Zoonotic campylobacteriosis via broiler chicken in Germany: a risk assessment approach

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Introduction

Campylobacteriosis is an important human health issue in developed countries where contaminated broiler chicken meat is assumed to be the major source of human infection. This disease is responsible for economic and life comfort losses in infected humans. Current control strategies are mainly based on biosecurity measures at the farm level and HACCP measures at slaughterhouses. These measures are not sufficient to effectively control the disease in humans.

Objectives

- Quantitative risk assessment (QRA) of campylobacter via broiler meat in Germany
- Assessing the effectiveness of non biosecurity control measures to decrease campylobacter infection in humans via broiler meat using the developed QRA model

Chosen model: Modular structure

Farm model

- Primary phase od fast spread within a cluster of animals
- Then epidemic spread: SI mechanistic model (Fig.1)
- Calibration based on experimental study (Jacobs-Reitsma.1996, Stern et al. 2001, Conlan et al. 2007)

Rapid spread within a cluster of animals

S → I

5 days post introduction

Fig.1: model of Campylobacter transmission dynamics within flock

Transport model

- Assuming a homogeneous contamination of the animals before transport → Neglect horizontal contamination
- Vertical contamination of low crates by faeces leakage from upper crates
- Model calibration: Based on field studies (in progress)
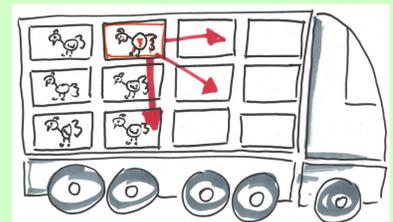
Processing model

- Adaptation of the CARMA project model (Fig.2)
- At each processing step and for each carcass in the processing line:
  ✓ Exchange of bacteria between the environment and the carcass
  ✓ Probability of faeces leakage during processing
  ✓ Bacteria survival dynamics in the carcass and in the environment
- Calibration based on field studies

Environment

Removal

Contamination through Leaking faeces

Removal
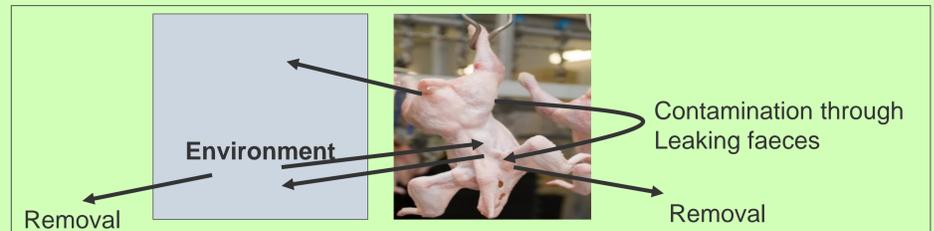
Fig.2: Campylobacter dynamics through slaughter processing steps

Transformation + storage model

- For each carcass: estimation of
  ✓ Bacteria concentration in entire carcasses or cut pieces (legs + filet)
  ✓ Bacteria survival among storage
- Calibration based on national broiler production data

At home preparation model

Up-to-date BfR/DVN model:
- Based on field study in Germany
- Mechanistic representation of foods cross contamination during preparation at home:
  ✓ Bacteria exchange between the meat and hand, cutting board and knife.
  ✓ Contamination of fresh food (salad)
  ✓ Meat under cooking

Human infection + disease burden

- BfR/DVN model: accounts for low dose response
  ✓ calibration based on an experimental study (Black & al. 1988)
- Estimation of the disease burden:
  ✓ Human infection severity after exposure (Fig.3)
  ✓ Use of German data (Lackner et al. 2019)

Infection by Campylobacter → Asymptomatic
Gastroenteritis
Death
Inflammatory bowel disease | Irritable bowel syndrome | Reactive arthritis | Guillain Barré syndrome
Long-term sequelae
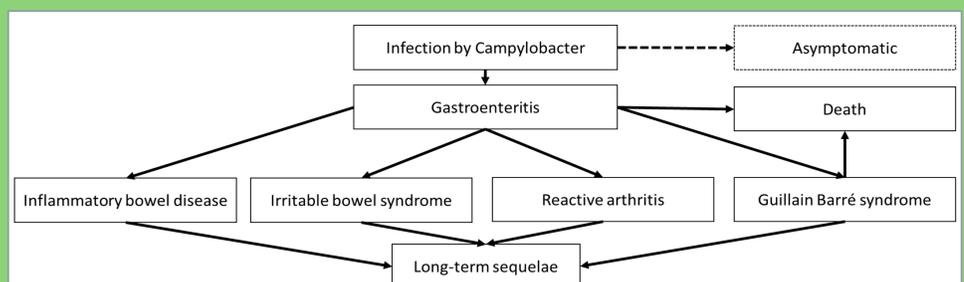
Fig.3: Outcome of infection by Campylobacter (adapted from Pires. 2014 and Lackner et al. 2019)

Conclusion

- Conceptual modules and data calibration based on review of published risk assessment and field studies and national experts elicitation
- Development of the first from farm to consumer QRA model designed and calibrated to represent the German context: adapted from published models
- Individual based model: easier implementation of individual targeted control measures

References

- **BfR/DVN model (DE):** Brynestad, S., Luber, P., Braute, L. & Bartelt, E. 2008. Quantitative microbiological risk assessment Of campylobacteriosis cases in the German population due to consumption of chicken prepared in home.International Journal of Risk Assessment and Risk Management,8(3): 194-213.
- Black R.E., Levine M.M., Clements M.L., Hughes T.P., Blaser M. 1988. Experimental Campylobacter jejuni infection in humans. Journal of Infectious Diseases, 157: 472–479.
- **CARMA project model (NL):** Nauta M.J., Jacobs-Reitsma W.F., Evers E.G., Pelt W. van, Havelaar A.H. 2005. Risk assessment of Campylobacter in the Netherlands via broiler meat and other routes. RIVM report 250911006/2005.
- Lackner J, Weiss M, Müller-Graf C, Greiner M 2019 The disease burden associated with Campylobacter spp. in Germany, 2014. PLoS ONE 14(5): e0216867. https://doi.org/10.1371/journal.pone.0216867
- Pires SM. Burden of Disease of Foodborne Pathogens in Denmark. Søborg: National Food Institute, 2014

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CAMPYLOBACTER
Preventing and Combating Infections