2023

Supervisor: Lotta Siira (THL)

Aim: To gain insights into accreditation of laboratories at a national level. The audit aimed at renewing accreditation, ensuring compliance with international standards, and assessing the laboratory's quality management systems.

Methods: The audit, conducted in May 2023, adhered to ISO/IEC 17025:2017 standards and included a vertical audit and witnessing at the bacteriology laboratory in Helsinki. The evaluation covered documentation, calibration, maintenance, and adherence to standard operating procedures (SOPs). The audit was conducted in Finnish, so the revision of all the steps and the audit report was conducted afterwards.

Results: No deviations were found in the management systems, but nine technical deviations were identified, four specific to the bacteriology laboratory. Key deviations included inadequate documentation of data entries, expired calibrations, and deviation from SOPs due to unavailable materials. Corrective actions were promptly implemented, including modifying data entry tables, scheduling calibrations, and addressing SOP deviations in team meetings.

Public health implications: Accreditation audits ensure high standards in laboratory operations, which are critical for reliable public health surveillance and disease control. The audit underscored the importance of rigorous documentation, proactive calibration scheduling, and adherence to SOPs. Continuous internal and external evaluations are essential for maintaining quality standards and preparedness in public health laboratories. This experience reinforced the need for thorough preparation, regular self-assessment, and timely corrective actions to uphold accreditation and improve laboratory practices.

Role: Cristina observed the audit process; reviewed documentation and the final audit report; wrote a reflective note on the activity.

4.3. Interlaboratory pneumococcal external quality assurance (EQA), Finland, 2024

Supervisor: Lotta Siira (THL)

Aim: To gain insights into External Quality Assessment (EQA) programmes. The aim of the EQA was to evaluate the performance of pneumococcal serotyping among reference laboratories, ensuring the highest quality standards and validating new serotyping methods.

Methods: The EQA, organised by the Finnish Institute for Health and Welfare (THL), involved eight reference laboratories from various geographic locations. Each laboratory received a blinded panel of seven invasive pneumococcal isolates, representing a range of relevant serotypes. The panel was shipped in compliance with international packaging and transportation requirements. Participating laboratories used their routine procedures for pneumococcal serotyping, employing both phenotypic and genotypic methods. Results were submitted to THL within six weeks, and a final report was prepared. The process, documentation, and final report were revised for the learning purposes of this activity.

Results: All eight participating laboratories provided accurate serotyping results for the seven isolates, despite using different methodologies. The methods ranged from traditional phenotypic approaches, such as the *Quellung* reaction, to advanced genotypic techniques like WGS. The diversity of methods highlighted the complementary nature of different serotyping techniques, with some laboratories also performing multi-locus sequence typing (MLST).

Public health implications: Participation in the pneumococcal EQA is crucial for ensuring the quality and accuracy of pneumococcal serotyping in reference laboratories. It supports the validation of new methods, such as WGS-based serotyping, and reinforces the importance of phenotypic methods. This collaborative effort enhances global pneumococcal surveillance, informing vaccination strategies and improving public health responses to emerging serotypes. The EQA programme fosters continuous learning and standardisation, ensuring laboratories remain well-equipped to tackle evolving epidemiological challenges.

Role: Cristina observed the EQA process; reviewed documentation and the final report; wrote a reflective note on the activity.

4.4. Verification of an updated NGS-based serotyping tool for surveillance of invasive pneumococcal disease in Finland, 2022

This project was conducted at an accredited reference laboratory, where quality and accreditation are paramount. As a certified institution, the laboratory adheres to rigorous standards in selecting bioinformatics tools to ensure accuracy, reliability, and consistency in its processes. The updated WGS-based serotyping tool, PneumoCaT v1.2, was verified as part of this commitment to maintaining high-quality surveillance. Routine use of automated tools like PneumoCaT enhances laboratory efficiency by reducing reliance on labour-intensive phenotypic testing and enabling batch processing of samples, thus speeding up serotype identification and strengthening overall surveillance of invasive pneumococcal disease.

For more details, see the section, 'Applied public health microbiology research and laboratory investigations'.

5. Public health microbiology management

5.1. Management during outbreak investigations and projects, 2022–2024

During her fellowship, Cristina developed robust public health management skills through her work on projects and outbreak investigations. She gained experience in team coordination and leadership, project management, scheduling, and communication. Her role included liaising with experts within different teams, collecting and incorporating feedback, translating data and reports, writing study protocols, and ensuring quality assurance. Cristina also contributed to conflict resolution, final reporting, and dissemination. A notable achievement was her significant role in the *Salmonella* Mbandaka outbreak, where she coordinated efforts and served as a liaison between epidemiologists, microbiologists, and international collaborators.

5.2. Management during teaching and training, 2022–2024

During various teaching and training activities, Cristina developed comprehensive management skills. She was involved in curriculum development, lesson planning, logistical management, student assessment, feedback collection and analysis, collaboration with colleagues, meeting organisation, and documentation. For the Nordic Mini Project Review Module 2024 in Helsinki, organised by THL fellows, Cristina, along with Wioleta Kitowska (cohort 2022) and Joana Sequeira Neto (cohort 2023), managed event planning, logistics, facilitator coordination, participant registration, scientific and social programme preparation, on-site coordination, evaluation session and survey preparation, result analysis, documentation, and dissemination.

5.3. EUPHEM cohort representative, 2022–2024

During the two-year fellowship, Cristina acted as a cohort representative for the EUPHEM fellows alongside João Pires from Folkehelseinstituttet, Oslo. She actively participated in meetings with cohort representatives from EPIET, PAE, and MediPIET, and engaged in monthly meetings with representatives from other cohorts. Cristina provided feedback and suggested improvements through monthly discussions with the EPIET Alumni Network (EAN) board and biannual meetings with the fellowship head. Moreover, she attended the annual meeting of the National Focal Points for Public Health Training (NFPT) and the Training Site Forum (TSF) in November 2023 in Barcelona. Her role involved organising initiatives, identifying challenges and solutions, providing feedback, advocacy, communication coordination, and continuous improvement. She also produced a reflective note.

5.4. Evaluation of the One Health European Joint Programme (OHEJP) simulation exercise (SimEx), 2023

Cristina led the project on evaluating the One Health European Joint Programme simulation exercise (SimEx), showcasing her management and organisational skills. She developed the study and analysis plan, identified and contacted the key participants, organised and conducted interviews, and maintained communication with various partners. Additionally, she collected and incorporated feedback, ensured ethical compliance, and managed the final reporting and dissemination of results. This project highlighted her ability to handle complex tasks and coordinate effectively with multiple stakeholders.

5.5. Nosocomial bloodstream infections caused by Escherichia coli and Klebsiella pneumoniae non-susceptible to third-generation cephalosporins in Finland, 2014–2022

For this project, the fellow prepared and submitted all necessary documentation for ethical approval. Cristina undertook study protocol writing, reviewed documentation of ethical considerations, organised meetings with collaborators, filled and submitted necessary documentation, ensured compliance with ethical guidelines, conducted risk assessments, liaised with the ethics committee, and received and incorporated feedback. This project emphasised her ability to manage ethical compliance and coordinate effectively with various stakeholders.

6. Teaching and pedagogy

6.1. Finnish educational programme to host school students at the workplace, Finland, 2023

Cristina, together with Wioleta Kitowska, supervised a 15-year-old student at THL, as part of the Finnish educational programme for school students. This included presenting the fellowship, detailing the projects and activities conducted by fellows at THL, introducing outbreak investigations, and facilitating a case study on a gastroenteritis outbreak in Sweden, which served as the final output of the activity.

6.2. Essentials of Infectious Disease Epidemiology, University of Tampere, Finland, 2024

EPIET/EUPHEM fellows from THL organised and taught a one-week course on 'Essentials of Infectious Disease Epidemiology' aimed at postgraduate students at Tampere University in Finland. Cristina was involved in all aspects of the course, including planning, designing the curriculum, developing training materials, teaching, facilitating, and conducting morning revision sessions. She prepared and delivered two lectures, as well as facilitated four case studies on outbreaks and surveillance of infectious diseases. Active participation was encouraged through group discussions and presentations. Students' feedback was collected via an electronic questionnaire, and an evaluation report and reflective note were also prepared.

6.3. Organisation of the Nordic Mini Project Review Module (NMPRM), Helsinki, Finland, 2024

EPIET/EUPHEM fellows from THL organised a two-day regional project review module. The NMPRM is an annual, fellow-driven event, initiated among Nordic countries to offer a platform for discussion, guidance, idea exchange, and to facilitate collaboration on projects. The event took place at THL and was attended by 12 fellows and facilitated by 15 experts from THL and WHO. Cristina was involved in all aspects of the module including planning, preparing the programme, arranging facilitators, preparing and conducting the evaluation survey. An evaluation report and reflective note were prepared.

6.4. Outbreak investigation day, Helsinki, Finland, 2024

EPIET/EUPHEM fellows from THL organised and taught a one-day course at THL to enhance staff knowledge on outbreak investigations. The event included lectures on outbreak investigations and study designs, and a case study in smaller groups to promote multidisciplinary thinking and collaboration between epidemiologists and microbiologists. Active participation was encouraged through group discussions. Cristina was involved in all aspects, including organising the course, developing the material, designing and delivering lectures, facilitating the case study, and preparing an evaluation survey. Feedback was overwhelmingly positive, with participants requesting future trainings or repeats of the event. An evaluation report was written and disseminated among participants, and a reflective note was also prepared.

6.5. EU Twinning Project Training implemented by THL and the Public Health Institute of Serbia, Belgrade, Serbia, 2024

See the section, 'International Assignments'.

7. Communications related to the EPIET/EUPHEM fellowship

7.1. Manuscripts published in peer-reviewed journals

1. **Gonzalez-Perez AC**, Landgren H, Vainio A, Kitowska W, Pihlajasaari A, Leinonen E, *et al*. A multi-country outbreak of *Salmonella enterica* serotype Mbandaka linked to pre-cooked frozen chicken meat in ready-to-eat products, 2022 – 2023. Eurosuveillance. Submitted.
2. Kitowska W, **Gonzalez-Perez AC**, Sequeira-Neto J, Kanerva M, Kaukavuori H, Lindström I, *et al*. A repeated outbreak of pneumococcal disease among shipyard employees in Turku, Finland August – October 2023: a case-control study. Eurosuveillance. Submitted.
3. **Gonzalez-Perez AC**, Brummer-Korvenkontio H, Liitsola K, Rautanen M. Addressing hepatitis C transmission risks: insights from Finnish prisons on injecting drug use, preventive measures, and access to treatment (tentative title). *In preparation*.

7.2. Other reports

1. **Gonzalez-Perez AC**, Kitowska W, Rimhanen-Finne R. Outbreak report: *Cryptosporidium parvum* outbreak after a business event in Hotel X, Helsinki (Finland), September – October 2022. A retrospective cohort study. Helsinki: THL; 2023.
2. Artursson K. D4.31 Final reports of JIP COVRIN and OHEJP exercise (SimEx) and evaluation reports. One Health European Joint Programme (OHEJP); 2023. Available at: https://zenodo.org/records/8143420
3. Rautanen M, Harald K, and Tyni S (eds.). Vankien terveys ja hyvinvointi 2023. Helsinki: THL; 2023. Raportti 007/2023. Available at: https://urn.fi/URN:ISBN:978-952-408-148-1 (ISBN 978-952-408-149-8, print)
4. Rautanen M, Harald K, and Tyni S (eds.). The Health and Wellbeing of Prisoners 2023. Helsinki: Finnish Institute for Health and Welfare (THL); 2024. Report 3/2024. Available at: https://urn.fi/URN:ISBN:978-952-408-297-6 (ISBN 978-952-408-296-9, print).
5. Verification report: Applicability of the PneumoCaT version 1.2 analysis tool for NGS-based serotyping of *Streptococcus pneumoniae.* Helsinki: THL; 2024.
6. Evaluation report of the genomic surveillance system for SARS-CoV-2 in Finland for the year 2023. Helsinki: THL; 2024.

7.3. Conference presentations

1. **Gonzalez-Perez AC**. Evaluation of the One Health European Joint Programme (OHEJP) simulation exercise (SimEx) – An analysis on actions taken and lessons learned (oral presentation as invited speaker). Presented at: One Health European Joint Programme Final Meeting; 11–12 September 2023; Paris, France. Presenter: Gonzalez Perez AC.
2. Kitowska W, **Gonzalez-Perez AC**, Suominen K, Vainio A, Åberg R, Hokkanen P, *et al*. Outbreak of cryptosporidiosis among a cohort of business event participants at a Finnish hotel associated with a green salad-mix, September – October 2022 (e-poster). Presented at: European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 22–24 November 2023; Barcelona, Spain.
3. **Gonzalez-Perez AC**, Landgren H, Vainio A, Kitowska W, Pihlajasaari A, Leinonen E, *et al*. A multi-country outbreak of *Salmonella enterica* serotype Mbandaka ST413 linked to consumption of chicken meat - a case-

case study in Finland, 2022 – 2023 (e-poster). Presented at: European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 22–24 November 2023; Barcelona, Spain.

4. **Gonzalez-Perez AC**, Brummer-Korvenkontio H, Liitsola K, Rautanen M. Addressing hepatitis C transmission risks: insights from Finnish prisons on injecting drug use, preventive measures, and access to treatment (oral flash poster). Presented at: European Society of Clinical Microbiology and Infectious Diseases (ESCMID); 27–30 April 2024; Barcelona, Spain. Presenter: Gonzalez-Perez AC.
5. Kitowska W, **Gonzalez-Perez AC**, Sequeira Neto J, Kanerva M, Kaukavuori H, Lindström I, *et al*. Pneumococcal pneumonia outbreak at a shipyard in Turku, Finland, August–October 2023. Presented at 2nd Annual Microbe Cruise; 4 September 2024; Turku, Finland. Presenter: Kitowska W.

7.4. Other presentations

7.4.1. Lectures and external presentations

1. **Gonzalez-Perez AC** and Kitowska W. *Cryptosporidium parvum* outbreak at a business event in Hotel X in Helsinki, Finland, September-October 2022. A retrospective cohort study (oral presentation). Presented at: "Klinfektiokokous" meeting at Hospital district of Helsinki and Uusimaa (HUS); 14 December 2022; Virtual.
2. **Gonzalez-Perez AC** and Kitowska W. Microbiology and epidemiology working together: a case – case study of a *Salmonella* Mbandaka outbreak in Finland, September 2022 – January 2023 (oral presentation). Presented at: Friday series of clinical microbiology (KLIMP) at Hospital district of Helsinki and Uusimaa (HUS); 12 May 2023; Virtual.
3. **Gonzalez-Perez AC**. Viruses with pandemic potential and diagnostic methods (lecture). Presented at: "Essentials of Infectious Disease Epidemiology" course at University of Tampere; 7 February 2024; Tampere, Finland.
4. **Gonzalez-Perez AC** and Kitowska W. An example of a case-case study: the multi-country outbreak of Salmonella Mbandaka (lecture). Presented at: "Essentials of Infectious Disease Epidemiology" course at University of Tampere; 7 February 2024; Tampere, Finland.
5. **Gonzalez-Perez AC** and Kitowska W. Study designs (lecture). Presented at: "Outbreak Investigation Day" training at THL Tilkanmäki; 18 March 2024; Helsinki, Finland.
6. **Gonzalez-Perez AC** and Ruotsalainen R. Study designs in outbreak investigations (lecture). Presented at: "Strengthening the capacity of Serbia's healthcare for communicable disease surveillance" - Module 1 and 2 training at Institute of Public Health in Belgrade; 22 May 2024; Belgrade, Serbia.
7. **Gonzalez-Perez AC** and Kitowska W. The interface between epidemiology and microbiology – an example based on a cohort study (lecture). Presented at: "Strengthening the capacity of Serbia's healthcare for communicable disease surveillance" - Module 1 and 2 training at Institute of Public Health in Belgrade; 22 May 2024; Belgrade, Serbia.

7.4.2. Presentations in EPIET/EUPHEM modules

1. **Gonzalez-Perez AC** and Kitowska W. *Cryptosporidium parvum* outbreak at a business event in Hotel X in Helsinki, Finland, September-October 2022. A retrospective cohort study (oral presentation). Presented at: Outbreak Investigation Module; 28 November 2022; Berlin, Germany.
2. **Gonzalez-Perez AC**. Nosocomial bloodstream infections caused by *Escherichia coli* and *Klebsiella pneumoniae* resistant to third-generation cephalosporins in Finland, 2014–2022 (oral presentation). Presented at: Nordic Mini Project Review Module 2023; 14 March 2023; Copenhagen, Denmark.
3. **Gonzalez-Perez AC**. Evaluation of the One Health European Joint Programme (OHEJP) simulation exercise (SimEx) – An in-depth analysis on actions taken and lessons learned (oral presentation). Presented at: Project Review Module 2023; 28 August 2023; Lisbon, Portugal.
4. **Gonzalez-Perez AC**. Evaluation of the Finnish genomic surveillance system for SARS-CoV-2 using a defined set of key descriptive attributes (oral presentation). Presented at: Nordic Mini Project Review Module 2024; 29 February 2024; Helsinki, Finland.
5. **Gonzalez-Perez AC**. Evaluation of the genomic surveillance system for SARS-CoV-2 in Finland for the year 2023 (oral presentation). Presented at: Project Review Module 2024; 26 August 2024; Lisbon, Portugal.

7.4.3. Internal meetings at THL

1. **Gonzalez-Perez AC** and Kitowska W. *Cryptosporidium parvum* outbreak at a business event in Hotel X in Helsinki, Finland, September-October 2022. A retrospective cohort study (oral presentation). Presented at: bi-weekly EPIET/EUPHEM meeting; 2 December 2022; Helsinki, Finland.
2. **Gonzalez-Perez AC**. Nosocomial bloodstream infections caused by *Escherichia coli* and *Klebsiella pneumoniae* resistant to third-generation cephalosporins in Finland, 2013–2022 (oral presentation). Presented at: bi-weekly EPIET/EUPHEM meeting; 12 January 2023; Helsinki, Finland.
3. **Gonzalez-Perez AC** and Kitowska W. Investigations of a multi-country outbreak of *Salmonella enterica* serotype Mbandaka ST413 in the EU/EEA, Israel and the UK – Finnish perspective (oral presentation). Presented at: weekly outbreak meeting; 21 February 2023; Helsinki, Finland.
4. **Gonzalez-Perez AC** and Kitowska W. A case–case study of an outbreak of *Salmonella* Mbandaka in Finland, September 2022 – January 2023 (oral presentation). Presented at: bi-weekly EPIET/EUPHEM meeting; 23 February 2023; Helsinki, Finland.
5. **Gonzalez-Perez AC**. Prisoners' health and well-being 2023 – Infectious diseases (oral presentation). Presented at: bi-weekly EPIET/EUPHEM meeting; 19 October 2023; Helsinki, Finland.
6. **Gonzalez-Perez AC**. Evaluation of the Finnish genomic surveillance system for SARS-CoV-2 using a defined set of key descriptive attributes (oral presentation). Presented at: bi-weekly EPIET/EUPHEM meeting; 11 April 2024; Helsinki, Finland.

8. EPIET/EUPHEM modules attended

- Introductory Course, 26 September – 14 October 2022, Spetses, Greece
- Fundamentals of R for public health (16h), Applied Epi, 28 November – 1 December 2022, virtual
- Outbreak Investigation, 5–9 December 2022, Berlin, Germany
- European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2022, 23–25 November 2022, Stockholm, Sweden
- Biorisk and Quality Management, 16–17 March 2023, virtual
- 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
- Vaccinology, 4–8 March 2024, virtual
- Qualitative Research – Elective course, 19 and 22 March 2024, virtual
- European Society of Clinical Microbiology and Infectious Diseases (ESCMID) 2024, 27–30 April 2024, Barcelona, Spain
- Public health microbiology III – Whole Genome Sequencing & Bioinformatics, 3–7 June 2024, Vienna, Austria
- Management, Leadership and Communication in Public Health, 24–28 June 2024, Stockholm, Sweden
- Project Review Module 2024, 26–30 August 2024, Lisbon, Portugal
- European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2024, 20–22 November 2024, Stockholm, Sweden

9. Other training

- Risk management in the digital world, eOppiva, 15 September 2022, virtual
- ABC of data protection for public administration personnel, eOppiva, 15 September 2022, virtual
- Digitally secure working life, eOppiva, 16 September 2022, virtual
- Nordic Mini Project Review Module 2023, 13–14 March 2023, Copenhagen, Denmark

- Webinar: Mobile Laboratories, EPIET/EUPHEM initiative, 4 May 2023, virtual
- BSAFE security awareness training, United Nations Department of Safety and Security, 2 June 2023, virtual
- ABC of data protection for public administration personnel, eOppiva, 15 September 2023, virtual
- Digitally secure working life, eOppiva, 15 September 2023, virtual
- Multidisciplinary training workshop for public health microbiologists and epidemiologists. Workshop Food and Waterborne diseases Antimicrobial Resistance (FWD AMR) – RefLabCap project (*Salmonella*), 23–27 October 2023, virtual
- Webinar: Field Epidemiology information webinar, Médecins Sans Frontières & EPIET Alumni Network, 2 November 2023, virtual
- Nordic Mini Project Review Module 2024, 29 February – 1 March 2024, Helsinki, Finland
- Biosafety Level Laboratory 3 training at the Finnish Institute for Health and Welfare (THL), April 2024, Helsinki, Finland
- Webinar: EU Health Task Force, European Centre for Disease Prevention and Control, 17 June 2024, virtual

10. International assignments

- **EU Twinning Project Training implemented by THL and the Public Health Institute of Serbia, Belgrade, Serbia, 2024.**

  Cristina was deployed on a five-day mission (20–24 May 2024) to the Institute of Public Health of Serbia ('Batut') in Belgrade, Serbia, as part of the THL EU Twinning Project, 'Strengthening the capacity of Serbia's healthcare for communicable disease surveillance'. The fellow supported the THL team in activities leading up the mission, including creation of the course programme, development of training materials (lectures, case studies, exercises), and pre-training consultations and preparations with Serbian colleagues. During the mission, the fellow conducted two training-of-trainers modules simultaneously (Module 1 and 2) for epidemiologists and microbiologists from the Serbian network of public health institutions. The trainings took place from 21–23 May 2024 at Batut and were accredited by the European Accreditation Council for Continuing Medical Education (EACCME). Cristina also took part in post-training discussions, review of evaluation forms, preparation of the mission report, and writing a news piece for the project's webpage. She summarised evaluation results and prepared a reflective note.

11. Other activities

- Attended weekly internal outbreak meetings, 2022–2024, on-site at THL, Helsinki, Finland
- Attended bi-weekly internal EPIET/EUPHEM meetings, 2022–2024, on-site at THL, Helsinki, Finland
- 'Vaccine hesitancy' scientific seminar at THL, 14 September 2022, Helsinki, Finland
- Laboratory visit to the Expert Microbiology Laboratory of THL to observe the routine genotyping of *Cryptosporidium*, October 2022, Helsinki, Finland
- 'Decision making' scientific seminar at THL, 19 October 2022, Helsinki, Finland
- Conference 'From Pasteur to the pandemic', 21 October 2022, Helsinki, Finland
- 'Understanding airborne transmission' scientific seminar at THL, 16 November 2022, Helsinki, Finland
- 'Healthcare associated infections' scientific seminar at THL, 11 January 2023, Helsinki, Finland
- Site visit to the Epidemiology Team at the City of Helsinki, 16 January 2023, Helsinki, Finland
- Site visit to the Research Center Neulanen of THL (i.e. the Environmental Health Unit and the Water Microbiology team), 31 March 2023, Kuopio, Finland
- Site visit to the Epidemiological Operations Unit for the Western Uusimaa Wellbeing Services County, 4 April 2023, Helsinki, Finland
- Site visit to the clinical microbiology laboratory of the Hospital district of Helsinki and Uusimaa (HUS) Diagnostic Centre, 16 May 2023, Helsinki, Finland
- MOOD Scientific Conference / General Assembly meeting, THL, 27–29 June 2023, Helsinki, Finland

- Laboratory visit to the Expert Microbiology Laboratory of THL to observe the routine serotyping of *Pneumococcus* using Quellung method, 18 October 2023, Helsinki, Finland
- Pitch at Global LOSKA (like Slush competition) event, THL, 27 October 2023, Helsinki, Finland
- Organiser of the Nordic Mini Project Review Module (NMPRM) 2024, 29 February – 1 March 2024, Helsinki, Finland
- Manuscript co-review for scientific journal, 21 March 2024, virtual
- Prepared and published a news piece for THL intranet about the Nordic Mini Project Review Module (NMPRM) 2024, 3 April 2024, virtual
- Reviewed news piece for EU project website about the EU Twinning Project, 'Strengthening the capacity of Serbia's healthcare for communicable disease surveillance' mission to Belgrade, Serbia, 11 June 2024, virtual
- Support on filling out ECDC survey on mapping available documentation for outbreak investigation and outbreak-related research in EU/EEA countries, 19 June 2024, virtual
- Site visit to the Vantaa prison, 15 August 2024, Vantaa, Finland

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