Berta Grau-Pujol

The European Programme for Intervention Epidemiology Training (EPIET), Cohort 2022
Directorate-General of Health, Portugal

Background

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

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

Pre-fellowship short biography

Berta Grau-Pujol has a PhD from the University of Barcelona in controlling neglected tropical diseases in Southern Mozambique. She also has an MSc in Control of Infectious Diseases from the London School of Hygiene & Tropical Medicine in the United Kingdom (UK), and a diploma in Geomatics applied to health from Instituto de Altos Estudios Espaciales Mario Gulich in Argentina.

Prior to the EPIET fellowship, Berta worked mainly in research academia. Trained in human biology, she combined her laboratory expertise with field epidemiology, advanced statistical skills, and geographic information systems (GIS). One of her main focuses was on water, sanitation, and hygiene (WASH)-related diseases. Her international professional experience included work on diverse infectious diseases in Spain, the UK, Paraguay, South Africa and Mozambique.

Results

The objectives of the core competency domains were achieved partly through project and activity work and partly by participating in the training modules. Results are presented in accordance with the EPIET/EUPHEM core competencies, as set out in the ECDC Fellowship Manual[1].

[1] European Centre for Disease Prevention and Control (ECDC). European public health training programme. Stockholm: ECDC; 2020. Available from: https://www.ecdc.europa.eu/en/publications-data/ecdc-fellowship-programme-manual-cohort-2021

Stockholm, 2024

1. Epidemiological investigations

1.1. Outbreak investigations

National Task Force for a rapid response to an outbreak of severe acute hepatitis of unknown aetiology in children in Portugal, 2022

Supervisor: Paula Vasconcelos

Category: Emerging and re-emerging diseases

Aim: To synthesise the constitution and management of the Task Force (TF) coordinating the response to the outbreak of severe acute hepatitis of unknown aetiology in children in Portugal, while describing the outbreak, to guide future outbreaks of this scale.

Methods: We compiled data from the TF, including standard operating procedures, meeting notes, emails, and guidelines. We documented the mechanisms implemented during the outbreak of severe acute hepatitis of unknown aetiology in Portugal in 2022. Moreover, we gathered epidemiological data from the National Epidemiological Surveillance System (SINAVE), followed by data cleaning, management, and analysis. We fitted a binomial regression model to assess the association between adenovirus infection and hospital admission, adjusting to age, sex and region.

Results: The experts of the TF came from various disciplines to ensure the inclusion of different perspectives – clinical, laboratorial, epidemiological, public health communication. Portugal adopted the ECDC and the WHO case definition. By 31 December 2022, 28 probable cases of severe acute hepatitis of unknown aetiology were reported: 16 male and 17 aged under two years. Of these cases, 23 were hospitalised but none required liver transplant or died. Adenovirus was detected from nine of 26 tested cases. Limited by the sample size, no association was observed between adenovirus infection and hospital admission.

Conclusions and public health implications: The outbreak of hepatitis of unknown aetiology in 2022 in Portugal had a null case fatality rate. The TF in Portugal may have played a crucial role in early detection and case management by raising awareness, guiding clinicians, and facilitating transdisciplinary interaction.

Role: Berta was an investigator. Her tasks were as follows: a) led the investigation and analysis; b) participated in regular meetings of the National Task Force; c) identified, compiled, reviewed and assessed relevant information, including grey literature, scientific articles, SOPs, guidelines and other internal notes; d) designed analysis plan and conducted data cleaning, management, visualisation and statistical analysis; e) made recurrent presentations of findings and preliminary results at the TF meetings; f) created flow-diagram explanatory figures; g) presented a poster at ESCAIDE 2023; h) drafted, wrote and published a scientific manuscript at *Eurosurveillance*, (Grau-Pujol, et al (2023); i) discussed public health emergency during the Weekly Epidemic Intelligence meetings (RONDA).

Food-borne outbreak in a company canteen in Porto, Portugal, September 2023

Supervisor: Delfina Antunes

Category: Food- and waterborne diseases

Aim: To identify the cause of the suspected food-borne outbreak reported in a company canteen on 29 September 2023 in Porto, Portugal.

Methods: We conducted a retrospective cohort study. All employees who had lunch at the canteen on 28 September 2023 were invited to participate. The case definition was anyone who experienced vomiting, diarrhoea, abdominal pain, fever, or general malaise within 72 hours. We gathered food consumption and illness data through phone interviews. We conducted phone interviews and calculated food-specific attack rates. We evaluated the association between each food item and case status using log-binomial regression adjusted for sex. Additionally, we conducted an environmental and hygiene assessment, with food and hand samples from food-handlers collected for microbiological culture.

Results: Among the 326 employees who had lunch at the company canteen on 28 September, we interviewed 117 and identified 44 (38%) as cases. Consumption of fruit salad exhibited an attack rate of 69% and was associated with double the risk of being a case (rate ratio: 2.2, 95% confidence interval 1.2–3.3). Consuming duck rice or pizza showed attack proportions of 38% and 0%, respectively, with no association of being a case. *E. coli* and *Staphylococcus spp* were detected in the duck rice, pizza, and in the hands of some food-handlers.

Conclusions and public health implications: Faecal contamination was considered a likely cause of the outbreak and food-handlers the main vehicle of transmission. The source of infection was traced to the meal served. *E. coli* and *Staphylococcus spp*. were found in the food and on the hands of some handlers. Implementing proper food handling measures in food service is essential to prevent future incidents.

Role: Berta was an investigator of the outbreak and participated in a three-day investigation at the local Public Health Unit Porto Ocidental, Portugal. Her tasks were as follows: a) participation in internal meetings to: establish and revise the case definition, identify the population at risk, formulate hypotheses, investigate infectious disease transmission patterns, implement strategic control and preventive measures, and consistently update them

throughout the ongoing process; b) definition and execution of sampling design, data collection, data management, statistical analysis and interpretation; c) identification of the limitations of the study design and potential biases; d) writing and reviewing the local outbreak report including evidence-based recommendations; e) discussion of public health emergency during the national weekly epidemic intelligence meetings (RONDA).

Legionella *contamination in a hotel in Lisbon, Portugal, during winter 2022–2023*

Supervisors: Paula Vasconcelos, Maria de Jesus Chasqueira and Bruno Castro

Category: Respiratory diseases

Aim: To identify and control the source of *Legionella* bacteria in a hotel in Lisbon during winter 2022–2023, following a case of Legionnaires' disease, in order to prevent further cases.

Methods: Environmental studies began on 12 December 2022, with land regional public health authorities inspecting the hotel's water systems and cooling tower. We collected initial water samples on 28 December, followed by additional samples on 30 December, 2, 11, 19, and 23 January to monitor *Legionella* detection and quantification. Water analysis included on-site measurements of temperature, chlorine concentration, and pH, while the national reference laboratory tested for *Legionella* using real-time polymerase chain reaction (RT-PCR). We managed and analysed data using R statistical software. From the outset and throughout the monitoring process, we recommended and implemented various actions, such as relocating guests, chlorinating and thermally disinfecting plumbing pipes, disinfecting showers and taps, and assessing and cleaning the cooling tower.

Results: For the initial site visit, the measured temperature, pH, and mean residual chlorine levels in water were below the recommended thresholds. Environmental contamination with *Legionella pneumophila* serogroup 1 was spread across the 13 floors' hotel water system. *Legionella* was observed in at least one water site per floor. By the conclusion of the monitoring period, *Legionella* was no longer detected.

Conclusions and public health implications: The physical and chemical parameters of the hotel's water system did not meet national public health recommendations. There is a need for operational guidelines and training for *Legionella* prevention and control in hotels in Portugal.

Role: Berta was an investigator. She joined the field investigation team composed of the local and regional public health units. Her tasks were as follows: a) collected and measured physical and chemical parameters; b) cleaned, managed, analysed and visualised data using R; c) interpreted results; d) contributed to evaluate the hotel's contamination and to formulate recommendations for *Legionella* prevention and control at the hotel; e) prepared field reports and an environmental investigation report; f) contributed to the DGS initiative aimed at enhancing national recommendations for *Legionella* prevention and control in hotels for local health authorities.

Outbreak of hepatitis A associated with sexual transmission among men who have sex with men in Portugal, 2023–2024

Supervisors: Paula Vasconcelos and João Vieira Martins

Category: Viral hepatitis and sexually transmitted infections (STIs)

Aim: To investigate the ongoing outbreak of hepatitis A in Portugal in 2023–2024 and discuss the public health response in order to raise awareness and provide guidance in order to manage similar outbreaks in the future.

Methods: A national Task Force was established to investigate the outbreak. Confirmed cases were defined as any person with clinical symptoms consistent with acute hepatitis A with onset of symptoms since 7 October 2023 and a laboratory-confirmed HAV infection according to the European Union case definition for surveillance. We used epidemiological data from the national surveillance system (SINAVE). We employed a case–case design comparing the outbreak period (October 2023–April 2024; n = 71) with hepatitis A cases from the baseline period before the outbreak (January 2020–October 2023; n = 101).

Results: From 7 October 2023 to 24 April 2024, there were 71 confirmed cases of hepatitis A in Portugal. The incidence rate was six times higher in the outbreak period compared with the baseline (1.8 vs 0.3 cases per 100,000 people and year). Most cases were males aged between 18 and 44 years, with many identifying as men who have sex with men (MSM). Cases reported a suspected sexual transmission. Phylogenetic analysis identified the subgenotype IA, VRD 521–2016 strain, which was last observed in an MSM-associated multi-country outbreak during 2016–2018.

Conclusions and public health implications: Similarities with recent MSM community outbreaks in Europe highlight the need for increased hepatitis A awareness and vaccination among MSM at higher risk.

Role: Berta was an investigator of the outbreak. Her tasks were as follows: a) participated in national TF meetings managing the outbreak; b) discussed case definitions and analysis to describe the outbreak; c) contributed to the discussion and implementation of public health measures; d) co-authored an article published by *Eurosurveillance* (Rosendal et al, 2024).

Outbreak of measles in Portugal in 2024: international, national, regional and local perspective

Supervisors: Paula Vasconcelos, Anna Firme and Ana Mendes

Category: Vaccine-preventable diseases

Aim: To understand and control the outbreak of measles in Portugal in 2024 from international, national, regional and local perspectives and implement public health interventions.

Methods: The outbreak investigation was divided into three parallel activities. The first activity was led by the Public Health Emergency Operations Centre (CESP) at DGS, focusing on identifying, monitoring, and controlling imported cases while coordinating cross-country collaboration and providing national guidance to health authorities, as at least two regions were involved. For the second activity, we worked with the local public health unit in Lisbon to contribute to the outbreak investigation in Lisbon, conduct contact tracing and manage cases. For the last activity, we joined the regional public health authority and the local health authority in the Norte region to conduct the outbreak investigation of suspected autochthonous transmission, prioritising resources and implementing preventive measures.

Results: The initial imported measles case was traced to an outbreak of measles in the nursery attended by the infected child in the UK. In Lisbon, we identified 69 contacts of this case based on the hospital admission list. Of these, 37 were deemed potentially susceptible to infection, and 23 out of 37 (59%) eligible contacts received timely immunisation (< 72 hours). In the Norte region, three confirmed cases were linked epidemiologically, indicating autochthonous transmission. From January to July 2024, 34 measles cases were confirmed, 13 of them imported.

Conclusions and public health implications: Preventive measures, vaccination efforts and high coverage may have effectively contained the outbreak, as indicated by the low number of measles cases during the outbreak in Portugal.

Role: Berta was an investigator of the outbreak. She joined the national Response and Management Team and the Local and Regional Public Health Units for outbreak investigation. Her tasks were as follows: a) participated in national, regional and local meetings managing the outbreak and implemented public health measures; b) facilitated cross-country collaboration to investigate the outbreak and coordinate response efforts between the IHR NFP teams; c) contributed to elaborate national guidance to regional and local public health authorities, aimed at improving overall public health preparedness and response to measles outbreaks in Portugal; d) wrote a national internal alert; e) created case definitions; f) identified imported cases, conducted contact tracing (e.g. flight passengers) and followed-up suspected cases in Portugal; g); assessed epidemiological link, built epicurve and network diagram; h) contributed to the optimisation of resources and response: priorities in contact tracing, sample transportation logistics, vaccine stockpile and logistics of vaccination (vaccine distribution, cold chain and vaccine administration).

1.2. Surveillance

Multiannual national report of notifiable diseases in Portugal, 2015–2021

Supervisors: Pedro Pinto Leite and João Vieira Martins

Type of project: Analysing data from a surveillance system

Aim: To describe the cases of notifiable diseases reported between 1 January 2015 and 31 December 2021 in Portugal, to understand their epidemiological trend and to generate information for action regarding those diseases.

Methods: We extracted, cleaned, managed, analysed, and interpreted data from the National Epidemiological Surveillance System (SINAVE) for all notifiable diseases during that period. The data included case classification (suspected, probable, or confirmed), year of notification, sex, age group, and region and location of occurrence by NUTS 2 and NUTS 3. This work was collaborative within the Directorate of Information and Analysis (DSIA), DGS, Portugal.

Results: Between 2015 and 2021, 40,704 cases of notifiable diseases were reported and validated by the national network of health authorities. Analysing their overall distribution by year and disease group (aligned with the disease groups of the ECDC) revealed an upward trend in all disease groups, the increasing trend only interrupted in 2020, during the acute phase of the COVID-19 pandemic. The group of sexually transmitted infections had the highest number of notified cases in the period from 2015 to 2021, with a total of 21,844 (53.7%) cases, followed by waterborne and food-borne diseases (10,342 cases, 25.4%) and invasive and vaccine-preventable diseases (4,825 cases, 11.9%).

Public health implications: We believe that the interpretation of the incidence and trends for the notifiable diseases serves as a compass for refining surveillance systems, and guides the recommendations for prevention and control measures, underscoring the necessity for further investigations.

Role: Berta was the author of the national report. Her tasks were as follows: a) participated in preparation meetings for the national report of notifiable diseases in Portugal (2015–2021) within the DGS; b) conducted data cleaning and data management for all notifiable diseases in Portugal during 2015–2021; c) performed descriptive analysis, calculated incidences, prepared graphs, interpreted and wrote the results; d) drew conclusions to support future public health actions; e) contributed in the Methods section; f) reviewed the final report; g) reviewed the data sharing document prepared for the Transparency Portal of the National Health Service.

Surveillance of mpox virus infection in Portugal in the context of a public health emergency of international concern (PHEIC) during 2022–2024

Supervisors: Pedro Pinto Leite, Paula Vasconcelos, João Vieira Martins and Vitor Cabral Veríssimo

Type of project: Analysing data from a surveillance system

Aim: To monitor and understand mpox virus infection patterns and trends in Portugal during 2022–2024 to guide response strategies and public health decision-making in the context of a public health emergency of international concern (PHEIC).

Methods: The mpox outbreak was declared a PHEIC by WHO on 23 July 2022. A national Task Force was established to monitor the outbreak, to assess the risk and to promote the adequate public health measures for prevention, control and protection of the most vulnerable population groups in alignment with WHO and ECDC. We created an automatised report using R to clean, manage, analyse and interpreted data from the SINAVE and VACINAS. The DGS monitored mpox cases daily in 2022 and 2023, transitioning to weekly monitoring as the outbreak progressed. From 2024, mpox was monitored monthly.

Results: Portugal was the second country to report mpox cases in Europe, after the United Kingdom. The first mpox case in Portugal was confirmed on 17 May 2023. On 1 June 2023, a new outbreak with 241 cases (99% male) was identified in the country, after a period of approximately three months with no reported cases (since March 2023). During 2024, this outbreak had a decreasing trend, and no new cases of mpox were reported during April and May 2024.

Public health implications: Although the outbreak is under control, the DGS emphasises the importance of early detection of new cases, considering the potential reintroduction. Preventive vaccination for the high-risk population is continuously being promoted.

Role: Berta was accountable for mpox surveillance in Portugal and was a member of the National Task Force. Her tasks were as follows: a) participated in national TF meetings; b) participated in the biweekly meetings of the ECDC Public Health Emergency mpox team; c) created an automatised report of mpox surveillance with R Markdown for a weekly bulletin using SINAVE data, including: descriptive analysis of surveillance data, creation of epicurves, spatial analysis (GIS) and calculation of estimated Rt; d) weekly monitoring, analysis and interpretation of national and regional epidemiological situations and vaccine administration data to prevent mpox virus infection in Portugal; e) identified key findings from surveillance data analysis and drew conclusions; f) redefined national mpox case definitions; g) prepared progression reports, weekly bulletins and situation reports; h) presented epidemiological and vaccination situation for mpox in Portugal in national Task Force meetings and national meetings with stakeholders (e.g. non-governmental organisations, national vaccination points, national testing points and representatives of the community); i) contributed to the update of the national guidelines for vaccination; j) prepared monitoring tool for vaccination data collection; k) presented national mpox data in national congress: Pandemias na Era da Globalização - 10º Congresso e VI Congresso Nacional de Virologia from 10–12 May 2023; l) co-authored a manuscript on viral genetic clustering and transmission dynamics in Portugal in *Nature Medicine*, Borges V, et al (2023).

RONDA: Epidemic Intelligence weekly report in Portugal post-COVID-19 pandemic

Supervisors: Paula Vasconcelos, Ana Firme, Mariana Ferreira and Vasco Ricoca Peixoto

Type of project: Analysing data from a surveillance system

Aim: To contribute to Epidemic Intelligence activities in Portugal to elaborate RONDA's content post-COVID-19 pandemic. The RONDA objective is to early detect, conduct prompt risk assessment and provide response to alerts and PHE.

Methods: At DGS, a 24/7 Epidemic Intelligence activity ensures the collection, filtration, validation and summarisation of information on events with potential impact on public health, at a national or international level. CESP prepares a weekly bulletin and coordinates a weekly meeting with national and regional health authority focal points, experts from the National Reference Laboratory (INSA) and other stakeholders to discuss national and international threats and consider cross-border contexts. Specific activities include forecasting non-COVID-19 reports on threats until March 2020 using a time-series model and comparing observed and expected values.

Results: The ECDC and WHO were the most frequent sources of information followed by national public health sources. Non-COVID-19 threats had a decrease in the monthly average frequency of reporting during acute COVID-19 restrictions (April 2020–February 2022) compared to before COVID-19 (January 2016–March 2020), with a mean of 4.7 threats per month compared to 2.3 respectively, $p < 0.001$. Using the forecast method, there were 114 (−70%) fewer non-COVID threats than expected during acute COVID-19 restrictions.

Public health implications: Epidemic Intelligence activities ensure the monitoring of events with potential impact on public health, support risk assessment with complementary indicator-based surveillance, and facilitate early detection and timely response. During COVID-19, there was a decrease in reports on non-COVID-19 threats in Portugal. The COVID-19 pandemic likely impacted global epidemiological intelligence by diverting attention and resources away from other health threats.

Role: Berta was an Epidemic Intelligence (EI) team member. Her tasks were as follows: a) participated in the EI activities with the CESP team, contributing to the collection, filtration, validation, detection of new alerts, and writing threat assessment, compiling and summarising information to be included in the RONDA document or Situation Reports; b) wrote and updated alerts (e.g. hepatitis of unknown aetiology, mpox virus infection, botulism, West Nile virus infection, avian flu and *Aedes albopictus* infection in Lisbon); c) co-authored a manuscript (Ricoca Peixoto, et al 2024) on the impact on COVID-19 on Epidemic Intelligence-based surveillance in Portugal.

Public health surveillance during the religious mass gathering of World Youth Day (WYD) 2023 in Portugal

Supervisors: Pedro Pinto Leite, Paula Vasconcelos and João Vieira Martins

Type of project: Setting up a surveillance system and analysing data from a surveillance system

Aim: To contribute to the Epidemic Intelligence activities (indicator- and event-based surveillance) put in place to monitor the World Youth Day (WYD) 2023 in Portugal.

Methods: Key experts discussed the type of surveillance system to implement during WYD. We collected syndromic data from hospital records in the National Health Service (SIM@SNS), notifiable diseases data from SINAVE, and event-based data from web crawlers (e.g. Medisys), social media, and formal national and international alert platforms. We developed automated epidemiological reports in R Markdown. The surveillance system was piloted one month before the event, and we monitored health events two weeks before, the week during the event, and four weeks after WYD.

Results: The demand for National Institute of Medical Emergency (INEM) services rose, surpassing June 2023 heatwave peaks. SNS24, the National Health Service's telephone assistance, reported increased triaged cases referred to primary care for heat-related issues, while INEM referrals for heat, sunburns, and nausea were stable. Hospital emergency services faced rising demand, particularly for dehydration and respiratory infections. Primary care consultations remained stable, with flu-like symptoms lower than peak winter levels. Notifications to SINAVE for water- and food-borne illnesses and vaccine-preventable diseases were within expected levels, and overall mortality rates aligned with national expected values during that period of the year.

Public health implications: Increased demand for INEM and SNS24 services highlighted heatwave and possible health risks during the mass gathering. The establishment of a National Management Committee and a health surveillance system during the mass-gathering event of 1.5 million people might have contributed to early detection and mitigation of potential health issues and ensured community safety.

Role: Berta contributed as an epidemiologist. She collaborated in the development of a surveillance system: discussing the type of surveillance and data collection needed to support fast risk assessment of public health events during mass gathering. Berta also contributed to setting up a surveillance system to monitor health indicators before, during, and after the event. Her tasks were as follows: a) supported the preparedness activities for outbreaks or public health threats; b) participated in the implementation of a syndromic surveillance system to detect and monitor clusters of symptoms or illnesses among event participants in real-time; c) elaborated on automatised reports using R that included data collection and data management using national data sources for hospital registries, data cleaning, data analysis, data visualisation and interpretation; d) monitored health indicators to identify emerging health issues; e) collaborated with event organisers, national, regional and local health authorities for signals verification, risk assessment and supported the guidance on public health response.

Surveillance of seasonal health and acute respiratory infections in Portugal during 2022–2024

Supervisor: Pedro Pinto Leite

Type of project: Analysing data from a surveillance system

Aim: To detect and monitor seasonal health and acute respiratory infections, guide evidence-based public health interventions, and reduce related morbidity and mortality.

Methods: DGS conducts weekly monitoring of seasonal health, focusing on environmental and epidemiological surveillance outputs, including acute respiratory infections and gastrointestinal infections. Data are obtained from multiple sources: the Portuguese Institute of Sea and Atmosphere (IPMA) supplies daily and weekly air

temperatures and UV index; the National Institute of Health's ÍCARO/FRIESA Index assesses the impact of forecasted temperatures on mortality; SNS24 provides information on triaged calls related to heat-related conditions; INEM contributes data on emergency calls regarding heat issues; the National Reference Lab (INSA) offers information on respiratory virus strains; ACSS supplies hospitalisation data and SICO (DGS) supplies mortality data. DGS compiles this information into comprehensive weekly reports. The process of integrating, analysing, interpreting the data and preparing the report was optimised using R software.

Results: DGS developed the National Contingency Plan for Extreme Temperatures for 2022–2023 and 2023–2024, outlining national guidelines for seasonal health. We validated the R scripts used for analysis and updated the standard operating procedure for data analysis and report preparation. Additionally, we created a universal script for automated weekly situational reports on seasonal health in Portugal, which involved reorganising data sources and compiling scripts.

Public health implications: Coordination and collaboration among different sectors to integrate critical information from surveillance systems are essential for effectively responding to the challenges of seasonal health surveillance.

Role: Berta contributed as an epidemiologist. Her tasks were as follows: a) participated in weekly meetings; b) contributed to the elaboration of weekly reports for seasonal health to analyse and visualise seasonal health data; c) identified surveillance data needs for risk assessment; d) contributed to risk assessments using epidemiological data; e) identified target groups for recommendations and public health interventions; f) validated and developed universal automatised R scripts for weekly situational reports; g) revised the final report; h) participated in meetings and review of the National Contingency Plan for Extreme Temperatures (2022–2023 and 2023–2024); i) attended a webinar on the new European Respiratory Virus Surveillance Summary (ERVISS) organised by ECDC and the WHO Regional Office for Europe (7 November 2023); j) participated in the ECDC 2022 Winter Workshop on communicable disease prevention and control strategies within the EU.

Implementation of the Severe Acute Respiratory Infections (SARI) surveillance system based on electronic health records in Portugal

Supervisor: Pedro Pinto Leite

Type of project: Setting up a surveillance system

Aim: To design and implement a Severe Acute Respiratory Infections (SARI) surveillance system based in electronic health records (EHRs) in Portugal.

Methods: We aligned the SARI surveillance system with European recommendations. We described the existing SARI surveillance methods and discussed the development plans for implementing a universal SARI surveillance system based in EHR. We designed the system focusing on public health importance, case definitions, data collection methods, and data analysis. Moreover, we identified the key stakeholders who could be involved. Furthermore, we addressed challenges in implementing SARI surveillance using electronic health records. Finally, we exchanged best practices with other European countries and requested recommendations for system maintenance.

Results: We defined the case definition for the SARI surveillance system and drafted a data integration plan, which is currently pending institutional approval. We discussed data quality assurance and validation procedures at both national and European levels. We identified the stakeholders involved in the surveillance system, and are in the process of signing inter-institutional agreements. Additionally, we developed a protocol for the SARI surveillance system, which is set to be piloted in sentinel hospitals.

Public health implications: Establishing a SARI surveillance system using electronic health records in Portugal improved the capacity to promptly detect and respond to SARI outbreaks, thereby ultimately reducing morbidity and mortality rates. This system also facilitates data-driven public health interventions, leading to enhanced preparedness, prevention and control strategies.

Role: Berta was the coordinator and project manager. Her tasks were as follows: a) managed and coordinated the implementation of the SARI surveillance system, promoting collaborations and partnerships; b) participated in weekly meetings; c) described the current SARI surveillance systems in Portugal, including sentinel and active case reporting; d) identified stakeholders; e) identified challenges for implementing SARI surveillance using electronic health records and provided technical guidance; f) prepared presentations for internal and external audiences; g) organised a one-day site visit for stakeholders (e.g. ECDC, National Reference Lab to discuss findings, challenges, and recommendations; h) presented the Portuguese SARI surveillance system approach at an ECDC and EU Member States' meeting and exchanged best practices; i) reviewed state-of-the-art implementation reports for the SARI surveillance system.

National strategy to prevent and control Legionnaires' disease in Portugal

Supervisors: Pedro Pinto Leite and Maria de Jesus Chasqueira

Type of project: Analysing data from a surveillance system

Aim: To understand the current epidemiological situation of Legionnaires' disease in Portugal, review and update the national strategy to prevent and control this disease in the country, in compliance with the current legislation.

Methods: The national strategy to prevent and control Legionnaires' disease in Portugal was evidence-based, guided by literature review and national data analysis. We conducted an epidemiological analysis of cases of Legionnaires' disease in Portugal during 2015–2022. We collected epidemiological data from the National Epidemiological Surveillance System (SINAVE). Data cleaning, management, analysis and visualisation was conducted in R. Strategic meetings were organised regularly with key experts to review, discuss and update the national strategy as required.

Results: The national strategy to prevent and control Legionnaires' disease in Portugal is under revision. From 2015 to 2022, Portugal reported 1,800 confirmed cases of Legionnaires' disease, with an incidence of two cases per 100,000 habitants. A majority (95%) were over 40 years old and 73% were male. Most cases were autochthonous (94%), with 50% occurring in the Norte region. Diagnosis primarily relied on urine antigen tests (91%). All confirmed cases were hospitalised, with a mortality rate of 5%. The disease exhibited a seasonal pattern, peaking between September and November.

Public health implications: There is a need to enhance the national plan to prevent and control Legionnaires' disease in Portugal, implementing measures to substantially reduce *Legionella* infection rates and disease severity.

Role: Berta contributed as an epidemiologist. Her tasks were as follows: a) participated in strategic meetings with leading experts to discuss and refine the national strategy for Legionnaires' disease; b) drafted the first automated report on Legionnaires' disease using R Markdown for the weekly bulletin, including descriptive analysis of surveillance data, epidemic curves, and spatial analysis (GIS); c) authored the epidemiological situation chapter for Legionnaires' disease in both Portugal and Europe as part of the national strategy; d) assessed the Legionnaires' disease outbreak in Portugal in 2023–2024. This included: a) describing the outbreak by time, place, and person; b) integrating indicator- and event-based surveillance; c) conducting an epidemiological study; d) performing risk assessment; e) implementing effective risk communication strategies; f) identifying key findings from surveillance data analysis and drawing actionable conclusions.

Epidemiological analysis of cases of tinea infection in Portugal, based on electronic health records, 2016–2022

Supervisor: Pedro Pinto Leite

Type of project: Analysing data from a surveillance system

Aim: To conduct an epidemiological analysis of tinea in Portugal from 2016 to 2022, to determine the magnitude of public health implications of tinea infection in 2022 and inform public health actions.

Methods: We performed a descriptive analysis of cases of tinea in Portugal from 2016 to 2022. We collected Primary Care diagnostic data from the Information and Monitoring System of the NHS/SNS (SIM@SNS, accessed 30 January 2023), which aggregates national primary care data. We included monthly primary care consultations with a diagnosis of dermatophytosis (S74 code from ICPC-2) from 2016 to 2023, encompassing skin infections due to fungi, onychomycosis, pityriasis versicolor, and tinea. Episodes of moniliasis and candidiasis were excluded. Additionally, we used prescriptions of clotrimazole and miconazole as indicators, as these are the primary antifungals for treating tinea. We obtained prescription data from the Primary Healthcare Identity Card platform (BI-CSP). We illustrated patterns and trends using line and bar graphs.

Results: From 2016 to 2019, monthly primary care consultations for dermatophytosis slightly rose, remaining stable during 2020–2021 and slightly declining in 2022. ARS Norte and ARS Lisboa e Vale do Tejo reported the highest number of consultations. From January to April 2020, the beginning of COVID-19 restrictions, clotrimazole and miconazole prescriptions halved, then fluctuated between 10,171 and 14,724 monthly until the end of the period under analysis. Women had more prescriptions than men, except for boys under five years old, who had higher rates in 2022.

Public health implications: Fungus and tinea infection among adolescent males was not identified as a public health problem in Portugal in 2022.

Role: Berta contributed as an epidemiologist and led the epidemiological study. Her tasks were as follows: a) led the epidemiological analysis using event-based surveillance systems to promptly detect emerging public health threats; b) reviewed relevant literature and background information to contextualise the public health problem; c) collected data from electronic health records using the ICPC-2 diagnostic codes and the national electronic medical prescription system; d) developed an R script for the epidemiological analysis, including data cleaning, integration, management, analysis (descriptive and trends), and visualisation; e) wrote a national situation report on tinea in Portugal for the period 2016–2022, highlighting trends, key findings, and public health recommendations; f) engaged in discussions with the Director of the Directorate of Information and Analysis to assess whether tinea constituted a public health threat in Portugal.

National Task Force to address the detection of invasive Aedes albopictus *in Lisbon, Portugal, September 2023*

Supervisor: Paula Vasconcelos

Type of project: Setting up a surveillance system and analysing data from a surveillance system

Aim: To confirm the presence of *A. albopictus* in Lisbon, adjust the risk assessment accordingly, raise awareness to prevent the spread of mosquitoes, and revise national guidelines on the surveillance and control of arboviruses.

Methods: A multidisciplinary national Task Force (TF) was convened in Portugal after *A. albopictus* was first identified in Lisbon through community-based surveillance. The TF included experts in epidemiology, entomology, environmental health, laboratory diagnosis, prevention and control and communication. During September to December 2023, the National Network for Vectors Surveillance (REVIVE) and the Institute of Hygiene and Tropical Medicine sampled mosquito-prone habitats within 2 kilometre-radius of the detection point using QGIS software. Snowball sampling was used to identify any new foci. Ovitraps were placed for ongoing surveillance and morphological analysis and xenomonitoring were conducted for pathogen DNA and RNA detection at the national reference laboratory.

Results: By November 2023, we identified *A. albopictus* in two additional locations. All mosquitoes tested negative for arboviruses, and no local cases of mosquito-borne diseases were reported. The Task Force established national guidelines for vector prevention and control, along with awareness initiatives for arboviruses, and trained municipal workers. We raised public awareness by engaging with experts and utilising various communication channels. As of July 2024, no new foci have been reported in Lisbon.

Public health implications: *A. albopictus* has been spreading in highly populated areas. Community-based surveillance and the REVIVE approach were crucial for invasive *A. albopictus* detection and monitoring in Lisbon. Rapid multidisciplinary TF coordination may have been key for adequate risk assessment and guidance for vector control.

Role: Berta was a member of the National Task Force. Her tasks were as follows: a) participated in national Task Force meetings to monitor findings, update risk assessments and formulate a response plan; b) drafted the alert and risk communication; c) drafted technical documents such as national guidelines for *A. albopictus* vector control; d) developed proposals for press releases (e.g. report of the TF in the Portuguese journal *Expresso*) and public communication materials; e) participated in defining a qualitative, quick survey to assess public knowledge with WHO on *Aedes spp* vector; f) participated in a bilateral meeting with Spain to enhance cross-border collaboration; g) organised and delivered training sessions on vector control for Lisbon Municipality personnel; h) conducted field visits with entomologists to set traps and identify *A. albopictus* in Lisbon; i) contributed to the preparation of spatial monitoring plans for *A. albopictus*; j) delivered an oral presentation at the European Public Health Conference in Lisbon, showcasing findings and strategies of the *A. albopictus* Task Force for its prevention and control in Lisbon.

Evaluation of the National Epidemiological Surveillance System for dengue in Portugal, 2020–2024

Supervisor: Pedro Pinto Leite

Type of project: Evaluating a surveillance system

Aim: To evaluate the National Epidemiological Surveillance System for dengue in Portugal from January 2020 to July 2024.

Methods: We extracted and analysed SINAVE electronic data on all notified cases of dengue from 2020 to 2024 to perform a descriptive overview of the system and evaluate key attributes. Completeness was assessed using the proportion of compulsory fields filled. Positive predictive value was evaluated by the proportion of confirmed cases validated for surveillance purposes. Representativeness was discussed by analysing and comparing key characteristics with other systems using published findings in the literature. Timeliness was appraised by the proportion of notified cases in the first 24 hours after diagnosis.

Results: There were 204 dengue notifications in Portugal from January 2020 to July 2024. Data completeness of compulsory fields was above 98% for all variables. The surveillance system had a positive predictive value of 78% (159 confirmed cases over 204 notifications). All the cases were imported. More than half of the confirmed cases were male (59%), within the age group of 40–49 years old. Regional notification was highly asymmetrical, the majority of the cases were notified in two regions: Lisbon region (52%) and Norte region (32%). Timeliness for notified cases within the first 24 hours of diagnosis was 30%.

Public health implications: Given the presence of the dengue vector, *Aedes albopictus*, in certain regions of mainland Portugal and its recent detection in Lisbon, improving the timeliness of the surveillance system is crucial to implement prompt public health measures and prevent autochthonous transmission.

Role: Berta was an investigator and led the evaluation. Her tasks were as follows: a) described the national epidemiological surveillance system for dengue in Portugal; b) discussed the evaluation framework and key attributes with the Director of the Directorate of Information; c) developed the R script to perform data cleaning,

management, analysis and visualisation; d) interpreted the data and drew conclusions; e) wrote the evaluation report; f) made recommendations with regard to surveillance variables in notification and epidemiological enquiry forms.

Describing and comparing Aedes*-borne disease surveillance systems in Southern Europe: France, Italy and Portugal*

Supervisors: Paula Vasconcelos, Lauriane Ramalli, Flavia Riccardo, Tanja Charles, Pedro Pinto Leite and João Vieira Martins

Type of project: Evaluating a surveillance system

Aim: To systematically describe and compare the respective surveillance systems and response measures for *Aedes*-borne diseases in locations across France, Italy, and Portugal.

Methods: We employed a benchmarking analysis using a comprehensive set of surveillance system descriptors based on the ECDC handbook, 'Data quality monitoring and surveillance system evaluation – A handbook of methods and applications'. We collected and analysed data from key-informant interviews, national guidelines and literature, and ensured data collection harmonisation through a consensus-based decision-making process.

Results: Each country has an integrated surveillance system for *Aedes*-borne diseases. The three countries share similarities in surveillance type (passive, compulsory, comprehensive, year-round operating systems), geographic coverage (national), case definitions (adapted EU case definitions), and notification processes. France also practises active surveillance whereas Italy and Portugal practise event-based surveillance to complement routine surveillance. Common response measures include visiting affected areas, active case-finding, and blood safety measures in countries with autochthonous cases. The responses of France and Italy largely focus on vector control, while Italy and Portugal monitor pathogens in vectors.

Public health implications: Surveillance systems in France, Italy, and Portugal are similar, while their response measures vary, likely reflecting different epidemiological and entomological contexts. Implementation of harmonised, risk-based surveillance systems across southern Europe and enhanced cross-border collaboration may improve preparedness, control and response to *Aedes*-borne diseases.

Role: Berta was coordinator of the project. In September 2022, she explored a collaboration with Santé publique France for *Aedes*-borne diseases. Subsequently, the EPIET fellows from Portugal (Berta), France (David Kelly) and Italy (Max Fotakis) agreed on conducting a cross-country project. Berta chaired a meeting with Santé publique France and Istituto Superiore di Sanità to define the project's scope and feasibility. The three fellows designed the project and developed an adapted benchmark tool for the comparison among countries. Each fellow collected the information for their country site. The fellows co-coordinated the project and had equal contribution on drafting the manuscript and designing the figures. The fellows presented the project: a) to the ECDC expert team on Emerging and Vector-borne Diseases, b) during the ECDC-organised, '*Aedes*-borne Diseases Workshop' in April 2024, and c) at the European Public Health Conference 2024 in Lisbon, in an oral presentation. A manuscript has also been submitted at *Eurosurveillance*.

2. Applied public health research

Burden of varicella-zoster virus infection in Portugal 2013–2022: creating evidence for vaccine policy recommendations

Supervisor: André Peralta Santos

Aim: To understand varicella and herpes zoster burden and disease patterns in hospitalised cases in Portugal considering the impact of the COVID-19 pandemic, and to guide decision-making in vaccine recommendations.

Methods: The National Immunisation Technical Advisory Group held regular meetings with key experts to identify and assess the evidence needed to develop herpes zoster and varicella vaccine recommendations. We compiled scientific evidence on disease, risk groups, vaccine safety and effectiveness, EU and WHO vaccine recommendations and best vaccination practices from Member States. Additionally, we performed a retrospective cohort study from January 2013 to December 2022 in Portugal. We calculated annual hospitalisation incidence complication rates based on electronic health records from public hospitals in Portugal. We fitted a multivariable regression model to identify risk factors for hospitalisation or complications, and a negative binomial time-series regression model to evaluate pre-, during and post-pandemic trends, adjusting for seasonality.

Results: During the COVID-19 pandemic, varicella hospitalisations incidence was stable at pre-lockdowns but decreased during the COVID-19 pandemic in Portugal. NITAG recommended a universal vaccination strategy for individuals aged 65 and older, as well as for those aged 18 and older at increased risk of herpes zoster and its complications. Regarding varicella, consensus was not reached: some members highlighted uncertainties about the long-term impact of varicella vaccination on herpes zoster, while others noted the lack of clear evidence linking varicella vaccination to increased herpes zoster cases in Member States that implemented the vaccination.

Conclusions and public health implications: Herpes zoster vaccination included in the routine vaccination programmes in Portugal could prevent the disease and, in particular, the complications caused by it. Further evidence is needed for varicella vaccine recommendations.

Role: Berta was an investigator and led the epidemiological study. Her tasks were as follows: a) participated in routine meetings with NITAG, contributing to evidence-based discussions on immunisation strategies; b) conducted critical appraisal of scientific literature to understand the public health problem and identify information needs; c) designed and executed an epidemiological study to assess disease burden and impact in a specific population; d) wrote a detailed study protocol and submitted it to the ethical committee; e) conducted statistical analysis of a retrospective cohort using multivariable regression and time-series analysis in R; f) addressed potential limitations, biases and confounders; g) interpreted and drew conclusions and implications for public health policy; h) regularly presented analytical results to NITAG; i) presented in the EPIET Time-series analysis Module; j) presented research findings as a poster at the Congress of the Portuguese and Spanish Societies of Epidemiology in Porto and at ESCAIDE in Barcelona, 2023; k) contributed to the NITAG final expert report summarising epidemiological evidence to inform vaccine recommendations and possible introduction in the routine national immunisation programme in Portugal.

World Youth Day (WYD) in August 2023 in Lisbon, Portugal – After Action Review

Supervisor: Paula Vasconcelos

Aim: To identify successes, challenges, and lessons learnt during the preparedness and response activities of the WYD CESP team for the WYD mass gathering, to enhance the future performance of CESP in mass gathering events in Portugal.

Methods: Data collection involved two processes: a) a document review of key materials such as the strategy notes, operational plan and public health guidelines, and b) structured, anonymised questionnaires to stakeholders of CESP addressing the positive and negative aspects of WYD activities and lessons learnt. The data collection spanned between 23 and 31 August 2023. We employed an After Action Review (AAR) using a modified SWOT analysis for data analysis.

Results: The specific RONDA meetings during WYD 2023 demonstrated effective collaboration among the stakeholders, enhancing public health response. Daily reports provided clear, updated information and threat assessment, facilitating timely decision-making. Meetings showcased punctuality and organisation, with increased partner contributions enriching discussions regarding potential risk for WYD population. However, concerns emerged regarding repetitive content and unclear relevance to some alerts within WYD settings. Recommendations include refining focus on critical health alerts, improving accessibility of information for local professionals, and integrating behavioural insights into risk assessments to enhance future Epidemic Intelligence activities in mass-gatherings.

Conclusions and public health implications: A post-event evaluation is key to assess the effectiveness of public health measures implemented during the World Youth Day, identifying strengths and weaknesses in the response, and ensuring that lessons learnt can enhance future preparedness for mass gathering events and mitigate potential health risks associated with such events.

Role: Berta was an investigator. Her tasks were as follows: a) participated in meetings to discuss and prepare the research study for the post-event evaluation and selection of the study population; b) contributed to the preparation of the questionnaire for the AAR for stakeholders; c) conducted qualitative analysis of data collected at AAR questionnaire, supporting the categorisation of results by groups and subgroups of opinions, employing a SWOT approach; d) interpreted the qualitative results of the AAR; e) wrote the results of the AAR report, including assessment of the effectiveness of health interventions, challenges, lessons learnt, and suggestions for future events tailored to the targeted audience; f) identified potential biases and conflicts of interest; g) revised the entire AAR report.

Research proposal to investigate the association between COVID-19 vaccination status and COVID-19 severity in immunocompromised population

Supervisor: Pedro Pinto Leite

Aim: To assess the degree of protection and susceptibility to severe COVID-19 in immunocompromised individuals following vaccination.

Methods: We proposed a retrospective cohort study. This study will encompass all hospitalised patients within the National Health Service in Portugal who exhibit immunosuppression, identified through electronic health records, primarily using Diagnosis Related Groups as a secondary diagnosis from the Hospital Morbidity Database (BDMH). The study period will span from January 2022 to August 2023. We will calculate the time at risk for each case from the time of study inclusion until the end of the follow-up period. To assess the association between vaccination status and severe disease outcomes and mortality in immunocompromised individuals, we will employ a multivariable logistic regression model or a negative binomial regression model if data overdispersion is observed. The assessment of the COVID-19 mortality rate will involve fitting a Cox regression model. Model selection will be performed using a backward procedure. Our estimations will be adjusted for covariates including age, sex, nationality, and region of residence. All data will be analysed in R.

Results: Study proposal submitted to EU Horizon call.

Conclusions and public health implications: The rollout of COVID-19 vaccines had an outstanding impact in reducing the morbidity and mortality induced by SARS-CoV-2 infection. Despite the decline in vaccine efficacy against infection with variants such as Omicron, the protection against severe disease remains substantial. However, the susceptibility of immunocompromised patients to severe outcomes of SARS-CoV-2 infection is concerning, given the emergence of variants that remain transmissible even in populations with high vaccination coverage.

Role: Berta was an investigator and led epidemiological analysis proposed within Work Package 12 of the project proposal for the EU Horizon call (HORIZON-HLTH-2021-CORONA-01). Her tasks were as follows: a) collaborated with national and international universities, research institutions, and organisations; b) understood the public health problem, conducted literature reviews, and assessed information needs; c) designed, elaborated, and discussed the epidemiological study, study design, and statistical analysis; d) designed data collection strategies; e) outlined the analysis plan for a retrospective cohort study to assess the association between COVID-19 vaccination status, hybrid immunity, and severe COVID-19 outcomes and mortality in the immunocompromised population; f) identified potential biases and confounders; g) wrote the study design and statistical analysis components, and reviewed the proposal.

Research proposal for Early Warning Decision-Support Tool for vector-borne diseases transmitted by Aedes spp *in Portugal, based on spatiotemporal data sciences*

Supervisors: André Peralta Santos, Manuel Ribeiro and Pedro Pinto Leite

Aim: To develop a prototype of an improved Early Warning Decision-Support Tool (EWDST) to prevent, detect early, control and respond to *Aedes spp* mosquito invasion and *Aedes*-borne diseases.

Methods: We designed a spatiotemporal data science framework that will use geostatistical methods and machine learning algorithms to predict climatic and environmental conditions favourable for *Aedes spp* proliferation in Portugal. Data included vector data from the Portuguese surveillance network, Earth Observation (EO) data from satellites, and in-situ data from meteorological stations. Geostatistical techniques will integrate the data from different sources, and machine learning algorithms will be trained to identify patterns between vector presence and environmental factors. The system will produce spatiotemporal forecasts for vector presence and disease risk. A prototype offering real-time analytics and data visualisation will be developed and tested in a living lab hosted by the DGS. This will facilitate real-world testing and stakeholder engagement. The project will involve experts from public health, computer science, environmental science and spatial data sciences. It will also include robust communication and dissemination strategies to share findings.

Results: The study proposal has been submitted to IC&DT call from the Foundation for Science and Technology (FCT).

Conclusions and public health implications: The development of a functional prototype of an EWDST would bring a timely surveillance system essential to early detect, respond, and control imported cases of *Aedes*-borne diseases and prevent potential autochthonous transmission episodes.

Role: Berta was an investigator and led the conceptualisation of the study for the Portuguese IC&DT call from the Foundation for Science and Technology (FCT). Her tasks were as follows: a) identified and established partnerships with key experts (universities, national and international space agencies, and private companies), coordinated brainstorming and discussion meetings, and distributed roles and tasks; b) conducted a literature review to understand the public health problem and identify information needs; c) determined data collection methods and characterised available spatial data in Portugal; d) designed, elaborated on, and discussed the study framework, and spatiotemporal predictive model; e) developed a detailed analysis plan; f) identified and addressed potential limitations; g) explored the applicability and scalability of the research findings to other Mediterranean regions and additional vector-borne diseases; h) participated in a European workshop to share and assess similar EWDST tools under development for vector-borne diseases; i) contributed to writing and reviewing the proposal; j) provided scientific, epidemiological, and spatiotemporal technical support for the proposal.

3. Teaching and pedagogy

National School of Public Health (ENSP), Universidade Nova de Lisboa, April 2023

On 14 April 2023, Berta prepared and facilitated a 3.5-hour face-to-face session for medical doctors with Public Health Medical specialisation and Public Health Master's students from ENSP, Lisbon. Using a case study on tobacco and lung cancer, participants discussed epidemiological study design, biases, confounding, measures of association, and criteria for causality. Students were divided into groups to promote dynamic discussions. An online survey revealed positive feedback on knowledge gain and engagement in the session.

National School of Public Health (ENSP), Universidade Nova de Lisboa, October 2023

On 12 and 19 October 2023, Berta led two 1.5-hour face-to-face sessions for medical doctors with Public Health Medical specialisation and Public Health Master's students from ENSP, Lisbon. The sessions covered national and international epidemiological surveillance systems and rapid risk assessment (RRA). The training included theoretical lectures and interactive discussion-based exercises on using the International Health Regulations decision algorithm and ECDC's RRA tool. An online survey showed that all students agreed that the depth and methodology were appropriate and found the sessions very engaging and knowledge-enhancing.

Infection Control Africa Network (ICAN), May 2023

On 17 May 2023, Berta prepared and facilitated a 6-hour online session for students from different African countries taking the International Post-graduate Diploma in Infection Prevention and Control, organised by the Infection Control Africa Network (ICAN), South Africa, and Radboud University Medical Center, Nijmegen, the Netherlands. Students were divided into groups to work on case studies to understand the steps of an outbreak investigation, identify the study question, and discuss an appropriate study design. An online survey revealed very positive feedback on the usefulness, engagement, and knowledge gain from the session.

4. Communications related to the EPIET/EUPHEM fellowship

4.1. Manuscripts published in peer-reviewed journals

1. **Grau-Pujol B**, Vieira Martins J, Goncalves I, Rodrigues F, de Sousa R, Oliveira D, Bettencourt J, Mendes D, Mateus de Cunha I, Pocinho S, Firme A, dos Santos B, Peralta Santos A, Albuquerque MJ, Pinto-Leite P, Tato Marinho R, Vasconcelos P. Task Force for a rapid response to an outbreak of severe acute hepatitis of unknown aetiology in children in Portugal in 2022. Euro Surveill. 2023;28(38)=2300171. Available at: https://doi.org/10.2807/1560-7917.ES.2023.28.38.2300171

2. Rosendal E, von Schreeb S, Gomes A, Lino S, **Grau-Pujol B**, Magalhães S, Ricoca Peixoto V, Roque C, Moreno J, Maltez F, Almeida F, Sá Machado R, Marinho RT, Vasconcelos P, de Sousa R, Vieira Martins J. Ongoing outbreak of hepatitis A associated with sexual transmission among men who have sex with men, Portugal, October 2023 to April 2024. Euro Surveill. 2024;29(21)=2400272. Available at: https://doi.org/10.2807/1560-7917.ES.2024.29.21.2400272

3. Ricoca Peixoto V, **Grau-Pujol B**, Ourique M, Lourenço da Silva R, Ferreira M, Firme A, Sentís A, Vasconcelos P. Epidemic Intelligence Threat Reporting Profile in Portugal during the COVID-19: 2 Years of Decrease in Reporting on Non-COVID-19 Threats. Port J Public Health. 2024. Available at: https://doi.org/10.1159/000539616

4. Borges V, Duque MP, Martins JV, Vasconcelos P, Ferreira R, Sobral D, Pelerito A, de Carvalho IL, Núncio MS, Borrego MJ, Roemer C, Neher RA, O'Driscoll M, Rocha R, Lopo S, Neves R, Palminha P, Coelho L, Nunes A, Isidro J, Pinto M, Santos JD, Mixão V, Santos D, Duarte S, Vieira L, Martins F, Machado J, Veríssimo VC, **Grau-Pujol B**, Peralta-Santos A, Neves J, Caldeira M, Pestana M, Fernandes C, Caria J, Pinto R, Póvoas D, Maltez F, Sá AI, Salvador MB, Teófilo E, Rocha M, Moneti V, Duque LM, E Silva FF, Baptista T, Vasconcelos J, Casanova S, Mansinho K, Alves JV, Alves J, Silva A, Alpalhão M, Brazão C, Sousa D, Filipe P, Pacheco P, Peruzzu F, de Jesus RP, Ferreira L, Mendez J, Jordão S, Duarte F, Gonçalves MJ, Pena E, Silva CN, Guimarães AR, Tavares M, Freitas G, Cordeiro R, Gomes JP. Viral genetic clustering and transmission dynamics of the 2022 mpox outbreak in Portugal. Nat Med. 2023 Oct;29(10):2509-2517. Available at: https://doi.org/10.1038/s41591-023-02542-x

5. **Fotakis EA*, Grau-Pujol B*, Kelly D***, Leite PP, Martins JV, Alves MJ, Di Luca M, Venturi G, Ferraro F, Franke F, Pietin C, Calba C, Charles T, Riccardo F, Vasconcelos P, Ramalli L. Description and comparison of national surveillance systems and response measures for Aedes-borne diseases in three countries in Southern Europe (France, Italy and Portugal). Submitted to Eurosurveillance.
   *Authors shared equal contribution.

4.2. Conference presentations

1. **Grau-Pujol B**. Caracterização dos dados nacionais – Situação atual Desafios de um alerta transfronteriço (oral presentation), Presented at Pandemias na Era da Globalização at the panel session "Mpox - Dados Portugueses"; 11 Maio 2023; Coimbra, Portugal.
2. **Grau-Pujol B**, Perez Duque M, Valente Pinto M, Fernandes T, Vasconcelos P, Pinto Leite P, Peralta Santos A. Varicella burden in Portugal: implications of COVID-19 pandemic (poster presentation), Presented at the Portuguese and Spanish Annual Epidemiology Congress (APE/SEE); 8 September 2023; Porto, Portugal.
3. **Grau-Pujol B**, Vieira Martins J, Goncalves I, Rodrigues F, de Sousa R, Oliveira D, Bettencourt J, Mendes D, Mateus de Cunha I, Pocinho S, Firme A, Estela dos Santos B, Peralta Santos A, Albuquerque MJ, Pinto Leite P, Tato Marinho R, Vasconcelos P. Task Force for the rapid response to the outbreak of severe acute hepatitis of unknown aetiology in children in Portugal in 2022 (poster presentation), Presented at European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 22 November 2023; Barcelona, Spain.
4. **Grau-Pujol B**, Perez Duque M, Valente Pinto M, Fernandes T, Vasconcelos P, Pinto Leite P, Peralta Santos A. Varicella burden in Portugal from 2013 to 2022: implications of the COVID-19 pandemic in a context of a missing varicella vaccine recommendation (poster presentation), Presented at European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 24 November 2023; Barcelona, Spain.
5. **Grau-Pujol B**, Moreira A, Vieira Martins J, Costa Osório H, Ribeiro L, Dinis A, Sousa CA, Alves MJ, Pinto Leite P, Vasconcelos P. Rapid response Task Force: addressing the detection of Aedes albopictus in Lisbon, Portugal (oral presentation), Presented at European Public Health Conference (EPH); 14 November 2024; Lisbon, Portugal.
6. **Fotakis EA *, Grau-Pujol B*, Kelly D***, Charles T, Vasconcelos P, Vieira Martins J, Pezzotti P, Flavia R, Calba C, Ramalli L. Comparing Aedes-borne disease surveillance systems in Southern Europe: France, Italy and Portugal (oral presentation), Presented at European Public Health Conference (EPH); 14 November 2024; Lisbon, Portugal. *Authors shared equal contribution.
7. Von Schreeb S, Rosendal E, Gomes A, Lino S, **Grau-Pujol B**, Magalhaes S, Peixoto V, Roque C, Moreno J, Maltez F, Almeida F, Sá Machado R, Tato Marinho R, Vasconcelos P, de Sousa R, Vieira Martins J. Outbreak of Hepatitis A associated with sexual transmission among men who have sex with men (MSM) in Portugal, October 2023 to April 2024 (oral presentation), Presented at European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE); 20 November 2024; Stockholm, Sweden.

5. EPIET/EUPHEM modules attended

- Introductory Course, 26 September–14 October 2022, Spetses, Greece
- Outbreak Investigation, 5–9 December 2022, Berlin, Germany
- European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2022, 23–25 November 2022, Stockholm, Sweden
- Qualitative Research – Optional Inject Days, 31 January and 3 February 2023, virtual
- Multivariable Analysis, 22–26 May 2023, Frankfurt, Germany
- Rapid Assessment and Survey Methods, 19–23 June 2023, Stockholm, Sweden
- Project Review Module 2023, 28 August–1 September 2023, Lisbon, Portugal
- European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2023, 22–24 November 2023, Barcelona, Spain
- Time Series Analysis, 11–15 December 2023, Rome, Italy
- Writing Abstracts for Scientific Conferences, 14 March, virtual
- European Congress of Clinical Microbiology and Infectious Diseases (ECCMID) 2024, 27–30 April 2024, Barcelona, Spain
- Management, Leadership and Communication in Public Health, 24–28 June 2024, Stockholm, Sweden
- Project Review Module 2024, 26–30 August 2024, Lisbon, Portugal
- European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2024, 20–22 November 2024, Stockholm, Sweden

6. Other training

- Xenomonitoring and surveillance: Using mosquitoes to find (and control) pathogens. Organised by EAN, 26 October 2022, virtual
- Infectious Disease Preparedness course. Organised by ECDC, 1 November 2022, virtual
- How wastewater monitoring can boost preparedness for new health threats. Organised by EMCDDA/EUDA, 16 November 2022, virtual
- Introduction to R for applied epidemiology. Fundamentals of R for public health. Organised by Applied Epi, 28 November to 1 December 2022, virtual
- Public Health Surveillance – Lessons learned from COVID-19, Winter workshop: Recovery – from lessons identified to lessons learned. Organised by ECDC, 29 November, 1 December and 6 December 2022, virtual
- Global Governance for Pandemic Preparedness and Response post COVID-19. Organised by Centre for Epidemic Preparedness and Response at London School of Hygiene and Tropical Medicine, 16 January 2023, virtual
- Outbreak analysis tool showcase. Organised by Centre for Epidemic Preparedness and Response at London School of Hygiene and Tropical Medicine, 25 January 2023, virtual
- Holding mass and large gathering events during the multi-country mpox outbreak in the WHO European Region: Lessons identified for future mass gathering preparedness. Organised by the WHO Regional Office for Europe, 22 February, 2023, virtual
- Creating a template agreement for trans-country collaboration between authorities during health crises. Organised by SHARP Joint Action EU-funded, 27–28 February 2023, Lisbon, Portugal
- Cholera outbreaks: Emergency Preparedness and Response. Organised by WHO, 1 March 2023, virtual
- Spatial Data Science using R. Organised by the University of Lisbon and the Centro de Estatística e Aplicações, (CEAUL), 22–24 March 2023, Lisbon, Portugal
- Dengue and Climate Change: Emerging Disease in Non-Endemic Regions. Organised by International Society of Travel Medicine, 12 April 2023, virtual
- BSAFE. Organised by United Nations Department of Safety and Security, 1 June 2023, virtual
- Public Health Preparedness for Mass Gathering Events. Organised by WHO, 16 June 2023, virtual
- Vectors, what can we do to control them. Organised by Instituto Nacional de Saúde Doutor Ricardo Jorge (INSA), 19 September 2023, virtual
- Introduction to Go.Data – Field data collection, chains of transmission and contact follow-up. Organised by WHO/GOARN, 25–27 October 2023, virtual
- Molecular Epidemiology mini-module. Organised by EAN, 20–21 November 2023, Barcelona, Spain
- Standard Operating Procedures (SOPs) for Emergencies. Organised by WHO, 22 December 2023, virtual
- New Policy and Strategy on Preventing and Addressing Sexual Misconduct. Organised by WHO, 22 February 2024, virtual
- United to Respect: Preventing Sexual Harassment and Other Prohibited Conduct. Organised by WHO, 22 February 2024, virtual
- Ethics empowerment. Organised by WHO, 22 February 2024, virtual
- Prevention of Sexual Exploitation and Abuse (PSEA). Organised by United Nations, 22 February 2024, virtual

7. International assignments

Greater Horn of Africa – Food insecurity and health, G3 Emergency, WHO

Berta was on an eight-week deployment through the Global Outbreak Alert and Response Network (GOARN) as an epidemiologist to support the routine activities of the Health Information Management (HIM) team within the Incident Management Support Team (IMST) for the Greater Horn of Africa – Food insecurity and health, G3 Emergency at the World Health Organization (WHO AFRO and WHO EMRO), Nairobi, Kenya, March–April 2024.

8. Other activities

- Attended national or international webinars organised by WHO, ECDC or other organisations related to the public health emergencies preparedness and response.
- Wrote and reviewed public health alerts and situation reports regarding topics such as Avian Influenza A(H5N1) virus in a mink farm in Spain, an imported case of botulism in an infant in Portugal, or a national Streptococcus group A infection outbreak.
- Participation on meetings to set up a national waste-water surveillance system in Portugal.
- Attended WHO Preparedness and Resilience for Emerging Threats (PRET) initiative webinars, virtual.
- Participated during a visit by the Azerbaijan Ministry of Health in Portugal to share experiences between countries in the area of strengthening national public health emergency information management system under the WHO Europe Regional Office project within lessons learnt from COVID-19, 24–28 October 2022, Lisbon, Portugal.
- Participated during a visit by the São Tomé and Príncipe Government Delegation to share experiences within public health emergencies preparedness and response, 17–21 April 2023, Lisbon, Portugal.
- Participated in national meetings to manage and respond to an infant with imported botulism in October 2022 in Portugal, and activation of a shipment of human antitoxin from the United States.
- Participated in national meetings to manage and respond to neurological conditions associated with the consumption of bread in August 2023 in the Centre and Lisbon Region, Portugal.
- Participated in national meetings to manage and respond to contaminated imported raw shrimp from Ecuador in August 2023 in Portugal.
- Participated in local meetings to manage and respond to scombroid poisoning in a restaurant in Lisbon, Portugal in September 2023 in Lisbon, Portugal.
- Participated in the 14th National Vector Surveillance Network (REVIVE) annual workshop in April 2023, Lisbon, Portugal.
- Attended and served as the microphone runner during the visit of the Director of ECDC in Portugal, to gain insights into the main challenges for the public health network in Portugal in a post-acute pandemic phase, and the new challenges of the new EU regulations (the new ECDC mandate and cross-border threats) for ECDC and Member States, April 2023, Lisbon, Portugal.
- Attended webinars on how to share the results of a study on contact tracing (CT) tools, application and integration with EWRS, organised by the EUHealthSupport consortium, on behalf of DG SANTE and ECDC, April 2023.
- Attended the EAN Mobile Laboratory webinar organised by EAN, May 2023.
- Attended the EVD-LabNet webinars 2023 on Emerging Viral Disease.
- Organised and attended the Joint Action SHARP Workshop on 'Public Health Surveillance – Lessons learned from COVID-19', co-funded by the European Union Health Programme, July 2023, Lisbon, Portugal.
- Participated in the Joint Assessment and Detection of Events (JADE) simulation exercise organised by WHO Europe integrating the CESP/DGS team, including discussion, search for relevant information and guidelines, and contribution on responses to injects to the EURO JADE team, November 2023, Lisbon, Portugal.
- Participated and took notes in a WHO risk analysis project for EU Member States to develop a simple and harmonised risk analysis tool for Pandemic and Epidemic intelligence and preparedness.. Portugal was interviewed, as well as 18 Member States, regarding requirements of technical support, capacity building, advocacy, and information sharing.
- Attended the European Space Agency EO4Health User Forum 2024 virtually to review the latest advances in the use of Earth Observation technology for global health, January 2024.
- Attended (as a vector-borne disease expert from DGS) the 1st European workshop on arbocartoR, a predictive mapping tool to monitor vector-borne diseases, organised by Cirad and MOOD project (Monitoring Outbreaks for Disease surveillance in a data science context), 27–29 February, Paris, France.
- Presented two workshops for the European Public Health Conference 2024, Lisbon, Portugal. The two sessions were: a) scientific session: strengthening resilience against emerging vector-borne diseases through the ECDC Fellowship Programmes, and b) round table: strengthening preparedness for public health emergencies: lessons learnt and future perspectives.

- Prepared (as a subject matter expert) a West Nile Virus satellite e-learning within a series of e-learning modules for Member States on outbreak investigation, collaborating with the continuous professional development group at ECDC.

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