



Summary of work activities

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European Public Health Microbiology Training
Programme (EUPHEM), 2019 cohort

Background

According to the European Centre for Disease Prevention and Control (ECDC) Advisory Group on Public Health Microbiology ('national microbiology focal points'), public health microbiology is a cross-cutting area that spans the fields of human, animal, food, water and environmental microbiology, with a focus on human population health and disease. Its primary function is to improve health in collaboration with other public health disciplines, in particular epidemiology. Public health microbiology laboratories play a central role in detection, monitoring, outbreak response and the provision of scientific evidence to prevent and control infectious diseases.

European preparedness in responding to new infectious disease threats requires a sustainable infrastructure capable of detecting, diagnosing and controlling infectious disease problems, including the design of control strategies for the prevention and treatment of infections. A broad range of expertise, particularly in the fields of epidemiology and public health microbiology, is necessary to fulfil these requirements. Public health microbiology provides experts in all relevant communicable diseases at the regional, national and international level with the tools they need to mount rapid responses to emerging health threats. This enables them to plan appropriate prevention strategies, assess existing prevention disciplines, develop microbiological guidelines, evaluate/produce new diagnostic tools, assess risks from microbes or their products and provide pertinent information to policy makers from a microbiological perspective.

According to Articles 5 and 9 of ECDC's founding regulation (EC No 851/2004) 'the Centre shall, encourage cooperation between expert and reference laboratories, foster the development of sufficient capacity within the community for the diagnosis, detection, identification and characterisation of infectious agents which may threaten public health' and 'as appropriate, support and coordinate training programmes in order to assist Member States and the Commission to have sufficient numbers of trained specialists, in particular in epidemiological surveillance and field investigations, and to have a capability to define health measures to control disease outbreaks'.

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

This report summarises the work activities undertaken by Kamelia Stanoeva, cohort 2019 of the European Public Health Microbiology Training Programme (EUPHEM) at the National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu (RIVM)), Bilthoven, the Netherlands.

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Kamelia Stanoeva completed her medical studies (MD) in 2012 at the Medical University-Sofia, Bulgaria, and also holds degrees in ecology (BSc) and molecular biology – virology (MSc) with thesis work completed in the National Center of Infectious and Parasitic Diseases (NCIPD), Bulgaria. She continued her work in the virology and translational research fields in the Japanese Center for AIDS Research, where she successfully pursued a 'Translational Research for eradication of AIDS' doctoral course for medical doctors. She obtained her PhD from Kumamoto University in 2018 with a thesis on HIV DNA reservoirs. Prior to the EUPHEM fellowship, Kamelia was an Endeavour postdoctoral research fellow at the School of Public Health, University of Queensland, Australia. She returned to Europe to train further as a public health microbiologist under the EUPHEM programme with the objectives of broadening her public health experience and bridging it to her laboratory and medical background.

All EUPHEM activities aim to address different aspects of public health microbiology and underline the various roles of public health laboratory scientists within public health systems.

Methods

This report accompanies a portfolio demonstrating the competencies acquired during the EUPHEM fellowship by working on various projects, activities and theoretical training modules.

Projects included epidemiological investigations (outbreaks and surveillance); applied public health research; applied public health microbiology and laboratory investigation; bio-risk management; quality management; teaching and public health microbiology management and the summary and communication of scientific evidence and activities with a specific microbiological focus.

The outcomes include publications, presentations, posters, reports and teaching materials prepared by the fellow. The portfolio presents a summary of all work activities conducted by the fellow, with the exception of those prohibited for reasons of confidentiality.

Results

The objectives of these core competency domains were achieved partly through project or activity work and partly through participation in the training modules. Results are presented in accordance with the EUPHEM core competencies, as set out in the EUPHEM scientific guide¹.

1. Epidemiological investigations

1.1. Outbreak investigations

COVID-19 pandemic, the Netherlands 2020-2021

Supervisors: Chantal Reusken, Titia Kortbeek

In 2019 a novel human pathogenic coronavirus, later named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged in Wuhan, China, leading to a worldwide outbreak, declared a public health emergency of international concern on 30 January 2020 and a pandemic on 11 March 2020. In the Netherlands, the first cases were registered in February 2020, followed by an increase in the number of infected people and different degrees of prevention and control measures, including lockdowns in March-May 2020 and October 2020-March 2021. Vaccinations started in January 2021. Steps 1 to 4 of the reopening plan were introduced in April-June 2021, followed by an increase in cases and re-introduction of control measures in July 2021.

The fellow's objective was to support the laboratory response to the pandemic. In the beginning of the pandemic, the fellow was tasked with monitoring the laboratory detection methods, summarising the information, and reporting to various COVID-19 related team meetings. The results were further aggregated, analysed and compiled into a literature review (1, 2). The outcome of these activities helped to increase the understanding on SARS-CoV-2 detection via molecular assays and was further incorporated in RIVM reports and guidance documents. Kamelia was also invited to contribute to an RIVM letter report providing background information on SARS-CoV-2/COVID-19 to the Health Council of the Netherlands (9). The fellow took part in a COVID-19 literacy journal club and contributed to the internal bulletins for the Center for Infectious Disease Control (10). Several months into the pandemic, the fellow became part of the RIVM team following up the first COVID-19 re-infections in the Netherlands (12). Last but not least, the fellow supported the teams working on the validation of rapid antigen tests both at the RIVM and in partner organisations.

The fellow was involved in various activities related to the COVID-19 pandemic response in the Netherlands: she searched, analysed and summarised literature, and prepared and submitted a literature review to a peer-reviewed journal (1, 2). Moreover, Kamelia contributed to RIVM SARS-CoV-2/COVID-19 reports and bulletins, both for internal

¹ European Centre for Disease Prevention and Control. European public health training programme. Stockholm: ECDC; 2013. Available from: <http://ecdc.europa.eu/en/publications/Publications/microbiology-public-health-training-programme.pdf>

and external use (9, 10). She also participated and contributed to diverse COVID-19 related teams, prepared an abstract and presented orally at the ECCVID 2020 conference (12), translated protocols, and assisted fact-checking. The fellow also participated in a field activity in October 2020 on validating antigen tests coordinated by Zsófia Iglói (EUPHEM alumna) working with a partner organisation (Erasmus University Medical Center, Rotterdam).

COVID-19 outbreak in a meat processing plant, the Netherlands, 2020

Supervisors: Eelco Franz

In May-June 2020, an increased incidence of SARS-CoV-2 infections was notified amongst workers in a meat-processing facility in the Netherlands. An outbreak investigation was conducted in partnership with the municipal health service GGD Hart voor Brabant, the Institute for Risk Assessment Sciences, Utrecht University, and the Erasmus University Medical Center, Rotterdam. As part of the investigation, a cross-sectional study was performed in June 2020 aiming to assess the situation after the initial control measures' implementation and assess the possibility of environmental transmission in the factory. The screening included surveying the participants (questionnaires in five languages), collecting oro-nasopharyngeal swabs and performing environmental sampling (sampling of stationary and personal air, settling dust, ventilation systems, sewage, swabbing of high-touch surfaces and workers' hands). The results showed overall low numbers of workers testing positive for SARS-CoV-2 RNA (predominantly working in cooled production rooms), as well as low positivity rate from the environmental sampling, likely related to the prevention and control measures in place. The results were further used to inform a working group assessing the risks of COVID-19 among workers in the food industry.

The fellow participated in the development, translation and subsequent data analysis of study questionnaires, analysed the participants' laboratory samples results, and wrote an outbreak report. Language proofreading of the study questionnaires was performed with the kind collaboration of the following EPIET colleagues as native speakers: Łukasz Henszel (Cohort 2018) and Annamária Ferenczi (Cohort 2019). The work was also presented by the fellow as a poster during the ESCAIDE 2020 conference (13) and submitted for publication in a peer-reviewed journal (3, 4).

Training modules related to the assignment/projects

EPIET/EUPHEM Introductory Course - The EPIET/EUPHEM Introductory Course introduced the main concepts of outbreak investigations, study designs, and analysis. The fellows were able to familiarise themselves with the 10 steps of outbreak investigations and to practise analysis of data from outbreaks in case studies. Those core outbreak investigation skills were used in the assignments.

Outbreak Investigation Module – this was the main module to prepare fellows for outbreak investigations. It built on the EPIET/EUPHEM introductory course and deepened the fellows' understanding of outbreak investigations, including through a gastroenteritis outbreak case study. The module's content on statistical analysis and outbreak report-writing were used in the assignments.

Multivariable Analysis Module – this module built on the EPIET/EUPHEM introductory course and deepened the fellows' statistical skills. The module was useful for outbreak investigations as it allowed for a more in-depth analysis of any analytical studies done during outbreak investigations. The module's content on statistical analysis was used in the assignments.

Rapid Assessment and Survey Methods module – this module covered aspects of (survey) sampling, including spatial sampling, surveillance and response in (complex) emergencies, risk assessment and risk communications. As such, the module provides valuable skills and knowledge for outbreak investigations, particularly in emergency settings.

Educational outcome

Kamelia developed skills in applying microbiological knowledge as part of outbreak investigations, and also broadened her theoretical and practical knowledge on the core related epidemiological concepts. The fellow participated in an outbreak investigation team, as well as in diverse laboratory response activities in the course of the pandemic. She prepared and presented conference abstracts, an oral presentation and a poster, as well as manuscripts for peer-reviewed journals.

1.2. Surveillance

Haemophilus influenzae B in the Netherlands in 2020: surveillance data analysis

Supervisors: Mirjam Knol, Anneke Steens

Vaccination against Haemophilus influenzae b (Hib) disease has been included in the national immunisation program since 1993 and the vaccination coverage is >90%. An invasive infection with Hib is notifiable and typing is usually performed at the Netherlands' Reference Laboratory for Bacterial Meningitis, based at the Amsterdam UMC. An increase in Hib cases was observed in the Netherlands in 2020. The main objective of the project was explorative and descriptive analysis, aiming to describe situation in terms of time, place and cases' characteristics and compare with surveillance records for prior years. Descriptive and preliminary time-series analysis was performed using available national surveillance data from 2003 onwards. Incidence by age groups and vaccination status vaccine-eligible cases (born after 1993 and >3 months old) in 2020 was compared with 2015-2019 data. Hib incidence was also compared

between municipalities with low vaccination coverage and the rest of the country. The results of the study will be further used to explore the reasons behind the increase of Hib cases in 2020 and follow-up in 2021.

The fellow performed the statistical analysis using R (RStudio), prepared and submitted an abstract to an international conference (not accepted), and provided preliminary analysis data to be used in further analyses and a manuscript submission to a peer-reviewed journal (5).

Surveillance of respiratory disease associated with non-polio enteroviruses (ENPEN network)

Supervisors: Kim Benschop

Although poliovirus has nearly been eradicated worldwide through vaccination, non-polio enteroviruses (NPEV) continue to circulate and could cause severe outbreaks with a variety of respiratory and/or gastrointestinal symptoms. The project is part of the European Non-Polio Enterovirus Network (ENPEN) activities covering several streams such as respiratory infections, neurological infections, and hand-foot-and-mouth disease. This project in particular falls in the domain of respiratory diseases and focuses on establishing surveillance of NPEV in the European region and thus estimating the disease burden, incidence, clinical characteristics, and epidemiology of associated respiratory infections in children and adults. The project plans include a pilot and full study phase designed as a prospective, multi-centre, cross-sectional study over a one-year period. Due to the COVID-19 pandemic, the roll-out of both was postponed. The expected outcomes of the project include providing extended information on respiratory NPEV infections in Europe that could be used in developing clinical guidelines and disease prevention and control measures.

The fellow participated in the preparations phase and assisted the ENPEN respiratory surveillance stream coordinator in preparing protocol annexes, data management plan, data sharing agreements and submissions for ethical approval. The fellow worked on setting up an electronic systems for the participation forms and the electronic clinical research forms to be used for collecting data from the participating centres across Europe.

Enteric viruses in sewage in the Netherlands in 2020: surveillance data analysis

Supervisors: Erwin Duizer, Kim Benschop

Enteric viruses invade and replicate in the mucosa of the intestinal tract and can be excreted in the feces. Sewage sampling and monitoring is therefore a useful way to track enteric infections, even if cases have not sought medical advice and were not detected by other surveillance systems in place. Considering the COVID-19 pandemic and the related public health measures, 2020 was an unusual surveillance year. The incidence of reported respiratory and enteric viruses dramatically decreased, leading to questions regarding to what extent this was due to a true decrease or to reduced access to testing services. In the Netherlands, periodic collection of sewage samples is carried out at several collection points throughout the country. This project aimed at analysing the sewage sampling data on selected enteric viruses (entero-, adeno-, noro-, rota-, sapo-, parecho- viruses) in the Netherlands in 2020 and comparing them with the general surveillance data. Available sewage samples were tested via PCR assays and the results were summarised in a dataset. Both datasets on sewage and routine surveillance were cleaned and preliminary analysis was performed. Further analysis of the data is expected to confirm the enteric viruses incidence trends in 2020, identify any irregularities, and provide more detailed information derived from the sewage sampling.

The fellow merged and cleaned datasets from the routine national virologic surveillance and the sewage sampling collected in 2020. Preliminary statistical analysis was performed that could serve as basis for further analysis.

Training modules related to the assignment/projects

EPIET/EUPHEM introductory course – the introductory course familiarised the fellows with the core concepts of surveillance. It covered the development and evaluation of a surveillance system as well as key aspects of the analysis of surveillance data. The latter were applied during projects data analyses.

Multivariable Analysis Module – this module built on the EPIET/EUPHEM introductory course and deepened the fellows' statistical skills. The module introduced a variety of regression methods that can be applied for surveillance data analysis. The module's content on statistical analysis was used in the assignments.

Time Series Analysis module – this module built on the EPIET/EUPHEM introductory course and the Multivariable Analysis Module. It was a cornerstone in preparing the fellows for a more in-depth analysis of surveillance data. The module's content on statistical analysis was used in the assignments.

Project Review Module – this module was predominantly aimed at preparing fellows for presenting at ESCAIDE. However, presenting and discussing ongoing projects was also possible. The module was used as a forum for fellows to workgroup, peer-review and provide feedback and comments on a project.

Educational outcome

Kamelia was involved in different aspects and stages of surveillance activities: from study preparation and planning data entry for future multinational surveillance systems to interpretation of national surveillance system data, analysing datasets while understanding the surveillance system limitations and hypothesizing on the related events factors. The fellow took several R courses, enriched her statistical analysis skills and applied them in the projects. The fellow prepared conference abstracts, as well as a manuscript for a peer-reviewed journal.

2. Applied public health research

PIENTER-3 parasitology analysis

Supervisors: Titia Kortbeek, Ingrid Friesema

The protozoan *Toxoplasma gondii* is a zoonotic and ubiquitous parasite infecting about one third of the global human population. It is estimated that it affects more than two million people in the European region annually. In the Netherlands a continuous evaluation of toxoplasmosis seroprevalence and risk factors is carried out thanks to the nationwide serosurveys (PIENTER), held every 10 years. The objectives of this study were to analyse the data collected in the third national serosurvey, PIENTER-3, estimate the seroprevalence of antibodies against *T. gondii*, using an in-house ELISA IgG assay, as well as monitor the seroprevalence dynamics and risk factors in the span of the three national serosurveys period (1996/1997 -2016/2017). The results of the study allowed for better understanding of the prevalence of toxoplasmosis: age-related seroprevalence dynamics in a 20-year timespan and associated risk factors for seropositivity in the Netherlands, and could serve as basis for decision-making on prevention and control measures both nationally and abroad.

The fellow wrote a protocol, performed the laboratory data-checking and initial cleaning, and participated in the statistical analysis led by an epidemiologist colleague. The work was presented at a national conference by a team member (14) and to an international one by the fellow (15). A manuscript is currently in preparation (6).

Training modules related to the assignment/projects

EPIET/EUPHEM Introductory Course – the introductory course familiarised the fellows with the core concepts of operational and applied research. It covered the development of study protocols and the drafting of aims and objectives relevant to a national public health institute as well as data analysis and presentation skills.

Multivariable Analysis Module – this module built on the EPIET/EUPHEM introductory course and deepened the fellows' statistical skills. The module introduced a variety of regression methods that can be applied for data analysis, further covered in the Time Series Analysis module. The module's statistical analysis content was used in the research project.

Time Series Analysis module – this module built on the EPIET/EUPHEM introductory course and the Multivariable Analysis Module. It was a cornerstone in preparing the fellows for more in-depth data analysis. Parts of the module's statistical analysis content were used in the research project.

Educational outcome

The fellow further developed her research skills for targeted application in the public health microbiology context, applying both laboratory and epidemiological skills. Kamelia broadened her skills in conducting a public health research project, working in a multi-disciplinary team and analysing data from different perspectives and via different tools, including statistical analysis with R. The fellow prepared and presented conference abstracts and posters, as well as a manuscript for a peer-reviewed journal.

3. Applied public health microbiology and laboratory investigations

Measles virus identification – rapid differentiation between wild-type and vaccine viruses

Supervisor: Rogier Bodewes

Measles is a highly contagious disease caused by the measles viruses that continue to cause outbreaks despite various elimination efforts and the wide inclusion of the measles vaccine in national immunization schedules. Occasionally, vaccination with the measles virus genotype A vaccine (MeVA) could cause a vaccine reaction with clinical signs similar to infection with wild-type measles virus. Considering guidelines for post-exposure prophylaxis often include immunization, fast differentiation between the two is important for the implementation of prevention and control measures. The aim of the project was to establish a PCR-based protocol for determination of MeVA and wild-type genotype measles virus infections. The use of the validated MeVA RT-qPCR assays in combination with the routine measles virus RT-qPCR was evaluated, suggesting the use of the differences between the RT-qPCR Ct values, delta Ct, as criteria. A series of experiments was performed in order to establish, validate, and test this protocol, including using clinical samples and experimental mixes. The resulting workflow protocol could be used for the exclusion of infection with wild-type measles virus in cases with vaccine-associated measles reaction and is thus potentially applicable in public health laboratories providing support in the management of infectious exanthems.

The fellow performed experiments, analysed results, and participated in the establishment of the workflow protocol. The work was summarised in a manuscript and accepted for publication in a peer-reviewed journal (7).

Training modules related to the assignment/projects

EPIET/EUPHEM Introductory Course – the introductory course familiarised the fellows with the core concepts of public health laboratory investigations. It covered the development of study protocols and the drafting of aims and objectives relevant to a national public health institute as well as data analysis and presentation of the outcomes.

Educational outcome

The fellow further developed her research skills for targeted application in the public health microbiology context, applying both laboratory (Real-time PCR) and data analysis (GraphPad Prism) skills. Kamelia broadened her skills in preparing public health laboratory protocols, working in a team and analysing data from different perspectives. The work was summarised and submitted to a peer-reviewed journal.

4. Biorisk management

The fellow had prior laboratory experience, including working in biosafety level 3 (BSL3) laboratories, before the start of the fellowship. A laboratory induction training was done on joining the training site. Due to the workload caused by the COVID-19 pandemic, projects in areas in which the fellow had less prior experience were prioritised.

Training modules related to the assignment/projects

Biorisk and Quality Management Module – this module was cancelled for Cohort 2019.

Educational outcome

The fellow prepared a project proposal on biorisk management manual, but these activities were cancelled due to the COVID-19 pandemic. The fellow also attended several biorisk and biosecurity seminars and webinars and familiarised herself with key concepts from the field.

5. Quality management

The fellow had prior laboratory experience, including internal and external audit and quality assessment in the laboratory, before the start of the fellowship. A laboratory induction training was done on joining the training site. Due to the COVID-19 pandemic workload, projects in areas where the fellow had less prior experience were prioritised.

Training modules related to the assignment/projects

Biorisk and Quality Management Module – The Biorisk and Quality Management Module was cancelled for Cohort 2019.

Educational outcome

The fellow was an observer in laboratory external quality assessment for the IDS centre and familiarised herself with this EQA workflow and objectives, as well as broadly with laboratory accreditations procedures in the Netherlands.

6. Teaching and pedagogy

Case study facilitation and guest lecture at Radboud UMC, 2019

The fellow facilitated a case study on 'Salmonella in the Caribbean' for third-year Medical and Biomedical Science students, based on WHO and ECDC case study materials, as well as additionally prepared materials. The case study activity was followed by a guest lecture on HIV and personal career advice and were both held on-site on a single day at the Radboud UMC, Nijmegen.

Case study facilitation and guest lecture at Radboud UMC, 2020

The fellow facilitated a case study on 'Salmonella in the Caribbean' for third-year Medical and Biomedical Science students, based on WHO and ECDC case study materials, as well as additionally prepared materials. The case study activity was followed by a guest career talk and both were held in a hybrid manner on a single day: online and on-site at the Radboud UMC, Nijmegen.

Case report scientific writing guidance, 2020-2021

The fellow guided a Master's student from Maastricht University in the analysis and scientific writing of a SARS-CoV-2/COVID-19-related case report. The sessions were held online on multiple days and included guidance on making conclusions based on the laboratory and clinical evidence, structuring a manuscript, choosing an

appropriate peer-reviewed journal, and submitting via the journal's editorial platform. Finally, the discussed case was submitted to a peer-reviewed journal (8).

Case study facilitation at ECDC Introductory Course 3, 2021

The fellow was a case studies facilitator at the one-week ECDC introductory course for EPIET/EUPHEM fellows from Cohort 2020, providing active facilitation for the 'TB in Finland' case study and backup facilitation for the 'Salmonella Kentucky' case study. The materials were developed within ECDC's EPIET/EUPHEM network. The fellow also participated in a teaching and facilitation preparatory week and feedback sessions following the course activities.

Training modules related to the assignment/projects

EPIET/EUPHEM Introductory Course – the introductory course familiarised the fellows with the core concepts of teaching and public health communication. Strategies for effective teaching and evaluation were used in the teaching assignments.

Management, Leadership and Communication in Public Health Module – this module built on the EPIET/EUPHEM introductory course and deepened the fellows' communication skills in the public health context. Project management and feedback tips from it were also used in the teaching assignments.

Educational outcome:

The fellow developed further her teaching skills and engagement in teaching in the public health context. Kamelia appreciated the students' feedback and strived to incorporate it into subsequent teaching assignments.

7. Public health microbiology management

Implications of changing diagnostic approaches for the detection of Giardia and Cryptosporidium for Public Health Management, joint RIVM-RKI project

Supervisors: Titia Kortbeek, Anton Aebischer, Christian Klotz

Intestinal parasitic protozoa can cause severe infections, posing a serious health problem, as well as constituting a threat for outbreaks due to their faecal-oral transmission route. Giardiasis mostly affects infants, young children, travellers, and immunocompromised individuals and, together with Cryptosporidiosis and Rotavirus infections, accounts for the majority of diarrheal disease in children <5 years old. Surveillance, reporting, and infection control practices vary between the countries. The aim of this joint project between EUPHEM fellows at the RIVM (Kamelia Stanoeva) and the Robert Koch Institute (Jennifer Bender) was to conduct nationwide surveys in the Netherlands and Germany aiming to assess the current diagnostic tools in use for both parasites, the rules enforced upon notification and the recommendations for cases found. Questionnaires were developed along with preparing the supporting documentation and initial planning on the institutions to be surveyed. Separate questionnaires were designed for parasitological laboratories and local public health authorities. The roll-out of the survey had to be postponed due to COVID-19 pandemic and the increased workload that the target institutions were experiencing. We hope the project will be continued within the EUPHEM network in the future and provide information and comparison on the public health management of Giardiasis and Cryptosporidiosis, paving the way for harmonisation in recommendations and case management in Germany and the Netherlands.

In collaboration with Jennifer Bender (EUPHEM Cohort 2019), Kamelia designed the questionnaires targeted at laboratories and local public health authorities in both Germany and the Netherlands. In addition, the fellows prepared a joint report on the potential future continuation of the project.

SARS-CoV-2/COVID-19 report to the Health Council of the Netherlands

The Health Council of the Netherlands (Gezondheidsraad) is an independent scientific advisory body whose legal task it is to advise the Dutch ministers and Parliament in the field of public health and health/healthcare research. As part of the activities related to the COVID-19 pandemic the fellow was involved in the work on a COVID-19/SARS-CoV-2 background information RIVM letter report to the Health Council of the Netherlands (9).

Kamelia wrote the section 'Pathogen SARS-CoV-2 virus' and co-authored with a colleague the section on 'COVID-19 disease symptoms and pathogenesis'. The fellow also participated in the reviewing of the complete report.

Infectious diseases early warnings meetings and bulletin

The fellow participated in the weekly infectious diseases early warnings meetings (Signaleringsoverleg Infectieziekten): a national discussion group combining expertise from different fields (epidemiology, public health

microbiology, infectious diseases, infectious disease control, veterinary medicine, environmental sciences and others upon invitation). The tasks of the group include collecting, selecting and summarising infectious diseases signals of public health importance from the Netherlands and abroad. The latter are communicated to the wider infectious diseases professional community nationally through a weekly confidential bulletin. The fellow participated in the weekly meetings and contributed to signals within her expertise (11).

Training modules related to the assignment/projects

EPIET/EUPHEM Introductory Course – this course familiarised the fellows with the core concepts of public health communication and touched upon public health microbiology management.

Management, Leadership and Communication in Public Health Module – this module built on the EPIET/EUPHEM introductory course and deepened the fellows' communication and management skills in the public health context.

Vaccinology – this module, held towards the end of the fellowship, provided a revision and discussion forum on the key concepts in vaccinology, vaccination coverage, and vaccine hesitancy in the context of the current pandemic.

Educational outcome

Kamelia developed skills in public health management throughout the fellowship training, learning both from colleagues at the RIVM and programme training activities. All projects and activities within the fellowship had public health microbiology management elements. Thus, the examples listed above are only a selected part of the related activities. Furthermore, the fellow was also part of a working group and prepared a presentation on the fellows' views and recommendations for the future development of the EPIET/EUPHEM training programmes to the ECDC director (16).

8. Communication

Publications related to the EUPHEM fellowship

1. Stanoeva KR, van der Eijk AA, Meijer A, Kortbeek LM, Koopmans MPG, Reusken CBEM. Towards a sensitive and accurate interpretation of molecular testing for SARS-CoV-2: a rapid review of 264 studies. *Authorea*. 2020 doi: 10.22541/au.160322476.69793622/v1.
2. Stanoeva KR, van der Eijk AA, Meijer A, Kortbeek LM, Koopmans MPG, Reusken CBEM. Towards a sensitive and accurate interpretation of molecular testing for SARS-CoV-2: a rapid review of 264 studies. *Eurosurveillance*. 2021;26(10):2001134 doi: 10.2807/1560-7917.ES.2021.26.10.2001134.
3. De Rooij MMT, Sikkema RS, Bouwknecht M, de Geus Y, Stanoeva KR, Nieuwenweg S, et al. Potential environmental transmission routes of SARS-CoV-2 inside a large meat processing plant experiencing COVID-19 clusters. *medRxiv*. 2021:2021.06.20.21259212.
4. De Rooij MMT, Sikkema RS, Bouwknecht M, de Geus Y, Stanoeva KR, Nieuwenweg S, et al. Potential environmental transmission routes of SARS-CoV-2 inside a large meat processing plant experiencing COVID-19 clusters. Submitted. 2021
5. Steens A, Stanoeva KR, Knol MJ, Mariman R, de Melker HE, van Sorge NM. Increase in invasive disease caused by *Haemophilus influenzae* b, the Netherlands, 2020 to 2021. *Eurosurveillance*. 2021;26(42):2100956 doi: 10.2807/1560-7917.ES.2021.26.42.2100956.
6. Van den Berg O, Stanoeva KR, Zonneveld R, Hoek-van Deursen D, van der Klis F, Franz E, Opsteegh M, van der Giessen J, Friesema I, Kortbeek LM. *Toxoplasma gondii* seroprevalence and risk factors in the Netherlands: third national study results. In preparation. 2021
7. Stanoeva KR, Kohl RHG, Bodewes R. Co-detection of the measles vaccine and wild-type virus by real-time PCR: public health laboratory protocol. *Access Microbiology*. 2021;3(11) doi: 10.1099/acmi.0.000283.
8. Theuws S, Stanoeva KR, Lestrade PPA, Wouda S, Vennema H, Cremer J, et al. Evidence of SARS-CoV-2 RNA in utero after an at term delivery: a case report from the Netherlands. Submitted. 2021

Reports

9. Centrum Infectieziektebestrijding (CIb). COVID-19 / SARS-CoV-2 Background information for the Health Council. RIVM letter report 2020-0151. National Institute for Public Health and the Environment (RIVM); 2020.
10. Centrum Infectieziektebestrijding (CIb). COVID-19 Literacy. Key messages from the literature on COVID-19 (for CIb internal use only). 5th edition. 8 July 2020.
11. Signaleringsoverleg. Wekelijks Overzicht infectieziektesignalen (confidential). 36 ed2020

Conference presentations

12. Stanoeva KR, Kortbeek LM, Voordouw B. COVID-19 reinfection? ESCMID Conference on Coronavirus Disease (ECCVID); 23-25 September 2020; online 2020.
13. Stanoeva K, Duijster J, van Dam S, de Rooij M, Smit L, Bouwknecht M, et al. COVID-19 outbreak among employees of a meat-processing facility in the Netherlands. European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 24-27 November 2020; online 2020.
14. Zonneveld R, Stanoeva K, van den Berg O, Hoek-van Deursen D, van der Klis F, Franz E, et al. Seroprevalence of human Ascaris, Toxocara, and Toxoplasma in the Netherlands: results from the PIENTER-3 study. Scientific Spring Meeting 2021 KNVM & NVMM; 30-31 March 2021; online 2021
15. Stanoeva K, Zonneveld R, van den Berg O, Hoek-van Deursen D, van der Klis F, Franz E, et al. Toxoplasma seroprevalence in the Netherlands: preliminary results from the PIENTER-3 study. 31st European Congress of Clinical Microbiology & Infectious Diseases (ECCMID); 9-12 July 2021; online 2021.

Other presentations

16. De Muylder G, Hoefler A, Johansen T, Stanoeva K. Reflections on the ECDC EPIET/EUPHEM Fellowship. Presentation to the ECDC Director. Stockholm 2020
17. Stanoeva K. ECDC EUPHEM fellowship: Introduction to public health microbiology. Bilthoven 2020

9. Other activities

1. EUPHEM Cohort representative for Cohort 2019 – The fellow served as intermediary between the ECDC fellowship office, the National Focal Points of Training and Training Site Forum, the alumni network (EAN) and the fellows from Cohort 2019 and EUPHEM fellows in particular. In collaboration with the remaining cohort representatives from Cohort 2019 and Cohorts 2018 and 2020, Kamelia represented the interests of the programme fellows, participated in various meetings with the above-mentioned stakeholders, and was involved in the organisation of social events, career events and satisfaction surveys.
2. European Society of Clinical Microbiology and Infectious Diseases (ESCMID) Study Group for Public Health Microbiology (ESGPHM) member – The fellow is a member of the study group and participated in its' activities, for example by contributing to the September 2021 ESGPHM newsletter.

10. EPIET/EUPHEM modules attended

1. EPIET/EUPHEM Introductory Course, 23/09/2019-11/10/2019, Spetses, Greece
2. Outbreak Investigation Module, 09/12/2019-13/12-2019, Nicosia, Cyprus
3. Management, Leadership and Communication in Public Health Module, 10/02/2020-14/02/2020, Stockholm, Sweden
4. Multivariable Analysis Module, 15/06/2020-19/06/2020, online
5. Project Review Module, 24/08/2020-28/08/2020, online
6. Time Series Analysis module, 25/01/2021-29/01/2021, online
7. Rapid Assessment and Survey Methods module, 27/04/2021, 04/05/2021-06/05/2021, online
8. Vaccinology, 14/06/2021-18/06/2021, online

10. Other training

1. RIVM Epi referee, IDS VIR and BAC-PAR, EPIET-EUPHEM joint seminars & webinars series, 09/2019-09/2021, Bilthoven, the Netherlands & online

2. The Netherlands Centre for One Health (NCOH) Science Café 2019, 29/10/2019, Utrecht, the Netherlands
3. Biosecurity kennisdag 2019, 14/11/2019, Amersfoort, the Netherlands
4. European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2019, 26-29/11/2019, Stockholm, Sweden
5. RVP Onderzoeksdag 2020, 07/02/2020, Amersfoort, the Netherlands
6. ECDC COVID-19 surveillance videoconference, EPIET/EUPHEM, 08/06/2020, online
7. Pathways to an HIV cure: tools for community and clinicians, AIDS 2020: Virtual - Pre-Conference, 01-03/07/2020
8. IAS COVID-19 virtual conference, 10-11/07/2020, online
9. ECDC COVID-19 Think Tank teleconference series, 08/2020-06/2021, online
10. NWKV webinar 'SARS-CoV-2 antibodies and beyond: may the force be with you', 08/09/2020, online
11. ESCV Virtual Meeting on Covid-19, 09/09/2020, online
12. ESCMID Conference on Coronavirus Disease (ECCVID), 23-25/09/2020, online
13. WHO COVID-19 Laboratory Community of practice/ Public Health Laboratories webinar series, 09/2020 - 06/2021, online
14. RIVM Enteric theme open webinar, 27/10/2020, online
15. NCOH Annual Scientific Meeting, 29/10/2020, online
16. NVMM-webinar COVID-19 innovative techniques, 05/11/2020, online
17. RIVM en het coronavirus webinar, 09/11/2020, online
18. RIVM Biosecurity in het Onderzoek webinar, 19/11/2020 and 22/04/2021, online
19. NCOH 'Silent pandemic: Antimicrobial Resistance' webinar, 19/11/2020, online
20. European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2020, 24-27/11/2020, online
21. TEPHINET webinar 'How to Increase Your Chances of Being Selected for an International GOARN Response Mission', 02/12/2020, online
22. EUPHA 'Legal Epidemiology and the Path to Better Health Law and Policy' webinar, 21/01/2021, online
23. FETP/EPIET Masterclass: An Introduction to the Behavioural Science of Public Health Emergency Response, 05/02/2021, online
24. Netherlands School of Public & Occupational Health (NSPOH) E-learning COVID-19-vaccinatie, 10/02/2021, online
25. RIVM-webcollege Vaccinatie COVID-19, 11/02/2021, online
26. 7th Dutch Toxoplasma Gondii Working Group Meeting, 02/03/2021, online
27. Dutch Annual Virology Symposium, 05/03/2021, online
28. EAN Go Data webinar, part 1, 16/03/2021
29. WHO Global workshop on enhancing sequencing for SARS-COV-2, 19/03/2021, online
30. WHO 'Global Consultation on a Decision Framework for Assessing the Impact of SARS-CoV-2 Variants of Concern on Public Health Interventions', 29/03/2021, online
31. EAN Go Data webinar, part 2, 30/03/2021, online
32. Pre-ECCMID day: Vaccines, 20/04/2021, online
33. GOARN UN BSAFE, 02/04/2021, online
34. GOARN Tier 1 course 'The Global Outbreak Alert and Response Network(GOARN)', 09/04/2021, online
35. GOARN Tier 1 course 'The Public Health Emergency and Humanitarian Landscape and Architecture', 09/04/2021, online
36. GOARN Tier 1 course 'Working in an International Multidisciplinary Outbreak Response Team', 09/04/2021, online

37. GOARN Tier 1 course 'Working with GOARN in the Field', 09/04/2021, online
38. GOARN Personal well-being for deployment, 09/04/2021, online
39. WHO COVID-19 - Global Research and Innovation Forum, 13-14/05/2021, online
40. RIVM Begin-R cursus, 16/04/2021, online
41. Pre-ECCMID day: Diagnostics, 05/05/2021, online
42. RIVM Tidy-R cursus, 25/05/2021, online
43. RIVM Vis-R cursus, 28/05/2021, online
44. WHO Global Consultation on SARS-CoV-2 Variants of Concern and their Impact on Public Health Interventions, 10/06/2021
45. Pre-ECCMID Day: Antimicrobial Resistance, 30/06/2021, online
46. 31st European Congress of Clinical Microbiology & Infectious Diseases (ECCMID), 9-12/07/2021, online
47. 19th ESCMID Summer School, 4-11/09/2021, Carcavelos, Portugal
48. Dutch language courses A1-C1 levels, 10/2019-09/2021, Amersfoort, the Netherlands & online

Discussion

Coordinator's conclusions

One of the main goals of the EUPHEM programme is to expose fellows to diverse and multidisciplinary public health experiences and activities, thus enabling them to work across different disciplines. This report summarises all activities and projects conducted by Kamelia Stanoeva during her two-year EUPHEM fellowship (cohort 2019) as an EU-track fellow at the National Institute for Public Health and the Environment (RIVM) in Bilthoven, the Netherlands.

Kamelia Stanoeva was already a very accomplished microbiologist with expertise in the area of HIV. She has shown a high level of competency in management and leadership not only when working at her training site but also as a cohort representative. Her dedication and hard work are shown in this portfolio. The laboratory- and epidemiologically-based projects covered a diverse range of disease programmes involving multidisciplinary work and teamwork on all levels, including with physicians, laboratory technicians, epidemiologists, statisticians, government officials, and public health officers, showing the strength of the fellow and her ability to work within such an extended environment. During the two years, she not only achieved her primary objectives but was very productive in many of the areas producing valuable public health-related outputs, contributed to the response to the COVID-19 pandemic in the Netherlands in different areas such as supporting the laboratory response to the pandemic, or investigating a COVID-19 outbreak in a meat processing plant. Her dedication to the objective of the programme and public health went above and beyond the expectations. In addition to COVID-19 response, she took an important role in the surveillance of *Haemophilus influenzae B*, respiratory diseases associated with non-polio enteroviruses and enteric viruses in sewage, and contributed to the training sites' activities by validating a method to distinguish between wild type and vaccine measles viruses. Moreover, Kamelia expanded her research knowledge, participating in a research project on *Toxoplasma gondii* that helped her to not only cover the diseases' groups but also a wide range of pathogens, viruses, bacteria, and parasites, which is particularly remarkable during a pandemic. Finally, I would like to comment on Kamelia's personal attitude toward the fellowship. She was an independent and hard worker, eager to learn and cascade her knowledge and apply her new competences to her projects.

The activities were in line with the 'learning by doing' ethos of the EUPHEM programme and fulfilled the core competency domains described for professionals in their mid-career and above. The activities were complemented by training modules providing theoretical and practical knowledge and skills. The projects had a clear outcome, with results communicated in scientific journals and at conferences. The contributions made by Kamelia with her work at the training site indicates the importance of developing a future critical mass of highly skilled field public health microbiologists within Member States to contribute towards national preparedness as well as being available for responses in the interest of the EU.

The EUPHEM Coordinator Team concludes that the fellow succeeded in performing all her tasks to a very high standard and with a professional attitude. We wish her every success in her future career and congratulate the training site for the successful training of the fellow.

Supervisor's conclusions

Kamelia Stanoeva started her EUPHEM fellowship after five years working in Japan. She had a flying start with her measles work and initiated some projects with other countries. But then COVID-19 changed everything. Due to her remarkable flexibility and proactive attitude, Kamelia was able to start working on SARS-CoV-2, beginning with a major project on finding evidence and literature for SARS-CoV-2 molecular diagnostics and shedding in the first phase of the pandemic. Although the actual publication took some time, the data were very useful for virologists working with SARS-CoV-2. She used her extended network and language skills in a SARS-CoV-2 outbreak investigation in a meat processing facility. The sometime stressful situation due to all the COVID-19 restrictions did not influence her work. She was always willing to help and responded quickly and to the point. Working from a distance was not a problem for Kamelia and she attended many webinars and online meetings. She was able to be trained in R-statistics and collaborated closely with epidemiologists, working on Toxoplasma seroprevalence and Haemophilus influenza surveillance. Her excellent data analytical skills enabled her to contribute to different studies and reports. Her knowledge of a variety of lab techniques made it possible to participate in meetings and contribute to discussions. Kamelia was able to work very efficiently and stimulate others to contribute. In this fellowship, she was not only able to broaden her horizons from virology to public health microbiology but also in public health epidemiology.

Personal conclusions of fellow

During my two-year EUPHEM fellowship, I had the chance to collaborate with and learn from a lot of professionals, allowing me to gain public health experience in a dynamic context, including the COVID-19 pandemic. Working at the RIVM in the Netherlands, I feel I gained valuable public health insight not only on a national level, but also on local and European levels. It was a unique postgraduate European training opportunity that has broadened my multidisciplinary skills across the fields of public health microbiology and infectious diseases epidemiology. Moreover, I have become part of an active network and cohort of public health professionals, and I look forward to continuing our collaborations and friendship beyond the fellowship term. As one of the cohort representatives, I hope I was successful in creating bridges and communication channels between us, cohort 2019 fellows, our peers from other cohorts, the ECDC programme office and the EAN alumni network. I am extremely grateful for the ECDC EUPHEM fellowship, hosted by the RIVM, and will aim to contribute to the ever-changing public health microbiology field and to the great community of public health professionals that I am proud to now be part of.

Acknowledgements of fellow

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