FELLOWSHIP REPORT

Summary of work activities

Annalisa Quattrocchi
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 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.

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;

This portfolio does not represent a diploma. Fellows receive a certificate listing the theoretical modules attended and the 23-month training. Additionally, if all training objectives have been met, they receive a diploma.

Stockholm, September 2018

- 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.

Pre-fellowship short biography

Annalisa Quattrocchi is a Ph. Doctor in Translational Biomedicine and has a Masters in Human Biology.
She has previously worked at the University of Catania, Italy as post-doctoral fellow and at the European Centre for Disease Prevention and Control (ECDC), Stockholm, Sweden focusing on epidemiological studies on non-communicable disease, determinates of health inequalities, and healthcare-associated infections and antimicrobial resistance.

Fellowship assignment: Intervention Epidemiology path (EPIET)

On 11 September 2017, Annalisa started her EPIET fellowship at the Health Protection Surveillance Centre (HPSC), Dublin, Ireland, under the supervision of Margaret Fitzgerald (Senior Surveillance Scientist) and co-supervisor Suzanne Cotter (Specialist in Public Health Medicine, Head of the Vaccine Preventable Disease Team). This report summarises the work performed during the fellowship.

Methods

This portfolio demonstrates the competencies acquired during the ECDC Fellowship, EPIET path, by working on various projects, activities and theoretical training modules.

Projects included epidemiological contributions to public health event detection and investigation (surveillance and outbreaks); applied epidemiology field research; teaching epidemiology; summarising and communicating scientific evidence and activities with a specific epidemiology focus.

The outcomes include publications, presentations, posters, reports and teaching materials prepared by the fellow. The portfolio presents a summary of all work activities conducted by the fellow, unless prohibited due to confidentiality regulations.

Results

The objectives of these core competency domains were achieved partly through project or activity work and partly through participation in the training modules. Results are presented in accordance with the EPIET core competencies, as set out in the EPIET scientific guide[1].

Fellowship projects

1. Surveillance

Evaluation of the Invasive Meningococcal Disease surveillance system in Ireland, 2012-2017

Supervisors: Suzanne Cotter (Specialist in Public Health Medicine, Head of the Vaccine Preventable Disease Team, EPIET co-supervisor) and Margaret Fitzgerald (Senior Surveillance Scientist; EPIET supervisor), HPSC

The surveillance system for Invasive Meningococcal Disease (IMD) in Ireland is a clinical and laboratory-based, comprehensive, enhanced and passive surveillance system. Details of IMD cases are held in the national integrated electronic Computerised Infectious Disease Reporting (CIDR) system.

[1] European Centre for Disease Prevention and Control. European public health training programme. Stockholm: ECDC; 2013. Available from: http://ecdc.europa.eu/en/publications/Publications/.pdf

The objectives of the evaluation were to assess completeness of data and timeliness of notifications, sensitivity of CIDR system in detecting IMD deaths, simplicity, usefulness, and flexibility of the system.

We extracted IMD cases reported in CIDR between 2012-2017 to evaluate the level of field completion of selected variables, notification delay (time between onset and notification) and laboratory reporting delay (time between specimen collection and laboratory notification), and sensitivity of mortality through probabilistic record linkage with the national death register. We conducted an online survey among stakeholders evaluating, on a 5-point scale, simplicity, usefulness, and flexibility of the system.

Overall, 467 cases were reported. Completeness of age, serogroup, vaccination status and outcome was 100%, 97%, 87%, and 82%, respectively. Completeness of vaccination status increased from 2012-2014 (57%) to 2015-2017 (90%). In total, 47% of cases were notified within three days, but only 32% of results were reported from laboratories within seven days. Sensitivity of CIDR for mortality outcome was 86%.

Respondents' agreement on simplicity, usefulness, and flexibility was 62%, 46% and 6%, respectively. Users asked for more training, suggested automatic updating of laboratory fields and timely inclusion of enhanced variables on CIDR.

Data completeness and sensitivity of the system is very high, however, timeliness of electronic laboratory notifications is sub-optimal. We recommend additional resources to reduce delays in laboratory notifications and to identify technical solutions to improve CIDR flexibility in order for the electronic system to support a timely public health response.

Role: Annalisa was the principal investigator; she wrote the protocol (27), exported the data from the national database, developed a survey questionnaire and data entry mask, distributed it to system users nationally, performed data cleaning and data analysis of the national surveillance data and questionnaire responses and wrote the report (14), and the manuscript (2, planned). Annalisa presented the work as a poster at the Irish Faculty of Public Health Medicine Winter Scientific Meeting 2018 (19) and at ESCAIDE 2019 (23).

Design an enhanced surveillance system for Plague in Ireland

Supervisor: Mary O Riordan (Specialist in Public Health Medicine, Head of the Emergency Planning Team), HPSC

Plague is a notifiable disease in Ireland, but there were no systems in place for the surveillance of cases or the monitoring of contacts. Following the outbreak of plague in Madagascar in 2017, and the risk, although low, of receiving an imported case in the EU, we prepared a toolkit with guidance for healthcare professionals and set-up a surveillance system.

With regard to the surveillance system, the objectives were: i) to design the surveillance system framework by defining objectives, type of surveillance, and case definitions, and ii) to develop a new enhanced surveillance form.

The surveillance system aims to promptly identify and manage suspect cases of plague and their contacts, to ensure prompt identification of clusters/outbreaks, and to monitor trends in the burden of the disease. It is a comprehensive, enhanced and passive surveillance system, and since Plague is a notifiable disease, reporting is mandatory. Surveillance is based on clinical and laboratory notifications. Criteria for case definition were adopted from the 2012 Case definitions for Notifiable Diseases in Ireland.

We conducted a literature search to inform discussions on enhanced surveillance variables and drafted an enhanced surveillance form based on equivalent forms available elsewhere. We developed a paper-based form and a MS Excel database reflecting the variables on the form. We created a web page containing all guidance and surveillance documents, available at: http://www.hpsc.ie/a-z/zoonotic/plague/.

The Health Protection Surveillance Centre will alert Departments of Public Health and forward the link to the paper-based form which should be completed if and when cases arise. From the completed forms returned data will be collated in the electronic database. Descriptive analyses will be conducted and reports produced for relevant stakeholders.

Role: Annalisa was co-investigator; she developed the surveillance form (29) and a database in Microsoft Excel to collect information on cases. Annalisa wrote the final report (7) on the development of the surveillance system.

Point Prevalence Survey of Hospital-Acquired Infections and Antimicrobial Use in Adult Intensive Care Units, Ireland 2017

Supervisors: Karen Burns (Consultant Microbiologist), Stephen Murchan (Surveillance Scientist), Microbiology Team, HPSC

Every five years, Ireland conducts a national point prevalence survey (PPS) to assess the prevalence of hospital-acquired infections (HAI) and antimicrobial use (AMU) in acute care hospitals. The results of the PPS provide useful information in terms of HAIs and antimicrobial use, especially for Intensive Care Units (ICU), where a routine surveillance programme has never been implemented.

The aim was to calculate HAI and AMU prevalence, for ICUs participating to PPS 2017 and to compare results with the PPS conducted in 2012. The surveys were conducted in May 2012 and 2017, using a standardised protocol devised by the European Centre for Disease Prevention and Control and HAI were defined using standardised European definitions of infection.

In 2017, HAI prevalence in ICU was four times higher than in the overall population (24% vs. 6%) and AMU prevalence in ICU was 70.4%, versus 39.7% in the overall population. HAI prevalence was lower than 2012 (25% vs. 27%), although not statistically significant after adjusting for differences in patient case mix. Factors associated with HAI differed between the two surveys. Pneumonia was the most prevalent HAI in both PPS (42% and 52%), followed by surgical site infection in 2012 and bloodstream infections in 2017. Compared to 2012, in 2017 the AMU prevalence was lower (67% vs. 76%), the proportion of antimicrobials for which there was no documented indication fell from 23% to 8% and the percentage of antimicrobials compliant with local guidelines increased from 76% to 84%.

Although positive findings were shown, HAI remain an important target for improvement, and more accurate information on HAI burden and variation over time is lacking, in Ireland. We recommend resourcing and implementing a routine HAI-ICU surveillance programme, to estimate incidence and monitor trends of HAI in ICUs.

Role: Annalisa was the principal investigator (for the purposes of the 2017 PPS in ICU); she performed data cleaning and data analysis of the surveillance data and wrote the final report (10). Annalisa presented the work as a poster at ESCAIDE 2019 (24).

New measles outbreak case activity investigation form

Supervisor: Suzanne Cotter (Specialist in Public Health Medicine, Head of the Vaccine Preventable Disease unit, EPIET co-supervisor), HPSC

During two measles outbreaks occurred in Ireland in autumn 2017, we conducted investigations to identify the likely source of or venue for the measles infection and the opportunities to transmit while infectious and identify epi-links. The investigation form recommended for use during these outbreaks was a "21 day activity" investigation form, suitable for measles and rubella infections.

However, public health professionals seldom used this form, because it was not considered user-friendly. Thus, driven by the fragmented information on exposure history and contacts gathered during the measles outbreaks in autumn 2017, we developed and implemented a new user-friendly measles case activity investigation form for confirmed measles cases in order to conduct network analysis during outbreak investigations. The network analysis will help to identify potential place of exposure and likely epi-links and contacts and therefore assist in the control and prevention of further measles transmission.

We developed a new Microsoft Excel electronic form following a review of internationally used measles cases activity investigation forms. We piloted the electronic tool by entering data collected with the previous form and other information gathered through case investigation. We then shared the new form with Departments of Public Health and recommended that it would be adopted in further measles outbreak investigations.

The use of the new form resulted in the detection of additional epi-links among cases, although it did not assist in identifying the overall chain of transmission. In addition, the electronic form represents a useful database for case activity investigation, separate from the national electronic notification system (CIDR), to be used during investigation of confirmed measles cases during outbreak investigations.

Role: Annalisa was the principal investigator; she developed the electronic form (Microsoft Excel), performed data entry and data analysis.

2. Outbreak investigations

Measles outbreak in Ireland, 2017

Supervisor: Suzanne Cotter (Specialist in Public Health Medicine, Head of the Vaccine Preventable Disease Team, EPIET co-supervisor), HPSC and Mary Ward (Specialist in Public Health Medicine), Department of Public Health East

Ireland has made progress towards measles elimination, with no autochthonous cases reported since 2014. National MMR1 coverage in 2017 was still suboptimal at 92%, with regional variations between 88 and 95%. And pockets of unvaccinated in vulnerable groups are still present. In October 2017, two simultaneous measles outbreaks were identified in two adjacent regions in Ireland (East and North-East).

A joint Outbreak Control Team was convened to investigate and control the outbreak. We applied the national case definition for suspect cases resident in the outbreak areas between October-December 2017. We undertook active case finding and enhanced surveillance to identify risk factors for infection, clinical course and transmission pathways. Genotyping was performed for all confirmed cases. We piloted the new excel version of the case activity investigation form developed on this occasion (see surveillance project above "New measles outbreak case activity investigation form") to gather information on potential places of exposure, epi-links and identify contacts.

Overall, 186 suspect cases were investigated, and 22 were confirmed. Of these, 13 were notified in the Dublin north city region (East), mostly in children under 5 years of age (54%). High rates of hospitalisation were reported (54%). In the North-East, nine confirmed cases were identified, most of which were from ethnic minority groups (67%); 56% of all cases were under 15 years of age. In both areas, most cases were unvaccinated (50% and 71%, respectively). All genotyped cases were B3. Gaps in information gathered through the case activity investigation did not enable us to establish all epi-links among cases.

The outbreak was contained through intensified vaccination of at-risk groups and communications with stakeholders. However, despite intensive case investigation and the geographical/temporal links among cases, the source of infection and epidemiological links between subsequent cases were not determined. This outbreak highlighted gaps in immunity in specific areas and populations, the need to improve vaccine uptake and high levels of measles awareness to facilitate prompt notification and timely investigation of cases, thus preventing further spread.

Role: Annalisa was a co- investigator of the outbreak; she participated in the Outbreak Control Team meetings, performed data cleaning and analysis and wrote two interim reports in HPSC's monthly bulletin Epi-Insight (4-5) and the final report (8). Annalisa presented the work as an oral presentation at the Irish Faculty of Public Health Medicine Summer Scientific Meeting 2018 (17) and as a poster at ESCAIDE 2018 (18).

Outbreak of Acute gastroenteritis at an adventure centre, Ireland, May 2019

Supervisors: Patricia Garvey (Surveillance Scientist), Paul McKeown (Specialist in Public Health Medicine, Head of Gastrozoonotic and Vectorborne Disease Team) and Margaret Fitzgerald (Senior Surveillance Scientist, EPIET supervisor), HPSC

On May 14th 2019 cases of acute infectious gastroenteritis, among visitors and staff at an adventure centre in the North-East area of Ireland, during 11th-12th May 2019, were notified. The Outbreak Control Team initiated investigations to identify the mode and the vehicle of transmission and control the outbreak.

We defined case definition and interviewed initial cases with a trawling questionnaire on food history and activities, to assist with hypothesis generation. We conducted a cohort study and sent an electronic questionnaire via email to all visitors and staff. Stool specimens from symptomatic individuals, food and water samples from the adventure centre were submitted for microbiological testing.

Forty-six responded to the questionnaire (response rate: 18%) and 27 met the case definition. The epidemic curve suggested a point-source outbreak. Symptoms were mild and short lived. Cases were mainly adults (70%). Due to a low response rate, we used odds ratios (ORs) as a measure of association. On multivariable analysis consumption of beef lasagne was independently associated with illness (aOR=11; 95%CI: 1.1-114.7). However, beef lasagne was consumed only by 40% of the cases, all adults. Microbiological investigations did not identify any pathogen.

No further cases linked to the adventure centre were reported. Although, consumption of beef lasagne may be a possible vehicle of transmission, it can explain less than half the cases, and other transmission routes and/or vehicles of transmission may have played a role in this incident. In likely point-source outbreaks involving a well-defined cohort, we recommend that an outbreak specific study questionnaire be developed promptly following recognition of the outbreak and the analytical study conducted in as timely a manner as possible to maximise the likelihood of obtaining robust epidemiological information and increase the chances of identifying a vehicle of transmission.

Role: Annalisa was a principal investigator of the analytical study; she participated in the Outbreak Control Team meetings, wrote the analytical study protocol (31), developed the study questionnaire and data entry mask, exported the data, performed data cleaning and data analysis and wrote the final report (15).

3. Applied epidemiology research

Uptake of seasonal influenza vaccine in the adult Irish population in 2016/17 and 2017/18 and uptake of seasonal influenza and pertussis vaccines in pregnant women in Ireland in 2017/18

Supervisors: Suzanne Cotter (Specialist in Public Health Medicine, Head of the Vaccine Preventable Disease Team, EPIET co-supervisor) and Margaret Fitzgerald (Senior Surveillance Scientist, EPIET supervisor), HPSC

Ireland recommends influenza vaccination for those who are at increased risk of influenza-related complications (e.g. ≥65 years of age and pregnant women). Pertussis vaccine is also recommended in pregnant women. The aim of these studies were to assess vaccines uptake and factors associated with vaccination during the 2016/17 and 2017/18 influenza season in Ireland using an omnibus survey, in the absence of a national immunisation registry.

We conducted face-to-face omnibus surveys, with quota sampling, among a nationally representative sample of individuals ≥18 years. Sample sizes were calculated based on previous findings. We collected socio-demographic characteristics, self-reported vaccination status, awareness of vaccine campaigns, and attitudes towards vaccination. Sample was weighted to ensure representativeness with the target population. We performed univariate and multivariable regression analyses.

Seasonal influenza uptake among people aged 65 years and over was 64.5% in 2016/17 and 66.7% in 2017/18. In both editions, significant differences in vaccine uptake were detected among regions. GP recommendation was reported as one of the main reasons for receiving vaccine. In 2017/18, Influenza and pertussis vaccine uptake during pregnancy was 61.7% and 49.9%, respectively. Awareness of vaccine campaign and socio-economic status (SES) were associated with both influenza and pertussis vaccine uptake. Moreover the association between SES and vaccines uptake differed by awareness. Province of residence was associated with pertussis vaccine uptake only. GP recommendation was the main reason for receiving influenza vaccine (39.2%), and 71.8% of women were recommended pertussis vaccination from their GPs.

The survey reports moderate uptake of vaccines among risk groups, highlights the role of GPs as trusted source of information, positively influencing vaccine uptake, however it shows inequalities in uptake by regions and SES. We advocate engagement with GPs and implementation of tailored interventions in less advantaged groups.

Role: Annalisa was co-investigator in 2016/17 and principal investigator in 2017/18 studies; she updated the study protocol, amended the study questionnaires, performed data cleaning and data analysis, wrote the reports (6, 10, 11, 12) and the manuscript (1). Annalisa presented the work as oral presentation at the Irish Faculty of Public Health Medicine Summer Scientific Meeting 2018 (16) and Winter Scientific Meeting 2018 (20).

Impact of antimicrobial and alcohol-based hand rub consumption on the incidence of hospital-acquired *Clostridioides difficile* infection in Ireland, 2013-2017

Supervisors: Karen Burns (Consultant Microbiologist) and Ajay Oza (Surveillance Scientist), Microbiology Team, HPSC

Clostridioides or *Clostridium difficile* infection (CDI) may be acquired in hospital and is associated with high morbidity and mortality. Broad-spectrum antimicrobial exposure is a known risk factor for CDI. We investigated the temporal effect of antimicrobial consumption (AMC) on the incidence of new hospital-acquired CDI (HA-CDI) in Ireland, to guide hospitals to set priorities for AMC and prevent CDI.

We linked new HA-CDI (2013-2017) cases with quarterly AMC data (from 2012) from the respective national surveillance systems. We expressed AMC as defined daily dose (DDD) and all rates per 1,000 bed days used (BDU). We conducted an ecological study with multi-level time series analysis, allowing for variability between hospitals, trends, seasonality and AMC in previous quarters. We calculated adjusted incidence rate ratios (aIRR), per unit increase in AMC rate, using negative binomial regression.

There were 3,608 new HA-CDI cases in 31 public hospitals in the study period. Average annual HA-CDI incidence rates varied from 0.22 (2013) to 0.20 per 1,000 BDU (2017) and total AMC rates from 885 (2012) to 865 DDD/1,000 BDU (2017). Within the same quarter, HA-CDI rates increased with consumption of combinations of penicillins, including beta-lactamase inhibitors (aIRR=1.001; p=0.026), third-generation cephalosporins (aIRR=1.06; p=0.035), and lincosamides (aIRR=1.14; p=0.010). Previous consumption of carbapenems (aIRR=1.04; p=0.046), was also associated with increased HA-CDI incidence. No association with fluoroquinolones was found.

Increased consumption of beta-lactams and lincosamides was associated with increased HA-CDI incidence. The lack of association with fluoroquinolones may reflect a national reduction in consumption since 2009. We recommend using these findings to inform and tailor antimicrobial stewardship initiatives, coupled with continued AMC and CDI surveillance in hospital patients.

Role: Annalisa was the principal investigator; she wrote the study protocol (28), performed data extraction, cleaning and analysis, and wrote the manuscript (3; planned). Annalisa presented the work as oral presentation at ESCAIDE 2019 (25).

4. Communication

Publications

Publications in peer reviewed journals

1. Quattrocchi A, Mereckiene J, Fitzgerald M, Cotter S. Determinants of influenza and pertussis vaccine uptake in pregnant women in Ireland: a cross-sectional survey in 2017/18 influenza season. Vaccine. 2019. pii: S0264-410X(19)31196-X. doi: 10.1016/j.vaccine.2019.09.008

Manuscripts being drafted for peer-review journals

2. Quattrocchi A, Pezzotti P, O'Lorcain P, Fitzgerald M, Cotter S. Evaluation of the invasive meningococcal disease surveillance system in Ireland, 2012-2017. Manuscript to be submitted to the Irish Medical Journal (November 2019).
3. Quattrocchi A, Oza A, Karagiannis I, Mitchell T, Fitzgerald M, Burns K. Association between antimicrobial consumption and hospital- *Clostridioides difficile* n Ireland, 2013-2017. Manuscript to be submitted to Infection Control & Hospital Epidemiology Journal (November 2019).

Reports

4. Quattrocchi A, Cotter S, Gee S, Ward M, Ennis O, Kavanagh P, Quintyne KI, Brabazon E, on behalf of the OCT group. Measles outbreak in Ireland. Report in Epi-Insight HPSC website, December 2017. Available at http://ndsc.newsweaver.ie/epiinsight/2xp4434lh14imcmkeer4wk?a=1&p=52679960&t=17517774
5. Cotter S, Quattrocchi A, Gee S, Ward M, Ennis O, Kavanagh P, Quintyne KI, Brabazon E, on behalf of the OCT group. Measles outbreak 2017 - update. Report in Epi-Insight HPSC website, January 2018. Available at http://ndsc.newsweaver.ie/epiinsight/ovifbvm1o6r?a=1&p=52792563&t=17517774

6. Quattrocchi A, Mereckiene J, Fitzgerald M, Cotter S. Influenza and pertussis vaccine uptake in pregnant women, Ireland 2017-2018. Report in Epi-Insight HPSC website, August 2018. Available at http://ndsc.newsweaver.ie/epiinsight/157992d5qar?a=1&p=53699216&t=17517774

7. Enhanced Surveillance system for plague in Ireland of Plague. Final Report.

8. Two measles outbreaks in HSE East and HSE North East of Ireland, between October and December 2017. Outbreak Report. May 2018. HSE Ireland [internal report].

9. Quattrocchi A, Murchan S, Murphy H, Burns K. Point Prevalence Survey of Hospital-Acquired Infections and Antimicrobial Use in European Acute Care Hospitals. Intensive Care Unit Report, May 2019. Available at: https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hospitalpointprevalencesurveys/2017/nationalppsreports/PPS%202017%20Adult%20ICUs%20FINAL%20290519.pdf

10. Quattrocchi A, Mereckiene J, Fitzgerald M, Cotter S. Uptake of the Seasonal Influenza Vaccine in the Irish Adult Population in 2016-2017: a face-to-face omnibus survey. HPSC Report. June 2018

11. Quattrocchi A, Mereckiene J, Fitzgerald M, Cotter S. Influenza and Pertussis vaccination during pregnancy Omnibus survey, Ireland, 2017-2018. HPSC Report. July 2018

12. Quattrocchi A, Mereckiene J, Fitzgerald M, Cotter S. Uptake of the seasonal Influenza vaccine in the Irish adult population, 2017-2018: a face-to-face omnibus survey. HPSC Report. August 2018

13. Arnott J, Quattrocchi A, Domegan L, Huntm M, Flanagan P, O Donnell J. Quadrivalent Influenza Vaccine Review, November 2018. HPSC report. November 2018

14. Quattrocchi A, O'Lorcain P, Fitzgerald M, Cotter S. Evaluation of the Invasive Meningococcal Disease (IMD) surveillance system in Ireland, 2012-2017. HPSC report. August 2019

15. Outbreak of acute infectious gastroenteritis linked to an adventure centre, Ireland, May 2019. Outbreak Report. July 2019. HSE Ireland [internal report]. August 2019

Conference presentations

16. Quattrocchi A, Mereckiene J, Fitzgerald M, Cotter S. Moderate uptake of influenza and pertussis vaccination in pregnant women in Ireland, 2017-18. Oral presentation. Irish Faculty of Public Health Medicine Summer Scientific Meeting, May 2018, Dublin, Ireland.

17. Quattrocchi A, Cotter S, Ennis O, Gee S, Quintyne KI, Kavanagh P, Ward M, on behalf of the OCT group. Joint efforts to control two concurrent measles outbreak in Ireland, 2017. Oral presentation. Irish Faculty of Public Health Medicine Summer Scientific Meeting, May 2018, Dublin, Ireland.

18. Quattrocchi A, Cotter S, Ennis O, Gee S, Quintyne KI, Kavanagh P, Ward M, on behalf of the OCT group. A measles outbreak in Ireland, 2017: Low vaccination coverage at subnational level challenges the elimination goal. Poster presentation. ESCAIDE, November 2018, Malta

19. Quattrocchi A, O'Lorcain P, Fitzgerald M, Cotter S. Evaluation of the invasive meningococcal disease surveillance system in Ireland, 2012-2017. Poster presentation. Irish Faculty of Public Health Medicine Winter Scientific Meeting, December 2018, Dublin, Ireland.

20. Quattrocchi A, Mereckiene J, Fitzgerald M, Cotter S. Influenza vaccination in at-risk groups in Ireland, 2017-2018: vaccine uptake and factors associated with vaccination. Oral presentation. Irish Faculty of Public Health Medicine Winter Scientific Meeting, December 2018, Dublin, Ireland.

21. Quattrocchi A, Arnott J, Domegan L, Huntm M, Flanagan P, O Donnell J. A review of the effectiveness of the quadrivalent influenza vaccine: implications for its introduction into influenza vaccination programme in Ireland. Oral presentation. Irish Faculty of Public Health Medicine Summer Scientific Meeting, May 2019, Dublin, Ireland.

22. Arnott J, Quattrocchi A, Domegan L, Huntm M, Flanagan P, O Donnell J. To switch or not to switch: the benefit of quadrivalent influenza vaccine to the Irish paediatric population. Poster presentation the 9th Europaediatrics Congress 2019, June 2019, Dublin, Ireland.

23. Quattrocchi A, O'Lorcain P, Fitzgerald M, Cotter S. A comprehensive evaluation of the invasive meningococcal disease surveillance system in Ireland, 2012-2017. Poster presentation. ESCAIDE, November 2019, Stockholm, Sweden.
24. Quattrocchi A, Murchan S, Burns K. Hospital-acquired infections in adult intensive care units in Ireland: Comparison between two national point prevalence surveys. Poster presentation. ESCAIDE, November 2019, Stockholm, Sweden.
25. Quattrocchi A, Oza A, Karagiannis I, Mitchell T, Fitzgerald M, Burns K. Incidence of hospital-acquired *Clostridium difficile* infection and association with antimicrobial consumption in Ireland, 2013-2017. Oral presentation. ESCAIDE, November 2019, Stockholm, Sweden.

Other presentations

26. Evaluation of the Invasive Meningococcal disease surveillance system in Ireland, 2012-2017. HPSC Epidemic Intelligence and Audit Group, HPSC, July 2019.

Other

27. Quattrocchi A, O'Lorcain P, Fitzgerald M, Cotter S. Evaluation of the Invasive Meningococcal Disease (IMD) surveillance system in Ireland, 2012-2017. Study protocol. June 2018
28. Quattrocchi A, Oza A, Karagiannis I, Mitchell T, Fitzgerald M, Cunney R, Burns K. Impact of antimicrobial and alcohol-based hand rub consumption on the incidence of hospital-acquired *Clostridium difficile* infection in Ireland, 2013-2017. Study protocol. April 2019
29. Quattrocchi A, Jackson S, McKeown P, Martin G, Murphy H, O Riordan. Plague enhanced surveillance form. HPSC surveillance form, November 2017. Available at http://www.hpsc.ie/a-z/zoonotic/plague/surveillance/Plague%20Enhanced%20Surveillance%20Form%20v0.1%20FINAL.pdf
30. Exchange visit to the Italian Institute of Public Health (Istituto Superiore di Sanita' – ISS), December 2018. Activity report
31. Outbreak of acute gastroenteritis at an adventure centre, Ireland, May 2018 – Cohort study. Mini Protocol and Analysis plan. June 2019

5. Teaching and pedagogy

Case study: Salmonella Outbreak at a wedding in Dublin (cohort study)

Annalisa facilitated the case study above on four occasions (15 and 16 November 2017 and 14 and 15 November 2018) at the School of Veterinary Medicine, University College Dublin. The students were undergraduate veterinary students. The case study was undertaken by the students in a 3 hour practical session. The learning objectives were: i) to understand the steps of an epidemiological outbreak investigation; ii) to draw and interpret an epidemic curve and interpret it; iii) to calculate and interpret food specific attack rates and relative risks; and iv) to have an understanding of environmental investigations and control measures.

Reflection

Facilitating several times this case study has given me greater confidence in working with large groups and keeping everyone engaged during the exercise.
Active participation and engagement was sought by asking the students to read sections of the text, and through questions such as "What will you do next?" at the end of each section. Breaking the session into two parts was also important to keep high the level of attention. Using the whiteboard summarising the points of the discussion was useful to help students in understanding and fixing the 10 steps of the outbreak investigation. The board was also used to show the different types of epidemic curves and to explain the measure of association through 2x2 tables, to help the students to memorise basic concepts of epidemiology.

At these sessions only a few students answered the majority of the questions. Splitting the students into smaller groups might work better as it facilitates more peer discussion and interaction by students.The training event was not evaluated.

Lecture: The omnibus methodology: a valuable method for public health surveys?

Annalisa developed and delivered a 90 minute lecture as part of the HPSC Training and Research Forum (TRF) session conducted every month for staff. The first part of the presentation focused on the different sampling methods and the second one on the Omnibus survey conducted in Ireland to estimate of influenza vaccine uptake in adult population, which was part of one of my EPIET research projects.
The learning objectives were: i) to understand the main methods of random and non-random sampling; ii) to understand the importance of having a sampling method; and iii) to learn how to analyse survey data in STATA
The presentation was organised with a series of questions to interact with and get feedback from the audience.

Reflection

This was my first EPIET teaching activity at HPSC. By developing and delivering this teaching assignment, she managed to study and understand more in-depth epidemiological and statistical concepts. The interaction with my peers rather than students as the target audience helped me better understand how to communicate messages to an audience with varying degrees of knowledge and/or expertise on the subject matter. It also contributed to making me feel more comfortable with the topic and with her colleagues.
The activity was not formally evaluated. However, verbal feedback received was very positive.

Lecture: Outbreak Investigation - Methodological aspects

Annalisa developed and delivered a 1-hour lecture on outbreak investigation on 18 October 2018, for students of MSc in Healthcare Infection Management (Trinity College, Dublin, Ireland). The session included theoretical explanations followed by examples of recent outbreaks, chosen based on the area of interest/study of the students.
The learning objectives were: i) to understand the importance of outbreak investigation; ii) to describe the 10 steps of an outbreak investigation; and iii) to understand control measures that can be implemented during an outbreak.

Reflection

I developed an evaluation form and asked student to respond at the end of the lecture. The session fulfilled the learning objectives for all the students. Overall students found the lecture informative, up-to-date, and clear. The material was considered appropriate.

Adapting the examples to the target audience worked really well and kept the students engaged. Overview on epidemiological studies and measures of association was also important to allow all students to follow the rest of the lecture.

6. Other activities

Review on Quadrivalent Influenza Vaccine

Supervisor: Joan O Donnell (Specialist in Public Health Medicine, Head of the Respiratory Team), HPSC

Quadrivalent influenza vaccines (QIV) provide broader protection against circulating influenza B/lineage viruses than trivalent influenza vaccines (TIV). In Ireland, TIVs are the main vaccines in use. The 2017/2018 B/lineage

vaccine mismatched season resulted in reduced influenza B vaccine effectiveness (VE) estimates and increased influenza mortality and morbidity. We reviewed the VE and cost-effectiveness (CE) of QIV, to assess the benefit of its introduction in Ireland.

We conducted an extensive (non-systematic) literature review on Pubmed and the Cochrane library for articles published between 2009-2018 on VE and CE of QIV and TIV. Additionally, we searched for publications by selected study groups estimating influenza VE.

Cross-lineage protection against influenza B/lineages not included in the TIV was reported during some B mismatched seasons. Overall, QIV showed higher VE compared to TIV, but low VE for both vaccines was reported for older adults. Despite the greater unit cost of QIV, CE modelling studies showed substantial savings with QIV through reductions in influenza cases, hospitalisations and deaths and also gains in quality-adjusted life years. The use of QIV for children combined with adjuvanted/high dose TIV in those aged ≥ 65 years, resulted as the most CE vaccination strategy.

QIV can reduce the impact of a B/lineage vaccine mismatch, improving influenza B VE across seasons, which may increase public confidence in influenza vaccine and lead to increased vaccine uptake.

Following a review of the evidence and an internal discussion at HPSC, it is recommended that the best strategy to adopt in relation to the influenza vaccination programme in Ireland is as follows:

1. Adjuvanted trivalent influenza vaccine for those aged 65 years and older
2. Quadrivalent influenza vaccine for all those aged <65 years who belong to the risk groups for influenza as outlined in the National Immunisation Guidelines

Role: Annalisa was the co- investigator; she performed the literature review, summarised the data retrieved, and wrote the review document as co-author (13). Annalisa presented the work as oral presentation at the Irish Faculty of Public Health Medicine Summer Scientific Meeting 2019 (21) and she was co-author of a poster presentation for the 9th Europaediatrics Congress 2019 (22).

Exchange visit to the Italian Institute of Public Health (Istituto Superiore di Sanita' – ISS)

Supervisor: Patrizio Pezzotti (EPIET supervisor), Istituto Superiore di Sanita' – ISS

Between 10th and 21st December 2018, Annalisa had the opportunity to conduct a visit to ISS and to meet staff working at the ISS, the ministry of health and the regional department of public health, on surveillance and research on infectious diseases and get more aware of the activities conducted at ISS.
Furthermore, based on a common project with the EPIET fellow based in Italy, on the evaluation of a surveillance system, the fellows aimed at describing and comparing the methodology adopted for the evaluation.
In particular the two fellows focused on the evaluation of Invasive Meningococcal Disease (IMD) surveillance system (Ireland) and Invasive Bacterial Diseases surveillance system (Italy). The objectives were: to describe the surveillance systems and compare the methodologies, to share tools and methods adopted for the evaluations, and to apply a probabilistic record linkage for capture-recapture cases from two different data sources for the Irish cases, through the same approach that will be used for the Italian sources.

The joint project was a learning opportunity for both EPIET fellows to learn about the similarities and differences among the two systems but also to refine the analyses of the attributes and how best to present them.
No formal comparison of the two systems was agreed due to differences in the two surveillance systems.

In addition, Annalisa also worked on the probabilistic record linkage for the capture-recapture of IMD cases from two different data sources notification/surveillance and the hospital discharge data, under the supervision and statistical support of Patrizio Pezzotti. A probabilistic linkage was adopted because no common identifier was available in the two data sources. The methodology adopted and the results of the linkage are described in the final report of the evaluation of the Irish surveillance system (14). Annalisa also produced an activity report (30).

7. EPIET/EUPHEM modules attended

1. Introductory Course, 25 Sep - 13 Oct 2017, Spetses, Greece
2. Outbreak Investigation, 04 - 08 Dec 2017, Berlin, Germany

3. Multivariable Analysis, 16 - 20 Apr 2018, Nicosia, Cyprus
4. Rapid Assessment and Survey Methods, 14 - 19 May 2018, Athens, Greece
5. Project Review 2018, 27 - 31 Aug 2018, Lisbon, Portugal
6. Time Series Analysis, 05 - 09 Nov 2018, Brussels, Belgium
7. Vaccinology, 24 - 28 June 2019, Rome, Italy
8. Project Review 2019, 26 - 30 Aug 2019, Prague, Czech Republic

8. Other training

1. In-house HPSC training on Computerised Infectious Disease Reporting (CIDR), 15 September 2017, Dublin, Ireland
2. In-house HPSC training on Introduction to Stata, Descriptive analysis and Multivariable analysis, 2 and 22 November 2017, Dublin, Ireland
3. Visit to the Irish Meningitis and Sepsis Reference Laboratory (IMSRL), 23 November 2017, Dublin, Ireland
4. Stata training EpiConcept at HPSC "Multivariable Analysis", 28-30 November 2017, Dublin, Ireland
5. Training at Health Pricing Office on Hospital InPatient Enquiry (HIPE) and ICD-10 coding, 22 February 2018, Dublin, Ireland
6. Mini Project Review module, 5-6 March 2018, Nottingham, United Kingdom
7. In-house HPSC training on Data Protection (GDPR), 10 May 2018, Dublin, Ireland
8. Visit to Public Health Agency Northern Ireland and Reference Laboratory, 17 July 2018, Belfast, United Kingdom
9. Visit to Public Health Laboratory Cherry Orchard Hospital (VTEC Reference Laboratory) and St. James Hospital (Gonococcal, MRSA, Mycobacteria Reference Laboratory), 25 July 2018, Dublin Ireland
10. Network analysis in outbreak investigations, Public Health England, Webinar, 19 September 2018
11. Mini Project Review module, 18-19 March 2018, Bristol, United Kingdom

Discussion

Supervisor's conclusions

Supervisor(s): Margaret Fitzgerald and Suzanne Cotter

During her two years as an EPIET fellow at HPSC, Annalisa was a pleasure to work with. She was highly engaged and committed to her work, always approaching it in a professional and enthusiastic manner. She became an invaluable and well integrated member of staff. She had an extremely productive two-year fellowship, successfully fulfilling all of the EPIET training objectives and achieving a high level of competence in all the required domains. She completed several projects that have important implications for public health in Ireland and at the same time gained exposure to a range of infectious diseases and epidemiological methods.

She successfully led on the epidemiological aspects of measles and an acute infectious gastroenteritis outbreak investigations. Her collegial and collaborative approach was clearly evident when working with the multidisciplinary Outbreak Control Teams. Her comprehensive evaluation of the meningococcal disease surveillance system provided important insights and recommendations, resulting in improvements being made to the system. Her study to determine both influenza (adults and pregnant women) and pertussis (pregnant women) vaccine uptake and their determinants was the first time the omnibus household survey was used for this purpose and the findings will be used to guide future policy decisions using a multifaceted and tailored approach. Her findings from her ecological study on the impact of antimicrobial consumption on the incidence of hospital-acquired *C. difficile* infection in

Ireland using multilevel time series analysis will be used to inform and tailor antimicrobial stewardship initiatives in Irish hospitals.

While at HPSC, Annalisa participated in teaching sessions to undergraduate and post-graduate students and ably presented her work at international and national conferences. Annalisa was highly motivated and worked both independently and as part of a team. She was able to successfully navigate challenging situations to reach her goals in a pleasant but respectful and persistent manner. Consistently, her contribution, work and outputs have been invaluable to HPSC and of extremely high quality.

We wish Annalisa the very best in her future career. Annalisa brings with her the epidemiological and interpersonal skills that ensure she will be an asset to any team or organisation.

Coordinator's conclusions

Annalisa started her fellowship with research background and experience in public health topics of HAI and AMR. She was involved in six field assignments in the surveillance and research area, along with two outbreak investigations. Through her high commitment, she has completed all of these, achieving all EPIET objectives and producing high quality outputs. Particular highlights of her fellowship are the first evaluation of IMD surveillance system in Ireland, study of influenza and pertussis vaccine uptake in pregnant women, and study on the impact of antimicrobial consumption on the incidence of hospital-acquired *C.difficile* infection.

She is highly organised, able to work independently and effectively. Supported by excellent supervision and project availability at the HPSC training site, her fellowship has been very successful. She improved her competencies and skills working with several important public health topics, also using novel methods such as omnibus surveys and multi-level time series analysis.

I believe that Annalisa has considerable professional and technical skills needed for epidemiological and public health related work, and I wish her all the success in her further career.

Personal conclusions of fellow

During the two years of the fellowship, I gained advanced epidemiological and statistical skills, through the EPIET training modules attended and the projects conducted at HPSC, where I could apply what I learned.

The HPSC in Dublin is a very good training site, which provided interesting projects and excellent supervision and support. Being exposed to a variety of public health topics and working within multidisciplinary teams has enabled me to broaden my knowledge of different infectious diseases and further developed my interpersonal skills.

The opportunity to go for an exchange visit to the Italian Institute of Public Health represented a unique opportunity to understand how surveillance systems work under a different Infectious Diseases Regulations framework, and to learn new statistical methods.

Furthermore, EPIET allowed me to strengthen a network of public health colleagues across Europe.

I am very glad to have had the chance to benefit from the programme and the people involved; I feel it has been a very important and significant step for my career as an epidemiologist.

Acknowledgements of fellow

I would like to thank my main supervisor Margaret Fitzgerald and my co-supervisor Suzanne Cotter for their excellent supervision, mentoring and support during my fellowship. In addition, I would like to thank my EPIET co-ordinator Frantiska Hruba for her support and invaluable advice.

I would like to acknowledge the former acting Director of HPSC, Kevin Kelleher for his encouragement and giving me the opportunity to do an exchange visit to ISS in Italy.

I am grateful to the VPD team and all HPSC staff especially those who supported or supervised me in my EPIET projects (Karen Burns, Piaras O'Lorcain, Mary O Riordan, Joan O'Donnell, Ajay Oza, Jolita Mereckiene, Paul McKeown, Stephen Murchan, Tara Mitchell), to Ioannis Karagiannis, EAP Scientific Coordinator and Patrizio

Pezzotti, EPEIT supervisor at the Italian Institute of Public Health (ISS) for their methodological support. Many thanks also to Mary Ward and Helena Murray (Department of Public Health, HSE East) and Ian Keith Quintyne (Department of Public Health, HSE North-East for giving me the opportunity to contribute to the local outbreaks.

A big thank to past and present EPIET fellows at HPSC (Jolita Mereckiene, Patricia Garvey, Margaret Fitzgerald, Lois O'Connor and Lisa Domegan) for all their advice during my fellowship.