FINAL REPORT

Catarina Krug
The European Programme for Intervention Epidemiology Training (EPIET), Cohort 2021
Santé publique France, 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.

Both curriculum paths provide training and practical experience using the 'learning by doing' approach at acknowledged training sites across European Union (EU) and European Economic Area (EEA) Member States.

According to Article 9 (6), Article 5 (8) and Article 11a (1) of Regulation (EU) 2022/2370 of the European Parliament and of the Council of 23 November 2022 amending Regulation (EC) No 851/2004 establishing a European centre for disease prevention and control (the ECDC Founding Regulation):

Article 9 (6) 'The Centre shall, as appropriate, support and coordinate training programmes, in particular in relation to epidemiological surveillance, field investigations, preparedness and prevention, response to public health emergencies, public health research and risk communication. Those programmes shall take into consideration the need for training to be kept up-to-date, take into account the training needs of Member States and shall respect the principle of proportionality.'

Article 5 (8) 'By encouraging cooperation between experts and reference laboratories, the Centre shall foster the development of sufficient capacity within the Union for the diagnosis, detection, identification and characterisation of infectious agents that have the potential to pose a threat to public health. The Centre shall maintain and extend such cooperation and support the implementation of quality assurance schemes'.

Article 11a (1) 'The Centre shall establish a EU Health Task Force and ensure that there is a permanent capacity and an enhanced emergency capacity to mobilise and use it. The EU Health Task Force shall provide assistance with regard to requests for prevention, preparedness and response planning, local responses to outbreaks of communicable diseases and after-action reviews in Member States and in third countries, in cooperation with the WHO. The EU Health Task Force shall include the Centre's staff and experts from Member States, fellowship programmes and international and non-profit organisations'.

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

This final report describes the output of the fellow and the competencies they 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

Catarina Krug is a doctor of veterinary medicine (University of Lisbon, 2013) and holds a PhD in epidemiology (University of Montreal, 2018). In addition, she has three years of experience in the evaluation of public health interventions (London School of Hygiene and Tropical Medicine, 2018−2021).

Results

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

1. Epidemiological investigations

1.1.   Outbreak investigations

Outbreak of Shiga toxin-producing Escherichia coli infections associated with frozen pizzas – France, 2022

Supervisors: Gabrielle Jones, Nathalie Jourdan-Da Silva, Mathieu Tourdjman

Category: Food and waterborne diseases

In February 2022, we identified an excess of Shiga toxin-producing *Escherichia coli* (STEC)-associated pediatric hemolytic-uremic syndrome (HUS). Epidemiological, microbiological, and trace-back investigations aimed to identify the outbreak source and implement appropriate control measures. A confirmed case was defined as an STEC O26 or O103 outbreak strain infection in a person with symptom onset/strain isolation from 1 January 2022; a probable case was defined as HUS in a person epidemiologically linked to a confirmed case. We interviewed case caretakers about food exposures, identified purchases on supermarket loyalty cards and conducted a case-control study to test hypotheses. We identified 59 cases nationwide occurring from 18 January to 5 April. Median age was six years. Fifty children presented with HUS and two died. Initial interviews identified several suspected foods, but no common origin. Supermarket loyalty cards identified frequent purchase of Brand A-Type B frozen pizzas. A case-control study confirmed a strong association between consumption of Brand A pizzas and illness (OR: 116.0; 95% confidence interval: 26.8-501.9). Pizza samples and flour used for manufacturing tested positive for STEC outbreak strains. A recall and withdrawal of the pizzas was initiated on 18 March 2022. While flour is a known STEC vehicle, this outbreak is highly unusual, as the cooking of frozen pizzas should eliminate STEC risk. Manufacture of Brand A-Type B pizzas did not include pre-baking of the dough. This outbreak highlighted the STEC risk associated with flour-based products. Ongoing investigations aiming to understand the origins and persistence of contamination should contribute to improving food safety practices and consumer recommendations.

Role: Catarina was the main co-investigator and she was involved in all the 10 steps of the outbreak investigation: including communication with regional offices of Santé publique France (SpF) to request details on cases, and with the Directorate-General for Food (DGAL), to obtain information on the grocery lists of cases and collect food samples. She also generated hypotheses and tested hypotheses with a case-control study, developed the control questionnaire and data extraction form, and the data entry mask and communicated with the media [22]. She presented this work to collaborators [20 and 21] and at the ESCAIDE 2022 [16] and TEPHINET 2022 conferences [17] and drafted a peer-reviewed article [3].

Two outbreaks of multiple Salmonella enterica serotypes associated with sesame-based products in France and Canada, 2022

Supervisors: Nathalie Jourdan-Da Silva

Category: Food and waterborne diseases

In September 2022, the French National Reference Centre for Salmonella (CNR ESS), reported an unusual increase in *Salmonella enterica* serotype Menston (*S.* Menston) isolates to SpF. We conducted epidemiological, microbiological, traceback and international investigations to identify the outbreak source and implement control measures. We defined cases as a laboratory-confirmed *S.* Menston infection, belonging to the outbreak cluster HC5_297161 by whole genome sequencing (WGS) and symptom onset since 1 June 2022. We interviewed cases about food exposures before symptom onset. We performed traceback investigations on suspected foods and restaurants. Stool and food isolates were characterised using WGS. We identified 24 cases with onset between 19 June and 28 November 2022 (median age 30 years; 11 male, 13 female; 19 residing in the Paris region). One case was hospitalised and there were no deaths. Of 20 interviewed cases, 15 reported eating tahini (sesame paste), and seven

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

of these frequented a chain of restaurants. No other common food items or restaurants were identified. Samples of tahini from the wholesaler were positive for the *S.* Menston outbreak strain, and for *S.* Kavelinge HC10_297162. Similarly, there were 15 cases in Canada associated with tahini consumption in 2021−2022, with *S.* Menston and *S.* Kavelinge from the same outbreak cluster as in France. Epidemiological, microbiological, and trace-back investigations have identified contaminated tahini as the likely source of the outbreaks. In late December 2022, the wholesaler O recalled and withdrew the tahini in France. The tahini was difficult to trace and, because it is a popular food, there is a further risk of *Salmonella* spp outbreaks associated with tahini and sesame seeds.

Role: Catarina was the main co-investigator and she was involved in communication with regional offices of SpF to request details from cases and with Fraud Control (DGCCRF) to obtain information on product traceability and collect food samples. She drafted a peer-reviewed article [4].

Multi-country outbreak of Salmonella Virchow ST16 infections linked to the consumption of meat products containing chicken meat

Supervisors: Nathalie Jourdan-Da Silva

Category: Food and waterborne diseases

In January 2023, we identified an excess of *Salmonella* Virchow infections in France. Epidemiological, microbiological, and trace-back investigations aimed to identify and control the outbreak source. We defined cases as a laboratory-confirmed *S.* Virchow infection, belonging to the outbreak cluster HC5_82819, through whole genome sequencing (WGS) with symptom onset since 1 August 2022. We interviewed cases about food exposure before symptom onset. We performed traceback investigations on suspected foods and at restaurants. Stool and food isolates were characterised by WGS. There were 52 cases, their median age was 22.5 years (range: <1 to 73 years), and the male/female ratio was 0.8. Forty-two cases (81%) were residents in one region (Auvergne-Rhone-Alpes). Strains were isolated between 28 August and 13 December 2022. The results of the questionnaires identified the consumption of kebab with chicken meat in the days preceding the date of onset of the symptoms, by 19 of the 24 cases interviewed (79%); 14/19 (74%) cited the same kebab restaurant in Auvergne-Rhone-Alpes. For 17 of the 24 cases interviewed, there was information on five hospitalisations (29%, 5/17) and no deaths. We notified other countries via EpiPulse in January 2023, and Denmark, Germany, Ireland, the Netherlands, the UK, and the US reported having cases of the same cluster. Based on the results of our investigations, kebab meat products containing contaminated chicken meat were the likely vehicle of infection. The contamination could have occurred at the chicken farm or possibly higher up at breeding level. Further investigations are needed to be able to stop *Salmonella* Virchow HC5_82819 infections.

Role: Catarina was the principal investigator and she was involved in the communication with regional offices of SpF to request details from cases and with the Directorate-General for Food (DGAL), to obtain information on product traceability and collect food samples. She published a rapid outbreak assessment along with the other French and European collaborators [6].

Suspected collective foodborne illness at Santé publique France – France, June-July 2023

Supervisors: Nathalie Jourdan-Da Silva, Henriette de Valk

Category: Food and waterborne diseases

In July 2023, we identified an excess of gastrointestinal symptoms among SpF staff following a festive event on 29 June at SpF headquarters in Saint Maurice, near Paris. Epidemiological investigations were initiated to confirm the existence of a collective foodborne poisoning, identify the source and implement appropriate measures. On 7 July, we sent online questionnaires to SpF workers and asked those who were present at the Saint Maurice site between 29 June and 4 July to respond to the survey. Workers were interviewed about the presence or absence of gastrointestinal symptoms, meals they had eaten at Saint Maurice and specific food exposures. A case was defined as a person working at SpF who had experienced vomiting and/or diarrhea and was present at the Saint Maurice site between 29 June and 4 July. We compared age, sex, and frequency of food exposures between cases and controls, and tested the associations between cases and controls. Of 263 workers who participated in the survey, we identified 49 cases with date of onset from 28 June to 6 July. There were two peaks on the epidemic curve, one on 30 June (n=13) and another on 4 July (n=11). Forty workers presented with diarrhea, 22 presented with vomiting, and there were also other symptoms such as abdominal cramps and fever. None were hospitalised. We identified an association between illness and having lunch at SpF facilities on 29 June (88% (43/49) among cases versus 70% (n=150/214) among controls, p=0.012) and/or on 3 July 2023 (excluding those ill before 3 July: 88% [15/17] among cases versus 38% [82/214] among controls, p<0.001). Even though reports of having eaten fruit were associated with illness, reported food frequencies were lower than 50% (strawberry: 44% [14/32] among cases versus 18% [39/214] among controls; pineapple: 25% [8/32] among cases versus 11% [23/214] among controls). We could not confirm the existence of collective foodborne poisoning.

Role: Catarina was the main investigator and she was involved in all the 10 steps of the outbreak investigation including communication with the food company to request details of meal menus between 29 June and 4 July 2023, as well as generating online questionnaires, using eTIAC software, and analysing the data. She is planning to present this work to SpF and has drafted an internal report [11].

Other contributions to outbreak investigations

Catarina contributed to other outbreak investigations as a member of the outbreak investigation team. For instance, she contributed to the investigation of the mpox outbreak in the summer of 2022, interviewing an anglophone case, managing the line list and sending it to ECDC, and contributing to contact tracing activities.

She also contributed to the investigation of several outbreaks of salmonellosis in the winter of 2022, leading the investigations on the *Salmonella* enteritidis (HC5 332638) outbreak which occurred mainly in the Grand Est region; the *Salmonella* typhimurium (HC5 142832) outbreak which occurred in Brittany and the Loire region (link with regional cells, CNR); and leading the investigations into the *Salmonella* Braenderup (HC5 340124) outbreak which occurred mainly in the Île de France region (link with regional offices of SpF, CNR).

Educational outcome

The main educational outcome came through the daily activities carried out at SpF. Catarina gained valuable knowledge on how the criteria for investigating an outbreak could depend on pathogen/type of surveillance/particularities of cluster/availability of resources/other ongoing outbreaks. She had the opportunity to analyse *Salmonella* spp. signals and work on a number of outbreak investigations related to *Salmonella* spp. infections. The fellowship allowed her to apply her analytical knowledge to the outbreak investigations at SpF (e.g. creating study protocols, analysing data including building of multivariable regression models, and communicating results).

1.2. Surveillance

Mpox outbreak in France: epidemiological characteristics and sexual behaviour of adult cases aged 15 years and above, May to July 2022

Supervisors: Alexandra Mailles, Florence Lot, Emilie Chazelle

In May 2022, locally acquired mpox cases were detected in various European countries, including France. We described the epidemiological characteristics of mpox cases detected through the French national surveillance system, and trends in sexual behaviour among a subset of cases. We included all cases detected by clinicians or laboratories in France until 30 September 2022. Laboratory-confirmed cases tested positive for mpox or orthopox viruses using PCR; non-laboratory-confirmed cases had clinical symptoms and an epidemiological link to a laboratory-confirmed case. Cases notified up to 1 August were interviewed for demographics, epidemiological information and sexual behaviour. A total of 4 856 mpox cases were reported. Most of the notifications came from the Île-de-France region (62%, 3 025/4 855) and cases were predominantly male (97%, 4 668/4 812) and had a mean age of 37 years (range: 15−81). Between May and July, the geographical distribution of mpox cases increased in regions other than Île-de-France, and the mean (range) age increased from 35 (21−64) to 38 (16−75) years. The proportion of cases frequenting men who have sex with men (MSM) meeting venues decreased from 60% (55/91) in May to 46% (164/359) in July, and median (IQR) number of sexual partners decreased from 4 (1−10) to 2 (1−4). The observed changes in population characteristics could be interpreted as a spread of mpox virus from populations more behaviourally exposed to mpox in May, to less behaviourally vulnerable populations in July. They may also have been due to changes in the behaviour of MSM populations following recommendations to reduce the number of sexual partners.

Role: Catarina performed data entry, participated in the bi-weekly synthesis of mpox situation description, analysed the surveillance data, published a manuscript in a peer-reviewed journal [1] and will present the results at ESCAIDE 2023 [15].

Development and implementation of a new leptospirosis surveillance system

Supervisors: Alexandra Septfons

The aim of this project was to design and implement a new human leptospirosis surveillance system in France. We started by describing the current leptospirosis surveillance system in France, to assess its strengths and weaknesses and the needs for the new system. We did a rapid evaluation of the current system in metropolitan France, including some attributes (usefulness, simplicity, flexibility, data quality, representativeness) and a rapid literature review on the leptospirosis situation (incidence, morbidity, mortality, risk factors, etc) in the world, and more particularly in France. Based on these results, we decided to implement a new surveillance system with mandatory notification. A working group was created with members of the regional offices of SpF, the French national reference centre for leptospirosis and infectious diseases experts. The new surveillance protocol was produced with the objective of allowing for rapid outbreak detection, investigation, and implementation of control measures and preventive campaigns. The data to be collected on each case, the notification form for data collection and the database were created. Implementation of the new surveillance system also included sensitising biologists and clinicians to the disease and explaining how to declare. Staff of the laboratories and regional offices of SpF who will be responsible for ensuring that the system is implemented were also trained.

Role: Catarina drafted the implementation report [10], notification form and sensitisation/information sheets for partners of the surveillance systems.

Development and implementation of an active surveillance system for detection of human cases of highly pathogenic avian influenza infection
Supervisors: Sibylle Bernard-Stoecklin, Alexandra Septfons

The aim of this project was to design and implement an active surveillance system for detection of human cases of highly pathogenic avian influenza infection (HPAI) in France, among people occupationally exposed to infected farmed animals (poultry and/or swine). This decision was made because this was an epizootic of unprecedented intensity in wild and domestic birds, with a wide geographical spread. Moreover, HPIA infection was detected in humans (around 10 cases since 2021) and among a wide diversity of non-human mammal species (e.g. farmed mink in Spain, cats in Poland, France, Canada, USA and Italy). ECDC had recommended the implementation of active surveillance systems across Europe, for detection of human cases exposed to birds infected with HPAI. A working group was created with members of SpF, human and animal reference laboratories, veterinary services and other institutions (including infectiologists). The new surveillance protocol was designed to allow for rapid human case detection, treatment, and implementation of control measures and preventive campaigns, as well as to decrease the risk of sample contamination. The data to be collected on each investigated subject, the questionnaires for data collection and the database were created. The implementation of the new surveillance system also included sensitising doctors, veterinarians, and farmers to make them aware of the disease.

Role: Catarina contributed to the drafting of the surveillance protocol, prepared documentation for ethical approval, prepared future communication for cases and the media, and participated in meetings with partners involved in the implementation of the new system.

Surveillance of dengue in French Guiana
Supervisors: Tiphanie Succo and Luisiane Carvalho

There has been a significant increase in confirmed dengue cases in French Guiana since the beginning of 2023. The main circulating serotype is DENV-3, which has not been observed in the region in the past two decades. Initially, sporadic transmission occurred, but in March/June 2023 it escalated into outbreaks in two communities: Kourou and Saint-Laurent-du-Maroni. As a result, SpF regional office requested support for surveillance of an upcoming generalised dengue outbreak in July 2023. The aim of this assignment was to support the French Guiana regional team with the activities related to dengue surveillance and other relevant events, such outbreak investigations.

Role: Catarina managed the routine dengue surveillance data, analysed the data, evaluated time trends regarding number of cases, hospitalisations and deaths, produced weekly reports-bulletins [12 and 13] and a report [14], and presented the data to local experts, stakeholders, decision makers and Brazilian collaborators [23].

Educational outcome
Through the day-to-day activities at SpF, Catarina gained valuable knowledge of the collaboration between SpF and its various partners – i.e. the French General Directorate for Agriculture (DGAL) and Fair Trading, Consumer Affairs and Fraud Control (DGCCRF), laboratories, French regional health agencies and the Ministry of Health, including their roles and methods of communication. The fellowship allowed her to apply her analytical and epidemiological knowledge of surveillance data at SpF - for example with the analysis of mpox data. She also experienced a regional perspective by carrying out dengue surveillance at the French Guiana SpF regional office.

2. Applied public health research

Effectiveness of COVID-19 vaccination against symptomatic infection and hospitalisation in France: nationwide retrospective cohort study
Supervisors: Daniel Levy-Bruhl, Isabelle Parent

In September 2021, at the start of this project, several studies had shown a waning of vaccine-induced immunity from five months after the second dose, raising concerns about the duration of protection. However, there is still insufficient evidence to determine when the waning of vaccine-induced immunity occurs, and what the impact of the omicron variant is on vaccine effectiveness. We aimed to evaluate overall effectiveness of COVID-19 vaccination against symptomatic infections and hospitalisations, using three exhaustive national information systems dedicated to COVID-19 data (vaccination dataset VAC-SI, testing records SI-DEP, and hospitalisation records SI-VIC). This was a retrospective cohort study, including healthcare system users aged 12–74 years who had been vaccinated against COVID-19 between January 2021 and March 2022. The primary exposure was complete vaccination with a COVID-19 vaccine; each newly vaccinated individual was matched 1:1 to one unvaccinated control for age, sex, department and comorbidities. Primary outcomes were i) SARS-CoV-2 symptomatic infection; ii) critical care admission for COVID-19, and iii) hospital admission for COVID-19. For each matched pair, individuals were followed from start of follow-up, which was the vaccination of the vaccinated individual from the pair, until the earliest – either documentation of outcomes i, ii, or iii; or censoring at disenrollment. To investigate time until SARS-CoV-2 symptomatic infection, a Cox proportional hazard model was used. Vaccine effectiveness (VE) was calculated as one minus the adjusted HR multiplied by 100. Our preliminary results were compatible with the expected VE, but there were some results between October 2021 and March 2022 that we were unable to interpret/explain. For this reason, along with the lack of sufficient computational power to analyse the full datasets, and a very low frequency of outcomes leading to lower statistical power than initially anticipated, this study was deprioritised.

Role: Catarina collaborated in the study conceptualisation, defining the methodology, she also defined the model building strategies, prepared an analysis plan [7], and prepared an extraction protocol, conducted the data management, and prepared an internal report [8].

Seroprevalence of hantavirus in forestry workers, northern France, 2019–2020

Supervisors: Alexandra Septfons

In Eurasia, zoonotic hantaviruses are responsible for mild to severe hemorrhagic fever with renal syndrome. The spatial distribution of haemorrhagic fever with renal syndrome cases is not homogenous in metropolitan France, with detection of human cases being restricted to the north-eastern area (regions of Nord-Pas-de-Calais, Picardie, Franche-Comté). There was little information on the presence of *Puumala orthohantavirus* (PUUV) in French regions that are considered non-endemic. We aimed to estimate the seroprevalence of anti-PUUV antibodies among forestry workers in northern France, and to explore sociodemographic risk factors for seropositivity. We conducted a random cross-sectional seroprevalence survey among 1 777 forestry workers in 2019–2020. The presence of immunoglobulin G against PUUV antigens in serum was assessed using enzyme-linked immunosorbent assay and confirmed using immunofluorescence assay. Poisson regression models were used to explore factors associated with seropositivity. Weighted seroprevalence was 5% (95% confidence interval [CI]: 3–6) in north-eastern France, 4% (95% CI: 2–6) in north central France, and 1% in two regions located in the centre of the country (Auvergne and Limousin). There were no seropositive workers detected in north-western France. Seropositivity was associated with age, sex, and cumulative seniority in the forestry sector. Seroprevalence was highest in known endemic areas of the north-east and lowest in the north-west. Nevertheless, we found serological evidence of PUUV infection in two regions located in the centre of the country, suggesting circulation of the virus in these regions, previously thought to be non-endemic. Practitioners in non-endemic areas should still be aware of the possibility of haemorrhagic fever with renal syndrome cases, especially among patients returning from endemic areas. An improved understanding of hantavirus infection rates in reservoir host species is still needed to fully understand the absence of infection in non-endemic areas.

Catarina collaborated in the study conceptualisation, defining the methodology, and she also defined the model building strategies, conducted the statistical analysis, presented the results to collaborators [19], prepared the original draft of a manuscript, and published the manuscript in a peer-reviewed journal [2].

Analysis of surveillance data to describe the relationship between smallpox vaccination before 1980 and mpox disease severity

Supervisors: Anne-Sophie Barret

Experimental and observational studies have suggested that smallpox vaccines used before 1980 may reduce the risk of Mpox virus infection. The objective of this analysis was to assess the association between reported smallpox vaccination prior to 1980 (recollection of vaccination) and the presence of marked Mpox symptoms (fever, lymphadenopathy and extensive mucocutaneous lesions) presented by confirmed Mpox cases using data from the 2022 national Mpox surveillance. We included all cases detected by clinicians or laboratories in France until 1 August 2022. Cases tested positive for mpox or orthopox viruses by PCR. Cases were interviewed on demographics, epidemiological information and sexual behaviour. We quantified the association between vaccination and presence of marked Mpox symptoms by estimating prevalence ratios (PR) and 95% confidence intervals (CI) using Poisson regression models with robust standard errors. There were 1 916 confirmed cases of Mpox virus infection notified between 7 May and 31 July 2022. Among cases that provided information about their vaccination status, 84% (1 262/1 497) reported being unvaccinated and 16% (235/1 497) reported vaccination before 1980. Overall, 7% (95/1 419) presented marked Mpox symptoms. The proportion of marked symptoms was 3% (5/195) in cases reporting smallpox vaccination before 1980 and 8% (76/974) in cases who reported no vaccination (p-value=0.004). Specifically, the proportion of marked symptoms was three times greater among cases reporting no smallpox vaccination than in cases reporting previous vaccination (PR 0.35, 95% CI: 0.14−0.87; p-value=0.023). Our results indicated that smallpox vaccination during childhood appears to attenuate the clinical expression of Mpox virus infection.

Role: Catarina analysed the surveillance data, she drafted a letter to the Ministry of Health [9] and a manuscript to submit to a peer-reviewed journal as first author [5].

Educational outcome

Catarina had a great deal of experience in applied research, due to her PhD and previous professional experience., Catarina was able to apply her analytical and epidemiological knowledge in the day-to-day activities at SpF.

Catarina engaged in different steps of operational research, strengthening her skills in teamwork, communication with stakeholders, report and article writing, preparing analysis protocols, using large datasets, including overcoming computational difficulties, and communicating the results.

3. Teaching and pedagogy

IDEA

IDEA is a course given once a year by the School of Public Health in Rennes (EHESP) in partnership with SpF. This is a three-week field epidemiology introductory course, based on the CDC field introductory course model. The course targets public health students from the mastère spécialisé de Santé publique CNAM-Pasteur (as part of their course), public health professionals from SpF, from the Ministry of Health, and from other institutions. There were 45 participants in total. The fellow facilitated five case studies and gave two lectures during the first week of the 2023 IDEA training course at EHESP. Case studies included norovirus, *Trichinella* and Chikungunya outbreak investigations, and public health research on malaria and on the association between tobacco and lung cancer. Lectures covered the basis of surveillance (45 min), and the designing of questionnaires (60 min).

Educational outcome

This teaching assignment was a good opportunity for the fellow to revise surveillance concepts and to convey these in a teaching context. By going through various other presentations and materials on the topics, the fellow became familiar with several examples of the usefulness of surveillance in describing trends and identifying outbreaks. The fellow could also deepen and share the knowledge gained during the fellowship on the French public health surveillance systems.

4. Communication

8.1 Publications related to the EPIET fellowship

8.1.1 Manuscripts published in peer-reviewed journals

1. Krug C, Tarantola A, Chazelle E, Fougère E, Velter A, et al. Mpox outbreak in France: Epidemiological characteristics and sexual behaviour of cases aged 15 years or older, 2022. Eurosurveillance. Accepted for publication on 21/04/2023.
2. Krug C, Rigaud E, Siby-Diakite D, Benezet L, Papadopoulos P, et al. Seroprevalence of Hantavirus in Forestry Workers, Northern France, 2019–2020. 2023. Viruses, 15(2), 338. https://www.mdpi.com/1999-4915/15/2/338
3. Krug C, Jourdan-da Silva N, Tourdjman M, Mariani-Kurkdjian P, Cointe A, et al. Outbreak of Shiga Toxin-Producing Escherichia coli infections associated with frozen pizzas – France, 2022. To be submitted for publication.
4. Krug C, Fournet N, Serre E, Guibert V, Ravel M, et al. Two outbreaks of multiple Salmonella enterica serotypes associated with sesame-based products in France and Canada, 2022. In preparation.
5. Krug C, Chazelle E, Noel H, Parent I, Zanettti L, et al., Smallpox vaccination prior to 1980 decreases the severity of Mpox virus infections among cases notified in France, from May to July 2022. In preparation.

8.1.2 Other reports

6. Multi-country outbreak of *Salmonella* Virchow ST16 infections linked to the consumption of meat products containing chicken meat (available on ECDC website), 2023: https://www.ecdc.europa.eu/en/publications-data/salmonella-virchow-st16-chicken-meat
7. Analysis plan 'Protocole d'estimation de l'efficacité vaccinale contre l'infection symptomatique au SARS-CoV-2 et contre une hospitalisation au sein de la population française âgée de 12 à 74 ans'. Santé publique France, November 2021
8. Internal report 'Protocole 4 : Estimation de l'efficacité vaccinale contre l'infection symptomatique au SARS-CoV-2 et contre une hospitalisation au sein de la population française âgée de 12 à 74 ans'. Santé publique France, February 2023
9. Letter to the Ministry of Health 'Etude de l'association entre vaccination antivariolique antérieure à 1980 et la sévérité des infections par le virus de la variole du singe (mpox) parmi les cas notifiés en France, de mai à juillet 2022, analyse préliminaire'. Santé publique France, September 2022
10. Implementation report 'Développement et mise en place d'un système de surveillance pour la leptospirose'. Santé publique France, July 2023
11. Internal report: Suspicion TIAC Santé publique France, Juin-Juillet 2023. Santé publique France, in preparation
12. Bi-weekly report-bulletin 'Point épidémiologique de la dengue' number 6. Santé publique France, July 21 2023 https://www.santepubliquefrance.fr/regions/guyane/documents/bulletin-regional/2023/situation-epidemiologique-de-la-dengue-en-guyane.-point-au-21-juillet-2023
13. Bi-weekly report-bulletin 'Point épidémiologique de la dengue' number 7. Santé publique France, August 4 2023 https://www.santepubliquefrance.fr/regions/guyane/documents/bulletin-regional/2023/situation-epidemiologique-de-la-dengue-en-guyane.-point-au-4-aout-2023
14. End of international assignment report. Santé publique France, August 2023 (in preparation).

8.2 Conference presentations

15. European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) November 2023, Barcelona, Spain. Mpox outbreak in France: the association between reported sexual activity and epidemiological characteristics of male cases aged 15 years and above, 2022. Poster presentation.
16. European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) November 2022, Stockholm, Sweden. An outbreak of *Escherichia coli*-associated haemolytic uremic syndrome linked to consumption of an unexpected food vehicle, France 2022. Poster presentation.
17. Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET), September 2022, Panama City, Panama. An outbreak of *Escherichia coli*-associated Haemolytic Uremic Syndrome linked to consumption of an unexpected food vehicle, France 2022. Oral presentation.

8.3 Other presentations

18. Oral presentation 'Leadership in Public Health' at the Management, Leadership and Communication in Public Health EPIET module.
19. Oral presentation 'Seroprevalence of hantavirus forestry workers in northern France – Presentation of preliminary results to collaborators', May 2022, virtually.
20. Oral presentation 'Investigation of a HUS national outbreak caused by STEC *Escherichia coli* O26 – Presentation of results to GRIPPENET collaborators', Dec 2022, virtually.
21. Oral presentation 'Investigation of a HUS national outbreak caused by STEC *Escherichia coli* O26 – Presentation of results to GRIPPENET collaborators', January 2023, virtually.
22. BFM TV appearance 'Pizzas contaminées: comment les épidémiologistes ont enquêté' on 17 April 2022: https://www.bfmtv.com/sante/pizzas-contaminees-comment-les-epidemiologistes-ont-enquete_VN-202204170017.html
23. Oral presentation 'Réunion mensuelle situation épidémiologique guyane' for a discussion between French Guiana and Brazil on ongoing cases of arbovirosis, 3 August 2023, virtual.

9. EPIET/EUPHEM modules attended

1. Introductory course, part I, 21 September 2021 to 8 October 2021, virtual.
2. Inject day on Phylogeny and Whole Genome Sequencing, 20 October 2021, virtual.
3. Inject day on Operational Research, 27 October 2021 to 28 October 2021, virtual.
4. Outbreak Investigations, 6 December 2021 to 10 December 2021, virtual.
5. Multivariable Analysis, 14 March 2022 to 18 March 2022, virtual.
6. Inject day on Multivariable Analysis, 30 March 2022, virtual.
7. Introductory course, part II, 20 April 2022 to 22 April 2022 Spetses, Greece.
8. Mid-term project review, 25 April 2022 to 29 April 2022, Spetses, Greece.
9. Rapid assessment and survey methods (RAS), 6 June 2022 to 10 June 2022, Stockholm, Sweden.
10. Project review, 29 August 2022 to 2 September 2022, Lisbon, Portugal.
11. Time series analysis, 7 November 2022 to 11 November 2022, Bilthoven, The Netherlands.
12. Vaccinology, 13 February 2023 to 17 February 2023, virtual.
13. Management, Leadership and Communication in Public Health (MLCPH), 8 May 2023 to 12 May 2023, Stockholm, Sweden.
14. Project review, 28 August 2023 to 1 September 2023, Lisbon, Portugal.

10. Other training

1. PUBMED (by SpF), 11 October 2021, virtual.
2. SCOPUS (by SpF), 12 October 2021, virtual.
3. COVID-19 vaccine effectiveness (by ECDC), 15 October 2021, virtual.
4. French grammar (by Alliance Française), 27 October 2021, 2 November 2021, 4 November 2021 and 5 November 2021, Paris, France.
5. Writing Case Studies Global Workshop (by WHO), 8 December 2022, virtual.
6. Architecture and data of the National Health Data System, SNDS (Architecture et données du Système National des Données de Santé, SNDS), 25 January 2023 to 30 January 2023, virtual.
7. SAS Entreprise Guide – Using the software SAS for analysis of data of the National Health Data System (SNIIRAM), 7 March 2023, Paris, France.
8. Individual National Health Data (SNIIRAM) data, 8 March 2023 to 10 March 2023, Paris, France.

11. International assignments

18 July 2023 – 4 August 2023, Cayenne, France.

Acknowledgements