



EnvDis

D-PhD11-1.2

Responsible Partner: P23 UoS

Contributing partners: PHE



GENERAL INFORMATION

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Dissemination <i>Author's suggestion to inform the following possible interested parties.</i>	OHEJP WP 1 <input type="checkbox"/> OHEJP WP 2 <input type="checkbox"/> OHEJP WP 3 <input type="checkbox"/> OHEJP WP 4 <input type="checkbox"/> OHEJP WP 5 <input type="checkbox"/> OHEJP WP 6 <input type="checkbox"/> OHEJP WP 7 <input type="checkbox"/> Project Management Team <input checked="" type="checkbox"/> Communication Team <input type="checkbox"/> Scientific Steering Board <input type="checkbox"/> National Stakeholders/Program Owners Committee <input type="checkbox"/> EFSA <input type="checkbox"/> ECDC <input type="checkbox"/> EEA <input type="checkbox"/> EMA <input type="checkbox"/> FAO <input type="checkbox"/> WHO-EU <input type="checkbox"/> OIE <input type="checkbox"/> Other international stakeholder(s): Social Media: Other recipient(s):		



D-PHD11-1.2

Presentation of findings

1. University of Surrey Conferences

1.1. Veterinary School Research Celebration Event. Short oral presentation. 09/09/20. Online



- Oriented to the wide University community, and more especially to the Veterinary Medicine staff and students.
- Presentation of the mechanistic modelling as the method that will be used to tackle the research questions.
- About 72 attendants.

1.2. Project progress video presentation as part of the vHIVE group (Veterinary Health Innovation Engine) at the 6th One Health Congress. 30/10/2020. Online



- Oriented to the public interested on the members of the Veterinary Health Innovation Engine (vHIVE) within the 6th World One Health Congress.
- Presentation of PhD project and objectives.
- Over 2,000 attendants.

1.3. Project progress oral presentation at NTD group meeting. 28/09/2020. Online



- Oriented to the Neglected Tropical Diseases Faculty group.
- Presentation of progress open to questions and suggestions within an informal colleagues meeting.
- About 15 attendants



2. OHEJP-related Conferences

2.1. Annual Scientific Meeting 2020. Poster presentation and 3 minute thesis competition. 27-29/05/2020. Online.

Understanding the main environmental drivers for salmonellosis using mechanistic modelling.

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Salmonellosis is a major cause of disease in humans and animals, being the second most commonly reported foodborne disease in Europe. At the same time, weather and climate have proven to have an impact on the prevalence of salmonellosis. One of the principal drivers of seasonality is thought to be temperature, and the mechanism for this is assumed to be the ability of the organism to grow in food at ambient temperatures. The aim of our study is to understand the mechanism responsible for the association between the most influential weather parameters—including temperature—and the incidence of salmonellosis in humans.

METHODS

One or more mechanistic model(s) will be developed and validated by looking retrospectively at local and national-level outbreaks, i.e. records from national diagnostic laboratories across England and Wales provided by Public Health England, and their spatio-temporal linkage with a range of environmental variables (air temperature, precipitation, humidity, vapour pressure and UV radiation) provided by the MetOffice. The mechanistic models will be based on a Poisson process with rate of infection incorporating the dynamics of bacterial growth and 5000% relevant sources (e.g. eggs, chicken meat) responsible for transmission.

RESULTS

- Eggs and chicken meat appear to be the most relevant sources of transmission of *Salmonella*. The ongoing literature review will help to elucidate the main biological mechanisms for growth and survival of *Salmonella* in these sources and its relation with weather parameters used.
- After incorporating the mechanisms into the model, we will obtain a prediction of the expected cases in England and Wales over a given period of time in the past along with climate history (Fig 1). The results will be compared and adjusted with actual epidemiological reports to develop a more accurate prediction tool.
- The model will be validated in a different geographical area.

Fig 1 Predicted mean of the seasonal pattern of disease incidence expected in the future in new population in England for the period between 2020 and 2025.

Fig 2 Seasonal pattern of reported cases of salmonellosis by mean summer temperature (—), average temperature by week (---), no. of weekly cases, images taken from [Google](#) et al. 2020.

By reproducing recorded events of salmonellosis in the past from data available from Public Health England (PHE) (Fig 1) we will precisely shape the model. Knowing the effect that environment exerts on *Salmonella*, our aim is to replicate the results of [Poulsen et al., 2004](#) (Fig 2) for the main environmental agents.

CONCLUSION AND PERSPECTIVES

From the modelling insight and outputs, we aim to elucidate the causal mechanisms for climate/weather dependency in the incidence of human salmonellosis (seasonality), understand and better predict the risk of disease. After validating the model in a different geographic region other than England and Wales, the model could be used in a different array of weather and climate scenarios.

This poster is part of the European Joint Programme One Health EJP. This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 773830.

- Oriented to the OHEJP consortium as well as open to the general public interested in One Health-related research (Foodborne zoonoses, antimicrobial diseases and emerging threats).
- Presentation of the research question which takes a look at seasonality as a driver of salmonellosis and research objectives.
- Over 750 participants

2.2. Invited presenter 6th Cogwheel Workshop, 25/11/2020. Online

A general method linking Mechanism and Phenomenology

6th Cogwheel Workshop

By Laura C. Gonzalez Villeta
WP 6 EnvDis
l.gonzalezvilleta@surrey.ac.uk
25th Nov 2020 – Virtual

This presentation is part of the European Joint Programme One Health EJP. This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 773830.

- OHEJP partner SafeConsume, a research and innovation action funded by Horizon2020 which objective is to reduce health burden from foodborne illness through changing consumer behavior.
- Presentation of preliminary results linking chicken and eggs to salmonellosis.
- About 29 participants



3. External Conferences

3.1. 6th World One Health Congress. Poster presentation. 30/10/2020-03/11/2020.

Online

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SURREY

Understanding the main environmental drivers for salmonellosis using mechanistic modelling.

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Salmonellosis is a major cause of foodborne disease, with *S. Enteritidis* being the causal agent involved in most of the human outbreaks in Europe. Growing evidence shows that weather has an impact on the prevalence of salmonellosis. One of the principal drivers of seasonality is thought to be temperature, and the mechanism for this is assumed to be the ability of the organism to grow in food at ambient temperatures. The aim of our study is to understand and predict the patterns in the prevalence and incidence of salmonellosis and how these patterns depend on key influential weather parameters, such as temperature.

METHODS

We are developing mechanistic models for the prevalence of salmonellosis to be validated with records from national diagnostic laboratories across England and Wales provided by Public Health England (PHE). The models are based on a Poisson process with a rate of infection that incorporates the dynamics of bacterial growth and survival in relevant sources responsible for transmission (e.g. eggs, chicken meat), assuming that the number of cases are proportional to the average bacterial load in food, in response to the local weather data (e.g. air temperature, humidity and radiation) provided by the MetOffice.

RESULTS

- Based on the path mechanism breakdown from eggs alone and the inverse proportional relationship with temperature, a simulation of salmonellosis cases was plotted (Fig. 1) and Fig. 2. A seasonal pattern was identified between the weeks 25 and 40 that corresponds approximately to the months of May to September.
- The predicted cases of salmonellosis (Fig. 1, blue) in England and Wales closely matched the real pattern of recorded cases by PHE for the years 1990-1999 (Fig. 1, red).
- When a simulation of a 2°C increase in temperature was performed, the number of salmonellosis cases increased as well (see red line and its corresponding 25 and 75 quantile shadow in Fig. 2), showing that, once fully validated, the model can be readily used to assess the impact of climate change on disease incidence.



Fig. 1. Comparison of the mean normalized preliminary predicted (blue) and recorded (red) cases of salmonellosis for the years 1990-1999.

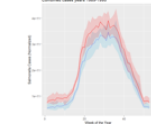


Fig. 2. Preliminary prediction of salmonellosis cases when considering egg origin and temperature alone (blue line) to highlight and model for the years 1990 to 1999. Simulation of the expected cases in a scenario of a 2°C temperature increase is also shown in red. The shaded area represents the 25th and 75th quantiles and the solid line for the mean values.

CONCLUSION AND PERSPECTIVES

There are encouraging preliminary results. **Temperature** seems to have a key influence on the incidence of salmonellosis, but other food sources of disease (e.g. chicken meat) and other weather-driven mechanisms are being investigated for more updated years. From the modelling insight and output, we aim to elucidate the **causal mechanisms** at the origin of the weather/climate dependency in the patterns of human salmonellosis (eventually), assess the relative importance of the different disease sources and food sources, and **understand** and **better predict** the risk of disease. The model will also be used spatially to investigate a possible geographic influence on the incidence of disease. After validating the model in a different geographic region other than England and Wales, the model could be used in a different array of weather and climate scenarios.

- Oriented to the world-wide community interested in One Health latest breakthroughs within the 4 main topics: One Health Science, Antimicrobial Resistance, Science-Policy interface and SARS-COV-2.
- Presentation of first modellisation of human salmonellosis based on eggs and temperature, and simulations of disease increase in an $\Delta 2^{\circ}\text{C}$ scenario.
- Over 2,000 attendants