

FINAL REPORT

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The European Programme for Intervention Epidemiology Training (EPIET), Cohort 2021
Health Protection Surveillance Centre (HPSC), 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.

Both curriculum paths provide training and practical experience using the 'learning by doing' approach at acknowledged training sites across European Union (EU) and European Economic Area (EEA) Member States.

According to Article 9 (6), Article 5 (8) and Article 11a (1) of Regulation (EU) 2022/2370 of the European Parliament and of the Council of 23 November 2022 amending Regulation (EC) No 851/2004 establishing a European centre for disease prevention and control (the ECDC Founding Regulation):

Article 9 (6) 'The Centre shall, as appropriate, support and coordinate training programmes, in particular in relation to epidemiological surveillance, field investigations, preparedness and prevention, response to public health emergencies, public health research and risk communication. Those programmes shall take into consideration the need for training to be kept up-to-date, take into account the training needs of Member States and shall respect the principle of proportionality.'

Article 5 (8) 'By encouraging cooperation between experts and reference laboratories, the Centre shall foster the development of sufficient capacity within the Union for the diagnosis, detection, identification and characterisation of infectious agents that have the potential to pose a threat to public health. The Centre shall maintain and extend such cooperation and support the implementation of quality assurance schemes'.

Article 11a (1) 'The Centre shall establish a EU Health Task Force and ensure that there is a permanent capacity and an enhanced emergency capacity to mobilise and use it. The EU Health Task Force shall provide assistance with regard to requests for prevention, preparedness and response planning, local responses to outbreaks of communicable diseases and after-action reviews in Member States and in third countries, in cooperation with the WHO. The EU Health Task Force shall include the Centre's staff and experts from Member States, fellowship programmes and international and non-profit organisations'.

Moreover, Article 47 of the Lisbon Treaty states that 'Member States shall, within the framework of a joint programme, encourage the exchange of young workers.' Therefore, ECDC initiated the two-year EUPHEM training programme in 2008. EUPHEM is closely linked to the European Programme for Intervention Epidemiology Training (EPIET). Both EUPHEM and EPIET are considered 'specialist pathways' of the two-year ECDC fellowship programme for applied disease prevention and control.

This final report describes the output of the fellow and the competencies they acquired by working on various projects, activities, theoretical fellowship training modules, other modules or trainings and international assignments or exchanges during the fellowship.

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Pre-fellowship short biography

Charlotte Salgaard Nielsen obtained a BSc in Food Science and a MSc in Human Nutrition from University of Copenhagen, Denmark, with integrated stays in Uganda during her MSc. Prior to starting the EPIET Fellowship, Charlotte built up experience in public health research and scientific risk assessment from international organisations and public health authorities within and outside the EU. Charlotte brought experience within nutritious disease epidemiology, and the interaction between nutritious and infectious disease. Most recently, Charlotte worked at EU authorities with the safe authorisation of foods for specific groups in the European Food Safety Authority (EFSA) and medicinal products in the European Medicines Agency (EMA).

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 Manual¹.

1. Epidemiological investigations

1.1. Outbreak investigations

Investigation of a monophasic Salmonella Typhimurium outbreak linked to chocolate products as part of wider international outbreak, Ireland, 2022

Supervisors: Paul McKeown (Consultant in Public Health Medicine), Patricia Garvey (Principal Epidemiologist), HPSC, Dublin, Ireland

Category: Food- and waterborne diseases

An outbreak investigation was initiated in Ireland on 24 March 2022 after identifying a cluster of seven monophasic *Salmonella* Typhimurium cases, affecting primarily small children. Microbiological investigations revealed that the cluster was part of a wider international outbreak, for which an EpiPulse alert had been issued by the United Kingdom (UK) on 17 February 2022. International epidemiological investigations indicated a link to specific chocolate products of Brand A produced by Company A. This hypothesis was strengthened by positive *Salmonella* sampling in the production environment of Brand A at a Belgian processing plant, which triggered the first product recall in Ireland on 2 April 2022. A total of 18 cases was linked to the outbreak in Ireland. We undertook a matched case-control study using the case-case method (ratio 1:3) to determine if exposure to the implicated products was associated with illness. Any case meeting the international case definition and notified on or after 7 March 2022 as part of outbreak cluster 1 (n=16) were included. Conditional logistic regression was used to calculate matched odds ratio (mOR) and 95% confidence intervals (CI). In univariable analysis, the highest odds of disease due to monophasic *Salmonella* Typhimurium versus other gastrointestinal disease was obtained for a chocolate Product A of Brand A [mOR=7.77, 95% CI 0.89–67.20]. When grouping the implicated products in a composite variable, the odds of disease due to monophasic *Salmonella* Typhimurium versus other gastrointestinal disease were 10.5 times higher with consumption of at least one of the implicated products [mOR=10.50, 95% CI: 1.24–88.60]. This analytical investigation supported the internationally generated hypothesis that certain chocolate products were the likely sources of the outbreak. With Easter approaching and high levels of chocolate purchasing, early outbreak identification and involvement in the internationally coordinated investigation proved essential to an efficient response.

Role: Charlotte was co-investigator of the outbreak and led on the design and implementation of the Irish analytical epidemiological investigation in the form of a case-control study. This involved developing the study protocol, questionnaire and data entry mask in EpiData, training surveillance personnel in data entry, communicating with the Departments of Public Health on data collection, carrying out data analysis, and developing outputs communicating the study findings to the Incident Management Team (IMT) members and to the public (including Report 1 in [Epi Insight, Vol 23 Issue 5](#)). Charlotte prepared the situational reports and participated in the IMT meetings where she provided the epidemiological updates. Finally, Charlotte led the preparation of a manuscript submitted to an international peer-reviewed journal (Paper 1), contributed to the publication of a Eurosurveillance Rapid Communication by [Larkin et al. \(2022\)](#) (Paper 2), and presented the findings at the European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) 2022 conference and at the Faculty of Public Health Medicine (FPHM) Summer Scientific Meeting 2023 in Ireland.

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

Analytical epidemiological investigation in response to the mpox outbreak, 2022, Ireland

Supervisors: Derval Igoe (Consultant in Public Health Medicine), Eve Robinson (Specialist in Public Health Medicine), Patricia Garvey (Principal Epidemiologist), HPSC, Dublin, Ireland

Category: Hepatitis B and STDs

From May 2022, cases of human mpox (monkeypox) were identified in several non-endemic countries including Ireland. The first known Irish case was reported on 31 May 2022. The majority of cases were male and, among those with known sexual orientation, cases predominantly self-identified as gay, bisexual, and other men who have sex with men (gbMSM). A limited number of vaccine doses available in comparison to the estimated population at risk emphasised the need to prioritise dose distribution to mitigate the impact of the outbreak. In July 2022, a study group was convened in Ireland to collaboratively establish a prospective multi-site case-control study with a nested case-crossover study component, to be conducted in three sites providing infectious disease and sexual health services in Dublin. The aim was to inform the prioritisation of gbMSM and transgender people at higher risk of acquiring a mpox infection for PrEP via vaccination, and to improve knowledge on risk and protective factors for acquiring a mpox infection in order to inform health promotion and harm reduction interventions in Ireland. The study was implemented in the participating sites with confirmed mpox case(s) from November 2022, though low case numbers in Ireland necessitated a decision to pause the analytical investigations in December 2022, as it was deemed unlikely to reach the target sample size. In the context of after-action reviews and strategical discussions on future research capacity to ensure resilient health authorities in Ireland, the mpox analytical epidemiological investigation provided an opportunity to reflect on the lessons identified in order to carry forward recommendations for consideration, to ensure future implementation and success of analytical epidemiological investigations responding to outbreaks or other health emergencies.

Role: Charlotte led on the design and implementation of the analytical epidemiological investigation, in close collaboration with the study group and senior HPSC colleagues. This involved developing the study protocol, the online survey for distribution to cases and controls and the Standard Operating Procedures (SOP), communicating with the participating sites regarding the necessary preparations enabling participant recruitment, communicating identified technical issues and implementing mitigation measures. Charlotte participated in the IMT and provided updates relating to the analytical investigation. She also prepared a technical document reflecting on the lessons identified and a repository of documents essential to future analytical investigations and/or study collaborations in the context of outbreaks or health threat response (Report 2), which was shared with relevant high-level stakeholders. Due to an international assignment (see Section 7), Charlotte was temporarily absent from the project but re-joined activities on her return.

Educational outcome

Taking the role as a co-investigator together with opportunities to lead on analytical investigations, in the context of two international outbreaks, provided Charlotte with excellent learning experiences as these challenged her to rapidly transform her epidemiological knowledge into practice, and to show leadership in responding to health threats at times of pressured resources. The involvement enabled the hands-on application of all steps of an outbreak investigation, which will certainly prove useful in future outbreak investigations. The international aspects provided vital learning in emphasising the importance of national investigations feeding into internationally coordinated outbreak responses, and the challenges in adapting and responding to health threats in a timely manner, particularly when multiple health threats co-occur.

1.2. Surveillance

Timeseries analysis on the impact of the COVID-19 pandemic on gastroenteric disease notifications, Ireland, 2015–2021

Supervisors: Patricia Garvey (Principal Epidemiologist), Paul McKeown (Consultant in Public Health Medicine), HPSC, Dublin, Ireland

Category: Food- and waterborne diseases and respiratory diseases (including influenza and TB)

Nationwide restrictions were introduced in Ireland on 12 March 2020 to reduce the spread of SARS-CoV-2, affecting travel, social activities, childcare facilities and educational institutions, and working mode. Internationally, implemented pandemic control measures have been associated with changes in reported incidences of non-COVID-19 infectious diseases. We aimed to assess the impact of the COVID-19 pandemic restrictions on laboratory confirmed notifications of *Campylobacter*, *Salmonella*, VTEC and *Cryptosporidium* in Ireland. We conducted interrupted timeseries analyses using negative binomial regression modelling of weekly or monthly case counts of notifications made between 2015 and 2021, in order to estimate the change in incidence rates by infectious disease and selected case subsets following the introduction of the nationwide lockdown on 12 March 2020. After adjusting for underlying trend and seasonality, we observed significant reductions after 12 March 2020 by 19% (95% CI 4-32%), 54% (95% CI 45-62%) and 82% (95% CI 64-91%) in notified VTEC, *Salmonella* and

Campylobacter cases, respectively, indicating that pandemic restrictions reduced incidence rates for these gastroenteric diseases. An effect on reporting of hospitalised campylobacteriosis and salmonellosis suggested that restrictions likely affected true disease incidence, and that reductions in reported incidence was not solely due to possible influential factors such as reduced access to health services. We observed differences in the impact on different strata, with more pronounced reductions in older compared to younger ages. When assessed, urban cases showed a greater reduction compared to rural cases, which is consistent with an expectation of continued exposure to environmental risk factors (including private well use) during the period of pandemic restrictions for *Campylobacter*, VTEC and *Cryptosporidium*. These analyses may prove useful in advancing our knowledge on the epidemiology of these gastroenteric diseases in Ireland as well as supporting public health messages to limit the disease burden in the future.

Role: Charlotte developed the study protocol and conducted the timeseries analysis. She also prepared a manuscript for submission to an international peer-reviewed journal (Paper 3), and submitted the findings to the ESCAIDE 2023 conference, the Faculty of Public Health Medicine (FPHM) Summer Scientific Meeting and FPHM Winter Scientific Meeting 2023 where they will be/was presented orally.

Evaluation of the capacity of the surveillance system in Ireland to describe and report on underserved populations

Supervisors: Sarah Jackson (Senior Epidemiologist), Louise Cullen (Principal Epidemiologist), Patricia Garvey (Principal Epidemiologist), HPSC, Dublin, Ireland

Category: Vaccine-preventable diseases, Emerging and re-emerging diseases including vector-borne diseases, Hepatitis B and STDs, Respiratory disease (including influenza and TB), Food- and waterborne diseases and Healthcare-associated infections and antibiotic resistance

In the context of the Health Service Executive (HSE) Health Protection Strategy 2022-2027 to achieve protection of the population of Ireland from all health protection hazards, in order to mitigate the impact of health inequities, it is within the remit of the HPSC to deliver a surveillance system which includes specified variables to capture groups at risk. As advised by the WHO, health equality may be captured in routinely collected surveillance data, beginning with the collection of disaggregated data. This study aimed to evaluate the capacity of the surveillance system in the HPSC to describe and report on infectious disease incidence in underserved population groups in Ireland. We found that PROGRESS Plus equity stratifiers relating to Religion, Education, Disability (Plus 1), Sexual preference (Plus 1), Features of relationships (Plus 2) and Time-dependent relationships (Plus 3) were not captured as core data elements for any of the 80 (out of 89) notifiable infectious diseases on the Computerised Infectious Disease Reporting (CIDR) system. Enhanced surveillance information was requested for 39 (out of 80) infectious diseases on CIDR, with equity stratifiers captured for a limited number of diseases and with considerable inconsistency in the answer options. Of these, at least one equity stratifier was captured for 30 (of 39) diseases. Completeness was higher (100%) for mandatory core data elements and basic demographics (>90%) than any optional data element. Completeness of variables with a repeated opportunity for data collection was higher than single opportunities (without contact with Public Health). Despite ongoing discussions on the importance of addressing health inequity in Ireland, equity stratifiers are inconsistently requested, and discordance remains with available subpopulation denominators and recurring data requests made by external stakeholders, which reduces the capacity to report on underserved populations in Ireland. Key equity stratifiers should be incorporated into routine surveillance as core variables, particularly for notifiable infectious diseases known to disproportionately affect underserved populations, in order to detect and address inequality, and essentially achieve health equity, in Ireland.

Role: Charlotte developed the surveillance protocol, developed the data extraction forms, conducted a complete mapping of requested equity stratifiers for all notifiable infectious diseases in Ireland, evaluated the completeness, and generally coordinated the project activities including assigning tasks to internal support personnel. Charlotte established an Advisory Group for the assessment, acted as point of contact, and chaired meetings with the group. She also wrote the final report (Report 3), presented at the National Health Protection Conference in Ireland (October 2023), and communicated findings to relevant stakeholders.

Educational outcome

Involvement in the surveillance projects added experience in writing up surveillance protocols and reports, as well as managing and coordinating project activities of high-level interest. These activities further advanced the statistical skills of Charlotte to include (interrupted) timeseries analysis. Together with other project activities, Charlotte gained positive exposure to a wide range of stakeholders from different settings (including healthcare, national authorities, non-governmental organisations and academia), through which the value of collaborating with experts within specific fields was always emphasised.

2. Applied public health research

Prevalence of antibodies to COVID-19 in Irish healthcare workers (PRECISE 4), November 2021

Supervisors: Lisa Domegan (Principal Epidemiologist), HPSC, Dublin, Ireland

Category: Respiratory disease (including influenza and TB)

With progression of the COVID-19 pandemic, it became evident that hospital settings constituted an important setting for SARS-CoV-2 viral transmission. Two hospital sites were identified for a series of multi-site cross-sectional seroprevalence study (Prevalence of COVID-19 Antibodies in Irish Healthcare Workers: PRECISE). The PRECISE 4 study was conducted in November 2021 to assess risk factors for SARS-CoV-2 seropositivity and changes over time, and the durability of antibody responses in a highly vaccinated population of healthcare workers (HCWs) prior to booster vaccination. Serology samples were used to analyse anti-nucleocapsid (N) and anti-spike (S) antibody status using the Roche Elecsys Anti-SARS-CoV-2 and Elecsys-S Anti-SARS-CoV-2 assays. Paired serology with HCWs participating in previous study-phase April 2021 allowed an assessment of change in serostatus over time. SARS-CoV-2 risk factors were assessed for demographics and work-related factors, and adjusted relative risks (aRR) and 95% CI calculated in multivariable analysis. A total of 2 415 HCWs participated. The majority were female (80.5%), Irish (white) (78.9%), and median age was 43 years (IQR 33-50). SARS-CoV-2 seroprevalence was 23.4% (compared to 18% in April 2021), of which 33.6% (n=184) represented undiagnosed infections. All vaccinated HCWs had detectable anti-S antibodies. No participating HCWs with paired serology demonstrated loss of their anti-S positivity since the previous study phase, while 8.8% lost their anti-N positivity. Risk factors for SARS-CoV-2 seropositivity included age 18-29 years (aRR 1.50, 95% CI: 1.19–1.90) compared to age 50-59, India as country of birth (aRR 1.35, 95% CI: 1.01–1.73) compared to Ireland, primary/secondary/third level education (aRR 1.35, 95% CI: 1.11–1.66) compared to post-graduate, and being a HCA (aRR 2.12, 95% CI: 1.51–2.95) compared to administrative staff. The increase in SARS-CoV-2 seroprevalence between study phases reflects the magnitude of the fourth pandemic wave in Ireland. This study may inform targeted messaging and vaccination strategies towards high-risk groups in healthcare settings.

Role: Charlotte prepared the analysis plan and performed the data analysis. She also presented findings to the PRECISE Steering Group and co-authored a manuscript by [McGrath et al. \(2023\)](#) (Paper 4) published in an international peer-reviewed journal, and wrote a final report for publication on the HPSC website together with previous PRECISE work (Report 4).

Observational study of COVID-19 diagnosed Irish healthcare workers (PRECISE 3), September 2021 to March 2022

Supervisors: Lisa Domegan (Principal Epidemiologist), HPSC, Dublin, Ireland

Category: Respiratory disease (including influenza and TB)

HCWs constitute an important and ideally placed population group to describe the evolving epidemiology of COVID-19 cases. The PRECISE 3 study was conducted as part of a series of studies carried out in two large tertiary referral hospitals in Ireland. This was a cross-sectional cohort study of HCWs testing positive for COVID-19 by polymerase chain reaction (PCR) between 9 October 2021 and 12 January 2022. HCWs were interviewed by telephone, and positive nasopharyngeal samples analysed using whole genome sequencing (WGS) when available. HCWs were described for sociodemographic, occupational and COVID-19 related characteristics for the total study population and by hospital site. Mean intervals in days between either Comirnaty or Vaxzevria COVID-19 vaccine doses and positive COVID-19 PCR test were calculated and compared using the Welch t-test. A total of 474 HCWs participated. The majority were female (77%), born in Ireland (80.4%) and median age was 34 years (IQR 28-45). The dominating staff role were nurses/midwives (31.6%). Approximately half of the HCWs reported contact with known COVID-19 patients, with differences in prevalence between the hospital sites. The mean number of days between receiving a Comirnaty primary vaccination course and positive COVID-19 PCR test was longer than for Vaxzevria ($p < 0.001$). The same applied for those HCWs who had received a COVID-19 booster vaccine at time of participation. The mean number of days between last self-reported COVID-19 vaccine dose and positive PCR test was shorter during the Omicron wave compared to the Delta wave (< 0.001). Constructed epi-curves showed that the number of participating COVID-19 cases in the two hospital sites followed a comparable trend with what was observed nationally, and the same did the shift to BA.1 Omicron dominance in late December 2021. These findings may be indicative of healthcare environments constituting a suitable setting to study COVID-19 epidemiology.

Role: Charlotte prepared the analysis plan and performed the data analysis of the enhanced surveillance data on HCWs generated from the PRECISE 3 study. Charlotte also presented findings to the PRECISE Steering Group and co-authored a manuscript for submission to an international peer-reviewed journal (Paper 5).

Educational outcome

The involvement in the research activities provided an excellent opportunity to improve Charlotte's skills in efficient data management and conducting multivariable regression analyses, writing scientific reports and manuscripts for peer-reviewed journals. Charlotte also gained experience in building positive working relations with external stakeholders as the studies constituted a research collaboration with colleagues from healthcare environments and academia.

3. Teaching and pedagogy

Case study: An outbreak of trichinosis in France

Charlotte co-facilitated an online case study 'An outbreak of trichinosis in France' of a three-hour duration in November 2021 to students at the School of Veterinary Medicine, University College Dublin. A pre-existing case study was used and supplemented with pre-reading material and a PowerPoint presentation to guide the students through the case. Charlotte produced a teaching reflective note (Report 5).

R tutorial on simple and conditional logistic regression when analysing case-control study data

Charlotte gave a tutorial of the R approach of carrying out simple and conditional logistic regression when analysing data from (matched) case-control studies to an HPSC R User Group during a 1-hour online session in April 2023. Charlotte used the example of an analytical study conducted in the context of a monophasic *Salmonella* Typhimurium outbreak in Ireland, 2022. The tutorial consisted of a PowerPoint presentation to introduce the case and basics on generalised linear models, followed by a live demonstration of simple and conditional logistic regression in R. Charlotte produced a teaching reflective note (Report 6).

Lecture: Outbreak Investigation

Charlotte gave a 40-minute lecture on Outbreak Investigation to MSc students in Healthcare Infection Management at Trinity College Dublin, as part of an in-person 3.5-hour HPSC lecture series in May 2023. She adapted existing material to the learning needs of the students and to ensure carrying forward the most essential messages during the allocated timeslot. The lecture series was positively evaluated at the end of the series, assessing the usefulness of the individual lectures and informing potential areas of interest for the future. Charlotte produced a teaching reflective note (Report 7).

Training of surveillance personnel in EpiData entry

Charlotte trained surveillance personnel in EpiData entry during an online session in April 2022. This followed the development of case and control questionnaires and data entry masks in the context of an analytical study investigating the source of a monophasic *Salmonella* Typhimurium outbreak, and preceded the return of the completed questionnaires from the Departments of Public Health in Ireland.

Educational outcome

The teaching activities provided Charlotte with excellent opportunities to recap and advance epidemiological terms and concepts as well as to develop and adapt learning material to best convey key (and in some instances complex) principles to various target audiences. The activities challenged Charlotte to assess the learning needs of the target audience, to decide on a realistic scope and teaching approach, and to adapt previous teaching styles to meet specific learning objectives. Further, taking part in an HPSC lecture series gave the opportunity to evaluate the activity and to share the main findings and recommendations with the coordinators to inform future improvement.

4. Communication

4.1 Publications related to the EPIET fellowship

4.1.1 Manuscripts published in peer-reviewed journals

1. **Nielsen CS**, Garvey P, Cormican M, DeLappe N, Lenahan M, Moore O, et al. Investigation of a monophasic *Salmonella* Typhimurium outbreak linked to chocolate products as part of wider international outbreak: a matched case-control study, Ireland, 2022. *Public Health Challenges*. 2023;2:e116. <https://doi.org/10.1002/puh2.116> (published).
2. Larkin L, Pardos de la Gandara M, Hoban A, Pulford C, Jourdan-Da Silva N, de Valk H, et al. Investigation of an international outbreak of multidrug-resistant monophasic *Salmonella* Typhimurium associated with chocolate products, EU/EEA and United Kingdom, February to April 2022. *Eurosurveillance*. 2022;27(15):2200314 (published).
3. **Nielsen CS**, McKeown P, Colgan A, Garvey P. Impact of the COVID-19 pandemic restrictions on notifications of *Campylobacter* and *Salmonella*, Ireland, 2015–2021. 2023 (in preparation).
4. McGrath J[†], Kenny C[†], **Nielsen CS**, Domegan L, Walsh C, Rooney P, Walsh S, Conlon N, Brady G, Ibrahim A, Dunne J, McCormack W, Corcoran N, Allen N, Fleming C and Bergin C (2023) SARS-CoV-2 epidemiology, antibody dynamics, and neutralisation capacity in Irish healthcare workers in the era of booster COVID-19 vaccinations. *Front. Med.* 10:1078022. doi: 10.3389/fmed.2023.1078022 (published). [†]These authors share first authorship.
5. Kenny C[†], McGrath J[†], **Nielsen CS**, Walsh E, Piggot O, Janiesen D, et al. (2023) Prevalence of COVID-19 in Irish Healthcare workers (PRECISE 3): A multi-centre observational study describing the evolving epidemiology of COVID-19 cases in healthcare workers in two large tertiary referral hospitals in Ireland during the Delta and Omicron waves. (in preparation). [†]These authors share first authorship.

4.1.2 Other reports

1. HSE-Health Protection Surveillance Centre (HPSC). Monophasic *Salmonella* Typhimurium outbreak in Ireland, January to April 2022. *Epi Insight, Vol 23 Issue 5, July 2022*.
 2. Mpox (monkeypox) analytical epidemiological investigation in Ireland during the 2022 outbreak: Reflections on lessons identified. Reflective note, 2023.
- Appendix B: Repository of documents essential for future analytical epidemiological investigations and/or study collaborations in the context of outbreaks or health threat response.
3. HSE-Health Protection Surveillance Centre (HPSC). Evaluation of the capacity of the surveillance system in Ireland to describe and report on underserved populations. Final report, 2023.
 4. Prevalence of COVID-19 Antibodies in Irish Healthcare Workers (PRECISE 4). Final report, 2023.
 5. Case study: An outbreak of trichinosis in France. Teaching reflective note, 2021.
 6. R tutorial on simple and conditional logistic regression when analysing case-control study data. Teaching reflective note, 2023.
 7. Lecture: Outbreak Investigation. Teaching reflective note, 2023.
 8. End of Mission Report. International Assignment supporting the Greater Horn of Africa drought and food insecurity emergency response, WHO Kenya Country Office, 2022.
 - 9 and 10. Postcards from the field: Supporting the Greater Horn of Africa drought and food insecurity emergency response. Available on [ECDC's website](#) and [Epi Insight, Vol 24 Issue 2, February 2023](#).

4.2 Conference presentations

- Nielsen, CS**, et al. Faculty of Public Health Medicine Winter Scientific Meeting, 6 December 2023, Dublin, Ireland. Reduced Verotoxigenic *Escherichia coli* notifications in adults and urban residents following introduction of COVID-19 measures in Ireland. Poster presentation.
- Nielsen, CS**, et al. ESCAIDE 2023, 22 November 2023, Barcelona, Spain. Reduction in *Salmonella* notifications following introduction of COVID-19 control measures, Ireland, 2015–2021. Oral presentation.
- Nielsen, CS**, et al. National Health Protection Conference, 12 October 2023, Dublin, Ireland. Evaluation of the capacity of the infectious disease surveillance system to describe and report on underserved populations in Ireland. Oral presentation.

Nielsen, CS, et al. Faculty of Public Health Medicine Summer Scientific Meeting, 23 May 2023, Dublin, Ireland. The impact of the COVID-19 pandemic on *Salmonella* notification, Ireland, 2015–2021. Poster presentation.

Nielsen, CS, et al. Faculty of Public Health Medicine Summer Scientific Meeting, 23 May 2023, Dublin, Ireland. Investigation of a monophasic *Salmonella* Typhimurium outbreak linked to chocolate products as part of wider international outbreak, a matched case-control study, Ireland, 2022. Oral presentation.

Nielsen, CS, et al. ESCAIDE 2022, 25 November 2022, online. Monophasic *Salmonella* Typhimurium outbreak linked to chocolate products, Ireland, 2022. Poster presentation.

4.3 Other presentations

PRECISE Steering Group, online oral presentation, 8 March 2023. Observational study of COVID-19 diagnosed Irish healthcare workers (PRECISE 3): Summary of findings.

HPSC Training and Research Forum, online oral presentation, 9 February 2023. Monophasic *Salmonella* Typhimurium outbreak linked to chocolate products, Ireland, 2022.

Info session on International Assignments to EPIET/EUPHEM fellows C2021, Greater Horn of Africa Drought and Food Insecurity Situation – GOARN deployment in support of WHO Kenya Country Office, online oral presentation, 30 January 2023.

Greater Horn of Africa Incident Management Support Team (IMST), online oral presentation, 16 November 2022. Summary of Nutrition Actions in WHO Kenya Country Office.

PRECISE Steering Group, online oral presentations, 6 April and 22 June 2022. Prevalence of antibodies to COVID-19 in Irish healthcare workers (PRECISE 4): Summary of findings.

5. EPIET modules attended

1. Introductory Course part 1, 20 September 2021 to 8 October 2021, virtual
2. Introductory Course Inject days, Phylogeny, 19–20 October 2022, virtual
3. Introductory Course Inject Days, Operational Research, 27–28 October 2021, virtual
4. Introductory Course Inject Days, Data Management, 10–11 November 2021, virtual
5. Outbreak Investigation, 6–10 December 2021, virtual
6. Multivariable Analysis, 14–18 /March 2022, virtual
7. Mid-term Project Review, 20–22 April 2022, Spetses, Greece
8. Introductory Course part 2, 25–29 April 2022, Spetses, Greece
9. Rapid Assessment and Survey Methods, 6–10 June 2022, Stockholm, Sweden
10. Project Review Module, 29 August to 2 September 2022, Lisbon, Portugal
11. Qualitative Research Inject Days, 31 January 2023 and 3 February 2023, virtual
12. Vaccinology, 13–17 February 2023, virtual
13. Management, Leadership and Communication in Public Health, 8–12 May 2023, Stockholm, Sweden
14. Project Review Module, 28 August to 1 September 2023, Lisbon, Stockholm

6. Other training

1. HPSC training on Computerised Infectious Disease Reporting (CIDR) system, 14 October 2021, Dublin, Ireland (virtual)
2. Introduction to International Health Regulations (IHR) 2005, 17 October 2021, WHO, Geneva, Switzerland (e-learning)
3. HPSC Introduction to R, 1 October 2021 to 30 November 2021, HPSC, Dublin, Ireland (self-paced e-learning)
4. Contact tracing in the context of COVID-19 response, 6 February 2022, ECDC, Stockholm, Sweden (e-learning)
5. Endemic and pandemic infectious diseases and their disruptive impact in society, 1st International Spring School in Global Health, 28 March to 1 April 2022, ISGlobal Barcelona Institute for Global Health, Barcelona, Spain (virtual)
6. WHO Mass Gatherings, Module 2: Risk Assessment and Management for Mass Gatherings, 30 May 2022, WHO, Geneva, Switzerland (e-learning)
7. BSAFE, 2 June 2022, United Nations Department of Safety and Security (e-learning)
8. WHO Standard Operating Procedures (SOPs) for Emergencies, 19–23 September 2022, WHO, Geneva, Switzerland (e-learning)

9. UN Human Rights and Responsibilities, 24 September 2022, WHO, Geneva, Switzerland (e-learning)
10. Prevention and Sexual Exploitation and Abuse (PSEA), 25 September 2022, WHO, Geneva, Switzerland (e-learning)
11. United to Respect: Preventing Sexual Harassment and Other Prohibited Conduct, 25 September 2022, WHO, Geneva, Switzerland (e-learning)

7. International assignments

WHO Kenya Country Office, Nairobi, Kenya, 26 September 2022 to 19 November 2022:

Charlotte was deployed through the Global Outbreak and Alert Response Network (GOARN) in support of the Greater Horn of Africa drought and food insecurity emergency response, 2022, as Nutrition Expert, from her duty station at the WHO Kenya Country Office. The objective of the assignment was to provide technical expertise to the team members, national authorities, related health and non-health partners in the planning, implementation, monitoring and evaluation of nutrition programmes and activities. Deployment activities included: capacity building at community and health facility level to train HCWs in the Integrated Management of Acute Malnutrition (IMAM) as a collaborative effort between partners (Ministry of Health, UNICEF, Kenya Red Cross, etc.), procurement and distribution of emergency supplies responding to supply gaps of essential commodities (Interagency Emergency Health Kits, F-15, F-100, RUTF), stakeholder engagement to strengthen the existing surveillance system and reporting mechanisms of nutrition indicators, strategic planning to guide the emergency response 2023, documentation efforts of the drought response and establishment of joint visibility efforts with partners to leverage response activities for documentation.

Charlotte prepared an End of Mission Report summarising the response activities and made short-, medium- and long-term recommendations for an efficient response reaching those most in need (Report 8), and wrote Postcards from the field published on the [ECDC website](#) and in [Epi Insight, Vol 24 Issue 2, February 2023](#) (Report 9 and 10). She also prepared comprehensive handover notes to her successor due to arrive in order to ensure maintenance of ongoing nutrition activities.

8. Other activities

1. ESCAIDE 2021 conference, 16–19 November 2021 (virtual)
2. COVID-19 Think Tank on Omicron (13 December 2021) and Vaccination effectiveness and COVID-10 vaccination in Kosovo, Serbia and Georgia (07/02/2022) (virtual)
3. Faculty of Public Health Medicine Winter Scientific Meeting, 1 February 2022, Dublin, Ireland (virtual)
4. Faculty of Public Health Medicine Summer Scientific Meeting, 24–25 May 2022, Dublin, Ireland
5. Faculty of Public Health Medicine Winter Scientific Meeting, 7 December 2022, Dublin, Ireland
6. Masterclass in Achieving Equity in Healthcare, Royal College of Physicians of Ireland, 8 March 2023, Dublin, Ireland (virtual)
7. ECDC webinar on Stigma: what you as a healthcare provider can do to address it, 14 June 2022, ECDC, Stockholm, Sweden (virtual)
8. Social Inclusion Working Group of National Immunisation Oversight Committee, 27 June 2022 (virtual)

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