Louise Marron
The European Programme for Intervention Epidemiology Training (EPIET), Cohort 2022
Health Protection Surveillance Centre, Dublin, Ireland

Background

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

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

Pre-fellowship short biography

Louise Marron is a medical doctor who is dual specialty trained in General Practice and Public Health Medicine. After undertaking professional examinations, Louise achieved her Membership of the Royal College of Physicians of Ireland (MRCPI) in 2011, the Irish College of General Practitioners (MICGP) in 2016, and the Faculty of Public Health Medicine in Ireland (MFPHMI) in 2021. She completed a Master's Degree in Public Health (MPH) in 2018. Prior to her fellowship, Louise worked regionally and nationally in public health in Ireland, including in the Health Protection Surveillance Centre, the National Immunisation Office, and the Department of Public Health in the East of Ireland. Louise has a particular interest in vaccine-preventable diseases.

Results

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

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

Stockholm, February 2025

1. Epidemiological investigations

1.1. Outbreak investigations

1.1.1 An outbreak of norovirus linked with a social event, Ireland, 2024

Supervisor: Dr Patricia Garvey, Principal Epidemiologist, Health Protection Surveillance Centre, Dublin, Ireland

Category: Food- and waterborne diseases

Introduction: In 2024, a regional Department of Public Health in Ireland was notified of an outbreak of norovirus among attendees at a social event that took place in a commercial venue. We conducted a retrospective cohort study among adult event attendees to investigate a potential food source as the vehicle of transmission.

Methods: An online questionnaire collected demographic, symptom, healthcare utilisation, and food exposure information. We calculated food-specific attack rates (AR) and adjusted risk ratios (aRR) using multivariable binomial regression.

Results: The AR within the study population was 55%. The shape of the epidemiological curve suggested a point source outbreak. The peak of cases occurred within 24 hours of the event. In univariable analysis, two food exposures (food 1 and food 2) were associated with an increased risk of gastrointestinal illness. However, multivariable analysis indicated no significant association between the consumption of any food served at the event and an increased risk of gastrointestinal illness (aRR 1.71 (95% CI 0.84–3.61) for food 1 and aRR 1.48 (95% CI 0.71–2.99) for food 2). There were reports of gastrointestinal illness among guests with onset on the day of the event which preceded food exposures. Norovirus was confirmed in five attendees; there was no illness reported among staff or any non-event attendee before or after the event.

Conclusions: This cohort study did not provide evidence for any food source as a vehicle for transmission of infection in this outbreak. A plausible source of infection may have been person-to-person spread of norovirus from attendees who were unwell at the event. This outbreak therefore highlights the potential for a social event to facilitate transmission of viral gastroenteritis due to norovirus.

Role: Louise was the lead investigator for the analytical epidemiological investigation and was a member of the Outbreak Control Team (OCT). Working with the regional Department of Public Health, Louise developed the study protocol and the questionnaire. Louise collated the questionnaire data and conducted all data analysis and interpretation, presented the key findings to the OCT, and authored an outbreak report (see section 4.1.2, Report 1).

1.1.2 The development and implementation of a national Measles Contact Tracing Database in Ireland, 2024

Supervisor: Dr Lois O'Connor, Consultant in Public Health Medicine, National Health Protection Office, Ireland

Category: Vaccine-preventable diseases

Introduction: Contact tracing is critical to inform public health action to manage and control the spread of measles. In the context of a surge of measles cases in Ireland in 2024, and a related increase in measles contact-tracing activities, a multidisciplinary Measles Contact Tracing Database Team (MCTDT) was formed, to pilot and operationalise a measles contact-tracing tool. This was adapted from a contact-tracing tool developed by a Regional Department of Public Health to create a standardised contact-tracing process across the Regional Departments of Public Health and enable the collation of contact-tracing data at regional and national levels to inform public health action.

Methods: The user interface was an excel sheet with dynamic cell content to support public health professionals undertaking contact tracing in response to notification of measles cases. An automation and analysis system with an R-script created an area database providing a summary of cases, contacts and epidemiological links to monitor public health activities and actions. A pseudo-anonymised dataset was merged into the national database to allow for national reporting on the epidemiology of measles contacts to the National Incident Management Team (NIMT).

Results: As of July 2024, over 2,000 close contacts of 78% of the 68 confirmed measles cases were recorded in the database which is being used by all Regional Departments of Public Health in Ireland. The MCTDT provided a practical, standardised, dynamic contact-tracing database to assist Public Health clinical teams and facilitated regional and national analysis.

Role: Louise was a member of the MCTDT and the national measles IMT. She provided clinical and epidemiological advice to the MCTDT, specifically in the inital phase in relation to the collection of variables to expand the use of the regional contact-tracing tool for national use. Louise supported the team and advised about adapting and editing the tool as the roll-out commenced.

1.1.3 Measles in Ireland, January to June 2024: Focus on imported measles cases

Supervisor: Dr Lois O'Connor, Consultant in Public Health Medicine, National Health Protection Office, Ireland

Category: Vaccine-preventable diseases

Introduction: Measles was eliminated in Ireland in 2018. However, as uptake of both doses of the MMR vaccine has been below the recommended 95% to achieve population-level immunity, Ireland has remained at risk of measles importation and related secondary spread within under-vaccinated populations. In 2024, Ireland experienced a surge of measles cases in the context of large outbreaks occurring in multiple countries in Europe and the United Kingdom. We aimed to describe the epidemiology of measles in Ireland from 1 January to 30 June 2024, with a focus on imported measles cases, to inform the ongoing public health response to measles in Ireland.

Methods: We used the national surveillance database (CIDR) and laboratory data (including measles virus sequencing data) from the National Virus Reference Laboratory (NVRL) to describe measles cases, outbreaks and genetically related clusters by time, person and place, overall and by measles importation status.

Results: Among 67 confirmed measles cases in Ireland, 18 (27%) were imported. Of these, 78% (14/18) had a country of infection in Europe. Among all cases, 64/67 (96%) were not fully vaccinated and 19/67 cases (28%) were of Roma ethnicity. Ten outbreaks with 46 linked cases were reported with spread in household, school and nosocomial settings. Five genetically related clusters with 60 (90%) linked cases were identified. Among all the cases (n=67), the mode of acquisition of measles infection was unknown for 10 (15%) cases.

Conclusions: The clinical and molecular epidemiology of measles in the first six months of 2024 in Ireland has highlighted the risk of measles importation, the risk of measles in those who are unvaccinated, the risk in under-served populations, including the Roma community. The findings emphasise the importance of prompt recognition of measles cases to allow for contact tracing and implementation of control measures to reduce the risk of onward transmission. Additionally targeted MMR vaccination campaigns, particularly for under-served communities, should continue in addition to addressing immunity gaps.

Role: Louise was a member of the national measles Incident Management Team (IMT). Louise collaborated with the Vaccine Preventable Diseases (VPD) team in the Health Protection Surveillance Centre (HPSC), the National Virus Reference Laboratory (NVRL), and the Measles Contact Tracing Database Team (MCTD) to complete this study. She authored a study report with recomendations in July 2024 for the national measles IMT.

1.1.4 An increase in non-tuberculosis mycobacterium infections in Ireland, 2022

Supervisors: Dr Lisa Domegan, Principal Epidemiologist, Health Protection Surveillance Centre, Ireland; Dr Robert Cunney, Consultant Microbiologist, Children's Health Ireland

Category: Emerging and re-emerging diseases including vector-borne diseases

Introduction: In 2022, a signal of increased numbers of skin and soft tissue infections due to non-tuberculosis mycobacterium (NTM) was observed by hospital-based paediatricians in Infectious Diseases and Otolaryngology in Ireland. In Ireland, until April 2015, there was a universal Tuberculosis (TB) BCG vaccination programme. We aimed to describe the epidemiology of NTM infections in children in Ireland between 2007 and 2022 to determine if the epidemiology of NTM had changed before and after cessation of the universal BCG programme.

Methods: The proposed study population was paediatric cases of NTM in two national tertiary paediatric centres. A case was defined as a child aged less than 16 years with a clinical or laboratory diagnosis of NTM skin or soft tissue infection. Case finding was from clinical and laboratory hospital records. A data extraction tool was developed to extract data from clinical medical records. An ethics application was completed. A descriptive analysis of NTM infection in Ireland was planned to describe paediatric NTM cases in terms of time, person and place. Overall and age-specific incidence rates of NTM before and after cessation of the BCG programme would be calculated. This study would inform the development of national guidelines to inform the clinical and public health management of NTM infection in children. It would also estimate the burden and impact of NTM on health services and inform health services planning for NTM. Unfortunately, due to lack of availability of data and another study that had already commenced within a paediatric hospital, this study did not proceed.

Role: Louise developed a draft project proposal including the development of a case definition. She developed a draft ethics application in collaboration with the EUPHEM fellow, Lieke Brouwer, in the Public Health Laboratory in Dublin, Ireland. Louise proposed variables for collection and provided epidemiological advice to clinical colleagues on a data collection tool that had been developed.

1.1.5 An outbreak of VTEC 0157 VT1+2 in Ireland, September 2022

Supervisor: Dr Patricia Garvey, Principal Epidemiologist, Health Protection Surveillance Centre, Ireland

Category: Food- and waterborne diseases

Introduction: In September 2022, the Health Protection Surveillance Centre (HPSC) was notified by the Public Health Laboratory (Verotoxigenic *Escherichia* Coli (VTEC) national reference laboratory, VTEC NRL) of 17 VTEC 0157 VT1+2 cases that clustered through routine whole genome sequencing (WGS). The isolates were distinct from other isolates previously seen in Ireland. The cluster was genetically related to an ongoing outbreak in the United Kingdom (UK) with over 100 confirmed cases. As a result of the identification of this cluster of illness, an outbreak was declared, and a multidisciplinary outbreak control team (OCT) was convened by the HPSC to initiate an outbreak investigation.

Methods: We undertook a descriptive epidemiological investigation. Regional Departments of Public Health undertook trawling questionnaires on confirmed cases. Trawling questionnaires were collated by HPSC and shared with environmental health professionals and the Food Safety Authority in Ireland.

Results: There were 25 confirmed cases, 17 females and 8 males, the age range was 17–84 years, distributed geographically across five out of the six regional public health areas in Ireland. No definite food exposure signal was identified on trawling questionnaires. No further cases were reported, and the outbreak was declared over after more than three maximal incubation periods had passed.

Conclusions: As there was no clear signal to generate a hypothesis, we did not undertake a case–control study. An outbreak investigation in the UK suggested the possibility that the source was a single supplier supplying food to the Irish market due to a brief but extensive contamination, possibly due to the use of contaminated irrigation water.

Role: Following the initial notification, Louise worked with the OCT to develop the trawling questionnaire and collated the information returned by trawling. Louise developed the initial case definition and drafted the initial epidemiological situation report and presented it at the first national OCT meeting and at an OCT meeting in the United Kingdom.

Educational outcome

Leading on the design, analysis and reporting of a cohort study was an excellent learning opportunity for Louise to further develop her skills in outbreak investigation and control. In the outbreak of norovirus linked to a social event (see 1.1.1), Louise delivered an output for the OCT in tight timelines gaining experience in leadership, communication and project management. Through her involvement in this and other outbreak investigations, Louise gained experience in all the steps of an outbreak investigation which will be useful in her career for leading future outbreak investigations.

1.2. Surveillance

1.2.1 An evaluation of the severe acute respiratory infection (SARI) surveillance system in Ireland, September 2021 to November 2022

Supervisors: Dr Lisa Domegan, Principal Epidemiologist, Health Protection Surveillance Centre, Ireland; Dr Joan O'Donnell, Specialist in Public Health Medicine, Health Protection Surveillance Centre, Ireland

Introduction: SARI surveillance in Ireland is an active, hospital-based surveillance system established in July 2021. Expansion of the current single hospital site severe acute respiratory infection (SARI) surveillance programme in Ireland, to create a SARI sentinel hospital network, commenced in 2023. We aimed to assess the performance of key surveillance system attributes to identify areas for improvement within the existing system to inform and guide expansion.

Methods: We conducted a mixed quantitative and qualitative evaluation from September 2021 to November 2022 using ECDC guidance as a framework. SARI surveillance data were analysed to assess completeness, timeliness and the sensitivity of the case definition. Semi-structured focus group discussions, key informant interviews and an online stakeholder questionnaire were used to evaluate usefulness, simplicity, flexibility and acceptability. Qualitative data were analysed using thematic analysis.

Results: Completeness of key variables including age and outcome was 100% (n=747). COVID-19 vaccination status was completed in 89%, completeness of ethnicity data was only 0.6%. Median time from hospitalisation to commencement of data entry was one day (IQR 1–3). Time to receipt of whole genome sequencing (WGS) results was 40 days (IQR 30–61). Themes identified in the qualitative evaluation were the complexity of SARI surveillance and dependence on key individuals and skilled staff. Suggested areas for improvement included process automation and additional resources to improve timeliness and acceptability, particularly during epidemic or pandemic surge periods.

Conclusions: This evaluation concluded that SARI surveillance is a useful, flexible and acceptable surveillance system that reports high-quality, timely data. We recommend that timeliness of WGS data and the recording of vaccination status and equity stratifiers e.g. ethnicity should be improved. Priorities for expansion should be process automation, adequate resource allocation, ongoing strong clinical and public health leadership.

Role: Louise designed the SARI evaluation and developed the study protocol. She led on all aspects of the evaluation including extensive stakeholder engagement. She produced a final evaluation report which included a set of recommendations that were used to inform the expansion of SARI surveillance in Ireland. Louise presented this work internationally at the European Public Health Conference in 2023 and at the Faculty of Public Health Medicine Winter Scientific Meeting in 2023 where it was awarded the first prize for best poster presentation. The abstract for this evaluation was published in the *European Journal of Public Health*. This work was published in BMC Public Health (see sections 4.1.1 and 4.1.2, Manuscript 1 and Report 2).

1.2.2 Influenza vaccine effectiveness against symptomatic laboratory-confirmed influenza in primary care patients in Ireland: A test-negative design case–control study, 2022/2023

Supervisors: Dr Lisa Domegan, Principal Epidemiologist, Health Protection Surveillance Centre, Ireland; Dr Joan O'Donnell, Specialist in Public Health Medicine, Health Protection Surveillance Centre, Ireland

Introduction: Seasonal influenza vaccines are recommended in Ireland for defined risk groups, all those aged 2–17 years and those aged ≥65 years. During the 2022/2023 influenza season, influenza A(H1N1)pdm09, A(H3N2) and B circulated in Ireland. We aimed to estimate influenza vaccine effectiveness (IVE) against symptomatic presentation to primary care with an acute respiratory infection (ARI) due to influenza infection during the 2022/2023 influenza season in Ireland.

Methods:We undertook a test-negative case–control study within the Irish sentinel General Practice surveillance network, which is part of the Vaccine Effectiveness Burden and Impact Studies (VEBIS) network. Influenza vaccination status among laboratory-confirmed influenza cases was compared with laboratory-negative controls. Overall, influenza (sub)type specific and age-specific IVE was estimated using multivariable logistic regression.

Results: In total, 288 cases (27%) and 765 controls (73%) were included in the final analysis of overall IVE estimates. The IVE against any influenza for all ages was 42% (95% CI 9, 54). Among those aged 2–17 years, IVE was 53% (95% CI -25, 85). Overall IVE for all ages was 68% (95% CI 18, 91) against influenza B, 55% (95% CI 8,79) against influenza A(H3N2) and 17% (95% CI -57, 58) against influenza A(H1N1)pdm09.

Conclusions: In 2022/2023, influenza vaccination prevented four in ten vaccinated individuals in all age groups, and over one in two children against medically attended influenza. Influenza vaccination therefore protected population health and the primary healthcare system demonstrating the benefits of vaccination, particularly among children. Seasonal influenza vaccine should continue to be offered and promoted to those in recommended groups, including children.

Role: Louise updated the European protocol for Ireland for the studies of influenza and COVID-19 vaccine effectiveness in primary care for the 2022/2023 season. She led the study of IVE in Ireland and produced an end-of-season report for the 2022/2023 season (see section 4.1.2, Report 3). She presented the findings at the Faculty of Public Health Medicine Summer Scientific meeting in 2024 and at the Five Nations Annual Influenza Surveillance Meeting in 2024. Louise authored a manuscript reporting IVE in the 2022/2023 and 2023/2024 seasons published in *Influenza and Other Respiratory Viruses* (see section 4.1.1, Manuscript 2). Louise presented this work as a poster at the European Public Health Conference in Lisbon in November 2024.

1.2.3 Influenza vaccine effectiveness against symptomatic laboratory-confirmed influenza in primary care patients in Ireland: A test-negative design case–control study, 2023/2024

Supervisors: Dr Lisa Domegan, Principal Epidemiologist, Health Protection Surveillance Centre, Ireland; Dr Joan O'Donnell, Specialist in Public Health Medicine, Health Protection Surveillance Centre, Ireland

Introduction: Live Attenuated Influenza Vaccine (LAIV) is recommended in Ireland for all children aged 2–17 years. Quadrivalent influenza vaccine (QIV) is recommended for all others eligible for vaccination, including those aged ≥65 years and those with specified medical conditions. We aimed to estimate the interim and final influenza vaccine effectiveness (IVE) against acute respiratory infection (ARI) presentations due to influenza to primary care during the 2023/2024 influenza season among children and adults.

Methods: We undertook a test-negative case–control study within the Irish sentinel General Practice surveillance network as part of the Vaccine Effectiveness Burden and Impact Studies (VEBIS) network, from 2 October 2023 to 7 April 2024. We compared influenza vaccination status among influenza PCR-positive cases with influenza PCR-negative controls, both with ARI presentations, of all ages. We estimated IVE using logistic regression adjusting for age, onset time, medical conditions, and sex.

Results: In total, there were 515 cases (25.7%) and 1,482 controls (74.3%). IVE against any influenza was 37% (95% CI 16, 54). Among those aged 2–17 years, IVE was 67% (95% CI 28, 87). IVE was 36% (95% CI -5, 62) against influenza A(H1N1)pdm09, 31% (95% CI 1, 52) against influenza A(H3N2), and 87% (95% CI 52, 99) against influenza B.

Conclusions: Influenza vaccination reduced the risk of influenza among ARI patients presenting to general practice, demonstrating the benefits of vaccination, particularly among children. Promotion of the seasonal influenza vaccine to recommended groups should remain a public health priority. Targeted vaccination campaigns for children promoting LAIV should emphasise higher IVE in children.

Role: Louise updated the European protocol for Ireland for the studies of influenza and COVID-19 vaccine effectiveness in primary care for the 2023/2024 season. She led the study of IVE in Ireland and produced an end-of-season report for the 2023/2024 season (see section 4.1.2, Report 4). She presented the findings at the Faculty of Public Health Medicine Summer Scientific meeting in 2024 and at the Five Nations Annual Influenza Surveillance Meeting in 2024. Louise authored a manuscript reporting IVE in the 2022/2023 and 2023/2024 seasons published in *Influenza and Other Respiratory Viruses* (see section 4.1.1, Manuscript 2). Louise presented this work as a poster at the European Public Health Conference in Lisbon in November 2024.

Educational outcome

Leading on the surveillance projects allowed Louise to gain extensive additional experience in epidemiological study design, protocol development, data analysis, and scientific communication. As these projects were undertaken within the Vaccine Effectiveness Burden and Impact Studies (VEBIS) network, Louise participated in the European SARI evaluation led by Epiconcept and attended training in vaccine effectiveness with Epiconcept. This was an excellent opportunity to further develop skills, knowledge and experience through learning from international experts. All surveillance projects undertaken were presented and submitted for peer-reviewed publication allowing Louise to gain additional experience in scientific communication and academic writing.

2. Applied public health research

2.1 The impact of the COVID-19 vaccination programme on symptomatic and severe SARS-CoV-2 infection during a period of Omicron variant dominance in Ireland, December 2021 to March 2023

Supervisor: Dr Lisa Domegan, Principal Epidemiologist, Health Protection Surveillance Centre, Ireland

Introduction: In Autumn 2023, COVID-19 booster vaccines were offered to all aged 50 years and older in Ireland. There was concern that vaccine fatigue would have an impact on uptake. We aimed to quantify the direct impact of the COVID-19 vaccination programme on averted outcomes in individuals aged 50 years and older, during a period of Omicron variant dominance, to inform vaccination strategy and public health communication.

Methods: We conducted a retrospective observational study from December 2021 to March 2023 in Ireland. We defined averted outcomes as symptomatic SARS-CoV-2 presentations to primary care/community testing centres, emergency department (ED) presentations, hospitalisations, intensive care unit (ICU) admissions and deaths due to COVID-19. We adapted a formula from other published vaccine impact studies, including national data on notified outcomes, vaccine coverage data and vaccine effectiveness (VE) estimates. This was sourced from the WHO's live systematic VE review to estimate the count and prevented fraction of outcomes in those aged 50 years and older averted by the COVID-19 vaccination programme. We calculated the number of expected outcomes in the absence of vaccination by summing the counts of outcomes observed and outcomes averted.

Results: The COVID-19 vaccination programme averted 48,551 symptomatic presentations to primary care/community testing centres (36% of expected), 9,517 ED presentations (53% of expected), 102,160 hospitalisations (81% of expected), 3,303 ICU admissions (89% of expected), and 15,985 deaths (87% of expected).

Conclusions: During Omicron dominance, the COVID-19 vaccination programme averted symptomatic and severe outcomes, including deaths due to COVID-19, underscoring the benefits of COVID-19 vaccination. In the context of vaccine fatigue emerging as an important public health issue in Ireland and internationally, we recommend that these findings should be used to inform future COVID-19 booster vaccination programmes and communication about the benefits and importance of COVID-19 vaccination.

Role: Louise designed this study and wrote the study protocol. She led on all aspects of this study including on collaboration with international colleagues in the Italian National Institute and the World Health Organization for methodological advice. She wrote the report (see section 4.1.2, Report 5) and communicated the findings nationally including to the Chief Medical Officer in Ireland and the Chief Clinical Officer of the Health Service Executive in Ireland. The findings were used in the vaccination communication campaign for the Autumn Winter COVID-19 Vaccination programme in Ireland in 2023/2024. Louise also authored a manuscript (see section 4.1.1, Manuscript 3) published in *Eurosurveillance*. She presented the findings at the Faculty of Public Health Medicine Winter Scientific Meeting at the Royal College of Physicians in Ireland in 2023 and presented a poster at the European Public Health Conference in Lisbon in November 2024.

2.2 PRECISE 5: COVID-19 in Healthcare Workers in Ireland: A prospective cohort study, December 2022 to September 2023

Supervisor: Dr Lisa Domegan, Principal Epidemiologist, Health Protection Surveillance Centre, Ireland

Introduction: Hospital healthcare workers (HCWs) have a high exposure risk to SARS-CoV-2 and are a high-risk population for SARS-CoV-2 infection, despite high rates of prior infection and COVID-19 vaccination. We aimed to identify factors associated with SARS-CoV-2 seropositivity and incident infection in HCWs in two hospital sites in Ireland.

Methods: In this prospective cohort study, we followed hospital HCWs from December 2022 to September 2023. SARS-CoV-2 anti-nucleocapsid (anti-N) antibodies were measured at study enrolment. An enrolment questionnaire recorded demographic data, underlying medical risk factors for severe SARS-CoV-2 infection, and history of previous infection. Monthly questionnaires recorded self-reported incident SARS-CoV-2 infection. COVID-19 vaccination status was verified using the national COVID-19 vaccination database in Ireland. To identify factors associated with seropositivity and incident infection, we calculated adjusted Odds Ratios (aOR) using multivariable logistic regression.

Results: Among 1,260 participants, 80% were seropositive, 91% had received at least one COVID-19 booster vaccine, and 22% reported incident infection. HCWs aged 50 years and older were less likely to be seropositive (aOR=0.41, 95% CI 0.22–0.74). Having at least one medical risk factor for severe infection was associated with incident infection (aOR=1.67, 95% CI 1.04–2.65), as was increased time (>180 days) since last SARS-CoV-2 infection (aOR=1.86, 95% CI 1.24–2.84).

Conclusions: Despite high rates of seropositivity and vaccination coverage, hospital HCWs had a high rate of SARS-CoV-2 incident infection. Our findings suggest that COVID-19 booster vaccination programmes for HCWs should target older age groups, those with underlying medical risk factors, and those with increased time since last infection (>180 days). We recommend strengthening surveillance of SARS-CoV-2 infection in HCWs to enable targeted COVID-19 vaccination programmes.

Role: Louise wrote the study protocol and the data analysis plan. She conducted all data cleaning and data analysis and wrote the final PRECISE 5 report (see section 4.1.2, Report 6). She co-authored the manuscript (see section 4.1.1, Manuscript 4) published in an international peer-reviewed journal. Louise presented the findings at the Faculty of Public Health Medicine Summer Scientific Meeting in 2024 at the Royal College of Physicians in Ireland and an oral presentation at ESCAIDE in November 2024.

Educational outcome

Leading the COVID-19 vaccine impact study provided the opportunity for Louise to lead on the design and delivery of a research activity that aligned with national priorities within timelines. Louise reported on the findings of this study prior to the launch of the 2023/2024 vaccination programme. She developed communication materials that were used to support the media campaign and promote vaccination among healthcare workers. By leading this COVID-19 vaccine impact study, Louise contributed to the national and international evidence base and informed public health communication and action. Involvement in PRECISE 5 was an opportunity for Louise to collaborate with multidisciplinary colleagues and build positive and efficient working relationships as part of a research collaboration. Both research projects were an opportunity to gain experience in data management, data analysis and scientific communication both written and oral.

3. Teaching and pedagogy

Case study: An outbreak of *Salmonella* at a wedding in Ireland, November 2022

Louise facilitated a case study on an outbreak of *Salmonella* at a wedding in Ireland in November 2022 for veterinary students at the School of Veterinary Medicine, University College Dublin. A pre-existing case study was used to deliver this teaching which was supplemented with pre-reading materials. Louise produced a teaching reflective note.

Lecture: The national and international role of the Health Protection Surveillance Centre, May 2023

Louise delivered a lecture on the national and international role of the Health Protection Surveillance Centre in Ireland to MSc students in Health Care Infection Management at Trinity College Dublin, as part of an in-person lecture series in HPSC in May 2023. Louise adapted existing lecture materials (which she had also developed for previous lecture series) to the learning needs of the students, based on a review of the course curriculum. She designed an evaluation which assessed the usefulness of the lectures and identified areas of interest for future lecture series. Overall, the lecture series, including Louise's lecture, was positively evaluated by the students. Louise produced a teaching reflective note and an evaluation report.

Training programme: Lab for Epi

In collaboration with the Cohort 2022 EUPHEM fellow (Lieke Brouwer) in the Public Health Laboratory in Dublin, Ireland, Louise designed and delivered a training programme in Public Health Microbiology for Epidemiologists and Public Health Doctors working regionally and nationally in Ireland. This was a training day with a morning lecture series and an afternoon case-study. Working with the EUPHEM fellow, Louise adapted an outbreak report of a waterborne VTEC outbreak to create a case-study. She was a facilitator for the case-study and also delivered a lecture as part of the lecture series on the 10 steps of an outbreak investigation. She designed and reported on a course evaluation which identified that the Lab for Epi training day was useful and informative for participants. It is planned that this training will be delivered at least annually as a joint EPIET/EUPHEM project, and the case-study has been shared with colleagues internationally. In Finland, the case-study has been used for teaching and educational purposes for PhD students in Infectious Disease Epidemiology and for training at the National Public Health Institute. Louise also wrote an article for Epi Insight (a national bulletin from HPSC) describing the training session and the evaluation.

Educational outcome

Involvement in teaching activities was an excellent opportunity for Louise to further develop her teaching skills, knowledge and experience. The audiences for the teaching activities were different and included undergraduate and postgraduate students as well as multidisciplinary public health professionals. This was an opportunity for Louise to demonstrate her flexible teaching style by adapting materials for different audiences. Through evaluating her performance and the performance of the teaching programmes, Louise had the opportunity to receive feedback which is useful for developing and delivering future teaching initiatives in her career.

4. Communication

4.1 Publications related to the EPIET fellowship

4.1.1 Manuscripts published in peer-reviewed journals

1. **Marron, L**, Duffy, R, O'Donnell, J, et al. An evaluation of the severe acute respiratory infection surveillance system in Ireland. BMC Public Health 25, 492 (2025). https://doi.org/10.1186/s12889-025-21645-3

2. **Marron, L,** McKenna, A, O'Donnell, J, Joyce, M, Bennett, C, Connell, J and Domegan, L (2024), Influenza Vaccine Effectiveness Against Symptomatic Influenza in Primary Care: A Test Negative Case Control Study Over Two Influenza Seasons 2022/2023 and 2023/2024 in Ireland. Influenza Other Respi Viruses, 18: e70023. https://doi.org/10.1111/irv.70023

3. **Marron L**, Mateo-Uridales A, O'Donnell J, Robinson E, Domegan L. The impact of the COVID-19 vaccination programme on symptomatic and severe SARS-CoV-2 infection during a period of Omicron variant dominance in Ireland: December 2021 to March 2023. Available at: https://doi.org/10.2807/1560-7917.ES.2024.29.28.2300697

4. Townsend L, **Marron L**, O'Brien K, Walsh C, Domegan L, McGrath J, Kenny C, Fleming C, Bergin C. Investigating incidence of and factors associated with SARS-CoV-2 infection over a nine-month period in a highly vaccinated healthcare worker cohort. Available at: 10.1093/qjmed/hcae093

5. Kelly Ciara, Gallagher Joan, Odewumi Lola, Conway Robert, Black Mary E, Concannon Kristin, **Marron Louise**, Doherty Lorraine. The approach to developing Ireland's first national health protection strategy and lessons learnt, December 2021 to October 2022. EuroSurveill. 2024;29(14): pii=2300326. Available at: https://doi.org/10.2807/1560-7917.ES.2024.29.14.2300326

6. **Marron L,** Gilroy J, Williams M, Parlour R, Boland M. A narrative literature review to inform the development of a health threats preparedness framework in Ireland. Frontiers in Public Health. 2025;13.

7. Kelly D, O'Donnell K, **Marron L**, Dwyer R, Power M, Migone C, O'Donnell J, Walsh C. Immunocompromise among vaccinated versus unvaccinated COVID-19 cases admitted to critical care in Ireland, July to October 2021. Vaccine. 2023 Apr 24;41(17):2811-2815. doi: 10.1016/j.vaccine.2023.03.011. Epub 2023 Mar 13. PMID: 36967284; PMCID: PMC10008797.

8. **Marron L**, Ferenczi A, O'Brien KM, Cotter S, Jessop L, Morrissey Y, Migone C. A national survey of parents' views on childhood vaccinations in Ireland. Vaccine. 2023 Jun 7;41(25):3740-3754. doi: 10.1016/j.vaccine.2023.05.004. Epub 2023 May 13. PMID: 37183073.

4.1.2 Other reports

1. Outbreak of norovirus linked with a social event, Ireland, May 2024

2. An evaluation of the severe acute respiratory infection (SARI) surveillance system in Ireland, June 2023

3. Influenza vaccine effectiveness against symptomatic laboratory-confirmed influenza in primary care patients in Ireland: A test-negative design case–control study, 2022/2023 season, April 2024

4. Influenza vaccine effectiveness against symptomatic laboratory-confirmed influenza in primary care patients in Ireland: A test-negative design case–control study, 2023/2024 season, June 2024

5. The impact of the COVID-19 vaccination programme on symptomatic and severe SARS-CoV-2 infection during a period of Omicron variant dominance in Ireland: December 2021 to March 2023, September 2023

6. PRECISE 5: COVID-19 in Irish Healthcare workers: A prospective cohort study in hospital healthcare workers in Ireland, March 2024, publication on the HPSC website is pending

7. The effect of COVID-19 vaccination in Ireland, February 2023

8. Core protocol for ECDC studies of vaccine effectiveness against symptomatic laboratory-confirmed influenza or SARS-CoV-2 infection at primary care level: Protocol for Ireland 2022/2023, February 2023

9. Core protocol for ECDC studies of vaccine effectiveness against symptomatic laboratory-confirmed influenza or SARS-CoV-2 infection at primary care level: Protocol for Ireland 2023/2024, February 2024

10. Migrant health strategy population health needs assessment: A briefing report, March 2023

4.2 Conference presentations

1. **Marron L,** et al. European Public Health Conference, 9–1 November 2023, Dublin, Ireland. An evaluation of the severe acute respiratory infection (SARI) surveillance system in Ireland. Poster presentation.

2. Abstract publication: **Marron L,** Duffy R, O'Donnell J, Domegan L. An evaluation of the severe acute respiratory infection (SARI) surveillance system in Ireland. Eur J Public Health. 2023 Oct 24;33(Suppl 2):ckad160.1687. doi: 10.1093/eurpub/ckad160.1687. PMCID: PMC10597185.

3. **Marron L,** et al. Faculty of Public Health Medicine Winter Scientific Meeting, 6 December 2023, Dublin, Ireland. An evaluation of the severe acute respiratory infection (SARI) surveillance system in Ireland. Poster presentation, awarded the first prize for best poster presentation.

4. **Marron L,** et al. Faculty of Public Health Medicine Winter Scientific Meeting, 6 December 2023, Dublin, Ireland. The impact of the COVID-19 vaccination programme on symptomatic and severe SARS-CoV-2 infection during a period of Omicron variant dominance in Ireland: December 2021 to March 2023. Oral presentation, awarded the second prize for best long oral presentation.

5. **Marron L,** et al. Faculty of Public Health Medicine Summer Scientific Meeting, 21–22 May 2024, Dublin, Ireland. PRECISE 5: COVID-19 in Irish Healthcare workers: A prospective cohort study. Oral presentation.

6. **Marron L,** et al. Faculty of Public Health Medicine Summer Scientific Meeting, 21–22 May 2024, Dublin, Ireland. Influenza vaccine effectiveness against symptomatic influenza in primary care: A test-negative design case-control study, 2022–2024. Poster presentation.

7. **Marron L,** et al. Faculty of Public Health Medicine Summer Scientific Meeting, 21–22 May 2024, Dublin, Ireland. A narrative literature to inform the development of a health threats preparedness framework for Ireland. Poster presentation.

8. **Marron L,** et al. Royal Academy of Medicine in Ireland, Jacqueline Horgan Bronze Medal Meeting, 23 November 2023. A national survey of parents' views on childhood vaccinations in Ireland during the COVID-19 pandemic. Oral presentation, awarded the first prize and the Jacqueline Horgan medal in Epidemiology.

9. **Marron L,** et al. European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 20–22 November 2024. High seropositivity and COVID-19 incidence among healthcare workers in Ireland: A prospective cohort study, 2022–2023. Oral presentation.

10. **Marron L,** et al. European Public Health Conference, 13–15 November 2024, Lisbon, Portugal. Influenza vaccine effectiveness against symptomatic laboratory confirmed influenza at primary care level during two seasons, 2022/2023 and 2023/2024, in Ireland. Poster presentation.

11. **Marron L,** et al. European Public Health Conference, 13–15 November 2024, Lisbon, Portugal. Estimating the impact of the COVID-19 vaccination programme on SARS-CoV-2 infection during a period of Omicron variant dominance in Ireland: December 2021–March 2023. Poster presentation.

4.3 Other presentations

1. The impact of the COVID-19 vaccination programme on symptomatic and severe SARS-CoV-2 infection during a period of Omicron variant dominance in Ireland: December 2021 to March 2023. Oral presentation to the Chief Medical Officer in the Department of Health, Ireland, 21 September 2023

2. The impact of the COVID-19 vaccination programme on symptomatic and severe SARS-CoV-2 infection during a period of Omicron variant dominance in Ireland: December 2021 to March 2023. Oral presentation to the Chief Clinical Officer in the Health Service Executive, Ireland, 3 October 2023

3. The impact of the COVID-19 vaccination programme on symptomatic and severe SARS-CoV-2 infection during a period of Omicron variant dominance in Ireland: December 2021 to March 2023. Oral presentation to the EpiTech meeting at Epiconcept, 28 November 2023

4. Influenza vaccine effectiveness against symptomatic influenza in primary care: A test-negative design case-control study, 2022–2024. Oral presentation at the Five Nations Respiratory Surveillance Meeting, Scotland, 23 May 2024

5. EPIET/EUPHEM modules attended

1. Introductory course, 26 September 2022 to 14 October 2022, Spetses, Greece
2. Outbreak investigation, 5 December 2022 to 9 December 2022, Berlin, Germany (attended online)
3. Qualitative research inject days, 31 January 2023 and 3 February 2023, online
4. Multivariable analysis, 22 May 2023 to 26 May 2023, Frankfurt, Germany (attended online)
5. Rapid assessment and survey methods, 19 June 2023 to 23 June 2023, Stockholm Sweden
6. Project review module, 28 August 2023 to 1 September 2023, Lisbon, Portugal
7. Time series analysis 11 December 2023 to 15 December 2023, Rome, Italy
8. Vaccinology, 4 March 2024 to 9 March 2024, online
9. Management, Leadership and Communication in Public Health, 24 June 2024 to 28 June 2024, Stockholm, Sweden
10. Project review module, 26 August 2024 to 30 August 2024, Lisbon, Portugal

6. Other training

1. European Centre for Disease Prevention and Control, Introduction to outbreak investigation e-learning, 20 October 2022, online
2. Fundamentals of R for public health (16 hours) with Applied Epi, 28 November 2022 to 1 December 2022, online
3. HPSC R training, self-paced, member of R users' group, online
4. Infectious Disease Epidemiology seminar series lectures in the Robert Koch Institute, 27 October 2022 to 23 February 2023 October, online
5. HPSC R training with Applied Epi in August 2023, 8 August 2023 to10 August 2023 and 15 August 2023 to17 August 2023 and 22 August 2023, online
6. Royal College of Physicians in Ireland Masterclass in achieving health equity, 8 March2023, online
7. WHO course in Public Health Preparedness of Mass Gathering Events, 29 May 2023, online
8. BSAFE, United Nations Department of Safety and Security, 29 May 2023, online
9. European Centre for Disease Prevention and Control, Epidemic intelligence e-learning course, 30 May 2023, online
10. Vaccine effectiveness training with Epiconcept, 2 October 2023 to 5 October 2023, Dublin, Ireland and follow up workshop on 19 January 2024, online
11. Joint Assessment and Detection of Events (JADE) simulation exercise for WHO European Region National IHR Focal Points, 14 November 2023, Dublin, Ireland
12. Workshop on the Development of a public health emergency preparedness plan for public health, Ireland, 4 April 2024, Dublin, Ireland
13. Writing abstract webinar, ECDC/EPIET, 14 March 2024, online
14. Attended WHO workshop on Mosaic Respiratory Surveillance framework, 27 May 2024, 30 May 2024, 31 May 2024
15. Training in statistics and epidemiology through R, in-house training in HPSC, online, 28 May 2024, 4 June 2024

7. Other activities

1. ESCAIDE 2022 conference, 23 November 2022 to 25 November 2022, online
2. Awarded the Jacqueline Horgan Medal in Epidemiology from the Royal Academy of Medicine in Ireland for presenting the findings of a national survey of parents views on childhood vaccinations in Ireland during the COVID-19 pandemic, 23 November 2022
3. Participated as an early-career researcher (ECR) in co-reviewing an article submitted for publication in Eurosurveillance in 2022, 29 December 2022
4. Led a rapid literature review and authored a briefing paper for the executive management team of the Health Service Executive (HSE) in Ireland on a migrant health strategy population health needs assessment for Ireland, March 2023

5. Participated in European severe acute respiratory infection (SARI) evaluation, Epiconcept, 15 June 2023 and 16 June 2023, online
6. Mock case study for Lab for Epi training day with EPIET fellows, 12 September 2023, online
7. Member of the PRECISE 5 data analysis sub-group from September 2023 to April 2024
8. European Public Health Conference (EPH), 8 November 2023 to 10 November 2023, Dublin, Ireland
9. Lab for Epi training day, 11 November 2023, Dublin, Ireland
10. National Health Protection Conference, 12 October 2023, Dublin, Ireland
11. ESCAIDE 2023 conference, 22 November 2023 to 24 November 2023, Barcelona, Spain
12. Updated and authored a narrative literature review to inform the development of a health threats preparedness framework for Ireland for the National Health Threats Preparedness Programme, Ireland, January–April 2024 (see section 4.1.1., Manuscript 6)
13. ESCAIDE 2024 conference, 20 November 2024 to 22 November 2024, Stockholm, Sweden
14. Member of the National Measles Incident Management Team (IMT), February 2024–present
15. Member of the measles contact tracing database development (MCTD) team, February 2024–present

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