



FELLOWSHIP REPORT

Summary of work activities

Maja Ilić

Intervention Epidemiology path (EPIET)

Cohort 2018

Background

The ECDC Fellowship Training Programme includes two distinct curricular pathways: Intervention Epidemiology Training (EPIET) and Public Health Microbiology Training (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 are part of the ECDC fellowship programme that provides competency based training and practical experience using the 'learning by doing' approach in acknowledged training sites across the European Union (EU) and European Economic Area (EEA) Member States.

Intervention Epidemiology path (EPIET)

Field epidemiology aims to apply epidemiologic methods in day to day public health field conditions in order to generate new knowledge and scientific evidence for public health decision making. The context is often complex and difficult to control, which challenges study design and interpretation of study results. However, often in Public Health we lack the opportunity to perform controlled trials and we are faced with the need to design observational studies as best as we can. Field epidemiologists use epidemiology as a tool to design, evaluate or improve interventions to protect the health of a population.

The European Programme for Intervention Epidemiology Training (EPIET) was created in 1995. Its purpose is to create a network of highly trained field epidemiologists in the European Union, thereby strengthening the public health epidemiology workforce at Member State and EU/EEA level. Current EPIET alumni are providing expertise in response activities and strengthening capacity for communicable disease surveillance and control inside and beyond the EU. In 2006 EPIET was integrated into the core activities of ECDC.

The objectives of the ECDC Fellowship - EPIET path are:

- To strengthen the surveillance of infectious diseases and other public health issues in Member States and at EU level;
- To develop response capacity for effective field investigation and control at national and community level to meet public health threats;

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This portfolio does not represent a diploma. Fellows receive a certificate acknowledging the 2-year training and listing the theoretical modules attended. Additionally, if all training objectives have been met, they receive a diploma.

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- To develop a European network of public health epidemiologists who use standard methods and share common objectives;
- To contribute to the development of the community network for the surveillance and control of communicable diseases.

Fellows develop core competencies in field epidemiology mainly through project or activity work, but also partly through participation in training modules. Outputs are presented in accordance with the EPIET competency domains, as set out in the ECDC Fellowship Programme Manual.

Pre-fellowship short biography

Maja Ilić is a medical doctor and epidemiology resident at the Division for Epidemiology of Communicable Diseases at the Croatian Institute for Public Health in Zagreb, Croatia. Prior to her work as an epidemiology resident, she worked as a public health physician on a regional level, and as a general practitioner.

Fellowship assignment: Intervention Epidemiology path (EPIET)

On 11 September 2018, Maja Ilić started her EPIET fellowship at the Croatian Institute of Public Health in Zagreb, Croatia, under the supervision of Mirjana Lana Kosanović Ličina. This report summarizes the work performed during the fellowship.

Fellowship portfolio

This portfolio presents a summary of all work activities (unless restricted due to confidentiality regulations) conducted by the fellow during the ECDC Fellowship, EPIET path. These activities include various projects, and theoretical training modules.

Projects included epidemiological contributions to public health event detection and investigation (surveillance and outbreaks); applied epidemiology field research; teaching epidemiology; summarising and communicating scientific evidence and activities with a specific epidemiology focus. The outcomes include publications, presentations, posters, reports and teaching materials prepared by the fellow.

This portfolio also includes a reflection from the fellow on the field epidemiology competencies developed during the 2-year training, a reflection from the supervisor on the added value of engaging in the training of the fellow, as well as a reflection by the programme coordinator on the development of the fellow's competencies.

Fellowship projects

1. Surveillance

Title: Hepatitis B and hepatitis C notifications – first year of enhanced surveillance in Croatia

Hepatitis B (HBV) and hepatitis C (HCV) are mandatory notifiable diseases in Croatia according to the Law on the Protection of the Population against Communicable Diseases, and EU case definitions for HBV and HCV are in place for case notification. The surveillance system is passive, case-based and comprehensive; cases are reported to the national surveillance system (NAJS) software. Since January 2018, an additional web-questionnaire for all cases was introduced to regional epidemiologists to collect additional information required or recommended to report to The European Surveillance System (TESSy).

We described the distribution of HBV and HCV cases reported in 2018 by disease stage (acute, chronic and unknown) and the most probable route of virus transmission identified by regional epidemiologists; we assessed the completeness of variables "HBV vaccination status" and "importation status" that are requested both in the surveillance notification and the additional questionnaire for HBV cases, and we assessed the simplicity of the process of data merging from two systems.

Of 101 HBV and 209 HCV cases reported to the NAJS, for 53 (53%) and 34 (16%), additional questionnaires were completed, respectively. At the time of notification, 15% HBV cases were in acute stage of illness, 77% in chronic and 8% unknown; most probable routes of transmission were household contact with positive person (11%) and nosocomial transmission (11%). Three percent of HCV cases were reported in acute stage, 70% in chronic and for 27% the stage was unknown. Injecting drugs was the most probable way of infection for 41% of HCV cases. Importation status data was missing for 93% of HBV cases in surveillance notifications, and for 6% cases in additional questionnaires; for 35% cases the vaccination data were missing in notifications and for 13% in additional questionnaires. The merging process is classified as not simple and susceptible to errors.

The completeness of additional questionnaires was satisfactory to develop conclusions for HBV cases, but it was low for HCV cases. The majority of HCV and HBV cases are notified in the chronic stage of illness. Additional questionnaires are helpful to better understand risk factors for cases, and they can provide more complete information for variables like vaccination and importation status. Enhanced surveillance should be continued and implementation of additional questionnaire to NAJS is recommended.

Role and outputs: *principal investigator*

Maja was involved in routine surveillance activities of hepatitis B and C (data quality control, data analysis, data management, communication with users) and preparation of data for TESSy upload. She prepared a power point presentation with results and presented during the Public Health Expert Meeting in the Croatian Institute of Public Health (11).

Supervisor: *Sanja Kurečić Filipović*

Title: Evaluation of the Croatian surveillance system for adverse events following immunization (AEFI)

Vaccination is a public health measure that has greatly reduced morbidity and mortality from some infectious diseases, but as with any medical intervention, it carries a certain risk of adverse events. Maintaining a high-quality surveillance system for adverse events following immunization (AEFI) is a basic requirement for a national immunization programme, to provide insight into vaccine safety. To make sure that the system is meeting its purpose and objectives, it should be evaluated regularly.

The AEFI surveillance in Croatia is an integral part of the national immunization programme, to monitor the safety of the national immunization programme and vaccines in use. We decided to evaluate the system for the first time using methodology CDC document Updated Guidelines for Evaluating Public Health Surveillance Systems (July 27, 2001/50(RR13);1-35). We described the system and prepared a protocol for system evaluation.

The AEFI surveillance in CIPH exists since 1991, it is a population-based, passive surveillance system; it provides national coverage and the data are collected during the whole year. The objectives of the surveillance are: early detection of rare or new adverse events (signal detection), monitoring change in known adverse events, identification of vaccine lots with increased numbers or types of reported adverse events, providing evidence for appropriate and timely response to emerging AEFI, in order to decrease the negative impact on the health of individuals and national immunization programme.

We suggested evaluation of usefulness, timeliness, data completeness and simplicity via data analysis of adverse events following MMR immunization from 2008-2018, outputs review and survey among regional epidemiologists and the National Focal Point for Vaccination.

Role and outputs: *principal investigator*

Maja was the principal investigator. She conducted an interview with the National Focal Point for Vaccination, described the system, wrote the evaluation protocol and developed a questionnaire. She would like to support and introduce this project to a new fellow who could conduct the evaluation and present the results.

Supervisors: *Mirjana Lana Kosanović Ličina, Vesna Višekruna Vučina*

Title: COVID-19 surveillance in Croatia

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by a novel coronavirus called SARS-CoV-2, detected for the first time in January 2020 in the city of Wuhan, Hubei province in China in cluster of patients presenting with symptoms of bronchopneumonia. In a short period of time, the infection started to spread to other areas of China and to other countries, and on 12 March 2020 the World Health Organization declared a pandemic. In Croatia, COVID-19 case-based, passive surveillance with the national coverage started early in the epidemic and a notification for COVID-19 case was implemented in the National Public Health Surveillance System (NAJS) of the Croatian Institute of Public Health.

Probable and confirmed cases, following ECDC case definition were reported. We extracted COVID-19 data on 1 May 2020 from the NAJS, described cases by time, place and person, calculated the proportion of imported cases and identified countries of importation, described characteristics of two subgroups of cases: health care workers (HCW) and residents and employees of nursing homes.

Of 1851 cases reported, 54.3% were female, median age of cases was 51 years (range 2.5 months-92 years). Forty-three cases (2.3%) died. The highest number of cases had symptom onset in week 12 and 13 (387 and 391 respectively). Cases were reported from all Croatian counties. Two-hundred-and-forty-two (13%) cases were

imported; Austria and Turkey were identified as infection sites for 24.4% and 22.3% of imported cases, respectively. Two-hundred cases (10.8%) were HCW, of which 37% nurses, 31% physicians, with no deaths reported among HCW. Two-hundred-and-eight (11.2%) cases were residents and employees of nursing homes, and among residents 17 (10.4%) died.

People of all ages were affected by SARS-CoV-2 infection in the first two months of the epidemic. Considering significantly higher fatality in nursing home residents than in general population, we recommend the daily monitoring for any respiratory and general infection signs and symptoms in nursing home residents, timely isolation, and testing of all suspected cases.

Role and outputs: principal investigator

Maja was the principal investigator. She wrote the protocol, exported the data from the national database, performed data cleaning and analysis, wrote the report which was published in monthly epidemiological bulletin of Croatian Institute of Public Health. (14)

Supervisor: Sanja Kurečić Filipović

Competencies developed:

Maja has been continuously involved in daily activities of the Infectious diseases surveillance department at the Croatian Institute of Public Health. She has been using data from the system and has gained experience in data analysis and interpretation. System description and evaluation have allowed her to approach the system from a different point of view and to strengthen her critical thinking in terms of infectious diseases surveillance.

2. Outbreak investigations

Title: A cluster of tick-borne encephalitis cases linked to a raw goat milk consumption in the village of Lokve, Gorski Kotar, Croatia, June 2019

In June 2019, the Croatian Institute of Public Health was informed of a cluster of laboratory-confirmed tick-borne encephalitis (TBE) cases from the Gorski Kotar region. We investigated to assess the extent of the outbreak, identify the mode/vehicle of transmission and to initiate appropriate control measures.

We conducted a case control study to assess association between possible TBE exposure and illness outcome. A confirmed case was defined as any person living in or visiting the village of Lokve, Gorski Kotar region, from 1 May to 30 June, 2019, with self-reported fever ($>38^{\circ}\text{C}$) for at least one day from 15 May to 30 June, 2019, and laboratory confirmation of TBE. Controls were selected from a healthy family and community members, and a case-control study was implemented among six cases and six controls.

Serum samples from all goats, horses and one dog from the implicated farm were collected and tested for TBEV antibodies. Milk samples from 12 goats were tested for TBEV RNA using RT-PCR. In addition, 65 ticks were collected from the goats; they were pooled and tested for TBEV RNA using RT-PCR.

Five of six cases reported consuming raw goat milk in the two-week period before symptom onset, and one case reported a recent tick bite. Cases had 25 (95% CI 0.8-1410.2, $p=0.021$) times higher odds of being exposed to raw goat milk consumption compared to controls. TBEV RNA was not detected in the milk, but serological testing of goats and other farm animals yielded evidence of exposure to the virus: eight goats from the flock had positive TBEV neutralizing antibodies. Our findings suggested that the vehicle of the outbreak was raw goat milk from a single farm. After the confirmation of the outbreak, and following advice to cease consumption of raw dairy products, no further cases have been reported.

Role and outputs: principal investigator

Maja was the principal investigator. She led the outbreak investigation, designed the questionnaire, conducted case finding, interviewed cases and controls, she spent some time in the field where she supported veterinarians in the collection of the samples, communicated with regional public health and microbiological team, did the data entry and cleaning, conducted data analysis, interpreted the epidemiological data, developed recommendations, wrote and submitted a manuscript as a first author to a peer-reviewed journal (1).

Supervisors: Tatjana Vilibić-Čavlek, Mirjana Lana Kosanović Ličina

Title: Salmonellosis outbreak following wedding dinner, September 2019, Croatia; the role of outbreak investigation in considering legal action against caterer

On September 18, 2019, the Andrija Stampar Teaching Institute of Public Health (ASTIPH) was informed of an outbreak of gastrointestinal illness among guests at a wedding on 14 September. We investigated to identify the vehicle and to prevent further cases. Although the outbreak investigation proceeded per usual practice, the communication of findings had unforeseen implications: the wedding couple subsequently requested the outbreak report, as they considered legal actions against the caterer.

We conducted a retrospective cohort study among wedding guests, through an online questionnaire. Probable cases were defined as guests who developed diarrhoea from 15-18 September, and confirmed cases as guests with laboratory confirmation of *Salmonella* from a stool sample. We assessed associations between food exposures at the wedding and illness. Microbiological testing was performed in local laboratories and the National Reference Laboratory for *Salmonella*. A Sanitary Inspector provided environmental investigation of the catering premises.

Forty-three of 92 guests (47%) completed the online questionnaire; 14 guests met the case definition (attack rate 33%). *Salmonella* Typhimurium and *Salmonella* type B were identified for 9 confirmed cases. Two food items were significantly associated with being a case; eating roasted piglet had the highest risk ratio (RR=5.18, 95%CI:1.32-20.3) and explained 86% of cases. Eight (19%) respondents reported the piglet was visibly undercooked. The pathogen was not confirmed in leftover food or from environmental testing.

The epidemiological investigation suggested that undercooked piglet was the vehicle of infection, but no microbiological results were available to support this hypothesis. We provided a report to the couple with most important findings but we suggest that the State Inspectorate develops protocols with objectives and guidelines for communicating investigation results in such scenarios. We recommend implementing more information on proper heat treatment of high-risk food during the organized obligatory education for food handlers provided by Public Health institutes in 5 year intervals. Routine analytical epidemiological studies of outbreaks following private events should be carried out to better understand sources of outbreaks in Croatia, and how to prevent them.

Role and outputs: principal investigator

Maja was the principal investigator. She led the outbreak investigation, developed the questionnaire, conducted a cohort study, did the data cleaning, conducted data analysis, interpreted the epidemiological data, developed recommendations, wrote a report and submitted an abstract to ESCAIDE 2020 which is accepted for a poster presentation (7, 13).

Supervisor: Mirjana Lana Kosanović Ličina

Title: Gastroenteritis outbreak during the Rapid Assessment & Survey methods module in Zagreb, Croatia, May 2019

The Rapid Assessment & Surveys methods (RAS) module for Cohort 2018 fellows took place in Zagreb, Croatia, 13-18 May 2019. On 14 May, some fellows reported gastro-intestinal complaints and could not attend the module. Based on symptoms, we hypothesized a food-borne infection as a potential cause of the outbreak, the topic was discussed via informal chats during coffee breaks among fellows. We described the extent of the outbreak and investigated to identify the potential source.

We designed a cohort study, including the RAS module participants. Via online questionnaire, we started case finding and asked about social events and food exposures to assess associations between exposures and illness. We defined cases as fellows who attended the module and who had any of the following symptoms on 14-16 May: diarrhoea, vomiting, abdominal cramps.

Thirty-seven fellows attended the module; among them we identified eight cases (attack rate 22%). The only social event visited by all cases was the dinner on 13 May. Eating goulash during the implicated dinner was significantly associated with being a case (RR=5.63; 95%CI:1.37-23.10) and explained 63% cases. Stool sample from one case was negative for norovirus, adenovirus, rotavirus, *Salmonella spp.*, *Shigella spp.*, *Campylobacter spp.* and *Escherichia coli*. Sanitary inspection in the restaurant on 17 May did not find leftover food for testing.

Our investigation suggested that goulash was the vehicle of infection. No microbiological results were available to support this hypothesis. Information bias could be the limitation of the study due to fact that fellows exchanged their thoughts on the potential vehicle, even before the study was conducted. We recommended proper hand hygiene for fellows during lectures and social activities.

Role and outputs: principal investigator

Maja led the outbreak investigation; Laurène Peckeu and Sonia Boender were co-investigators. The outbreak investigation included defining case definition, designing the study and questionnaire, data collection, data analysis, and interpretation of the findings. Laurene, Sonia and Maja submitted an abstract to ESCAIDE 2020, and the abstract is accepted for a poster presentation (8).

Supervisor: *Dr Ioannis Karagiannis*

Title: *COVID-19 epidemic response in Croatia*

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by a novel coronavirus called SARS-CoV-2, detected for the first time in January 2020 in the city of Wuhan, Hubei province in China in cluster of patients presenting with symptoms of bronchopneumonia.

The Croatian Institute of Public Health announced on 23 January 2020 the first recommendation for self-isolation of people returning to Croatia from COVID-19 affected regions and for monitoring the existence of symptoms compatible with COVID-19 such as cough, fever and shortness of breath. PCR testing was recommended for all individuals who met both criteria. On 25 February 2020, the Croatian Institute of Public Health was informed of the first confirmed COVID-19 case in Croatia. The outbreak investigation started immediately and media attention was intensive. The following measures were dependent on daily evaluation of the local and global epidemiological situation, and on 16 March (week 12), the *lockdown* was implemented affecting schools, Universities, recreational venues, restaurants, bars and other public places. The first peak of the outbreak was in weeks 12 and 13, 2020, followed by decrease in number of cases. The gradual relaxation of measures started early in May 2020. Since the beginning of the summer 2020 and as Croatia has opened borders as a touristic destination, the number of COVID-19 cases expectedly started to increase and currently, we have been experiencing the second peak of the outbreak, with many cases linked to events in which a large number of people gather in closed venues not respecting physical distancing measures e.g. wedding celebrations and night bars.

Role and outputs: *co-investigator*

Maja has been a member of the COVID-19 response team of the Department for the epidemiology of infectious diseases, Croatian Institute of Public Health, Zagreb, Croatia. Since the beginning of the epidemic, her duties were related to contact tracing of exposed healthcare workers (HCW) in the Clinical Hospital Center Zagreb and she has been coordinating measures like self-isolation and referring to testing for HCW for who were in close contact with the COVID-19 case.

She has been involved in on-call duty during which she has had to communicate and provide advice to various stakeholders: decision-makers, epidemiologists and microbiologists from regional institutes of public health, general practitioners, clinicians, general public, as well as international public health community via EWRS and IHR.

Supervisor: *Bernard Kaić*

Title: *Measles outbreak in Dubrovnik-Neretva County, Croatia, May-June 2018*

Beginning from May 19, 2018, an adult who had recently travelled to Kosovo, sought care from health care facilities in Dubrovnik, before developing a rash on May 24. On May 25, a hospital notified regional public health authorities of a possible case of measles. Epidemiological investigation and control measures were implemented immediately, and additional cases were subsequently reported.

A confirmed case was defined as a resident of or visitor to Dubrovnik-Neretva County, with laboratory-confirmed measles and symptom onset after May 19. Vaccination status was extracted from medical records. RT-PCR detection of viral RNA and IgM/IgG was used to confirm infection, and genotyping was performed for the index case.

Sixteen confirmed cases were reported, primarily by hospital physicians. Symptom onset ranged from 19 May to 15 June; four cases were health care professionals (HCP). One case with a history of travel to France was not epidemiologically linked to other cases. The median age was 34 years, with one 8-month-old infant. Vaccination status was unknown for 10/16 cases, there were 11 hospitalizations, and one person developed pneumonia. We identified 711 contacts: 116 received post-exposure vaccination including 62 HCP. Three contacts (one immunocompromised health care worker and two infants) received passive post exposure prophylaxis. In a catch-up campaign triggered by the outbreak, 898 children received vaccination. The detected strain was identified as B3 genotype.

This outbreak was limited to 16 cases and no deaths or disabilities were recorded. The outbreak did not spread to neighbouring regions, indicating the effectiveness of rapid outbreak control measures. Vaccine coverage among children in the last few years in Croatia was declining with the lowest coverage recorded in Dubrovnik, but after the intervention the coverage improved. With continuing ongoing measles transmission in Europe, even small outbreaks create a massive public health burden, thus illustrating the importance of maintaining high immunization coverage.

Role and outputs: *co-investigator*

Maja was part of the outbreak investigation team before starting her fellowship, and during her fellowship she co-authored a publication (2).

Supervisor(s): *Sanja Kurečić Filipović, Bernard Kaić*

Competencies developed:

Maja has investigated outbreaks as a principal investigator using the classic 10-step field epidemiology approach. She has conducted analytical epidemiological investigation, reported odds ratios and risk ratios and has acquired an understanding of the role of the laboratory and interdisciplinary approach in the context of outbreak investigation, as well as the importance of the communication between all stakeholders involved in the outbreak response or affected with it. She prepared a short communication based on information obtained from the outbreak investigation, which was published in a peer-reviewed journal. She has been continuously involved in the COVID-19 response within Croatia since February 2020.

3. Applied epidemiology research

Title: *Motivators and barriers to seasonal influenza vaccination of hospital health care workers in Vukovar-Srijem County, Croatia, March 2020 – a cross-sectional survey*

Influenza is an acute respiratory disease caused by influenza virus and it is a major public health problem. Many studies have showed the benefits of health care workers (HCW) seasonal influenza vaccination (SIV) in preventing influenza outbreaks and transmission in hospital settings as well as reducing HCW absenteeism during influenza seasons. As recommended by World Health Organization, seasonal influenza vaccination is recommended for HCW in Croatia, and it is free of charge, but the coverage has been lower than recommended for years.

In March 2020 we conducted a cross-sectional survey via paper-based, structured questionnaires among hospital HCW in two general hospitals in Vukovar-Srijem County in Croatia with objectives to describe vaccine uptake in the season 2019/2020, identify motivators for and barriers to vaccination and identify factors associated with vaccination in the season 2019/20. Participants were described by sex, age, hospital, and occupation. We calculated proportions of vaccinated study participants and odds ratios. The multivariable logistic regression model included sex, age, occupation, presence of chronic diseases, medical history of influenza, beliefs and attitudes about severity of influenza, exposure at the workplace, and attitude to vaccination.

Of 1036 HCW from two investigated hospitals, 532 filled in the questionnaire (51%). The seasonal influenza vaccine uptake for the season 2019/20 was 19%. The majority of respondents were female (78%) and nurses (65%). The most common reason for vaccination were awareness of belonging to a risk group by profession (86%) and protection of one owns health (74%). The most common reasons to refuse vaccination were the belief that seasonal flu vaccine is not needed if they are healthy (34%) and not observing a greater risk of contracting the flu compared to others (26%). In the multivariable model several factors were positively associated with vaccination in the 2019/20 season: older age group (aOR=4.7 [1.7-12.0]); female sex (aOR=2.7, [1.2-5.8]), medical history for influenza (aOR=2.7, [1.3-5.2]), a belief that influenza virus infection could harm one own's health (aOR=3.0, [1.1-8.6] and attitude that seasonal flu vaccination should be mandatory for all HCW (aOR=5.4 [2.3-12.8]). The vaccine uptake among Croatian HCW was far below the 75% as recommended by European Council. Future campaigns should emphasise personal vaccination benefits and address identified barriers. The reasons for low seasonal influenza vaccine uptake are complex; qualitative research should be performed to better understand opportunities for the improvement of influenza vaccine uptake.

Role and outputs: *principal investigator*

Maja was the principal investigator. She wrote the protocol, developed the questionnaire, submitted to ethical committee, developed a data entry mask, communicated with hospital representatives, collected data, performed data entry, data cleaning and data analysis and wrote the report (15).

Supervisor: *Mirjana Lana Kosanović Ličina*

Title: Epidemiological characteristics of Haemorrhagic fever with renal syndrome cases during the 2017 outbreak in Croatia

Haemorrhagic fever with renal syndrome (HFRS) is endemic in Croatia. Five outbreaks have been documented since 1995. Exposure occurs when people inhale aerosol or dust contaminated by excreta of infected rodents.

In 2017, during the largest outbreak in Croatia, we collected additional information to better understand how cases may have been exposed to infection in different counties. We interviewed cases using a structured questionnaire and collected information on risk activities before disease onset, hospitalization, and disease severity. Risk activities were grouped in five categories: hiking/picnicking, forestry/farm work, cleaning house or surroundings, multiple activities, and unknown. We defined severe cases as those resulting in death or requiring intensive care treatment. We calculated odds ratios for different risk activities for severe cases.

In 2017, 389 HFRS cases from 15/21 Croatian counties were reported to the Croatian Institute of Public Health. 340 questionnaires were completed: 99 from Zagreb and 241 from other counties. 79% of all cases were male; 51% were aged 25-44 years. The largest proportion (55/99, 56%) of cases from Zagreb reported hiking in recreational areas as the main risk activity. In other counties, 48% (115/241) cases reported farm/forestry work, and 26% (64/241) cleaning house or surroundings. There was no difference in hospitalization between Zagreb and other counties. The odds of being exposed through forestry/farm work was 2.09 (95%CI:0.82-5.3) among severe cases.

Risk activities varied between Zagreb and other counties. Continued national surveillance is required to inform specific prevention strategies for people living and working in or travelling to endemic areas. Prevention strategies in Zagreb should include communication to the group of people visiting recreational area for hiking or picnicking, while in other Croatian counties, prevention activities should focus on forestry and farm workers.

Role and outputs: co-investigator

Maja was the co-investigator in this project. The questionnaires were collected during the 2017 outbreak, but Maja did data entry, data cleaning and data analysis, prepared an abstract and presented in the scientific conference during her fellowship (3).

Supervisors: Sanja Kurečić Filipović, Mirjana Lana Kosanović Ličina

Competencies developed:

Maja was a principal investigator of an operational research project: she has developed a protocol in which she has defined objectives of the study, framed research questions, described analysis plan, prepared data collection instruments. She obtained the ethical approval for the study, has coordinated data collection, entry, cleaning and analysis. She formulated conclusions and proposed recommendations based on the collected information. She wrote the report, prepared an abstract following guidelines provided by a conference organization office and had a poster presentation at the ESCAIDE conference.

4. Communication

Publications in peer reviewed journals

1. Ilic M, Barbic Lj, Bogdanic M, Tabain I, Savic V, Kosanovic Licina ML, Kaic B, Jungic A, Vucelja M, Angelov V, Kovacevic M, Roncevic D, Knezevic S, Stevanovic V, Slavuljica I, Lakoseljic D, Vickovic N, Bubonja-Sonje M, Hansen L, Vilibic-Cavlek T. Tick-borne encephalitis outbreak following raw goat milk consumption in a new micro-location, Croatia, June 2019. *Ticks Tick Dis.* November 2020;11(6):101513

2. Tomljenovic M, Lakic M, Vilibic-Cavlek T, Kurecic Filipovic S, Visekruna Vucina V, Babic-Erceg A, Ljubic M, Pem Novosel I, Ilic M, Tabain I, Ivancic-Jelecki J, Hansen L, Kaic B. Measles outbreak in Dubrovnik-Neretva County, Croatia, May to June 2018. *Euro Surveill.* 2020;25(7):pii=1900434. <https://doi.org/10.2807/1560-7917.ES.2020.25.7.1900434>

Conference presentations

3. Ilic M, Kurecic Filipovic S, Kosanovic Licina ML, Vilibic-Cavlek T, Pem Novosel I, Kaic B. Epidemiological characteristics of haemorrhagic fever with renal syndrome cases during the 2017 outbreak in Croatia. European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE), Stockholm, Sweden, 27-29 November 2019. Available at: <https://www.escaide.eu/sites/default/files/documents/ESCAIDE-abstract-book-2019.pdf>

4. Nemeth Blažić T, Ilić M, Kurečić Filipović S, Erceg M, Mihel S. Trends in mortality and morbidity from chronic hepatitis in Croatia. 12th Croatian Congress of Clinical Microbiology, 9th Croatian Congress on Infectious Diseases, Split, Croatia, 24-27 October 2019.
5. Petrović G, Ilić M, Lovrić Makarić Z. Estimation of seasonal influenza intensity in Croatia using the epidemic movement method. 4th Croatian Epidemiological Congress, Opatija, Croatia, 16-18 May 2019.
6. Pem Novosel I, Kurečić Filipović S, Kaić B, Barbić L, Višekruna Vučina V, Ilić M, Marić V, Janković I, Vilibić-Čavlek T. Emerging and re-emerging antropozoonoses in Croatia 1999-2018. Abstract book. 4th Croatian Epidemiological Congress, Opatija, Croatia, 16-18 May 2019.
7. Ilić M, Kosanovic Licina ML, Boneta J, Lazić N, Lipovac I. Salmonellosis outbreak following wedding dinner, September 2019, Croatia; the role of outbreak investigation in considering legal action against caterer. Submitted to ESCAIDE 2020, accepted as a poster presentation.
8. Ilić M, Peckeu L, Boender TS, Karagiannis I, Ličina MLK. Gastroenteritis outbreak during the Rapid Assessment & Survey methods module in Zagreb, Croatia, May 2019. Submitted to ESCAIDE 2020, accepted as a poster presentation.

Other presentations

9. Ilić M, Kurcic Filipovic S, Vilibic Cavlek T, Pem Novosel I, Kaic B. Epidemija hemoragijske groznice s bubrežnim sindromom u Hrvatskoj 2017. godine. International Workshop on Emerging and Neglected Zoonoses in the context of One Health, 18-19 October 2018, Zagreb, Croatia. (poster presentation) Available at: <https://croneuroarbo.hzjz.hr/wp-content/uploads/sites/6/2018/10/Zbornik-radova-CRONEUROARBO.pdf>
10. Ilić M, Kaic B, Višekruna Vucina V, Kurecic Filipovic S. Measles outbreaks in Croatia in the last decade. Workshop on Current Measles Outbreaks and Response Challenges in SEE Countries, 27 June 2019, Skopje, North Macedonia (oral presentation)
11. Ilić M, Nemeth Blazic T, Zrakić I, Kurecic Filipovic S. First year of enhanced surveillance of hepatitis B and C in Croatia. Public Health Expert Meeting, Croatian Institute of Public Health, 10 May 2019, Zagreb, Croatia (oral presentation)
12. Kurecic Filipovic S, Pem Novosel I, Višekruna Vucina V, Ilić M, Kaic B. Risk communication in measles outbreak, Croatia, 2018. High-level Meeting on Risk Communication for Public Health Emergencies: „Risk Communication beyond the country borders“, Bangkok, Thailand, 18-19 September 2019

Reports

13. Ilić M, Kosanovic Licina ML. Report of Salmonellosis outbreak following wedding reception, Donja Stubica, Croatia, September 2020.
14. Ilić M, Kurečić Filipović S, Kaić B. Pandemija COVID-19 i epidemiološke karakteristike oboljelih u Republici Hrvatskoj do kraja travnja 2020. Monthly Epidemiological Bulletin of Croatian Institute of Public Health, April 2020
15. Ilić M, Kosanovic Licina ML. Motivators and barriers to seasonal influenza vaccination of hospital healthcare workers in the Vukovar-Srijem County, March 2020, Croatia – a cross-sectional survey

Other

16. Nemeth Blažić T, Tomljenović M, Ilić M, Lovrić Makarić Z, Lazić N. Edukacija specijalizanata epidemiologije na europskom programu (EPIET) – naša iskustva. Liječničke novine 187, 58-59.

5. Teaching activities

Case study “An outbreak of gastro-enteritis in Kalundborg, Denmark”

Maja facilitated the case study “An outbreak of gastro-enteritis in Kalundborg, Denmark” on 21 March 2019 as a part of Specialist postgraduate studies in epidemiology. Duration time of the case study was 3 hours. Target audience were students attending Specialist postgraduate studies in epidemiology, University of Zagreb, School of Medicine. Seven students attended the class. Training objectives of the teaching activity were to identify 10 steps of the outbreak

investigation, define an outbreak, elaborate a case definition using time, place and person approach, generate hypotheses, decide about analytical study to test the hypothesis and explain it, interpret microbiological results, combine epidemiological, microbiological and environmental data to formulate conclusions, communicate findings, formulate recommendations and understand the importance of multidisciplinary approach in an outbreak investigation. Students evaluated this training activity using an anonymous paper-based questionnaire. All of the students had positive comments on this way of learning and the content of the case study. They all agree that there should be more exercises about outbreak investigation during specialist education (7/7; 100%), and overall are very content with the exercise (7/7; 100%). They suggested more case studies on outbreak investigation and with real life examples from Croatia.

Supervisor: *Branko Kolarić*

Reflection:

This activity helped me to look at a case study from the other perspective, for the first time as a facilitator. During the preparation I was trying to think on fitting the content into the timeframe, and also to prepare myself on the sub-questions related with the topic that will help guiding the discussion. Teaching others and trying to explain things increases awareness for the topic and helps to intensify and think deeply about possible answers.

Regular education of food-handlers

Maja is one of the educators in mandatory education of food-handlers during course provided by Institutes of Public Health in Croatia. The topics which she covers with her presentations are the epidemiology of infectious diseases and food hazards and food poisoning. Objectives of this education are to get participants familiar with the basic principles of infectious diseases, the most common causes of food poisoning, the most common mistakes that occur when handling food and protection measures that lead to a reduction in the risk of transmission of infectious diseases. The knowledge of participants is evaluated through oral exam by an epidemiology specialist.

Reflection:

Through giving this kind of lectures I learned how important it is to know the previous knowledge and educational level of attendees to prepare yourself for the presentation. To improve the training in the future, I would recommend structuring it in the form of case-studies or problem-based learning.

Other activities

Maja was accepted for a GOARN Request for Assistance for Preparedness and Readiness for Ebola Virus Disease, to support the Health Information Management team in Geneva Headquarters, but due to COVID-19 emergency, the international assignment was canceled.

7. EPIET/EUPHEM modules attended

1. Introductory Course, 24 Sep - 12 Oct 2018, Spetses, Greece
2. Outbreak Investigation Module, 3 - 7 Dec 2018, Robert Koch Institute, Berlin, Germany
3. Multivariable Analysis, 25 - 29 Mar 2019, Instituto de Salud Carlos III, Madrid, Spain
4. Rapid Assessment and Survey Methods, 13 - 18 May 2019, Croatian Institute of Public Health, Zagreb, Croatia
5. Project Review Module 2019, 26 - 30 Aug 2019, Prague, Czech Republic.
6. Time Series Analysis, 4 - 8 Nov, 2019, National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands
7. Vaccinology Module, 4 May - 24 June, 2020, online
 - Online course by Institute Pasteur, SPOC (4 May - 12 June 2020,
 - Webinar facilitated by the National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands, 22-24 June 2020

Other training:

RCON / EAN pre-ESCAIDE Introduction course in R for outbreak analytics, 25 – 26 Nov, 2019, Stockholm, Sweden

Social Media for Public Health Professionals, workshop, 31 Aug - 1 Sep 2019, National Institute for Public Health Prague, Czech Republic

EVA online course: Influenza vaccination campaigns targeting health care workers, 27 May, 2019

UNDSS "BSAFE" online course, 29 Apr, 2019

WHO/UN courses: To serve with Pride – Zero Tolerance; UN Course on Prevention on Harassment, Sexual Harassment and Abuse of Authority; GO Training 2.0; Human Rights Responsibilities (Feb 2020); Go.Data open course

Specialist postgraduate studies in epidemiology, University of Zagreb, School of Medicine, Jan – April , 2019

Supervisor's conclusions

Maja started an EPIET fellowship in the middle of her specialization in epidemiology, as a medical doctor facing with lot of strict time deliverable's both in everyday work and fellowship, but she managed to fulfil all objectives of fellowship timely, enthusiastically and innovatively She started with a fair background on disease burden and outbreak investigation, and during the 2 years period Maja improved in all areas, especially in the area of surveillance analysis and overall analytical skills. In her outbreak investigation of tick-borne encephalitis, she has managed to gain real One health approach involving all important local and national stakeholders from veterinary and human medicine, resulting in expanding a network of dedicated professionals. Her research project trying to identify motivators and barriers to flu vaccination of health care workers in a county, laid out a foundation to perform a bigger nationally representative research on this topic. Last but not the least, she was heavily involved starting and setting up surveillance of COVID in Croatia. Maja has shown great commitment to the fellowship work and its application to public health issues in Croatia, and I look forward to her using the new skills and knowledge to improve surveillance, research and field investigations across all areas of infectious disease work in Croatia. I have really enjoyed supervising Maja in her path of EPIET fellowship, particularly in our brainstorming and conversations, setting up a higher standard of communicable diseases surveillance and research in Croatia.

Coordinator's conclusions

Maja entered the fellowship with excellent preparation in epidemiologic practice and experience as a public health physician in Croatia. She also brought tremendous curiosity and enthusiasm for every aspect of field epidemiology, and during her two years, and was able to apply her skills to addressing zoonotic, foodborne, vector-borne and vaccine preventable disease outbreaks in Croatia, while expanding her analytical skills. Maja exemplifies a field epidemiologist who is competent to address every aspect of a public health issue: she has engaged community members to identify risky and hidden behaviours in an outbreak, leveraged relationships with clinical, veterinary and food safety colleagues to support rigorous investigations, and, in addition to sharing scientific findings with her peers via publications and conference presentations, has ensured that affected populations and individuals have received the information they need about public health concerns. Like many in her cohort, Maja's fellowship workplan was interrupted by the COVID-19 pandemic, and she has made an important contribution to Croatian capacity for surveillance and disease control at a critical moment. It has been a pleasure to work with Maja, both professionally and personally, and I am confident that her passion for learning and open collaboration will lead her to continued success.

Personal conclusions of fellow

Working as an EPIET fellow in the Croatian Institute of Public Health I have had the opportunity to take on responsibilities including defining objectives and developing protocols and data collection instruments for operational research projects, data cleaning and analysis, writing reports and manuscripts, and communicating in professional fora. The combined requirements of my epidemiology residency and EPIET fellowship have allowed me to develop my organizational skills, my skills in statistical methods and software applications, scientific writing, and communication. I have been able to share my work by presenting a poster in an international conference and publishing an article as a

first author in a peer-reviewed journal. By doing the fellowship, I have realized the value of the project-based learning and I will advocate for the implementation of the similar concept in education of epidemiologists in Croatia. The EPIET fellowship has allowed me to learn with and from public health colleagues from around the world, and share experiences and insights that transcend borders, which I'm extremely grateful for.

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