Eliciting expert knowledge on *Salmonella enterica* dynamics in swine at the pre-harvest level

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Abstract: A workshop was conducted to elicit expert knowledge on infection status and transmission of salmonella in pigs at the farm of origin, during transport and during lairage. Thirty-six experts from 11 countries filled in a paper-and-pencil questionnaire during an international conference. The group of US and Danish experts were large enough to be analysed separately. The results indicated that experts from all countries agreed on the risk of salmonella introduction related to live animals and the significance of general hygiene and all-in/all-out management for salmonella control. However, workshop participants from Denmark put more weight on factors related to feed while experts from the USA rated factors related to rodents and people contact higher. The experts believed that 1/3 of the infected pigs from a chronically infected farm would be shedders. There were differences in risk perception between experts from Denmark and the USA regarding contamination during lairage and transport as well as regarding incidence of salmonella shedding during transport and lairage. In conclusion, the results reflect the differences in the level of salmonella infection and control between countries. The study does not allow differentiation between true differences in salmonella dynamics between countries or differences in perception only.

Keywords: expert opinion, epidemiology, infection dynamics, risk assessment

Introduction: The expert workshop described in this report was part of a larger project regarding risk assessment of *Salmonella enterica* transmission and contamination in the Danish pork production chain (Stärk et al., 1999). Within this project, a quantitative risk simulation model was developed. The unit of analysis in this model is the individual pig. Each pig can be in one of six distinct infection and contamination states regarding salmonella. As the pig is moving through the production chain, the infection state can change according to state-transition probabilities. When developing this model, the literature was searched to obtain
input parameters for transition probabilities and also regarding other necessary input values. It was discovered, that the currently published knowledge base was insufficient to finalise the model. In such situations, temporary help can be found by using expert opinion. Various techniques for eliciting expert knowledge are available and have been used in the veterinary field. A knowledge elicitation workshop was conducted with the following objectives: 1) to elicit expert knowledge on infection status and transmission of salmonella in pigs at the farm of origin, during transport and during lairage, and 2) to compare expert opinions between countries.

Materials and Methods: The elicitation workshop was conducted during the 3rd International Symposium on the Epidemiology and Control of Salmonella in Pork (5-7 August 1999, Washington DC). All participants of the conference were eligible as experts. A questionnaire was designed using regular closed questions and also conjoint analysis methods (Horst et al., 1996). All participants filled in the questionnaire individually. The six most significant risk factors for introduction of salmonella on a pig farm and for control of salmonella were identified. The factors were selected to be consistent with both the ‘Danish salmonella philosophy’ as well as with what is published in the literature. Possible combinations of risk factors were created using an orthogonal design with 8 profiles. Three additional profiles were used as ‘hold-outs’ to assess the fit of the model for individual participants. The data was analysed using regression analysis. Participants with a lack of fit of their individual model for the holdouts (p>0.20) were excluded from the analysis because their answers were inconsistent. Probabilities were elivated using true frequencies. For transport and lairage, different scenarios regarding mixing of pigs, their infection status and duration of transport were defined. Descriptive statistics were calculated using standard statistical software.

Results: Out of the 143 participants of the symposium, 36 participated in the workshop. Fourteen participants were from the USA (39%), 11 from Denmark (31%) and 9 from European countries other than Denmark (25%). The group of US and Danish experts were large enough to be analysed separately. The questionnaire was completed by all participants in 45-60 minutes.
All 36 participants answered the first question on risk factors for the introduction of salmonella onto a farm. After exclusion of inconsistent participants 224 scenarios remained to be included in the model. All factors were significant except “birds”. When participants were grouped according to their country of origin, there were considerable differences. Although all participants agreed on the risk related to live pigs, the factors ‘people’ and ‘rodents’ were perceived as risk factors only by participants from the USA, while participants from Denmark and elsewhere
attributed more significance to the factor ‘feed’. Regarding salmonella control on infected farms, the factors ‘hygiene’ and ‘all-in/all-out management’ were rated as significant control factors by all groups. There was however no consensus regarding the usefulness of ‘medication’ or the control factors ‘acid’ and ‘feed management’.

When loading pigs for slaughter from a chronically infected farm, experts estimated that 18% of pigs would be infected with salmonella, but only 7% out of these would be shedding salmonella. 25% of slaughter pigs from infected farms were estimated to be contaminated with salmonella on their skin. Regarding salmonella dynamics during transport, participants estimated that if salmonella-free pigs were transported with infected pigs, approximately 20% would become infected and 40% contaminated with salmonella. Marked differences were observed between experts from Denmark and the USA. The latter perceived the probability of infection of salmonella-free pigs to be much higher regardless of whether there were other infected pigs on the truck or not. Similar results were observed for infection probabilities during lairage.

**Discussion:** Acknowledging the limitations of expert opinion, the estimates on salmonella dynamics can be used as ‘best guess’ estimates in the salmonella risk simulation model that is currently being validated (Stärk et al., 2000). Although this workshop did not allow distinguishing between the perception of experts and ‘the truth’, there are some processes that are – according to experts from all countries – related to significant risk potential. These processes are transport and lairage. A detailed report of the workshop can be obtained from the first author.

**References**

