A comparison of two different approaches to investigate the role of air temperature as a key driver of salmonellosis

Main author: Laura C. Gonzalez Villeta (University of Surrey/One Health EJP (UoS-OHEJP))

Co-authors: Alasdair Cook, Caitriona Fenton, Emma Gillingham, Theo Kanellos, Gordon Nichols, Joaquin M. Prada, Giovanni Lo Iacono

INTRODUCTION

Salmonellosis continues to be a major cause of disease in humans and animals, being the first agent involved in foodborne outbreaks in Europe. The observed incidence of salmonellosis in humans reveals a seasonal pattern, with a higher number of cases reported during the warmest months. This seasonality alludes to the importance of the environment as a modulator of infection. The main driver of seasonality is believed to be temperature, but other influential variables may well be involved. Our goal is to explore the role of temperature as a key weather variable driving the incidence of salmonellosis in humans. We want to test the hypothesis that seasonality in the incidence of salmonellosis is largely driven by the response of bacterial growth in food to air temperature.

METHODOLOGY

We will compare the outcomes of two different approaches, using temperature records for both. The first method is based on a mechanist approach that simulates the number of salmonellosis cases due to the growth of temperature-driven Salmonella in eggs. We simulated the number of human salmonellosis cases observed during the past 30 years at a postcode-resolution location in England and Wales with a mechanistic model and using historical temperatures as input. Our estimations were based on a Poisson process with a rate of infection assumed to be proportional to the bacterial load in relevant food (i.e. eggs and chicken). The bacterial load, in turn, depends on air temperature according to the empirical relationship available in the literature. On the basis of the mechanistic model, we estimated the theoretical probability of observing a case of salmonellosis at a given temperature. The second method is a statistical approach, where we used the disease records and their spatio-temporal links to environmental variables (temperature, precipitation, humidity, vapour pressure, and UV radiation) to estimate the empirical probability of finding a case of salmonellosis conditional to a range of temperatures.

RESULTS

In a subsequent step, we will compare simulated and observed conditional probabilities to validate the underlying hypothesis. With the first approach, we have found a positive agreement between the predicted and observed incidence curves for England and Wales. This tentatively confirms the relevant role that temperature and eggs play in salmonellosis temporal incidence patterns – positioning temperature as a potential primary weather driver of salmonellosis. We will validate this finding if both approaches lead to a similar conditional incidence of salmonellosis to temperature. On the other hand, if the results do not match, this would indicate a research gap and point to further experiments involving other food sources of salmonellosis as well as other weather variables involved.

DISCUSSION

Having solid proof of the main environmental factors that influence salmonellosis transmission is important to tackle future disease events, especially in the framework of global warming. Understanding why the incidence of salmonellosis is conditioned to certain weather variables will be useful for practical public health applications to better elucidate observed spatio-temporal patterns and improve future incidence predictions. In particular, we will build on this model to develop a tool to predict the likelihood of infection based on known weather variations prior to the occurrence of an infection. Once the model has been validated, it is our aim to apply it to a different geographic area to test the efficacy of the model.