

Summary of work activities

Joaquin Baruch

The ECDC Fellowship Programme

Field Epidemiology path (EPIET), 2020 cohort

Background

The ECDC Fellowship Programme is a two-year competency-based training with two paths: the field epidemiology path (EPIET) and the public health microbiology path (EUPHEM). After the two-year training, EPIET and EUPHEM graduates are considered experts in applying epidemiological or microbiological methods to provide evidence to guide public health interventions for communicable disease prevention and control.

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

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.' Therefore, ECDC initiated the two-year EUPHEM training programme in 2008. EUPHEM is closely linked to the European Programme for Intervention Epidemiology Training (EPIET). Both EUPHEM and EPIET are considered 'specialist pathways' of the two-year ECDC fellowship programme for applied disease prevention and control.

This report summarises the work activities undertaken by Joaquin Baruch, cohort 2020 of the Intervention Epidemiology path (EPIET) at the Infectious Disease Prevention and Control Unit (IDPCU), Ministry for Health, Malta.

Pre-fellowship short biography

Joaquin Baruch is an epidemiologist who originally trained as a veterinarian. Before coming to Malta, he worked on zoonotic diseases in South America and the United States, primarily focusing on disease eradication and surveillance programmes for brucellosis and tuberculosis in livestock, as well as foodborne illnesses in North America. Joaquin also worked for the Food and Agriculture Organization of the United Nations (FAO) on global trends of rabies in humans. He completed a PhD from Kansas State University, United States, with a focus in diagnostics, risk factors, and risk assessment of respiratory disease in cattle, while also working with the United States Department of Agriculture (USDA) in *E. Coli* food safety programmes.

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Methods

This report accompanies a portfolio that demonstrates the competencies acquired during the EPIET fellowship by working on various projects, activities 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. The portfolio presents a summary of all work activities conducted by the fellow, unless prohibited due to confidentiality regulations.

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

1. Epidemiological investigations

1.1 Outbreak investigations

1.1.a Gastrointestinal disease outbreak at a wedding in Malta in December 2020

Supervisor: Dr Maria-Louise Borg

On 11 December 2020, the Infectious Disease Prevention and Control Unit (IDPCU) was notified of a large (unknown) number of cases presenting with gastrointestinal symptomatology starting six hours after a wedding celebration on 8 December 2020. At the time of the notification, four people were admitted to hospital but were discharged on the same day. We conducted an outbreak investigation to find the source of the outbreak, stop potential continuous transmission, and implement control measurements. The outbreak team was composed of Drs Borg and Baruch from IDPCU, and the environmental health unit from the Ministry for Health. We obtained 64 responses out of the 80 people attending the wedding (80% response rate) and used the data for conducting a retrospective case-control study. Among the respondents, 53 (83%) presented with symptomatology (cases), and 27 did not (controls). Most symptoms were related to vomiting and diarrhoea, and occurred during the first 48 hours. No specific food items were associated with higher odds of disease, which could be attributed to the high attack rate and high exposure rate to most food items. Although a good response rate was obtained, no isolates were obtained from patients. However, *bacillus cereus* and coagulase-positive *staphylococci* were isolated from food items.

While the outbreak was self-limiting, the fact that *bacillus cereus* and coagulase-positive *staphylococci* were found in food items was concerning. This fact led the team to work with the wedding venue to improve food storage methods. Overall, this outbreak was a good experience to learn about the complexities and logistics of investigating a food-borne outbreak.

Role: The fellow was involved with setting up the outbreak team, designing the questionnaire, implementing the questionnaire, analysing the data, linking with the laboratory, and writing the report.

1.1.b Lessons learnt from the first reported outbreak of the Alpha (B.1.1.7) SARS-CoV-2 variant in Malta

Supervisor: Dr Tanya Melillo

The first COVID-19 case due to the Alpha (B.1.1.7) variant in Malta was detected on 23 December 2020, in a hospitalised patient with no travel history. The finding implied that this variant, which was reported to be more virulent than the wild-type SARS-CoV-2 variant, had been circulating without detection.

An outbreak investigation was conducted to identify its source, track and isolate contacts, and identify potential risk factors for increased transmission. Age, sex, source (household, social, work), number of contacts, and hospitalisations were recorded. Logistic regression was used to estimate secondary attack rates (number of new cases generated by a case divided by number of contacts of that case) by type of contact adjusted by age and sex.

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 outbreak source was a Maltese national returning from the United Kingdom (UK) on 11 December 2020 who had tested negative to a PCR test upon arrival at the airport. Forty cases were linked to the initial imported case (directly and indirectly). All cases and contacts were isolated, and the outbreak was resolved on 2 January 2021 when no more linked cases were identified. Although 87.5% of cases were symptomatic, only two patients were hospitalised, and no deaths were recorded. No significant differences in secondary attack rates by sex, age (<50, >50), or type of contact (household, social, work) were observed. Secondary attack rates were 73% (95% CI: 48–87%), 60% (40–77%), 97% (56–100%), for household, social, and work contacts, respectively.

Disease severity was not higher in this outbreak than other outbreaks linked to other variants, but we observed higher secondary attack rates than with other variants in Malta. Furthermore, these attack rates were high across all types of contacts, having implications for disease control strategies. This outbreak investigation highlighted the importance of surveillance of variants at the hospital level and enhanced contact tracing to rapidly contain outbreaks of emerging variants.

Role: The fellow was involved with designing the questionnaire, analysing the data, linking with the laboratory, and writing the report.

1.1.c Outbreak investigation of a clinical case of rabies in the Cabo Delgado province, Mozambique*

Supervisor: Aicha Taybi

On the 28 May 2022 the Ministry of Health of Mozambique (MoH) informed the World Health Organization (WHO) of a suspected case of rabies in the Mueda district of the Cabo Delgado province. The suspected case was a male in his thirties who had been bitten by a dog a month earlier. The symptoms led to hospitalisation, and the patient died at the local hospital in Mueda. In addition, the government notified WHO of an increase in dog bites in the district of Mueda, which prompted concerns of under notification of suspected rabies cases.

Given this situation, WHO, FAO, MoH, and the Ministry of Agriculture (MoA) deployed an outbreak investigation team to Mueda. During the outbreak investigation, the fellow visited the local hospital and met with the local health and agricultural authorities. After the meeting, the team identified eight villages with a high number of dog bites in and around the city of Mueda. The following day, the team visited the villages to conduct active case findings. Through the investigation, it was identified that dog bites and suspected rabies had been under reported (double the number of cases were found), and that almost none of the people bitten had received post-exposure vaccination.

Therefore, the team set up actions at local, national, and international levels. First, the team strengthened the one-health collaboration between MoA and MoH, by facilitating communication channels. Second, a mass dog-vaccination campaign was organised. Third, since rabies requires laboratory diagnostics for confirmation, the team obtained international support to acquire rapid diagnostic kits and training courses. Third, the team is working with the Pan American Health Organization (PAHO) to obtain human post-exposure vaccination to protect those who had been bitten by the suspected rabid dog.

Role: The fellow set up the outbreak team, leading the collaboration between different organisations, conducting the active case finding, interviewing the families of the deceased organising the vaccination campaign and procuring rapid diagnostic tests and post-exposure vaccines.

**Exact number of cases cannot be provided due to confidentiality reasons.*

Training modules related to assignment/projects

EPIET/EUPHEM Introductory Course: This module helped the fellow in understanding the importance of a strong foundation when conducting field epidemiology assignments.

Outbreak Investigation Module: The outbreak module was important to follow a structured framework when conducting an outbreak investigation.

Multivariable Analysis Module: Most analyses in an outbreak investigation require multivariable analysis regression, and this module was a good refresher for statistical methods.

Educational outcome

The outbreak investigations conducted during the fellowship allowed the fellow to expand his knowledge of infectious disease epidemiology by providing a practical space to continue learning. Joaquin was able to work with different stakeholders (such as, nurses and doctors-) from the Mater Dei Hospital (Malta) when investigating COVID-19 outbreaks, the national reference laboratory when evaluating foodborne outbreaks, and FAO, WHO, as well as the ministries of health and agriculture in Mozambique when investigating cases of clinical rabies. These tasks were the best way to gain practical skills during the fellowship. These outbreaks also allowed him to expand his diplomatic and leadership skills.

2. Surveillance

2.1 Evaluation of the Maltese COVID-19 surveillance system

Supervisor: Dr Maria-Louise Borg

Since the start of the COVID-19 pandemic, cases in Malta remained relatively low due to stringent border measures and contact tracing. However, as the fellow started this programme, the COVID-19 cases started to increase. This led the fellow to search for potential opportunities to improve the existing COVID-19 surveillance system. The objectives were five-fold: a) to describe the existing surveillance system in Malta; b) to evaluate, analyse, and summarise all the components of the existing COVID-19 surveillance system; c) to enhance the surveillance system by linking information and creating a new visualisation platform; d) to provide timely information for public health decision-making, and e) to provide feedback to the public health authorities and healthcare personnel.

To conduct this, we evaluated the data sources, data collection tools, completeness, data summarisation tools, and feedback to stakeholders. Data which were collected through several sources of information (swabbing centres, case management, contact tracing, follow up, and hospital records) were stored in different databases. We identified more efficient ways to clean and compile the sources of information into a single database.

Data tools were developed to unite case management and hospitalisation data, to automatically aggregate case management data, to send quarantine letters automatically, to generate contact lists for contact tracing, and to generate reports for international reporting. Data were also reported weekly through the development of an R Shiny app for visualisation and easy communication with decision-makers and healthcare professionals. In summary, this project served to create systems that adapted to the needs of the epidemic in Malta. Through data automation, we were able to eliminate redundancy in data collection, reduce data entry mistakes, cut time from data collection to analysis from a week to automating the process, and reduce the time for contact tracing time from ten days to one.

Role: The fellow worked with a team developing solutions for data management and summarisation, supervised a team of four information technology officers to develop new tools to meet the needs of the epidemic, delivered weekly epidemiological updates as presentations, developed daily and weekly epidemiological reports and sent them to the head of the public health institution, and overall worked to improve and maintain the existing systems.

2.2 Enhancing cholera, polio and measles surveillance in a conflict zone, the Cabo Delgado province, Mozambique, 2022

Supervisor: Aicha Taybi

Northern Mozambique is affected by an ongoing armed conflict, insecurity, and violence. This has led to significant displacement and lack of access to essential health services with nearly 800 000 (~40% of the population) people displaced due to the conflict. In this emergency context, disease surveillance is becoming increasingly challenging, especially in the context of the province being prone to outbreaks of cholera and measles. Circulating vaccine-derived poliovirus (cVDPV) was detected in one district of Cabo Delgado and thereafter a case of wild poliovirus WPV1 was reported in another province, prompting demand for increased surveillance activities. In addition, suspected rabies cases were documented in two districts of the province. Therefore, the fellow was deployed to Cabo Delgado to support surveillance activities and develop a surveillance strategy for the complex humanitarian emergency in Cabo Delgado.

We evaluated the surveillance indicators and trained 55 healthcare workers at 11 hospitals. In addition, we set up a six-month strategy to enhance surveillance activities with the MoH. To ensure feasibility, we conducted a pilot to evaluate the current surveillance system for acute flaccid paralysis, measles, diarrhoeal diseases, neonatal tetanus, and maternal and neonatal death in four districts of the Cabo Delgado province. As a result, we set up a strategy with two officials at the provincial level of the MoH, the district surveillance officer, and the healthcare facility (HCF) surveillance officer.

The six-month surveillance plan is currently being implemented by a new GOARN-deployed person who will be in the field for a period of two months.

Role: The role of the fellow was to co-lead the surveillance activities together with the emergency officer from the WHO sub-country office in Pemba, draft the surveillance strategy for the long term, and support the government on the surveillance activities in the field.

2.3 Development and evaluation of a surveillance system for severe acute respiratory infection (SARI) in Malta

Supervisor: Dr Maria-Louise Borg

Viral and bacterial pathogens are a significant cause of hospitalisations due to severe respiratory infections around the world, and Malta is no exception. For example, in Malta, in the period between 19–30 October 2020, 73 SARI-related hospitalisations were identified (personal communication). Therefore, a surveillance system for SARI has the potential to enable Malta to monitor the circulation of COVID-19 and other respiratory infections while contributing to a European-level SARI surveillance system. The aim of this project was to set up a national SARI surveillance system in Malta. We obtained funding from ECDC and Epiconcept for setting up this system, and the fellow was in charge of supervising the project, the budget, and the four people who were hired to set up the systems and occasionally contribute to the project.

The main focus of the project was to create an automatic surveillance system, which would allow Malta to continue surveillance even with a lack of funding. For this, we sought to unify existing databases (laboratory, vaccination, hospital bed management, death notifications, and electronic health records). Efforts were concentrated towards mapping the key stakeholders, creating platforms for data management and summarisation, generating automatic reports, and switching the hospital-patient management system from free text notes to questionnaires for data extraction.

The development of this system led to a manuscript which is currently under [review](#).

Role: The role of the fellow was to find funding, negotiate the budget with the funding sources, set up the respiratory surveillance team, lead the team for over a year and half, procure software development, and negotiate data accesses with different teams. The fellow also created a SARI-network in Malta, bringing together actors from different areas in the public and private sector in Malta. In total, the fellow led the process to obtain 188 000 euros for surveillance activities in Malta.

2.4 Go.Data implementation in the Sahrawi refugee camps, Algeria

Supervisor: Lucas Deroo

The Sahrawi refugees have an estimated population of 190 000 and are based in five camps along the Algeria–Mauritania border. Armed conflict in the western Sahara region has been ongoing for over 40 years, creating a complex humanitarian situation. The fellow was deployed to the camps to lead the WHO country office in setting up a surveillance system with an initial focus on COVID-19. Through this process, we identified the technical expertise in disease surveillance, outbreak investigation, COVID-19 preventive measures, and interpretation of epidemiological indicators. To address these gaps, the fellow was deployed to the Sahrawi camps for a period of seven weeks to work with the health authorities and set up the Go.Data platform. The surveillance officers from each camp were trained and case management and contact tracing teams were set up. In total, five hospitals were trained in the use of this tool, and 5–10 contact tracers per camp were also trained. Surveillance activities were set up, and to this date, the system is still ongoing and being used for COVID-19 and the surveillance of other infectious diseases.

The team also set up weekly epidemiological updates to the partners in the field through the establishment of an emergency coordination centre. Through this centre, collaboration between the different partners was strengthened, allowing for prioritisation of resources and strengthening the capacities of the health authorities at the refugee camps.

Role: The fellow was deployed to the field for a period of seven weeks; he trained the personnel, identified the surveillance structures, and set up data-flow paths for the surveillance system. Together with the country office, the fellow also led the implementation of the emergency coordination centre for COVID-19 and led the field activities. An [interview](#) with the Task Force for Global Health was published describing the fellow's achievements.

2.5 Monkeypox case management and contact tracing among MSM (men who have sex with men), Latin American community in Malta

Supervisor: Maria-Louise Borg

Cases of monkeypox in Malta have been increasing since the first case was detected on 28 May 2022 and as seen in other countries, most cases have been related to sexual transmission among men who have sex with men (MSM). This mode of transmission has also been the most relevant in Malta so far, with only two out of 20 cases in Malta not being related to this specific group.

In addition to this demographic characteristic, many of the cases and their contacts have been among immigrants to Malta from Latin America, most of them from Spanish-speaking countries. Given the language barrier between the language spoken by this community and the local Maltese, the fellow's language skills were relevant to conduct case management activities, as many of the patients did not speak English. In addition, the fellow's background of growing up in South America helped create a link between the community and public health authorities.

The activities conducted by the fellow were related to case management. Specifically, calling the cases and assessing their health status through a standardised tool for collecting and reporting data to the national public health institute, ECDC and WHO. In addition, during case investigation, the fellow ascertained potential sources of infection, conducted contact tracing, and provided information about infection control and prevention measures to the cases and their contacts.

Role: The role of the fellow was to call the cases and contacts of monkeypox patients with different language barriers.

Training modules related to assignment/projects

EPIET/EUPHEM introductory course: This module was important to understand the basic concepts of setting up/evaluating a surveillance system.

Rapid Assessment and Survey Methods module: This module facilitated the fellow with knowledge on risk assessment methods.

Vaccinology: During this module the fellow learnt the principles of vaccine effectiveness studies, which were important when setting up SARI surveillance, which was the framework for the vaccine effectiveness studies conducted in Malta.

Educational outcome

Through the surveillance assignments conducted during my fellowship I was exposed to different environments in three different countries and contexts. I led the implementation of two surveillance systems as well as evaluated and supported three others. It was an amazing experience that showed me the complexities in setting up surveillance with a complex set of stakeholders and allowed me to develop my diplomatic and project management skills.

3. Applied public health research

3.1 Measuring behavioural change during the COVID-19 epidemic in adults and children in Malta, 2021

Supervisor: Dr Tanya Melillo

To respond to the COVID-19 pandemic and other epidemics we must understand how people behave. Control measurements might seem appropriate at an epidemiological or statistical level, but we need to balance this knowledge with social understanding to implement disease interventions.

The H2020 EpiPose project, a contact survey (called CoMix) is a consortium that measures behavioural change over time during the COVID-19 epidemic. This ongoing study is a multi-country effort to understand the principle mentioned above. Malta was part of this study as a collaborating site, and the fellow along with Dr Melillo led this process. Due to the small sample size, the results at the local level could not be analysed as people had to be repeatedly interviewed over time. However, given the international collaboration, IDPCU contributed to the international dataset, the meetings on network analysis, and in the drafting of two manuscripts.

The fellow contributed to setting up the surveys together with the London School of Hygiene and Tropical Medicine (LSHTM) and co-authored two manuscripts currently under review as part of the working group (see the 'Communication' section for manuscripts).

Role: The fellow participated in the local design of the study, sought local ethical approvals, managed the project locally, contributed to international analyses, and drafted the manuscripts.

3.2 European study of COVID-19 vaccine effectiveness against hospitalised SARI laboratory-confirmed patients with SARS-CoV-2

Supervisor: Dr Maria-Louise Borg

When COVID-19 vaccination began in Europe, the European Centre for Disease Control and Prevention (ECDC) funded a multi-country, test-negative, case control study to measure product-specific COVID-19 vaccine effectiveness (VE). This study measured VE against COVID-19 severe acute respiratory illness (SARI; as hospitalised patients with fever, cough or shortness of breath, and onset of symptoms within 10 days) in Malta.

Our study population were all SARI cases in Malta eligible for vaccination at the time of hospital admission between 1 February 2021 to 6 March 2022. Cases were defined as SARS-CoV-2 PCR-positive or rapid antigen-positive patients, and controls were the PCR-negative patients. We collected vaccination status (not vaccinated, one dose, two doses, three doses), vaccine brand, sex, chronic conditions, age, and admission date (as a proxy for variant). Using logistic regression, we measured VE as $(1 - \text{odds ratio}) \times 100$ adjusted for the confounders mentioned above and stratified by variant (Delta and other variants versus Omicron). 20 December 2021 was used as the cut-off point between Omicron and Delta, when 80% of the community cases were Omicron.

Thousand and seven SARI cases were included in the study. For vaccination programmes with three doses, VE against hospitalisation during the period of Delta and other variants was 99.4% (95.4%–99.9%), while VE during the Omicron period was lower at 80.8% (53.8% – 92.0%). These results suggest that Pfizer/BioNTech and AstraZeneca vaccines confer high protection against SARI laboratory-confirmed COVID-19. However, during the Omicron wave, the VE decreased for most vaccination programmes. The drop in VE against hospitalisation from Delta and other variants to Omicron is also corroborated with other studies, stressing the need to periodically assess VE.

Role: The fellow led this project from design, sourcing funding with Epiconcept, coordinating data collection, analysing the data, and writing the report. Through this project, the fellow obtained 200 000 euros to set up COVID-19 and influenza vaccine effectiveness studies in Malta. A publication in which the fellow is a co-author, is under review.

3.3 A national cohort study of risk factors for COVID-19 hospitalisation and death

Supervisor: Dr Maria-Louise Borg

Understanding the drivers for hospitalisation rates is key to prioritising public health messages. Therefore, we aimed to understand the risk factors driving hospitalisation and death rates among COVID-19 patients in Malta. To assess this, we used the existing databases in the COVID-19 and the SARI surveillance systems evaluated and set up respectively, by the fellow.

Our target population for this study were COVID-19 patients in Malta from December 2020 to December 2021. This range of dates was chosen, given the availability and ease of collating the epidemiological data. We conducted a retrospective cohort study. The following databases were compiled to conduct a retrospective cohort study: a) epidemiological data from the SARI-COVID-19 cases; b) hospitalisation census from the Mater Dei Hospital, and c) the mortality registry of COVID-19 cases. The results were presented in a manuscript currently under review, for setting up SARI surveillance in Malta. In brief, it was found that less than one in five COVID-19 patients had chronic heart disease, one in four had diabetes, and one in three had hypertension.

A lengthier explanation of the results and conclusions of this analysis have been presented in the manuscript currently under review.

Role: The fellow designed the analysis and supervised a team member on the analysis of the data. The fellow revised the manuscript of this project.

3.4 National long-COVID impact and risk factors

Supervisor: Dr Tanya Melillo

Our objective was to estimate the prevalence and risk factors for long-COVID symptoms and indicators of quality of life among PCR-confirmed COVID-19 patients (both hospitalised and in the community) in Malta. For this we designed a national cross-sectional survey among COVID-19 patients in Malta during 2020. Patients were sent a questionnaire three to six months after testing positive for COVID-19. Data were analysed descriptively to estimate symptom prevalence, and multivariable logistic regressions were used to determine risk factors for long COVID symptoms. Age, sex, initial symptoms, hospitalisation, and healthcare-worker status were used as risk factors and symptoms (cough, shortness of breath, fatigue, anxiety, sadness, and memory loss) two and a half months or more after COVID-19 onset, were used as outcomes.

Out of 8 446 eligible participants, 2 665 (31.55%) responded with a median age of 37 years. Initial symptoms were reported in 82% of responders, 7.73% were hospitalised, and 47.2% were discharged from isolation with at least one symptom. Among the long-COVID symptoms, fatigue persisted among most non-hospitalised responders, while anxiety, shortness of breath, and sadness were the most common symptoms. Female sex, hospitalisation, and initial symptoms were associated with higher odds of fatigue, shortness of breath, cough, anxiety, sadness, and memory loss as long-COVID symptoms.

Our study is the first to highlight long-COVID symptoms and risk factors in Malta, showing that long COVID is common among hospitalised and non-hospitalised patients. This data should increase awareness of long COVID and facilitate support to those affected nationally.

Role: The fellow assisted with data cleaning the questionnaire, analysed the data, wrote the manuscript, and led the investigation team after the survey was conducted.

Training modules related to assignment/projects

EPIET/EUPHEM Introductory Course: This course allowed the fellow to refresh the basic concepts of setting up a research protocol and the steps of implementing research projects. The operational research inject days were also relevant to making sure that all the steps necessary for his projects were in place.

Multivariable Analysis Module: Many of the fellow's studies required multivariable analyses. This course provided him with a good refresher on how to conduct this type of analysis.

Vaccinology module: While leading the vaccine effectiveness studies in Malta, the fellow used part of the material from this course to understand and implement his projects.

Educational outcome

Through the applied research assignments, the fellow was able to develop skills in the areas of drafting research proposals, meeting with funding bodies, setting up budgets, leading a team of people to conduct projects, and responding to international partners. Joaquin had the privilege of being the national focal point for several international research projects, which allowed him to expand his public health network and diplomatic skills when dealing with international partners.

4. Teaching and pedagogy

4.1 Teaching at the University of Malta on outbreak investigations, food-borne illnesses, and infectious diseases

For this assignment, the fellow developed three lectures which were given to environmental health students at the University of Malta. The lectures were given during his first and second year in November and December. The learning objectives were to understand the basic concepts of infectious diseases, food-borne illnesses and outbreak investigations. The evaluation was in the form of a set of open-ended questions that were asked in the final examination of their course.

4.2 R course for public health trainees

For this activity, the fellow supervised two people who were hired for the SARI and vaccine effectiveness projects to develop and deliver a course on R for public health activities. The course was aimed at public health trainees. The idea was to transition some of the surveillance systems that are currently used in paper format to digital format by using R. Three-hour sessions were delivered once a week over the course of three months in 2022. No evaluation was carried out.

Training modules related to assignment/projects

EPIET/EUPHEM Introductory Course: In the introductory course, the fellow learnt the basics of setting up a course for a broad audience. These skills allowed him to identify the audience and tailor the message towards it.

Educational outcome

The development of these case studies contributed to the fellow's development as an epidemiologist as it allowed him to communicate basic epidemiological principles to people with different levels of knowledge. Through these activities not only did he deliver lectures, but also led the development of a course, something that he had not done prior to the fellowship.

5. Communication

Publications related to the EPIET fellowship

1. 'Necessity is the mother of invention: digitising national SARI surveillance in an island country' John Paul Cauchi; Maria-Louise Borg; Ausra Dziugyte; Jessica Attard; Tanya Melillo; Graziella Zahra; Christopher Barbara; Michael Spiteri; Allan Drago; Luke Zammit; Joseph Debono; Jorgen Souness; Steve Agius; Sharon Young; Alan Dimech; Ian Chetcuti; Mark Camenzuli; Ivan Calleja; Neville Calleja; Lorraine Tabone; Charmaine Gauci; **Joaquin Baruch**. Published in *JMIR*
2. 'National long-COVID impact and risk factors' **Joaquin Baruch**, Charmaine Zahra, Tania Cardona, Tanya Melillo. Published in *Public Health*.
3. 'Effectiveness of primary series and booster mRNA vaccination against COVID-19 hospitalisation in adults aged ≥ 20 years during Omicron circulation, Europe: I-MOVE-COVID-19 and ECDC VEBIS SARI VE networks, 27 December 2021–31 March 2022' Angela MC Rose, Nathalie Nicolay, Virginia Sandonis Martín, Clara Mazagatos, Goranka Petrović, **Joaquin Baruch**, Sarah Denayer, Lucie Seyler, Lisa Domegan, Odile Launay, Ausenda Machado, Cristina Burgui, Roberta Vaikutyte, F Annabel Niessen, Isabela I Loghin, Petr Husa, Nasser Aouali, George Panagiotakopoulos, Jennifer Howard, Francisco Pozo, Virtudes Gallardo, Diana Nonković, Ausra Dziugyte, Nathalie Bossuyt, Thomas Demuyser, Róisín Duffy, Liem binh Luong Nguyen, Irina Kislava, Iván Martínez-Baz, Giedre Gefenaite, Mirjam J Knol, Corneliu Popescu, Lenka Součková, Marc Simon, Stella Michelaki, Concepción Delgado, Zvezdana Lovrić Makarić, Maria-Louise Borg, Cyril Barbezange, Els Van Nederveelde, Joan O'Donnell, Christine Durier, Raquel Guiomar, Jesús Castilla, Aukse Mickiene, Patricia C.J.L. Bruijning-Verhagen, Mihaela Laza, Regina Demlová, Gil Wirtz, Marina Amerali, Esther Kissling, Sabrina Bacci, Marta Valenciano, I-MOVE-COVID-19 hospital network team, ECDC VEBIS SARI VE network team. Manuscript is currently under review.
4. 'Pregnancy during COVID-19: social contact patterns and vaccine coverage of pregnant women from CoMix in 19 European countries' Kerry LM Wong, Amy Gimma, Enny S Paixao, Christopher Jarvis, EpiPose members, **CoMix Europe Working Group**, W. John Edmunds. Published in *BMC*.
5. 'Social contact during the COVID-19 pandemic in 21 European countries – evidence from a two-year study' Kerry LM Wong, Amy Gimma, Pietro Coletti, **CoMix Europe Working Group**, Christel Faes, Philippe Beutels, Niel Hens, W John Edmunds, Christopher I Jarvis. Manuscript is currently under review.
6. 'Hybrid immunity and protection against infection during the Omicron Wave' John Paul Cauchi, Ausra Dziugyte, Maria-Louise Borg, Tanya Melillo, Graziella Zahra, Christopher Barbara, Jorgen Souness, Steve Agius, Neville Calleja, Charmaine Gauci, Pauline Vassallo, **Joaquin Baruch**. Manuscript is currently under review.

Reports

1. Weekly epidemiological reports for SARI surveillance
2. Monthly epidemiological reports for SARI surveillance
3. Monthly epidemiological reports for vaccine effectiveness
4. Weekly and daily epidemiological reports for COVID-19

Conference presentations

1. COVID-19 vaccine effectiveness in Malta in SARI hospitalised patients: preliminary results February – April 2021. ESCAIDE, 2021.
2. COVID-19 vaccine effectiveness in Malta in SARI hospitalised patients. MAPHM conference, November 2021.
3. Setting up a Severe Acute Respiratory Surveillance system during the COVID-19 pandemic in Malta: a framework for early disease detection. MAPHM conference, November 2021.
4. COVID-19 vaccine effectiveness in Malta in SARI hospitalised patients. ECCMID, 2022.

Other presentations

1. Contribution to the Task Force for Global Health annual report – Pure Mettle [interview](#)
2. Video on the field epidemiologist day ([link](#)) from ECDC.
3. Contribution to the Think Magazine in Malta.
4. The fellow gave a presentation to the EPIET think tank on challenges and experiences during deployments with the Global Outbreak Alert and Response Network (GOARN).

6. Management and leadership

The fellow had a unique project management and team leadership experience during his fellowship. Most notably, the fellow's leadership activities were two-fold: a) development of new technologies for case management and contact tracing during the rise of COVID-19 cases at the start of his fellowship, and b) leadership for several European-level projects.

Developing new technologies

When the COVID-19 cases in Malta started to increase beyond the surveillance system's capacity, the fellow, the Director of the Directorate for Health Information and Research, Malta, and a member of the COVID-19 coordination response team, worked on transitioning the case management and contact tracing system from a free-text system to an electronic automated system. To accomplish this task, the Ministry for Health hired four information technology officers. The fellow **coordinated and managed this team of four ICT** officers to develop questionnaires and the reporting systems for COVID-19 for a period of four months. This involved the fellow managing the activities of this team, arranging for deliverables, and monitoring and evaluating the progress of the activities. As outputs, the team generated tools that allowed the COVID-19 team to cut down on case management times, delays of data reporting, and delays of contact tracing activities.

European-level projects

The fellow searched for funding to conduct projects at the beginning of his fellowship. This search led the fellow to identify sources of funding such as the Joint Action funds, academia (LSHTM), and Epiconcept. This process of searching for funding and leading the projects was a unique experience for the fellow as he managed to interact directly with the funders as the representative of Malta, secure funds for up to **half a million euros**, and **lead a team of five people** in setting up research networks, surveillance systems, and vaccine effectiveness platforms in Malta.

In total, the fellow's activities related to the following areas: managing timelines of the projects and reporting to international bodies, leading Malta's initiative to create a vaccine effectiveness and SARI network, leading the procurement of changes to the hospital electronic health records system, working with the laboratory to obtain supplies for the sequencing of COVID-19 samples, and developing strategies to share data between the various teams.

Most significantly, the fellow managed his own team of up to five people, conducting respiratory surveillance activities, leading research projects as the senior author of two manuscripts currently under review, and administering the budget and national deliverables of highly relevant European-level projects.

In addition, the fellow was responsible the creation of the SARI network and vaccine effectiveness platforms in Malta, which roughly brought together 20 people from various departments such as: the Superintendence of Public Health, Mater Dei Hospital, the vaccination registries team, the hospital IT system team, the national reference laboratory, and the COVID-19 coordination team. This network is currently active, with monthly and weekly reports shared internally, and research projects being carried out in accordance with the data sharing understandings. The network is leading the transition of the Emergency Department of Mater Dei Hospital to electronic health records.

Overall, during the fellow's fellowship, he supervised a total of two teams of nine people in different capacities, managed to secure over 500 000 euros for projects, represented Malta as the spokesperson in EU-level discussions on how to implement international surveillance activities and vaccine effectiveness platforms, and influenced cooperation in Malta between public health actors.

7. Applied public health microbiology and laboratory investigation

The fellow played a significant role in facilitating cooperation between the national laboratory and the Infectious Disease and Prevention Control Unit. This involved cooperation on surveillance, research, and outbreak investigations. Through these activities, the fellow worked with the laboratory to procure supplies for sequencing during the COVID-19 pandemic, facilitated the arrangement of sequencing from the ECDC laboratory, and led a team on coordinating activities to create solutions to logistic gaps in laboratory reporting activities.

Other training modules

1. United Nations courses: BSAFE, GOARN, GOARN in the Field, Personal Well-Being for Deployment, The Public Health Emergency and Humanitarian Landscape and Architecture, Working in an International Multidisciplinary Outbreak Response Team

8. Other activities

1. One of the two EPIET representatives for C2020.
2. Part of the organisation committee for the career compass for ESCAIDE 2021 with Drs Marion Koopmans, Chikwe Ihekweazu, and Mike Ryan.
3. Co-organised with the other cohort representatives, the career sessions from December 2020 to December 2021.

9. EPIET/EUPHEM modules attended

1. Intro course, 28/09/2020 – 16/10/2022 + inject days, Online
2. Outbreak investigation, 7/12/2020 – 11/12/2020, Online
3. Multivariable analysis, 15/02/2021 – 19/02/2021, Online
4. Intro course, 7/04/2021 – 16/04/2021, Online
5. RAS, 5/05/2021- – 6/05/2021, Online
6. Vaccinology 14/04/2022 – 18/04/2022, Online
7. Time series analysis 4/04/2022 – 8/04/2022, Rome
8. Project review module, 29/08/2022 – 2/9/2022, Lisbon

Discussion

Coordinator's conclusions

One of the main goals of the EPIET programme is for fellows to develop core competencies in field epidemiology mainly through project or activity work, but also partly through participation in training modules and applying epidemiological methods to provide evidence to guide public health interventions for communicable disease prevention and control. This report summarises all activities and projects conducted by Joaquin Baruch during his two-year EPIET fellowship (cohort 2020) as an EU/MS-track fellow at the Public Health Institute in Malta (Valletta, Malta).

Joaquin has been an exemplary fellow both at a professional and personal level. As a professional he has shown great competencies to handle different kind of projects at national level (e.g. measuring behavioural change during the COVID-19 epidemic in adults and children in Malta during 2021; gastrointestinal disease outbreak at a wedding in Malta in December 2020; lessons learnt from the first reported outbreak of the Alpha (B.1.1.7) SARS-CoV-2 variant in Malta; evaluation of the Maltese COVID-19 surveillance system), EU-level or with impact at the EU-level (e.g. development and evaluation of a surveillance system for severe acute respiratory infections in Malta; monkeypox case management and contact tracing among the MSM, Latin American community in Malta; European study of COVID-19 vaccine effectiveness against hospitalised SARI patients laboratory-confirmed with SARS-CoV-2); and finally at the international level with two deployments by GOARN (enhancing cholera, polio and measles surveillance in Cabo Delgado, Mozambique; Go.Data implementation in the Sahrawi refugee camps, Algeria).

This portfolio is evidence of a fellow with high capacity of management and leadership. His ability to manage projects, resources (applying for financial and human resources), working with multi-sectoral professionals, and managing crises where the planned projects were cancelled and proactively finding solutions. As a person he is pleasant to work with, honest, gives constructive feedback, is creative and thinks out of the box, with a positive attitude even during crises. Joaquin and the training site and supervisors in Malta have shown to be one of the best combinations for the training of fellows. I, on behalf of the coordinating team, congratulate Joaquin and the supervisors, in particular Maria Borg, for such a success. We wish all the luck to Joaquin for achieving all his objectives in high quality and beyond expectations.

Supervisor's conclusions

Coming from an academic background with a lot of technical and statistical expertise, coupled with a proactive and ambitious attitude, Joaquin immediately proved pivotal in enhancing the way data were being collated during the COVID-19 pandemic. This served to automate processes, saving time, and improving the quality and analysis of the data which was crucial to inform policy and decisions throughout the pandemic. Throughout his fellowship he kept supporting the unit in improving its processes and systems to enhance infectious disease surveillance at a national level.

Joaquin also set up and led SARI surveillance in Malta. He managed the project, obtained funding, trained and managed the local team and collaborated with different stakeholders to establish a long-term SARI surveillance system for Malta. This was possible through his leadership, negotiation and management skills and capacity to assess and adapt to different health systems.

Joaquin is very proactive, independent, focused and motivated. He was able to successfully lead international projects and put his knowledge and skills into practice to enhance systems within the IDPCU. He is a good team player, training/supervising teams to ensure the successful implementation of long-term surveillance systems. During his fellowship, Joaquin was involved in various tasks and research projects. His presentations and publications also helped showcase all the work being done by the unit. His work enabled the IDPCU to enhance its systems, training and surveillance capacity in the long term.

Through his dedication, vision, perseverance and positive attitude, Joaquin managed to achieve a lot during his fellowship despite working during the challenging pandemic period, as attested by all the outputs in the portfolio. He proved to be an exceptional fellow, an invaluable asset in any team and a future leader in public health.

Personal conclusions of fellow

My fellowship during the last two years has been a great learning experience. I have been exposed to several projects in areas that were relatively new to me. My experiences working with the IDPCU, the laboratory, the hospital, universities and the WHO have allowed me to expand my knowledge, put theoretical concepts into practice, develop core skills, and help populations in need. I believe that the FETP programmes play a key role in strengthening health systems and establishing capacity for epidemic and pandemic preparedness and response.

Acknowledgements of fellow

I want to acknowledge my site supervisor Dr Maria Louise Borg, who has been a fantastic supervisor and friend for the last two years. Maria made my stay in Malta feel like home, and I believe that without her support, none of my achievements would have been possible. In addition, special thanks go to Dr Tanya Melillo for her collaboration and guidance as project supervisor in many of my assignments and for leading the unit to which I was assigned. I would also like to thank the fantastic team that Maria, Tanya and I created to work on the SARI and vaccine effectiveness projects. Without the support of these great team members, we would not have achieved all the milestones that we did. In addition, I would like to thank Epiconcept for our collaborations during the last two years; I am sure this is the start of a long road ahead.

In addition, my fellowship was a great experience thanks to the collaborations between GOARN and EPIET. Therefore, I thank the fantastic WHO team in GOARN and the WHO teams in Algeria and Mozambique. Lastly, I would like to thank my two front-line coordinators, Aftab and Zaida, who played a significant role in my professional development.