

# Summary of work activities

## Oliver McManus

### The ECDC Fellowship Programme

#### Field Epidemiology path (EPIET), 2020 cohort

## 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 in acknowledged training sites across European Union (EU) and European Economic Area (EEA) Member States.

According to Articles 5 and 9 of ECDC's founding regulation (EC No 851/2004) 'the Centre shall, encourage cooperation between expert and reference laboratories, foster the development of sufficient capacity within the community for the diagnosis, detection, identification and characterisation of infectious agents which may threaten public health' and 'as appropriate, support and coordinate training programmes in order to assist Member States and the Commission to have sufficient numbers of trained specialists, in particular in epidemiological surveillance and field investigations, and to have a capability to define health measures to control disease outbreaks'.

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 report summarises the work activities undertaken by Oliver McManus, cohort 2020 of the Intervention Epidemiology path (EPIET) at Statens Serum Institut (SSI), Denmark.

## Pre-fellowship short biography

Oliver McManus is from the Netherlands. After completing a Master's degree in Global Health Science and Epidemiology in the United Kingdom, he worked in a regional field epidemiology team at Public Health England (now the UK Health Security Agency) for three years. He worked in several disease areas including gastrointestinal illnesses, influenza, tuberculosis, and COVID-19. His work had a focus on data analysis and automation of routine reporting.

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## Methods

This report accompanies a portfolio that demonstrates the competencies acquired during the EPIET fellowship by working on various projects, activities and theoretical training modules.

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

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

## Results

The objectives of these core competency domains were achieved partly through project or activity work and partly through participation in the training modules. Results are presented in accordance with the EPIET core competencies, as set out in the ECDC Fellowship Manual<sup>1</sup>.

### 1. Epidemiological investigations

#### Outbreak investigations

##### *1.1 COVID-19 outbreak in a boarding school linked to a sauna trip*

**Supervisors:** Steen Ethelberg, Laura Espenhain

There was a large outbreak of COVID-19 at a Danish boarding school in late 2020. The index case was known, and had little contact with fellow students other than during a visit to a sauna just before testing positive. Saunas are popular in Denmark, so there was media interest in possible widespread COVID-19 transmission there. The outbreak team created an online questionnaire about students' behaviours around the time of the outbreak and sent it to all the students. The team used logistic regression to identify factors associated with testing positive for COVID-19 (all students had been tested in the course of the outbreak). They found that attending the sauna together with the index case was associated with testing positive, but the sauna could account for only half of the cases. Other risk behaviours (contrary to school COVID-19 safety policies) were very common, so there were many other opportunities for transmission. They recommended the implementation of more rigorous quarantine for people entering boarding schools such as these, where enforcement of COVID-19 safety policies was not feasible.

**Role:** Oliver co-led this outbreak investigation together with another EPIET fellow. He shared responsibility for developing the questionnaire, data entry and management, the statistical analysis, and the interpretation of results. He wrote an abstract and presented the findings in a poster at the European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE, 2021).

##### *1.2 EIEC at a residential care facility for developmentally disabled people*

**Supervisors:** Steen Ethelberg, Laura Espenhain

There was an outbreak of enteroinvasive *Escherichia coli* (EIEC) at a residential care facility for developmentally disabled people in 2021, affecting both residents and staff members. The Danish Veterinary and Food Administration collected information from staff members about the illness and the meals eaten at the facility canteen, for a cohort study. Oliver was part of the outbreak team at Statens Serum Institut analysing the data. The outbreak team used negative binomial regression to examine the association between specific meals eaten at the staff canteen, as well as working at different locations on specific dates, and the illness. They found associations for many of the days at work and individual meals, but no single exposure was clearly linked to the illness. The outbreak team concluded that continual exposure through a re-used food ingredient or person-to-person transmission was most likely.

**Role:** Oliver joined the outbreak investigation team once data had already been collected. He performed the data analysis, presented results to the team and interpreted them together, and wrote the outbreak report.

<sup>1</sup> 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>

### *Training modules related to assignment/projects*

**EPIET/EUPHEM Introductory Course:** This module provided an introduction to epidemiological concepts and outbreak investigations. It went through the ten steps of outbreak investigation and included case studies for practising them. This provided a framework for Oliver to follow as he performed outbreak investigations.

**Outbreak Investigation Module:** This module built on the outbreak investigation content presented in the Introductory Course. It included information on univariate analysis and statistical software, as well as a multi-day case study. Oliver used these analysis methods and software skills in the outbreak investigations.

**Multivariable Analysis Module:** This module further built on previous modules and presented information about the regression models that Oliver used in these outbreak investigations, specifically multiple logistic regression and negative binomial regression.

### *Educational outcome*

Oliver was involved in two outbreak investigations, in the course of which he collected data, analysed data, interpreted results, wrote an outbreak report, and presented his findings at an international conference. This experience, along with the training modules, has helped him become familiar with the steps of outbreak investigations, and has prepared him to work independently in this field.

## 2. Surveillance

### *Wastewater surveillance of COVID-19*

**Supervisors:** Steen Ethelberg, Laura Espenhain

Getting consistent data on COVID-19 incidence is difficult because of ever-changing testing policies. Many countries have turned to measuring levels of SARS-CoV-2 RNA in wastewater as an indicator that is not affected by changes in testing patterns. Oliver was part of the team that set up the first wastewater surveillance system in Denmark. The team set up thrice-weekly sampling from some 200 wastewater treatment plants across the country. They used geographical data to link each treatment plant to the individuals living in its catchment area to capture information on positive SARS-CoV-2 tests among the populations of the catchment areas. Samples were sent to a private laboratory for quantification of SARS-CoV-2 RNA concentrations, using two gene targets (N2 and RdRp). The wastewater team at Statens Serum Institut analysed the data and published weekly reports, which gained increasing prominence as the Minister for Health relied on the results for weekly evaluations of the COVID-19 situation in Denmark. They also wrote a manuscript about the association between wastewater results and human incidence. They used a time series model to examine how accurately wastewater results, in combination with information on the testing rate, could predict incidence. They found a good association, both for the historical data they used to fit the model, and for forecasting later incidence data. They used this model to simulate the incidence that might have been observed if the testing rate in Denmark had stayed at its peak rate.

**Role:** During the first phases of the surveillance system setup, Oliver performed all of the data analysis and produced all the outputs for weekly reporting. He was the first author on a manuscript associating wastewater results and human incidence and performed all the analysis for the paper. He submitted an abstract about the research, which was accepted for an oral presentation at ESCAIDE 2022.

### *Training modules related to assignment/projects*

**EPIET/EUPHEM introductory course:** This module provided an introduction to epidemiological concepts and surveillance systems.

**Time Series Analysis module:** This module was an introduction to time series models. The analysis comparing wastewater results and incidence used an autoregressive integrated moving average (ARIMA) model, which was an extension of what was presented at the Time Series Analysis module.

**Multivariable Analysis Module:** This module further built on previous modules and presented information about the regression models that Oliver used in this surveillance. He used knowledge he gained about building multivariable models to help with variable selection in the analysis for the manuscript.

### *Educational outcome*

Oliver gained valuable experience setting up a new surveillance system. He has become aware of both the theoretical considerations about how a system should work, as well as the practical considerations related to where data comes from and what to do when it is missing or incorrect. He has also learnt to use time series models, and is aware of the complications that come with analysing data over time.

### 3. Applied public health research

#### *Association between residential characteristics and Legionnaires' disease*

**Supervisors:** Laura Espenhain, Steen Ethelberg

Denmark has one of the highest rates of Legionnaires' disease case notifications in Europe. Unlike in other countries, most Danish cases are thought to be sporadically acquired in Denmark, i.e. not as part of outbreaks. So, it is likely that many cases were infected at home. Since Denmark has good register data on cases and residences, it was possible to perform a case-control study, comparing residential characteristics between cases and controls. The analysis method was multivariable logistic regression. Characteristics independently associated with Legionnaires' disease included living in a ground-floor flat, renting rather than owning, and living in a smaller home. The interpretation was that these factors are probably proxies for lower socio-economic status, rather than themselves being causative of infection.

**Role:** Oliver wrote the protocol, linked the data across databases, performed the data analysis, interpreted the results, and wrote them up in an internal report.

#### *Training modules related to assignment/projects*

**EPIET/EUPHEM introductory course:** This module provided an introduction to epidemiological concepts and operational research.

**Multivariable Analysis Module:** This module further built on previous modules and presented information about the regression models that Oliver used in this research. He used the knowledge he gained about building multivariable models to help with variable selection in the analysis.

#### *Educational outcome*

In this research project, Oliver learnt a lot about the difficulties of linking data across complicated public databases. He also learnt to write a protocol and perform multivariable analysis for a matched case-control study in a situation where there were multiple analysis options available.

### 4. Teaching and pedagogy

#### **Epidemiology course for Nordic public health nurses**

Oliver taught a week-long introductory infectious disease epidemiology course as part of a team at the University of Gothenburg in early 2021. The audience was public health nurses from Denmark, Sweden and Norway. His main topics were the epidemiological concepts of chance, bias and confounding. He created teaching materials from scratch, drawing on his own experiences, and delivered interactive and engaging lectures. He also helped prepare exercises about other topics taught in the course. Students gave excellent feedback about his teaching and style, which led to him being invited to return the following year.

#### *Training modules related to assignment/projects*

**EPIET/EUPHEM introductory course:** Most of the topics Oliver covered in his teaching were part of the introductory course. Having the introductory course as a basis, as well as the materials to independently review later, was very valuable for Oliver as he put together his own teaching materials.

#### *Educational outcome*

Oliver learnt to prepare teaching materials while considering the audience's background and level of knowledge. His teaching was interactive and kept the audience engaged. Preparing and delivering teaching materials also helped him clarify his own understanding of the topics he covered.

### 5. Communication

#### **Publications related to the EPIET fellowship**

**McManus O** et al. Wastewater surveillance for SARS-CoV-2 closely mirrors RT-PCR throat swab incidence data: results from national surveillance in Denmark, October 2021 – June 2022. (Submitting) 2022

#### **Reports**

**McManus O** et al. The association between Legionnaires' Disease and residential characteristics. (Internal report) 2021

#### **Conference presentations**

**McManus O**, Voss S, Holt J, Müller L. Are saunas safe in the COVID-19 pandemic? Results from an outbreak at a Danish boarding school, 2020. ESCAIDE 2021.

## 6. EPIET/EUPHEM modules attended

1. Introductory Course part 1 (28/09/2020 – 16/10/2020), virtual
2. Introductory Course part 2 - Operational Research inject days (9–10/11/2020), virtual
3. Outbreak Investigation (7–11/12/2020), virtual
4. Multivariable analysis (15–19/12/2020), virtual
5. Introductory Course part 3 (26/04/2021 – 07/05/2021), virtual
6. Rapid Assessment and Survey Methods (5–16/05/2021), virtual
7. Project Review 2021 (23–27/08/2021), virtual
8. Vaccinology (14–18/02/2022), virtual
9. Time Series Analysis (4–8/04/2022), ISS, Rome, Italy
10. Management, Leadership and Communication in Public Health (13–17/06/2022), ECDC, Stockholm, Sweden
11. Project Review 2022 (29/08/2022 –02/09/2022), IMM, Lisbon, Portugal

## Discussion

### Coordinator's conclusions

Before starting the EPIET fellowship, Oliver had already worked in epidemiology at the regional level for three years, with data analysis and automation of routine reporting being the main focus of his work. In the two years of the fellowship, he improved his analytical skills even further, for instance, through his research project on the association between residential characteristics and Legionnaires' disease. He also developed his skills in the other areas covered by the programme. Through an outbreak of COVID-19 and one food-borne outbreak, Oliver gained experience in outbreak investigations, making him confident to work independently in this field. He further contributed to the national COVID-19 response with a very interesting and relevant project on wastewater surveillance of COVID-19, which allowed him to further develop his surveillance skills as well as his management competencies. Through his successful involvement in an infectious disease epidemiology course, Oliver further improved his teaching skills. It has been great to work with Oliver; besides him being very skilled, his positive attitude and energy made the collaboration very enjoyable. I wish him all the best for his future career.

### Supervisor's conclusions

During the two-year fellowship at the SSI in Copenhagen, Oliver McManus has been part of the staff at the Department of Infectious Disease Epidemiology & Prevention, where he was placed in the Section for Zoonotic, Food and Waterborne Infections. Oliver worked on several different projects and fulfilled all his EPIET obligations. Besides his major contribution to setting up the Danish wastewater-based surveillance system, Oliver also worked on several other projects, including a large register-based study on possible risk factors for *legionella* infection associated with where the patients lived. Oliver did two outbreak investigations and several rounds of teaching in different settings, receiving very positive feedback from the students every time.

Oliver's fellowship coincided in part with the COVID-19 pandemic. This of course had a negative impact on the fellowship overall, for instance, the imbedded teaching modules were largely done by distance, limiting the degree to which the fellows could interact with each other, but it also gave opportunities that would not have presented themselves otherwise. At the SSI, a number of surveillance instruments not previously used, were set up, including surveillance for SARS-CoV-2 by analysis of wastewater samples. Denmark ended up opting for a large-scale national system which was set up from scratch, involving many reports, assessments, applications, pilots, negotiations, planning, meetings and communication, tests and analyses, as well as lots of R-code and epi decisions being made. As part of the small wastewater team that was initiated within the department, Oliver played a central role in this work. He fulfilled both surveillance and research activities in the fellowship doing so. He thereby helped the Danish COVID-19 epidemic control and did a huge job for the SSI, which we are very thankful for. Oliver quickly began to appreciate the challenges of wastewater analysis and worked with much enthusiasm. His excellent skills in R helped everyone, along with his analytical skills and overall positive attitude. Besides classical epidemiology, the work also involved interacting with a huge network of people from different sectors in Denmark. Oliver benefitted from learning Danish to a degree that he could work in the language already halfway into the fellowship.

Oliver is a strong team player, but also a person who would always contribute his own opinion of subjects and work situations. During his time in Denmark, Oliver has clearly developed a lot, both as an epidemiologist and by being confronted with the different challenges that he met. He grew into a much-liked colleague at the department whom I think all of us will miss.

## Personal conclusions of fellow

I had a fantastic time over the two years of the fellowship. Being part of EPIET training and working practically at SSI has allowed me to become a more independent field epidemiologist and to understand the public health system in a new country. I have had the opportunity to participate in outbreak investigations and to do operational research, and I have helped set up a brand-new surveillance system. The work with wastewater surveillance was especially valuable because I was part of a team doing something that had never been done before in Denmark. I worked with different kinds of data than I had before, using different analysis methods, and I took on more responsibilities for the surveillance system we set up than I had before. Working in Denmark, I also learnt how a different health system works, which will help me understand other health systems with greater perspective. I have also grown personally through the experience of finding my way in a new country where I initially did not understand the language. Finally, I am very grateful to be part of a network of public health professionals spanning Europe. Although the pandemic kept us apart at the start of the fellowship, my cohort managed to get to know each other well and form close bonds.

## Acknowledgements of fellow

I would like to thank my supervisor, Steen Ethelberg, for his positivity. Whenever a problem seemed difficult, he had a way of making the solution feel easy. And my co-supervisor, Laura Espenhain, for listening to me complain when things weren't so easy after all. I would also like to thank my coordinators, Zaida Herrador Ortiz and Tanja Charles, for their support and their patience. I always felt I could come to them with any questions I had.

Thanks also to the whole wastewater team: Lene Wulff Krogsgaard, Lene von Kappelgaard, Naja Stolberg Bahrenscheer, Tobias Christiansen, Nicco Claudio Hansen, and Mikkel Hansen. Working with them was fun even when it was tough, and together we managed to go from knowing nothing to something resembling expertise. Special thanks to our honorary team member, Tjede Funk, for her welcome interruptions in the office.

Many thanks to the entire EPIET and EUPHEM coordination team for running this programme, despite all the difficulties we had during the pandemic. And thanks to Sooria Balasegaram, without whose encouragement I would never have applied in the first place.