



JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEx COMMITTEE ON FOOD HYGIENE

Fifty-fifth Session

Nashville, Tennessee, United States of America

15–19 December 2025

PROPOSED DRAFT REVISION OF THE *GUIDELINES FOR THE CONTROL OF CAMPYLOBACTER AND SALMONELLA IN CHICKEN MEAT* (CXG 78-2011)

(Prepared by the Electronic Working Group chaired by the United States of America, co-chaired by Australia, Brazil, Denmark, Honduras, and India)

Codex Members and Observers wishing to submit comments on the discussion paper should do so as instructed in CL 2025/61/FH available on the Codex webpage/Circular Letters 2025: <https://www.fao.org/fao-who-codexalimentarius/resources/circular-letters/pt/>

Background

1. The 52nd session of the Codex Committee on Food Hygiene (CCFH52, 2022) requested that the Joint FAO/WHO Expert Meeting on Microbiological Risk Assessment (JEMRA) collate the relevant scientific information on *Salmonella* and *Campylobacter* in chicken meat in preparation for an update to the existing *Guidelines for the Control of Campylobacter and Salmonella in Chicken Meat* (CXG 78-2011).
2. In response to the request from CCFH52, FAO and WHO organized the first JEMRA meeting on the pre- and post-harvest control of non-typhoidal *Salmonella* spp. from 12 to 16 September 2022. A subsequent JEMRA meeting on postharvest control of *Campylobacter* spp. in poultry meat was held 6 to 10 February 2023. The two JEMRA¹ meetings provided recommendations for revisions to the *Guidelines for the Control of Campylobacter and Salmonella in Chicken Meat* (CXG 78-2011).
3. The electronic working group (EWG) was charged with revising and updating the *Guidelines for the Control of Campylobacter and Salmonella in Chicken Meat* (CXG 78-2011). It was advised that the revision will provide risk management options based on the latest scientific advice from FAO/WHO and incorporate relevant aspects of the latest revision of the *General Principles of Food Hygiene* (CXG 1-1969). The project document and discussion paper presented at CCFH54 addressed the scientific advice from the two JEMRA meetings and discussed opportunities for revision based on critical developments in the last decade. These include:

Campylobacter

- 1) Biosecurity and biosecurity production management approaches that employ multiple good production practices, such as hygiene practices and sanitation, which can enhance control of *Campylobacter* in meat chickens.
- 2) Incorporating risk factors for *Campylobacter* contamination at primary production sites, including partial depopulation, litter management, down period length, proximity to other livestock, and slaughter age.
- 3) Feed and water additives such as short chain fatty acids, peroxyacetic acid (PAA), and caprylic acid.
- 4) Processing interventions to include processing effects and pre-harvest interventions designed to reduce the pathogen load on incoming flocks.

¹ <https://doi.org/10.4060/cc9607en> and <https://doi.org/10.4060/cc9026en>

- 5) Interventions such as carcass chilling or freezing to reduce *Campylobacter* loads in broiler chickens.

Salmonella

- 1) Controlled access to breeding flocks, recognizing the heightened risk factors of access and the downstream impacts of flocks contaminated with *Salmonella*.
- 2) Clarify the use of cleaning compounds and disinfectants as Good Hygienic Practices (GHP). Economic incentives can promote adoption of GHP and should be part of an updated Codex document.
- 3) The previous JEMRA report did not discuss dose response curves due to a lack of scientific support. The recent JEMRA report for the control of *Salmonella* in raw poultry includes discussion about using quantitative data to evaluate process controls during the farm to fork journey.
- 4) There is an additional need to hone testing paradigms to look more closely for pathogens of public health concern to ensure public safety. More work is needed to improve available technology and scientific applications before these techniques can be implemented.
- 5) A review of interventions and their role in preventing contamination is needed, which should consider a response to recent reports of *Salmonellosis* from consumption of poultry liver and *Salmonella* infection that leads to osteomyelitis
- 6) More research is still needed to produce commercially available vaccines that do not negatively impact lifespan of chickens or the time-to-entry for broiler slaughter and processing.

Summary of Discussion

4. The EWG took significant measures to improve the readability of the document and to provide technical updates that incorporated the latest scientific evidence. The list of participants in the EWG is presented in Appendix II. The following describes where significant changes were made in the document after two rounds of discussion:

Alignment

5. After considering feedback from the EWG during the first round of revisions, the co-chairs adopted a hybrid approach to alignment. In addition to updating the technical aspect of the guidelines based on JEMRA recommendations and recent scientific evidence, this approach included partial structural alignment with cross references to CXC 1-1969, revised main headings, and a detailed review and alignment of definitions. Due to the specific nature of the topic and the preferred format of the guidelines, the EWG did not recommend full structural alignment.

JEMRA recommendations

6. The EWG provided two rounds of feedback on both the selection of JEMRA recommendations included and the level of detail provided in hazard controls and quantitative recommendations. For those accepted, the EWG agreed that the recommendations should be written in a manner that allows flexibility based on specific national situations and the understanding that processes may vary while providing equivalent outcomes.

Introduction

7. The introduction was extensively rewritten to reflect public health concerns and a review of relevant characteristics for both pathogens. It builds on general hygiene provisions established in the Codex system and establishes a framework which includes good hygiene practices and hazard-based controls anchored in the farm to fork process. This framework is defined by an updated flow chart which provides a guide for the practical application of guidance presented in the rest of the document.

Scope

8. The co-chairs considered feedback from the EWG and determined the scope of this revision to address the control of *Campylobacter* and *Salmonella* in raw chicken meat will focus primarily on broiler carcasses and parts (raw chicken legs, breasts, and wings). Some EWG members recommended guidance to cover offal, ground/minced meat and raw material to be used in chicken products. However, the co-chairs decided that these additional commodities and preparations should be the focus of future annexes to these guidelines. Finally, as consumer

demand has increased for free-range production systems, the EWG expanded the scope to include new guidance that addresses differences in risk profiles between the controlled-environment and free-range housing systems.

Definitions

9. Definitions were cross referenced to align with CXC 1-1969 and clarified to better reflect topics covered in the guidelines. The definitions for “batch”, “epidemiological unit”, and “lot” were removed as they are not used in the new text. The definitions for “fit-for-purpose water” and “potable water” were added and align with definitions provided in CXG 100-2023. A definition for “biosecurity” was also added. The document was harmonized for the use of the word “flock” and the definition was updated to reflect a combination of the previous definition and the WOA definition for flock and epidemiological unit.

Flow diagram

10. The flow diagram was modernized and significantly updated from the 2011 version. It offers a simplified visual for the poultry primary production to consumption process. This flow diagram provides sufficient resolution so that readers may quickly find recommendations most relevant to their needs while maintaining process flexibility which accounts for variations between countries. This improved flow diagram facilitates the removal of redundant guidance and the resulting document is significantly easier to read.

Other important updates

- GHPs and Hazard Controls: GHPs are listed in-line with the main text of the guidelines while hazard controls are placed in call-out boxes, making it easy to find hazard controls and differentiate them from GHP guidance.
- References: References were updated to the most recent versions of published guidelines and terminology was cross referenced with CXC 1-1969.
- Free-range: The guidelines have been updated with specific recommendations to address the difference in risk profiles for free-range systems versus controlled-environment housing systems.
- Vaccines: Guidance was added for the application of vaccines as part of a multi-hurdle approach to reduce the prevalence of *Salmonella* in broiler chickens. In relation to vaccines, the updated guidance also added the recommendation for regulatory purposes under Section 12. Monitoring and review that, “Where live *Salmonella* vaccines are used, precise testing that differentiates between vaccine strains and field strains of the pathogen is essential.”
- Water use: This updated draft takes steps to align references to water usage with CXG 100-2023. The EWG broadly agreed that fit-for-purpose water is suitable for use in earlier parts of broiler processing and that potable water should be used in later parts where water could be considered an ingredient.
- Portioning: Portions have increased risk due to increased handling. This section, which addresses the control of *Campylobacter* and *Salmonella* during portioning which is the cutting up (e.g., trimming, deboning, slicing, dicing) of chilled, raw chicken carcasses into parts, was significantly expanded in the updated text. A hazard-based measures call-out box was added to highlight the use of antimicrobial processing aids in controlling *Campylobacter* and *Salmonella*.
- Product storage temperatures: Temperature ranges for processing plant (3-5°C) and retail (-18°C to 5°C) storage were added. These ranges are applicable to both *Campylobacter* and *Salmonella* and provide flexibility for national situations but define safe ranges supported by scientific evidence.
- Chicken liver: As noted, the scope of the guidance is primarily focused on broiler carcasses and parts. However, in response to recent reports of campylobacteriosis and salmonellosis associated with the consumption of chicken liver, the EWG agreed to include hazard-based control measures for reducing the prevalence of *Campylobacter* and *Salmonella* under the Section 9.5 Packaging and Storage: High pressure processing) in chicken liver.
- Monitoring and review: This section was clarified to provide more actionable guidance on surveillance, testing, and pathogen characterization. Specific guidance on the use of whole genome sequencing was added and should promote ongoing efforts to sequence and characterize *Campylobacter* and *Salmonella* isolated from raw chicken meat. This additional information can provide regulators and public health experts with valuable

insight regarding specifics about pathogens circulating in a country's poultry production system (e.g., antimicrobial resistance, *Salmonella* serovars of public health concern, and highly virulent strains of both pathogens). This level of resolution can inform relevant stakeholders of risks and promote defining pathogens by virulence potential.

Recommendations

11. It is recommended that CCFH55 consider the proposed Draft Revised *Guidelines for the Control of Campylobacter and Salmonella in Chicken Meat (CXG 78-2011)* as presented in Appendix I with a view to progress it through the Codex Step Process.

Appendix I

PROPOSED DRAFT REVISION OF THE GUIDELINES FOR THE CONTROL OF CAMPYLOBACTER AND SALMONELLA IN CHICKEN MEAT (CXG 78-2011)

1. INTRODUCTION

Campylobacteriosis and salmonellosis are among the most frequently reported foodborne diseases worldwide. While numerous potential vehicles of transmission exist, raw chicken meat has been identified as one of the most important food vehicles for the transmission of these organisms. The risk in different countries varies according to control measures and practices implemented along the chain from primary production to final preparation of the meat for consumption. The burden of the diseases and the cost of control measures are highly significant in many countries and contamination with *Campylobacter* and *Salmonella*² has the potential to severely disrupt trade between countries.

Campylobacter spp. are a Gram-negative, non-spore forming obligate microaerophile belonging to the family Campylobacteraceae. Organisms of the genus have optimal growth at a pH between 6.5 and 7.5, and at temperatures between 42°C and 43°C (ICMSF 1996). *Campylobacter* spp. lack the necessary cold shock proteins to thrive at temperatures below 30 °C, however, some species can grow slowly and persist in moist environments at lower temperatures. *Campylobacter* spp. cannot grow when water activity (a_w) concentration is less than 0.987. Domestic and wild poultry are a major reservoir of *Campylobacter* with a high prevalence of *C. jejuni* and *C. coli* found in broiler chickens used in commercial production. While *C. jejuni* is the leading cause of campylobacteriosis worldwide, other species, such as *C. coli*, commonly cause human illness.

Salmonella spp. are a Gram-negative, non-spore forming, rod-shaped facultative anaerobe belonging to the family Enterobacteriaceae. The genus *Salmonella* is divided into two species: *S. enterica* (comprising six subspecies) and *S. bongori*. *Salmonella* spp. can grow between 5.2°C and 46.2°C, with the optimal temperature being between 35°C and 43°C (ICMSF 1996). *Salmonella* spp. will grow over a broad pH range between 3.8 and 9.5, with an optimal pH range for growth between 7 and 7.5 (ICMSF 1996). The optimum a_w for *Salmonella* is 0.99 and the lower limit for growth being 0.94. *Salmonella* spp. can survive for months or even years in foods with a low a_w . Over 99% of human *Salmonella* spp. infections are caused by *S. enterica* subsp. *enterica*. Pathogen virulence and public health impact can be viewed through the lens of serovars and virulence genes, to better focus surveillance efforts on screening for pathogens of public health concern in the global food supply.

These guidelines build on general food hygiene provisions already established in the Codex system and develop potential control measures specific for *Campylobacter* and *Salmonella* of public health relevance in raw chicken meat. In this context, the guidelines give effect to the Codex Alimentarius Commission (CAC) commitment to developing standards that are based on sound science and risk assessment³. Potential control measures for application at single or multiple steps are presented in the following categories:

- Good hygienic practices (GHP). Fundamental measures and conditions applied at any step within the food chain to provide safe and suitable food. They are usually prescriptive and may differ between countries.
- Hazard-based. They are developed from scientific knowledge of the likely level of control of *Campylobacter* or *Salmonella* at a step (or series of steps) in a food chain, have a quantitative basis in the prevalence and/or concentration, and can be validated as to their efficacy in hazard control at the given step. Any reduction in hazard prevalence and/or concentration has the potential to provide human health benefits depending on the type of food, stage in the food chain, intended use and preparation of the food, and consumer habits.⁴

Examples of hazard-based control measures have been subjected to a rigorous scientific evaluation and review

² Human pathogens of public health relevance only. For the purposes of this document, all references to *Salmonella* and *Campylobacter* relate only to human pathogens.

³ Objective 2 “Promoting widest application of scientific principles and risk analysis” of the [Codex Strategic Plan 2020-2025](#) and the first Statement of Principle relating to the Role of Food Safety Risk Assessment “Health and safety aspects of Codex decisions and recommendations should be based on a risk assessment, as appropriate to the circumstances” Codex Procedural Manual Safety Risk Assessment “Health and safety aspects of Codex decisions and recommendations should be based on a risk assessment, as appropriate to the circumstances” [Codex Procedural Manual](#).

⁴ JEMRA, 2002. [Risk Assessments of Salmonella in Eggs and Broiler Chickens](#). FAO/WHO Microbial Risk Assessment Series No. 2. Joint FAO/WHO Expert Committee for Microbial Risk Assessment. JEMRA, 2009. [Risk Assessment of Campylobacter spp. in Broiler Chickens, Technical Report](#). FAO/WHO [Microbial Risk Assessment Series No. 12](#) Joint FAO/WHO Expert Committee for Microbial Risk Assessment

in the development of these guidelines. Such examples are illustrative only and their use and adoption may vary amongst member countries. Their inclusion in these guidelines highlights the value of a quantitative approach to hazard reduction throughout the food chain and, where the decision support tool for risk-based control measures (Section 10) is applied, the likely level of public health protection that may result from implementing these control measures at the national level.

These guidelines are presented in a flow diagram format to enhance practical application of a primary production to consumption approach to food safety. This format:

- Demonstrates differences and commonalities in control measures for *Campylobacter* and *Salmonella*
- Illustrates relationships between control measures applied at different steps in the food chain
- Facilitates development of Hazard Analysis Critical Control Point (HACCP) plans at individual premises and national levels
- Assists in judging the equivalence⁵ and appropriateness of control measures for raw chicken meat applied in different countries

These guidelines provide flexibility for use at the national (and individual primary production and processing) level.

2. OBJECTIVES

The primary objective of these guidelines is to provide information to governments and industry on the control of *Campylobacter* and *Salmonella* in raw chicken meat to reduce foodborne disease from this source whilst ensuring fair practices in international food trade. The Guidelines provide a scientifically sound international tool for robust application of GHP and hazard-based approaches to control *Campylobacter* and *Salmonella* in raw chicken meat according to national risk management decisions.

It is not the intention of these guidelines to set quantitative limits for *Campylobacter* and *Salmonella* in raw chicken meat for international trade. Rather, the Guidelines follow the example of the overarching Codex *Code of Hygienic Practice for Meat* (CXC 58-2005) and provide an enabling framework that countries can use to establish control measures appropriate to their national situation. As a result, control measures may vary between production systems and countries.

3. SCOPE

These guidelines apply to the control of all *Campylobacter* and *Salmonella* that may contaminate raw chicken meat (*Gallus gallus*) and cause foodborne disease. The primary focus is raw chicken meat in the form of broiler carcasses and parts (raw chicken legs, breasts, and wings). These guidelines do not include recommendations for raw chicken meat preparations (raw chicken meat which has had foodstuffs, seasonings or additives added to it). These guidelines can be applied to other classes of chickens, e.g., end-of-lays, as appropriate.

While the biosecurity provisions in this document have been developed primarily for chickens raised in controlled-environment housing systems, they also have applicability to other housing systems such as free-range. Where appropriate, free-range specific guidelines are noted.

4. USE

These guidelines describe specific guidance for control of *Campylobacter* and *Salmonella* in raw chicken meat according to a “primary production to consumption” food chain approach. Potential control measures are considered at each step, or group of steps, in the process flow.

These guidelines are supplementary to and should be used in conjunction with the [Code of Practice – General Principles of Food Hygiene \(CXC 1 – 1969\)](#), the [Code of Hygienic Practice for Meat \(CXC 58-2005\)](#), the [Code of Practice for the Processing and Handling of Quick Frozen Foods \(CXC 8-1976\)](#), the [WOAH Terrestrial Animal Health Code](#), and the [Code of Practice on Good Animal Feeding \(CXC 54-2004\)](#).

General and overarching provisions are referenced as appropriate, and their content is not duplicated in these guidelines.

The guidelines systematically present GHP-based control measures and examples of hazard-based control measures. GHP are pre-requisites to selecting hazard-based control measures. Examples of hazard-based control

⁵ [Codex Guidelines on the Judgement of Equivalence of Sanitary Measures Associated with Food Inspection and Certification Systems \(CXG 53-2003\)](#).

measures are limited to those that have been scientifically evaluated as being effective under conditions of commercial use. Where no quantifiable outcome is mentioned for a specific control measure, it should be noted that the effect may be different between *Salmonella* and *Campylobacter*. Countries should also note that these hazard-based control measures are indicative only and the references provided should be reviewed to assist application. The quantifiable outcomes reported for control measures are specific to the conditions of particular studies and would need to be validated under local commercial conditions to provide a meaningful estimate of hazard reduction.⁵ Government and industry can choose hazard-based control measures to inform decisions on critical control points when applying HACCP principles to a particular food process.

Several hazard-based control measures as presented in these guidelines are based on the use of chemical decontaminants to reduce the prevalence and/or concentration of *Campylobacter* and/or *Salmonella* in broiler carcasses. The use of these control measures, including chemical decontaminants where relevant, in the food chain, is subject to approval by the competent authority⁶, where appropriate. Also, these guidelines do not preclude any other choice of a hazard-based control measure that is not included in the examples.

Provision of flexibility in the application of these guidelines is an important attribute. They are primarily intended for use by government risk managers and industry in the design and implementation of food safety control systems.

The Guidelines can be useful when judging the equivalence and assessing the appropriateness of different food safety measures for raw chicken meat in different countries.

5. GENERAL PRINCIPLES

Refer to the General Principles of Food Hygiene (CXC 1-1969).

Overarching principles for good hygienic practice for meat are presented in the Code of Hygienic Practice for Meat (CXC 58-2005) section 4: General Principles of Meat Hygiene. Two principles that have particular relevance to these guidelines are:

- The principles of food safety risk analysis should be incorporated wherever possible and appropriate in the control of *Campylobacter* and *Salmonella* in raw chicken meat from primary production to consumption.
- Wherever possible and practical, Competent Authorities should formulate risk management metrics⁷ to objectively express the level of control of *Campylobacter* and *Salmonella* in raw chicken meat that is required to meet public health goals.

6. DEFINITIONS

For the purpose of this document, definitions of the *General Principles of Food Hygiene* (CXC 1-1969), the *Code of Hygienic Practice for Meat* (CXC 58-2005), and the following definitions apply:

Biosecurity: Set of management and physical measures designed to reduce the risk of introduction, establishment and spread of animal diseases, infections or infestations to, from and within an animal population

Broiler: Birds of the species *Gallus gallus* selectively bred and reared for their meat rather than eggs

Chicken: Birds of the species *Gallus gallus*.

Competitive exclusion⁸: Administration of defined⁹ or undefined bacterial formulations to poultry to prevent gut colonization by enteropathogens, including *Campylobacter* and *Salmonella*

Crate: Container used to transport live chickens.

Fit-for-purpose water¹⁰: Water that is determined to be safe for an intended purpose through the identification, evaluation, and understanding of potential microbiological hazards and other relevant factors (e.g., history of use, the intended use of the food, etc.), including the application of control measures such as treatment options and

⁶ Competent authority as defined in CXC-1 1969, "The government authority or official body authorized by the government that is responsible for the setting of regulatory food safety requirements and/or for the organization of official controls including enforcement.

⁷ [Principles and Guidelines for the Conduct of Microbiological Risk Management \(MRM\) CXG 63-2007](#)

⁸ This definition is taken directly from the [WOAH Terrestrial Animal Health Code](#).

⁹ Probiotics may be competitive exclusion products

¹⁰ This definition is taken directly from the [Guidelines for the safe use and reuse of water in food production and processing CXG 100-2023](#)

their efficacy to ensure effective elimination or mitigation of such hazards.

Flock: Group of chickens raised and/or handled together and share a common environment and management and biosecurity practices that affect the likelihood of exposure to a pathogenic agent.

Horizontal transmission: Transmission of infectious disease or pathogens between birds of the same generation sharing the same living space.

Module: Structure containing crates / cages that facilitates loading and unloading.

Partial depopulation: Incomplete harvest, or “catching” of chickens from a growing flock that, for the purposes of this document, will be transported to slaughter.

Potable water: Water fit for human consumption. This refers to water that is safe and satisfactory for drinking and cooking.

Total depopulation: Full harvest or “catching” of chickens from a growing flock that, for the purposes of this document, will be transported to slaughter.

7. RISK MANAGEMENT AND RISK PROFILES

These guidelines apply a risk management framework (RMF) approach as advocated in the Codex *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007). Preliminary microbiological risk management activities and identification and selection of risk management options are represented by the guidance developed for control measures at each step in the food chain. Following sections on “Implementation” and “Monitoring” complete the application of all the components of the RMF.

Risk profiles are an important part of preliminary risk management activities when applying a RMF to a food safety issue. They provide scientific information to risk managers and industry in the design of food safety control systems that are tailor-made to individual food production and processing systems.

The contents of these guidelines are predicated on two extensive risk profiles on *Salmonella* and *Campylobacter* in broiler chicken:

- Measures for the control of non-typhoidal *Salmonella* spp. poultry meat: Meeting report (2023)¹¹
- Measures for the control of *Campylobacter* spp. in chicken meat: Meeting report (2024)¹²

8. INTRODUCTION AND CONTROL OF FOOD HAZARDS

Refer to the [General Principles of Food Hygiene \(CXC 1-1969\)](#).

9. PRIMARY PRODUCTION TO CONSUMPTION APPROACH TO CONTROL MEASURES

These guidelines incorporate a “primary production to consumption” flow diagram which includes guidance from *General Principles of Food Hygiene* (CXC 1-1969) in each section and identifies all steps in the food chain where control measures can potentially be applied. It facilitates a systematic approach to the identification and evaluation of all potential control measures. Consideration of all steps in the food chain allows different combinations of control measures to be developed. This is particularly important where differences between countries occur in primary production and processing systems and risk managers need the flexibility to choose risk management options that are appropriate in the national context. General guidelines at each step refer to GHP measures and where appropriate, hazard-based recommendations are noted in text boxes.

Unless otherwise specified, where appropriate, the general principles for primary production, establishment design and equipment, training and competence, establishment maintenance, personal hygiene, control of operation, product information and consumer awareness and transportation apply. Refer to the *General Principles of Food Hygiene* (CXC 1-1969) – sections 8-15.

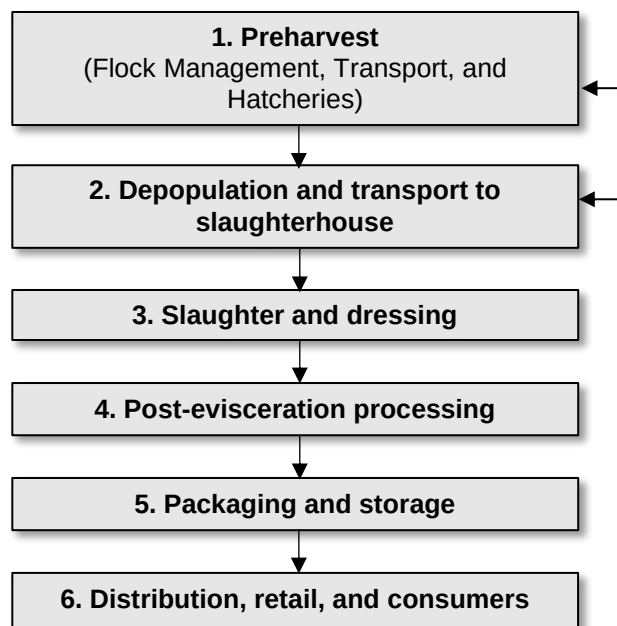
Generic flow diagram for application of control measures

A generic flow diagram is presented in sequence on the following pages. Individual premises will have variations in process flow and should adapt the design of HACCP plans accordingly.

¹¹ <https://www.who.int/publications/i/item/9789240078826>

¹² <https://www.who.int/publications/i/item/9789240088085>

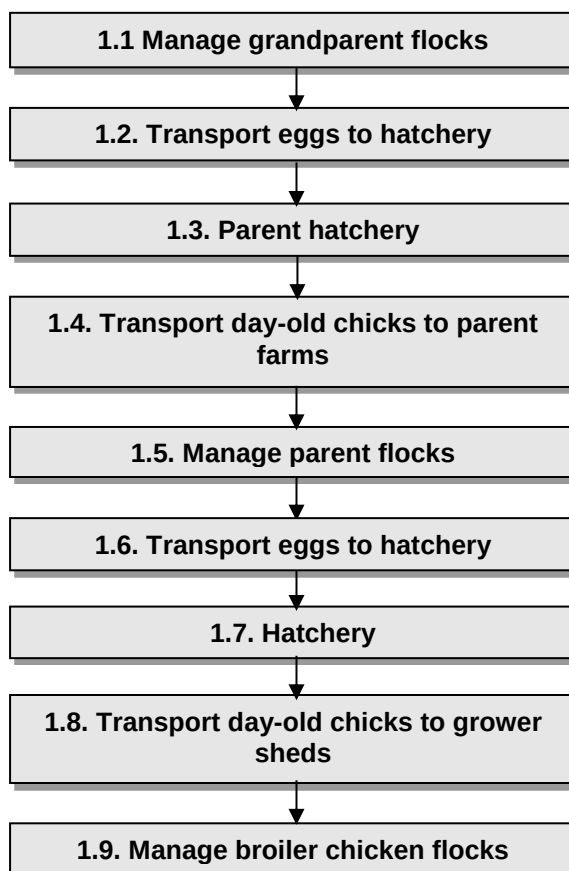
Figure 1. Example flow diagram of poultry primary production to consumption



Source: Authors' own elaboration based on CXG 78-2011.

9.1 Preharvest (Flock Management, Transport, and Hatcheries)

Figure 2. Example flow diagram of poultry primary production



Source: Authors' own elaboration based on CXG 78-2011.

Flock management (Steps 1.1, 1.5, and 1.9)

Control of *Campylobacter* and *Salmonella* in poultry flocks is strengthened by the application of a combination of biosecurity and personnel hygiene measures. This combination of control measures adopted at a national level should be determined in consultation with relevant stakeholders. The recommendations in this section are applicable for all stages of flock management.

General flock management control measures for *Campylobacter* and *Salmonella*

- a. When designing or maintaining production farms, consideration should be given to adequate ventilation, flock welfare, housing type, building age, and layouts that provide easy access for cleaning and disinfection to reduce contamination levels and the potential for horizontal transmission. Staff training and strict compliance with biosecurity and personnel hygiene measures are necessary to ensure effective management systems and to prevent contamination to subsequent flocks in the same house.
- b. Production systems utilizing outdoor areas should consider risks associated with exposure to external environmental hazards (e.g., soil, vegetation cover, wild birds, pests, standing water).
- c. Pest control programs should be specific to the challenges in a given farm or geographic location and may include a combination of physical, chemical, and biological control factors. Use of chemical pesticides may require approval by a competent authority.
- d. Measures such as change-in-change-out or shower-in-shower-out in an anteroom where possible should be implemented for poultry house workers.
- e. Removal of organic material should be carried out prior to cleaning. Cleaning and disinfection protocols should involve critical locations in broiler houses such as drinking cups, drain holes, and floor cracks.
- f. The use of dedicated tools, equipment, biosecurity barriers, and personal protective equipment (PPE) for individual flock houses and separated paddocks on farms is an effective way to reduce the risk of transmission.
- g. Total depopulation of the flock should be carried out where possible. Where this is not practicable and partial depopulation is practiced, particular attention should be paid to strict biosecurity and hygiene of catchers and the equipment they use to minimize the risk of cross contamination between flocks.
- h. Proper cleaning and disinfection of crates, catcher's clothing, and transport vehicles is critical when catchers move between farms and especially after total depopulation is essential to reduce the risk of contamination.
- i. Feed should be treated, stored, and delivered in a manner that prevents contamination. Feed should preferably be delivered in dedicated vehicles used only for feed transport. The effectiveness of these measures can be verified by testing critical control points (e.g., feed, dust from feed silos, storage containers).
- j. Specific to free-range production systems:

Access to areas where wild birds visit (e.g., trees, vegetation, water sources) should be limited and should consider keeping feed, feeders, and drinking water indoors or sequestered from wildlife and pests.

Farms should assess previous and current land uses and should evaluate contamination risks for free-range areas and birds. Any unique risks associated with accessing outdoor areas should be managed (e.g., monitoring the environment, evaluating that time between livestock grazing and foraging by a flock is sufficient).

If litter is used in outdoor areas, it should be kept dry and regularly rotated out of the free-range area.

Specific flock management control measures for *Campylobacter*

For non-free-range situations, the use of fly screens to reduce or eliminate fly infestation in broiler houses has been shown to decrease the percentage of *Campylobacter*-positive flocks, when implemented with other biosecurity measures.

Specific flock management control measures for *Salmonella*

- a. The use of *Salmonella*-infected eggs will increase the likelihood of the flock being infected. As an additional measure for breeders to reduce contamination of chicks after incubation, hatching eggs should be cleaned and sanitized as soon as possible after collection, using a sanitizing agent, according to the guidance of a veterinarian.
- b. Where possible, breeder flocks should be *Salmonella*-free at both the parent and grandparent flock levels.

- c. When a flock is found to be *Salmonella*-positive, a range of responses, detailed in the WOA *Terrestrial Animal Health Code*, chapter 6.6 “Prevention, Detection and Control of *Salmonella* in Poultry”, should be implemented. Surveillance and traceback requirements should be designed by a competent authority and based on contextually relevant public health concerns.
- d. Where feasible (e.g., in countries or situations with low *Salmonella* prevalence), depopulation of *Salmonella*-positive breeder flocks can reduce the risk of horizontal and vertical transmission¹³. Infected broiler flocks increase the risk of spread in the slaughter environment and the potential for contamination of raw chicken meat.

Flock Management Hazard-Based Control Measures

Specific to *Salmonella*

- The use of control measures such as probiotics, prebiotics, competitive exclusion bacteria, organic acids in pre- slaughter drinking water, and organic acids or formaldehyde in feed, may reduce the prevalence when used in a multi-hurdle approach with other measures. The use may require approval by a competent authority
- Vaccination of breeders and broilers with live or inactivated *Salmonella* vaccines, done according to manufacturer’s instructions, has shown to be effective in reducing the prevalence of *Salmonella* at the slaughterhouse
- The use of live and inactivated vaccines may require approval by the competent authority to permit their use

Transport – Hatchery Eggs and Live Birds (Steps 1.2, 1.4, 1.6, and 1.8)

The recommendations in this section are applicable for all references to transportation of eggs to hatchery and live birds.

General eggs and live bird transport control measures for *Campylobacter* and *Salmonella*

- a. Personnel involved in the transportation of live birds should follow appropriate biosecurity procedures to avoid cross-contamination of live birds during loading and unloading. All live bird transport trucks, crates and modules should be effectively cleaned, disinfected, and dried on site to the greatest extent practicable before reuse.
- b. Personnel should not enter any buildings used to house livestock without following appropriate biosecurity protocols. Measures should be taken to prevent cross-contamination of live birds during loading and unloading.

Specific eggs and live bird transport control measures for *Salmonella*

- a. Only eggs from *Salmonella*-negative flocks should be transported for hatching. When this is not practical, the eggs from *Salmonella*-positive flocks should be transported separately from other eggs and either discarded or handled according to guidance established by a competent authority.
- b. Eggs from *Salmonella*-positive flocks should not be used for propagation.
- c. Lining paper should be used in crates used to transport chicks to facilitate verification testing for *Salmonella* in flocks.

Hatchery Management (Steps 1.3 and 1.7)

The recommendations in this section are applicable for all stages of hatchery management.

General hatchery management control measures for *Campylobacter* and *Salmonella*

- a. Trace back of contamination to the infected breeder flocks should be performed and control measures should be reviewed.
- b. Measures such as change-in-change-out or shower-in-shower-out in an anteroom where possible should be implemented for poultry house workers.

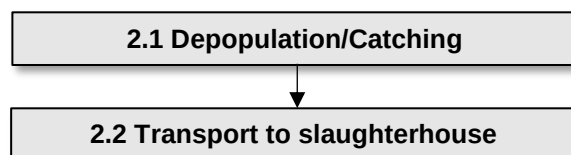
¹³ Transmission of infectious disease or pathogens from a parent bird to an offspring through an egg.

Specific hatchery management control measures for *Salmonella*

- a. If possible, only eggs from *Salmonella*-negative flocks should be hatched.
- b. Where the use of shared equipment is unavoidable, such as conveyors for hatching incubators, chicks hatched from *Salmonella*-negative flocks should be conveyed and packed before chicks from *Salmonella*-positive flocks. Conveyors and related equipment should be thoroughly cleaned, sanitized, and tested before reuse for chicks from *Salmonella*-negative flocks.

9.2 Depopulation and Transport to Slaughterhouse

Figure 3. Example flow diagram of depopulation and transport to slaughterhouse



Source: Authors' own elaboration based on CXG 78-2011.

General depopulation and transport control measures for *Campylobacter* and *Salmonella*

- a. Total depopulation or catching of the entire flock is recommended and should be carried out at one time. Where this is not feasible, partial depopulation can be performed. Because partial depopulation carries an increased risk of contamination and transmission of pathogens, particular attention should be paid to strict biosecurity and hygiene of catchers and the equipment used.
- b. Poultry houses and outdoor areas should have dedicated tools and PPE for partial depopulation. Sheds must be thoroughly sanitized after use.
- c. Measures such as change-in-change-out or shower-in-shower-out in an anteroom where possible should be implemented for poultry house workers.
- d. When partial depopulation is scheduled on the same day as total depopulation, it is preferable to catch birds from partially depopulated poultry houses before those being fully depopulated. This minimizes the risk of contamination and transmission of pathogens to areas where live birds will continue to be maintained for a period of time.
- e. In mixed-farm situations where partial depopulation is practiced, or where catchers move between farms, house-raised flocks should be caught prior to the free-range flocks to minimize the risk of horizontal transmission from higher-risk free-range flocks.
- f. Farm workers should take additional biosecurity and sanitation measures to minimize contamination from range areas contaminating the flock prior to harvest.
- g. All live-bird transport trucks, crates and modules should be effectively cleaned, disinfected, dried, and tested to the greatest extent practicable, before reuse.

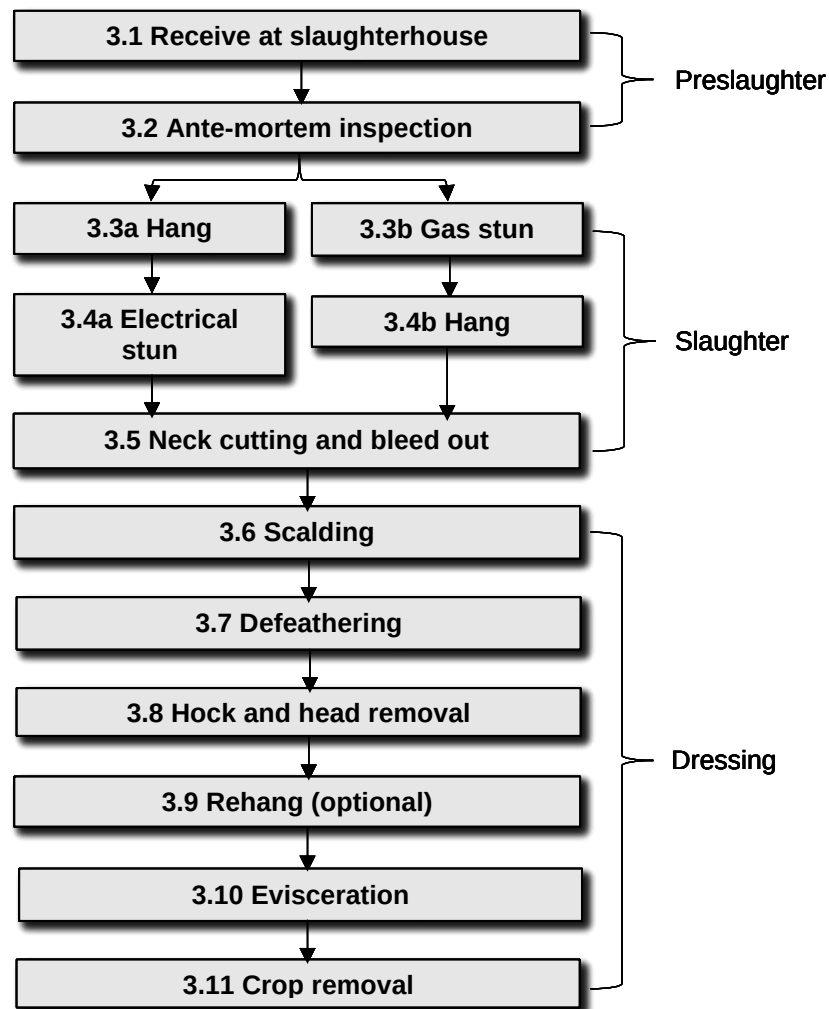
Depopulation and Transport Hazard-Based Control Measures

General

- Ensure appropriate feed withdrawal fasting of 8-12 hours prior to slaughter to minimize gastrointestinal spillage during processing.
- When feed withdrawal is practiced, water additives such as lactic acid may be used to acidify the crop contents and reduce bacterial contamination of the crop, which can rupture during processing and lead to cross-contamination.

9.3 Slaughter and Dressing

Figure 4. Example flow diagram of slaughter and dressing



Source: Authors' own elaboration based on CXG 78-2011.

Preslaughter (Steps 3.1 and 3.2)

General preslaughter control measures for *Campylobacter* and *Salmonella*

- Stress to chickens should be minimized, through measures such as dim lighting, minimizing noise, optimal temperature, weather protection, minimal handling and avoiding delays in processing.
- Moribund, unhealthy, or otherwise unsuitable chickens should not be processed.
- Where numbers of chickens that are dead on arrival, moribund, unhealthy or otherwise unsuitable for processing exceed expected levels, the processor should notify the relevant responsible person, e.g. the competent authority, the farmer, veterinarian, catcher or transportation company, so that appropriate preventative and/or corrective action can be taken.
- Specific to free-range: Flocks should be slaughtered at the end of a processing period to minimize cross-contamination and equipment should be sanitized between the processing of different flocks.

Specific preslaughter control measures for *Salmonella*

Where appropriate to the national situation, information about the *Salmonella* status should be provided to the establishment and competent authorities in a timely manner to enable logistical slaughter and/or diverting of raw chicken meat to intervention.

Slaughter (Steps 3.3 to 3.5)

General slaughter control measures for *Campylobacter* and *Salmonella*

- a. Measures should be taken to minimize bird stress at live hanging, (e.g., use of blue light, breast comforter and suitable line speed).
- b. Birds must be slaughtered in accordance with good commercial practices in a manner that will result in thorough bleeding of the carcasses and ensure that breathing has stopped prior to scalding. Bleeding should be thorough, and workers should confirm that the chickens are no longer breathing before scalding can begin. In addition to ensuring proper animal welfare, this will reduce the amount of blood entering the scalding.
- c. Specific to free-range: When processing free-range flocks, consider enhanced sanitation measures to food contact surfaces, scalding, defeathering, and evisceration equipment.

Specific slaughter control measures for *Salmonella*

- a. Screen flocks prior to slaughter to determine their *Salmonella* status and apply logistic slaughter which prioritizes slaughter of uninfected flocks first and colonized flocks at the end of the day or week.
- b. Positive flocks may be diverted for specific processing and/or treatment according to national food safety policies.

Slaughter Hazard-Based Control Measures

General

Where practical, flocks should be slaughtered after 8-12 hours of feed withdrawal in order to reduce the likelihood of contamination of carcasses by fecal material and ingesta

Dressing (Steps 3.6 to 3.11)

General dressing control measures for *Campylobacter* and *Salmonella*

- a. To minimize carcass contamination, control measures may include:
 - Washing with abundant, fit-for-purpose water
 - Trimming the carcass to remove unwanted parts
 - Reprocessing or disposal of carcasses with visible fecal contamination prior to dressing
 - Use of other physical methods approved by the competent authority
 - Use of chemical decontaminants approved by the competent authority
- b. These control measures can be applied alone or in combination at key process steps. Care should be taken to avoid combining interventions that may reduce the efficacy of a given control measure such as conditions that neutralize decontaminants (e.g., inappropriate pH for a rinse or spray).
- c. Control measures may be evaluated by qualitative or quantitative metrics to evaluate performance against regulatory limits established by the competent authority.
- d. All chickens which drop on the floor should be condemned or reprocessed under specific conditions as determined by the competent authority. Any dropped product should trigger corrective actions as appropriate, such as trimming and re-washing.

Specific scalding control measures for *Campylobacter* and *Salmonella*

- a. Contamination during scalding can be minimized by:
 - Using pre-scald brush and wash systems
 - The use of counter-current, high-flow rates of fit-for-purpose water with an adequate degree of agitation
 - Maintaining an optimal scalding temperature¹⁴ and duration for specific types of scalding processes (e.g., hard, medium, or soft scalding)

¹⁴ Taking into consideration, suitability requirements (i.e. not affecting the skin)

- Using multi-staged tanks
 - Emptying and cleaning tanks at the end of a processing period and cleaning and disinfecting tanks at least daily
 - Raising the temperature during processing breaks high enough for a long enough time to kill *Campylobacter* and *Salmonella* in the scalders
 - Incorporating approved antimicrobials as a multi-hurdle approach to reducing contamination
 - Using a water treatment to ensure that reused water is fit-for-purpose
- b. Specific to free-range: Free-range chickens may be older, have stronger feather follicles and feathers compared to broilers raised in controlled-environment housing systems. Consider adjusting the scalding time and temperatures needed to loosen feathers and ensure adequate defeathering

Specific defeathering control measures for *Campylobacter* and *Salmonella*

Cross-contamination at defeathering can be minimized by:

- Prevention of feather build-up on equipment
- Continuous rinsing of equipment and carcasses with fit-for-purpose water
- Regular adjustment and maintenance of equipment, paying particular attention to the cleaning of moving parts
- Regular inspection, cleaning, and replacement of plucker fingers

Specific hock and head removal control measures for *Campylobacter* and *Salmonella*

- a. Head pulling/removal should be carried out in a manner that leakage from the crop is prevented. Heads should be pulled downwards to reduce contamination due to crop rupture.
- b. Specific to free-range: Free-range chickens may have stronger joints, higher bone density, and denser muscle tissue. Ensure processes for hock removal are effective and do not result in contamination of raw chicken meat.

Specific rehang control measures for *Campylobacter* and *Salmonella*

Using automated transfer (rehang), where possible, rather than manual transfer of carcasses between the defeathering and evisceration lines can reduce external surface cross-contamination

Specific evisceration control measures for *Campylobacter* and *Salmonella*

Improper evisceration may result in cross-contamination of carcasses. Properly calibrated and maintained equipment minimizes the risk of ruptured viscera and the spread of gastrointestinal contents or feces. This can be minimized by:

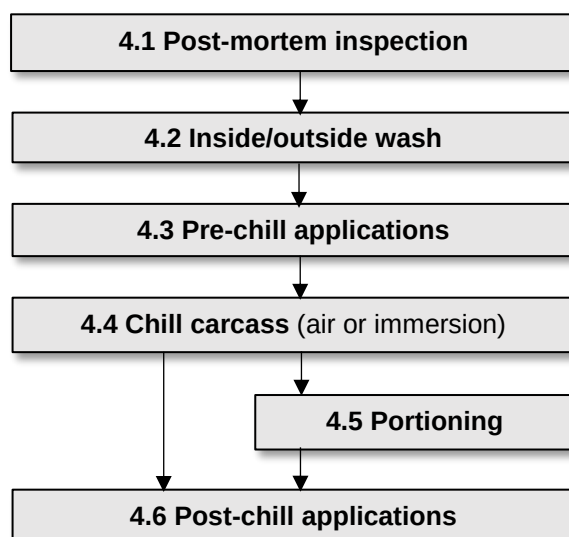
- a. Ensuring birds of similar size are processed together. Inconsistent carcass weight and sizes (for example, because of poor bird size uniformity within a grower house or processing male and female birds together) can result in mis-cuts and fecal contamination
- b. Ensuring carcasses are shackled correctly and monitored as they move through the process
- c. Ensuring evisceration blades are kept sharpened and thoroughly clean
- d. Keeping equipment in good sanitary condition and free of intestinal contents
- e. Careful adjustment, calibration, and regular maintenance of machinery to effectively handle the size, shape, sex, and average live weight of the birds to be slaughtered. These considerations apply to manual evisceration processes as well

Specific crop removal control measures for *Campylobacter* and *Salmonella*

- a. Where possible, crops should be extracted in a manner that is likely to limit carcass contamination.
- b. The use of cropper systems allows the release of accumulated dirty water in the carcass cavity, so efforts to remove collected water prior to chilling should be considered.

9.4 Post-Evisceration Processing

Figure 5. Example flow diagram of post-evisceration processing



Source: Authors' own elaboration based on CXG 78-2011.

Post-Mortem Inspection

General post-mortem inspection control measures for *Campylobacter* and *Salmonella*

- Line speed and the amount of light in the facility should be appropriate for effective post-mortem inspection of carcasses for visible contamination, organoleptic defects, and relevant gross pathology.
- Monitor for fecal contamination prior to pre-chill applications to ensure that chicken carcasses contaminated with visible fecal material do not enter the chiller.

Inside/Outside Wash

General inside/outside wash control measures for *Campylobacter* and *Salmonella*

The inside and outside of all carcasses should be thoroughly washed, using sufficient water pressure to remove visible contamination. Appropriate equipment should be used to ensure direct water contact with the carcass. The removal of contaminants may be aided by the use of brushing apparatus installed in line with the inside/outside wash.

Pre-Chill Applications

Pre-Chill Applications Hazard-Based Control Measures

General

- An on-line reprocessing¹⁵ spray system incorporating acidified sodium chlorite (ASC) has been shown to reduce *Campylobacter* in the whole carcass rinse sample and to reduce the prevalence of *Salmonella* positive carcasses
- Additional significant reductions in *Campylobacter* and *Salmonella* contamination of carcasses can be achieved by post-chilling decontamination sprays or dips
- Dipping carcasses in TSP reduced *Campylobacter* and for *Salmonella*, the estimated concentration of viable microorganisms was reduced to undetectable levels

Specific to *Salmonella*

- The use of a pre-chill ASC spray or ASC for dipping carcasses has been shown to reduce *Salmonella*

¹⁵ Additional washing or trimming step performed without removing the chicken carcass from the main processing line. This is used as a control measure that aims to eliminate fecal or ingesta contamination.

prevalence on carcasses

- Spray application of TSP immediately before carcass chilling was shown to reduce *Salmonella* prevalence
- Sequential application of ozonated water to skin and subcutaneous tissue of drumsticks could be applied to reduce *Salmonella* loads below detectable levels

Chill Carcass (Air or Immersion)

General chill carcass (air or immersion) control measures for *Campylobacter* and *Salmonella*

- a. Raw chicken meat should be chilled, using air or immersion chilling, as quickly as possible to limit the growth of microorganisms on the carcass.
- b. Potable water should be used in any chilling system.
- c. Design and operation of chilling systems should ensure that the target temperature of chilled carcasses is achieved by the time carcasses exit the chiller.
- d. Chilling relies on carcasses reaching temperatures relevant to controlling microbial growth. Care should be taken to monitor carcass temperature, application of processing aids, and pH to ensure efficacy.
- e. Specific to air chilling: If water sprays are used during air chilling to prevent desiccation of carcasses, they should be arranged to minimize cross contamination.
- f. Specific to immersion chilling:
 - Chilled water can be used, or ice made with potable water may be added.
 - Water flow should be counter-current and may be agitated to assist cooling and washing action. The water and agitation create a washing off effect that helps to remove organisms from the carcass.
 - Chlorine in the chill tank may not act as a decontaminating agent directly on the contaminated carcass but by both inactivating *Campylobacter* and *Salmonella* washed off the carcass into the water, and preventing re-attachment and cross-contamination. This requires the addition of chlorine at a level sufficient to maintain a free residual in the water.
 - The number of birds, the water back-flow rate, temperature, pH, and the level of decontaminants (e.g., free available chlorine) in the immersion tank should be carefully balanced and controlled as excess organic matter will reduce the effectiveness of the decontaminant thereby allowing greater cross-contamination of carcasses. Free movement of water around carcasses should be maintained.
 - Post-chilling, any excess water should be allowed to drain away from the carcasses to minimize cross-contamination at subsequent steps in the processing chain.
 - Drip trays should be considered to prevent cross-contamination from dripping water.

Chill Carcass (Air or Immersion) Hazard-Based Control Measures

General – Immersion Chilling

- Where possible, immersion chilling of carcasses combined with decontaminants (e.g., according to their specified permissible limits by competent authority (e.g., chlorine, organic acids, cetylpyridinium chloride [CPC]) can reduce the concentration of *Campylobacter* and *Salmonella* and is more effective than air chilling in terms of reducing surface concentrations on carcasses
- Where considered necessary for control of *Campylobacter* and *Salmonella*, antimicrobial processing aids may be added to the chiller water. These should be approved by the competent authority within their specified permissible limits and may include, among others:
 - Free chlorine (as produced by chlorine gas, sodium-hypochlorite, calcium hypochlorite tablets or electrolytically generated hypochlorous acid)
 - Organic acids (e.g., citric, lactic or peracetic acid)
 - Other oxidants (e.g., hydrogen peroxide, peroxyacids, chlorine dioxide, acidified sodium chlorite)

Specific to *Campylobacter* – Air or Immersion Chilling

Forced air chilling (blast chilling) or immersion chilling may reduce the concentration of *Campylobacter* on chicken carcasses

Specific to *Salmonella* – Immersion Chilling

Immersion chilling in water treated with antimicrobial processing aids according to their specified permissible limits by competent authority can reduce *Salmonella* prevalence

Portioning

This section addresses the control of *Campylobacter* and *Salmonella* during portioning which is the cutting up (e.g., trimming, deboning, slicing, dicing) of chilled, raw chicken carcasses into parts. This is done prior to packaging or further processing. Portioning chicken carcasses can lead to cross contamination from the surface tissues to the internal, uncontaminated muscle tissue.

General portioning control measures for *Campylobacter* and *Salmonella*

- a. The operation should be done in a way to avoid cross contamination by separating portioning areas from earlier, higher-contamination operations and with unidirectional product and personnel flow.
- b. Whenever possible, portioning operations should be done in exclusive, isolated, and pre-chilled areas, with adequate temperature control and recording equipment.
- c. Smooth, preferably self-cleaning conveyor belts should be used to minimize exudate buildup. The work surface should have effective drainage to prevent liquid buildup.
- d. Accumulation of raw chicken meat, trimmings and byproducts on processing lines should be avoided to prevent an increase in product temperature during operations.
- e. Temperatures can rise during mechanical deboning and throughout portioning. Maintain product at temperatures that prevent the growth of *Campylobacter* and *Salmonella* throughout portioning and staging (e.g., through pre-chilled rooms, chilled tables, and short exposure times).
- f. Ensure an orderly workflow by controlling work-in-process volumes and implement limits for time and temperature based on scientific criteria.
- g. Minimize the product-to-product, handlers-to-product, and product-to-surface contact, especially for skin-on parts where *Campylobacter* and *Salmonella* are frequently present on the skin.

Portioning Hazard-Based Control Measures

General

Where considered necessary for control of *Campylobacter*, and *Salmonella*, antimicrobial processing aids (e.g., organic acids, peroxyacids) may be applied, if authorized by competent authority. Products used should be approved by the competent authority and applied within their specified permissible limits with documented control of concentration, pH, oxygen reduction potential, temperature and contact time.

Post-Chill Applications

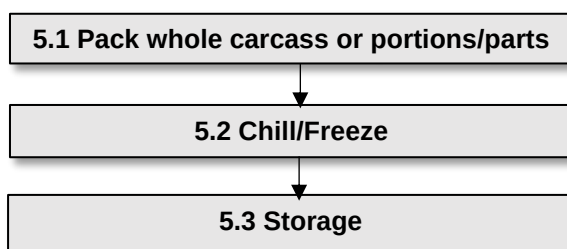
Post-Chill Applications Hazard-Based Control Measures

Specific to *Salmonella*

- Several different antimicrobial processing aids have been demonstrated to be effective in reducing carcass contamination at different washing steps and should be used to permissible limits specified by a competent authority
- The use of ASC post-chill has been shown to reduce the prevalence of *Salmonella* positive carcasses
- Spray applications of chlorinated water have been shown to reduce the prevalence of *Salmonella*-positive carcasses
- A chlorine dioxide generating system applied as a dip post-chill resulted in a reduction in *Salmonella* prevalence
- Immersion in PAA has been shown to reduce *Salmonella* populations
- High pressure processing may be effective in reducing *Salmonella* in chicken liver

9.5 Packaging and Storage

Figure 6. Example flow diagram of packaging and storage



Source: Authors' own elaboration based on CXG 78-2011.

Pack whole carcass or portions/parts

General packaging control measures for *Campylobacter* and *Salmonella*

- a. Care should be taken when packaging to minimize external contamination of the pack, e.g., by use of leakproof packaging or absorbent pads.
- b. Pre-packed chicken products intended to be cooked by the consumer should be labelled with safe handling, cooking, and storage instructions as appropriate to the national situation.

Packaging Hazard-Based Control Measures

General

Various doses of Gamma rays or electron beams applied to warm, chilled, or frozen carcasses have been shown to be effective at eliminating *Campylobacter* and *Salmonella*. Where irradiation is permitted, levels should be validated and approved by the competent authority

Chill/Freeze

Chill/Freeze Hazard-Based Control Measures

Specific to *Campylobacter*

- Freezing carcasses has been shown to reduce *Campylobacter* prevalence in chicken liver and meat
- Crust freezing using continuous carbon dioxide belt freezing of chicken meat products has been shown to reduce level of *Campylobacter* on the surface of chicken meat

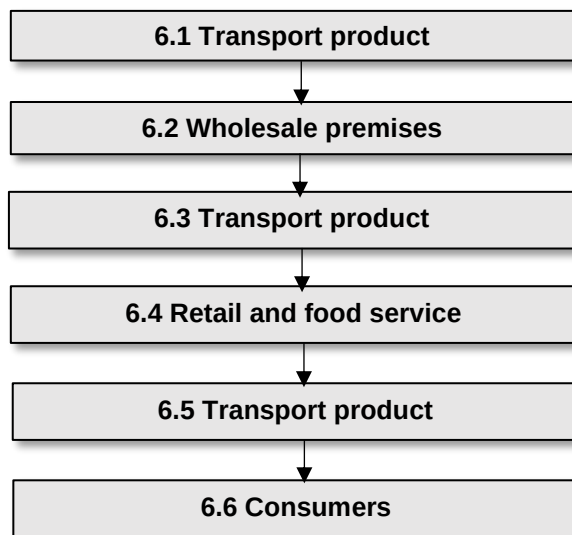
Storage

Specific storage control measures for *Salmonella*

Products should be stored at temperatures that prevent the growth of *Salmonella*. Temperature recommendations differ by country of origin but are typically 3-5°C and should be determined by a competent authority. Packaging in modified atmosphere does not prevent growth of *Salmonella* if temperature abuse occurs.

9.6 Distribution, Retail, and Consumers

Figure 7. Example flow diagram of product distribution channels



Source: Authors' own elaboration based on CXG 78-2011.

Transport Product (Steps 6.1, 6.3, and 6.5)

General transport product control measures for *Campylobacter* and *Salmonella*

- For GHP-based control measures for all aspects of transport, refer to the *Code of Practice – General Principles of Food Hygiene* (CXC 1-1969) and the *Code of Hygienic Practice for Meat* (CXC 58- 2005).
- Products should be transported at temperatures that prevent the growth of *Campylobacter* and *Salmonella* and in a manner that prevents cross-contamination with other foods and surfaces.

Wholesale premises (Step 6.2)General wholesale premises control measures for *Campylobacter* and *Salmonella*

Products should be stored at temperatures that prevent the growth of *Campylobacter* and *Salmonella* and in a manner that prevents cross-contamination with other foods and surfaces.

Retail and Food Service (Step 6.4)**Retail**General retail control measures for *Campylobacter* and *Salmonella*

- a. Hygiene measures should be in place to prevent cross-contamination between raw chicken meat, surfaces, cutting boards, utensils, and other food, especially cooked, ready-to-eat products.
- b. Retailers should separate raw chicken meat from cooked or ready-to-eat products.
- c. Hands should be washed and sanitized before and after handling raw chicken meat. Retailers may also provide customers with the means to sanitize hands before and after handling raw chicken meat packs.
- d. Where products are packed at retail for individual selection by customers, packs should be leak-proof.
- e. Extra packaging should be supplied at the display counter to allow customers to separate packaged raw chicken meat from other purchases.
- f. Products should be stored at temperatures that prevent the growth of *Campylobacter* and *Salmonella* and in a manner that prevents cross-contamination with other foods and surfaces (-18°C to 5°C).

Food ServiceGeneral food service control measures for *Campylobacter* and *Salmonella*

- a. For GHP-based control measures, also refer to the *Code of Hygienic Practice for Precooked and Cooked Foods in Mass Catering* (CXC 39-1993).
- b. Thawing of frozen chicken should be carried out in a manner that minimizes the potential for growth of microorganisms and prevents cross-contamination.¹⁶
- c. Washing of raw chicken meat should not be carried out as it is likely to spread contamination.
- d. Food service operators should be fully trained and aware of the differences between raw and cooked chicken products in relation to food safety and ensure separation at all times.
- e. Food service operators should have hygiene measures in place that minimize cross-contamination between raw chicken and hands, contact surfaces, cutting boards, and utensils, and should prevent contamination of other foods, especially ready-to-eat foods.
- f. Products should be stored and transported at temperatures that prevent the growth of *Campylobacter* and *Salmonella* and in a manner that prevents cross-contamination with other foods and surfaces. Home delivery services should consider safe storage and transportation where space may be limited and refrigeration may not be available.

Consumers (Step 6.6)General control measures for *Campylobacter* and *Salmonella*

- a. Consumer education should focus on:
 - Proper handwashing and other hygienic measures
 - Separating raw and cooked foods to prevent cross-contamination
 - Cooking foods to safe minimum internal temperatures
 - Prevention of temperature abuse including during transport

¹⁶ Refer to the [Code of Practice for the Processing and Handling of Quick Frozen Foods](#) (CXC 8-1976)

The WHO Five keys to safer food¹⁷ can assist in this process.

- b. Special attention should be paid to the education of all people preparing food, and particularly to all people preparing food for vulnerable populations (e.g., the young, elderly, pregnant, and those with compromised immunity).
- c. The above information for consumers should be provided in appropriate languages and forms. Multiple channels such as the internet, media, public health providers, healthcare professionals, food hygiene trainers, product labels, meal-kit recipes, posters and pamphlets, school curricula and cooking demonstrations should be considered when disseminating educational information.
- d. Washing raw chicken in the kitchen should be discouraged to minimize the possibility of cross-contamination of other foods and surfaces that come into contact with food and humans.
- e. Consumers should wash and disinfect food-contact surfaces, including chopping boards, bowls, plates, knives, and other utensils after handling raw chicken to significantly reduce the potential for cross-contamination in the kitchen, and to cooked, ready-to-eat foods.

Retail, Food Service, and Consumer Hazard-based Control Measures

General

Chicken meat should be cooked according to a process that is capable of reaching an internal temperature, as determined by a competent authority, that can inactivate or kill *Campylobacter* and *Salmonella*

10. RISK-BASED CONTROL MEASURES

GHP provides the foundation for most food safety control systems. Where possible and practical, food safety control systems should incorporate hazard-based control measures and risk assessment to determine risk-based control measures. Identification and implementation of risk-based control measures can be elaborated by the application of a RMF process as advocated in the *Principles and Guidelines for the Conduct of Microbiological Risk Management* (MRM) (CXC 63-2007).

While these guidelines provide generic guidance on the development of GHP and hazard-based control measures for *Campylobacter* and *Salmonella*, the development of risk-based control measures for application at single or multiple steps in the food chain are primarily the domain of competent authorities at the national level. Industry may derive risk-based measures to facilitate the application of process control systems.

Development of risk-based control measures

Competent authorities operating at the national level should develop risk-based control measures for *Campylobacter* and *Salmonella* where possible and practical. Risk modeling tools used to explore risk management options and contribute to risk management decisions should be fit for purpose. The risk manager needs to understand the capability and limitations of the risk modeling tools they select.¹⁸ When developing risk-based control measures, competent authorities may use quantitative examples of the likely level of control of a hazard at certain steps in the generic food chain in this document, as a peer-reviewed scientific resource. Competent authorities formulating risk management metrics as regulatory control measures should apply a methodology that is scientifically robust and transparent.

Availability of a web-based decision support tool

FAO/WHO developed through JEMRA a web-based decision support tool¹⁹ to assist with the development of risk-based control measures for *Campylobacter* and *Salmonella* in the raw chicken meat food chain at the national level²⁰. This web-based tool can be used, complementary to these guidelines, to model different food chain scenarios and to estimate relative risk reduction and/or ranking consequential to:

- Implementation of a specific control measure at a particular step in the food chain (from primary production through to consumption),

¹⁷ <https://www.who.int/publications/i/item/9789241594639>

¹⁸ [Principles and Guidelines for the Conduct of Microbiological Risk Assessment \(CAC/GL 30-1999\)](#)

¹⁹ Initiated after FAO/WHO Technical Meeting on *Salmonella* and *Campylobacter* in chicken meat. Rome 4-8 May 2009. Trialed November 2009. Reviewed April 2010.

²⁰ www.mramodels.org

- Implementation of a combination of control measures at different steps in the food chain, and
- Modeling of different food chain scenarios similar to the flow diagrams presented in this document

Industry may also make use of the decision support tool when designing premise-specific food safety programs that may differ in the availability of specific control measures.

The user of the decision support tool should:

- Take responsibility for the appropriateness of the scientific data that is introduced
- Be aware of the uncertainty that inevitably accompanies risk modeling and, in conjunction with the risk manager, use the web-based tool to *explore* risk management options and *inform* risk management decisions, rather than provide a prescriptive base

11. VALIDATION, IMPLEMENTATION, AND VERIFICATION OF CONTROL MEASURES

Validation

Refer to the *Guidelines for the Validation of Food Safety Control Measures* (CXG 69 -2008). Note: GHP-based control measures are not subject to validation. Prior to the validation of hazard-based control measures for *Campylobacter* and/or *Salmonella*, the following tasks should be completed:

- Identification of the specific measures to be validated. This would include consideration of any measures approved by the competent authority and whether any measure has already been validated in a way that is applicable and appropriate to specific commercial use, such that further validation is not necessary
- Identification of any existing food safety outcome or target, established by a competent authority or industry. Industry may set stricter targets than those set by a competent authority

Validation of measures may be carried out by a competent authority and/or industry and should be carried out prior to implementation. Where validation is undertaken for a measure based on a hazard control for *Campylobacter* and/or *Salmonella*, evidence will need to be obtained to show that the measure is capable of controlling *Campylobacter* and/or *Salmonella* to a specified target or outcome. This may be achieved by the use of a single measure or a combination of measures. The *Guidelines for the Validation of Food Safety Control Measures* (CXG 69 -2008) provide detailed advice on the validation process (section VI).

Implementation

Refer to section 9.2 of the *Code of Hygienic Practice for Meat* (CXC 58-2005).

Industry has the primary responsibility for implementing, documenting, applying, and supervising process control systems to ensure the safety and suitability of raw chicken meat. These activities should incorporate GHP and validated measures (HACCP) for control of *Campylobacter* and/or *Salmonella* as appropriate to national government requirements and industry specific circumstances.

Implementation involves:

- Determining the effect of the selected control measures
- Developing an implementation plan
- Communicating the control measures and implementation plan with stakeholders
- Ensuring that the regulatory framework and infrastructure are in place for implementation
- Establishing an evaluation process to assess whether the control measures have been properly implemented

The documented process control systems should describe the activities applied including any sampling procedures, specified targets, such as performance objectives or performance criteria set specifically for *Campylobacter* and/or *Salmonella*, industry verification activities, and corrective and preventive actions.

In regulatory systems, the competent authority should provide guidelines and other implementation tools for the development of process control systems to industry as appropriate. The competent authority may choose to approve the documented process control systems for GHP and HACCP and stipulate verification frequencies.

Verification

Refer to section 9.2 of the *Code of Hygienic Practice for Meat* (CXC 58-2005) and section IV of the *Guidelines for the Validation of Food Safety Control Measures* (CXG 69 -2008).

Industry verification should demonstrate that all control measures for *Campylobacter* and/or *Salmonella* have been implemented as intended. Verification should include observation of processing activities, documentary checks, and sampling for *Campylobacter* and/or *Salmonella* testing as appropriate. Verification frequency should vary according to the operational aspects of process control, the historical performance of the establishment and the results of verification itself.

In regulatory systems, the competent authority⁶ should verify that all regulatory control measures implemented by industry comply with regulatory requirements as appropriate for control of *Campylobacter* and/or *Salmonella*. Microbiological testing requirements should be provided for verification of HACCP systems where specific targets for control of *Campylobacter* and/or *Salmonella* have been stipulated.

The competent authority⁶ may choose to use a competent body (e.g., academia, trade associations, professional societies) to undertake specific verification activities in relation to the industry's process control systems. Where this occurs, the competent authority should stipulate specific functions to be carried out.

12. MONITORING AND REVIEW

Monitoring and review of food safety control systems are essential components of the application of a RMF⁷. It contributes to process control verification and demonstrating progress towards achieving public health goals. Monitoring systems allow for the precise application of control measures such as breeder flock status which informs control measures for day-old progeny and pre-slaughter monitoring of broilers that can inform control measures for slaughter of infected flocks. These data, together with public health surveillance data, are used in risk assessments and risk profiles of pathogen/food combinations to prioritize foods and pathogens considered to be a country's highest priority (e.g., those strains with virulence factors capable of causing severe illness or considered to cause significant illness in that country).

Information on the level of control of *Campylobacter* and *Salmonella* at appropriate points in the food chain can be used for several purposes. For example, to validate and/or verify outcomes of food control measures, to monitor compliance with hazard-based and risk-based regulatory goals, and to help prioritize regulatory efforts to reduce foodborne disease. Systematic review of monitoring information allows the competent authority and relevant stakeholders to make decisions in terms of the overall effectiveness of the food safety control systems and make improvements where necessary.

Monitoring

Monitoring should be carried out at appropriate steps²¹ in the food chain using randomized or targeted sampling.

Primary production and processing:

Examples of monitoring systems for *Campylobacter* and/or *Salmonella* throughout primary production and processing include:

- Environmental sampling (e.g., boot swabs, litter, feed, lining paper from chick trays) and surveillance at breeder farms and hatcheries to inform flock risk, status, and preharvest control measures
- Environmental sampling prior to transport to slaughter to determine flock status and permit logistic scheduling and/or channeling of positive chickens for specific processing steps such as heat treatment or freezing
- Whole bird rinse, neck skin, parts, or other sampling at the end of processing (e.g., after immersion or air chilling) to verify compliance with hazard-based regulatory or company performance goals

Regulatory:

Regulatory monitoring programs should be designed in consultation with relevant stakeholders and be made available to them in a timely manner. Given the importance of monitoring data in risk management, sampling and testing components should be standardized on a national basis and be subject to quality assurance. The type of data collected in monitoring systems should be appropriate for the outcomes sought. Examples of monitoring

²¹ Recommendations on surveillance in poultry flocks for *Salmonella* are provided in the WOAHP *Terrestrial Animal Health Code*, Chapter 6.6 "Prevention, Detection and Control of *Salmonella* in Poultry"

systems in a regulatory environment include:

- Sampling of retail products to determine contamination trends post-processing
- National or regional surveys for establishing baseline levels of contamination and assisting in the development of regulatory performance goals and pathogen reduction programs within the food chain.
- Routine whole genome sequencing of *Salmonella* isolates from feed, *Salmonella* and *Campylobacter* isolates from live chickens, and from sampling retail meat to provide information on circulating strains, presence of antimicrobial resistance genes, and to assist in outbreak investigations

Laboratory testing of raw chicken meat during and after processing is vital to surveillance and verification activities. The results should be used to determine prevalence, and when possible, quantification, of pathogens of public health concern as determined by a competent authority.

Where live *Salmonella* vaccines are used, precise testing that differentiates between vaccine strains and field strains of the pathogen is essential. Otherwise, there is a risk that the use of the vaccine increases the prevalence of positive *Salmonella* results from slaughterhouse samples. Utilizing proper diagnostic methods, such as molecular tests and serotyping, is necessary for monitoring vaccination efficacy and implementing appropriate biosecurity measures.

Wherever possible, monitoring information from the food chain should be combined with human health surveillance data and food source attribution data to validate risk-based control measures and to verify progress towards risk-reduction goals. Activities supporting and integrated response include:

- Surveillance of clinical salmonellosis and campylobacteriosis in humans
- Epidemiological investigations, including outbreaks and sporadic cases
- Surveillance for antimicrobial resistance in isolates from clinical, bird, and food samples

Reliable surveillance for *Salmonella* spp. and *Campylobacter* spp. should utilize reference methods validated by independent bodies or official organizations that are accredited for the use of international standards for microbiological testing. *Salmonella enterica* is one of two *Salmonella* species that represent over 2500 distinct serovars with a small subset of these representing most human salmonellosis infections across the globe. Because of this, a robust surveillance system should include methods that can distinguish *Salmonella* serovars of differing levels of public health concern. Serovars of higher concern to human health vary geographically and temporally and should be prioritized for monitoring and control at the national level. These serovars can be distinguished by a variety of technologies and cross-referenced with clinical data to determine public health priorities. It has also been recognized that some strains of *Campylobacter* spp. are highly virulent and antimicrobial resistant. This highlights the importance of laboratory testing to ensure pathogens of public health concern are identified prior to raw chicken meat entering commerce.

Review

Monitoring data on *Campylobacter* and *Salmonella* and associated risks should be reviewed on a periodic basis to provide information on the effectiveness of risk management decisions and actions. *Campylobacter* and *Salmonella* spp. sampling results should be shared with competent authorities so that the information can be integrated into trend analyses.

Periodic review of monitoring data at relevant process steps should be used to inform future decisions on selection of specific control measures and provide a basis for their validation.

Information gained from monitoring in the food chain should be integrated with public health surveillance, food source attribution data, and withdrawal and recall data, where available, to evaluate and review the effectiveness of control measures.

Where monitoring of hazards or risks indicates that regulatory performance goals are not being achieved, risk management strategies and/or control measures should be reviewed.

Appendix II**List of participants****Chair****United States**

William Shaw
U.S. Department of Agriculture
William Zaragoza
U.S. Department of Agriculture
Kristal Southern
U.S. Department of Agriculture

Co-chairs**Australia**

Nora Galway
Food Standards Australia New Zealand

Brazil

Ligia Lindner Schreiner
Brazilian Health Regulatory Agency
Carolina AraújoVieira
Brazilian Health Regulatory Agency
Cesar Augusto Vandesteem Junior
Ministério da Agricultura e Pecuária

Denmark

Gundrun Sandø
Danish Veterinary and Food Administration

Honduras

Maria Sevilla
SENASA

India

Dr. S. B. Barbuddhe
National Meat Research Institute

Members**Argentina**

Maria Esther Carullo
SENASA- National Service of Agrifood Health and
Quality

Australia

Mark Pythian
Food Standards Australia New Zealand
Ben Daughtry
Australia Microbiology and Food Safety

Barbados

Kerrilyn Pilgrim
Veterinary Services- Barbados

Belgium

Katrien De Pauw
Belgian Federal Public Service of Health, Food
Chain Safety and Environment

Canada

Cathy Breau
Health Products and Food Branch, Health Canada

Chile

Andrea Schain
Department of Health and Nutrition, Ministry of
Health

Nicolás Tobalina
Ministry of Agriculture

Egypt

Zeinab Mosaad Abdel Razik
Egyptian Organization for Standardization & Quality

France

Marilyne Schell
Ministry of Agriculture

India

Asish Kumar Mukhopadhyay
ICMR-National Institute for Research in Bacterial Infections
Durge Arvindkumar Vasantrao
Export Inspection Agency, Ministry of Commerce & Industry
Kamran Khan
Export Inspection Agency, Ministry of Commerce & Industry
Nilanjan Chakraborty
ICMR-National Institute for Research in Bacterial Infections
Vandan Nagar Bhabha
Atomic Research Centre
Geetanjali
FSSAI

Indonesia

Dwita Indah Sari
Ministry of Health
Wara Fitria Tristiyanti
National Food Agency

Ireland

Denis Carroll
Department of Agriculture, Food, and the Marine
Wayne Anderson
Food Safety Authority of Ireland

Netherlands

Moniek Ringenier
Ministry of Health, Welfare and Sport

New Zealand

Nicola Dermer
Ministry for Primary Industries
Roger Cook
Ministry for Primary Industries

Norway

Catherine Signe Svindland
Norwegian Food Safety Authority
Gerda Ingrid Hegleback
Norwegian Food Safety Authority
Randi Edvardsen

Norwegian Food Safety Authority

Peru

Rosa María Curi Ayamani
Ministry of Health
Erick Denis Sardon Mamani
Ministry of Health

Philippines

Kris Jenelyn P. De Las Peñas
Food and Drug Administration

Poland

Maja Czerwinska
Safety of Food Animal Origin Office

Saudi Arabia

Mohammed M. Al Johani
Saudi Food and Drug Authority
Nada G. Saeed
Saudi Food and Drug Authority
Sarah A. Alfaifi
Saudi Food and Drug Authority
Suliman M. Al Otabi
Saudi Food and Drug Authority

South Korea

Eunsong Cho
Ministry of Agriculture, Food and Rural Affairs (MAFRA)
Minjin Park
MFDS

Spain

Blanca Ortega Medina
Spanish Agency for Food Safety and Nutrition

Sweden

Satu Salmela
Swedish Food Agency

Thailand

Pimmaphetch Maenam
Ministry of Agricultural Commodity and Food Standards (ACFS)

Uganda

Edward Kizza
Uganda National Bureau of Standards
Berna Wabule Ugachick
Poultry Breeders Ltd
Nyakato Susan Ugachick
Poultry Breeders Ltd
Rwakijuma Brian Ugachick
Poultry Breeders Ltd

United Arab Emirates

Asma Sultan Ali Al Senaida

Ministry of Industry and Advanced Technology
Hamdan Salem Rashed Al Nuaimi
Ministry of Industry and Advanced Technology

United States

Benjamin Warren
U.S. Food and Drug Administration
Shaina Craige
Elanco Animal Health

Uruguay

Norman Bennett
Ministerio de Agricultura, Ganadería y Pesca

MEMBER ORGANISATIONS**European Commission**

Kris De Smet

OBSERVERS**International Commission on Microbiological
Specifications for Foods (ICMSF)**

Leon Gorris* (Netherlands)
Tom Ross (Australia)
Nigel French (New Zealand)

International Poultry Council

Nicolò Cinotti (Italy)

World Organisation for Animal Health (OIE)

Aki Kawamura

WHO

Akio Hasegawa