15. Environmental survival of infectious forms of Campylobacter: insights from mathematical modelling and experiments in broilers.

Anna Gamża[1,2*], Thomas Hagenaars[2], Miriam Koene[2], Mart de Jong[1]

[1] Quantitative Veterinary Epidemiology, Wageningen University & Research, the Netherlands
[2] Wageningen Bioveterinary Research, Wageningen University & Research, the Netherlands
* Corresponding author. E-mail: anna.gamza@wur.nl

Modelling transmission of zoonotic bacteria in farm animals helps to establish and test control strategies focusing on the farm-level stages of the food chain to reduce risks of animal products to human health. *Campylobacter* is a zoonotic bacterium species commonly found in poultry in spite of control efforts, so it is crucial to further study its epidemiology to help the development of new control strategies. Mechanisms underlying environmental transmission of *Campylobacter*, such as survival and dispersion of infectious forms, were not satisfactorily studied in the past. For example, it is still not known in what form *Campylobacter* is spread through environment and how viable-but-nonculturable (VBNC) forms contribute to transmission. To study the mechanisms underlying environmental transmission we formulated a parsimonious spatial modelling framework including hypothesised mechanisms of pathogen decay and dispersion. To calibrate and validate the model, we conducted a series of experiments studying transmission of *Campylobacter jejuni* in broilers, where recipient hosts were separated from infectious hosts by a range of distances and checked daily for their infection status. By fitting the data to our model we obtained informative simultaneous estimates for all three model parameters: a decay rate describing how fast the pathogen is inactivated in the environment; a diffusion coefficient describing how the spatial distribution of infectious material in the environment changes in time; a transmission parameter describing host-dependent processes that individually are structurally non-identifiable. The time and distance dependence of transmission in the fitted model was consistent with marked spatiotemporal patterns in the experimental observations. The value of decay rate parameter we estimated is significantly lower than a value estimated previously from a separate survival experiment, which was conducted in the same environmental conditions and where culturable forms of *C. jejuni* were measured in faeces. This indicates that infectious forms of *C. jejuni* that were responsible for the colonisations observed in our transmission experiments survive better in the environment than culturable forms measured in faecal material. In the future, insights obtained from transmission experiments can be analysed together with the data from separate pathogen survival experiments to further study mechanisms of *Campylobacter* decay in animal systems.

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