Summary of work activities
Miguel Ángel Sánchez Ruiz
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 Miguel Ángel Sánchez Ruiz, cohort 2020 of the Intervention Epidemiology path (EPIET) at the Regional Office of Santé publique France (SpF), the French National Agency for Public Health, in Provence-Alpes-Côte d'Azur (PACA) and Corsica.

Pre-fellowship short biography

Miguel Ángel Sánchez Ruiz graduated as a pharmacist in 2008 and specialised in pharmacy management and coordination in the humanitarian field at Doctors without Borders/Médecins sans Frontières (MSF) in different settings. He obtained a Master's degree in Public Health in 2014. Then, he worked as a pharmaco-epidemiologist on drug safety and effectiveness at IQVIA and as a field epidemiologist on HIV, Ebola, vaccination and COVID-19-related projects at MSF in several countries. In 2020, he decided to further specialise in field epidemiology and joined the 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 Manual[1].

1. Epidemiological investigations

Outbreak investigations

1.1 Outbreak of SARS-CoV-2 Delta variant affecting two nursing homes in PACA region, France

Supervisors: Pascal Chaud, Philippe Malfait (Santé Publique France), Provence-Alpes-Côte d'Azur, France

On 10 May 2021, the Regional Health Agency (Agence Régionale de Santé, ARS) of Provence-Alpes-Côte d'Azur was notified of a SARS-CoV-2 outbreak within a long-term care facility (LTCF-1). The ARS conducted contact tracing and implemented control measures. Further investigations found that another facility (LTCF-2) was also affected by the same transmission chain. The National Public Health Agency (Santé publique France, SpF) conducted epidemiological and microbiological investigations to characterise the outbreak and evaluate vaccine effectiveness against SARS-CoV-2 (see project 'Effectiveness of mRNA BNT162b2 COVID-19 vaccine against SARS-CoV-2 Delta variant among elderly residents from a long-term care facility, South of France, May 2021').

In total, 44 residents presented SARS-CoV-2 infections (54% of residents in LTCF-1 and 25% of residents in LTCF-2), 13 had symptomatic COVID-19, nine had severe COVID-19 and six died. The same genomic sequence of SARS-CoV-2 Delta variant was identified in all sequenced samples from residents (n=21). The index case was a medical staff from LTCF-1 who possibly imported SARS-CoV-2 from an archipelago in the Indian Ocean. He/she might have been a known SARS-CoV-2 close contact at the time of travelling back to France, not respecting isolation. One LTCF-1 staff member with a SARS-CoV-2 infection used to work in LTCF-2 as well, which explained the spread of the outbreak from LTCF-1 to LTCF-2. The outbreak was considered to be over on 11 June 2021, 14 days after the last SARS-CoV-2 infection was diagnosed.

This was one of the first SARS-CoV-2 Delta variant outbreaks investigated in France. We recommended that the close contacts respect the COVID-19 control measures, including travel restrictions and self-isolation. A multidisciplinary approach was essential to investigate and effectively control SARS-CoV-2 outbreaks, this was especially relevant for outbreaks affecting LTCF considering that residents are at higher risk of severe COVID-19.

Role of the fellow: Principal investigator, data consolidation, data analysis, report writing, communication of results to Santé publique France at the national level.

1.2 Gastroenteritis Outbreak in a holiday resort, France, September 2021
Supervisor: Philippe Malfait (Santé Publique France), Provence-Alpes-Côte d'Azur, France

In September 2021, the Regional Health Agency of Provence-Alpes-Côte d'Azur and the French Public Health Agency were informed that several people staying at a holiday club from 24–26 September (Friday to Sunday) presented acute gastrointestinal symptoms. We conducted an investigation to estimate the extent of the outbreak, identify risk factors, the causal agent, and implement prevention and control measures.

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[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

A questionnaire was conducted to describe the outbreak and the risk of gastroenteritis by food items served at the weekend buffet. Univariate and multivariate analyses (logistic regression) allowed calculating risk ratios with 95% confidence intervals. Tap water, stool and food samples followed microbiological investigations.

In total, 502 questionnaires were completed. The attack rate (AR) of acute gastrointestinal symptoms was 50% (n=5/10) among staff and 40% (n=213/492) among responding guests. The epidemiological investigations found that one staff member and two guests had a symptom onset a few days before the weekend. The epidemic curve showed a common point source with a quick increase of cases from Saturday to Sunday morning, and a quick decrease afterwards. Norovirus was identified in two stool samples and is compatible with the epidemic curve and the high AR. People who consumed starters on Friday evening were associated with a higher risk of reporting symptoms (RR 95%CI: 1.89 [1.34-2.68]). The microbiological investigations did not identify any causal agents in tap water or remaining food samples; however, only left-overs were available from the Saturday menu.

The likely norovirus contamination of food, cutlery and kitchen utensils by sick guests or staff during the preparation of meals; the consumption of starters on Friday; and the probable person-to-person transmission might explain this outbreak. As observed in other viral gastroenteritis outbreaks, self-service buffets and sharing spaces might increase person-to-person norovirus transmission. We recommended strict hygiene measures for food preparation, storage, and waste management, as well as not allowing staff with gastroenteritis-like symptoms to handle food ingredients.

Role of the fellow: The fellow developed the questionnaire, performed data management and data analysis, and contributed to the final outbreak report.

1.3 Sick building syndrome in a primary school in Pernes-les-fontaines, France, January–March 2021
Supervisors: Laurence Pascal, Philippe Malfait (Santé Publique France), Provence-Alpes-Côte d'Azur, France

In early January 2021, children from a primary school in Pernes-les-fontaines, Vaucluse (Provence-Alpes-Côte d'Azur, France) reported general and digestive symptoms. Due to the COVID-19 pandemic at the time of these events, a viral circulation of SARS-CoV-2 was considered as a potential cause. However, SARS-CoV-2 PCR results were negative. In addition, the first environmental investigations showed that carbon monoxide (CO) levels were within the normal range.

An epidemiology survey questionnaire was conducted among the affected students. Further environmental investigations were carried out in order to identify the origin of this episode.

The attack rate (any general or digestive symptoms) was 27% among all students and 56% among first-grade students, with a total of 40 students affected. The environmental investigations ruled out the hypothesis of chemical poisoning or problems with the heating system. The characteristics of the episode with symptoms mainly reported during school hours met the definition of sick building syndrome (SBS). Health professionals were deployed at the school level for the management of symptomatic children. Symptoms were considered to be likely related to the COVID-19 context. The obligation of wearing masks at school in the 5–11 years age group might have resulted in anxiety and the consequent occurrence of the described symptoms during school hours. The deployment of health professionals at the school apparently reduced anxiety and tensions amid the students, and contributed to a control of the situation.

Role of the fellow: Co-investigator responsible for the epidemiological investigations. The fellow performed a site visit to assess the situation in the affected school, created a database, performed data management, data cleaning, and data analysis, wrote follow-up reports for communication purposes during the outbreak investigation, as well as the section on epidemiological investigations of the final outbreak report.

1.4 Autochthonous transmission of dengue in Nice, France, 2020
Supervisors: Sandra Giron, Florian Franke (Santé Publique France), Provence-Alpes-Côte d'Azur, France

Around the end of July 2020, one autochthonous case of dengue was identified through the arboviruses surveillance system in Nice, France.

An outbreak investigation was carried out to describe the autochthonous transmission episode, control and prevent further infections and reinforce public health recommendations. We carried out activities for the retrospective identification of the imported index case. Additionally, autochthonous case identification included remote active case finding via notifications by health professionals and laboratories, and active case finding within the community. Furthermore, microbiological investigations (serotyping and genotyping), vector control and a communication campaign were part of the investigation.

In total, five autochthonous cases (four men and one woman) were identified; age range was 34–53 years old. The index case was not found. Cases were distributed in two areas which were 550 meters apart. Serotyping was done for one case in each area, both corresponding to the serotype DENV-2. Furthermore, one case was genotyped, corresponding to a strain native to the Indian Ocean. Vector control was conducted both outdoors (e.g., parks, roads, the rivershore, etc.) and indoors (e.g. treatment of stagnant water that could not be removed). Active case finding within the community was conducted several weeks after the identification of the first case. This endeavour did not identify any additional cases but contributed to raising community awareness.

This was the first autochthonous episode of dengue affecting two areas so far apart in mainland France, which could be explained by the favouring weather conditions in summer, or the possibility that a viremic person or mosquito may have moved between the areas inside a car or by other means. The different activities conducted during the investigation contributed to control the transmission chain. Our results recommended a multidisciplinary approach, increasing awareness among health professionals and the community and continuing the implementation of enhanced surveillance of arboviral diseases during the months of high mosquito activity (May to November).

Role of the fellow: Co-investigator participating in active case finding in the city of Nice.

1.5 Autochthonous transmission of dengue in Var, France, 2022
Supervisor: Clémentine Calba, (Santé Publique France), Provence-Alpes-Côte d'Azur, France

At the beginning of August 2022, the French National Centre for Scientific Research (CNRS) notified a confirmed autochthonous case of dengue (NS1+ PCR+: DENV-1) through the arbovirus surveillance system. The confirmed case was reported living in Fayence village (Var district, France) and did not travel outside the district within 15 days before the date of symptom onset (incubation period).

An investigation was carried out within the village to describe the autochthonous transmission event, identify the index and secondary cases, control and prevent further infections, and reinforce public health recommendations. Investigations included a communication campaign, awareness raising among health professionals from the surroundings to prompt case notifications, and active case finding within the community. Furthermore, vector control was carried out around the affected area.

In total, five autochthonous cases of dengue were confirmed through notifications by health professionals and community active case finding, with dates of symptom onset between 21 June and 27 July 2022. None of the confirmed cases or interviewed people had a travel history to an endemic area that could explain the onset of the event. Thus, the index case remains unknown.

The activities carried out throughout our investigation decreased the chances of new infections occurring. By the end of August, no additional cases linked to this transmission chain were expected.

Role of the fellow: Co-investigator participating in active case finding in Fayence village.

Training modules related to assignment/projects
EPIET/EUPHEM Introductory Course: This module offered an introduction to key principles of outbreak investigations, study designs, and analysis, including the field epidemiology approach, the design of data collection instruments, the data collection process, as well as data analysis.

Outbreak Investigation Module: This module built on the introductory course to provide a deeper understanding and practice of all aspects of outbreak investigations through case studies (detection, data analysis and interpretation including effect modification and confounding, microbiological and environmental investigations, report writing, communication, etc.).

Multivariable Analysis Module: This module furthered the fellow's statistical skills by covering various aspects of multivariable analysis, confounding and effect modification.

Educational outcome
The fellow formulated case definitions, designed and conducted outbreak questionnaires, visited areas affected by outbreaks to better understand the context of the outbreak and conducted situation assessments. He performed active case finding, described outbreaks in terms of time, place and person, generated hypotheses and conducted analytical studies to identify the source of the outbreak and risk factors. He also learnt how to effectively communicate with laboratory teams, provided regular updates on the progress of investigations to other members of the outbreak investigation team and representatives of the affected community, and recommended evidence-based measures for outbreak prevention and control. Furthermore, the fellow communicated the results of his findings to scientific colleagues.

2. Surveillance

2.1 Burden of COVID-19 on long-term care facilities in Provence-Alpes-Côte d'Azur, France, 2020–2022

Supervisors: Pascal Chaud, Florian Franke, Philippe Malfait (Santé Publique France), Provence-Alpes-Côte d'Azur, France

Long-term care facility (LTCF) residents are at risk of severe COVID-19. While the burden of COVID-19 is not fully known, we studied the burden in LTCF during the first two years of the pandemic in Provence-Alpes-Côte-d'Azur (PACA), France.

We conducted a study using data collected through the LTCF COVID-19 surveillance system across the five COVID-19 waves identified from week 9, 2020 to week 16, 2022 in the PACA region. We compared the attack rate (AR), hospitalisation rate (HR) and case fatality rate (CFR) among residents (Pearson Chi-square test) from an LTCF that reported COVID-19 episodes (i.e., at least two residents with COVID-19 and <15 days between cases). We also described the two-dose vaccination coverage (VC).

Overall, 1 435 COVID-19 episodes were included, accounting for 30 110 infections among residents. The AR decreased gradually from wave-2 (31.8%) to wave-4 (16.2%), increasing again in wave-5 (27.8%, p<0.01). HR and CFR decreased from wave-1 to wave-5 (from 21.2% to 2.7% and from 18.4% to 3.0%, respectively; p<0.01). VC was 72% in wave-3 and 90% in wave-4.

COVID-19 significantly affected LTCFs in PACA during the studied period. There was a generalised HR and CFR improvement overtime with the lowest levels observed in wave-4 and wave-5, which may be explained by the high VC reached at that point. However, the observed AR fluctuations suggest that vaccination did not necessarily provide protection against infections. We recommend the administration of a booster dose of vaccine among LTCF residents to prevent severe COVID-19.

Role of the fellow: Principal investigator. The fellow wrote the study protocol, performed quality control of the surveillance system, data management, data cleaning and analysis, and wrote a scientific manuscript.

2.2 COVID-19 surveillance system in institutions providing health and social care, PACA region, France

Supervisor: Florian Franke (Santé Publique France), Provence-Alpes-Côte d'Azur, France

From March 2020, the COVID-19 surveillance system in institutions providing health and social care (ESMS, e.g. long-term care facilities, nursing homes, etc.) monitored episodes of COVID-19 in Provence-Alpes-Côte-d'Azur. This allowed the Regional Health Agency to conduct situation assessments and implement prevention and control measures. In addition, the National Public Health Agency supported this surveillance system by performing data quality controls, writing situation reports shared with stakeholders, and conducting additional epidemiological investigations to help manage episodes where needed.

As of 16 June (week 24, 2022), 4 559 episodes of COVID-19 had been reported by ESMS, with 4% still ongoing. In total, 37 453 infections, 2 977 hospitalisations and 3 486 deaths were reported among residents. Staff members reported 19 754 infections, 148 hospitalisations and two deaths. During week 23, 2022 the number of newly reported cases were considered to be low (59 residents and 16 staff). Data for week 24 were not consolidated at the time of this report; however, the available information showed an increase in the number of confirmed cases with regards to the previous week (67 and 28 cases among residents and staff, respectively) which suggested that the ongoing Omicron dominance wave would still last for some time. No hospitalisations or deaths were reported in week 24.

The COVID-19 surveillance system in ESMS provides essential information to implement outbreak prevention and control measures, and carry out epidemiological studies in ESMS settings (see 'Burden of COVID-19 on long-term care facilities in Provence-Alpes-Côte d'Azur, France, 2020–2022').

Role of the fellow: The fellow performed routine quality control in direct contact with LTCFs. Provided updates to stakeholders and contributed to the surveillance system.

2.3 Surveillance system of severe cases of influenza and SARS-CoV-2 infections requiring intensive care, PACA, France

Supervisor: Jean-Luc Lasalle (Santé Publique France), Provence-Alpes-Côte d'Azur, France

In 2009, the French Public Health Agency set up the surveillance system of severe cases of influenza admitted to intensive care unit (ICU) in order to monitor the severity of the flu epidemic seasons and adapt public health interventions. With the arrival of the COVID-19 pandemic in France in March 2020, COVID-19 was integrated into this sentinel surveillance system with 24 reporting hospitals in the PACA region. The main objective was to describe the characteristics and evolution of influenza and COVID-19 patients admitted to ICU.

By week 22, 2022, 2 744 COVID-19 patients admitted to ICU had been reported. Most of them (69%) were male. The mean (SD) age was 62.4 (12.8) years. Most of the patients (85.2%) had at least one comorbidity. The most prevalent ones were obesity (BMI≥30, 23.8%), hypertension (21.3%) and diabetes (11.4%). Both men and women presented a similar distribution of age and comorbidities. Among patients with their vaccination status reported, 72% were not vaccinated. Half of the patients developed a severe acute respiratory distress syndrome (ARDS), and 32.7% a moderate ARDS. Invasive ventilation was reported for 49.3% of patients. In total, 594 (21.7%) COVID-19 patients admitted to ICU died.

During the same period, only 24 patients admitted to ICU with flu were reported through this sentinel surveillance system. The sex ratio was 1. The mean (SD) age was 60.7 (12.7) years. The majority (91.7%) had at least one comorbidity, and the most common ones were obesity, hypertension and cardiovascular disease (25% each). Severe and moderate ARDS were reported for 45.8% and 8.3% of the patients, respectively. Invasive ventilation was reported for 41.7% of the patients. In total, 30.4% patients died.

Role of the fellow: The fellow coordinated this surveillance system. He also conducted routine data entry and quality control, contacted ICU services and cross-checked databases to complete patients' reports. The fellow also wrote weekly surveillance bulletins and co-authored a COVID-19 surveillance bulletin for the period March 2020 to June 2021. In addition, he provided on-the-job training on this surveillance system (see Teaching and Pedagogy section).

2.4 Autochthonous transmission of dengue, chikungunya and Zika virus in mainland France, 2010–2020

Supervisors: Florian Franke, Sandra Giron (Santé Publique France), Provence-Alpes-Côte d'Azur, France

The spread of *Aedes albopictus* favoured the autochthonous transmission of dengue, chikungunya and Zika virus in southern Europe, with mainland France reporting most of the events. We described characteristics of dengue, chikungunya and Zika transmission events in mainland France from 2010 to 2020, and provided prevention and control recommendations.

Data from surveillance and autochthonous transmission investigations were described. Events were counted per year, causative agent, and region. We described the number of cases, circulation period, affected areas, land cover, vector density (larvae-positive containers per 100 households, Breteau index), primary case origin, prevention challenges, and control measures.

From 2010 to 2020, we identified 17 events of autochthonous transmission of dengue (six occurring in 2020), three events of chikungunya, and one Zika event with 80 autochthonous cases. All events happened in three vector-colonised southern regions from July to October. In most events, cases were ≤300 meters apart (n=20), areas were peri-urban ('Discontinuous Urban Fabric', n=18). When measured (n=7), Breteau index varied from 38 to 267. Identified primary cases travelled from outside the European and Eastern Mediterranean regions (n=12). Prevention challenges included missing (n=5), or reportedly insufficient (n=2) vector control around primary cases, unidentified (n=9), or late identification (after local transmission, n=4; 40 days after symptom onset, n=1) of primary cases.

Mainland France presents dengue, chikungunya and Zika transmission events, yet the limited number of cases and affected areas might depend on surveillance. Time-place characteristics, prevention challenges, and case identification patterns recommend: rigorous surveillance from July to October; enhanced vector control upon case identification in vector-colonised areas; awareness-raising among professionals for early diagnosis and notification; door-to-door active case finding, community awareness.

Role of the fellow: The fellow reviewed data from surveillance and autochthonous transmission investigations of dengue, chikungunya and Zika virus in mainland France from 2019 and 2020, and updated the French arbovirus disease database. He also summarised data from 2010 to 2020 and presented a poster in the European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE 2021); see 'Conference Presentations' section.

Training modules related to assignment/projects
EPIET/EUPHEM introductory course: The Introductory Course familiarised the fellow with the core concepts of surveillance, such as the need for surveillance, the key components and types of surveillance systems, the analysis and interpretation of surveillance data, and the development and evaluation of surveillance systems.

Educational outcome
The fellow ran several surveillance systems, coordinated the surveillance of severe cases of influenza and SARS-CoV-2 infection requiring intensive care. He also conducted quality controls, and completed information by contacting partners and cross-checking databases.

He performed analysis of surveillance data, wrote surveillance reports and communicated with stakeholders on a regular basis. In addition, the fellow presented a poster on the autochthonous transmission of dengue, Zika and chikungunya in France, at ESCAIDE. Furthermore, the fellow wrote a scientific manuscript as the main author and recommended evidence-based interventions in response to findings.

3. Applied public health research

3.1 Effectiveness of mRNA BNT162b2 COVID-19 vaccine against SARS-CoV-2 Delta variant among elderly residents from a long-term care facility, South of France, May 2021

Supervisors: Philippe Malfait, Pascal Chaud (Santé Publique France), Provence-Alpes-Côte d'Azur, France

The Delta variant of SARS-CoV-2 was classified as a variant of concern in May 2021 due to its increased transmissibility. It became dominant in Europe during the summer, raising concerns on the effectiveness of vaccines. We assessed the vaccine effectiveness (VE) of mRNA BNT162b2 (BioNTech-Pfizer) against the SARS-CoV-2 Delta variant during an outbreak affecting long-term care facility (LTCF) residents in southern France, May 2021.

We conducted a retrospective cohort study among LTCF residents. We described, sex, age, dependency level, reverse transcription PCR and sequencing results, clinical evolution, and vaccination status. We compared the attack rates of SARS-CoV-2 infection, symptomatic coronavirus disease 2019 (COVID-19), and severe COVID-19 (respiratory support, hospitalisation, and/or death) by vaccination status (two doses administered versus none) to estimate VE (1 − Relative Risk [RR]) with 95% confidence intervals (CI). VE was adjusted by age (Poisson regression).

Among 72 LTCF residents, 75.0% (n=54) were women, mean age was 88.7 (SD 8.1) years, 69% (n=49/71) were severely dependent on care. SARS-CoV-2 infections were identified in 39 residents (54.2%), 11 with symptomatic, and eight with severe COVID-19. All sequenced samples (n=19, 48.7%) had the same Delta variant genomic sequence. Age-adjusted BNT162b2 VE against the SARS-CoV-2 Delta variant infection was 11.2% (95% CI: 0.0–61.1%), it was 88.4% (95% CI: 59.9–96.7%) against symptomatic, and 93.5% (95% CI: 67.2–98.7%) against severe COVID-19.

We found a high BNT162b2 VE against symptomatic and severe COVID-19 caused by SARS-CoV-2 Delta variant among elderly residents at LTCFs, but not against Delta variant infection. This supports vaccination roll-out and the implementation of control measures for close contacts among vaccinated elderly residents at LTCFs.

Role of the fellow: The fellow was the principal investigator and performed data consolidation, data management and data analysis, wrote and published a scientific paper.

3.2 The first year of COVID-19 vaccine roll-out in Africa: challenges and lessons learnt

Supervisor: Balcha Masresha (World Health Organization, African Regional Office), Brazzaville, Congo

In the first year following the introduction of COVID-19 vaccines, only 6.8% of the total population in the 47 countries of the World Health Organization (WHO) African Region received full vaccination (two doses). In an emergency context, the intra-action review helps countries to assess their progress and document what has and has not worked.

We reviewed and identified the key lessons and challenges documented in reports resulting from intra-action reviews of COVID-19 vaccine roll-out in 22 African countries of the WHO African Region.

All countries documented a high level of political commitment, but a serious shortage of COVID-19 vaccines and funding. Seven countries identified gaps in microplanning because of lack of funding or due to the unpredictability in the type and volume of vaccine supplies. The shortage of operational funding also affected training of health workers and hampered the expansion of service delivery. Countries implemented multi-channel communications and social mobilisation activities, alongside social media engagement and social listening. However, country capacities were limited in terms of timely responding to infodemics. Hesitancy among health workers and the general population was a challenge in most of the countries.

During 2021, countries gained valuable experiences exploring various COVID-19 vaccination delivery models, including the integration of COVID-19 vaccination within routine healthcare programs. There is a need to regularly monitor or conduct studies measuring public perceptions towards COVID-19 vaccination, in order to drive demand generation efforts, as well as use evidence in addressing hesitancy.

Role of the fellow: The fellow was co-investigator, and conducted thematic analyses to formulate lessons learnt and best practices for COVID-19 vaccine roll-out in African countries during 2021. He also participated in writing and publishing a scientific paper.

3.3 Vaccination coverage assessment among 3–4-year old children in Alpes-Maritimes, France

Supervisors: Lauriane Ramalli, Clémentine Calba, Philippe Malfait (Santé Publique France), Provence-Alpes-Côte d'Azur, France

Vaccination is an essential prevention measure to reduce morbidity and mortality. For several vaccines, vaccination coverage (VC) among children remains insufficient in France. In addition, there are strong disparities across districts in terms of coverage. Since 2007, a health check that includes vaccination status is carried out for 3–4-year olds attending public or private nursery schools ('BS3-4-ans' check-up). Such check-ups have the advantage of providing granular information specific to small areas within French districts. At the end of 2017, the Ministry of Health approved a law by which children born from 2018 onwards need to be mandatorily vaccinated against 11 diseases.

A protocol was written to conduct a cross-sectional study using 'BS3-4-ans' check-ups for children born in 2017 and 2018, and enrolled in the first year of nursery school in the Alpes-Maritimes district. The objectives of the study were: a) to assess the feasibility of using the 'BS3-4-ans' health check-up as a source of information for routine VC estimations; and b) to estimate the VC and its evolution between children born in 2017 (not subject to mandatory vaccination) and 2018 (subject to mandatory vaccination), for the following vaccines: diphtheria, tetanus, poliomyelitis, whooping cough, *Haemophilus influenzae b* (Hib), hepatitis B, *Meningococcus C, Pneumococcus*, measles, mumps, rubella and tuberculosis (BCG vaccine).

Obtaining positive feasibility results, would mean that the 'BS3-4-ans' check-up may be used on routine basis to estimate VC among children and identify areas with low VC where public health actions can be proposed.

This project is still ongoing at the time of finishing the EPIET fellowship.

Role of the fellow: The fellow was the principal investigator and wrote the study protocol, conducted meetings with stakeholders to provide project updates and get clarifications on the different databases available. He also created a script that produces a consolidated database for children born in 2017 from different sources.

Training modules related to assignment/projects

Operational Research Inject Days: This module laid the foundations for designing, planning, and conducting applied public health research. It covered the development of study protocols relevant to public health, the operational steps including project management and collaborative working, ethical aspects, as well as data analysis and presentation of results.

Multivariable Analysis Module: The Multivariable Analysis Module equipped fellows with advanced statistical skills needed for the development of statistical analysis plans while conducting applied public health research.

Vaccinology: This module covered vaccination programmes and their impact on populations, the evaluation of vaccination interventions in routine work, methods to measure and improve vaccination coverage, and types of vaccine effectiveness studies. It also covered barriers to vaccination uptake, and principles of decision-making for the introduction of new vaccines.

Educational outcome

The fellow wrote study protocols, discussed them with stakeholders and adapted content according to needs and feasibility. The fellow conducted applied public health research studies from beginning to end, prioritising and scheduling tasks. He discussed findings according to relevant literature available and recommended evidence-based interventions in response to findings. He also reported and communicated results at the ESCAIDE conference and published two research papers.

4. Teaching and pedagogy

4.1 IDEA, French training on field epidemiology

Supervisor: Agnès Lepoutre –(Santé Publique France), Provence-Alpes-Côte d'Azur, France

IDEA is an introductory three-week course providing on-field epidemiology training. Lessons focus on outbreak investigations, applied public health research, and surveillance. In addition, participants have the opportunity to conduct a real survey during the training days.

The target audience included Public Health Master's students and Public Health professionals working for a Regional Health Authority (Agence Régionanle de Santé) or for the National Public Health Agency (Santé Publique France).

The fellow facilitated six case studies and three workshops at the 2022 IDEA training for ten days in the 'Ecole des hautes études en santé publique' (EHESP), Rennes. Case studies included norovirus*, Trichinella* and SARS outbreak investigations, measles surveillance, and public health research on malaria and lung cancer. Workshops consisted in protocol writing, and survey design. The fellow also participated in case study reviews prior to the training to improve clarity and quality.

4.2 On-the-job training on the surveillance system of severe cases of influenza and SARS-CoV-2 infection requiring intensive care
Supervisor: Jean-Luc Lasalle (Santé Publique France), Provence-Alpes-Côte d'Azur, France

The fellow provided on-the-job training for one medical doctor, two pharmacists and one nurse specialising in public health to better understand and run the surveillance system of severe cases of influenza and SARS-CoV-2 infection requiring intensive care. This included conducting data entry, quality controls, completing patients' information by contacting intensive care services and cross-checking different databases, as well as updating a database that provides an overview of the surveillance system data and patients' statuses.

The training consisted of a two-hour session per trainee to provide a general overview of the surveillance system and the main principles to run it, and one more hour to show how to conduct phone calls to ICU services and update patients' files. In addition, on-the-job training was provided for two weeks to provide clarifications and guidance whenever needed.

Training modules related to assignment/projects
EPIET/EUPHEM Introductory Course: The Introductory Course introduced theoretical and practical aspects about the preparation and delivery of teaching and trainings, focusing specifically on adult learners. It addressed topics such as facilitation, instructional design, evaluation of training activities, and reflective practice in a learning environment. It also offered an introduction to key principles of outbreak investigations and the core concepts of surveillance.

Outbreak Investigation Module: This module built on the Introductory Course to provide a deeper understanding and practice of all aspects of outbreak investigations through case studies.

Operational Research Inject Days: This module laid the foundations to designing, planning, and conducting applied public health research. Specifically, it covered the development of study protocols relevant to public health, the operational steps including project management and collaborative working, ethical aspects, as well as data analysis and presentation of results.

Multivariable Analysis Module: This module furthered the fellow's statistical skills by covering various aspects of multivariable analysis, confounding and effect modification.

Vaccinology: This module covered vaccination programmes and their impact on populations, the evaluation of vaccination interventions in routine work, methods to measure and improve vaccination coverage, and types of vaccine-effectiveness studies. It also covered barriers to vaccination uptake, and principles of decision-making for the introduction of new vaccines.

Educational outcome
Participating in teaching activities increased the fellow's understanding of outbreak investigations, surveillance and public health research and most importantly helped him improve his teaching and communication skills by adapting his style to audiences with different levels of prior knowledge. It also helped the fellow reflect on the importance of clear and well-tailored teaching materials to support teaching sessions.

5. Communication

Publications related to the EPIET fellowship
- **Miguel Angel Sanchez Ruiz**, Gisèle Adonias, Andree Robaglia-Schlupp, Florence Rapilly, Margaux Chabert, Lauriane Ramalli, Olivier Reilhes, Christiane Bruel, Philippe Malfait, Pascal Chaud. Effectiveness of mRNA BNT162b2 COVID-19 Vaccine against SARS-CoV-2 Delta Variant among Elderly Residents from a Long-term Care Facility, South of France, May 2021. Eur Rev Med Pharmacol Sci 2022. www.europeanreview.org/article/28496

- Balcha Masresha, **Miguel Angel Sanchez Ruiz**, Phionah Atuhebwe, Richard Mihigo. The first year of COVID-19 vaccine roll-out in Africa: challenges and lessons learned. Pan African Medical Journal. 2022;41(2):2. [doi: 10.11604/pamj.supp.2022.41.2.33686]. www.panafrican-med-journal.com/content/series/41/2/2/full/

Manuscript under review
- **Miguel Angel Sanchez Ruiz**, Florian Franke, Sandra Giron, Ophelie Boulogne, Elodie Marchand, Karine Mantey, Catherine Aventini, Fabien Marcangeli, Pascal Chaud, Philippe Malfait. Burden of COVID-19 on long-term care facilities in Provence-Alpes-Côte d'Azur, France, 2020-202. Bulletin épidémiologique hebdomadaries. www.santepubliquefrance.fr/revues/beh/bulletin-epidemiologique-hebdomadaire

Outbreak Reports

- **Miguel Angel Sanchez Ruiz**, Florence Rapilli, Lauriane Ramalli. Gastroenteritis Outbreak in a holiday resort, France, September 2021.

- Laurence Pascal, **Miguel Angel Sanchez Ruiz**, Emilie Bonnet. Sick Building Syndrome in a primary School in Pernes-les-Fontaines, France, January–March 2021.

- **Miguel Angel Sánchez Ruiz**, Gisele Adonias, Andree Robaglia-Schlupp, Florence Rapilly, Margaux Chabert, Lauriane Ramalli, Olivier Reilhes, Christiane Bruel, Philippe Malfait, Pascal Chaud. SARS-CoV-2 Delta variant outbreak among long-term care facility residents, <mark>South of France</mark>, May 2021.

Surveillance Reports

- Weekly Surveillance Bulletins on severe cases of influenza and SARS-CoV-2 infection admitted to intensive care. Weeks 9, 10, 15, 2021 and weeks 10 and 19, 2022. www.paca.ars.sante.fr/veille-hebdo

- COVID-19 Surveillance Bulletin March 2020 – June 2021. www.santepubliquefrance.fr/regions/provence-alpes-cote-d-azur-et-corse/documents/bulletin-regional/2021/bulletin-de-sante-publique-covid-19-en-paca-novembre-2021

Conference presentations

- **Miguel Ángel Sánchez Ruiz**, Gisèle Adonias, Andrée Robaglia-Schlupp, Florence Rapilly, Margaux Chabert, Lauriane Ramalli, Olivier Reilhes, Christiane Bruel, Philippe Malfait, Pascal Chaud..Effectiveness of Comirnaty COVID-19 vaccine against SARS-CoV-2 Delta variant among elderly residents from a long-term care facility, South of France, May 2021. Oral Presentation at the 2021 ESCAIDE Conference; Stockholm and online, 23–25 November 2022.

- **M. Sanchez Ruiz**, S. Giron, A. Cochet, C. Jeannin, E. Brottet, I. Leparc-Goffart, G. Durand, G. Grard, H. Noël, H. De Valk, F. Jourdain, G. L'Ambert, G. Lacour, F. Vernichon, R. Foussadier, M. Paty, F. Franke. Autochthonous transmission of dengue, chikungunya and Zika virus in mainland France, 2010-2020. Poster Presentation at the 2021 ESCAIDE Conference; Stockholm and online, 23–25 November 2022.

Other presentations

- Oral presentation 'Dengue outbreak in Nice, France, 2020' at the Outbreak Investigation EPIET module.
- Oral presentation 'Outbreak of SARS-CoV-2 Delta Variant affecting two long-term care facilities in PACA region' at the Santé publique France weekly meeting.
- Oral presentation 'The first year of COVID-19 vaccine rollout in Africa: Best practices and lessons learned' at the Vaccinology EPIET module.
- Oral presentation 'Leadership in Public Health' at the Management, Leadership and Communication in Public Health EPIET module.

6. Other activities

International assignment with the Global Outbreak Alert and Network (GOARN)/World Health Organization (WHO) Office for the African Region

The fellow joined the GOARN/ WHO office for the African Region for six weeks.

His role was collecting and synthesising information from country-level implementation of COVID-19 vaccine roll-out, identifying lessons learnt and best practices for COVID-19 vaccination through the experience of countries from across the region in 2021 using standard methodologies, and conducting research.

The main outputs of this assignment consisted of: a) the consolidation of lessons learnt and best practices at WHO AFRO Lessons Library (Microsite) https://covid-19vaccineslessonslearned.afro.who.int/ and b) the publication of a scientific paper (see project 'The first year of COVID-19 vaccine roll-out in Africa: challenges and lessons learnt')

Educational Outcome

This project provided the fellow with the opportunity to further his qualitative analytical skills, widen his understanding of challenges regarding the roll-out of COVID-19 vaccines in the WHO African region, and interacting with international organisations and WHO country offices.

Conduction of interviews during several outbreak investigations in Provence-Alpes-Côte d'Azur

The fellow conducted questionnaires during *Yersinia enterolitica*, *Salmonella*, monkeypox, hemolytic uremic syndrome (HUS) and Hepatitis A outbreaks. He contacted confirmed cases to explore symptomatology, exposures, risk factors and severity. Cases were reported by the French National Centre for Scientific Research (CNR) or local laboratories and assigned to the corresponding regional office of the National Public Health Agency. This activity included participating in meetings with microbiologists, epidemiologists from several regional offices and other members of the outbreak investigation teams such as clinicians. Meetings included providing updates and discussing hypotheses on the origin of outbreaks all along the investigations.

Educational Outcome

The fellow gained skills to effectively communicate and conduct questionnaires to cases affected by outbreaks. He improved his ability to explain the aim of the investigations, characteristics of the disease, clarify the rights of respondents to not provide any information they may not wish to share, adapt his communication style, and provide further information where needed. In addition, he improved his ability to effectively communicate with laboratory teams.

7. EPIET/EUPHEM modules attended

1. Introductory Course, 28 September – 16 October 2020 and 26 April – 07 May 2021, online

2. Operational Research Inject Days, 9 and 10 October 2020, online

3. Outbreak Investigation module, 7–11 December, online

4. Multivariate Analysis, 15–19 February and 18 March 2021, online

5. Rapid Assessment and Survey Methods module, 5–6 May 2021, online

6. Project Review module, 23–26 August 2021, online

7. Vaccinology module, 14–18 February 2022, online

8. Time Series Analysis module, 4–8 April 2022, Rome, Italy

9. Management, Leadership and Communication in Public Health module, 13–18 June 2022, Stockholm, Sweden

7. Other training

1. R training, Santé publique France.

2. World Health Organizations (WHO), Introduction to COVID-19: methods for detection, prevention, response and control.

3. WHO, WHO Standard Operating Procedures (SOPs) for Emergencies.

4. WHO, Health Emergencies Programme. COVID-19: Operational Planning Guidelines and COVID-19 Partners Platform to support country preparedness and response.

5. WHO, Health Emergencies Programme. ePROTECT Respiratory Infections.

6. WHO, Prevention of sexual exploitation and abuse (PSEA) – Multilanguage.

7. United Nations, Human Rights Responsibilities.

8. WHO. Mini-cPIE Clinic, COVID-19 Vaccination Intra-Action review.

9. UNDSS United Nations Department for Safety and Security. BSAFE.

10. The Global Outbreak Alert and Network (GOARN), Tier 1 Course.

11. GOARN, Personal Well-Being for Deployment.

12. GOARN, The Public Health Emergency and Humanitarian Landscape and Architecture.

13. GOARN, Working in an International Multidisciplinary Outbreak Response Team.

14. GOARN, Working with GOARN in the field.

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 application of epidemiological methods to guide public health interventions for communicable disease prevention and control. This report summarises all the activities and projects conducted by Miguel Ángel Sánchez Ruiz during his two-year EPIET fellowship (cohort 2020) as an EU-track fellow at the Regional Office of Santé publique France, the French National Agency for Public Health, in Provence-Alpes-Côte d'Azur (PACA) and Corsica.

Miguel started his fellowship as a pharmaco-epidemiologist with experience as a field epidemiologist in the humanitarian sector. He was involved in seven field assignments in the surveillance and research area, along with four outbreak investigations. Through his high commitment, he has completed all of these, achieving all the EPIET objectives and producing high-quality outputs. Specific highlights are relevant projects related to not just the COVID-19 pandemic (surveillance and burden in LTCF, surveillance of severe SARS-Cov-2 and influenza infections requiring intensive hospital care, vaccine effectiveness in elderly LTCF residents against Delta variant), but also analysis of autochthonous transmission events of dengue, chikungunya, and Zika in mainland France from 2010 to 2020 and childhood vaccines coverage assessment in the Alpes-Maritimes region.

He is highly interested in learning, communicative, and able to work effectively. Supported by excellent supervision and project availability, his fellowship has been very successful. He developed new epidemiological competencies working with several important public health topics.

I believe that Miguel has the professional and technical skills needed for epidemiological and public health-related work. Miguel has been a pleasure to work with and I wish him all the success in his career.

Supervisor's conclusions

Miguel Ángel Sánchez Ruiz spent two years at the Regional Office of Santé publique France, the French National Agency for Public Health, in Provence-Alpes-Côte d'Azur (PACA) and Corsica. These two years were deeply impacted by the COVID-19 pandemic, which affected the organisation and planning of public health projects and studies.

Even though Miguel Ángel has mainly worked on projects related to COVID-19, it appeared essential to the Regional Office team to offer Miguel Ángel diverse experiences across various fields.

Thus, he worked in the field of vaccination, a very important subject in the region where vaccination coverage against childhood diseases and COVID-19 is among the lowest in the country. He led an evaluation on COVID-19 vaccine effectiveness against the COVID-19 Delta variant in a long-term care facility. He also helped to launch a project aiming to evaluate the impact of mandatory vaccination for children aged two years in PACA, a project which will carry on for several years.

His work was of high quality, and he quickly fulfilled the EPIET objectives. He showed great rigor in his work with a very good ability to manage his projects independently. Miguel Ángel was not a novice when he arrived on the team. He already had experience and knowledge in epidemiology, with both theoretical experience and experience in the field with 'Doctors without borders'.

However, these two years allowed him to reinforce his competencies, in particular, in outbreak investigation during various outbreaks *(Salmonellosis, Yersinia enterolitica*, gastroenteritis in a holiday resort, sick building syndrome initially misidentified as a COVID-19 outbreak, etc.) He also participated in various surveillance systems and coordinated the surveillance of severe cases of COVID-19 and influenza in intensive care units.

He got the opportunity to lead a WHO mission aiming to review and identify the key points of success and shortcomings of national COVID-19 immunisation programs of 22 African countries that implemented these programs. His work was recognised to be of high quality and led to an international publication, testifying to the quality of his work.

His investment in all areas, his curiosity and his desire to participate in many projects have enabled him to gain knowledge and skills in applied epidemiology. Furthermore, he is a very reliable person who established a constructive relationship with all of his colleagues and is a highly appreciated team member.

Personal conclusions of fellow

I joined the EPIET fellowship after having relevant experiences as a pharmaco-epidemiologist in the private sector and as a field epidemiologist in the humanitarian sector. My main interests consisted in increasing my knowledge and understanding of infectious disease field epidemiology, as well as having the opportunity to work within a well-established European Public Health Institute. EPIET gave me the opportunity to work and team up with great professionals at the Regional Office of Santé publique France, the French Public Health Agency, in Provence-Alpes-Côte d'Azur (PACA) and Corsica. I had a chance to participate in many outbreak investigations, run and coordinate surveillance, analyse surveillance data, conduct operational research and communicate results. The team provided me with high quality scientific support, counted on me and respected my insights from the beginning and included me in relevant discussions that helped to widen my views and increase my ability to critically interpret scientific results, and surveillance trends.

Acknowledgements of fellow

I am very grateful to have had the opportunity to be part of the EPIET programme. The EPIET modules gave a strong theoretical framework to my previous knowledge, and the diverse projects I worked on increased my experience and taught me new concepts on infectious disease field epidemiology.

I would like to show my appreciation to my frontline coordinators, Guido Benedetti and Frantiska Hruba, for their support and guidance to achieve the programme goals.

In addition, I would like to thank the team at the Regional Office of Santé publique France, the French Public Health Agency, in Provence-Alpes-Côte d'Azur (PACA) and Corsica for their teachings, passion and interest to discuss so many scientific topics. Furthermore, I really appreciate their warmheartedness in making me feel welcome and comfortable from the beginning, especially during the COVID-19 related lockdown period.

I would like to specially thank my site supervisor, Philippe Malfait, whose scientific knowledge and mentorship helped me widen my views as an epidemiologist; Pascal Chaud for his guidance to conduct vaccine effectiveness studies; Florian Franke for his support to interpret surveillance data; Sandra Giron for her coaching on arboviral disease investigations; Jean-Luc Lasalle for his teachings on surveillance coordination; Laurence Pascal for her support to conduct investigations under sensitive circumstances; Isabelle Mertens-Rondelart for her availability to help with administrative and technical issues; Lauriane Ramalli for her careful approach to conduct outbreak investigations; Clémentine Calba for her willingness to provide scientific support where needed; Yvan Souares for his passion to discuss emerging health threats; Joël Deniau, Élodie Carpentier, Robinson Gravier, Leila Bekheira and Ilias El Bilouzi for the good times.

Finally, I would like to thank my cohort fellows for their effort and interest to keep in touch throughout the fellowship despite the few in-person meetings.

Thank you all, merci d'avoir été avec moi pendant ces deux années.