codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

JOINT OFFICE: Viale delle Terme di Caracalla 00100 ROME Tel: 39 06 57051 www.codexalimentarius.net Email: codex@fao.org Facsimile: 39 06 5705 4593

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DISCUSSION PAPER ON RISK MANAGEMENT STRATEGIES FOR *CAMPYLOBACTER* SPP. IN POULTRY

(Prepared by the Netherlands, with the assistance of Australia, Belgium, Denmark, Finland, Norway, UK, US and the European Commision)

1. BACKGROUND INFORMATION AND TASK

1.1. GENERAL

At its 34th session the Codex Committee on Food Hygiene considered several risk assessment activities jointly undertaken by WHO and FAO. The Committee noted the ongoing Risk Assessment work on *Campylobacter* spp. in broiler chickens. The Committee therefore agreed that a drafting group led by the Netherlands, with the assistance of Australia, Belgium, Denmark, Finland, Norway, the United Kingdom, the United States and the European Commission (EC) would develop a Discussion Paper on Risk Management Strategies for *Campylobacter* spp. in Poultry with a view towards defining questions to be addressed in the risk assessment.

The Committee stressed that, in light of the current ongoing risk assessments being undertaken in FAO and WHO for the selected pathogen/commodity combinations, the drafting groups should finalize the discussion papers as soon as possible, so that they could be circulated for comments at the earliest opportunity. The Committee also suggested that the discussion paper could provide guidance to FAO and WHO in their continued elaboration of the risk assessment on *Campylobacter* spp. in broiler chickens. The Committee also requested that countries which already had control programs in place for the pathogens under consideration provide information describing these programs to the leaders of the drafting groups as soon as possible.

The Committee noted the importance of developing well focused risk management questions to be addressed by the risk assessment, to clearly communicate the desired results, to take the farm-to-table continuum into account when developing risk management options and to take the needs of global health concerns for all countries into account.

In view of the Committee's need to achieve a better understanding on how to integrate risk assessment results into the development of standards, guidelines and other management documents, the Committee

requested FAO and WHO convene an expert consultation to address this point. Therefore an FAO/WHO expert consultation on the principles and guidelines for incorporating quantitative microbiological risk assessment in the development of standards, guidelines and other management documents took place in March 2002 in Kiel, hosted by Germany.

1.2. RISK ASSESSMENT WORK OF WHO/FAO

WHO/FAO initiated work on a risk assessment for *Campylobacter* in broilers in 2001. This was agreed upon at the 33rd session of CCFH. The objective of this assessment was comparable to the one formulated for the ongoing risk assessment of *Salmonella* in broilers. The requested outputs include:

- An estimate of the risk from pathogenic thermophilic *Campylobacter* in chicken (broilers) consequential to a range of levels in raw poultry for the general population and for various susceptible population groups (elderly, children, and immunocompromised patients).
- Estimate the change in risk likely to occur for each of the interventions under consideration including their efficacy.
  a) Reduce the prevalence of positive flocks
     - Destruction of positive breeder and broiler flocks
     - Vaccination of breeding flocks
     - Competitive exclusion
  b) Reduce the prevalence of positive birds at the end of slaughter
     - Use of chlorine in water chilling of chicken (broilers)
     - Water chilling vs. air chilling of chicken (broilers)
- Evaluate the importance of various routes for introduction of pathogenic *Campylobacter* into flocks including feed, replacement birds, vectors and hygiene.

An expert consultation, convened by FAO and WHO[1] concluded that these "risk management questions were not very well tailored to the particular problem. A risk profile could help in identifying relevant risk management questions in particular in relation to interventions."

There is a significant amount of work that has been and is currently being conducted regarding risk assessment for *Campylobacter* in broilers, including national risk assessments. Work conducted by Canada, Denmark and the U.K. was used in developing the WHO/FAO risk assessment.

To date a Hazard Characterization, Hazard Identification and Exposure Assessment have been developed and reviewed by the joint expert consultation in 2001. A draft risk characterization was completed in mid 2002 and reviewed by the joint Expert Consultation in August 2002. At the August meeting of the expert consultation an early draft of this discussion paper was available. An executive summary of the risk assessment is available for the present CCFH meeting. The final report of the "FAO/WHO *Campylobacter* in broilers risk assessment" is scheduled to be available at the end of 2003.

1.3. ANALYSIS OF THE TASK

In the preliminary stages of risk management it is important to get a clear view on potential interventions for reducing the risk in question to the extent possible. This facilitates the development of clearly defined risk management questions which need to be addressed by the RA. This information is also vital for effective interactive communication between risk managers and risk assessors during the process, up to the final decisions on the best intervention approaches and during review of the results.

The latest version of the Codex draft for Microbiological Risk Management defines in its protocol a working order that is supposed to start with certain preliminary risk management activities, such as preparing a risk profile; these should be executed before the risk assessment activities are commissioned. However, in both

[1] Joint FAO/WHO Expert Consultation on Risk Assessment of Microbiological Hazards in Food. Hazard identification, exposure assessment and hazard characterization of *Campylobacter* spp. in broiler chickens and *Vibrio* spp. in seafood, Geneva, Switzerland, 23-27 July 2001. WHO/SDE/FOS/01.4.

this specific instance and most other cases the preliminary management activities as described in the protocol, were not initiated until the assessment activities had already begun.

The Committee, realizing this drawback, indicated that an important role for this paper (and for the comparable discussion papers on other pathogen/commodity combinations) is to better define, as soon as possible, questions to be answered by the risk assessors, even if the risk assessments are underway. In essence, it is better to have management input in the risk analysis (RA) process in a reversed order, then no input at all.

The US is leading the task to develop guidelines for a process by which Codex could undertake its work in Microbiological Risk Assessment/Risk Management[2]. Similarly, France is responsible for developing Guidelines for Microbiological Risk Management. The drafting group considered these documents in an effort to more sharply define its own task. It is suggested that it could be the role of Codex as a risk manager to focus on global aspects, whereas the French draft could focus on risk management at the national / local level with its guidelines for application. This proposed functional separation between both guideline documents should thus avoid confusing overlaps in both protocols. This reasoning has consequences for the content of the required papers on RM of the selected pathogen-commodity combinations.

Developing a management strategy that effectively addresses the problem of *Campylobacter* in all regions, human populations, animal populations, *et cetera*, was determined to be exceptionally difficult given the variety of circumstances and conditions that exist.

An extensive discussion on intent and value of the risk profile (RP) as an essential step in managing the risks, [of a pathogen/commodity combination] taking *Campylobacter* in poultry as an example, led to the conclusion that it is very hard to formulate a meaningful risk profile in the case of *Campylobacter* that has direct applicability at any specific location or under any circumstance. The original ambition to proceed with a RP with global applicability seemed counterproductive to the drafting group. It was decided to take an example type approach: to consider a model that could be helpful when risk profiling was to be applied in a specific given location / condition. Specifically, this discussion paper includes an abbreviated risk profile for *Campylobacter* in poultry based on an previously developed risk profile produced by the Netherlands. The intent is to outline the scientific issues and assist the risk managers with developing risk management questions of interest for consideration in a risk assessment.

The main objectives of the task are therefore:

- Reflection on the best format for a risk profile with global applicability (see par. 2.3)
- Definition of relevant potential interventions to reduce the risks from Campylobacter in poultry (see chapter 3)
- Definition of relevant questions to be addressed in both ongoing and future risk assessments (also see chapter 3).

2. RISK MANAGEMENT STRATEGIES AND THE ROLE OF A RISK PROFILE

2.1. GENERAL CONSIDERATIONS

2.1.1. What are the issues, general and specific?

General issues

The prevalence of campylobacteriosis in humans is increasing in western nations. As a consequence campylobacteriosis is a human health concern of growing importance. We do not know if the problem is also of (equal) importance in third world countries. Unfortunately, the attributable fraction of human campylobacteriosis cases associated with exposure from chicken versus other potential sources of

[2] CX/FH 03/6 Proposed draft process by which the Codex Committee on Food Hygiene could undertake its work in Microbiological Risk Assessment/Risk Management

Campylobacter has not been determined. Similarly, the impact that regional, national and other differences have on the attributable fraction of human illness associated with poultry is unknown. Despite these data-gaps, the goal of any mitigation or management option would be to reduce human illness due to *Campylobacter* in poultry. Consequently, how risk managers would achieve a reduction in the incidence and magnitude of human exposure to *Campylobacter* in poultry is a question of great importance. Stages within the food chain that most effectively reduce human exposures to *Campylobacter* from poultry must be identified. Similarly, how such reductions in exposure correlate to the change in expected incidence of human illness is a matter of importance. Risk managers need information that would describe the stages in the food chain where interventions can be most effective.

2.1.2. Who are the risk managers?

Governments (strategic risk managers) will be the main risk managers but the involvement of others (operational risk managers) will be governed by the approach to be adopted. These role models will probably be further developed in the near future. Due to the variety of operational managers, those involved in farm-to-fork mitigations will be different from those involved in a farm-only approach. In the farm-to-fork approach, operational managers could be stakeholders, which include:

- Those who farm chickens.
- Those who transport and process chickens.
- Those who sell chicken and meals containing chicken.
- Government agencies and educators.
- Consumers.

International organisations such as CODEX and OIE, who set standards and produce guidance documents can be seen in this context as strategic risk managers. Codex facilitates conversation and assessment of management options among nations; nations are then responsible for choosing management options and implementing them via legislation etc. Risk management may sometimes be delegated by government to industry.

2.1.3. What are the roles of risk managers?

The risk managers should develop a risk profile to determine the need for actions such as:

- a risk assessment,
- research to fill data-gaps,
- the development of regulations (in absence or presence of RA), and
- communication, particularly in terms of consumer education pertaining to food hygiene.

If a risk assessment is determined to be necessary, risk managers should:

- develop the questions to be addressed,
- understand cost and willingness to pay (for assessment itself but also for any action toward campylobacteriosis reduction),
- determine time frame, and
- orchestrate all conversation between managers and assessors THROUGHOUT the process, either by periodic reviews of the risk assessment and progress toward a risk decision.

2.1.4. What strategies could be used?

The types of risk management strategies that can be used to address the growing public health concern for campylobacteriosis include:

- setting standards or produce or promote codes of practice by governments,

- retailers and trade organisations can establish codes of practice,
- on-farm intervention management strategies can be developed by governments or trade organisations,
- slaughter hygiene and end product treatments may be improved,
- consumer education.
- reduction of the incidence of positive carcases, and
- reduction of the levels of contamination on individual carcasses.

2.2. INTERACTION BETWEEN RISK MANAGEMENT AND RISK ASSESSMENT

A formal process delineating a framework for risk management ["Proposed Draft Principles and Guidelines for the Conduct of Microbiological Risk Management" CX/FH 00/6, July 2000] and a draft discussion paper outlining the interaction between risk assessors and risk managers (see draft paper [3]) are currently under development and were discussed at the recent Kiel expert meeting[4]. Both of these documents discuss how the development of a risk profile is essential to the process of risk assessment. For example, the document developed in Kiel 2002 includes a decision tree depicting the central role of the risk profile in the management process including when deciding whether conducting a formal, quantitative risk assessment is appropriate to support the risk management decisions under consideration.

This discussion paper, highlighting management strategies, includes an abbreviated risk profile for *Campylobacter* in poultry based on an extensive risk profile produced by the Netherlands. The intent is to outline the scientific issues and assist the risk managers with developing risk management questions to be addressed by a risk assessment. In light of the fact that the present WHO/FAO Campylobacter risk assessment is near completion, it is important to note that the process is iterative and that additional risk assessment work may be needed to address other risk management strategies. Ideally, this iterative process would have been initiated with a risk profile to assist managers in determining appropriate actions including whether or not to conduct a risk assessment.

2.3. SETTING UP A RISK PROFILE

2.3.1. Incidence rates and health risks other than acute gastroenteritis

Campylobacter infections pose a serious public health problem for the entire world[5]. In countries where surveillance is conducted, there is evidence that this problem is on the rise. Reported incidence rates of campylobacteriosis differ by as much as an order of magnitude (between 25 and 250 per 100,000 persons). These data may reflect true regional differences in the incidence of campylobacteriosis but may also be related to the difficulty associated with assessing the incidence of campylobacteriosis across the globe in light of differing monitoring systems, analytical techniques and data sources. *Campylobacter* infections pose additional health risks besides gastro-enteritis, including mortality, Guillain-Barré syndrome and reactive arthritis. It is important to note the issue of antibiotic resistant*Campylobacter*.

2.3.2. Reservoirs and sources of contamination

The most important reservoirs of *Campylobacter* are found among animals, including farm animals, wild animals and pets. Food products and the environment including the domestic environment undergo continuous contamination from these reservoirs, creating many pathways by which humans can come into contact with *Campylobacter*. Many studies have indicated poultry as an important source of contamination, but this is by no means the only important contamination route. Other identified risk factors include the

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[3] CX/FH 03/6 Proposed draft process by which the Codex Committee on Food Hygiene could undertake its work in Microbiological Risk Assessment/Risk Management

4 Principles and guidelines for incorporating microbiological risk assessment in the development of food safety standards, guidelines and related texts Report of a FAO/WHO consultation, Kiel, Germany, February 2002

[5] The increasing incidence of human campylobacteriosis. Report and proceedings of a WHO Consultation of Experts. WHO/CDS/CSR/APH 2001.7.

consumption of pork, beef or raw milk, direct contact with animals, and water [including surface water]. In trying to identify risk factors, there is evidence that many cases of campylobacteriosis are acquired by persons travelling abroad. The relative importance of these risk factors for campylobacteriosis is uncertain and is likely to vary among different regions of the world.

2.3.3. Risk of illness attributable to the consumption of poultry

Although the specific attributable risk of illness from the consumption of poultry is unknown, it is known that poultry is a significant reservoir of the organism. There is evidence that *Campylobacter* is common both in broiler flocks and poultry products at retail although there are known exceptions to this (Norway, Sweden). Although *Campylobacter* does not multiply during proper storage, it is known that the organism is present at high levels (# organisms on product) especially in fresh poultry. For this reason it was determined that the risk associated with *Campylobacter* in poultry should be managed, in order to reduce the illness attributable to the consumption of poultry .

2.3.4. Interventions to reduce exposure of consumers

Interventions aimed at reducing the likelihood of exposure of consumers to *Campylobacter* either directly from poultry products or from cross-contaminated foods are expected to contribute to a reduced incidence of illness in humans. A variety of management options can be and are applied at the farm, during slaughter, throughout processing and during food preparation both in the home and the catering industry (i.e. farm-to-fork). Ultimately, it is unlikely that a single option will address the risk posed from *Campylobacter* in poultry. In fact, due to regional differences in prevalence, levels, production, processing, and human incidence of illness, the management options chosen will vary. It was identified that management options can be implemented for intensively produced poultry however free-range flocks may have more limited management options.

Examples of risk management options currently in use

A number of countries, including Norway and Denmark, have implemented control options in an effort to reduce *Campylobacter* in poultry and the consequent burden of illness. In some cases these actions were taken after evaluating a risk assessment but in others they were done in the absence of a risk assessment. Although the RA/RM process is under development within CCFH, this should not prevent risk management options from being developed. While the impact that these interventions have had on the incidence of campylobacteriosis is uncertain, they are worth note. These options include the testing and deep freezing of products of positive flocks, that is applied in Iceland This approach is reported to be successful in significantly lowering *Campylobacter* prevalence in poultry meat. Effective mitigation strategies that have been shown to reduce flock prevalence in certain nations should also be evaluated for their general applicability and their effect on public health.

2.3.5. Farm to fork risk assessment

The complex epidemiology of campylobacteriosis and the limited available knowledge make reliable predictions of the expected results of interventions difficult and necessitate one exercise prudence when defining policy objectives. Effective interventions will require a carefully balanced set of measures. A risk assessment model of the food production chain is recommended to structurally integrate the available knowledge, so that the effects of interventions and the accompanying uncertainty can be quantified. Ultimately, integration of these models with economic models and policy analyses will provide an optimal basis for risk management decisions.

2.3.6. Data limitations, comparability of data and research needs

Effective prevention of campylobacteriosis in humans requires more knowledge than is currently available. Research is needed in the following fields: epidemiology of gastroenteritis and complications in humans, options to reduce the contamination of poultry meat, modelling the risks of infection by poultry meat and other exposure pathways, the costs of campylobacteriosis, the costs and benefits of interventions, and, finally, the societal and political factors in relation to risk perception and acceptance of interventions.

Present and future data on the prevalence of Campylobacter should be comparable in an international context. Therefore there is an urgent need to collect data in a comparable manner, i.e. uniform sampling schemes and also uniform analytical methodology. At least the scheme and analytical method used have to be documented together with the presented data, to facilitate correct interpretation.

Considering that campylobacteriosis is a global problem of increasing significance, CCFH is developing a global risk assessment model to be adapted by all risk managers to reflect their specific situation. Currently, the RA model is based on different modules as developed in industrialized countries and the data inputs used are country-specific. The farm-to-fork nature of the risk assessment under development allows one to consider a number of mitigations for the management of this risk.

3. POTENTIAL INTERVENTIONS AND DEFINITION OF RISK MANAGEMENT QUESTIONS TO RISK ASSESSORS

3.1. GENERAL ISSUES

As stated in paragraph 1.3, it is an important part of this task to define relevant questions to be addressed by the ongoing and also in future risk assessments on *Campylobacter* in poultry. The questions themselves are presented throughout this chapter in bold italics.

There was some discussion about whether general questions (e.g., what is the effect of reducing prevalence) or specific questions (e.g., what is the effect of scalding) are most appropriate. Both type of questions can be valid, and ultimately it must be sorted out in the interaction between risk managers and assessors which approach is most promising for the specific situation under scrutiny.

This chapter will also discuss intervention strategies that could be considered for implementation at different stages of broiler production during which they could be introduced.

Management options are categorized according to whether or not the option:

A. Can be answered by the current WHO/FAO risk assessment,

B. Could be answered by the current risk assessment if data is made available,

C. Could be answered by extending the current risk assessment,

D. Could be answered by extending the current assessment if data is made available,

E. Needs another type of scientific study, and

F. Is a statement of fact for use as an input to risk assessment.

3.2. OVERVIEW OF STAGES IN BROILER PRODUCTION AND USE: POSSIBLE INTERVENTIONS

In considering methods for control of *Campylobacter* in poultry, various stages of the farm to fork continuum may be appropriate for interventions. Specific management options that apply to each stage of this process are outlined in Annex 1. This table includes assumptions and statement of fact based on the current state of knowledge.

3.3. ON FARM

3.3.1. General, Reduction of the Flock Prevalence of *Campylobacter*

Biosecurity and hygiene measures at the farm level are paramount as interventions in reducing the flock prevalence of *Campylobacter*. Although a reduction in prevalence may occur from the supplementation of basic biosecurity and hygiene measures with measures specific for *Campylobacter*, it is important to note that and then consider putting in place further biosecurity is unlikely to be 100% effective in producing negative flocks. Therefore, it is likely that other intervention options further along the food chain are required. Additionally, one should note that the promotion of good flock health may lead to a reduction in

the probability that chickens will become infected by *Campylobacter*. On the other hand it has to be taken into account that high levels of cleaning and disinfection can lead to a relative sterile environment. Suppletion of a colonisation resistant flora could enhance flock health and reduce the risk of infection with small numbers of residual pathogens.

The following are statements of fact: cat. F:

- Antibiotic treatment is not an option for the routine control of *Campylobacter* due to the ease at which the organism becomes antibiotic resistant.
- Vertical transmission is a possible source of infection but not thought to be significant by most.
- Feed and litter are possible sources of horizontal transmission but are not thought to be significant.

Questions:

- ***Could suppletion of colonization resistant microflora in the chicken gut lower the chance of colonization with pathogens, especially with Campylobacter?***
- ***What impact will training of farmers in bio-security have on the final health risk to consumers?***

This requires data on the effect of training on the time of colonisation and flock prevalence. Given data this could be incorporated into the current model: cat. B

3.3.2. Extensive (Free range/organic)

The following are statements of fact: cat. F.

- At present there is nothing that can be done to prevent colonisation of birds produced outdoors. Also, the likelihood of colonization increases with bird age.
- As a short term intervention, promote good husbandry including basic hygiene.

Options requiring further scientific study: cat. E.

Options resulting in reduction in numbers (and hence prevalence) of *Campylobacter* in birds

- Colonisation resistant breeds (long term and also production concerns, developing countries)
- Vaccines (in the short term likely to be too expensive, supply of cheap vaccine is needed)
- Competitive exclusion (naturally occurring and artificial)
- Phage treatment (potential but need more research)
- Dietary manipulation i.e. acidified feed, certain carbohydrates (potential but needs more research)

Other issues:

- Information on the likelihood of *Campylobacter* being present in the birds when no further controls are implemented?
- Further study on the reasons for summer peaks in flock infections and the relationship with summer peaks in humans.

Questions:

- ***What impact do good husbandry practices in the raising of free-range birds have on the prevalence of Campylobacter?***
- ***What is the effect of reducing flock prevalence of free-range birds on risk of human illness?***

No data are available. If the impact of husbandry is quantifiable then the current model can be used to assess this: cat. B.

3.3.3. Intensive (housed)

Options that change in-flock prevalence and flock prevalence of housed birds.

- Biosecurity measures (some show reductions in prevalence and are currently being researched). These options could be assessed by the current model if data were available as to the effect of each option on the prevalence: cat. B.

– House construction

– Cleaning and disinfection

– Water

– Visitors/vehicles

– Barriers

– Rodent control

– Wild birds

– Thinning/crate hygiene

- Farm practices (could be evaluated if data were available on effect on prevalence: cat. B)

– Number flocks per farm e.g. single age farms, all in all out policies

– Effect of thinning

– Single species farms (chickens only)

– Environmental hygiene (disposal waste – litter, manure, dead birds, etc)

– Bird health

– Harvesting (stress can increase levels, cross contamination between flocks)

The following question deals with flock and within flock prevalence and is fundamental if previous options are to be assessed. The current model can assess the health impact of reducing flock and within flock prevalence.

Question:

- **How relevant to the final human health outcome is it to reduce between flock and within flock prevalence of housed birds?**

Channelling of positive birds

A promising approach to protect consumers from disease from *Campylobacter* in poultry is the combined application of testing and channelling. The term channelling refers to a selection process by which contaminated flocks are separated and processed (scheduled) in such a way as to reduce the level of *Campylobacter*. (further see 3.5.1.)

Testing refers in this context to checking the chicken (flocks) for presence of *Campylobacter* at a suitable stage in their life that is as close to slaughter as possible.

Question:

- ***What would be the effect of sampling at different times before slaughter and of different sample sizes and tests on the likelihood of not identifying flocks that are positive at slaughter?***

3.4. TRANSPORT

Management options addressing both prevalence (flock and within flock) and levels. Transportation is complicated but time is likely to be the major factor.

- Crates (cross-contamination between flocks)
- Trucks (cross-contamination between flocks)
- Stress – Time/distance (concentration)
- Separation of flocks during transportation (avoiding between flock cross-contamination)

Question:

- ***What are the effects of transportation time on both concentration and within flock prevalence?***

3.5. SLAUGHTER

3.5.1. Reduction of proportion of positive poultry products/reduction of levels of *Campylobacter* on poultry products

Approaches available to reduce contamination levels in poultry products:

- Testing and channeling
- Freezing
- Heat treatment
- Decontamination
- Chemical washes
- Irradiation
- Encourage application of economic incentives

A promising approach to protect the consumer against *Campylobacter* in poultry is the combined application of testing and channelling.

Testing refers in this context to checking the chicken (flocks) for presence of *Campylobacter* at a suitable stage in their life that is as close as possible to slaughter. A possible protocol is as follows:

Step 1. Testing flocks – identification of positive flocks

Step 2. Slaughter of positive flocks at end of day or on separate lines

Step 3. Handle products from positive flocks in a way that excludes human infection: “channelling”.

The term channelling refers to a selection process by which contaminated chicken (flocks) are separated and processed in a different way along a different route than the non-contaminated chicken (flocks).

For this approach to be effective it is essential that a very rapid and reliable detection method is available and applied. This methodology is expected to be operational soon.

This may not be a suitable option when prevalence of *Campylobacter* is high. In such instances, a risk-based approach that considers concentrations of the bacteria on poultry products may be more appropriate. Emphasizing good biosecurity may reduce the prevalence of *Campylobacter* and eventually enable channelling to be used.

Slaughter of contaminated flocks at the end of the day or via a separate slaughter line is an essential element of channelling.

Additional management options addressing prevalence and levels.

- Testing of live birds on entry (of limited use with regard to channelling unless results are available within 4-hours, therefore need for research into rapid tests)
- Good Manufacturing Practice/ HACCP
  - Proper cleaning and disinfection
  - Stunning
  - Scalding
  - Plucking
  - Evisceration
  - Water quality/temperature throughout the entire process. During stunning, birds inhale water which may increase the risk of contamination (gas stunning may be an alternative option). The volume of water used during processing i.e. scalding/washing/spin chiller can affect the risk of cross contamination.
- Further points for consideration
  - Chilling method (air, spin or spray chilling), effect of chlorination.
  - Further processing – cutting etc. Cross-contamination can be of major concern. Good hygienic practice.
  - Packaging (contamination on outside packs, leak proof packs).

Questions:

- ***What stages during slaughter reduce the prevalence and levels of Campylobacter on contaminated carcasses and to what extent?***
- ***What are the effects on human disease of either reducing the prevalence or reducing concentration of Campylobacter on poultry carcasses or reducing both prevalence and concentration?***
  What is the effect of reducing proportion of contaminated product on human illness?
  What is the effect of reducing levels of contamination in poultry on the risk of human illness?

3.6. RETAIL

The final use of imported product is country specific and therefore the current WHO/FAO Campylobacter risk assessment would require extending its scope: cat. D.

Question:

- ***What is the relative contribution of imported and home produced poultry to the levels of human disease?***

Management options addressing prevalence and levels on individual birds

- Labelling – Can be either a warning i.e. potential contamination, cooking and handling instructions or a claim of "pathogen free". Some participants see the application of this label as promising intervention approach for the future, others fear that such labelling can have a negative effect i.e. false sense of security and could lead to misleading the consumer.
- GMP (need to take account of markets/butchers/other non-supermarket outlets)
  - Control of cross-contamination (including contamination on the outside of packaging) especially during further processing or preparation.

- Testing at point of entry to channel product or promote as "pathogen free".

Questions:

- ***What is the health benefit of labelling packaged chicken highlighting the possibility of harmful bacteria being present ("warning label")?***
- ***Is the sale of unpackaged chicken potentially unsafe for the consumer?***
- ***What is the risk of human illness associated with Campylobacter contamination of the outside of the packaging?***
- ***Is there a different level of risk of human illness associated with purchasing chicken from different types of retail outlet and what are the significant risk factors involved?***
- ***Is there a greater risk of human illness associated with purchasing whole chicken for portioning in the home or pre-portioned chicken?***

Management options addressing prevalence and levels on individual birds

- Labelling – a warning about potential contamination, in combination with instructions for cooking and handling.
- GMP (need to take account of markets/butchers/other non-supermarket outlets)
  - Control of cross-contamination (including contamination on the outside of packaging) especially during further processing or preparation.
- Testing at point of entry to channel product or promote as "pathogen free".

Question:

- ***What effect would having only Campylobacter free fresh chicken on the market have on the incidence of human disease?***

3.7. FOOD PREPARATION AND HANDLING (COMMERCIAL AND DOMESTIC)

- Hygiene
- Cross contamination
- Cooking

Note - Time/temperature control for controlling regrowth is not important for *Campylobacter* as they need microaerophilic conditions and a temperature above 25°C. It may be important for survival. Cat. F.

Questions:

- What is the effect of improving the hygiene knowledge of food handlers at commercial level and at domestic level respectively?
- What proportion of cases of human disease is associated with cross contamination in the commercial and in the domestic kitchen respectively?
- What are the relative contributions of cross contamination and under cooking to the incidence of human disease?
- What are the relative impacts of chicken as the direct source (i.e. undercooked chicken) or indirect source (cross contamination) on human disease?

Note - The incidence of *Campylobacter* carriers is low and therefore does not need to be considered, there is no documented secondary transmission of *Campylobacter*[6]. Statement of fact: F.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL RECOMMENDATIONS

- National monitoring programmes – including surveillance to determine prevalence at various stages, implementation controls etc.
- Education, training and information transfer is important for all stages.
- Evaluation of information in current FAO/WHO risk assessment on *Campylobacter* in poultry
- Additional risk assessment studies or to other scientific activities
- Primary definition of questions and subsequent
- refinement in consultation with risk assessors and other experts

SPECIFIC CONCLUSIONS AND RECOMMENDATIONS

- Future calls for data should be explicitly designed to help answer the questions specifically cited in this discussion paper. These calls for data be formulated with both risk assessors and risk managers
- To facilitate collection and comparison of datasets relevant for Campylobacter RA/RM, harmonisation and documentation of analytical techniques is needed
- Define a mechanism for the possible continued interaction during the ongoing development of RM options for *Campylobacter* in poultry etc. Ask risk assessors to run their model to assess specific risk management options for *Campylobacter* in poultry
- There is a need for clarification of the roles of all parties (i.e. RA, RM, who commissioned RA? What is the role of the expert consultation?)
- Ask CCFH to develop Codes of Hygienic practice for the reduction of *Campylobacter* in broilers (Note this is very specific and may need to broaden to reduction of pathogens or GHP for broiler production)
- Assess current codes to determine whether they are relevant to poultry production – output may be a review or position paper. (This recommendation will need some research to define exactly what is involved and which Codes are to be assessed)
- Ask risk assessors to review current risk assessment models and develop new models as required to examine specific risk management options.
- Periodic reviews should be built into the risk assessment/risk management process
- Establish a co-ordinated approach with the work on *Salmonella* in chicken
- Ensure a farm to fork approach. Current approaches concentrate on specific sectors.
- The case of *Campylobacter* in poultry, as outlined in this paper, demonstrates that feasibility and cost-effectiveness studies will need to be conducted prior to implementation of any option(s). This may require input from OIE.

[6] Friedman CR, Neimann J, Wegener HC, Tauxe RV. Epidemiology of Campylobacter jejuni infections in the United States and other industrialized nations. In: Nachamkin I, Blaser MJ (eds). Campylobacter, 2 nd edition. Washington, D.C. ASM Press, 2000:212-138.

ANNEX 1: *Stages in broiler production and use and possible interventions*

In considering methods for control of *Campylobacter* in poultry, various stages of the farm to fork continuum may be appropriate for interventions. Specific management options that apply to each stage of this process are outlined, the table includes assumptions and statement of fact based on the current state of knowledge.

Stage in Farm to Fork Chain	**Possible Interventions**
Breeding	None (Vertical transmission is not thought to be a significant source of Campylobacter infection in broilers)
Hatcheries	None (Current evidence suggests that current practices ensure the supply of Campylobacter free chicks)
On farm	*Extensive (Free range/organic)* No current management options except promotion of good husbandry practice including good hygiene. Future management options may include: • Colonisation resistant breeds • Vaccination • Competitive exclusion • Phage treatment *Intensive production* Promotion of good biosecurity addressing the following issues: • House construction including ventilation • Environment surrounding poultry houses • Cleaning and disinfection • Water • Visitors/vehicles • Physical barriers • Rodent and pet control • Wild birds • Thinning/crate hygiene • Number flocks per farm e.g. single age farms, all in all out policies • Monospecific (single species) farms • Environmental hygiene (disposal waste – litter, manure, dead birds, etc) • Pre-slaughter testing Information/technology transfer
Transport	Controlling the breach of biosecurity addressing: • Catching hygiene • Crates • Trucks/drivers • Information/technology transfer Reduce cross contamination by addressing : • Stress – Time/distance • Segregation of flocks Information/technology transfer
Slaughter	Reduce the number of Campylobacter positive carcasses leaving the slaughter house and/or reduce the numbers of Campylobacter on positive carcasses by: • Reducing cross contamination. • Application of processes which reduce or eliminate Campylobacter. Specific interventions to consider include: • Testing on entry (conventional or rapid test) • Scheduling (end of day) /channelling; in combination with decontamination • Proper cleaning and disinfection

	• HACCP • Stunning • Scalding • Plucking • Evisceration • Water quality • Carcass treatment – decontamination by freezing, lactic acid, mild heat treatment etc. • End product tests • Scald temperature • Chilling method • Packaging (contamination on outside packs, leak proof packs) • Information/technology transfer
Food processing/ manufacturing	• Prevention or reduction of cross contamination • Further processing to reduce or eliminate Campylobacter from poultry • Application of HACCP, GMP, GHP
Retail	Control cross contamination of other food products. Specific issues to consider: • Processing at retail • Packaged/unpackaged • Testing at local and national level to inform management decisions Labelling product to address risks associated with Campylobacter on poultry. To consider including: • Campylobacter status of flock • Warnings that Campylobacter may be present on chicken and how the product should be handled to avoid human illness. Encourage application of economic incentives
Food preparation and handling (domestic and catering)	Promote good hygienic practice particularly focusing on: • Cross contamination • Hygiene • Cooking Storage time/temperature is not an issue for Campylobacter so is not noted here.