



Summary of work activities

Tobias Homan

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 Tobias Homan, cohort 2020 of the Intervention Epidemiology path (EPIET) at the University of Foggia in Italy.

Pre-fellowship short biography

Tobias Homan graduated from the Vrije Universiteit Amsterdam in the Netherlands in 2012, with two MSc degrees in health sciences, one in International Public Health and one in Policy and Organisation in Healthcare. He then moved on as a PhD candidate at the Wageningen University and Swiss TPH where he graduated in malaria epidemiology in 2016. In the years before the EPIET programme, Tobias worked as a post-doc and in the humanitarian sector as an epidemiology manager. Tobias gained international experience and worked with a wide range of diseases in various settings, having spent four years in the Middle East during the conflict in Syria and

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Stockholm, September 2022

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Myanmar with Doctors without Borders. He then became affiliated to the Red Cross before joining ECDC's EPIET programme.

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

Outbreak investigations

1.1 Response to COVID-19 pandemic in Apulia region, Italy

Supervisors: Rosa Prato, Domenico Martinelli, Pier Luigi Lopalco

Tobias was part of the epidemiology and health protection team that responded to the COVID-19 pandemic at regional level in Apulia, Italy. The activities conducted by the team included evaluation of the epidemiological situation based on surveillance data analysis and resulting recommendations; management of COVID-19 outbreaks; discussions on prevention measures to be implemented in the region; participation in various meetings within the National Institute of Health (Istituto Superiore di Sanità – ISS) and representatives of the Italian Minister of Health (MoH).

Role: Tobias contributed to discussions about COVID-19 outbreaks at schools and elderly homes. Ad hoc literature reviews were performed by the fellow, and surveillance data was analysed using automated R-scripts in order to describe the evolution of the pandemic at local level, generate hypotheses and to draw conclusions to communicate findings to the highest level health authority to implement control measures.

1.2 Preparation of community-based surveillance to detect future Ebola outbreaks in Guinea (IFRC deployment)

Supervisors: Amrish Baidjoe

In February 2021, multiple cases of Ebola were confirmed by WHO in the Nzezokore district of Guinea. This area has been the epicentre of Ebola outbreaks several times in the past. By May 2021, no new cases were detected, but the International Federation of Red Cross and Red Crescent Societies (IFRC) suggested implementing community-based approaches to detect, communicate, and contain current or future outbreaks. The aim was to set up community-based surveillance to be able to act as an early warning system. By training local volunteers, health officers and health authorities in different areas, outbreaks should be managed more effectively and efficiently. The content of training courses existed in two parts: (1) training of local volunteers to be able to detect cases and educate them on how to handle and communicate these cases; and (2) training of focal points on how to collect community data and how to escalate these to health authorities. Phone messages were used by volunteers to signal information about suspected cases, and then Kobo software was used to enter data about time, place, and person to be shared with health authorities. The steps to be taken for an outbreak investigation were embedded in the training, including real case examples of Ebola outbreaks.

Role: Tobias edited and prepared pre-existing training modules on community-based surveillance for Ebola and prepared Kobo software and data collection devices to implement the outbreak warning system. This preparation

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>

took place in Senegal, unfortunately, since the implementation of the training itself was postponed due to visa issues.

1.3 Response and support to a monkeypox outbreak in Apulia

Supervisor: Domenico Martinelli

From May 2022 monkeypox also emerged in the Apulia region, with the first case identified and reported to the regional health authorities on 27 May 2022. By July 2022, nine cases were confirmed in Apulia, of which most (8/9) were among young adult men with an average age of 37 years. At regional level, a team was established to coordinate the surveillance and response to the monkeypox virus outbreak with the Hygiene and Public Health Services. At the beginning of the outbreak, not much was known about the transmission and the characteristics of the disease. Therefore, WHO guidelines were used as much as possible to guide the process of investigating suspected, probable, and confirmed cases. Although only few cases were identified in the period between May and July 2022, contact tracing, information dissemination and clinical investigations were carried out meticulously in order to reduce the spread of the virus. Public health activities included raising awareness about the disease in risk groups and the promotion of vaccinations.

Role: Tobias supported the team in the formulation of the case definitions, as well as the development of a questionnaire to collect the necessary information from cases. At the time of writing, no analytical study would advance the outbreak investigation due to a low number of cases. Nevertheless, for this investigation, Tobias prepared a brief outbreak report that included a line list, questionnaire, and an epi curve.

Training modules related to assignment/projects

Introductory Course part 1 – This module familiarised Tobias with the core parts of outbreak investigation, in particular the 10 steps, different study designs, and data analysis methods.

Introductory Course part 3 – This module provided Tobias with an understanding of relevant epidemiological concepts for surveillance and outbreak investigations, as well as how to communicate relevant public health information to health authorities.

Outbreak Investigation Module – This module built on the introductory courses to provide a better understanding and practice of all aspects of outbreak investigations through real-life case studies (detection, data analysis and interpretation, microbiological and environmental investigations, report writing, communication, etc).

Educational outcome

Before starting EPIET, Tobias already had relevant experience with outbreaks in various contexts and with several pathogens. During the fellowship, the relatively small field site in Foggia was overwhelmed with COVID-19 activities and practically no classical outbreaks of pathogens other than COVID-19 were detected or investigated. Despite having done the 10 steps in an outbreak investigation in previous experiences, the extent of theory provided by the fellowship including case studies in well-functioning health systems in the European context were of value for him. During the fellowship, the last six steps of the outbreak investigation were carried out ad hoc at the field side in discussions and through data analysis of COVID-19 data which led to relevant recommendations to the Minister of Health. Finally, a large part of the theory learned was conveyed by preparing a community-based surveillance system against an Ebola outbreak in Guinea, as well as doing some practical applications of the first steps in a monkeypox outbreak.

2. Surveillance

2.1 Development of automated analysis of COVID-19 surveillance data in the province of Foggia

Supervisors: Domenico Martinelli, Rosa Prato, Francesca Fortunato, Lucia Bisceglia

Following the initial wave of COVID-19 in March 2020, scientific and public health institutions were required to elucidate more about the epidemiology of the virus. Testing capacity increased and guidelines about clinical management and possible intervention measures improved once the second wave arrived. To monitor the epidemiology of the disease, timely data analysis and reporting were essential. The surveillance system was relatively well-functioning by late 2020, and in order to summarise the epidemiological situation on a weekly basis an automated tool providing key indicators and trends at provincial level was developed by the fellow.

Tobias developed the R scripts in order to automate the process of generating weekly surveillance reports, which has been an excellent way to assess the situation more rapidly and to inform relevant policy and decision-makers on how to manage the pandemic. The surveillance analyses included weekly numbers of cases, deaths, hospitalisations, calculation of seven-day incidence, the number of patients in hospitals, at the intensive care unit, and the number of isolated people, among other indicators. An age pyramid with infected cases is provided as well as age and sex breakdowns on prevalence and for those on the ICU and those that died. Trend graphs showed the incidence and death rates over time. The analysis was also automatically performed every week on the cumulative numbers.

The outputs of these analyses were used to provide weekly situation reports to local public health managers and the office of the regional authorities with data for them to be able to make evidence-based decisions.

Role: Tobias developed a comprehensive R markdown script for automatic analyses of COVID-19 surveillance data. He was actively engaged in formulating the interpretation of the indicators and the development of recommendations to the highest regional level health authority.

2.2 Field evaluation of the performance of a novel immunofluorescence Rapid Antigen Diagnostic Test in Puglia, Italy

Supervisors: Domenico Martinelli, Rosa Prato

During 2020 and early 2021 experts recommended that in the absence of treatment for COVID-19 or a vaccine for SARS-CoV-2, timely and accurate testing, followed by case identification, isolation and contact tracing were the best approaches to contain the pandemic. There was a high demand for SARS-CoV-2 testing, real-time, quantitative PCR is the recommended diagnostic test, but a number of constraints, including the time until results as well as costs, prevented its rapid introduction in routine use. Next to the gold standard (PCR) there was the rapid antigen test, which relies on direct detection of SARS-CoV-2 viral proteins in nasal swabs and other respiratory secretions using a lateral flow immunoassay. Such antigen tests could be a cheap and fast alternative to PCR but questions on its performance remained at the beginning of the pandemic.

The primary objective of the activity was to determine the diagnostic performance on sensitivity and specificity of the Boditech RAT compared to RT-PCR regarding usefulness point of care settings in the province of Foggia, Italy using available surveillance data. Secondary objectives included determining the analytical and diagnostic performance of sensitivity and specificity compared to RT-PCR stratified by age, sex and (the onset) of symptoms.

This evaluation study found that the Boditech-RAT does not meet the minimum performance requirement for RAT set by WHO ($\geq 80\%$ sensitivity and $\geq 97\%$ specificity). The specificity was considerably lower (83%), whereas the sensitivity (94%) was in line with some of the best RATs tested. We concluded that the Boditech-RAT is suitable for screening purposes but should not be used for symptomatic patients arriving late for diagnosis to avoid false positivity.

Role: Tobias developed the protocol, designed the study, collaborated with relevant health departments, analysed the data and presented this work at ESCAIDE 2021 as a poster presentation.

2.3 Development of automated analysis of COVID-19 vaccination surveillance data in the province of Foggia, Italy

Supervisors: Domenico Martinelli, Rosa Prato

The roll-out of COVID-19 vaccinations in Italy was planned over several phases. Priority was given to healthcare workers, nursing home staff and residents, chronically ill individuals, and high-risk groups, followed by the rest of the population descending from old to younger. To help maintain the proposed strategy, regular reporting on vaccination coverage was vital to be able to see if the roll-out was going according to plan and where post hoc recommendations, direction and support was required. The vaccination strategy was complicated due to delays in vaccination deliveries as well as updates on effectiveness estimates in certain groups. There were also practical and logistical challenges during the roll-out, given the scale and duration of the vaccination campaign. It was therefore vital to closely monitor the progress of vaccinations to make sure the priority groups and later the general population had been offered COVID vaccinations. In this way, public health authorities and medical institutions at local and regional levels were provided with a complete overview of those vaccinated and they could respond rapidly to inconsistencies where necessary.

In a first phase, routine surveillance data captured by hospitals and other vaccination facilities in Puglia was used to monitor vaccine coverage among healthcare workers, to efficiently respond to gaps in vaccinations for those most exposed to the risk of COVID-19, and to keep track of vaccination coverage in different departments, and for different groups of (para) medical personnel. Surveillance data aimed to provide an overview and visualisation of current numbers and to survey and monitor the progress of different vaccines and doses throughout the stepwise introduction of the vaccination schedule. Weekly reporting included breakdown summaries with denominators and percentages on sex, age, health institute, job description as well as different health departments. In the following phases where the general population was targeted for vaccinations against COVID-19, the denominator was based on age specific population registers on a geographical scale.

Role: Tobias developed a comprehensive R markdown script for automatic analyses of COVID-19 vaccination surveillance data. He was actively engaged in formulating the interpretation of the indicators and pointing out data? gaps where extra emphasis was required with the roll-out of the vaccinations.

2.4 Introducing and implementing a quarterly reporting tool for anti-microbial resistance surveillance data in the region of Apulia, Italy

Supervisors: Domenico Martinelli, Rosa Prato

The surveillance of the anti-microbial resistance (AMR) data presents the opportunity to develop an essential tool for describing the spread, and the trend of the AMR phenomenon in the Apulian region. The surveillance is based on a network of hospital laboratories present throughout the regional territory. It systematically collects AMR data obtained during the routine laboratory analyses for pathogens isolated from invasive infections (blood or cerebral spinal fluid). There are eight pathogens under surveillance: *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Enterococcus faecalis* and *Enterococcus faecium* among Gram-positive bacteria, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Acinetobacter* species among Gram-negative bacteria. Monitoring the epidemiological situation in Apulia is essential to assess resistance to the various classes of antibiotics that are of crucial importance for therapeutic purposes against specific pathogens.

The aim of this surveillance activity was to draft a R-studio tool that can produce quarterly reports of the epidemiology of antibiotic resistance throughout the region. The trend over time gives managing healthcare workers and decision-makers a clear overview of the current state of affairs. The proportional distribution of the eight different pathogens are summarised followed by the numbers and demographic distribution of patients by the type of pathogen. The main results consist of gram-positive and gram-negative pathogens each broken down by the antibiotics used. The report describes the percentage of resistance by the four main pathogen/antibiotic combinations particularly relevant for Italian surveillance and under observation at a European level by ECDC.

Role: Tobias developed a comprehensive R markdown script for automatic analyses of AMR surveillance data. He familiarised himself with the databases and gave feedback for data collection and data cleaning for the future. He was actively engaged in formulating the interpretation of the indicators and actively assisted the surveillance referents with discussion on the development of AMR and the recommendations for the future.

Training modules related to assignment/projects

Introductory Course part 1 – The introductory course familiarised the fellow with the core concepts in surveillance, such as the needs for surveillance, the key components and types of surveillance systems, the analysis and interpretation of surveillance data, and the development and evaluation of a surveillance system.

Introductory Course part 3 – This module provided deeper insights into the understanding and analysis of surveillance systems. In addition, the theory on proposed public health control measures and recommendations based on investigation or research findings was applied throughout several projects.

Time Series Analysis module – This module provided the fellow with in-depth knowledge of how to use time series analysis to examine surveillance data for the reporting of trends.

Educational outcome

Tobias developed competencies in epidemiological surveillance by being involved in various projects such as indicators and event-based routine surveillance and the analysis of surveillance system data. He regularly gathered, analysed, interpreted, and reported surveillance data and, more specifically, contributed to different outputs, including the analysis of surveillance data for diagnostic tools, the automatization of reporting on essential outcomes during multiple waves of COVID-19, and information-sharing at a regional level.

3. Applied public health research

3.1 Effect of previous SARS-CoV-2 infection on antibody response to a single immunisation with the Pfizer BNT162b mRNA vaccine among healthcare workers in Foggia, Italy

Supervisors: Domenico Martinelli, Rosa Prato, Pier Luigi Lopalco

After the introduction of COVID-19 vaccinations, data had suggested that SARS-CoV-2 infection causes an antibody response at least as strong as one BNT162b2 vaccine dose. Nevertheless, some aspects required further investigation to better understand the immunogenicity of one vaccine dose among infected individuals.

We evaluated how previous SARS-CoV-2 infection may influence the humoral immunity after a single Pfizer BNT162b mRNA vaccine dose in a sample of healthcare workers (HCWs). As part of the routine surveillance activity conducted among HCWs of the Policlinico di Foggia Hospital, we conducted a retrospective serosurvey in the period January–March 2021. We compared specific antibody titres (anti-spike IgGs measured by enzyme-linked immunoassay, ELISA) after SARS-CoV-2 infection and after the first dose of the BNT162b2 vaccine, analysing the impact of sex, age, time since infection, and presence of symptoms on the humoral response. A 36-fold difference between IgG-titres of exposed HCWs pre-dose and HCW unexposed post-dose (Medians: 25.35-0.7; p-value <0.001) was found. Between exposed HCWs with an infection more or less than six months post-dose (Medians: 96-291 days) titres were similar (Medians: 2010-1250; p-value =0.154). Post-dose titres among exposed HCWs did

not vary by sex but differed between symptomatic and asymptomatic individuals (Medians =1900, 1170; p-value =0.048). SARS-CoV-2 infection yielded higher IgG-antibody titres than a first dose vaccine (Pfizer-BioNTech) in HCWs, regardless of sex. Immunogenicity after the first dose did not depend on the time since infection and was stronger in symptomatic individuals, although high titres remained among asymptomatics. Our data suggest that SARS-CoV-2 infection may serve as a priming dose regarding antibody response, irrespective of sex, time since infection and symptoms.

Role: Tobias and supervisors conceptualised the idea of the economic use of vaccinations in order to better protect large groups of people not only in high income countries. He designed the study, wrote the protocol, conducted the analysis and wrote the manuscript. The paper was published in *Infectious Disease and Therapy*, and the results presented as an oral presentation at ESCAIDE 2021.

3.2 One year into the pandemic: How deadly has COVID-19 been in Puglia, a region with one of the most aged populations in Europe?

Supervisors: Domenico Martinelli, Rosa Prato, Francesca Fortunato

One major risk factor for death in COVID-19 is old age, and the population ≥ 65 years in Puglia is 17.6% greater than average in EU.

This study aimed to quantify the COVID-19 mortality and standardised case fatality rate (SCFR) during the pandemic's first year in Puglia, Italy. We used the national COVID-19 database to analyse the mortality and the SCFR (by national age, sex) in Puglia. We reported the median age of death and time from diagnosis to death with interquartile-ranges (IQR). We calculated the mortality (per/100 000) and analysed the SCFR stratified by two waves, age and sex. COVID-19 data since February 2020 (one year) demonstrated 147,047 confirmed cases and 3929 deaths in Puglia. The median age of death was 80.2 years. The time between diagnosis and death was 10.5 days (IQR:7-16). In ≥ 65 -year-olds, the SCFR was 7% higher for men than for women. The mortality rate in the first wave was 4.2 (CI95%:3.3-6.3) and 24.6 (CI95%:22.6-26) in the second. The SCFR for those ≥ 65 years were respectively 30 (CI95%:27.8-31.9) in the first wave and 7.8 (CI95%:7.3-8.2) in the second. The median age of COVID-19 deaths in Puglia was similar to that of Italy, but five years higher than the European average. Like other findings, the SCFR was larger for men than women. The SCFR in those ≥ 65 years is among the highest in Europe, likely attributable to Italy being the first epicentre of COVID-19 and the age-structure. The SCFR was lower in the second wave, due to increased testing. The mortality rate increased in the second wave. Better public health interventions are required in regions with high proportions of people aged 65+ years. For instance, strict testing at entering elderly homes and special times for public activities, like groceries.

Role: Tobias developed the research concept, designed the study, analysed the data, drafted the report, and wrote an abstract that was accepted for a poster presentation at the ECCMID 2022 conference.

3.3 The association between Rota virus vaccination and the onset of type 1 diabetes, using vaccination registry data in Puglia Italy, 2008-2020

Supervisors: Domenico Martinelli, Rosa Prato, Francesca Fortunato

As global availability of rotavirus vaccines increases, recent studies have assessed whether rotavirus vaccination modifies type-1 Diabetes (T1D) development. The rarity of T1D as well as its long latent period make this a challenging research question to address, especially because current rotavirus vaccines have been licensed only recently, with high and rapid uptake in many countries. Existing findings have led to mixed conclusions, further highlighting the need for additional research with diverse methods, data sources, and populations. The new insights about the possible effect of rotavirus vaccinations in young children on developing T1D can have large implications both on the vaccination programme and on dealing with this chronic disease. Rotavirus vaccination may be the first practical measure that could play a role in the prevention of T1D. Epidemiological research on the available data can shed light on the relationship between T1D incidence and rota virus vaccination, including the modelling of other relevant factors.

We performed a retrospective cohort study with the diagnosis of diabetes type 1 as outcome. We compared the Intervention group, those that received full vaccination for Rota virus with three comparison groups: partially vaccinated, those contemporaneous with no vaccination and those with no vaccination before the follow-up of the intervention group. Incidence rates (IR) and incidence rate ratios (IRR), survival curves and Cox proportional regression was performed to yield answers to the research question. Preliminary results show a strong protective effect for children who received Rota virus vaccinations against developing T1D. With an IR of 8.53 versus 15.77 those children vaccinated yield an IRR of 0.54 (CI95% 0.31-0.93). The IRR, compared with the historically unvaccinated was 0.51 (CI95% 0.29-0.89). At the moment of writing this portfolio, an important part of the data (part of T1D register) has not been released, and therefore a final analysis including hazard ratio's is still pending. We are therefore careful with any recommendation at this stage.

Role: Tobias and supervisors collected the data and Tobias designed the study and wrote the analytical plan. He then went on to analyse the available data with R-scripts and produced a preliminary data report.

3.4 COVID-19 vaccination programme effectiveness against SARS-CoV-2 related infections, hospital admissions and deaths in the Apulia region of Italy: a one-year retrospective cohort study

Supervisors: Domenico Martinelli, Rosa Prato, Pier Luigi Lopalco, Lucia Bisceglia

COVID-19 vaccine effectiveness decline for some outcomes and populations during 2021 has been reported.

We estimated the effectiveness of the whole COVID-19 vaccination programme in Apulia region, Italy, at preventing SARS-CoV-2 infections, COVID-19-related hospital admissions and deaths during alpha and delta variant dominant periods, including waning effects. Using electronic health records of persons 16 years and older, we conducted a retrospective cohort study assessing effectiveness of combined BNT162b2, mRNA-1273, ChAdOx1-S and Ad26.COVS vaccines against rtPCR-confirmed COVID-19 infection, hospitalisations and deaths, by time since vaccination and variant dominant period, calculating Hazard ratios from Cox-regression models.

Between 1-Jan/1-Dec 2021, we included 3 530 967 persons in the cohort. Some 2 770 299 people were fully vaccinated and 158 313 were COVID-19 positive at the end of the study period. Programme vaccine effectiveness for fully vaccinated against COVID-19 infection, hospitalisation and death were 87.69% (87.73-88.18), 94.08% (93.58-94.54) and 95.95% (95.26-96.54) respectively. The effectiveness during the Alpha and Delta periods was 88.20% (87.60-99.78) and 59.31% (57.91-60.67) against infection, 93.89% (92.67-94.90) and 88.32% (86.50-89.90) against hospitalisation and 93.83% (91.65-95.45) and 85.91 (79.98-90.09) against death. Waning effects regarding COVID-19 infection during the Delta period were stronger than for Alpha, with 75.85% (74.38-77.24) effectiveness after 1-2 months and 8.35% (3.45-13.01) after 5-6 months after full vaccination. Effectiveness against hospitalisation and death during the Delta period waned rapidly since 1-2- and 7-8-months full vaccination with respectively 27.67% (7.48-43.45) and 48.47 (53.97-34.82). Our study suggests that the vaccination program in Apulia was strongly protective against COVID-19 infections, hospitalisation, and death due to the Alpha variant as well as Delta variants, although effectiveness decreased over time. We recommend booster doses, primarily to vulnerable groups and additional effectiveness studies of new variants to inform public health policy.

Role: Tobias conceptualised the research and designed the full study including the relevant approach on the combination of waning effects and virus variants. He wrote the R-scripts, conducted the analysis and wrote the paper. The paper accepted at Nature Scientific Reports and its results were submitted and accepted for two oral presentation (AIE 2022 and ESCAIDE 2022) with different focus.

Training modules related to assignment/projects

Introductory Course part 2 – As a refreshing exercise, the fellow benefitted from the basic principles of operational research provided during the operational research inject days.

Multivariable Analysis – During this module the fellow strengthened and broadened his skills regarding the use of multivariable statistical modelling. In various research topic advanced statistics were used that were taught during the module.

Vaccinology – Prior to EPIET Tobias had never worked with vaccination programme evaluation or the clinical point of view. This module came at the right moment since he was just analysing the vaccine effectiveness in Apulia.

Educational outcome:

Tobias did already acquire substantial experience in operational research. On the one hand this was gained in a pure academic setting and on the other hand in humanitarian settings. However, in the context of an operational setting of a well-functioning health system within the EU in combination with a major public health crisis, he managed to improve his knowledge and skills significantly. The use of near-real time readily available population databases during the COVID-19 pandemic enabled him to come up with relevant and creative original research by applying various advanced statistical techniques acquired during EPIET modules.

4. Teaching and pedagogy

4.1 Course in outbreak investigation to medical residents

Tobias facilitated a three-day intro course on outbreak investigations. The target audience was a group of 25 medical students who were specialising in public health. During three five-hour sessions at the department of hygiene in Foggia, he taught the basics of outbreak investigation and relevant study designs accompanied by two case studies. The materials provided by ECDC were edited and used as training material. The students were highly enthusiastic and were very happy with the course. The evaluation of the course was excellent. By the end of the course, students indicated that they were able to independently carry out an outbreak investigation using the 10 steps, applying hypotheses and corresponding control measures, as well as conducting epidemiological study designs.

4.2 Preparation of community-based surveillance materials to prevent Ebola outbreaks in Guinea

Tobias edited and created multiple trainings for local Red Cross volunteers and supervisors in order to detect Ebola outbreaks, and communicate and involve health authorities. The aim was to prepare villagers and local health authorities for future Ebola outbreaks in a very susceptible population and area. The trainings were about educating the volunteers and that the volunteers would educate their community to gain know-how on what Ebola is, what to do with a suspected case, what behaviour should be avoided and how to inform the local Red Cross and health authority. The training encompassed case studies, exercises, and practical assignments on what had happened in previous Ebola outbreaks. Additional technical trainings were drafted for the supervisors, who manage volunteers in multiple villages and who have the responsibility to collect data and research the nature of the alert. By means of data collection software and thorough exercises on how to handle the software, the tablet and the communication to health authorities, supervisors would be enabled to quickly escalate a possible outbreak.

Training modules related to assignment/projects

Outbreak investigation module – The fellow benefitted from the outbreak investigation theory and case studies, and he then went on to teach it to medical students himself.

Educational outcome:

By spring 2022, the COVID-19 situation allowed Tobias finally to organise a lecture for the medical students. Although he gained experience with teaching during his years in academia, the operational nature of these lectures were new to him and a skill that will probably be highly relevant later in the career. He always enjoys working with groups and students, and he is inspired by the didactics and content provided by EPIET to provide high quality education himself.

5. Communication

Publications related to the EPIET fellowship

1. **Homan T**, Fortunato F, Corso G, Lopalco PL, Prato R, Martinelli D. Effect of Previous SARS-CoV-2 Infection on Antibody Response to a Single Immunization with the Pfizer BNT162b mRNA Vaccine Among Healthcare Workers in Foggia, Italy. *Infectious Diseases and Therapy* volume 11, pages607–615 (2022)
2. **Homan T**, Mazzili S, Chieti A, Musa A, Roth A, Fortunato F, Bisceglia L, Lopalco PL, Martinelli D. COVID-19 vaccination programme effectiveness against SARS-CoV-2 related infections, hospital admissions and deaths in the Apulia region of Italy: a one-year retrospective cohort study. Accepted in *Nature Scientific Reports*
3. **Homan T**, Lopalco PL, Prato R, Martinelli D. The association between Rota virus vaccination and the onset of type 1 diabetes, using vaccination registry data in Puglia Italy, 2008-2020. In preparation for submission

Reports

1. Weekly epidemiological situation reports on COVID-19
2. Daily COVID-19 vaccination coverage situation reports. Quarterly epidemiological situation reports on anti-microbial resistance

Conference presentations

1. **Homan T**, Fortunato F, Corso G, Lopalco PL, Prato R, Martinelli D. Previous SARS-CoV-2 infection as a first dose for Pfizer vaccinations. Oral presentation at ESCAIDE 2021
2. **Homan T**, Prato R, Martinelli D. Evaluation of an Antigen Rapid Diagnostic Test for SARS-CoV-2 at a south Italian field site: despite limitations, could it serve as a useful screening tool? Poster presentation at ESCAIDE 2021
3. **Homan T**, Bisceglia L, Martinelli D. One year into the pandemic: How deadly has COVID-19 been in Apulia, one of the most aged regions in Europe? Poster presentation at ECCMID 2022
4. **Homan T**, Mazzili S, Chieti A, Musa A, Roth A, Fortunato F, Bisceglia L, Lopalco PL, Martinelli D. Efficacia di campo del programma di immunizzazione anti-COVID-19 nel prevenire le infezioni, i ricoveri e i decessi SARS-CoV-2 correlati in Puglia tra gennaio e dicembre 2021. Oral presentation at Associazione Italiana di Epidemiologia 2022
5. **Homan T**, Mazzili S, Chieti A, Musa A, Roth A, Fortunato F, Bisceglia L, Lopalco PL, Martinelli D. Covid-19 vaccination programme effectiveness against SARS-CoV-2 related infections, hospital admissions and deaths in the Apulia region of Italy: a one-year retrospective cohort study. Accepted for Oral presentation at ESCAIDE 2022

Other presentations

1. Contribution to ECDC think tank session in 2021. Immunogenicity pre and post the first Pfizer anti COVID-19 vaccination dose among priorly SARS-CoV-2 infected individuals and those previously not infected.

6. Other activities

1. International assignment with WHO-EURO in Serbia. COVID-19 vaccination effectiveness study at multiple hospitals in Serbia using a test-negative design. Seven weeks in country support with drafting of SOPs, setting up data collection systems and the preparation of the implementation of the study. Supervisor: Mark Katz Avram

7. EPIET/EUPHEM modules attended

Introductory Course part 1. 28 September–16 October 2020. Virtual

Introductory Course part 2 – 9-10 November 2020. Virtual

Outbreak Investigation: 7– 11 December 2020. Virtual

Multivariable Analysis: 15– 19 February 2021. Virtual

Introductory Course part 3, including RAS: 26 April– 7 May 2021. Virtual

Project Review Module 2021: 23– 27 August 2021. Virtual

Vaccinology: 14– 18 February 2022. Virtual

Time Series: 4–8 April 2022. Rome, Italy

Management, Leadership and Communication in Public Health: 13– 17 June 2022. Stockholm, Sweden

Project Review Module 2022: 29 August– 2 September 2022. Lisbon, Portugal

8. Other training

1. Community-based surveillance. Facilitated by Emergency Response Unit of the Norwegian Red Cross and the IFRC. Five-day training. 24–28 November 2020. Virtual

Discussion

Coordinator's conclusions

Tobias started his fellowship with strong epidemiological skills from his previous work and doctoral studies. During his two-year fellowship, Tobias exceeded the number of projects to satisfy EPIET requirements, while producing high-quality outputs on diverse topics that expanded his competencies into new areas and methodologies.

Tobias was involved in numerous field assignments including three outbreak investigations, four surveillance projects, and four research studies. These projects resulted in two published papers and a manuscript as first author, and five conference presentations. Particular highlights from his portfolio include: (1) a COVID-19 programme effectiveness study suggesting the overall vaccination program was strongly protective against hospitalisations and death; (2) development of R scripts to automate analysis and weekly COVID-19 surveillance reports; (3) evaluation of a rapid antigen test for COVID-19 detection that showed its potential suitability for screening programs; (4) international assignment with WHO in Serbia to help develop a COVID-19 vaccination effectiveness study, including developing the SOP and data collection system that would support study implementation.

Through the fellowship, Tobias developed new competencies, most notably with vaccine effectiveness studies and developing R scripts to automate surveillance work. He also gained further experience in preparing research manuscripts and conference presentations. Tobias has been highly committed to the fellowship and showed perseverance through a two-year period marked by COVID-19 restrictions, remote working, and disruptions to in-person training and networking opportunities. While his advanced epidemiological skills allowed him to work independently during this unique period, he also had an inspiring supervisor at his institute that further supported his fellowship success. I wish Tobias all the best in his future work and career.

Supervisor's conclusions

Tobias's fellowship was strongly conditioned by the COVID-19 pandemic. If this situation limited some aspects of the training, in particular those requiring involvement in the field, on the other hand it offered a unique opportunity for Tobias to experiment as an epidemiologist. Considering the emergency, since the start of the fellowship, he was involved in the most significant activities of the site, the Sector of Hygiene, University of Foggia, Italy. In particular, he was involved in COVID-19 surveillance activities: his great capability in the use of R Studio was helpful in automatising the analysing and reporting processes. From the COVID-19 surveillance as well as from the monitoring of the COVID-19 vaccination campaign were born most of the suggestions to develop applied public health research projects that ended in valuable contributions presented at national and international conferences and in papers in prestigious journals.

Moreover, Tobias was involved in other activities at the site, such as the surveillance of AMR and the evaluation of the impact of routine vaccination programmes. Also in these, he gave his valuable contribution in simplifying several processes and elaborating some research hypotheses such as on the possible association between rotavirus vaccination and the onset of type 1 diabetes.

Personal conclusions of the fellow

I have been privileged to be an EPIET fellow during the COVID-19 pandemic. Over the course of two years, I started at Foggia University at the start of the second wave of the pandemic in Europe in the autumn of 2020. From that moment on, the fellowship would be quite different from what it usually is according to supervisors and alumni. And although the disappointment was great regarding the modules being online only, I am well aware that a better training than during a respiratory pandemic is probably hard to imagine. I learned a great deal about supporting and acting on the acute necessities that emerge during this period. This encompassed a wide range of interesting topics, including diagnostic evaluation, the use of immunological data, the collection and use of vaccination data, as well as numerous other topics related to surveillance and ad hoc research.

The programme as a whole was a great experience despite the limitations of this period. The network I have made with fellow fellows is moreover something that is of unbelievable value. I have been very happy with my supervisor and frontline coordinator, they have been very resourceful, flexible and extremely knowledgeable.

Acknowledgements of the fellow

I want to first of all acknowledge Domenico Martinelli for his endless energy during my fellowship while managing the pandemic from a crucial position. On a personal level, I have also been grateful to have had him as a supervisor. Furthermore, the head of department Prof. Rosa Prato was always there for me and supported me in times that were challenging at times. Furthermore, I want to thank Prof. Pier Luigi Lopalco, who was in the background with critical notes and advice on the work performed. I would also like to thank Lucia Bisceglia and Sara Mazzilli for their help with a complex vaccination effectiveness paper. I have great gratitude for my frontline coordinator Adam Roth, with whom I had regular contact about the progress as well as interesting discussions on current topics. Finally, I would like to thank all the fellows of cohort 2020, of whom I formed a great impression – I hope to see much more of them in the rest of our careers.