Workpackage 24:
Annual Research Report

WP number	24
Title	Comparison of *Campylobacter* risk assessment models: Towards a European consensus model?
WP Leader	Maarten NAUTA
Name and Address	Microbiological Laboratory for Health protection (MGB) National Institute for Public Health and the Environment (RIVM) P.O. Box 1 3720 BA Bilthoven NETHERLANDS
Project Start date	1 March 2006
Project End date	28 February 2009

Objectives

- To organize an initial meeting to exchange modelling experiences, indicate the specific topics of interest and discuss research plans.
- To publish a collaborative report on the comparison of models and the feasibility of a 'consensus model'.
- To organize a meeting about developing a software package for a European consensus model for risk assessment of *Campylobacter*.
- To develop a research plan for a 'user-friendly' risk model as a software package applicable in Europe, to support risk management on campylobacteriosis.
- To catalogue any relevant data available in Europe and suggestions for harmonized, quantitative data collection in Europe, to meet the data needs of the proposed model.

Key Achievements to date

- A report and review paper on the comparison of European *Campylobacter* risk assessments have been completed.
- European risk assessment approaches have been integrated into a research plan for a consensus framework.
- Collaboration with experts in non-European risk assessments on *Campylobacter* in broiler meat (FAO–WHO, New Zealand).
- A data catalogue relevant for risk assessment of *Campylobacter* in broiler meat has been compiled.

Progress summary

Workpackage 24 aims to compare the existing national risk assessments on *Campylobacter* in broiler meat in Europe, and to develop a European consensus approach. For a comparison of models, expert partners held three subgroup meetings covering: (1) the farm phase; (2) the processing and retail phase; and (3) the consumer preparation and illness phase. Models were discussed in detail to identify the important differences and similarities, and to find the strengths and weaknesses in the available risk assessments. Results have been presented and discussed in a meeting with risk managers and other interested parties. This has resulted in a report and a review paper on *Campylobacter* risk assessments in Europe.

It has been concluded that the development of one single consensus European risk assessment model is not a feasible option, because of: (1) the variety of questions that risk managers may want risk assessments to answer; (2) the variety in consumer behaviour and food consumption patterns within Europe; and (3) the fact that risk assessment is still a developing science. However, WP24 will elaborate on a consensus framework to risk assessment modelling for *Campylobacter* in broiler meat, both as an aid to support countries with limited experience in risk modelling, and to further aid harmonization of European risk assessment. This framework will formulate minimum requirements for risk-assessment models and some general categories of risk-management questions, based on some additional research to allow a combination of the strengths of the different approaches.

Over the past decade, microbiological risk assessment has developed into an important tool for food safety control. Its use has been promoted by international bodies including the WTO, the Codex Alimentarius, WHO and FAO, since it offers a structural, unified approach to complex problems, as well as a scientific basis for risk-management decisions. Within Europe, the experience in risk research has substantially increased. Several food-chain risk assessments have been conducted in different countries, for various food–pathogen combinations. Microbial risk assessment is a relatively new and rapidly evolving discipline, for which a variety of methodologies have been explored, each of which has its own strengths and weaknesses. This variety supports the progress of risk assessment as a research discipline, but also has its disadvantages: comparison of risk assessments between countries is complicated when analysis tools differ, and for less experienced researchers, who need to set up their own risk assessments, it is difficult to choose the most appropriate methodology.

The aim of this Workpackage is to combine the best aspects of the individual approaches, in order to improve microbial risk assessments within Europe. By bringing together the researchers who set up risk assessments in different countries, the different approaches can be compared. This comparison includes both the methods applied and the results obtained and will provide insight into the differences, and their relative impacts on the risk-management advice based on the risk assessments. Thus, WP24 should lead to a consensus approach to microbial risk assessment modelling, which may guide others in Europe who want to set up their own risk assessment. Also, a harmonized approach may facilitate risk management on a European scale, which can be required for zoonoses that know no boundaries and continuously cross borders.

WP24 focuses on *Campylobacter* in broiler meat as a model organism. *Campylobacter* is the most commonly reported food-borne bacterial pathogen in Europe, and broiler meat is generally considered as a major source of campylobacteriosis. A number of quantitative risk assessments on *Campylobacter* in the food chain are currently available or in progress within Europe. Some of these risk assessments have been developed by Med-Vet-Net partners (VLA, DTU, AFFSA, BfR and RIVM/ASG). The different risk assessments have been established more or less independently: for each assessment data were collected (both country-specific and international) and new models built for various stages of the food chain.

Campylobacter risk assessments have also been developed in a broader international

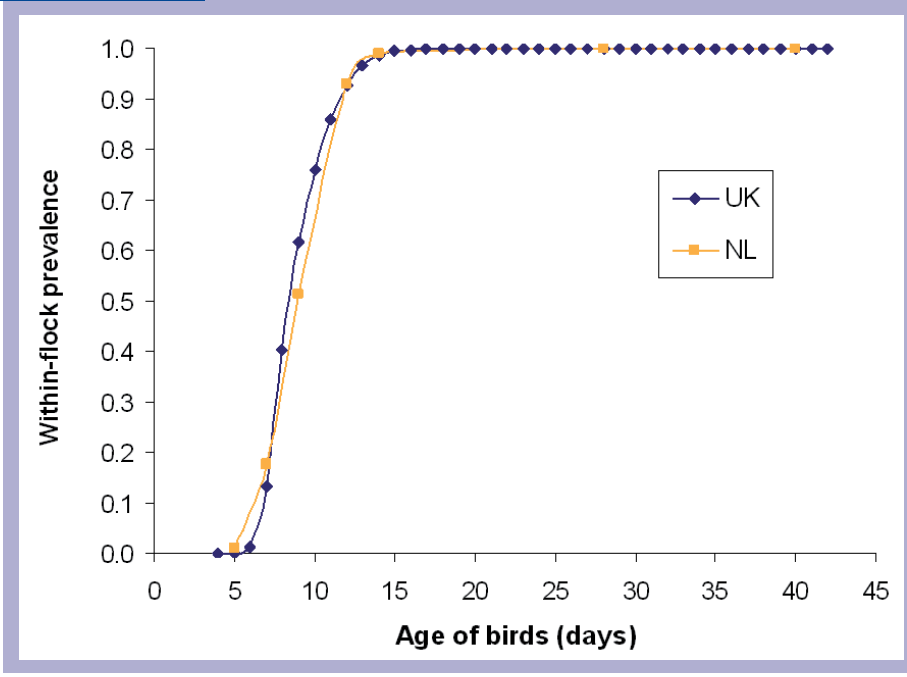

Figure 24.1 The epidemic spread of Campylobacter *in broiler flocks: The predicted within flock-dynamics given introduction of a single infected bird at* t=0 *according to the NL model and UK model.*

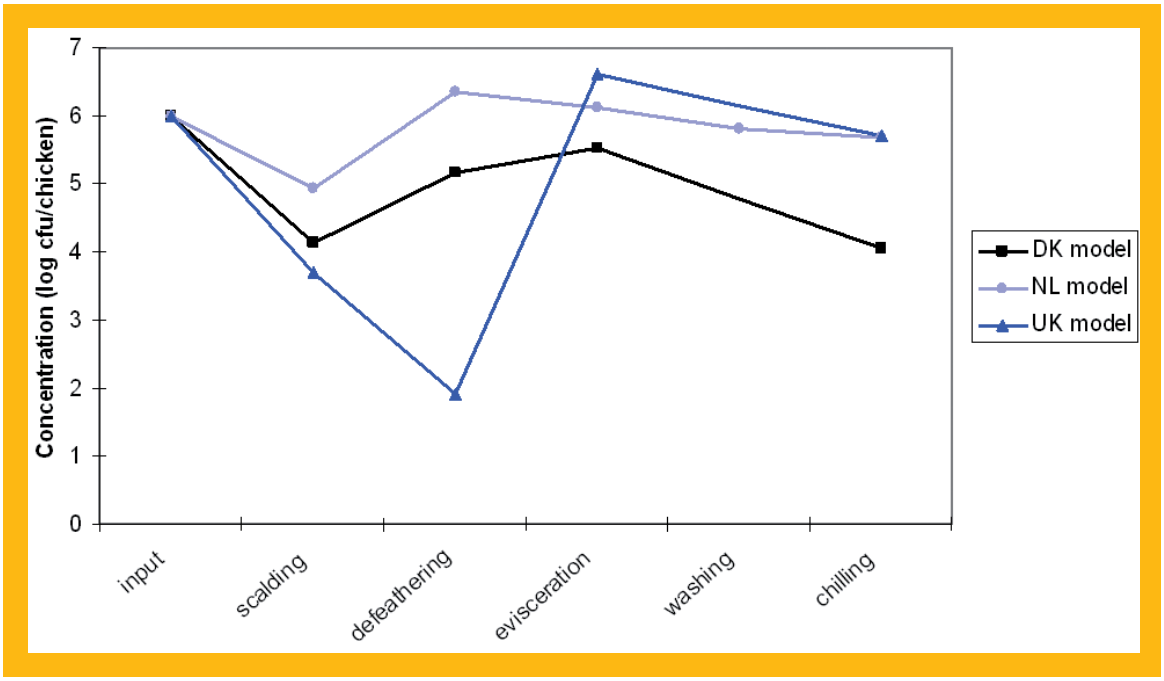

Figure 24.2 An illustration of the dynamics predicted by three processing models. Note the difference in effects of defeathering and evisceration.

context. Representatives of three Med-Vet-Net partners (VLA, DTU, RIVM) have previously collaborated with partners from the USA and Canada in the WHO–FAO drafting group on risk assessment of *Campylobacter* in broiler chickens. This experience in the search for a consensus approach in a global perspective proved to be extremely useful for WP24, and has facilitated further collaboration with non-European experts. Results from the *Campylobacter* risk assessment in New Zealand are also integrated into the Workpackage.

To date the focus has been on a comparison of the available models, where the search for consensus was leading. Expert subgroups met to discuss models covering: (1) the farm phase; (2) the processing and retail phase; and (3) the consumer preparation and illness phase. Models have been discussed in detail to identify the important differences and similarities, and to find the strengths and weaknesses in the available risk assessments. The results of this work have been published in a report (Deliverable D24.1) and will be published in a peer-reviewed review paper (D24.2)

Summary of results of the comparison of risk assessments on *Campylobacter* in broiler meat

On the farm (UK and NL models)

The epidemic spread within the flock is modelled differently, but the overall dynamics are highly comparable (see Figure 24.1). There are some common observations, for example at slaughter the within flock prevalence is either low (<5%) or high (95%) in the large majority of flocks and the within-flock prevalence can increase dramatically within a week.

During processing (UK, DK and NL models)

The modelling approach is the major difference between the models. Models are primarily based on the available quantitative data (DK), the basic mechanistics of processing (NL) or both (UK). By the use of data, the model dynamics may give a better representation of the current situation, whereas a mechanistic approach may be preferred to predict the effects of interventions. As a consequence the models predict different dynamics for the change in *Campylobacter* concentrations during processing (see Figure 24.2). Nevertheless, some conclusions on the effect of interventions on human health risks are common in particular logistic slaughter has negligible effect on risk, changing flock prevalence has a linear effect, and reduction of the levels of contamination on carcasses is an effective intervention.

At the consumer level (UK, DK, NL and D models)

Cross contamination from fresh chicken meat to other foods and to hands is the dominant route of exposure in all models. The consumer phase is therefore essential for risk assessment, because it links product contamination to exposure in a non-linear way. Description of the variability in the level of contamination on meat products and the variability in behaviour is important. The models all indicate that the human-health risk depends on the tails of the distributions and not so much on the mean values. Therefore, quantitative data and models are required on bacterial transfer, frequencies of food hygiene related behaviour, and consumption patterns (including social aspects). Variability in food handling and consumption practices within and between European populations complicates a unified European approach. Consumer information is the only option for risk mitigation at this stage, but its effect is obscure.

Dose response (UK, DK, NL and D models)

The dose–response relationship most often used is the beta-Poisson, or a related model, based on one study of human volunteers. The German model also uses an alternative model. It is clear that the uncertainty about the dose–response model for *Campylobacter* to be used in risk assessment remains large.

From the comparison of risk assessment models the Workpackage has concluded that the development of a single European 'consensus risk assessment model' was confounded by:

- Differences in approaches relate mainly to differences in the available (national) data or in the dynamics of the process modelled.
- A good risk assessment has to be fit for purpose. This implies that the choice for a 'best model' can only be made in the context of the risk management, question at hand and depend on the availability of (suitable) data, both of which can vary between countries.
- Food consumption patterns, including the quantity of chicken consumed and the preparation of the meat and the accompanying dishes between European population groups, is highly variable.

These findings were presented and discussed in the second meeting of WP24, 25–26 January 2007 in Copenhagen. National risk managers and EU and EFSA representatives were invited to this meeting, along with researches from countries with (future) ambitions to perform a risk assessment of *Campylobacter* in broiler meat, and experts from Canada and New Zealand. The meeting concluded that the construction of a user-friendly software tool that serves as the European consensus risk assessment model is neither feasible nor desirable. There is, however, a need for a flexible tool that can help those who want to set up a new risk assessment for their own country (or region), and may help countries where a risk-assessment model is available to further develop this model. Plans for such a tool have been generated (D24-3).

Therefore, it was decided to develop a 'Consensus framework' rather than a 'Consensus model'. This framework will aim to guide future risk assessment on *Campylobacter* in broiler meat in Europe. Such a framework would offer a catalogue of modules for specified stages in the 'farm-to-fork' chain. These modules may reflect the existing risk assessments, but may also be simplifications or elaborations of modules from these risk assessments. Input and output of the module models would be standardized. It should also be possible to update or modify modules with new or alternative data. The framework would enable the development of country-specific models.

It will be necessary to validate and update this model with microbiological data. A catalogue of current available data has been prepared (D24.4). The catalogue is structured to reflect the farm to fork chain, starting with information on rearing, then transport to abattoir, processing, retail and consumer handling and, finally, dose response. Each step is subdivided into descriptions of relevant parameters, e.g. flock prevalence, within flock prevalence, followed by specific remarks describing the data, e.g. per cent positive broiler flocks, percentage of birds colonized in an infected flock, and concentration on neck skin. The risk assessments, in which the data are used, are also stated. These observations and research requirements have been combined into a strategic research plan (D24.3). In particular, information on the effects of chicken processing is required. The consumer phase is also an important part of the food chain. Many things can happen in this phase; the variety in transmission routes is large, and the dependence on human behaviour is important. It is clearly necessary to study the relevance of detailed modelling in this phase with regards to the effects of relative risks and the uncertainty compared to that of the dose–response relationship.