

Bojana Mahmutović

The European Programme for Intervention Epidemiology Training (EPIET), Cohort 2020
CROATIAN INSTITUTE OF PUBLIC HEALTH, Croatia

Background

The ECDC Fellowship Programme is a two-year competency-based training with two paths: the field epidemiology path (EPIET) and the public health microbiology path (EUPHEM). After the two-year training, EPIET and EUPHEM graduates are considered experts in applying epidemiological or microbiological methods to provide evidence to guide public health interventions for communicable disease prevention and control. The Administrative Decisions ECDC/AD/2023/23 and ECDC/AD/2023/06 govern the EU-track and MS-track, respectively, of the ECDC Fellowship Programme, field epidemiology path (EPIET) and public health microbiology path (EUPHEM).

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

Pre-fellowship short biography

Bojana Mahmutović, from Zagreb, Croatia, has worked at the Institute of Public Health in Krapina-Zagorje County as an epidemiology specialist. She has a medical degree from the University of Zagreb, School of Medicine and has a Master's degree in epidemiology.

From 2012 to 2014 she worked as a General Practitioner (GP) in the Municipality of Stubičke Toplice in Krapina-Zagorje County, where she was, amongst others, engaged in educating the local population about public health topics and was responsible for health control and surveillance of the local kindergarten.

Since 2014, she has been working in the Epidemiology Department of the Institute of Public Health in Krapina-Zagorje County. In her daily work, she is responsible for monitoring and surveillance of communicable and vector-borne diseases, providing compulsory and voluntary vaccinations, educating parents who refuse to vaccinate their children, providing expert consultations and vaccinations to travellers and specific occupational groups, teaching courses, and conducting health monitoring of public and occupational populations regarding food safety.

From October 2021 to June 2022, she worked as the President of the Supervisory Board of the Health Centre in Krapina-Zagorje County. In this role, she supervised the institution's financial and professional operations and management, including the employment of health workers, financial management, and the development of the institution's strategic plans.

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Bojana started the EPIET Fellowship in September 2020, as the epidemiology resident at the Croatian Institute of Public Health, at the beginning of the COVID-19 pandemic, being the first cohort that had an Introductory Course and almost the whole Fellowship, online.

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 following the EPIET core competencies, as set out in the ECDC Fellowship Manual¹.

1. Epidemiological investigations

1.1. Outbreak investigations

Potential impact of SARS-CoV-2 B.1.1.7 variant in school settings – results from an outbreak investigation in Croatia, March 2021

Supervisor: Goranka Petrović

On 2 March 2021, a COVID-19 outbreak was reported in a fourth-grade class in a primary school in Zabok, Croatia. The rapidly evolving situation raised the suspicion of a more infectious SARS-CoV-2 variant of concern. An outbreak investigation was urgently carried out. Telephone interviews of all cases and their contacts were conducted, and testing was recommended to all exposed individuals, including asymptomatic contacts, to early detect and promptly isolate potential additional cases and extend contact tracing if needed.

A total of eight samples were selected for whole genome sequencing (WGS). There were 38 cases of COVID-19 identified between 26 February and 11 March 2021, of which 37 were confirmed and one was a probable case, according to the ECDC criteria. One child from the class was identified as the possible index case based on the date of symptom onset, with 13 secondary cases (12 classmates and their teacher), and 24 tertiary cases (20 household members, two school children, and two schoolteachers). Attack rate (AR) in the class was 58.3%. The age range of children (21 cases) and adults (17 cases) was one month to 14 years and 32 years to 66 years, respectively. The majority of cases (34) presented with mild symptoms, while four children were asymptomatic. WGS confirmed the SARS-CoV-2 B.1.1.7 lineage (UK variant) in seven samples, and B.1.258 in one specimen. It was generally perceived that younger children are less susceptible to infection with the wild-type variant and less often lead to onward transmission. This outbreak demonstrated the potential significant impact of the B.1.1.7 lineage in school settings and further spillover to the community, and the importance of appropriate and timely outbreak control measures as well as genomic surveillance.

Role: The fellow was the lead investigator. She developed the questionnaire, developed a data entry form, and performed data entry and data analysis. She wrote the outbreak report and an abstract for the European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2021, (accepted as poster presentation) [2].

Educational outcome

During this outbreak investigation, Bojana improved her competencies in creating a case definition, describing the outbreak in time, place and person, and formulating the objectives of the study. She also enhanced her competencies in conducting the descriptive epidemiological study, recommending evidence-based control measures, and applying basic principles of risk communication. She prepared the final report on the outbreak investigation and gave a poster presentation at ESCAIDE 2021.

1.2. Surveillance

Influenza-like illness (ILI) sentinel surveillance protocol in primary healthcare during the 2020/2021 flu season and the COVID-19 pandemic in Croatia

Supervisor: Goranka Petrović

The influenza monitoring and surveillance system was significantly affected by the COVID-19 pandemic due to the overload on the health system, the lack of health personnel and resources, and the changed way of seeking and providing healthcare by patients and health workers at the level of primary healthcare. In many countries, weekly influenza reporting was delayed, irregular, or stopped altogether. In this protocol, the existing, long-lasting monitoring algorithm for influenza surveillance, which was performed through weekly aggregated reports on influenza-like illness (ILI), was improved and supplemented with surveillance of COVID-19.

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>

The protocol was intended for family medicine doctors and paediatricians, epidemiologists, microbiologists, and all other health professionals involved in the surveillance of influenza and other respiratory infections. Objectives of ILI sentinel surveillance were ensuring timely and high-quality epidemiological and virological data, identifying isolate types and subtypes of circulating influenza viruses necessary for characterising influenza seasonality; determining the beginning and the end of the influenza season; detecting seasonal circulating influenza viruses for the purpose of a targeted selection of vaccine strains for the vaccine production in the following season; analysing the genetic and antigenic properties of circulating viruses for timely detection of virus mutations, risk assessment, and possible consequences of such mutations; monitoring high-risk groups for developing severe forms of disease and complications; assessing the intensity and severity of the influenza season; monitoring sensitivity to antiviral drugs; timely detection of signals that indicate a possible deviation from the average influenza season in the form of unusual and unexpected events and the dynamics of the epidemic. Due to the impossibility of distinguishing influenza and COVID-19 based on the clinical picture, systematically sampling both viruses gave an insight into the intensity of their co-circulation.

Role: The fellow developed the surveillance protocol and prepared the budget calculations.

Establishing Severe Acute Respiratory Infections (SARI) surveillance in Croatia, 2021

Supervisor: Goranka Petrović

Croatia participated in a project developed by the European Centre for Disease Prevention and Control (ECDC) titled, 'Establishing Severe Acute Respiratory Infections (SARI) surveillance and performing hospital-based COVID-19 transmission studies' as a site country. Data were collected through a sentinel hospital-based active surveillance system from two selected hospital sites – University Hospital of Split, Split-Dalmatia County and Zabok General Hospital, Krapina-Zagorje County. SARI aggregated data were collected by the sentinel hospital team and delivered weekly to county epidemiologists for data control and validation. Case-based data were collected by the sentinel hospital staff and entered on an online platform monthly. The county epidemiologist performed data cleaning and validation.

The project aimed to set up a sentinel SARI surveillance in Croatia and the objectives were to design, pilot and evaluate SARI surveillance in Croatia to monitor SARI incidence trend by place, time and person; describe the intensity and severity of SARI cases; identify and monitor groups at risk of SARI; detect unusual and unexpected events across time and place; identify bottlenecks in establishing sustainable national SARI surveillance and provide recommendations for addressing them.

Project results were used to inform the government and ensure a legal framework and resources for establishing sustainable national SARI surveillance in the future. Moreover, the project contributed to the development and refinement of the standardised European SARI surveillance.

Role: The fellow developed the country-specific protocol, prepared the budget for the project, developed a paper questionnaire, performed data cleaning, prepared data for uploading to The European Surveillance System (TESSy), conducted descriptive data analysis, and wrote the report [3].

Educational outcome

While developing and conducting both surveillance projects, Bojana cultivated project management skills; learnt how to prepare a project budget; developed project protocols and questionnaires; communicated with clinicians who performed data collection; closely collaborated with public health microbiologists for the specimen collection, transport and interpretation of the lab results; learnt to define a sampling strategy and select a sample; applied basic concepts of protection of individuals, by observance of relevant laws in data collection, management, use and dissemination of information and adherence to ethical principles regarding data protection and confidentiality; performed data cleaning and validation, and learnt how to prepare data to upload to TESSy.

2. Applied public health research

Symptom onset to admission time as a predictor of COVID-19 death outcome

Supervisors: Goranka Petrović, Tanja Charles

From February 2020 until October 2021, Croatia reported 427,914 cases of COVID-19 and 8,896 deaths due to the same. This study aimed to determine whether late hospital reporting was associated with increased fatality.

A retrospective cohort study was conducted using data that were collected within the scope of Bojana's 'Surveillance' project, in two hospitals in Split-Dalmatia County and Krapina-Zagorje County. In total, 1,472 participants hospitalised with the clinical picture of severe acute respiratory infection and positive polymerase chain reaction (PCR) test on SARS-CoV-2 were included. Using binomial regression, the association of the symptom onset to admission time (SOAT) to the death outcome was investigated. The influence of sex, age, comorbidities, hospital of admission, and variant of SARS-CoV-2 were investigated as well. The median of SOAT was seven days (0 to 38), with 712 (48.3%) patients hospitalised for 5 to 10 days after the symptom onset. Two hundred and ninety-seven (20.2%) patients died.

Unstratified analysis showed a significantly higher risk of death outcome for individuals older than 65 years (RR=2.98, 95% CI: 2.19 to 4.06), with comorbidities (RR=1.69, 95% CI: 1.04 to 2.74) and male (RR=1.32, 95% CI: 1.08 to 1.63). We found a statistically significant inverse association between SOAT and death, respectively (RR=0.69, 95% CI: 0.56 to 0.85 for 5–10 days; RR=0.29, 95% CI: 0.19 to 0.45 for 11 or more days; ref. 0–4 days). Stratified by age, there was a difference in association for sex, comorbidities, SARS-CoV-2 variant and SOAT. Results indicated that reporting to the hospital due to COVID-19 was related to age and comorbidities as the main influences on healthcare-seeking behaviour and outcome prognosis.

Role: The fellow identified a public health issue, defined objectives, wrote a study protocol, performed data cleaning and determined the sample size, developed operational definitions, performed data analysis, reported results, recommended evidence-based interventions, and submitted a manuscript to a peer-reviewed journal [1].

Educational outcome

While conducting the research, Bojana developed several competencies. She learnt how to recognise and define a public health issue, and based on that, define the objectives of the research. She also learnt how to prepare operational definitions and select an appropriate sampling strategy. She drafted a study protocol, developed evidence-based recommendations for target groups, calculated and interpreted point estimates and confidence intervals for measures of outcome frequency and measures of association, drew conclusions from analysis results, and performed statistical analyses with statistical software (STATA) including multivariable analysis. She wrote an article for a peer-reviewed journal, wrote an abstract for a conference, and prepared a poster presentation.

3. Quality management

Internal audit of Microbiology department in Institute of Public Health Krapina-Zagorje County, May 2022

Supervisors: Aftab Jasir, Marijana Zadravec

As part of a training activity in the Biorisk and Quality Management Module, Bojana carried out an internal audit of the microbiology laboratory at the Institute of Public Health Krapina-Zagorje County which has Biosafety level-2 (BSL-2). Bojana assessed the quality protocols, process management, documentation and workflows in the laboratory. She evaluated that in 'process and quality control', the parts that were done well were 'accommodation and environmental conditions', 'quality assurance', 'analytical process', and 'post-analytical process'. In 'Documentation control', the parts that were done well were 'biosafety documentation and standardised operating procedures'. This audit was a perfect opportunity to detect and address the missing parts and start working on improvement. The observations were noted down and presented to the staff.

Role: The fellow conducted an internal audit within the microbiology laboratory.

Educational outcome

During the audit and report-writing process, Bojana gained valuable insights into the quality management of the laboratory at the Institute. She identified ways to improve the quality management system, and in collaboration with the head of the laboratory, proposed necessary changes to enhance it.

4. Teaching and pedagogy

Training on interviewing COVID-19-confirmed cases and conducting contact tracing, CIPH, online

Bojana trained young medical doctors and students in their sixth year of medicine school at the University of Zagreb on interviewing COVID-19-confirmed patients, conducting contact tracing, and using data collection tools at the Department for Epidemiology of communicable diseases at Croatian Institute of Public Health, November to December 2020. She was engaged in developing written materials and handbooks and administered online courses based on those materials.

COVID-19 vaccination campaign: presentation for healthcare workers, IPH-KZC, online

Bojana developed materials for a vaccination campaign and a protocol for vaccination distribution to GP medical doctors in Krapina-Zagorje County. She presented the materials and protocol at an online presentation in December 2020.

Recommendations and protocol for vaccination against COVID-19 for patients with a history of allergies: presentation for healthcare workers, IPH-KZC, online

In March 2021 Bojana recognised difficulties in vaccination against COVID-19 patients with a history of allergies. The GP medical doctors were reluctant to vaccinate anyone with any kind of allergies, despite very clear recommendations in the literature. She developed a protocol for vaccination against COVID-19 for those patients and organised vaccination sessions based on the protocol. This resulted in the successful immunisation of 134 individuals with a history of allergies within three months following the completion of the training. She also organised an online meeting with healthcare workers to raise awareness of that problem.

COVID-19 vaccination and multiple sclerosis (MS): presentation for MS patients, Society of Multiple Sclerosis, Zabok, 24 October 2021

The Institute for Public Health Krapina-Zagorje County was invited on behalf of the Society of Multiple Sclerosis, Zabok to give a lecture on COVID-19 and vaccines against COVID-19 with regards to MS. A pre-lecture evaluation form was delivered a week before to evaluate the learning needs of the audience. Bojana developed the pre- and post-lecture evaluation forms, and a presentation based on the available literature on the subject. It was aimed that, by the end of the lecture, participants should be able to recall key information about COVID-19, understand the importance of preventive measures, explain the functioning and potential side effects of COVID-19 vaccines, analyse the risk factors associated with severe COVID-19 in people with MS, and evaluate the effectiveness of vaccination in mitigating severe forms of the disease. The training activity was evaluated in the form of a questionnaire.

Educational outcome

While preparing teaching assignments, Bojana learnt how to prepare a presentation for a certain target group and meet their educational needs. She engaged with a wide range of audiences during her teaching assignments from peers to postgraduate students, and also the general population. Bojana acquired skills in crafting questionnaires, developing evaluation forms, and presenting findings. Looking ahead, she aspires to further refine her abilities by creating unbiased and effective questionnaires, along with enhancing her techniques for presenting evaluation results optimally. She also learnt the importance of assessing knowledge about the topic early enough to be able to adapt the presentation and learning objectives accordingly.

5. Communication

5.1 Publications related to the EPIET fellowship

5.1.1 Manuscripts published in peer-reviewed journals

1. **Mahmutović B**, Petrović G, Dörre A, Charles T, Tomljenović M, Tabain I, Kutschke J, Tomaš Petrić P, Karabuva S, Ljubičić S, Marković M, Nonković D. Symptom onset to admission time as predictor of COVID-19 death outcome. (Submitted to the *Croatian Medical Journal* on 29 July 2024; presently being reviewed.)

5.1.2 Other reports

2. Impact of SARS-CoV-2 Alpha variant in school settings- results from an outbreak investigation in Croatia, March 2021. Outbreak report.
3. Severe acute respiratory infection (SARI) sentinel surveillance final report, Croatia, February to October 2021. Surveillance report.

5.2 Conference presentations

1. **Mahmutović B**, Petrović G, Popijač-Cesar G, Ramadani H, Zdravec M, Lipovac I, Tabain I, Nonković D. Impact of SARS-CoV-2 Alpha variant in school settings- results from an outbreak investigation in Croatia, March 2021. ESCAIDE 2021, online. Poster presentation.
2. Granec D, Andrić D, **Mahmutović B**. Post-COVID rehabilitation at the Special Hospital for Medical Rehabilitation in Krapinske Toplice. The 5th Croatian Epidemiology Congress with International Participation, 18–21 May 2023, Osijek, Croatia. Oral presentation.
3. **Mahmutović B**, Petrović G, Tomljenović M, Tabain I, Tomaš Petrić P, Karabuva S, Ljubičić S, Marković M, Nonković D. Delay in hospital admission as a possible risk factor for fatal outcome in COVID-19 hospitalized patients. The 5th Croatian Epidemiology Congress with International Participation, 18–21 May 2023, Osijek, Croatia. Poster presentation.

5.3 Other presentations

1. Epidemiological report on COVID-19 for Civil Protection Headquarters in Krapina-Zagorje County. 19 October 2021, Krapina, Croatia.

2. COVID-19 and Multiple Sclerosis. 24 October 2021, Zabok, Croatia.

6. EPIET/EUPHEM modules attended

1. Introductory Course part 1, 28 September 2020 to 16 October 2020, virtual
2. Introductory Course part 2 - Operational Research inject days, 9–10 November 2020, virtual
3. Outbreak Investigation, 7–11 December 2020, virtual
4. Introductory Course part 3, 26 April 2021 to 7 May 2021, virtual
5. Rapid Assessment and Survey Methods, 5–16 May 2021, virtual
6. Project Review 2021, 23–27 August 2021, virtual
7. Biorisk and Quality Management, 17–18 January 2022, virtual
8. Vaccinology, 14–18 February 2022, virtual
9. Multivariable analysis, 14–18 March 2022, virtual
10. Time Series Analysis, 4–8 April 2022, ISS, Rome, Italy
11. Management, Leadership and Communication in Public Health, 8–12 May 2022, ECDC, Stockholm, Sweden
12. Project Review 2023, 28 August – 1 September 2023, INSA, Lisbon, Portugal

7. Other training

1. Open WHO, Influenza sentinel surveillance training, two days, virtual
2. Symposium on COVID-19 today and tomorrow – medical aspects, one day, virtual
3. Symposium on COVID-19 vaccination, one day, virtual
4. EAN, Infectious disease epidemiology webinar, one day, virtual
5. EAN, Go.data webinar, two days, virtual
6. ERI-HEALTH – Public Health Preparedness for Cross-border Epidemics and Emergencies- Control the spread of COVID-19 through community and cross-border public health measures control of SARS CoV 2 / COVID 19, one day, virtual
7. Croatian Medical Chamber webinar: Vaccination against COVID-19 – doubts and the latest findings, one day, virtual
8. WHO – webinar on SARI surveillance, one day, virtual
9. EVA COURSE: Essentials of writing and reviewing scientific abstract: a field epidemiology focus, one day, virtual
10. BSAFE, UNDSS online course, one day, virtual

8. Other activities

1. Contributed with ideas at the meetings of representatives of all Epidemiology departments in Croatia, topic: COVID-19 pandemics.
2. Contributed with ideas at the meeting of the Department for Epidemiology of communicable diseases at the National Institute of Public Health, topic: COVID-19 pandemics.
3. Based on interviewing COVID-19-positive patients, Bojana noticed very early a loss of smell between the third and fifth day of disease as a specific COVID-19 symptom. After confirming her finding in the literature, this information was widely shared with other epidemiologists in the field as something to keep in mind when interviewing COVID-19 patients.
4. Prepared framework for Letter of intention recommending the introduction of automatised delivery of SARS-CoV-2 test results via e-mail or SMS with guidance for action after receiving positive/negative results, sent from the Department for Epidemiology of communicable diseases at the National Institute of Public Health to Ministry of health.
5. Attended the COVID-19 Think Tank organised by ECDC.

6. Developed guidelines for monitoring COVID-19 patients at the primary care level in Krapina-Zagorje County by reviewing the literature.
7. Planned vaccination activities and coordinated COVID-19 vaccine distribution to GPs in Krapina-Zagorje County.
8. Developed a protocol for flu sampling in GP offices in Krapina-Zagorje County.
9. Worked in a call center: answering emails with questions about COVID-19 (general population, media, local civil protection headquarters, etc).
10. Contributed to the first World Field Epidemiology Day by preparing video materials.
11. Prepared regular written reports on the COVID-19 epidemiological situation to the local headquarters and county government in Krapina-Zagorje County.
12. Reported on the COVID-19 epidemiological situation in Krapina-Zagorje County at live press conferences on national TV and local media every Friday in 2021 and 2022.

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I extend my acknowledgments to Morana Tomljenović, Achim Dörre, and Yulia Kutschke for their significant contributions to the Research project. They not only helped me set up the research but also taught me how to analytically investigate the research question and provided invaluable assistance in using STATA.

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