



## FELLOWSHIP REPORT

### Summary of work activities

Alexis Sentís Fuster

Intervention Epidemiology path (EPIET)

Cohort 2017

## Background

The ECDC Fellowship Training Programme includes two distinct curricular pathways: Intervention Epidemiology Training (EPIET) and Public Health Microbiology Training (EUPHEM). After the two-year training EPIET and EUPHEM graduates are considered experts in applying epidemiological or microbiological methods to provide evidence to guide public health interventions for communicable disease prevention and control.

Both curriculum paths are part of the ECDC fellowship programme that provides competency based training and practical experience using the 'learning by doing' approach in acknowledged training sites across the European Union (EU) and European Economic Area (EEA) Member States.

### Intervention Epidemiology path (EPIET)

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

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

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*The views expressed in this publication do not necessarily reflect the views of the European Centre for Disease Prevention and Control (ECDC).*

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

Stockholm, July 2017

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The objectives of the ECDC Fellowship - EPIET path are:

- To strengthen the surveillance of infectious diseases and other public health issues in Member States and at EU level;
- To develop response capacity for effective field investigation and control at national and community level to meet public health threats;
- To develop a European network of public health epidemiologists who use standard methods and share common objectives;
- To contribute to the development of the community network for the surveillance and control of communicable diseases.

Fellows develop core competencies in field epidemiology mainly through project or activity work, but also partly through participation in training modules. Outputs are presented in accordance with the EPIET competency domains, as set out in the EPIET scientific guide<sup>1</sup>.

## Pre-fellowship short biography

Alexis Sentís graduated as a medical doctor in 2007, later as specialist in Nephrology in 2012, completing his Masters in Public Health in 2016. He obtained his second medical speciality in Preventive Medicine and Public Health in 2018. Since 2012, he has worked in different public health and research areas mainly interested in communicable disease.

## Fellowship assignment: Intervention Epidemiology path (EPIET)

On 11<sup>th</sup> September 2017, Alexis Sentís started his EPIET fellowship at the Directorate-General of Health (DGS), Lisbon, Portugal at the department of Information and Analysis, headed by professor Paulo Nogueira (2017-18)/Dra Graça Lima (2018- ), having as supervisor Paula Vasconcelos, and with support from Rita Sá Machado (2018- ) and EPIET alumni Carlos Carvalho (2018 -). His EPIET frontline coordinator was Daniel Thomas. This report summarizes some of the work performed during the fellowship.

## Fellowship portfolio

This portfolio presents a summary of all work activities (unless restricted due to confidentiality regulations) conducted by the fellow during the ECDC Fellowship, EPIET path. These activities include various projects, and theoretical training modules as well other initiatives where the fellow was participating at local, regional, national and international level.

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

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

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<sup>1</sup> European Centre for Disease Prevention and Control. European public health training programme. Stockholm: ECDC; 2013. Available from: [http://ecdc.europa.eu/en/epiet/Documents/Scientific%20guides/EPIET%20Scientific%20Guide\\_C2015.pdf](http://ecdc.europa.eu/en/epiet/Documents/Scientific%20guides/EPIET%20Scientific%20Guide_C2015.pdf)

# Fellowship projects

## 1. Surveillance

### **Title: The effect of interventions to improve the Early Warning, Alert and Response System (EWARS) reporting and implementation in response to cyclone Idai, Mozambique 2019**

#### **Background**

In the context of the response to cyclone Idai, the Early Warning, Alert and Response System (EWARS) was rolled out on 4th April 2019 in four priority districts in Sofala Province (Mozambique). The objective was to improve early detection of outbreaks by ensuring real-time reporting of epidemic-prone diseases, conditions and health related events in the districts affected by the disaster, in the context of a weak routine surveillance system. In the weeks following EWARS roll-out, the completeness of reporting did not reach the target of 90% overall and reporting was irregular. The main objective was to increase the completeness of reporting of EWARS by the 53 included healthcare facilities (those who received a EWARS phone).

#### **Methods**

Field teams were constituted, to assess the needs and barriers to reporting, as a first approach. Persons in charge of EWARS reporting at each facility were asked about local conditions to access the electricity network, telephone network, availability of telephone credit, and specific needs for technical advice on how to collect the data or the use of the EWARS telephone-based App. The working group conducted an assessment of the state of reporting and completeness for each healthcare facility, identified those that had low reporting rates or had never reported. This information, together with the accessibility to the sites, was used to draw an action plan to conduct face-to-face visits to healthcare facilities included in EWARS. Healthcare facilities that were accessible by car and had low reporting rates were prioritized. A schedule was made to visit every facility accessible by car in the week from 29th April to 3rd May. For facilities that could not be reached by car, two trainings were planned. Raw data, as well as the completeness report were exported from EWARS and analyzed using Excel and Stata v.14.

#### **Results**

Up to 7th May 2019 the teams visited 39 (58%) of all facilities targeted for EWARS. This corresponds to 74% of all facilities with phones. The four districts were covered between 19th of April and 3rd of May. Additional visits to sites with persisting reporting problems were performed on the 6th and 7th May, while revisits to facilities in other districts were planned from 8th May onwards. The completeness of reporting was high in two districts (> 80%) and low in the other two (<50%).

#### **Conclusions**

This intervention to strengthen EWARS reporting and implementation increased completeness of reporting through structured assessment of needs and face-to-face visits to the health care facilities. The districts differences in completeness of reporting is explained mainly by accessibility constraints, but also because of the late arrival of the solar panels, the hard to reach sites were postponed until the panels could be provided together with the phones and the training. The challenges were high, especially with the App failure to synchronize after the form was changed, and regarding data collection flows within the facilities. Some facilities had to be revisited multiple times to achieve active and accurate reporting.

#### **Role and outputs:**

- Under a WHO-GOARN international assignment in Mozambique, member of the WHO – Epi team task force coordinating and participating in the intervention, led by the National Institute of Health (INS-CIOB) and Provincial Health Directorate (DPS), to improve EWARS reporting and implementation in health facilities in the four most affected districts by cyclone Idai in Sofala province.
- Elaboration of the report "The effect of Interventions to improve EWARS reporting and implementation" requested by the National Institute of Health (INS-CIOB).

**Supervisor(s):** Emmanuel Musa (WHO Africa).

## **Title: Decline of tuberculosis notification rate in different population groups and regions in Portugal, 2010-2017**

### **Background**

Tuberculosis (TB) incidence has declined in Portugal in recent decades, but trends appear to differ between regions and population groups. We investigated these differences in order to inform prevention and control programmes.

### **Methods**

In Portugal, cases of active TB are notified to the national tuberculosis surveillance system. We performed a time series analysis of TB notification rates between 2010-2017 in different population groups and Portuguese regions. Interannual decline percentages and respective 95% confidence interval (95%CI) were estimated using Poisson and binomial negative regression models.

### **Results**

The overall TB notification rate decreased from 25.7/100.000 population in 2010 to 17.5/100.000 in 2017 (5.3%/year). The range of the interannual decline percentages in the continental Portuguese regions was between -4.4% (95%CI:-8.2%, -0.5%, for Alentejo) and -5.4% (95%CI:-6.4%, 4.4%, for Northern region). The interannual decline in notification rate was smaller in non-Portuguese nationals (-1.57%, 95%CI:-4.79%, 1.75%) versus Portuguese (-5.85%, 95%CI:-6.98%, -4.70%); children under five years (+1.77%, 95%CI: -4.61%, 8.58%) versus other ages (-5.38%, 95%CI:-6.33%,-4.42%); and HIV-negative people (-6.48%, 95%CI: -9.54%, -3.31%) vs HIV-positive (-13.12%, 95%CI: -14.81%,-11.40%).

### **Conclusions**

The declines in TB notification rates were smaller in children under five years old and non-Portuguese nationals, although numbers were very small for children. No significant differences were observed between Portuguese regions. The steeper decline of TB notification rates in HIV-positive may be due to more intensive screening and preventive treatment in the last decades. We recommend focusing opportunistic screening of TB in non-Portuguese and ensuring that new-borns with specific risk factors are timely offered BCG vaccination.

### **Role and outputs:**

Alexis's role was as principal investigator. Alexis reviewed available scientific literature, and designed the study with his supervisor and project supervisor, and prepared, managed and analyzed the data. The project has been accepted as poster for the ESCAIDE'19, results will be presented in November 2019.

**Supervisor(s):** Paula Vasconcelos with support from Carlos Carvalho

## **Title: Aedes-transmitted arbovirus infections: strengthening capacity and information systems in Madeira, Portugal**

Since the outbreak of dengue fever in Madeira in 2012-13, IASaúde has had a permanent surveillance system for dengue fever that integrates data from epidemiological, entomological and meteorological surveillance. There has been no further history of outbreaks by vector borne diseases (VBD) in Madeira. With the current political situation in Venezuela (country with major number of migrants from Madeira and the possibility of return of citizens to the island), Madeira health authorities have focused on enhancing the early detection of VBD in the archipelago. A technical support from ECDC has been requested aiming to assess and reinforce capacities for preparedness and response of VBD.

Alexis joined a visit team to Madeira with experts from ECDC and DGS. The visit also included a workshop with further experts joining from DGS, Regional departments of Public Health, National Lab (INSA), with the following objectives: i) Sharing experiences about preparedness and response of VBD in Europe (including workshop on MVB), ii) assessing the surveillance system for dengue mostly its suitability for detection and monitoring of other arboviruses, iii) revising the layout and contents of epidemiological reports. This visit was held in Madeira from 1st to 5th of April 2019. During this week, Alexis gathered information regarding different sources of information and products of the integrated surveillance for

Dengue, identified the capacities for early detection and surveillance for other arboviruses and respective VBD surveillance systems.

### Role and outputs:

- Revision of the 'Entomological Panel' to improve layout, format as well as content (including integration and analysis of data available from different sources of information) and data presentation.
- Preliminary time series analysis from entomological data (BGTraps) in order to provide a big picture of the dengue entomological surveillance system data trends after the outbreak.
- Contributions on identifying steps of workflow and information flow Dengue Madeira surveillance system based on interviews to health workers involved; it included contributions on the elaboration of charts and tables with listed sources of information and its use.
- Contributions in the ECDC report "Aedes-transmitted arbovirus infections: strengthening capacity and information systems in Madeira, Portugal".

**Supervisor(s):** Paula Vasconcelos with support from Bertrand Sudré and Benedetto Simone.

### Competencies developed:

Regarding the competencies developed in surveillance, I believe that I had the opportunity to develop the following specific skills: i. setting up a surveillance system, ii. analysing data from a surveillance system and iii. evaluating a surveillance system. In my GOARN mission in Beira I had the opportunity to see, almost from the beginning, how a surveillance system was set up, that is EWARS (Early Warning, Alert and Response System) from WHO in countries in conflict or following a natural disaster. My mission to Madeira joining an ECDC team was very useful experience in collaborative working with subject experts to achieve results in a short time to assess capacities and abilities in place for the preparedness and response to Aedes transmissible arboviruses. Regarding surveillance data analysis, I was involved in several different activities during the two years of the fellowship, not only in the three projects that I am mentioning in surveillance, also in other several activities in DGS (mentioned in further chapter of "others") where I have been analysing data for action. All together I believe that I obtained a good practical knowledge of the essentials of public health surveillance.

## 2. Outbreak investigations

**Title: Learning points from a large hospital outbreak of Legionnaires' disease in Lisbon, 2017.**

### Background

We analysed a large Legionnaires' disease (LD) hospital outbreak with 61 confirmed cases that occurred in Lisbon in 2017, to describe the key facts identified during the outbreak investigation that could have facilitated the outbreak in order to implement timely control measures, and to identify recommendations to prevent future outbreaks.

### Methods

Data on the cases were obtained from the National System for Epidemiological Surveillance. *Legionella pneumophila* was genotyped from clinical and environmental samples using seven-allele standard sequence-based typing and whole-genome sequencing. Meteorological data and models were obtained from the Portuguese Institute for Sea and Atmosphere and the Portuguese Environment Agency.

### Results

The hospital cooling tower was identified as the most likely source of infection and the night of October 25th 2017 as the period of greatest risk for the spread of contaminated aerosols. Need to improve the programme for prevention of LD, and for reinforcement of structures maintenance, standard procedures and training were pointed out.

## Conclusions

We recommend to consider: i) the use of meteorological data to assist in investigations of LD outbreaks, mostly to identify the time of exposure, ii) a detailed and structured guidance following existing guidelines including risk assessment and training the staff in preventive measures against LD, iii) to disseminate the recently approved Portuguese law to prevent LD.

## Role and outputs:

Alexis was a member of the DGS Task Force nominated to support the outbreak investigation with experts from local, regional and national level. He participated in the analysis of the epidemiological link and georeferencing cases regarding probable time exposure within the hospital structure by level and department. He also reviewed available scientific literature, designed an outbreak report with his supervisor, prepared-managed and analyze the data. He wrote the outbreak report for publication, discussed and revised with the co-authors and it has been planned to send to an international journal. He will subsequently reply all the reviewers' comments and make all the required changes. Finally, Alexis disseminated the results at ESCAIDE'18 on poster.

**Supervisor(s):** Paula Vasconcelos with support from Gonçalo Figueiredo Augusto (2017) and Rita Sá Machado (2018-).

## Title: Gastrointestinal outbreak in a National Guard training centre in Alentejo in October 2018.

### Background

An outbreak of acute gastroenteritis occurred between October and December 2018 in the facilities of a training centre, where 601 trainees lived, affecting a total of 304 people.

### Methods

The case definition was any person with a link to the facilities that presented diarrhoea throughout the period from 10 October to 14 December. A Questionnaire (EUSurvey) was answered by 758 people who were exposed to the training centre (trainees, trainers and other individuals with contact and/or meals on the premises). Data compilation and epidemiological approach were carried out with the collaboration of other EPIET fellow (MS -track). A retrospective cohort studied was performed. The results of descriptive and analytical epidemiology were organized in tables summarizing the main aspects of the outbreak. As response to the outbreak, the regional and local authorities implemented generic public health measures on food safety and prevention of transmission routes; the training course was interrupted for six days within the peak of the outbreak.

### Results

Of 758 answers, we identified 304 cases (AR 40%). Symptoms included diarrhoea (100%), abdominal pain (36%), headache (34%), fever (23%), with less frequent vomiting (18%) and had a median duration four days and interquartile rank between two and six. The risk of being a case was higher among: i) trainees than all the other respondents (relative risk (RR): 5.8, (confidence interval (CI) 95%: 3.4-9.9), ii) women than men (RR: 1.5, CI95%: 1.2-1.9), iii) respondents under 25 years of age than the others (RR:1.4, CI95%: 1.2-1.7), and those who had always or almost always dinner at the canteen than all the other than had dinner less frequently at the canteen (RR:2.5, CI95%: 1.7-3.5). The Epidemic curve suggests several moments of exposure with several peaks, the largest with 61 cases, On October 19. Of 22 samples from the cases, *Campylobacter* Jejuni was isolated in five. Specific food items list could not be retrieved.

### Conclusions

Considering the clinical picture, the waves in the epicurve, analytical epidemiology and incubation period, campylobacter was probably responsible for most of the cases and was reintroduced from contaminated food items before each of the waves. Difficulties were identified in articulation for timely sample collection (stools and food) and to receive lists of specific food items.



## Role and outputs:

Alexis integrated the local and regional team responsible for the outbreak investigation. He collaborated in the design and content of the survey, the review of scientific literature, data collection, and coding variables to study and carry out the subsequent exploitation, analysis and interpretation of information. He is co-author of the outbreak report. Final report is under responsibilities of regional authorities.

**Supervisor(s):** Paula Vasconcelos.

## ***Title: Sampling strategy for measles confirmation outbreak in a refugee camps (Bangladesh)***

### **Background**

A large measles outbreak occurred in a refugee camps in Bangladesh between September and December 2017, and cases steadily declined since mid-December, following a large MR mass vaccination campaign which ended on 8 December 2017. A total of 106 cases were investigated for lab confirmation and vaccine status (93% were positive and 90% weren't vaccinated against measles). The number of new cases significantly declined since January. However, syndromic measles/rubella continued to be reported on a weekly basis through EWARS, with around 50 – 70 cases per week in February 2018. As none of those had been tested for measles or for other pathogens, we were unable to assess whether measles continued to circulate, or whether those cases represented other differential diagnoses instead, such as scarlet fever or other viral illnesses. In order to better understand the current disease epidemiology at that time in the camps, and assess whether other public health interventions needed to be conducted, we proposed to undertake selective testing of measles cases reported in the camps.

### **Objective**

The main objective was to confirm diagnosis for measles outbreak. In practice it was to verify if the proportion of measles confirmed cases was maintained during the last few weeks or not due to the similarity in symptoms and signs to other exanthematic diseases.

### **Methods**

Under a WHO-GOARN field team, Alexis elaborated a sampling strategy in collaboration with other members of the team. The target population was all patients presenting measles like symptoms and signs within testing period in three major health facilities in the refugee camps. The planned testing period was seven days, in April-May 2018. The study inclusion criteria was any person, presenting at one of the three chosen health facilities, with fever and general maculopapular (i.e. non-vesicular) rash and any one of the following: cough/coryza (i.e. runny nose)/conjunctivitis (i.e. red eyes) or any person in whom a clinician suspects measles infection (EWARS Bangladesh case definition for measles). Sampling strategy proposed, jointly with National lab representatives in Dhaka consisted in proceed as follows: First, perform IgM ELISA blood test for measles. Second, if the result is negative, perform IgM ELISA blood test for Rubella. Based on the current reported cases per week at that time, and assuming about 50-70 cases/week load in EWARS in February 2018, it was expected to collect serum for 30 patients for measles detection in approximately seven days.

## Role and outputs:

Within an international assignment, Alexis joined the WHO-GOARN team, being responsible from first draft report, and coordinated the feedback for further versions with other members from WHO. Also contributed to smooth the process between the international team and the National lab representatives. To promote the final approval of the strategy and to perform the sampling strategy, he met with the health facilities representatives. Fellow left mission before the final approval of the strategy.

**Supervisor(s):** Olivier le Polain (GOARN, PHE).

## Competencies developed:

Regarding the competencies developed in outbreak investigation I had the opportunity to be actively involved in all the steps of an outbreak investigation. Besides my participation as a member of the outbreak investigation team in the main projects mentioned above, I worked also in several outbreak investigations mainly during my two international missions with GOARN but also in Portugal. In the legionella outbreak in Lisbon I could experience the outbreak from the beginning and I participated in all the steps of the investigation. In the gastrointestinal outbreak in Alentejo I was involved also from the beginning and I was able to go to the field to visit the cases and join the local- regional team, design and perform the survey, collect, prepare and manage data to finally analyse it. In my international mission with GOARN I had the opportunity to work in outbreak control and investigation in two different environments, a refugee camp and in an emergency (after cyclone Idai). In both situations, several outbreaks were simultaneously ongoing and I had the opportunity to participate in field work activities as mentioned in this portfolio, work in respective bulletins, design surveys, forms and SOP, data analysis and epidemic reports elaboration. I also gained experience in how to integrate different teams and perform epidemiological tasks useful for all.

## 3. Applied epidemiology research

### Title: Failure to complete treatment for latent tuberculosis infection in Portugal, 2013-2017: geographic, socio-demographic and medical associated factors.

#### Introduction

There is conflicting evidence about factors associated with failure to complete treatment (FCT) for latent tuberculosis infection (LTBI). We aim to identify the geographic, socio-demographic and medical factors associated with FCT in Portugal, highlighting the two main metropolitan areas of Porto and Lisbon.

#### Methods

We performed a retrospective cohort study including LTBI patients that started treatment in Portugal between 2013 and 2017. We calculated adjusted odds-ratios (aOR) and 95% confidence intervals (95%CI) using multivariable logistic regression to identify geographic, socio-demographic and medical factors associated with FCT.

#### Results

Data on completion of treatment were available for 15,478 of 17,144 patients (90.3%). Of those, 2,132 (13.8%) failed to complete treatment. Factors associated with FCT were being older than 15 years (aOR: 1.65 [95%CI=1.34-2.05] for those aged 16 to 29), being born abroad (aOR: 2.04 [95%CI=1.19-3.50] for Asia, aOR: 1.57 [95%CI=1.24-1.98] for Africa), having a chronic disease (aOR: 1.29 [95%CI=1.04-1.60]), alcohol abuse (aOR: 2.24 [95%CI=1.73-2.90]), and being IDU (aOR: 1.68 [95%CI=1.05-2.68]). Three-month course treatment with isoniazid plus rifampicin was associated with decreased FCT when compared to 6- or 9-month courses of isoniazid-only (aOR: 0.59 [95%CI=0.45-0.77]). In Lisbon metropolitan area, being born in Africa, and in Porto metropolitan area, alcohol abusing and being intravenous drug user were distinctive factors associated with FCT.

#### Conclusions

Socio-demographic and medical factors associated with FCT may vary by geographical area and should be taken into account when planning interventions to improve LTBI treatment outcomes. This study reinforces that shorter course treatment for LTBI might reduce FCT.

#### Role and outputs:

Alexis main role was principal investigator. He reviewed available scientific literature, designed the study with his project supervisor, prepared-managed and analyzed the data. He wrote the manuscript, discussed and revised with the co-authors and it has been planned to send to an international journal. After that he will reply all the reviewers' questions and make all the required changes. Finally he will disseminate the results.

**Supervision:** Carlos Carvalho with support from Paula Vasconcelos



## **Title: Feasibility of using social media data and other sources of information to support surveillance for infectious diseases: Pilot study for Malaria, Gonorrhoea and Syphilis in Portugal, 2000-2016.**

### **Background**

For different diseases, positive correlations or associations between novel indicators (such as google queries or the number of passengers) and classical indicators (such as number of cases or incidence rates), often coming from official public health organizations, have been described in the scientific literature.

### **Objective**

The aim of this pilot study was to explore novel information sources that could be used to improve public health surveillance systems in Portugal for malaria, gonorrhoea and syphilis.

Specific objectives:

1. Determine the correlation between the number of google queries and annual number of passenger from non-endemic areas and from endemic areas with the number of cases notified of Malaria in SINAVE (Portuguese Information System for Epidemiological Surveillance) and the Malaria annual incidence in Portugal from 2000 to 2014.
2. Determine the correlation between google queries for sexually transmitted disease, gonorrhoea and syphilis with the number of cases notified in SINAVE in Portugal in 2015 and 2016.

### **Methods**

I reviewed scientific literature in PubMed and in google scholar, using terms as : 'internet-based surveillance', 'digital surveillance' or 'epidemic intelligence' or 'google queries' and 'surveillance' or 'outbreak' or 'infectious disease and communicable diseases' or 'vector-borne diseases' or 'sexually transmitted diseases'. All relevant articles were selected and read and further references as well. Information was collected and variables were chosen according to objectives. Data sources were from websites from different institutions: Direção-Geral da Saúde (DGS), Instituto Nacional de Estatística of Portugal, European Centre for Disease Prevention and Control (ECDC), the World Bank and Google trends. We also used data from SINAVE. We used excel 2016 to make the graphics and to calculate the Pearson correlation coefficient to check the possible associations between the different quantitative independent variables and the outcomes (incidences or number of notifications).

### **Results**

We found a positive correlation between the notified number of malaria cases and "Malaria" google queries and between the incidence of malaria in Portugal (all imported cases) and the number of passengers coming from probable endemic areas such as Africa and South America. The notified number of gonorrhoea cases showed a negative correlation with the number of "STI" google queries but also with "gonorrhoea" google queries in 2015. Moreover, the notified number of syphilis cases showed a negative correlation with the number of "STI" google queries in 2016 but also with "syphilis" in 2015.

### **Conclusions and recommendations**

We believe that this pilot study shows some examples of different kind of data that are being used for public health purposes, and specifically, the increasing relevance of internet-based data for epidemic intelligence and big data analysis. This is an exploratory descriptive analysis and further analysis need to be performed in the future to disentangle the associations identified. In addition, the results could be indicating that for some diseases as is the malaria's case, passengers coming from endemic areas should be taken into account. For others, as is the case of sexually transmitted diseases, consideration should be given to including behavioral data in the surveillance systems maybe gathering information from social media.

### **Role and outputs:**

Alexis main role was principal investigator. He prepared-managed and analyzed the data. He wrote the report, reviewed available scientific literature, discussed and revised with his supervisor, frontline

coordinator and other colleagues. Finally, he disseminated the results in a presentation in DGS.

**Supervision:** Paulo Nogueira with the support by Paula Vasconcelos.

## **Title: Notifiable diseases during religious mass gathering in May 2017.**

### **Background**

On May 12 2017 Pope Francis visited the Sactuary of Our Lady in Fátima, mobilizing many pilgrims to the town. The rate of some infectious diseases and several outbreaks of meningitis, gastroenteritis or even blood-borne diseases have been described in other mass gathering religious events, leading to the reinforcement of prevention and control of communicable disease. The aim of this report is to explore the trends of notifiable diseases in Portugal during Pope Francis' visit to Fátima in May 2017, in order to give some insight to establish future preventive measures in similar mass gathering events.

### **Methods**

We analysed data in SINAVE (Portuguese Information System for Epidemiological Surveillance) of notifiable diseases with date of onset of symptoms between 1st May to end of July in Portugal in the three years, 2015, 2016 and 2017. Pearson Chi-square and Fisher's exact tests were performed in 2x2 tables, comparing the number of cases by disease in 2017 compared to previous years. We carried out the analysis first for all cases and then for confirmed cases only.

### **Results**

The number of notifications (both not confirmed and also confirmed) of campylobacteriosis in May to July 2017 were more than the double in 2017 compared to 2015 and 2016 (188 compared to 86 and 94 confirmed cases, respectively) ( $p < 0.001$ ). The increase of more than 50% of salmonellosis cases (non-typhi and non-paratyphi) was also statistically significant in not confirmed and also in confirmed cases again ( $p = 0.02$  and  $p = 0.03$ , respectively) between 2016 (102 cases) and 2017 (153 cases). Parotiditis and Hepatitis A showed increased numbers due to already known outbreaks in Portugal during the study period. The rest of changes on trends in the number of cases in the different notifiable diseases do not show any clear statistically significant increase during this period (2015-2017). In the health region around Fátima, Lisbon Tejo Valley region of Portugal, the cases of Campylobacteriosis and Salmonellosis increased between 2016 and 2017 (19 to 37 for Campylobacteriosis and 43 to 52 for Salmonellosis). Most populated regions of Portugal (Alentejo, Central and North regions) show similar increases. Smaller regions such as are the cases of Algarve, Madeira and Açores did not show the increases mentioned above.

### **Conclusions**

At least two notifiable diseases showed an increase in the most populated regions in Portugal, in this case two gastrointestinal infections such as Campylobacteriosis and Salmonellosis. Further analysis must be carried out to investigate whether these increases were associated with the event. We conclude that epidemic intelligence should be strengthened in mass gathering events to improve early detection of infectious diseases.

### **Role and outputs:**

Alexis main role was principal investigator. He prepared, managed and analyze the data. He wrote the report, discussed and revised with his supervisor, frontline coordinator and other colleagues. Finally, he disseminated the results in a presentation in DGS.

**Supervision:** Paulo Nogueira with support by Paula Vasconcelos

### **Competencies developed:**

Before the fellowship I had some experience in research (basic and epidemiology). The fellowship added the applied epidemiology research to my background and reinforced my experience in research investigation

steps but with a focus in communicable disease. During the fellowship, as a first author and related to activities previously to EPIET fellowship, I wrote two manuscript, discussed and revised with the co-authors. Both manuscripts were published in international journal and presented in international congresses. At the time of writing this portfolio, I had prepared two manuscript drafts in discussion with co-authors and one of them already has been send to an international journals. One project was already presented in ESCAIDE and for the other has been accepted as poster in ESCAIDE'19.

## 4. Communication

### *Publications in peer reviewed journals*

Two developed and published articles in an international journals as a first author related to activities previously to EPIET fellowship:

- 1) Sentís A, González C, Montero M et al. Risk of hospital readmission and associated factors after a positive sample for a multidrug-resistant microorganism. *Eur J Public Health*. 2018 Dec 24. <https://academic.oup.com/eurpub/advance-article-abstract/doi/10.1093/eurpub/cky262/5259048?redirectedFrom=fulltext>  
Role and outputs: Alexis main role was principal investigator. He disseminated the results in the Spanish and Portuguese Epidemiology Societies congress'18.
- 2) Sentís A, Martin-Sanchez M, Arando M, et al. Sexually transmitted infections in young people and factors associated with HIV coinfection: An observational study in a large city. *BMJ Open*. 2019 May 5;9(5):e027245. <https://bmjopen.bmj.com/content/9/5/e027245>  
Role and outputs: Alexis main role was principal investigator. He disseminated the results in the Spanish and Portuguese Epidemiology Societies congress'17.

### *Manuscripts submitted to peer reviewed journals (in review process)*

- Failure to complete treatment for Latent tuberculosis infection in Portugal, 2013-2017: geographic, socio-demographic and medical associated factors (in Applied epidemiology research): submitted (under review).

\*Manuscripts in elaboration (not submitted):

- Learning points from a large hospital outbreak of Legionnaires' disease in Lisbon, 2017 (at final stage of elaboration).
- Decline of tuberculosis notification rate in different population groups: A time series analysis in Portugal, 2010-2017 (in surveillance).

### *Conference presentations*

Three presentation in international congresses:

- Poster presentation for ESCAIDE'18: "Investigation of a large hospital outbreak of Legionnaires' disease in Lisbon, Portugal, October to November 2017" (in Outbreaks). Malta, November 2018.
- Oral communication at international congress of the Spanish and Portuguese Epidemiology Societies congress'18: "*Gran brote hospitalario de enfermedad del legionario en Lisboa, Portugal, octubre-noviembre de 2017*" (in communication). Presented in Lisbon, September 2018.

- Oral communication for Spanish and Portuguese Epidemiology Societies congress'18: "*Factores asociados al reingreso hospitalario en pacientes con una muestra positiva para un microorganismo multiresistente*" (in communication). Presented in Lisbon, September 2018.
- Poster presentation accepted for ESCAIDE'19 (Stockholm, Sweden): "Decline of tuberculosis notification rate in different population groups: A time series analysis in Portugal, 2010-2017" (in surveillance).

## Reports

1. The effect of Interventions to improve EWARS reporting and implementation, Beira (Mozambique) (surveillance project 1)
2. Gastrointestinal outbreak in a National Guard training centre in Alentejo in October 2018 (outbreak project 2).
3. Sampling strategy for measles confirmation outbreak in a refugee camps (Bangladesh) (outbreak project 3).
4. Feasibility of using social media data and other sources of information to support surveillance for infectious diseases: Pilot study for Malaria, Gonorrhoea and Syphilis in Portugal, 2000-2016 (applied research project 2).
5. Notifiable diseases during religious mass gathering in May 2017 (applied research project 3).
6. Support in response to a Diphtheria outbreak in refugee camps in Cox's Bazar (Bangladesh) (GOARN report, in other activities).
7. Support in response to a Cholera outbreak in Beira (Moçambique) after cyclone Idai (GOARN report, in other activities).

## 5. Teaching activities

### **Title: Classes, exams and seminars delivering epidemiology and public health related subjects, to nurse students at the Portuguese Catholic University in Lisbon, June-July 2018.**

Alexis gave four lectures of four hours each, including facilitating four case studies related with the subject of the previous lecture for a 30-target audience at the second academic year of Nursing. He developed himself and delivered classes, case studies, seminars and exams.

These were the lectures- seminars subjects:

1. What is public health?.
2. Causality and causal inference.
3. Introduction to epidemiological surveillance .
4. 10 steps from an outbreak investigation.
5. The essential steps in a research investigation – things to take into account in the research protocol elaboration.
6. Community-Based Interventions.

Each lecture-seminar had the purpose to give a clear and generic message of each subject taking into account that this was the first time that the students were exposed to epidemiology/public health subjects. In addition he tried to stimulate the students interest in epidemiology and public health and develop critical thinking, "pushing" them to think of their own experiences that could be related. Before the exam he took a 3 hour seminar with "typical" exam questions to be answered by all the students together. This

was in order to integrate the different subjects, raise new questions and build further the students' knowledge. The main focus of the of the evaluation, through written examination, was to assess whether the students could identify the main ideas and critical points in the subjects given in class.

**Supervisor(s):** *Andreia da Silva Costa*

### **Educational outcome:**

I believe that this activity had an enormous value in my knowledge of teaching. I think that it was a great opportunity to experience performing all the essential points as a teacher in an university environment: I prepared material, elaborated and delivered classes, seminars and exams. I think that I gained confidence in all the different processes of teaching and, above all, I realize that the most important is to focus on your audience, on their needs and in the way to keep them interested and engaged.

## **6. Other activities**

### **Title: Support in response to a Diphtheria outbreak in refugee camps in Cox's Bazar (Bangladesh)**

Since 25 August 2017, targeted violence against Rohingya communities in Rakhine State, Myanmar, had forced 671,000 people, mostly women and children, to flee their homes and seeking asylum in Bangladesh. This exodus had become one of the fastest growing refugee crises in the world. The Government of Bangladesh opened its borders to Rohingya refugees and continues to lead the humanitarian response. In support of these efforts, the humanitarian community has rapidly scaled up its operations (JRP for Rohingya humanitarian crisis, March-December 2018).

Alexis was deployed to Cox's Bazar (Bangladesh) from 6 till 27 March 2018, to join and support the Epi team from WHO office in Cox's Bazar. During his stay, his major activities and outputs completed in collaboration with other WHO team members, included:

1. Elaboration of reports about the current situation for mumps and measles to inform partners or other WHO teams. By arrival in March 2018, a huge measles outbreak was ongoing since January in the camps. In the meantime a Mumps also occurred in the camps. The mumps outbreak reached the peak during his stay. In this context, elaboration of Sitrep and up-to-date report for measles and mumps.
2. Lab sampling strategy elaboration to verify the occurrence of a measles outbreak.
3. Coordination and participation in the elaboration of the "outbreak investigation toolkit" for partners for use in future outbreaks.
4. Support the Health Sector Coordination team in the elaboration of the plan and material for the simulation exercise (table-top) for monsoon season preparedness provided to governmental actors, NGO's and partners held on March 22 in Hotel Ocean Paradise in Cox's Bazar.
5. Finalize the case report forms for priority conditions reported through EWARS (WHO's Early Warning, Alert and Response System).
6. Support the active finding for Diphtheria cases in the Host community among contacts of confirmed cases beyond the camp community.
7. Participation in the Epi and case management discussion. This included updating report case of Diphtheria (Refugee camps and host community), Acute Jaundice Syndrome (mostly Hepatitis A) and acute watery diarrhoea (investigation for Cholera: discarded through case report forms and interviews with clinicians).

## **Title: Support in response to a Cholera outbreak in Beira (Moçambique) after cyclone Idai.**

Cyclone Idai made landfall on 14–15 March 2019 directly affecting 1.8 million people in six provinces of Mozambique. It displaced 109,199 people in Sofala and 21,937 people in Zambezi, Tete and Manica. As of 30 March 2019, the Ministério de Saúde (MISAU) reported that 79 health facilities were severely damaged or completely destroyed (28 in Sofala, 17 in Manica and 31 in Zambezia). This led to severe disruption of the provision of health services. Facility destruction had been further compounded by inaccessibility due to destruction of roads and bridges, as well as a loss of electricity and running water. According to the Government, reports of acute watery diarrhea were increasing as of April 9th.

In the context of the response to cyclone Idai, Alexis was deployed to Beira (Mozambique) from 9/4/2019 to 16/5/2019, to join and support the Epi team from WHO office in Beira. During his stay, his major activities and outputs completed in collaboration with other WHO team members, included:

1. Member of the WHO – Epi team task force coordinating and participating in the intervention, lead by the National Institute of Health (INS-CIOB) and Provincial Health Directorate (DPS), to improve EWARS reporting and implementation in health facilities in the four most affected districts by cyclone Idai in Sofala province.
2. Elaboration of the report “The effect of Interventions to improve EWARS reporting and implementation” requested by INS-CIOB.
3. Provide training for district-province surveillance officers in order to improve EWARS reporting and implementation in the four most affected districts by cyclone Idai in Sofala province. Event held on Tuesday 16th of April at DPS, Beira.
4. Elaboration of SOP for alert management in Sofala Province requested by INS-CIOB.
5. Support the CDC team in the strategy for setting up outbreak investigation teams and creating outbreak investigation kits lead by INS-CIOB.
6. Participation and support in alerts data analysis in Sofala Province requested by INS-CIOB.
7. Participation and support data analysis, the elaboration of the Epi bulletins and other tasks as member of the WHO epiteam when required by INS-CIOB.
8. Active participation in the epidemiology and surveillance task force meeting lead by INS-CIOB, including presentation of results regarding two and six.

## **Title: Analysis of routine notification data from the National Surveillance System (SINAVE)**

For Legionnaire’s Disease: Alexis analysed information available on the national surveillance system (SINAVE) and through Epidemic Intelligence in order to confirm the existence of an outbreak in the north region. No outbreak was confirmed.

For listeriosis: Alexis analysed data of notified cases trying to identify clusters according to the information given by the national Lab. With the information available, it was not possible to confirm the clusters.

For campylobacteriosis: Alexis attempted to identify common variables to match SINAVE data coming from both epidemiological and laboratorial notification. With the available variables, the match was only possible for a very small number of cases.

For HIV and Tuberculosis: Alexis tried to match data from four different systems to get data of coinfection. With the available variables, the match was only possible for a very small number of cases.

For dengue and arbovirosis: Alexis analysed data, including with georeferencing in SINAVE from 2015 and performed a descriptive analysis. Since the implementation of electronic surveillance system, an average of 11 imported confirmed cases per year were reported.

For different diseases: performing time series analysis to describe trends and seasonality and to set up thresholds and alerts for Salmonella, Legionella, Mediterranean spotted fever and whooping cough in Portugal.

For measles: daily updating information in measles outbreak in Lisbon and performing reports for decision making during the outbreak.



## **Title: Participation in weekly meeting on Epidemic Intelligence – RONDA**

Regular participant of the RONDA (Reunião sobre Observações, Notícias, Dados e Alertas), weekly meeting organized by the Public Health Emergencies Centre (CESP) of DGS to share most alerts detected within Epidemic Intelligence activities. Joining the Epidemic Intelligence team and achieving progressive autonomy on handling tasks in the epidemic intelligence screening and filtering information and its relevance at local, regional and national level. Following events at international level and the assessment of its impact at national level as well as national events with a potential cross border potential. Examples includes: Crimea Congo Haemorrhagic Fever in Spain, Ebola in Rep Democratic of Congo, suspected Creutzfeldt-Jakob Variant in neurological patient, dengue in France and Spain, West Nile Fever in human and equids in Europe, Leptospirosis in municipality parks in Lisbon, Listeriosis in South Africa, Paralytic shellfish poisoning in Spain and Portugal. Also, he had the opportunity to support the threat assessments performed by the team in several of the alerts detected.

## **7. EPIET/EUPHEM modules attended**

1. EPIET Introductory Course, Spetses, Greece, 25h September-13th October 2017
2. EPIET Outbreak Investigation module, Berlin, Germany, 4th-8th December 2017
3. EPIET Multivariable Analyses module, Nicosia, Cyprus, 16h-20h April 2018
4. EPIET Rapid Assessment module, Athens, Greece, 14-19th May 2018
5. EPIET Project Review module, Lisbon, Portugal, 27th-31st August 2018
6. EPIET Time Series Analyses module, Brussels, Belgium, 5th-9th November 2018
7. EPIET Vaccinology module, Rome, Italy, 24th-28th June 2019
8. EPIET Project Review Module, Prague, Czech Republic, 26th August-29th August 2019

## **Supervisor's conclusions**

Being a public health doctor, Alexis had a great knowledge of best use of epidemiology and tools to collect and analyse data. He focused on how best improve his skills on understanding processes and better interpret data, besides the quantitative aspects. He showed to be committed with the tasks provided and how to achieve goals expected. He shown a great facility to deal with data and data base and how best use the electronic tools to produce information and knowledge. He succeeded to adapt to several changes in the hierarchy of the department of Information and Analysis and the Division of Epidemiology and Statistics and keep the track of the relevant task of the fellowship without losing the vision of contributions to the DGS overall work in Essential Public Health operations. He's engagement of the Legionella outbreak and in the deeper analysis he tried to performed in the National Surveillance System (SINAVE) are example on how dedicated he is in the matters of surveillance and data analysis. We are sure he can best use further in his professional life the increased knowledge and skills achieved with the EPIET fellowship. We are certain he can contribute for improving surveillance and outbreak investigations being that local, regional, national or international level.

## **Coordinator's conclusions**

During his two years at Directorate-General of Health (DGS), Lisbon, Alexis has gained considerable skills in field epidemiology, and has met all the required competencies. This is a reflection of Alexis' dedication to the programme but also the support he has received during this time from his primary site supervisor and project supervisors. As well as experiencing many aspects of field epidemiology in Portugal, including getting involved in investigating a large legionella hospital outbreak, Alexis has taken part in two overseas missions in response to two

complex public health emergencies. He has carried out a variety of surveillance and applied research projects and has presented at international conferences. This has all been undertaken whilst completing his public health training and balanced with bringing up a young family. It has been a pleasure getting to know Alexis and I wish him every success in the next chapter of his career in public health.

## Personal conclusions of fellow

I truly believe that EPIET is a unique program in field epidemiology in Europe. After my medical residence in Public health, the fellowship was a great opportunity to go further in my knowledge and complete or develop my skills and competencies in surveillance, outbreaks, applied research, teaching and communication in communicable diseases. I think that the fellowship provided me the knowledge to autonomously manage and support solving most of the situations that can occur working in field epidemiology or at least provided me the essential tools to feel confident enough to find the way to work in the right direction. In addition, it brings you the valued opportunity to find support in a European network of highly experienced professionals and colleagues. Actually, the fellowship is a great opportunity to work in communicable diseases epidemiology and work side by side with other colleagues all around Europe as well as collaborating with governmental and non-governmental organizations with national and international interest in the prevention and control of communicable diseases all over Europe and worldwide in the international missions. I truly believe that EPIET is a great opportunity for anyone who wants to grow in their knowledge in field epidemiology in communicable diseases, and believes that cooperation between professionals and countries is essential to promoting the development of global health and for achieving the ultimate public health goal to improve the health of the population worldwide.

## Acknowledgements

I want to remark the support not only in the professional, but also on the personal issues of all from below:

I would like to thank Paula Vasconcelos for all her support as a supervisor. Although working in another department, she was able to guide, facilitating my fellowship development in a direct way. She has been always available to support projects taking into account my preferences.

I want to thank Daniel Thomas, my frontline coordinator for his very good and helpful advice and support to solve problems, organize and improve the projects and any other issue that came across during the fellowship.

I would like to thank Paulo Nogueira, Graça Lima and Rita Sá Machado (department of Information and Analysis) for hosting me in the department, and giving always all their kind support and help during my two years fellowship. In addition, I want to mention the strong support in some of my main projects as a project supervisor that I received from Carlos Carvalho and to thank all the staff from DGS that, when necessary, timely help me to solve all the problems that came across the different process during the fellowship.

I would like also thank Marion Muehlen, the Faculty Office, all my colleagues from cohort 2017 and from other cohorts, the coordinators and supervisors during the modules, Epiet Alumni Network (EAN), and all the people who work or collaborate in making possible the EPIET programme. It was a great pleasure to be an EPIET.

Last but not least I want to thank my family (Carola, Lucas and Julieta) for being so patient, loving and supportive during all the process.