FELLOWSHIP REPORT

Summary of work activities
Lisa Domegan
Intervention Epidemiology path (EPIET)
Cohort 2018

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.

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 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 2020

- 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 ECDC Fellowship Programme Manual.

Pre-fellowship short biography

Dr Lisa Domegan obtained a B.A. degree in Natural Science - Moderatorship in Microbiology (1996) and a Ph.D. in Virology (2001), at University of Dublin, Trinity College, Ireland. Lisa's Ph.D. research involved an investigation of the pathogenicity of rubella virus wildtype and vaccine strains for the central nervous system. Lisa also completed a postgraduate diploma in Quality Improvement and Statistics (2000), University of Dublin, Trinity College, Ireland. Between 2001 and 2018, Lisa worked as a Surveillance Scientist at the Health Service Executive-Health Protection Surveillance Centre (HPSC). During this time, Lisa's main roles and responsibilities included surveillance of influenza (seasonal, avian and pandemic), respiratory syncytial virus (RSV) and other seasonal respiratory viruses in Ireland. Other areas of work included monitoring influenza vaccine effectiveness and mortality modelling. Lisa also worked on syndromic surveillance in primary care, poliovirus laboratory containment and acute flaccid paralysis surveillance and surveillance of sexually transmitted infections in Ireland.

Fellowship assignment: Intervention Epidemiology path (EPIET)

On the 11th September 2018, Lisa Domegan started her EPIET fellowship at the Health Service Executive-Health Protection Surveillance Centre, Dublin, Ireland, under the supervision of Patricia Garvey. This report summarises 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.

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.

Fellowship projects

1. Surveillance

Title: Descriptive epidemiology of 2017/2018 influenza season

The 2017/2018 influenza season was a severe season with high influenza-like illness (ILI) GP consultations rates and high influenza hospitalisation and ICU admission rates. Influenza activity was elevated and geographically widespread for an extended period. All age groups were affected; however, there was a high impact on those aged 65 years and older with very high hospitalisation rates in this age group, a record number of notified influenza outbreaks in nursing homes and excess deaths were reported. Influenza associated hospitalisations were four times greater than those recorded during the 2009 influenza pandemic. Influenza B/Yamagata and influenza A(H3N2) were the predominant influenza viruses circulating during the 2017/2018 season, with significant levels of influenza A(H1N1)pdm09 also circulating during the season. The 2017/2018 influenza season was a B/lineage mismatched season, when influenza B/Yamagata viruses circulated and a B/Victoria lineage virus was included in the trivalent vaccine. The B/Yamagata lineage virus was not included in the northern hemisphere trivalent vaccine for 2017/2018 used in Ireland and across most of Europe. Additional strategies were needed to reduce the morbidity and mortality associated with influenza in

high-risk groups and elderly populations. The high burden of influenza in children and the elderly in Ireland called for sustained efforts to improve protective measures. Increasing vaccine uptake levels, introducing alternative vaccination strategies, such as universal influenza vaccination of children and/ or the use of improved (adjuvanted/high dose) vaccines for the elderly, were recommended for consideration. A descriptive analysis of all influenza surveillance data reported during the 2017/2018 season was conducted. The impact of the 2017/18 season on the Irish Health system, identified a need for further detailed analysis, which was requested by the National Immunisation Advisory Committee: (a) Epidemiological analysis of paediatric influenza data in Ireland; (b) A review of Quadrivalent Influenza Vaccines.

Role and outputs: Principal Investigator

Lisa analysed influenza surveillance data for the 2017/2018 season and wrote the HPSC Annual Epidemiological Report for Influenza and Other Seasonal Respiratory viruses (28) and an article for Epi-insight - the National Epidemiological bulletin (29), both were published on the HPSC website.

Competencies developed:

Lisa performed descriptive analyses on national surveillance data, from which she drew conclusions and made recommendations for public health action.

Supervisor(s): Joan O'Donnell, Specialist in Public Health Medicine, Health Protection Surveillance Centre, Dublin, Ireland.

Title: Descriptive Epidemiology of Influenza in the Paediatric Population in Ireland, 2009/10-2018/19

In Ireland, influenza places a substantial burden on the health system, with the highest disease occurrence in children and the elderly. Influenza vaccines are recommended for use in risk groups (e.g. chronic health conditions and age ≥65 years). Up to and including the 2018/19 season, trivalent infuenza vaccines were mainly used and there was no universal paediatric influenza vaccination programme in Ireland. We aimed to provide evidence to support decisions regarding alternative influenza vaccination strategies. We described the burden of influenza among children aged 0-14 years in Ireland over ten seasons (2009/2010-2018/2019). We calculated clinical influenza-like illness (ILI) GP consultation rates and laboratory confirmed influenza hospitalisation and intensive care unit (ICU) admission rates. Data sources included Ireland's sentinel GP, Computerised Infectious Disease Reporting and ICU surveillance systems. The highest GP ILI consultation rates were during seasons when influenza A(H1N1)pdm09 predominated (460/100,000 in 2009/2010; 206/100,000 in 2010/2011) and B/lineage vaccine mismatched viruses (co)predominated (112/100,000 in 2015/2016; 118/100,000 in 2017/2018). Since 2009, over 4,700 hospitalisations, 180 ICU admissions and 40 deaths were reported in children with laboratory-confirmed influenza. Hospitalisation rates were highest when influenza A(H1N1)pdm09 or a B/lineage mismatched virus (co)predominated (110/100,000 in 2017/2018 and 120/100,000 in 2018/2019). Low GP ILI consultation rates, hospital and ICU rates were observed in children during A(H3N2) predominant seasons. Over the study period, 68% of hospitalised influenza cases had no underlying medical conditions. In hospitalised children in risk groups, vaccine uptake ranged from 5-20% each season. Considerable paediatric morbidity and mortality was observed due to influenza, particularly when A(H1N1)pdm09 or B/lineage mismatched viruses (co)predominated. This study identified that additional strategies were needed to improve vaccine uptake in at-risk children and to protect healthy children. Subsequently, quadrivalent influenza vaccines were introduced in Ireland (2019/2020) and universal paediatric influenza vaccination will be implemented in October 2020.

Role and outputs: Principal Investigator

Lisa analysed ten years of surveillance data and wrote a report (30), in consultation with the HPSC respiratory team, that was submitted to the National Immunisation Advisory Committee. Lisa presented this work as oral presentations at an international conference, Europaediatrics (Dublin, June 2019) (12) and at a national conference of the Irish Faculty of Public Health Medicine (Dublin, May 2019) (17) and as a poster presentation at ESCAIDE, Stockholm 2019 (14). As part of this work, Lisa was co-author on a report on quadrivalent influenza vaccines (31). A manuscript of this work is in preparation (10).

Competencies developed:

Lisa performed descriptive analyses of national surveillance datasets, from which she drew conclusions, wrote a report and made public health recommendations. Lisa developed communication skills, presenting these findings as oral and poster presentations to different professional groups (Paediatricians and Clinicians, Public Health Specialists and Epidemiologists) at national and international conferences.

Supervisor(s): Joan O'Donnell, Specialist in Public Health Medicine, Health Protection Surveillance Centre, Dublin, Ireland.

Title: Monitoring Influenza Vaccine Effectiveness in Ireland

In Ireland, influenza vaccines are recommended for use in risk groups each season. A single brand trivalent inactivated sub-unit vaccine represented the main vaccine used during the 2018/2019 season. We aimed to estimate influenza vaccine effectiveness (VE) in primary care in Ireland during the 2018/2019 season. We undertook a test-negative design (TND) case-control study, as part of the I-MOVE network. We compared vaccination status of laboratory confirmed influenza cases with laboratory-negative patients among those meeting the EU influenza-like illness (ILI) case definition presenting to primary care. We used logistic regression to calculate influenza VE, adjusting for potential confounders. A random sample of influenza virus positive specimens was selected for sequencing. We included 183 cases and 151 controls in the analysis (October-April), with vaccine uptake at 15%. Adjusted influenza VE estimates were 52% [95% CI: -3-78] against all medically attended laboratory confirmed influenza and 71% [95% CI: 28-88] against influenza A(H1N1)pdm09. Among target groups for vaccination, adjusted VE was 58% [95% CI: -14-85] against all influenza and 77% [95% CI: 22-93] against A(H1N1)pdm09. Age specific estimates against all influenza were 51% [95% CI: -23-80] for those aged 15-64 years and 39% [95% CI: -187-87] for those ≥65 years. Further subset analysis was not possible, due to small sample size. Of sequenced viruses the majority were influenza A(H1N1)pdm09 clade 6B.1 (vaccine strain A/Michigan/45/2015), including three emerging subgroups, all containing the HA1 amino acid substitution S183P. Moderate influenza vaccine effectiveness against A(H1N1)pdm09 was observed in Ireland during the 2018/2019 season. Increasing genetic diversity of A(H1N1)pdm09 viruses did not affect VE, however further monitoring of variants and the potential impact on VE is necessary. This study was repeated for the 2019/2020 influenza season.

Role and outputs: Co-investigator

Lisa wrote and submitted an ethics application, outlining that this project should be regarded as routine public health surveillance (rather than health research). This submission was needed in light of new Irish legislation (Health Research Regulations 2018), developed in the context of the GDPR. This submission involved a wide consultation process with many stakeholders including the Irish College of General Practitioners Research Ethics Committee, ECDC, the Irish Health Research Consent Declaration Committee and others. Lisa wrote the protocols for the 2018/19 and 2019/20 seasons (32, 33) and the patient information leaflets, designed and developed an online questionnaire and database, performed data cleaning, validation and analysis in STATA, managed the tasks (data entry/processing) of research assistants and wrote reports for 2018/2019 and 2019/2020 (34-37). Lisa is co-author on several manuscripts (1-3, 6) and a manuscript of this work is in preparation (11). Lisa presented this work as a poster at ESCAIDE 2019 (13), an oral presentation at a national conference, Irish Faculty of Public Health Medicine (18) and during the EPIET 2020 vaccinology module (26). Lisa liaised with European partners Epiconcept and other Member States in the European Influenza Monitoring of Vaccine Effectiveness (I-MOVE) primary care network, including reporting Irish data for pooled European estimates and reviewing reports/papers. Lisa is currently involved in project work to monitor influenza vaccine effectiveness when faced with the challenges of the COVID-19 pandemic. This work also includes development of the Irish I-MOVE network to include monitoring effectiveness of a future COVID-19 vaccine.

Competencies developed:

Lisa developed competencies in submitting and writing ethics applications, protocol development, project coordination and management, data management, statistical analysis and methodology, abstract writing, manuscript reviewing, surveillance report writing, conference oral and poster presentations and formulating public health recommendations. In particular, Lisa developed analytical and statistical skills during this project.

Supervisor(s): Joan O'Donnell, Specialist in Public Health Medicine, Health Protection Surveillance Centre, Dublin, Ireland.

Title: Establishing a COVID-19 Pandemic Severity Assessment (PSA) surveillance system in Ireland

Following the declaration of the COVID-19 pandemic on the 11th March 2020 and in the absence of a national surveillance system for assessing the severity of pandemics in Ireland, we aimed to develop and implement a Pandemic Severity Assessment (PSA) monitoring system in Ireland, in order to inform public health preparedness, response and recovery measures, and to assist in improving the response to future waves of COVID-19. A severity assessment provides information to determine the timing, scale, emphasis and intensity of pandemics and to

support decisions on the urgency of pandemic response actions and on implementing/lifting control measures. A panel of parameters were identified and threshold levels established for the following indicators - transmissibility, seriousness of disease and impact, in order to monitor the severity of the COVID-19 pandemic in Ireland. This project was based on the WHO Pandemic Influenza Severity Assessment (PISA) project.

A PSA surveillance system for COVID-19 was successfully established for Ireland. The panel of parameters selected has enabled us to observe the differences between age groups for all indicators: transmissibility, severity and impact. We recommend that pandemic severity assessments, using the PSA monitoring system in Ireland be conducted at regular intervals as the pandemic evolves, particularly as Ireland moves through the phases of control measures. Preliminary findings provided an epidemiological description and assessment of the severity of the first wave of the COVID-19 pandemic in Ireland. We believe this is a useful surveillance tool, as it will inform and guide national decisions and recommendations on public health interventions and COVID-19 control measures in Ireland and in preparation for the 2020/2021 winter.

Role and outputs: Principal Investigator

Lisa developed the PSA surveillance system for Ireland, based on the WHO PISA project, following consultation with the COVID-19 National Expert Advisory Committee (oral presentation (25)) and experts in ECDC and WHO. Lisa selected the parameters and indicators for surveillance, processed and analysed the data, developed statistical thresholds (using R), developed a reporting tool in excel and wrote a report on establishing this surveillance system (38). Lisa analysed preliminary data from the first COVID-19 pandemic wave in Ireland (up to June 2020) and wrote a report on the preliminary findings (39), which was reported to the COVID-19 National Public Health Emergency Team (NPHET) in Ireland. A short manuscript on the latest data is in preparation (8). The COVID-19 epidemiology team plan to include PSA outputs in future weekly COVID-19 reports. An abstract of this work was accepted for oral presentation at ESCAIDE 2020.

Competencies developed:

Lisa developed competencies in project coordination and management, data management, statistical analysis (in R) and methodology, surveillance report writing, oral presentations and formulating public health recommendations. Lisa also developed communication skills, communicating and consulting with various national stakeholders/organisations and professional groups within the Irish Health System and at an international level (with various Member States, ECDC and WHO).

Supervisor(s): Joan O'Donnell and Lois O'Connor, Specialists in Public Health Medicine and Patricia Garvey, Surveillance Scientist & EPIET supervisor - Health Protection Surveillance Centre, Dublin, Ireland

2. Outbreak investigations

Title: Salmonella Bredeney International Outbreak, 2019 – involving UK, Ireland and Romania

An outbreak investigation was launched by HSE-HPSC on July 3rd 2019 following identification of a cluster of six Salmonella Bredeney cases (ST241 - with sequences within 1 allele difference) at the National Salmonella Reference Laboratory (NSSLRL) in Ireland during routine whole genome sequencing (WGS) analyses. In the period 2010-2018, fewer than six S. Bredeney clinical isolates were recorded annually in Ireland, only one of which shared sequence similarity with this new cluster. On 4th July 2019, Ireland posted an enquiry on the EPIS (FWD) system, alerting Member State colleagues about a cluster of S. Bredeney and provided sequence data of a representative outbreak strain. In the following days, the United Kingdom (UK) reported a number of isolates genetically closely related to the Irish representative outbreak strain and therefore suspected to be associated with the same event. In Ireland, this outbreak predominantly affected Romanians and Moldavians resident in Ireland for whom the most common reported exposure was processed pork consumption. Isolates from Irish cases were identical on WGS to isolates from food samples of a traditional Romanian processed pork product called 'Toba de casa' (which was sampled both at market level in Ireland and at the level of the production facility in Romania). Descriptive epidemiological analysis of international data (UK and Ireland) was undertaken and reported to the following: Irish National OCT, UK colleagues, International OCT (Ireland, UK, Romania and ECDC) and communicated to other European MS via EPIS. Control measures after identification of positive food samples included a product recall, withdrawal from the market of further contaminated product and temporary suspension of the production activities at the Romanian producer to facilitate a deep clean at plant level.

Role and outputs: Co-investigator

Lisa was a member of the national (Ireland) and international (Ireland, United Kingdom and Romania) outbreak control teams (OCTs) and attended OCT meetings/teleconferences. Lisa conducted a descriptive epidemiological

analysis of available international outbreak data for Ireland and the UK and wrote a short situation report (40) that was submitted to the following: Irish National OCT, International OCT (Ireland, UK, Romania and ECDC) and communicated to European Member States via EPIS.

Competencies developed:

Lisa gained experience in an international foodborne outbreak, including analysing and writing a situation report on international data. Lisa experienced outbreak teleconferences with national and international stakeholders (Ireland, UK, Romania and ECDC), with different professional groups and organisations. This outbreak, provided Lisa with experience working on both national and international multidisciplinary Outbreak Control Teams.

Supervisor(s): Patricia Garvey, Surveillance Scientist & EPIET supervisor and Lois O'Connor, Specialist in Public Health Medicine, HPSC, Dublin, Ireland.

Title: An outbreak of Norovirus linked to Christmas party events in a Hotel, Ireland, December 2019

On 16 December 2019, the Health Service Executive was alerted to gastrointestinal illness among individuals who attended events in a hotel on Friday 13 December 2019. Ultimately, 413 gastroenteritis complaints were received. An outbreak control team was convened and aimed to identify the outbreak source and implement control measures. We conducted a cohort study among three groups that attended the hotel. Cases were defined as individuals attending the hotel on 13/12/2019, who developed gastrointestinal symptoms with onset within 72 hours. We developed an online questionnaire to collect exposure information. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated using exact logistic regression. Environmental/clinical samples were tested for enteric pathogens. A staff questionnaire was also distributed. Ninety-eight per cent (47/48) of individuals from the identified groups completed the questionnaire, with a 62% attack-rate (AR). The epidemic curve was suggestive of a common point-source. Twenty-nine cases and 18 controls were analysed. Toilet use was associated with illness (OR 17.7, 95%CI 2.3-Inf, p0.004); while food and drinks consumed were not. Despite low chlorine residual readings in two local water supplies, possible interaction involving ice consumption was inconclusive. Norovirus was detected in six stool samples. A vomiting incident was reported in the toilets. Fifty-four hotel staff completed questionnaires, with 19 reportedly ill (35% AR). The hotel outbreak was limited to one evening. Epidemiological investigations pointed towards illness associated with exposure to contaminated toilet facilities. Substantial crowds and insufficient toilet facilities may have amplified transmission. We recommend rapid cleaning response to vomiting incidents and provision of additional hand washing and toilet facilities when large events are organised.

Role and outputs: Principal Investigator of outbreak analytical study

Lisa wrote the protocol (41), developed an online questionnaire, followed up with schools, performed data validation and processing, analysed outbreak data, wrote an outbreak report (42), submitted an abstract to an international conference, Five Nations Health Protection conference (postponed to June 2021 due to COVID-19), and to ESCAIDE 2020. A short manuscript for submission to a peer-reviewed journal is planned.

Competencies developed:

Lisa gained experience in planning and conducting an outbreak analytical investigation, using the classic 10-step field epidemiology approach. Lisa developed competencies in the development of questionnaires, creation of case definitions, generation of hypotheses, outbreak data analysis, outbreak report writing, abstract writing and communication skills. Lisa developed a variety of analytical and epidemiological skillsets, during this complex cohort study. This outbreak, provided Lisa with experience working on a multidisciplinary Outbreak Control Team for a large Norovirus hotel outbreak.

Supervisor(s): Patricia Garvey, Surveillance Scientist & EPIET supervisor and Lois O'Connor, Specialist in Public Health Medicine, HPSC, Dublin, Ireland.

Title: Mumps National Outbreak, Ireland, 2018-2020

Between 18 August 2018 and 24 January 2020, 3,736 mumps cases were notified in Ireland. The highest numbers of notifications were observed in the age group 15–24 years. Vaccination status was reported for 32% (n = 1,199) of cases: 72% of these had received two doses of measles-mumps-rubella (MMR) vaccine. Vaccination uptake after free MMR vaccination targeting colleges and universities since early 2019 was low. Therefore, a national media campaign began in January 2020.

A short report of case scenarios was produced for HPSC and Departments of Public Health in order to facilitate interpretation of clinical and laboratory outbreak data, to identify acute mumps infection and to assign mumps case classifications (confirmed, probable and possible).

Role and outputs: Member of National Mumps OCT – epidemiological support for OCT

Lisa was a member of the National Mumps OCT and attended OCT meetings. Lisa wrote a short report on mumps case scenarios (43). Some of the scenarios were originally devised by Dr Regina Selb (EUPHEM fellow, C2017), Robert Koch Insitute, Berlin, Germany and were adapted following consultation (and with permission) for the 2018-2020 mumps outbreak in Ireland. The developed case scenarios will be published on the Health Protection Surveillance Centre website www.hpsc.ie.

Competencies developed:

Lisa obtained experience as a member of the Outbreak Control Team during this extended national mumps outbreak. Lisa attended the OCT teleconferences as an observer, however identified a need for mumps case scenarios to facilitate interpretation of clinical and laboratory mumps outbreak data. Lisa developed her knowledge base regarding vaccines and immunology and enhanced her writing skills during this project.

Supervisor(s): Suzanne Cotter, Specialist in Public Health Medicine and Sarah Gee, Surveillance Scientist, HPSC, Dublin, Ireland.

Title: CPE hospital outbreak in Ireland 2018-2019 - investigation of transmission patterns using social network analysis and whole genome sequencing – Joint EPIET and EUPHEM project

Carbapenemase-producing Enterobacterales (CPE) infection adversely impacts treatment, hospital stay, healthcare costs and mortality. In July 2018, a CPE outbreak was declared. The aim of this study was to investigate transmission patterns on a hospital ward using social networks and genomics. All patients admitted to ward A between July 2018 and December 2019 were included in a retrospective descriptive analysis. Cases were defined as patients with a negative admission screen, and subsequent positive CPE test. Genomic analysis was used to describe species, genotypes, CPE plasmids and genetic relatedness. Social networks of cases and patient contacts were constructed. Forty-five cases with 844 contacts were analysed. The median age of cases was 78 years (IQR 67-83), 58% (26/45) were male and 100% had co-morbidities. The median outbreak ward length-of-stay (LOS) was 17 days (IQR 10-34). OXA-48 CPE was confirmed in all cases and detected from 26 environmental samples from the ward. Two OXA-48 plasmid types and seven species were identified, with predominance of Enterobacter hormaechei (63%; 35/56 isolates) and ST78 over time. Social networks identified temporal clusters by gender and species/ST/plasmid type, coinciding with interventions. Network metrics identified possible super-spreading events involving patients with behavioural disturbances. This lengthy CPE outbreak involved two OXA-48 plasmids, multiple species and genotypes. Persistence of E. hormaechei ST78 and OXA-48 plasmid group 2 may be due to nosocomial adaptation. Cases declined following interventions and further spread to other wards was prevented. An older patient cohort with extended hospital LOS, dated ward infrastructure and fabric and multiple patient transfers within the ward likely prolonged this outbreak. We recommend heightened surveillance for high-risk clones (ST78), systematic environmental sampling and tailored measures for patients with behavioural issues.

Role and outputs: Principal Investigator jointly with EUPHEM fellow, Carina Brehony

Lisa and Carina wrote the protocol (44) and collected/collated hospital data from hospital systems. Lisa analysed the outbreak descriptive epidemiological data and conducted social network analysis of outbreak data. Carina analysed the microbiological data including molecular epidemiology using Whole Genome Sequencing (WGS). Lisa and Carina presented this analysis at the UK-FETP project review module, Birmingham, March 2020 (24). Lisa wrote a report on the epidemiological and social network analysis (45), Lisa is co-author on a report on the microbiological/WGS analysis (46). Two manuscripts are in preparation for submission to peer reviewed journals – one on social network analysis and one on genomic analysis. A joint EPIET and EUPHEM abstract was accepted for oral presentation at ESCAIDE 2020. This work will also be presented at the hospital journal club in November 2020.

Competencies developed:

During this outbreak, Lisa gained experience working onsite in a hospital setting, on a nosocomial outbreak involving a complex pathogen, CPE. Lisa extracted data from multiple hospital systems and worked directly with members of the hospital outbreak control team. Lisa developed a variety of analytical and epidemiological skillsets, including analysis of transmission patterns using social networks. This joint EPIET and EUPHEM outbreak project, provided a unique opportunity for Lisa to enhance her knowledge of WGS and other laboratory techniques and to experience the benefit and value of microbiologists and epidemiologists working together on hospital outbreaks.

Supervisor(s): Karen Burns, *Consultant Clinical Microbiologist, HSE-HPSC & Beaumont Hospital, Dublin, Ireland & Honorary Clinical Senior Lecturer, RCSI.*

Title: COVID-19 Pandemic in Ireland, 2020

On 31 December 2019, a cluster of pneumonia cases of unknown aetiology was reported in Wuhan, Hubei Province, China. On 9 January 2020, China CDC reported a novel coronavirus as the causative agent of this outbreak, coronavirus disease 2019 (COVID-19). On the 12 March 2020, the World Health Organization declared a pandemic and since then COVID-19 has affected all continents.

Role and outputs: Co-investigator/Epidemiological support

Lisa is a member of the following COVID-19 national groups in Ireland: HPSC COVID-19 core team (March only), HPSC COVID-19 epidemiology team, HPSC COVID-19 epidemiology outbreak subgroup and the National Health Protection Pandemic Incident Control Team (PICT). HPSC's role and remit during the COVID-19 pandemic has been to provide public health and infection prevention and control guidance, to conduct epidemiological analysis and reporting and to undertake research into the seroepidemiology of COVID-19 in Ireland. The work at HPSC helps frontline healthcare workers, communities, and the public to protect themselves and to save lives. Lisa has been involved in a variety of work related to the National COVID-19 pandemic response in Ireland including:

- Epidemic intelligence, including monitoring EWRS/IHR – March 2020
- Knowledge management – led knowledge management team, work included literature reviews and providing background material for specific research questions requested by Irish COVID-19 Expert Advisory Group and other national COVID-19 groups. Established literature archive and reference manager for HPSC – March 2020
- Surveillance forms/database - Reviewed contact surveillance form and tested contact database. Reviewed COVID-19 case surveillance form – March 2020
- COVID-19 mortality – worked on HPSC document on definition of COVID-19 deaths. Liaised with Euromomo hub (SSI Denmark), Irish Department of Health, General Registry Office, HPSC Director and COVID-19 epidemiology team lead regarding delayed registration of deaths in Ireland. Produced analysis on estimated delayed registration of COVID-19 deaths in Ireland, requested by the Department of Health. Responded to queries regarding excess deaths. Co-author on Euromomo excess mortality manuscript (5). April-July 2020.
- COVID-19 social network analysis – produced/analysed social networks of early/initial COVID-19 cases and clusters in Ireland to assist with identifying chains of transmission. The networks were reported to the HPSC Director and to local Departments of Public Health (confidential outputs). March 2020
- COVID-19 outbreak surveillance – in consultation with COVID-19 outbreak and epidemiology teams, developed and produced daily and weekly COVID-19 outbreak reports. Produced 11 weekly outbreak reports – these were confidential reports for the HPSC Director and the COVID-19 National Public Health Emergency Team (NPHET). Provided additional analysis on COVID-19 outbreaks as requested by HPSC Director, NPHET and COVID-19 epidemiology team leads. Liaised with COVID-19 HSE community operations to establish daily reports used for distribution of PPE and oxygen to Residential Facilities. Involved in validation/follow-up work on COVID-19 outbreaks with local Departments of Public Health. Assisted COVID-19 modelling groups with queries related to COVID-19 outbreaks/clusters. Worked with COVID-19 outbreak team to identify additional variables required for outbreak surveillance. Developed Standard Operating Procedures, excel reporting spreadsheets and online training (provided to two scientists) to assist with production of COVID-19 weekly outbreak reports. March-June 2020.
- COVID-19 surveillance in Long term care facilities – Reviewed and listed as consulted expert in ECDC document: 'European Centre for Disease Prevention and Control. Surveillance of COVID-19 in long-term care facilities in the EU/EEA, 19 May 2020. Stockholm: ECDC; 2020.' https://www.ecdc.europa.eu/en/publications-data/surveillance-COVID-19-long-term-care-facilities-EU-EEA. Co-author on ECDC group paper 'High impact of COVID-19 in long-term care facilities, suggestion for monitoring in the EU/EEA' (4). April -June 2020
- ECDC/WHO COVID-19 - Lisa participated in weekly/fortnightly COVID-19 surveillance/epidemiology teleconferences organised by ECDC and/or WHO.

Competencies developed:

Lisa was involved in the national COVID-19 pandemic response in Ireland. Lisa was a member of the HPSC COVID-19 epidemiology team and the National Health Protection Pandemic Incident Control Team, working with a variety of local and national stakeholders, with different professional groups and organisations, enhancing her knowledge of the Irish Health System. Lisa gained experience working as an epidemiologist during the COVID-19 pandemic, working in a high intensity environment on detailed epidemiological reports/analysis required with very short deadlines. During this time, Lisa developed her communication skills and broadened her experience, communicating with colleagues in the Irish Department of Health, members of the COVID-19 National Public Health Emergency Team, other Member States, ECDC and WHO.

Supervisors: John Cuddihy, HPSC Director, Joan O'Donnell and Lois O'Connor, Specialists in Public Health Medicine, Patricia Garvey, Surveillance Scientist & EPIET supervisor, HPSC, Dublin, Ireland.

3. Applied epidemiology research

Title: Cryptosporidium geospatial ecological study (including GIS)

Cryptosporidiosis remains a concern for human health and an important cause of severe gastrointestinal disease. In Ireland, cases of cryptosporidiosis are usually associated with Cryptosporidium parvum and are predominantly rural in occurrence. C. parvum is primarily a parasite of ruminant animals with incidental human infection associated with farming activities or interactions with animals. Epidemiological studies have revealed that exposure to drinking water from private supplies represents a high risk for cryptosporidiosis. The crude incidence rate (CIR) of cryptosporidiosis in Ireland has been slowly increasing in recent years, ranging from 8.6/100,000 in 2014 to 13.2/100,000 in 2018, with the highest CIRs reported in Europe. To date, no integrated epidemiological investigation of the spatiotemporal mechanisms associated with cryptosporidiosis has been undertaken in Ireland. The overall aim of this study was to increase understanding of environmental factors associated with primary cryptosporidiosis cases. The first step in this retrospective geospatial epidemiological investigation was to geocode a cryptosporidiosis dataset, thus enabling spatially specific linkage with existing secondary datasets. A secondary aim was to describe the development of a reliable, reproducible methodology to geocode spatiotemporal infectious disease datasets for use in geospatial epidemiological studies, in order to improve data validity, maximise data completeness and identify possible biases. The cryptosporidiosis geocoded dataset will be spatially linked to secondary datasets and a series of maps will be produced mapping cryptosporidiosis occurrence incidence relative to agricultural and infrastructural density by Small Area using QGIS. The final objective of this study will be to assess whether there is a geospatial association between the occurrence/incidence of cryptosporidiosis in children and agricultural and infrastructural risk factors.

Role and outputs: Co-investigator

Lisa wrote the protocol (47), developed a geocoding methodology, analysed geocoded data, wrote a geocoding methodology report (48), gave oral presentations (20, 21) and wrote a geocoding manuscript submitted to a peer-reviewed journal (7). Due to re-prioritisation of work during the COVD-19 pandemic, the final stages of this research project involving geospatial analysis of associations between the occurrence/incidence of cryptosporidiosis in children and agricultural and infrastructural risk factors were put on hold.

Competencies developed:

Lisa developed competencies in protocol development, project coordination and management, geocoding, report writing, manuscript writing and oral presentations. Lisa developed her communication skills, particularly with regard to communicating complex methodologies/techniques. Lisa gained knowledge on geocoding methodologies and geospatial analysis and the use of QGIS. Lisa developed experience using Health Atlas Ireland software tools. Lisa also gained experience working with a multidisciplinary research group including environmental scientists and geospatial analysts.

Supervisor(s): Patricia Garvey, Surveillance Scientist & EPIET supervisor

Title: Seroprevalence of Hepatitis C in an antenatal cohort Ireland

Hepatitis C is a chronic viral disease affecting the liver which can lead to cirrhosis, liver failure, and hepatocellular carcinoma. It is most commonly acquired through intravenous drug use or through unscreened blood products. In a small proportion of patients, no risk factor is identified. Hepatitis C is generally a silent condition and it may take 20-40 years to cause irreversible liver damage. Effective therapy is available and if the infection is recognised it can be eradicated by oral antivirals. The treatment is extremely cost effective and the Irish State has undertaken to provide it free for infected individuals. It is estimated that between 20-30,000 individuals in Ireland have hepatitis C. However, many may be unaware of their infection and screening may be required to identify patients who may benefit from treatment. Currently HSE guidelines recommend targeted screening during pregnancy (testing only women with risk factors for infection). In this study we aim to test anonymised stored samples (due to be discarded) from women with no known risk factors, who currently do not qualify for testing, from two maternity hospitals. These samples will be checked for hepatitis C antibody, with testing performed in the National Virus Reference Laboratory. Positive samples will be checked for hepatitis C antigen. Estimates of prevalence in the general population range from 0.18%-0.6%. It is planned to check 5,000 anonymised samples which should give a reasonable estimate of hepatitis C prevalence in this pregnant Irish population. The aim of this study is to assess

the effectiveness of the Hepatitis C Screening Guidelines for Ireland, which recommend targeted screening in pregnancy. The results will be submitted to the National Hepatitis C Treatment Program for review. This research will be used to determine whether universal antenatal screening for Hepatitis C should be recommended in Ireland.

Role and outputs: Co-investigator

Lisa reviewed the ethics application and was listed as a co-investigator. Lisa attended meetings with members of the research team. Lisa visited the National Virus Reference Laboratory - to review the process of anonymisation of the samples and the testing procedures. Lisa's main role in this project is to write the final report, pending completion of testing. Due to the COVID-19 pandemic, testing of these residual samples at the National Virus Reference Laboratory was delayed and had not been completed by the end of Lisa's Fellowship.

Competencies developed:

During this project Lisa developed insights into how to conduct seroprevalence studies, including hospital ethics applications, sampling strategies and testing of residuals. Lisa also gained knowledge on the epidemiology and seroprevalence of Hepatitis C.

Supervisor(s): Patricia Garvey, Surveillance Scientist & EPIET supervisor (HPSC), Cillian de Gascun - National Virus Reference Laboratory Director, John Cuddihy - HPSC Director.

Title: - Universal childhood influenza vaccination impact study on the island of Ireland – controlled interrupted time series analysis

A universal childhood influenza vaccination programme was introduced in Northern Ireland in 2013. In the Republic of Ireland up to 2019/2020, no universal childhood influenza vaccination programme was in place. This study aimed to do a childhood universal influenza vaccine impact study, comparing influenza activity in the two jurisdictions with differing vaccination programmes on the island of Ireland. The specific objective was to do a controlled interrupted time series analysis of sentinel GP influenza-like illness consultations and sentinel GP influenza virology positivity data over 10-12 seasons (up to 2018/19) in Northern Ireland and the Republic of Ireland. Sentinel GP ILI consultations and virological data were collated from both jurisdictions. Preliminary time series analysis of sentinel GP ILI data was conducted.

Role and outputs: Principal Investigator

Lisa liaised with colleagues in Northern Ireland for project agreement/approval and retrieval of datasets. Lisa developed the data extraction form for Northern Ireland and Republic of Ireland, Lisa processed and recoded datasets for comparison of similar age groups and seasons and conducted preliminary analysis of the datasets. Lisa did a literature search of controlled interrupted TSA. Due to priority COVID-19 work, this research project has been put on hold.

Competencies developed:

During this project, Lisa gained experience on the implementation of an international all-Ireland epidemiology study. Lisa developed insights into interrupted time series analysis (TSA) and it's use for vaccine impact studies and developed analytical skills on TSA.

Supervisor(s): Joan O'Donnell, Specialist in Public Health Medicine, Health Protection Surveillance Centre, Dublin, Ireland.

4. Communication

Publications in peer reviewed journals

Co-author/group* authorship on following manuscripts:

1. Kissling E, Rose A, Emborg H, Gherasim A, Pebody R, Pozo F, Trebbien R, Mazagatos C, Whitaker H, Valenciano M, European IVE group* . Interim 2018/19 influenza vaccine effectiveness: six European studies, October 2018 to January 2019. Euro Surveill. 2019;24(8). https://doi.org/10.2807/1560-7917.ES.2019.24.1900121
2. Kissling E, Pozo F, Buda S, Vilcu A, Gherasim A, Brytting M, Domegan L, Gómez V, Meijer A, Lazar M, Vučina V, Dürrwald R, van der Werf S, Larrauri A, Enkirch T, O'Donnell J, Guiomar R, Hooiveld M, Petrović G, Stoian E, Penttinen P, Valenciano M, I-MOVE primary care study team. Low 2018/19 vaccine effectiveness against influenza A(H3N2) among 15–64-year-olds in Europe: exploration by birth cohort. Euro Surveill. 2019;24(48). https://doi.org/10.2807/1560-7917.ES.2019.24.48.1900604

3. Kissling E, Emborg H, Larrauri A, McMenamin J, Pozo F, Trebbien R, Mazagatos C, Whitaker H, Valenciano M, European IVE group* . Interim 2019/20 influenza vaccine effectiveness: six European studies, September 2019 to January 2020. Euro Surveill. 2020;25(10). https://doi.org/10.2807/1560-7917.ES.2020.25.10.2000153
4. ECDC Public Health Emergency Team, Danis K, Fonteneau L, Georges S, Daniau C, Bernard-Stoecklin S, Domegan L, O'Donnell J, Hauge Siri H, Dequeker S, Vandael E, Van der Heyden J, Renard F, Sierra Natalia B, Ricchizzi E, Schweickert B, Schmidt N, Abu Sin M, Eckmanns T, Paiva J, Schneider E. High impact of COVID-19 in long-term care facilities, suggestion for monitoring in the EU/EEA, May 2020. Euro Surveill. 2020;25(22). https://doi.org/10.2807/1560-7917.ES.2020.25.22.2000956
5. Vestergaard L, Nielsen J, Richter L, Schmid D, Bustos N, Braeye T, Denissov G, Veideman T, Luomala O, Möttönen T, Fouillet A, Caserio-Schönemann C, an der Heiden M , Uphoff H, Lytras T, Gkolfinopoulou K, Paldy A, Domegan L, O'Donnell J, de' Donato F, Noccioli F, Hoffmann P, Velez T, England K, van Asten L, White R, Tønnessen R, da Silva S, Rodrigues A, Larrauri A, Delgado-Sanz C, Farah A, Galanis I, Junker C, Perisa D, Sinnathamby M, Andrews N, O'Doherty M, Marquess D, Kennedy S, Olsen S, Pebody R, ECDC Public Health Emergency Team for COVID-19, Krause T, Mølbak K. Excess all-cause mortality during the COVID-19 pandemic in Europe – preliminary pooled estimates from the EuroMOMO network, March to April 2020. Euro Surveill. 2020;25(26). https://doi.org/10.2807/1560-7917.ES.2020.25.26.2001214
6. Brehony C, Dunford L, Bennett C, O'Donnell J, Domegan L, McNamara E, De Gascun C. Neuraminidase characterisation reveals very low levels of antiviral resistance and the presence of mutations associated with reduced antibody effectiveness in the Irish influenza 2018. J Clin Virol. 2020; 132:104653. DOI: 10.1016/j.jcv.2020.104653

Manuscripts submitted to peer reviewed journals (pre-publication)

7. Domegan L, Garvey P, McKeown P, Johnson H, Hynds P, O'Dwyer J, ÓhAiseadha C. Geocoding cryptosporidiosis cases in Ireland (2008–2017) - Development of a reliable, reproducible, multiphase geocoding methodology. Irish Journal of Medical Science (submitted on 17th August 2020). Accepted with minor revisions.

Manuscripts being drafted for peer-review journals

8. Domegan L, Garvey P, McEnery M, Fiegenbaum R, O'Connor L, Cuddihy J, O'Donnell J, HPSC COVID-19 epidemiology team. Preliminary findings of a COVID-19 Pandemic Severity Assessment monitoring system in Ireland. Short manuscript in preparation (November 2020).
9. Domegan L, Brehony C, Garvey P, Burns K et al. CPE OXA-48 hospital ward outbreak in Ireland 2018-2019 - investigation of transmission patterns using social network analysis and genomics (in preparation).
10. Domegan L, O'Donnell J et al. Descriptive Epidemiology of Influenza in the Paediatric Population in Ireland, 2009/10-2018/19 (in preparation).
11. Domegan L, O'Donnell J et al. Influenza vaccine effectiveness in Ireland during the 2019/2020 influenza season (in preparation).

Conference presentations

International Conferences

12. Domegan L. June 2019. 'Descriptive Epidemiology of Influenza in the Paediatric Population in Ireland, 2009 – 2018'. Europaediatrics 2019, Dublin. Oral presentation.
13. Domegan L. November 2019. 'Moderate influenza vaccine effectiveness in Ireland during the 2018/2019 season'. ESCAIDE 2019, Stockholm. Poster presentation (and 3-minute oral presentation).
14. Domegan L. November 2019. 'High influenza morbidity in children in Ireland, 2009-2019, supports the need for improved/alternative vaccination strategies'. ESCAIDE 2019, Stockholm. Poster presentation (and 3-minute oral).
15. Domegan L & Brehony C. November 2020. CPE OXA-48 hospital ward outbreak in Ireland 2018-2019 - investigation of transmission patterns using social network analysis and genomics. ESCAIDE 2020, Online. Oral presentation. Joint EPIET and EUPHEM presentation.
16. Domegan L. November 2020. Establishing a COVID-19 Pandemic Severity Assessment surveillance system in Ireland - preliminary findings. ESCAIDE 2020, Online. Oral presentation.

National Conferences

17. Domegan, L. May 2019. 'Epidemiology of Influenza in the paediatric population in Ireland, 2009 – 2019'. Irish Faculty of Public Health Medicine - Summer Scientific conference. Oral presentation (10 minutes).
18. Domegan, L. December 2019. 'Influenza vaccine effectiveness in Ireland during the 2018/2019 influenza season'. Irish Faculty of Public Health Medicine - Winter Scientific conference. Poster and Oral (3 minute) presentations.

Other presentations

19. HPSC Training and Research Forum. Dublin, October 2018. Oral presentation (15 minutes). 'Whole (and partial) genome sequencing-current and future application at HPSC'.
20. HPSC Training and Research Forum. Dublin, March 2019. Oral presentation (10 minutes). 'A geospatial investigation of agricultural and infrastructural risk factors associated with cryptosporidiosis in Ireland, 2008-2017'.
21. UK FETP Project review module. Bristol, March, 2019. Oral presentation. 'A geospatial investigation of agricultural and infrastructural risk factors associated with cryptosporidiosis in Ireland, 2008-2017'
22. EPIET Fellowship Project Review Module_– Prague, August 2019. Oral presentation. 'Moderate influenza vaccine effectiveness in Ireland during the 2018/2019 season'
23. EPIET Fellowship Time Series Analysis module. RIVM, Netherlands, November 2019. Oral presentation on TSA and multilevel modelling (5 minutes). 'Association of antimicrobial consumption with hospital-acquired Clostridioides difficile infection: an ecological study in Ireland, 2013-2017' - slides courtesy of Annalisa Quattrochi, C2017
24. UK FETP Project review module. Birmingham, March 2020. Joint oral presentation (with Cohort 2018, EUPHEM fellow, Carina Brehony). 'Investigation of CPE outbreak in a large tertiary hospital in Ireland 2018-2019, including social network analysis for the investigation of disease transmission'.
25. COVID-19 National Expert Advisory Committee. March 2020. Oral presentation - 'COVID-19 Pandemic Severity Assessment Monitoring System for Ireland'.
26. EPIET Fellowship Vaccinology module. Online, June 2020. Oral presentation (20 minutes). 'Monitoring Influenza Vaccine Effectiveness in Ireland'.
27. Beaumont Hospital Journal Club. November 2020. CPE OXA-48 hospital ward outbreak in Ireland 2018-2019 - investigation of transmission patterns using social network analysis and genomics. Joint EPIET and EUPHEM oral presentation.

Reports

List of reports

28. HSE Health Protection Surveillance Centre. Influenza and Other Seasonal Respiratory Viruses in Ireland, 2017/2018. Dublin: HSE HPSC; 2018. https://www.hpsc.ie/a-z/respiratory/influenza/seasonalinfluenza/surveillance/influenzasurveillancereports/seasonsummaries/Influenza%202017-2018%20Annual%20Summary_Final.pdf
29. Domegan L, O'Donnell J. Overview of the 2017/2018 influenza season in Ireland. Epi-insight, Vol 19 (11). November 2018. http://www.hpsc.ie/epi-insight/volume192018/
30. Domegan L, O'Donnell J. HSE Health Protection Surveillance Centre. Epidemiology of Influenza in the Paediatric Population in Ireland, 2000 – 2018. Dublin: HSE HPSC; 2018. [HPSC report].
31. Arnott J, Quattrocchi A, Domegan L, Hunt M, Flanagan P, O Donnell J. Quadrivalent Influenza Vaccine Review, November 2018. HPSC report. November 2018. [HPSC report].
32. Monitoring of Influenza Vaccine Effectiveness (IMOVE) in Ireland. Protocol, 2018/19 season.
33. Monitoring of Influenza Vaccine Effectiveness (IMOVE) in Ireland. Protocol, 2019/20 season.
34. Monitoring of Influenza Vaccine Effectiveness (IMOVE) in Ireland. Interim report, 2018/19 season. February 2019. Submitted as an I-MOVE deliverable to ECDC.
35. Monitoring of Influenza Vaccine Effectiveness (IMOVE) in Ireland. End of season report, 2018/19 season. July 2019. Submitted as an I-MOVE deliverable to ECDC.
36. Monitoring of Influenza Vaccine Effectiveness (IMOVE) in Ireland. Interim report, 2019/20 season. March 2020. Submitted as an I-MOVE deliverable to ECDC.

37. Monitoring of Influenza Vaccine Effectiveness (IMOVE) in Ireland. End of season report, 2019/20 season. September 2020. Submitted as an I-MOVE deliverable to ECDC.
38. Report on establishing a COVID-19 Pandemic Severity Assessment (PSA) surveillance system in Ireland. July 2020. HPSC report.
39. Report on preliminary findings of COVID-19 Pandemic Severity Assessment (PSA) in Ireland. July 2020. HPSC report. Submitted to COVID-19 National Pubic Health Emergency Team (NPHET). HPSC report.
40. Situation report on Salmonella Bredeney International Outbreak, 2019 – involving UK, Ireland and Romania. September 2019. Submitted to EPIS.
41. An outbreak of Norovirus linked to Christmas party events in a Hotel, Ireland, December 2019. Protocol. January 2020.
42. An outbreak of Norovirus linked to Christmas party events in a Hotel, Ireland, December 2019. Final Outbreak report. August 2020 (delayed due to COVID-19 pandemic).
43. Short report on mumps case scenarios - Mumps National Outbreak, Ireland, 2018-2020. Due to be published on HPSC website. www.hpsc.ie.
44. CPE hospital outbreak in Ireland 2018-2019 - investigation of transmission patterns using social network analysis and whole genome sequencing – Joint EPIET and EUPHEM project. Protocol. May 2019.
45. CPE hospital outbreak in Ireland 2018-2019 - investigation of transmission patterns using social network analysis and whole genome sequencing – Joint EPIET and EUPHEM project. Social Network Analysis report. August/September 2020.
46. CPE hospital outbreak in Ireland 2018-2019 - investigation of transmission patterns using social network analysis and whole genome sequencing – Joint EPIET and EUPHEM project. Co-author - Microbiological analysis report. July 2020.
47. Cryptosporidium geospatial ecological study (including GIS). Protocol. September 2019.
48. Cryptosporidium geospatial ecological study (including GIS). Geocoding methodology report. November 2019.
49. Teaching reflective note – Salmonella case study
50. Surveillance reflective note – COVID-19 Pandemic Severity Assessment surveillance system

Other

Short articles/news items for Ireland's National Epidemiological bulletin - Epi-insight

51. Domegan L, Hunt M, Bruton O, O'Donnell J. 'Interim 2018/2019 influenza vaccine effectiveness estimates for Europe, October 2018 to January 2019'. Epi-insight, Vol 20 (4). April 2019. https://ndsc.newsweaver.ie/epiinsight/2a7hnqf8fdh10gkzp9yxn5?a=1&p=54794821&t=17517774
52. Domegan, L. 'Field Epidemiology and Public Health Microbiology traveling photo exhibition'. Epi-insight, Vol 20 (8). August 2019. https://ndsc.newsweaver.ie/epiinsight/13nz07ml6mb10gkzp9yxn5?a=1&p=55435972&t=17517774
53. Domegan, L. on behalf of the Influenza and Pneumococcal I-MOVE+ teams in Ireland '"Etoiles de l'Europe" 2019 award for European vaccine surveillance projects, involving Ireland.' Epi-insight, Vol 21 (1). January 2020. https://ndsc.newsweaver.ie/epiinsight/1jgr2tyi7im-1466qakmrz?a=1&p=56221600&t=17517774
54. Group article - ECDC Fellowship Programme: The Irish Experience. Epi-insight, Vol 21 (4). September 2020. https://www.hpsc.ie/epi-insight/

5. Teaching activities

Title: Lectures - Influenza surveillance

Lisa developed and delivered 1-hour lectures on Influenza Surveillance on 18 October 2018 and 12 September 2019, for Masters students in Healthcare Infection Management (Trinity College, Dublin, Ireland). Lisa developed evaluation forms which the students completed at the end of the lectures. Lisa communicated the outcome of the evaluations with the Masters course coordinator (Trinity College Dublin).

Title: Seminar – Whole Genome Sequencing

Lisa developed material for a seminar on whole genome sequencing on the 31 October 2018 at HPSC, as part of HPSC's Training and Research Forum attended by HPSC medical and scientific staff. The seminar was delivered by Lisa and two other scientists over a one-hour period. Lisa developed an evaluation form which was completed by participants at the end of the seminar.

Title: Case Study – Analysing influenza Vaccine Effectiveness using R

Lisa reviewed a case study on 'Analysing flu VE: A mixed case study with a non-computer component and a computerised component using R' for the European I-MOVE network in October-November 2018.

Title: Training – Routine Influenza Surveillance and COVID-19 Outbreak Surveillance

Lisa developed training material and Standard Operating Procedures and provided training for Surveillance Scientists and Surveillance Assistants on routine influenza surveillance (2018-2019) and for surveillance of COVID-19 outbreaks/clusters (2020).

Title: Case study - Salmonella Outbreak at a wedding in Dublin

Lisa facilitated the case study 'Salmonella Outbreak at a wedding in Dublin (cohort study)' on two occasions (13 and 14 November 2019) 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 understand environmental investigations and control measures. Lisa produced a teaching reflection note.

Educational outcome:

These teaching activities allowed me to gain invaluable experience in the development and delivery of teaching material for epidemiology in a variety of settings and scenarios, including routine training, delivering lectures and seminars and case studies. Teaching outbreak investigations in the form of a case study, supported a deeper understanding of food borne outbreaks. Teaching alongside an epidemiologist with extensive experience in food borne outbreaks and also with food safety scientists, also contributed to my knowledge in this area. Facilitating the case studies with food scientists, helped me understand, the benefits of a multidisciplinary approach to teaching outbreak investigations. Evaluating teaching sessions/lectures was a real learning experience for me, highlighting areas for improvement and the needs of the students. The evaluations helped me identify how to target teaching material to an audience.

Supervisor: Patricia Garvey, Surveillance Scientist & EPIET supervisor.

6. Other activities

- Co-moderated session at International Influenza Vaccine Effectiveness meeting - annual I-MOVE meeting - Veyrier, France. June 2019.
- Epiet fellow (and Senior Exchange) planned site visit to National Centre of Epidemiology, Institute of Health Carlos III, Madrid, Spain. February 2020. Fellow wrote proposal and produced agenda for planned trip. Trip postponed due to COVID-19 Pandemic.

7. EPIET/EUPHEM modules attended

- Introductory Course, 24 September - 10 October 2018, Spetses, Greece
- Outbreak Investigation Module, 3-7 December 2018, Berlin, Germany
- Multivariable Analysis, 25-29 March 2019, Madrid, Spain
- Rapid Assessment and Survey methods, 13-18 May 2019, Zagreb, Croatia
- Project Review Module, 26-30 August 2019, Prague, Czech Republic.
- Management, Leadership and Communication in Public Health, 10-14 February 2020, Stockholm, Sweden
- Vaccinology Module, 4 May – 24 June, 2020, online.

- Institute Pasteur, SPOC (Small Private Open Course), 4 May – 12 June 2020, online.
- Rijksinstituut voor Volksgezondheid en Millieu (RIVM), facilitated sessions, 22-24 June 2020, webinar.

Other training

- UK-FETP Master Class on Network Analysis in Outbreak Investigations (1 hour) – 19/09/2018
- Irish Health Research Regulations Seminar (2 hours) - 19/10/2018
- Attended workshop on Irish Health Research Regulations (0.5 day) – 06/12/2019
- Introduction to Outbreak Investigation - E-learning course- ECDC-EVA (estimated 6-8 hours). October-November 2018
- Bacterial Genomes: Disease Outbreaks and Antimicrobial Resistance – Online UK course from Wellcome Genome Campus. October 2018-March 2019.
- Attended Cohort 2018 Webinar series (one hour each) – various topics including Measles; Randomised control trials; Getting started with R, Exceedances.
- Rapid Risk Assessment E-Learning course (pilot edition) – ECDC-EVA (estimated time 3-5 hours). November - December 2018.
- Training on Health Atlas Geo-referencing (0.5 day) and on research microdata files with Central Statistics Office (CSO) (0.5 day). January 2019.
- Short training days on Systematic Reviews and Meta-Analysis – School of Public Health, University College Dublin. (2x0.5 days). January 2019.
- Influenza Bioanalytics E-Learning course (pilot edition) – ECDC EVA. Estimated time >5 hours. February-April 2019.
- Writing and Reviewing Scientific Abstracts: a field epidemiology focus (18 hours). ECDC-EVA. 4-28 March 2019.
- UK-FETP Project Review Module – Bristol, 18-19 March 2019.
- UN BSAFE online course. Estimated time >2 hours. April-May 2019.
- Cross-border sharing of public health data - E-learning course- ECDC-EVA. July-August 2019.
- Introduction into R for Outbreak Analytics, Stockholm, Sweden, a RECON Learn and EAN course (2 days). 25-26 November 2019.
- UK-FETP Project Review Module – Birmingham, 2-4 March 2020.

Supervisor's conclusions

Lisa has fully embraced the opportunities that come with being an EPIET fellow. She has undertaken several important projects, covering the surveillance, outbreaks and research curriculum. Her prodigious organisational skills were displayed during the I-MOVE project, where her negotiations on the classification of the I-MOVE project as a surveillance activity following the implementation of the Health Research Regulations 2018 will be a lasting legacy for the future running of the project in Ireland. The development of the Pandemic Severity Assessment (PSA) monitoring system for COVID-19 is a first for Ireland, and will make an important contribution to Irelands COVID response in the coming months. She has gained a wide range of experience in outbreak investigations; and has established a precedent in Ireland for the use of social network tools for epidemiological investigation of a hospital outbreak. The experience she has gained using R as well as STATA is critical for HPSC as more projects move to using R. She has strengthened her communication skills, presenting to a wide range of audiences, including outbreak control teams, the COVID expert advisory group, and to scientific audiences through presentations and papers. She has honed her use of 'the argument matrix' and developed a tighter more focussed use of language in her writing. I have no doubt she will continue to benefit from the training and contacts she has gained during the fellowship in the future, to the benefit of HPSC.

Coordinator's conclusions

Lisa was already well experienced in public health when she started as fellow in the EPIET programme. However, she managed to find suitable projects during her fellowship that allowed her to improve her skills even further. She especially gained a lot of experience in outbreak investigation (on international, national and local level) and in developing public health recommendations and messages and communicating these tailored to different audiences. Furthermore, she markedly improved her competencies in the area of public health science and policy, management, teaching and scientific writing. A joined EPIET-EUPHEM project allowed Lisa to enhance her knowledge of WGS and other laboratory techniques. Lastly, she greatly improved her statistical skills, learning to work with the software R additionally to STATA.

Personal conclusions of fellow

During the two years of my fellowship, I gained advanced statistical, analytical and epidemiological skillsets, enhanced oral communication and writing skills and experience in teaching and pedagogy, project management and coordination, through the EPIET training modules and projects conducted at HPSC, Dublin, Ireland. HPSC is an excellent training site, where I applied the skills I developed on a wide variety of interesting projects using varied methodology in different disease specific areas and settings, with 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 COVID-19 pandemic presented a unique opportunity to work as an epidemiologist on a national pandemic response. This has been a humbling experience as an epidemiologist and I have learnt so much about the Irish Health System and the work of WHO and ECDC during a pandemic. I stand in awe of the incredible dedication, determination, hard-work, skill and expertise of my colleagues at HPSC and in local Departments of Public Health and all those working in the Irish Health system.

The experience of learning from fellowship coordinators, who are among the most highly skilled and experienced epidemiologists in Europe was a privilege. Furthermore, the EPIET programme has enabled me to strengthen a network of public health colleagues (and friends) across Europe. This fellowship has been a very important and significant step for my career as an epidemiologist in Europe and I look forward to using the skills I have gained in in the COVID-19 pandemic response.

Acknowledgements

I would like to thank my supervisor Patricia Garvey and co-supervisor Jolita Mereckiene for their excellent supervision, mentoring, support and time during my fellowship. Many thanks also to my EPIET co-ordinators Alicia Barrasa, Frantiska Hruba and Tanja Charles for imparting their skill and expertise and for their invaluable advice, encouragement and kind support during my fellowship. I am also very grateful to the UK-Field Epidemiology Training Programme (UK-FETP) who are very supportive of Irish fellows, providing epidemiological and statistical advice during UK-FETP project review modules every year.

I would like to acknowledge the Assistant National Director - Strategic Planning and Transformation, Public Health and Child Health, Health Service Executive and former acting Director of HPSC, Dr Kevin Kelleher for his encouragement and support, allowing me the opportunity to apply for this fellowship in 2018. I would also like to greatly acknowledge the current HPSC Director, Dr John Cuddihy for his support throughout my fellowship and for the protected time to work on my fellowship. Many thanks also to Dr Lorraine Doherty, National Clinical Director of Health Protection and to all members of the National Health Protection Pandemic Incident Control Team (PICT). I really appreciate the opportunity to be on PICT, it continues to be an invaluable learning experience for me.

I am extremely grateful to Dr Joan O'Donnell, who has been so supportive and encouraging throughout my fellowship, in particular during the COVID-19 pandemic. Also, many thanks are due to Niamh Murphy, Sarah Jackson, Orla Bruton and other colleagues for their time covering my previous role.

Many thanks are also due to Karen Burns, Margaret Foley, Peter Finnegan, Elaine Brabazon, Lois O'Connor, Suzanne Cotter, Sarah Gee and their colleagues/teams for providing the opportunity to work on various outbreaks and for their support and advice. I am also grateful to Coilín ÓhAiseadha, Paul Hynds, Jean O'Dwyer, Howard Johnson and Trish for their advice and time they devoted to my cryptosporidiosis project.

To all of my colleagues at HPSC, thanks for allowing me the opportunity to benefit from the EPIET programme. I would particularly like to thank Kate O'Donnell and Stephen Murchan who provided endless advice and support.

Many thanks to Margaret Fitzgerald (HPSC Senior Surveillance Scientist) for her encouragement in applying for this fellowship and throughout the entire two years. Many thanks to all past and present EPIET and EUPHEM fellows in Ireland for all their advice and friendship during my fellowship, in particular to Annalisa Quattrochi (Cohort 2017), from whom I learnt so much during the year we shared an office and to Carina Brehony (EUPHEM Fellow, Cohort 2018) for the truly collaborative work during our joint EPIET/EUPHEM projects. To Annamaria Ferenczi and Jolita Mereckiene, it was a pleasure sharing an office. To all of the fellows of Cohort 2018, I have learnt so much from each of you during this fellowship, it has been an inspirational shared experience and the start of life-long friendships and collaborations.

My warmest thanks and gratitude are extended to my family, who were incredibly supportive and encouraging throughout the entire two years.