USA Comments – TAHSC September 2014 Report

Thank you for the opportunity to review and comment on this first iteration of the draft chapter on *Salmonella* control in pigs. After reviewing the draft, the United States strongly urges that the chapter be returned to the ad hoc Group for significant revision.

Non-Typhoid *Salmonella* is a ubiquitous, hardy bacteria known to be widely distributed in both domestic and wild animals. The goal of this revision should be to only include in the chapter those recommendations for *Salmonella* control at the farm level that are science-based, and to recommend pre-harvest controls that have been shown to be effective for a public heath outcome. There are no citations for the assertion of a direct cause/effect relationship or direct correlation between decreasing the prevalence of *Salmonella* in pigs and decreasing the level of foodborne disease.

The United States has four primary areas of concern with this first draft:

1. **Recommendations in the chapter on feed control methods are extensive but unproven to have a positive public health outcome. There are over 2,200 serotypes of *Salmonella* spp. and less than 1% of those have been documented in human food-borne illness. Scientific investigation has shown that, in general, the serovars that are commonly found in feed are not the serovars associated with human salmonellosis cases. Any recommendations in the chapter need to have a science-based public heath outcome. Furthermore, we are concerned with the *a priori* decision that feed contaminates pigs with *Salmonella*. After an exhaustive literature review and discussion with a body of world experts, the 2007 United Nations FAO/WHO expert panel on "Impact of Animal Food in Food Safety" concluded the opposite.**

2. **Recommendations in the chapter on new pig introductions are too prescriptive and not achievable for many OIE Member countries.**

3. **Many of the biosecurity measures recommended in the draft chapter are made with the assumption that such measures would result in decreased *Salmonella* prevalence on the farm. Unlike pathogens such as *Trichinella* or *Toxoplasma, Salmonella* is a ubiquitous organism. No specific biosecurity management practices have been shown to consistently result in *Salmonella* reduction and a positive public health outcome. While hygiene and other biosecurity recommendations may be helpful, they are not specific to *Salmonella* control (Lo Fo Wong DMA, Hald T, van der Wolf PJ, et al. 20002. Epidemiology and control measures for Salmonella in pigs and pork. Livestock Prod Sci. 76:215-222; Dr. Jan Dahl, Chief Advisor, Danish Agriculture and Food Council, personal communication) All recommendations in the chapter need to be science-based.**

4. **Nearly all of the recommendations in the chapter are not achievable for outdoor pig production facilities that are common in many OIE Member countries. They are prescriptive and focused on confinement swine production without having science-based evidence of leading to a positive public health outcome.**

DRAFT CHAPTER 6.X.

PREVENTION AND CONTROL OF *SALMONELLA* IN COMMERCIAL PIG HERDS

Rationale: title matches the stated scope below

Article 6.X.1.

Introduction

Nontyphoidal salmonellosis is one of the most common food-borne bacterial diseases in the world ~~with *Salmonella* Enteritidis and *S.* Typhimurium the predominant serotypes identified in most countries.~~

Rationale: The United States can find no evidence or scientific reports that this is a verified fact. If so, is it a fact for animals, humans, or both. Please provide a citation if this is indeed true.

As is the case in most food producing *animals*, *Salmonella infection* in pigs is mostly subclinical and of variable duration. Pigs with subclinical *infection* play an important role in the spread of *Salmonella* between *herd*s and may pose a potential public health risk.

Rationale: The United States recommends the added words indicated. Not all pigs with subclinical infection with *Salmonella* pose a public health risk since hygienic slaughter techniques and proper cooking and handling can negate such a risk.

Salmonella serotypes and their prevalence in pigs may vary considerably between farms and within farms, regions and countries. ~~It is important for *Veterinary Authorities* to consider the serotypes and their prevalence in pig populations when developing and implementing *Salmonella* reduction strategies~~. It is important to note that many serotypes of *Salmonella* that are common in pigs, e.g. *S.* Derby, are very rarely observed to cause human foodborne illness.

Rationale: The United States recommends the indicated changes because there are no serotype-specific controls, with the possible exception of vaccination, used to control clinical disease. Therefore, the good production practices that control one serotype will likely be effective for all serotypes. Additionally, it needs to be acknowledged that many serotypes found in pigs, or pig feed, are seldom found in humans. (*Scientific opinion on a quantitative microbiological risk assessment of Salmonella in slaughter and breeder pigs.* 2010. The EFSA Journal 8:1-80. http://www.efsa.europa.eu/fr/scdocs/doc/1547.pdf). Serotypes are also known to vary within the same farm.

Article 6.X.2.

Purpose and scope

To combat the occurrence of food-borne salmonellosis, a pre-harvest pathogen reduction strategy ~~can assist~~ may have some utility in reducing the presence of *Salmonella* in pig *meat*. However, consideration should be given if equally, or more effective control, can be achieved by focusing at the harvest facility or as a combination of pre- and post-harvest control.

Rationale: Changes in text made because on farm *Salmonella* control programs, e.g. Denmark, have had some utility in reducing the numbers of seropositive pigs entering the slaughter facility. However, assessments have indicated that minimal reductions in pork-attributable cases can be achieved by on-farm programs alone, and that processes in the abattoir, such as carcass decontamination, are the most effective means of reducing human health risk (Hurd HS, Enoe C, Sorensen L, et al. 2008. Risk-based analysis of the Danish pork *Salmonella* program: past and future. *Risk Anal* 28:341-351)

This chapter provides recommendations on the prevention and control of *Salmonella* in domestic pigs kept for commercial breeding and production from farm to slaughter. It should be read in conjunction with the Codex Alimentarius Guidelines for the Control of Nontyphoidal *Salmonella* spp. in Pork Meat (under development) and the Codex Alimentarius Code of Hygienic Practice for Meat (CAC/RCP 58-2005).

Article 6.X.3.

Surveillance in pig herds for *Salmonella*

~~Where justified by *risk assessment*, s~~*Surveillance* ~~should be carried out to~~ may be used to identify the occurrence and distribution of *Salmonella* in pig *herds* and/or pork products.

Rationale: The language as proposed is too prescriptive. Also, no definition of what is 'justified by risk assessment' is given. Prevalence of *Salmonella* on pork products will better define public health risk than will surveillance of pig herds. Therefore, the United States proposes the text as indicated.

Surveillance data ~~will~~ may provide information to assist the *Competent Authorities* in their decision making regarding the requirement for, and design of, control programmes. Sampling and testing methods, frequency and type of samples required should be standardized as determined by the *Veterinary Services* based on transparent, objective and measurable goals. ~~the *risk assessment*~~.

Rationale: any sampling and control program needs to be standardized and repeatable. Surveillance programs will not necessarily provide usable information on *Salmonella* control. Veterinary Services should communicate the objectives of a program as well as the metrics used to measure the successes to meet the objectives.

Serological testing, usually using 'meat juice' at slaughter, is ~~a common~~ one method for assessing exposure to *Salmonella* in pig *herds*. Benefits of serological testing include low cost per test, high throughput capability and the potential for automation of tests. Collection of samples at the *slaughterhouse/abattoir* can enable~~s~~ centralised sampling of multiple *herds*. Serological testing does not detect exposure to all serotypes and does not provide information on the serotypes present at the time of slaughter.

Rationale: While meat juice testing at slaughter is common in parts of the European Union, it is not widely utilized in other parts of the world. It may not be practical in countries where small slaughter plants are the norm.

Microbiological testing with additional phenotying and genotyping identifies serotypes present in pig *herds* and can provide epidemiological information on likely sources of *Salmonella* and on the presence of strains with higher public health risk, including those with enhanced virulence or resistance to medically important *antimicrobial agents*.

Rationale: added text is indicated. The public health significance of antimicrobial resistance is related to the medical importance of the antimicrobials to which a bacterium is resistant. Please also refer to the citations that show the science on food safety importance.

Bacteriological sampling of individual pigs has low sensitivity but this can be overcome by repeated sampling, by pooling of samples (such as individual faecal samples or mesenteric lymph nodes) or sampling naturally pooled material (such as sampling of faeces from the floor of pig pens).

~~Communication of the results of post-mortem *Salmonella* testing that are relevant to the *Salmonella* status of pigs at *herd* level to the *herd* manager or *veterinarian* is an important element of a *Salmonella* control programme.~~

Rationale: The United States recommends deleting the above sentence. It is not clear whether this post-mortem occurs in the slaughter facility or at a diagnostic laboratory. If this refers to a slaughter facility, HAACP plans will address *Salmonella* contamination and provide the appropriate interventions. Communication plans on a herd level are only applicable if there is some sort of on-farm control program in effect. This does not apply to the majority of OIE Member countries.

Article 6.X.4.

Definitions

Feed: means any material (single or multiple), whether processed, semi-processed or raw, which is intended to be fed directly to terrestrial *animals* (except bees).

Feed ingredient: means a component part or constituent of any combination or mixture making up a feed, whether or not it has a nutritional value in the *animal*'s diet, including feed additives. Ingredients are of plant (including aquatic plants) or terrestrial or aquatic animal origin, or other organic or inorganic substances.

The United States commends the OIE for including two feed definitions that mirror the ones from the *Codex Alimentarius Commission's* Code of Good Animal Feeding Practice adopted at Step 8 in 2004.

Article 6.X.5.

Prevention and control measures

Articles 6.X.6. to 6.X.14. provide recommendations for the prevention and control of *Salmonella* at *herd* level. Contamination of pig *meat* can be reduced by measures taken during the *slaughter* process. Reduction of *Salmonella* in pigs entering the *slaughterhouse/abattoir* may enhance~~s~~ the effectiveness of such measures.

Rationale: According to Baptista, F.M, Dahl, J., Nielson, L.R. 2010. Factors influencing Salmonella Carcass Prevalence in Danish Abattoirs. *Preventive Veterinary Medicine* 95: 231-238: "Large reductions in the number of seropositive pigs delivered to slaughter are unlikely to result in large reductions of the *Salmonella* carcass prevalence, unless the number of seropositive pigs can be kept below approximately 200. On average, individual *Salmonella* carcass prevalence can be kept below 1% by keeping a *Salmonella* input to the abattoir below approximately 50 seropositive pigs." Therefore, even when on-farm controls are implemented, very large establishments which harvest tens of thousands of market hogs daily will be unlikely to have fewer than 200 seropositive hogs enter the facility each day. While reductions may enhance the effectiveness of the post-harvest measures, it is not assured.

~~These recommendations will also have beneficial effects on the occurrence of other *infections* and *diseases*~~.

Rationale: The United States requests this language be deleted. It is too broad and definitive. There are other pathogens which may not be reduced by these recommendations and this is not what is being addressed by this chapter.

Article 6.X.6.

Biosecurity measures

~~It is important to have~~ ~~b~~Biosecurity measures may ~~in place to~~ reduce the risk of introduction of *Salmonella* or the entry of new strains of *Salmonella* into pig *herds*, the spread of these strains across the *herd,* as well as to minimise prevalence of existing strains.

Rationale: *Salmonella* is a ubiquitous organism, unlike pathogens such as *Trichinella* or *Toxoplasma*. No specific biosecurity management practices have been shown to consistently result in *Salmonella* reduction. While hygiene and other biosecurity recommendations may be helpful, they are not specific to *Salmonella* control (Lo Fo Wong DMA, Hald T, van der Wolf PJ, et al. 20002. Epidemiology and control measures for Salmonella in pigs and pork. *Livestock Prod Sci*. 76:215-222.; Dr. Jan Dahl, Chief Advisor, Danish Agriculture and Food Council, personal communication)

It is recommended that biosecurity measures include the following:

~~1)~~ Development and implementation of a *biosecurity plan* ~~including management strategies for the prevention and control of *Salmonella*.~~

Rationale: *Salmonella* is a ubiquitous organism, unlike pathogens such as *Trichinella* or *Toxoplasma*. No specific biosecurity management practices have been shown to consistently result in *Salmonella* reduction. While hygiene and other biosecurity recommendations may be helpful, they are not specific to *Salmonella* control (Lo Fo Wong DMA, Hald T, van der Wolf PJ, et al. 20002. Epidemiology and control measures for Salmonella in pigs and pork. *Livestock Prod Sci*. 76:215-222.; Dr. Jan Dahl, Chief Advisor, Danish Agriculture and Food Council, personal communication).

2) Training of personnel regarding their responsibilities and the significance of their role in improving animal health, human health and food safety.

3) Maintenance of records including data on pig health, production, movements, medications, *vaccination*, mortality, *surveillance,* and cleaning and *disinfection* of farm buildings and equipment.

4) Veterinary supervision of pig health ~~and *Salmonella* control~~.

Rationale: *Salmonella* is a ubiquitous organism, unlike pathogens such as *Trichinella* or *Toxoplasma*. No specific biosecurity management practices have been shown to consistently result in *Salmonella* reduction. While hygiene and other biosecurity recommendations may be helpful, they are not specific to *Salmonella* control (Lo Fo Wong DMA, Hald T, van der Wolf PJ, et al. 20002. Epidemiology and control measures for Salmonella in pigs and pork. *Livestock Prod Sci.* 76:215-222.)

5) Removal of unwanted vegetation and debris that could attract or harbour pests around pig housing.

6) Prevention of entry of wild birds into pig houses and buildings.

7) Cleaning and *disinfection* procedures for pig housing, general equipment, transportation equipment and animal walkways. The cleaning and *disinfection* procedures for pig housing after emptying should include at least feeders, drinkers, floor, walls, aisles, partitions between pens, and ventilation ducting. All visible organic material should be removed before *disinfection* with a suitable *disinfectant* at an effective concentration*. Disinfectants* should be used in accordance with Chapter 4.13.

8) Procedures for the control of vermin such as rodents and arthropods should be in place and regular checks should be carried out to assess effectiveness. When the presence of vermin is detected timely control actions should be taken to prevent the development of unmanageable populations; for example, the placement of baits for rodents where they are nesting.

9) Controlled access of persons and *vehicles* entering the *establishment*.

10) Biosecurity measures applied to all personnel and visitors entering the *establishment.* This may ~~should~~ include, at a minimum, hand washing and changing into clean clothes and footwear provided by the *establishment*. Similar precautions are recommended when moving between separate *epidemiological units* on large farms.

Rationale: language, as proposed, appears to recommend only hand washing and changing into clean clothes and footwear. However, additional biosecurity measures may be in place (e.g. shower in facilities) in some facilities. Specific practices such as hand washing and changing clothes and footwear have not been proven to be consistently effective in *Salmonella* control. *Salmonella* is a ubiquitous organism, unlike pathogens such as *Trichinella* or *Toxoplasma*. No specific biosecurity management practices have been shown to consistently result in *Salmonella* reduction. While hygiene and other biosecurity recommendations may be helpful, they are not specific to *Salmonella* control (Lo Fo Wong DMA, Hald T, van der Wolf PJ, et al. 20002. Epidemiology and control measures for Salmonella in pigs and pork. *Livestock Prod Sci*. 76:215-222.)

11) *Vehicles* and equipment identified as a *risk* in the *biosecurity plan* should be cleaned and *disinfected* before entering the *establishment*.

12) Pig carcasses, bedding, faeces and other potentially contaminated farm waste should be stored and disposed of or handled in a safe manner ~~to minimise the risk of dissemination of *Salmonella* and to prevent the direct or indirect exposure of humans, livestock and *wildlife* to *Salmonella*.~~ Particular care should be taken when pig bedding and faeces are used to fertilise horticultural crops intended for

human consumption.

Rationale: The safe storage and handling of farm waste is not specific to Salmonella. Not all waste needs to be disposed of. Land applications are an effective method of handling and recycling animal waste.

Article 6.X.7.

Facility design

Good design of pig units facilitates the management and control of pathogens.

It is recommended that facility design consider the following:

1) location of other livestock *establishments* in relation to wild bird and rodent populations;

2) adequate drainage for the site and control of run-off ~~and~~ of untreated waste water;

Rationale: Grammar -- it appears the authors meant to say control of run-off "of" untreated waste water, rather than "and".

3) use of smooth impervious materials for construction of confinement facilities to enable effective cleaning and *disinfection*;

Rationale: use of these materials for confinement facilities is appropriate, but not practical for pigs in extensive housing systems

4) surrounding indoor pig houses with concrete or other impervious material ~~to facilitate cleaning and *disinfection*~~;

Rationale: buffer zones made of impervious materials help prevent rodent colonization of confinement facilities. They do not facilitate cleaning and disinfection of those facilities.

5) a controlled entry point, when practical, to prevent the entry of unwanted *animals* and people;

Rationale: controlled entry points may not be feasible in extensive production systems. Consumer demand for pork from extensive systems can be significant, and those systems may raise pigs on a commercial scale.

6) a sign indicating restricted entry at the entrance to the *establishment*;

7) pig flow to minimise stress and spread of pathogens ~~*Salmonella infection*~~;

Rationale: Please provide scientific data to demonstrate pig flow schemes that specifically address Salmonella transmission. Otherwise, the changes indicated need to be made to the text.

8) prevention of entry, to the extent possible, of wild birds, rodents and *feral animals*;

Rationale: the added text is recommended because the exclusion of wild birds, rodents and feral animals may not be feasible in extensive production systems. Consumer demand for pork from extensive systems can be significant, and those systems may raise pigs on a commercial scale

9) location of delivery and collection points away from pig housing or feed storage.

Article 6.X.8.

Feed

Salmonella contaminated feed and feed ingredients ~~are known to~~ may be ~~important~~ a source~~s~~ of *infection* for pigs. Therefore, attention should be paid to feed and feed ingredients production, handling, storage, transportation and distribution, especially in countries with very low to negligible prevalence of *Salmonella*, ~~should be produced, handled, stored, transported and distributed according to Good Manufacturing Practices, considering Hazard Analysis Critical Control Points (HACCP) principles and recommendations in accordance with Chapter 6.3~~.

Rationale: The United States is concerned with the *a priori* decision that feed contaminates pigs with *Salmonella*. After an exhaustive literature review and discussion with a body of world experts, the 2007 United Nations FAO/WHO expert panel on "Impact of Animal Food in Food Safety" concluded the opposite. The FAO/WHO expert panel reviewing microbial contamination of feed and other contaminant issues stated the following: "Salmonella is still of worldwide human health concern. It is clear that infection in animals has a direct impact on transmission to humans via food of animal origin. Contaminated feed might represent an important route of exposure to Salmonella. However, at the Expert Meeting there was little scientific information available about the correlation between contaminated feed and infection of livestock by the same Salmonella strains and the contamination of meat, milk and eggs produced from these animals.

It is not uniformly accepted that feed and feed ingredients are the major source of infection for swine, or of public health risk. Exposure doses of 10^3 organisms given intranasally or orally are not sufficient to establish infections in pigs, and oral doses of 10^8 cfu have been required to consistently produce experimental infections. (Anderson RC, Nisbet DJ, and Buckley SA. 1998. Experimental and natural infection of early weaned pigs with *Salmonella cholerasuis*. Res. Vet. Sci. 64:261-262; Fedorka-Cray PJ, Kelley LC, Stabel TJ, et al. 1995. Alternate routes of invasion may affect pathogenesis of *Salmonella typhimurium* in swine. Infect. Immun. 63:2658-2664; Gray JR, Fedorka-Cray PJ, Stabel TJ, et al. 1995. Influence of inoculation route on the carrier state of *Salmonella cholerasuis* in swine. Vet. Microbiol. 47:32-59). Thus, feed would need to be contaminated with greater than 10^4 Salmonella per gram to deliver an infective dose to a market hog within two months of harvest (Davies PR, Hurd HS, Funk JA, et al. 2004. The role of contaminated feed in the epidemiology and control of *Salmonella enterica* in pork production. Foodborne pathogens and disease. 1:202-215).

While there is a paucity of published longitudinal studies where both pigs and feed are sampled, one such study demonstrated an insignificant role of feed contamination.
(Funk JA, Davies PR and Nichols MA. 2001. Longitudinal study of *Salmonella enterica* in growing pigs reared in multiple-site swine production systems. *Vet. Microbiol.* 83:45-60).

Additionally, there is a consistent disparity between serotypes isolated in animal feeds and those isolated from pigs.
References:
-Davies PR, Morrow WEM, Jones FT, et al. 1997. Prevalence of *Salmonella* in finishing swine raised in different production systems in North Carolina, USA. *Epidemiol. Infect.* 119:237-244;
-Funk JA, Davies PR and Nichols MA. 2001. Longitudinal study of *Salmonella enterica* in growing pigs reared in multiple-site swine production systems. *Vet. Microbiol*. 83:45-60;
-Korsak N, Jacob B, Goven B. et al. *Salmonella* contamination of pigs and pork in an integrated pig production system. *J. Food. Prot.* 66:1126-1133;
-Stege H. 2000. Subclinical *Salmonella enterica* infection in Danish finishing pig herds – prevalence and risk factors. Doctoral dissertation. Royal Veterinary and Agricultural University, Copenhagen, DK).

Furthermore, many *Salmonella* serotypes occurring in animal feed are not considered epidemiologically important for human foodborne disease and would be outside the scope of this document, while the most important serotypes, such as *Salmonella typhimurium* and *enteriditis,* are seldom reported in feed.
References:
-Davies PR, Morrow WEM, Jones FT, et al. 1997. Prevalence of *Salmonella* in finishing swine raised in different production systems in North Carolina, USA. Epidemiol. Infect. 119:237-244;
-Funk JA, Davies PR and Nichols MA. 2001. Longitudinal study of *Salmonella enterica* in growing pigs reared in multiple-site swine production systems. Vet. Microbiol. 83:45-60;
-Harris IT, Fedorka-Cray PJ, Gray JT, et al. 1997. Prevalence of Salmonella organisms in swine feed. J. Am Vet Med. Assoc. 210:382-385;
-Murray CJ. 1994. Salmonella serovars and phage types in humans and animals in Australia 1987-1992. Aust. Vet. J. 71:78-81;
-Stege H. 2000, Subclinical *Salmonella enterica* infection in Danish finishing pig herds – prevalence and risk factors. Doctoral dissertation. Royal Veterinary and Agricultural University, Copenhagen, DK; Notermans S and Beumer H. 2002. Microbiological concerns associated with animal feed production. In: Food Safety Assurance and Public Health. Volume 1. *Food Safety Assurance in the Preharvest Phase.* SMulders, FJM and Collins JD (eds), Wageningen Academic Publishers, Wageningen, The Netherlands, pp. 49-62;
-Veldman A, Vahl HA, Borggreve GJ, et al. 1995. A survey of the incidence of *Salmonella* species and enterobacteriaceae in poultry feed and feed components. Vet. Rec. 135:169-172;
-Jones FT and Richardson KE. 2004. *Salmonella* in commercially manufactured feeds. Poult. Sci. 83:384-391.)

Finally, it is considered that feed controls are likely only an important source of infection in countries with **very low to negligible prevalence of *Salmonella***. (*Analysis of the costs and benefits of setting a target for the reduction of Salmonella in slaughter pigs for European Commission, Health and Consumers Directorate-General* SANCO/2008/E2/036. http://ec/europa.eu/food/food/biosafety/salmonella/docs/fattening_pigs_analysis_costs.pdf)

This focus on feed is not applicable to third world countries, or countries with a non-negligible prevalence of *Salmonella* in their pig herds.

~~For the effective control~~ To minimize the prevalence of *Salmonella*

Rationale: "Effective control" is not defined in this document, and could be misconstrued to mean the absence of *Salmonella.* Salmonella control programs, such as those in Denmark and other European countries focus on reducing the sero-prevalence of *Salmonella* -- not on eliminating it. (Wegener, HC, Hald T, Lo Fo Wong D, et al. 2003. *Salmonella* control programs in Denmark. Emerg. Infect. Dis. 9:774-780)

it may be helpful to ~~is recommended that~~:

Rationale: As stated above, there is conflicting evidence on the importance of contaminated feed in the epidemiology of Salmonella in swine. Therefore, while the suggestions may be helpful, they are not uniformly accepted in all instances.

~~1) Feed and feed ingredients should come from monitored sources.~~

Rationale: In most cases contamination of feed and feed ingredients occur at low prevalence (<10% of samples tested from a contaminated batch) and are not homogeneously distributed within contaminated batches.
-Davis, MA, Hancock DD, Rice DH, et al. 2003. Feedstuffs as a vehicle of cattle exposure to *Escherichia coli* O157:H7 and *Salmonella enterica*. *Vet Microbiol.* 95:199-210;
-Jones FT and Richardson KE. 2004. *Salmonella* in commercially manufactured feeds. *Poult Sci*. 83:384-391;
-Notermans S and Beumer H. 2002. Microbiological concerns associated with animal feed production. In: Food Safety Assurance and Public Health. Volume 1. *Food Safety Assurance in the Preharvest Phase*. SMulders, FJM and Collins JD (eds), Wageningen Academic Publishers, Wageningen, The Netherlands, pp. 49-62.

These attributes, along with less than perfect sensitivity of available testing methods (Maciorowski KG, Pillai SD, and Ricke SC. 2000. Efficacy of a commercial polymerase chain reaction-based assay for detection of *Salmonella* spp. in animal feeds. *J. Appl. Microbiol*. 89:710-718.) make testing inefficient and unreliable – requiring too many samples to be tested to identify contamination . Additionally, many feed ingredients are produced on farm and would not be subject to monitoring.

Finally, this monitoring is not practical for developing countries without access to sophisticated testing laboratories. This provision seem to imply that each feed facility have a supplier selection/verification list. This is concerning, as it places a significant burden not only in developed countries but more so on feed mills in less-developed countries, which may have limited sources for important or major ingredients. Similarly, there is no scientific basis to determine that monitored sources are better than non-monitored. The occasional *Salmonella* occurrences in animal feed have usually been the result of recontamination by transportation vehicles or at the farm.

~~2)~~ Feeds treated with heat, bactericidal or bacteriostatic treatments e.g. organic acids are considered. ~~Heat treated feeds are used and may also include the addition of bactericidal or bacteriostatic treatments, e.g. organic acids. Where heat treatment is not possible, the use of bacteriostatic or bactericidal treatments or processes should be considered.~~

Rationale: The use of such treatments may not be practical with home mixed feeds. Additionally, since heat treatment is most often associated with pelletizing feed, and pelleted feed has been positively associated with risk of *Salmonella* compared to home mixed feeds, heat treatment may be counterproductive and should not be uniformly applied in all situations (Lo Fo Wong DMA; Hald T, van der Wolf PJ, et al. 2002. Epidemiology and control measures for *Salmonella* in pigs and pork. Livestock Prod. Sci. 76:215-222; van Winsen RL, van Nes A, Keuzenkamp D, et al. 2001. Monitoring the transmission of *Salmonella enterica* serovars in pigs using bacteriological and serological detection methods. *Vet. Microbiol*. 80:267-274)

4) Feed should be stored and transported in a hygienic manner that prevents exposure to possible residual *Salmonella* contamination.

5) Access to feed by wild birds and rodents should be prevented.

6) Spilled feed should be cleaned up immediately to remove attractants for wild birds, rodents and other pests.

Article 6.X.9.

Water

~~For the effective control~~ To minimize the prevalence of *Salmonella* it is recommended that:

Rationale: "Effective control" is not defined in this document, and could be misconstrued to mean absence of *Salmonella. Salmonella* control programs, such as those in Denmark and other European countries, focus on the reducing the sero-prevalence and not its elimination. (Wegener, HC, Hald T, Lo Fo Wong D, et al. 2003. *Salmonella* control programs in Denmark. Emerg. *Infect. Dis*. 9:774-780)

~~1) The drinking water supply be monitored and controlled to maintain it free from *Salmonella* contamination.~~

Rationale: This statement needs to be deleted because it is impractical for pigs that are maintained in outside housing, for pigs that use surface water as a source of drinking water, and for pigs raised in many developing countries.

~~2)~~ Water holding tanks are enclosed when practical.

3) The water delivery system is regularly cleaned and disinfected when practical. For example in an 'all-in-all-out' system this would occur before restocking.

Article 6.X.10.

Feed composition

For the control of *Salmonella* it is recommended that the following be considered when determining feed

composition:

1) Slower gastric transit time of ingested feed increases exposure of *Salmonella* to stomach acid resulting in decreased survival.

2) Modified fermentation conditions in the gastrointestinal tract may enhance colonisation by protective bacteria and thereby suppress the colonisation and multiplication of *Salmonella*.

3) Liquid feed that is fermented has a protective effect due to the presence of beneficial bacteria and low pH levels; for example, the inclusion of fermented *milk products*.

Where *Salmonella* is present in a pig *herd,* the composition of feed may influence the occurrence of *Salmonella* in individual pigs. ~~For the effective control~~ To minimize the prevalence of *Salmonella* ~~it is recommended that~~ the following may be considered:

Rationale: "Effective control" is not defined in this document, and could be misconstrued to mean absence of *Salmonella. Salmonella* control programs, such as those in Denmark and other European countries, focus on the reducing the sero-prevalence and not its elimination. (Wegener, HC, Hald T, Lo Fo Wong D, et al. 2003. *Salmonella* control programs in Denmark. Emerg. *Infect. Dis*. 9:774-780)

4) Feed may ~~should~~ be coarsely ground to reduce prevalence of *Salmonella* but not so coarse as to overly reduce feed conversion.

Rationale: increasing particle size will negatively impact feed conversion. This should be balanced to address both potential food safety and food security concerns

5) Where feed is wheat based, reducing the proportion of wheat may reduce the occurrence of *Salmonella* in pigs.

6) Coarsely ground material may be added to pelleted feed.

Article 6.X.11.

Pig flow management

The movement and mixing of pigs increase the risk of spread of *Salmonella*. ~~For the effective control~~ To minimize the prevalence of *Salmonella* it is recommended that:

Rationale: "Effective control" is not defined in this document, and could be misconstrued to mean absence of *Salmonella. Salmonella* control programs, such as those in Denmark and other European countries, focus on the reducing the sero-prevalence and not its elimination. (Wegener, HC, Hald T, Lo Fo Wong D, et al. 2003. *Salmonella* control programs in Denmark. Emerg. *Infect. Dis*. 9:774-780)

1) The number of pig movements and mixing of pigs between weaning and dispatch for *slaughter* should be minimised.

2) If possible, the 'all-in-all-out' single age group principle should be used. In particular, the addition to younger groups of pigs held back from older groups should be avoided.

Article 6.X.12.

Management of new pig introductions

To minimise the risk of new introductions of *Salmonella* in replacement pigs in a *herd*, it is recommended that:

1) There is good communication along the pig production chain to ensure that steps are taken to minimise the introduction and dissemination of *Salmonella*.

2) ~~A closed *herd* policy is applied with the introduction of new genetic material by semen only~~

Rationale: in developing countries where refrigeration for semen is not available, it may not be practical to rely only on semen for the introduction of new genetic material. Additionally, introduction of breeding animals from a breeding pyramid is the norm in commercial production in much of the world. It would limit genetic improvements and be largely impractical for most commercial pig farmers to close their herd and practice internal multiplication to produce new breeding females.

3) The number of separate sources for both replacement breeding stock and rearing pigs are as few as possible.

4) Newly introduced pigs are kept separate from the rest of the *herd* for a suitable period before incorporating with other pigs~~, e.g. four weeks.~~

Rationale: Propose deleting "four weeks". The United States cannot find the scientific justification for the "four weeks" recommendation.

5) When possible, r~~R~~eplacement breeding pigs are free of ~~of a similar~~ *Salmonella* ~~status to that of the *herd*, for example a *Salmonella* free *herd* should source replacements from *Salmonella* free *herds*; or *herds* that are free of specific *Salmonella* serotypes such as *S.* Typhimurium should avoid introducing pigs from breeding *herds* infected with such serotypes~~.

Rationale: Infected pigs are considered the most important reservoir for Salmonella infection on swine farms .
-Wierup M. 1997. Principles for integrated surveillance and control of *Salmonella* in swine production. 2nd International Symposium on Epidemiology and Control of *Salmonella* in Pork, Copenhagen, DK;
-Davies PR, Morrow WEM, Jones FT, et al. 1997. Prevalence of *Salmonella* in finishing swine raised in different production systems in North Carolina, USA. *Epidemiol. Infect.* 119:237-244;
-Berends BR, Urlings HAP, Snidjers JMA, et al. 1996. Identification of risk factors in animal management and transport regarding *Salmonella spp*. in pigs. *Int. J. Food Microbiol.*30:37-53).
Therefore, replacement stock should be as free from infection as possible. Additionally, categorization of farms to match status requires significant current and historical microbiological testing data that is often not available and may be difficult to interpret.

6) ~~Where appropriate, pooled faecal samples from introduced pigs are taken to assess their *Salmonella* status.~~

Rationale: The sentence is proposed for deletion because there is no definition of when it is appropriate to collect, and what actions should be taken in the event that all the samples are not uniformly negative.

Article 6.X.13.

Stress reduction

Given that stress may increase the multiplication and shedding of *Salmonella* by pigs and their susceptibility to *infection,* it is important to consider management measures that reduce stress.

Article 6.X.14.

Pig treatments

1) Some ~~A~~a*ntimicrobial agents* may modify normal flora in the gut and increase the likelihood of colonisation by *Salmonella*. If *antimicrobial agents* are used for the control of clinical *infection*s in pigs, they should be used in accordance with Chapters 6.7., 6.8., 6.9. and 6.10.

Rationale: Suggest adding the word "some" because not all antimicrobial agents will have the same spectrum of activity.

~~*Antimicrobial agents* should not be used to control subclinical *infection* with *Salmonella* in pigs because the effectiveness of the treatment is limited and can contribute to the development of antimicrobial resistance.~~

Rationale: The appropriate treatment for *Salmonella* cannot be prescribed through these recommendations. Since on farm conditions have wide variability, it is the responsibility of the attending veterinarian who has knowledge of the conditions on the farm and of the animals to advise how best to handle subclinical infections.

2) *Vaccination* may be used as part a *Salmonella* control programme. Vaccine production and use should be in accordance with Chapter 2.9.9. of the *Terrestrial Manual*.

Vaccines for *Salmonella* in pigs may increase the threshold for *infection* and reduce the level of excretion of the organism. The protective effect of vaccines is serotype specific and few licensed vaccines are available for pigs.

If serology is used as the *surveillance* method, it may not be possible to distinguish between *vaccination* and *infection* with a field strain.

If live vaccines are used:

a) it is important that field and vaccine strains be easily differentiated in the laboratory;

b) the vaccine strain should not be present at the time of *slaughter*.

3) Organic acids, probiotics and prebiotics may be added to feed or water to reduce shedding of

Salmonella by pigs. However, efficacy is variable.

Article 6.X.15.

Transportation

The relevant recommendations in Chapter 7.3. apply.

Article 6.X.16.

Lairage

Lairage can be used at various stages in pig production, for example accumulation of weaned pigs before movement to nursery *herds*, holding finisher pigs before transport to *slaughter* and holding pigs at the *slaughterhouse/abattoir* before *slaughter*. Important aspects of *lairage* management include effective cleaning and *disinfection* between groups, minimising mixing of separate groups and managing stress.

In addition, the relevant recommendations in Articles 7.5.1., 7.5.3., and 7.5.4. apply.

Article 6.X.17.

Prevention and control in low prevalence regions

In regions where *Salmonella infection* of pigs is uncommon it may be possible to eliminate *infection* from individual *herds* by means of a test and removal policy. This can be accomplished by placing movement controls on the *herd*, repeated bacteriological sampling of groups of pigs and culling of persistently infected pigs. Movement controls can be lifted after two rounds of negative tests and confirmation of implementation of effective prevention and control measures as described in Articles 6.X.5. to 6.X.14.

It may be possible to attempt this approach in individual *herds*, for example in valuable breeding *herds*, in higher prevalence regions. However, the risk of reintroduction of *infection* must be low to achieve success with this approach.

Article 6.X.18.

Outdoor pig production

As far as possible the prevention and control measures described in Articles 6.X.5. to 6.X.14. should also be applied to outdoor pig production to reduce *Salmonella infection* in pigs. It is recommended that:

1) field rotation programmes be used to minimise *Salmonella* contamination and accumulation in soil and surface water and therefore ingestion by pigs;

2) feed be provided using troughs or bird proof hoppers to minimise attraction of wild birds;

3) location of other outdoor pig *herds* and the concentration and behaviour of wild birds in the area be considered when establishing outdoor pig *herds*.

Article 6.X.19.

Live animal markets

Live animal markets pose a significant risk of spreading *Salmonella* and other *infections* and *diseases* among pigs. If possible, sourcing replacement pigs from live animal markets should be avoided. Precautions should be taken to prevent the spread of *Salmonella* from markets to pig *herds* by personnel or *vehicles*.

— Text deleted.