Kaisa Jaakkola

The European Public Health Microbiology Training Programme (EUPHEM), Cohort 2023

Hospices Civils de Lyon, France

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/2022/16 Rev.01 and ECDC/AD/2023/06 govern the European Union (EU)-track and Member States (MS)-track, respectively, of the ECDC Fellowship Programme, field epidemiology path (EPIET) and public health microbiology path (EUPHEM), Cohort 2023.

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

Kaisa Jaakkola earned her Licentiate of Veterinary Medicine in 2015, and her Master's degree in Biology, with a major in Microbial Genetics, in 2013, both from the University of Helsinki, Finland. In 2022, she completed her doctoral thesis at the same university, focusing on the epidemiology and ecology of environmental food-borne pathogens. Before joining the fellowship, Kaisa worked as a food safety official for the Joint Municipal Authority of North Karelia in Joensuu, as a municipal mixed practice veterinarian, and as Senior Manager for Quality, Food Safety and Environment at Finnair Kitchen in Vantaa.

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). Manual for the ECDC Fellowship Programme EPIET and EUPHEM paths. Stockholm: ECDC; 2025. Available at: https://www.ecdc.europa.eu/en/publications-data/ecdc-fellowship-programme-manual

Stockholm, 2025

1. Epidemiological investigations

1.1. Outbreak investigations

1.1.1. An outbreak of Serratia bockelmannii *in the neonatal intensive care unit of the Hospices Civils de Lyon, France, 2022–2023*

Supervisor: Cédric Dananché (Chef de Service par interim, Service Hygiène, Épidémiologie, Infectivigilance et Prévention, Hospices Civils de Lyon, Lyon, France)

Category: Healthcare-associated infections and antibiotic resistance

Aim: To investigate a seven-month-long outbreak of a multidrug-resistant (MDR) strain of *Serratia bockelmannii* (*S. bockelmannii*) at a neonatal intensive care unit (NICU), to trace the transmission and assess the acquisition risk factors.

Methods: Weekly screening at the NICU was used for case finding. *Serratia* isolates were sequenced and profiled for antimicrobial resistance (AMR). Cases (culture-positive for *Serratia*) were compared with birth date and ward-matched controls (*Serratia*-negative) to identify clinical factors and environmental factors associated with acquisition.

Results: A single strain (<15 allelic differences) of *S. bockelmannii* caused 42 cases from June 2022 to January 2023. All sequenced isolates (n=49) carried the same AMR genes, while the antibiogram (n=32) assigned 15 strains as MDR, and 17 as wild-type. The outbreak strain was recovered from ward surfaces, and an analytical study revealed that incubators used by several cases increased the acquisition odds by 3.27 (95% confidence intervals (CI): 1.71–8.77; p-value=0.003) after adjusting for sex and length of stay.

Public health implications/Conclusions: Genomic typing-supported confirmation of clonality across isolates despite varied antibiograms, and identifying the outbreak strains as *S. bockelmannii. S. bockelmannii* should be considered during *Serratia* outbreaks. Incubator-related within-ward transmission highlights the need for tailored risk assessments and disinfection protocols to prevent pathogen transmission and improve infection-prevention protocols.

Role: Kaisa participated in data collection, forming the case definition, and data analysis of epidemiological data and laboratory results. For the case–control study, Kaisa drafted a study protocol and an application for the ethical committee, presented the results at the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) 2025 [8], and submitted a manuscript to a peer-reviewed journal [2].

1.1.2. An outbreak of parvovirus B19 in the Lyon metropolitan area, France, 2023–2024

Supervisor: Jean-Sébastien Casalegno (Maitre de Conférence Universitaire - Praticien Hospitalier, Institut des Agents Infectieux, Hospices Civils de Lyon, Lyon, France)

Category: Emerging and re-emerging diseases

Aim: To evaluate whether there was a recent increase in congenital parvovirus B19 (B19V) infections in the Lyon metropolitan area, and assess the proportion of the population susceptible to congenital B19V infections before and after the Coronavirus disease 2019 (COVID-19) pandemic.

Methods: A retrospective study was conducted of women aged 14–45 (n=5 967) tested for B19V in Hospices Civils de Lyon from 1 January 2016 to 31 August 2024. A congenital case was defined as an amniotic fluid sample B19V+ in polymerase chain reaction (PCR) test. A susceptible patient was defined as a patient who tested negative for anti-B19V immunoglobulin G (IgG). We calculated the positive and susceptible proportion of samples with confidence intervals (95% CI, the Wilson method) and compared the different periods (Fisher's exact test).

Results: We identified 16 cases, four predating the outbreak cluster (January 2016 to August 2023, 7.7 years) and 12 from the past 12 months (September 2023 to August 2024). The positive proportion of B19V in amniotic fluid samples was significantly higher over the past 12 months (31.6%; 95% CI: 19.1–47.5 vs 3.6%; 95% CI: 1.4–8.8, p<0.001). We observed an increase in the susceptible population in 2021 (30.0%) to 2022 (34.0%), with a decrease and return to the pre-COVID-19 level in early 2023 (28.0%). Differences in susceptible populations between the years were not statistically significant. The results are limited by a lack of a clear testing strategy and systemic surveillance.

Public health implications/Conclusions: We observed a B19V outbreak with an unusually high number of congenital infections. It is recommended that awareness of B19V risks is increased among healthcare workers to facilitate early diagnosis, optimal treatment, and sharing of best treatment practices. Syndromic surveillance of congenital cases would support the early detection of outbreaks, and the incorporation of genomic data in syndromic surveillance would support tracking prevalent strains.

Role: Kaisa participated in data collection, forming the case definition, and defining the baseline level of cases to determine the presence of an outbreak cluster. She also analysed data, reported, and communicated the results by updating the epidemiological report [5] during the outbreak. The report was shared with the French National Public Health Agency (Santé publique France), contributing partially to the eventual issuance of a national alert on 22 April 2024. She presented the results as a poster at the European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2024 [7].

1.1.3. An outbreak of **Vibrio cholerae** *in the three islands of Comoros, 2024*

Supervisor: Sainda Mohammed (Responsable de la lutte et la prévention contre les maladies, World Health Organisation Country office in Comoros, Moroni, Comoros)

Category: Food- and waterborne diseases

Aim: To support the World Health Organization Global Outbreak Alert and Response Network (WHO GOARN) country office in Comoros with response and investigation during a resurgence of the cholera outbreak.

Methods: The WHO Comoros outbreak team was responsible for collating and verifying data on suspected and confirmed cholera cases and for coordinating the outbreak response at the national level. Epidemiological data were recorded in a line list and underwent routine quality checks. Descriptive analyses were performed by region and island. Laboratory results were gathered from the laboratories and compared with the epidemiological data using case definitions by the Global Task Force on Cholera Control (GTFCC). Findings were summarised in weekly situation updates with national partners.

Results: Between February and December 2024, 10 274 cholera cases were reported, with 140 deaths (case fatality rate 1.4%). A limited number of cases (n=68; 0.67%) were laboratory-confirmed. Toward the later stages of the outbreak, the need to strengthen laboratory surveillance and diagnostic capacity were noted. Discussions with stakeholders highlighted logistical and diagnostic challenges related to the collection and processing of faecal samples, as compared with the GTFCC guidance. To support improvements, training sessions were conducted and additional sampling materials were delivered. A reporting template using R Markdown was developed and shared to facilitate the integration of epidemiological and laboratory data.

Public health implications/Conclusions: This prolonged outbreak, part of a broader international event, had a considerable impact on public health in Comoros. The response required close coordination and adaptability to address evolving challenges. The outbreak team contributed to understanding the situation and identifying priority areas to strengthen the response, including support for laboratory surveillance and logistics.

Role: Kaisa contributed to the outbreak team by analysing epidemiological data and developing a workflow linking epidemiological and laboratory data. To support laboratory surveillance efforts, she prepared sampling guidelines for local staff, arranged and facilitated the delivery of sampling materials, and assisted the local laboratory team in data reporting and communication. She also represented laboratory surveillance efforts in team and stakeholder meetings.

1.2. Surveillance

1.2.1. Evaluation of the surveillance system for influenza antiviral resistance in South France, 2013–2023

Supervisor: Vanessa Escuret (Maitre de Conférence Universitaire - Praticien Hospitalier, Institut des Agents Infectieux, Hospices Civils de Lyon, Lyon, France)

Type of project: Evaluating a surveillance system and analysing data from it.

Aim: To assess the impact on data (simplicity, quality, sensitivity) of implementing an automated next-generation sequencing (NGS) pipeline within the surveillance system, which shifted strain characterisation from phenotypic testing to genotypic screening.

Methods: Surveillance data from 2013 to 2023 were analysed using WHO case definitions and a list of resistance mutations to calculate indicators (sequenced and phenotypically tested strains, prevalence of resistance). The data were also assessed for simplicity (decision-making steps), data quality (missing data), and sensitivity. For sensitivity, we compared 2018–2019 and 2022–2023, estimating the probability (%, pwr package in R) of detecting a 2% change in resistance and the positive predictive value (PPV) for resistant variants.

Results: The number of reported mutations increased with sample size (2018–2019: 17 mutations; 319 samples; 2022–2023: 37 mutations; 1 774 samples), as did the probability of detecting a change in resistance (44% versus 99%). But the prevalence of resistant variants remained stable (0.6%). The PPV declined (1.0 to 0.50). For an 80% probability of detecting a 2% change, only 40% of the total samples were required. The increase in community network samples increased the number of samples with missing data (0%; 20%) on patient risk status and previous use of antivirals.

Public health implications/Conclusions: The NGS pipeline increased the sensitivity for resistance detection but reduced PPV. Community sampling reduced data quality, underscoring the need for improved data completeness. While NGS improves surveillance sensitivity, setting detection targets supports evidence-based scaling for public health impact. Given the risk of false positives in genotypic methods, phenotypic testing remains essential.

Role: Kaisa analysed the data and drafted the study protocol for surveillance evaluation. She also wrote the final report [3].

1.2.2. Systematic screening and molecular surveillance of human enterovirus D68 revealing seasonal shifts in affected age groups and circulating clades in the Lyon metropolitan area, France, 2021–2023

Supervisors: Isabelle Schuffenecker (Praticien Hospitalier, Centre National de Référence des Enterovirus et Parechovirus, Laboratoire de Virologie, Hospices Civils de Lyon, Lyon, France), Marion Jeannoel (Praticien Contractuel, Centre National de Référence des Enterovirus et Parechovirus, Laboratoire de Virologie, Hospices Civils de Lyon, Lyon, France)

Aim: To report and describe the findings from systematic hospital surveillance of human enterovirus D-68 (EV-D68) from 2021 to 2023 in the Lyon metropolitan area, France.

Methods: Cases were defined as patients <5 years of age who were PCR-positive for EV-D68. The annual screening was conducted from September to December. We calculated the prevalence (95% CI; Wilson method) and compared the case demographics (age, gender) and clinical symptoms between seasons 2021, 2022, and 2023. Sequenced strains were clade-allocated using Nextstrain.

Results: We identified 65 (4.30%; 95% CI: 3.39–5.44), 53 (3.46%; 95% CI: 2.66–4.50), and 10 (0.67%; 95% CI: 0.36–1.21) EV-D68+ cases in 2021, 2022 and 2023, respectively. The median ages in 2021 (1.34 years) and 2023 (1.36 years) were lower than in 2022 (1.87 years), with the most affected age group being 0–3 months in 2021, compared to 1–2 years and 4–5 years in 2022. The clinical symptoms remained similar, and no cases of flaccid myelitis were recorded. In total, one D1 strain (2023; 0.9%) and 110 strains belonging to three subclades of B3 (2021–2023; 99.1%) were detected. Clades shifted, and in 2022, a new B3 subclade with capsid protein VP1:2DE mutation emerged, replacing other B3 subclades by 2023. Several epitope mutations emerged during the surveillance, and time-scaled phylogenetic analysis suggested this new B3 subclade was introduced, possibly via travel.

Public health implications/Conclusions: Age demographics might vary between EV-D68 seasons, but further studies are needed for solid evidence. We found no statistical associations between clinical disease and circulating strains, but the introduction of the new subclade in 2022 coincided with the increase in infections in 4–5-year-olds and older age groups. Molecular surveillance of EV-D68 clinical strains is important for understanding and quantifying the burden of disease.

Role: Kaisa wrote the study protocol, analysed the data, and wrote the final report [6].

2. Applied public health microbiology research and laboratory investigations

2.1. Urban environment and RSV: neighbourhood factors associated with the risk of severe disease in the infant population of the Lyon metropolitan area, France, 2015–2023

Supervisor: Jean-Sébastien Casalegno (Maitre de Conférence Universitaire - Praticien Hospitalier, Institut des Agents Infectieux, Hospices Civils de Lyon, Lyon, France)

Aim: To determine the incidence of severe acute respiratory syncytial virus infections (RSV SARI) across neighbourhoods of the Lyon metropolitan area, and assess how the urban environment at the metropolitan scale is associated with spatial variation in RSV SARI incidence.

Methods: Laboratory-confirmed RSV SARI cases (<2 years of age; from 2015 to 2023) were extracted from the laboratory database of university hospitals in Lyon. We calculated and mapped the incidence to assess spatial variation, and conducted a systematic literature review on urban environment features associated with RSV SARI to guide variable selection for temporal and spatial regression models. Using remote sensing data, we calculated spectral indices describing the metropolitan area. We also modelled temperature and air humidity at the metropolitan scale.

Results: Cumulative incidence varied significantly between neighbourhoods (0 to 1 166 cases per 100 000 people at risk; p-value <0.001). We identified 18 urban environment variables from the literature and included 15 of them in our study. The best model (r^2=0.39) included neighbourhood median income, which was negatively associated with incidence, and neighbourhood winter temperature as well as particulate matter <10 µm pollution, both of which were positively associated with incidence. Both urban index (UI) and normalised difference moisture index (NDMI) demonstrated strong (p-value <0.001) associations (UI: r^2=0.23; NDMI: r^2=0.21), accounting for a significant portion of the variation.

Public health implications/Conclusions: Substantial neighbourhood-level differences in RSV SARI incidence exist in Lyon. These differences are associated with features of the urban environment. The use of spectral indices may support the identification of vulnerable populations to guide public health measures and to integrate public health and urban planning.

Role: Kaisa participated in the study design and data collection, and was in charge of organising the working group meetings during the study. She wrote and submitted a manuscript to a peer-reviewed journal [1] and presented the results at 'Télédétection pour l'étude du milieu urbain' in Lyon in April 2025 [9].

2.2. Case–control study protocol for perigravidic **Toxoplasma gondii** *infections and development of a validated questionnaire for structured interviews*

Supervisor: Martine Wallon (Chef de service, Department of Parasitology and Medical Mycology, Institute for Infectious Agents, Hospices Civils de Lyon, Lyon, France)

Aim: To develop and validate a French questionnaire suitable for identifying risk factors and risk behaviours for perigravidic toxoplasmosis, and then, using this questionnaire, to identify the most important risk factors for perigravidic toxoplasmosis within the recruiting area of the National Reference Center for Toxoplasmosis in Lyon.

Methods: We reviewed the existing literature on risk factors of toxoplasmosis and drafted a French questionnaire based on available questionnaires. The questionnaire was made available online using KoboToolbox. Additionally, a study protocol for a case–control study within the French surveillance system for perigravidic toxoplasmosis was created, and approval for ethical study was obtained.

Results: We identified 19 relevant studies on risk factors and awareness of perigravidic toxoplasmosis and obtained 10 questionnaires used in those previous studies. Based on that material, we developed and validated a 58-item questionnaire covering key exposure routes, including animal contact, environmental factors, food and water, and hand hygiene. Data collection and analysis will be carried out at a later stage.

Public health implications/Conclusions: A decreasing trend in seroprevalence over the past decade means that the proportion of susceptible populations is increasing. Understanding the concurrent risk factors and behaviours associated with perigravidic toxoplasmosis will help identify at-risk populations and inform the development of targeted prevention and outreach programmes to raise awareness within these groups.

Role: Kaisa performed the literature review. She also developed the questionnaire and research study protocol. Together with her supervisor, the questionnaire was piloted and revised, and an application for the ethical committee was submitted.

2.3. The initial impact of the 2023–2025 nirsevimab and Abrysvo campaigns on the income–incidence association of severe RSV disease in children under two years in Lyon, France, 2018–2025

Supervisor: Jean-Sébastien Casalegno (Maitre de Conférence Universitaire - Praticien Hospitalier, Institut des Agents Infectieux, Hospices Civils de Lyon, Lyon, France)

Aim: To assess the impact of new immunisation recommendations for RSV disease on previously described income–incidence associations within the Lyon metropolitan area.

Methods: The incidence for RSV SARI and non-RSV viruses (rhinovirus, metapneumovirus, influenza) was calculated using hospital laboratory data on PCR-confirmed infections in hospitalised <2-year-olds per postal codes (n=41) and per RSV campaign period (pre-campaign period: 1 March 2018 to 28 February 2020 and post-campaign period: 1 March 2023 to 28 February 2025). The 24-month periods were selected to represent typical RSV seasons, excluding disruptions due to COVID-19. Relative risk reduction (RRR ($incidence_{PRE}$-$incidence_{POST}$)/$incidence_{PRE}$) was calculated and modelled using linear regression to assess associations with median income (2020 French census).

Results: We identified 2 462 RSV SARI (37%), 2 970 rhinovirus (44%), 516 metapneumoviruses (8%), and 769 influenza cases (11%). The RSV SARI incidence decreased by 25% post-campaign compared to pre-campaign (582 to 779 per 100 000 infants, p-value<0.001, mean RRR: 0.21), while the incidence of non-RSV increased (650 to 1 593 per 100 000, p-value<0.001, mean RRR: -1.7). The income–incidence association for RSV SARI and non-RSV was strong (p<0.001) in both periods, and the income effect had increased for RSV SARI post-campaign (p=0.036) compared to pre-campaign, while the opposite was true for non-RSV (p<0.005).

Public health implications/Conclusions: The short follow-up period is a key limitation, and ongoing surveillance is needed to confirm these trends. Studies exploring barriers and facilitators for RSV immunisation uptake are recommended to support equitable access and impact. Outreach programmes promoting nirsevimab and Abrysvo in vulnerable populations may help reduce the disease burden.

Role: Kaisa wrote the study protocol and drafted an application for ethical study permission. She analysed the data and wrote a report [4].

3. Biorisk management

Before the fellowship, Kaisa had professional experience working at a biosafety level-3 (BSL-3) laboratory handling primary cultures for suspected cases of anthrax. This work experience, awareness of risk management within BSL-3 laboratories, and training received were deemed sufficient for the competence requirements of the EUPHEM fellowship.

3.1. Risk assessment for the preparation of simulated water samples for **Legionella** *EQA purposes, Lyon, 2025*

Supervisors: Sophie Jarraud (Professeur des Universités – Praticien Hospitalier, Centre National de Référence des Légionelles and European Reference Laboratory for Public Health on Legionella, Hospices Civils de Lyon, Lyon, France), Camille Jacqueline (Chargée d'études, Centre National de Référence des Légionelles and European Reference Laboratory for Public Health on Legionella, Hospices Civils de Lyon, Lyon, France)

Aim: To assess the biorisks associated with the new procedures created for the preparation and rehydration of simulated water samples for external quality assessment (EQA) purposes.

Methods: We used the WHO biorisk assessment template and risk matrix, and created protocols to identify and assess the biorisks associated with the new working steps. Literature was searched for existing examples of laboratory-acquired infections by *Legionella* and other pathogens, their transmission routes, and infective doses.

Results: Our risk assessment confirmed that most of the new ways of working were effectively controlled by the existing control measures at the *Legionella* reference laboratory. Non-compliant or suboptimal ways of working were identified as a possible risk during the creation of highly concentrated bacterial suspensions with the use of a scalpel blade during the harvesting step. Control measures such as risk awareness and communication, and the possibility of reorganising the work, were identified as possible ways to reduce the biorisks during these working steps. However, the initial risk level was found acceptable when tasks are performed by competent staff following the described ways of working.

Public health implications/Conclusions: Biorisks are actively managed. However, regular revision of risk assessments is recommended as new procedures emerge and become established.

Role: Kaisa reviewed the literature as well as performed and wrote the initial risk assessment based on developed protocols. Risk assessment was revised by her based on the feedback received.

4. Quality management

4.1. Laboratory assessments conducted during an international mission in Comoros, comparison with laboratory audits at Hospices Civils de Lyon, France, 2024

Aim: To reflect on the differences and similarities in quality management systems and auditing practices between laboratories in Comoros and those at the training site (Hospices Civils de Lyon – HCL, France).

Methods: Laboratory assessments were conducted using International Organization for Standardization (ISO) 15189 standards and WHO Laboratory Quality Stepwise Implementation (LQSI) guidance. In both contexts, audits were structured around key elements of quality management systems. At HCL, audits were carried out by trained internal auditors. In Comoros, the audit team included Kaisa, a representative from the WHO country office in Comoros, and a representative from the Ministry of Health. At the end of each audit, findings and a list of corrective actions were reviewed in a closure meeting with the local laboratory team and relevant management. Action points were discussed, and corrective actions were assigned directly to responsible staff members of HCL or recommended to either the head of the laboratory, the local health district, or the Ministry of Health. Audit reports were shared with local and regional teams within two working days of each visit.

Results: The audits provided a structured overview of current capacities and areas for improvement, including infrastructure, documentation, biosafety practices, and quality control procedures. While the resource constraints and structural challenges varied between Comoros and HCL, both settings demonstrated engagement and motivation toward continuous improvement.

Public health implications/Conclusions: Well-structured audits are a useful tool for identifying capacity gaps and guiding targeted improvement efforts. They can also strengthen communication between local laboratories and health authorities, and support the prioritisation of national laboratory development initiatives.

Role: Kaisa conducted quality assessments in four laboratories in Comoros, contributed to the audit report writing, participated in post-audit debriefings with stakeholders, and compared findings with existing quality practices at HCL. She prepared final documentation and contributed to the identification of priority areas for quality system improvement.

4.2. Feasibility study for the **Legionella** *EQA exercise 2025 for members of the European Legionnaires' Disease Surveillance Network (ELDSNet), Lyon, 2025*

Supervisors: Sophie Jarraud (Professeur des Universités – Praticien Hospitalier, Centre National de Référence des Légionelles and European Reference Laboratory for Public Health on Legionella, Hospices Civils de Lyon, Lyon, France), Camille Jacqueline (Chargée d'études, Centre National de Référence des Légionelles and European Reference Laboratory for Public Health on Legionella, Hospices Civils de Lyon, Lyon, France)

Aim: To conduct feasibility and validation study of simulated water samples to assess the homogeneity, stability, and suitability of test panels before their distribution to participating laboratories in the EQA 2025 exercise.

Methods: A protocol for the preparation and rehydration of simulated water samples was developed and tested for homogeneity and stability during storage (-20°C, maximum three months) and different transportation conditions (+4°C to 20°C, up to 14 days). The rehydrated samples were treated as standard water samples for *Legionella* analysis and analysed following the standard methods for water filtration and culture (with acidic buffer) and/or quantitative PCR (qPCR). At the final stage of the feasibility test, the analyses for rehydrated samples were run as standard laboratory samples to ensure replicable and accurate results.

Results: We successfully created a protocol for the preparation of simulated water samples. The pellets prepared with this methodology produced reliable qualitative results. Homogeneity, stability, and assigned value assessments confirmed the reliability of the samples, ensuring that participating laboratories receive high-quality materials for analysis.

Public health implications/Conclusions: The validation study verified that the test samples are suitable for the piloting of the EQA 2025 exercise. Consistent and reliable testing panels are one of the key elements for a successful EQA.

Role: Kaisa tested different protocols for the preparation of water samples and analysed the produced samples using the methodologies for water filtration. She also did the *Legionella* culture and qPCR. She wrote the laboratory protocols and conducted a biorisk assessment of the new procedures (see section 3.1).

4.3. Verification of a new chemiluminescence analyser within the accredited diagnostic pipeline for syphilis serology at Hospices Civils de Lyon, France, 2025

Aim: To follow the verification process of a non-modified test performed according to the manufacturer's specification in an existing accredited diagnostic pipeline.

Methods: The methods and materials for the verification process follow the quality management procedures set by HCL, compliant with WHO guidelines, and are similar to the verification process of cobas e 801 (electrochemiluminescence immunoassay – ECLIA) analyser in 2023. The verification process had 13 elements (repeatability, fidelity, variability between technicians, accuracy, precision, sensitivity and specificity, measurement uncertainty, measurement range, comparison of methods, interference, contamination, robustness, and reference intervals), and all these were assessed during the verification process of new equipment. All tests and conclusions based on the literature review were documented, and a report was written to document the verification process

Results: The verification process formed a comprehensive overview of the performance of new equipment at HCL for their intended purpose. The results of testing confirmed that the new analyser produced the same qualitative results as existing methodologies. It was able to quantify the manufacturer's positive and negative controls as expected, with most quantitative differences occurring near the detection limit.

Role: Kaisa worked as an observer.

5. Public health microbiology management

5.1. Communication and updates during the parvovirus B19 outbreak, Lyon, France, 2023–2024

Kaisa drafted the initial communication report in November 2023 and updated that report in January 2024. The report was shared with the French National Public Health Agency (Santé publique France), contributing partially to the eventual issuance of a national alert on 22 April 2024.

5.2. Communication during the Vibrio cholerae outbreak, Moroni, Comoros, 2024

Kaisa coordinated laboratory activities and was in charge of communication of laboratory results with the outbreak investigation group and stakeholders from 5 November to 20 December 2024. She also prepared presentations for closing meetings of laboratory assessments to communicate the results to local public health stakeholders and wrote the final audit reports.

5.3. Project management and provision of technical support to the Virus Respiratoire Syncytial study group in Lyon, France, 2023–2024

Kaisa was the lead investigator for the main projects she was involved in at HCL. She led projects and was responsible for carrying out the analytical work and communicating the results. She worked on all stages of the projects, including designing and writing project proposals and study protocols, submitting documentation to the ethics committee, collecting and analysing data, attending and organising follow-up meetings with stakeholders, and writing the final manuscript/report or disseminating the results at conferences. Collaborators and stakeholders included a wide variety of healthcare professionals: paediatricians, neonatologists, infectious disease epidemiologists, medical residents, intensive care doctors, virologists, and hospital hygiene specialists.

6. Teaching and pedagogy

6.1. Lectures on RSV in infants, Université Claude Bernard Lyon 1 , 2024 and 2025

Kaisa prepared, revised, and delivered two lectures entitled, 'RSV in infants: virus, disease, and immune response' and 'Strategies for active and passive paediatric RSV immunisation' for the Master's degree course 3I: 'Immunology, Immunotherapy, Immunopathology' at the Université Claude Bernard Lyon 1, in collaboration with the site supervisor in September 2024 and 2025. The three-hour lectures were delivered face-to-face and evaluated by students. The feedback from the students in 2023 and 2024 were reviewed by the presenters and used to improve the lectures.

6.2. Lectures on quality management and audits, fellowship module on biorisk and quality management, online, 2024 and 2025

Kaisa prepared, revised, and delivered two lectures entitled, 'Introduction to Quality Management' and 'Audits' for the 'Biorisk and Quality Management' module for the ECDC EPIET/EUPHEM Fellowship programme in Spring 2024 and 2025. The lectures (45 minutes and 30 minutes, respectively) were delivered online. Additionally, Kaisa facilitated the biorisk assessment exercise.

Kaisa wrote a reflection note covering both of these teaching activities in 2024.

7. Communications related to the EUPHEM fellowship

7.1. Manuscripts published in peer-reviewed journals

1. **Jaakkola K**, Renard F, Roy A, Benchaib M, VRS Study group in Lyon, Metcalf J, et al. Urban environment and RSV: neighbourhood factors associated with the risk of severe disease in the infant population of a metropolitan area, Lyon, France. BMC Public Health. 2025. [Published]

2. **Jaakkola K**, Fischer A, Piquart L, Cassier P, Colomb-Cotinat M, Dauwalder O, et al. Understanding *Serratia bockelmannii* transmission during a neonatal ICU outbreak: A combined genotyping and case–control study. Antimicrobial Resistance and Infection Control. 2025. [Published]

3. **Jaakkola K**, Casalegno J-S, Lina B, Escuret V. Measuring the next-generation sequencing-related increase in sensitivity: evaluation of influenza antiviral resistance surveillance system 2013–2023 in National Reference Centre for South of France, Lyon. [Manuscript in preparation]

7.2. Other reports

4. Initial impact of the 2023–2025 nirsevimab and Abrysvo campaigns on the income–incidence association of severe RSV disease in children under two years in Lyon, France [Internal report]

5. Outbreak of parvovirus B19 in the Lyon metropolitan area, France, 2023–2024 [Internal report]

6. Systematic screening and molecular surveillance of human enterovirus D68 reveals seasonal shifts in affected age groups and circulating clades in the Lyon metropolitan area, 2021–2023 [Internal report]

7.3. Conference presentations

7. **Jaakkola K**, Ploin D, Mekki Y, Billaud G, Lina B, Casalegno J-S. Post-COVID-19 outbreak of parvovirus B19 affecting pregnant women: a retrospective study of laboratory-confirmed B19V congenital cases, 2016–2024, Lyon metropolitan area. Poster presented at: ESCAIDE 2024, 22 November 2024; Stockholm, Sweden.

8. **Jaakkola K**, Fischer A, Piquart L, Cassier P, Colomb-Cotinat M, Dauwalder O, et al. Understanding *Serratia bockelmannii* transmission during a neonatal ICU outbreak: a combined genotyping and risk factor analysis. Oral presentation at: ESCMID Global 2025, 9 April 2025; Vienna, Austria.

7.4. Other presentations

9. **Jaakkola K,** Renard F, Roy A, Casalegno J-S. Milieu urbain et bronchiolite: possibilités de télédétection pour expliquer les différences de santé entre quartiers dans la Métropole de Lyon. Oral presentation at: Télédétection pour l'étude du milieu urbain, 2 April 2025; Lyon, France.

8. EPIET/EUPHEM modules attended

- Introduction to R for Applied Epidemiology, Applied Epi, 19–22 September 2023, virtual
- Introductory Course, 25 September–13 October 2023, Spetses, Greece
- Study Protocol and Scientific Writing, 26–27 October and 7–8 November 2023, virtual
- European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2023, 22–24 November 2023, Barcelona, Spain
- Multivariable Analysis, 19–23 February 2024, Berlin, Germany
- Vaccinology, 4–8 March 2024, virtual
- Writing Abstracts for Scientific Conferences, 14 March or 20 March 2024, virtual
- Rapid Assessment and Survey Methods, 15–19 April 2024, Dublin, Ireland
- Public Health Microbiology II – Biorisk and Quality Management, 21–23 May 2024, virtual
- Public Health Microbiology III – Whole Genome Sequencing and Bioinformatics, 3–7 June 2024, Vienna, Austria
- Project Review Module, 26–30 August 2024, Lisbon, Portugal
- Social and Behavioural Sciences, 24–28 March, virtual
- One Health, 12–15 May 2025, virtual
- Project Review Module, 25–29 August 2025, Lisbon, Portugal
- Public Health Leadership, 1–3 September 2025, Lisbon, Portugal.

9. Other training

- Bacterial genome assembly and quality control, GenEpi-BioTrain, 4–7 December 2023, virtual
- Public Health Preparedness for Mass Gathering Events, World Health Organization (WHO), 11 April 2024, virtual
- Epidemic Intelligence e-learning course, ECDC, 10 April 2024, virtual
- Rapid Risk Assessment e-Learning, ECDC, 12 April 2024, virtual
- Phylogenetics and alignments. GenEpi-BioTrain, 21 June 2024, virtual
- Unix for beginners and Introduction to the Conda ecosystem, GenEpi-BioTrain, 20–22 August 2024, virtual
- Pathogens and Health Risks in Seafood Products. GenEpi-BioTrain, Institut Pasteur, 10 and 12 September 2025, virtual

- AMR in low resource settings and/or displaced populations, International Society of Antimicrobial Chemotherapy (ISAC)/ESCMID webinar, 22 October 2024, virtual
- Every Outbreak is a Story! Using Qualitative and Descriptive Data Clues to Complete the Story. Training Programs in Epidemiology and Public Health Interventions Network, 23 October 2024, virtual
- BSAFE, United Nations security awareness training, 28 October 2024, virtual
- WHO Ethics Empowerment, World Health Organization (WHO), 30 October 2024, virtual
- WHO's New Policy and Strategy on Preventing and Addressing Sexual Misconduct, World Health Organization (WHO), 29 October 2024, virtual
- Prevention of sexual exploitation and abuse (PSEA), World Health Organization (WHO), 30 October 2024, virtual
- United to Respect: Preventing sexual harassment and other prohibited conduct, World Health Organization (WHO), 30 October 2024, virtual
- Focus on the Agents of Diphtheria, GenEpi-BioTrain, 5–7 March 2025, virtual
- The Utility of Pathogen Genomics: Spotlight TB, WHO EPI-WIN webinar, 2 July 2025, virtual
- Internal seminars on infectious diseases are given by the residents every Friday (Les colloques de l'IAI), IAI Hospices Civils de Lyon, 10 September 2023 to 10 September 2025, Lyon, France.

10. International assignments

- Eight-week deployment to support the cholera outbreak response and laboratory capacity assessment at the World Health Organisation country office in Moroni, Comoros, from 5 November to 20 December 2024 (see sections 1.1. and 4 for more information).

11. Other activities

- As one of the EUPHEM representatives, Kaisa participated in training sites forums, some ECDC fellowship workgroups, meetings with the fellowship office, and performed a variety of other tasks (including the organisation of annual satisfaction surveys and psychosocial workload surveys for fellows).

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