

Linking Research Synthesis and Risk-Based Tools: Addressing Policy Makers' Needs in Zoonotic Public Health

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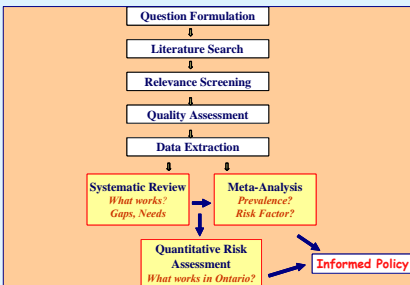
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Study Summary

Our objective was to evaluate the opportunities and challenges for linking research synthesis and risk-based tools using 'Salmonella issue in pork' as a model. Global knowledge-base on the effectiveness of interventions against Salmonella in the 'farm-to-processing' pork continuum was mapped out, appraised and summarized, utilizing a systematic review (SR). No single on-farm intervention was universally beneficial for Salmonella reduction in pork. SR-meta-analysis (MA) approach was applied to investigate factors affecting reported prevalence of Salmonella. A meta-regression revealed that prevalence estimates based on cultured feces or tissues were 12-27% lower than estimates obtained from serological tests; estimates based on convenience sampling were 10% higher than from random sampling. Evidence-based intervention and prevalence summaries, generated through SR-MA approach, were refined using expert-panel opinions and incorporated into a quantitative risk assessment (QRA) to investigate the effect of selected interventions. A package of interventions produced the largest (93%) overall prevalence reduction of Salmonella at the end of processing. SR-MA should be considered as a routine tool for generating evidence-based inputs for QRA.

Figure 1: Study Approach



Salmonella control: What works?

A Systematic Review Approach

Summary

Global scientific literature on the effectiveness of interventions against Salmonella in the 'farm-to-slaughter' swine production continuum was identified, appraised and summarized, utilizing the principles of a systematic review methodology (Figure 1). No single on-farm intervention was universally beneficial for Salmonella reduction in swine/pork. More consistent beneficial effects were observed for vaccines, feeding coarse mash feeds and acidification of feed. For fermented liquid feed, antibiotics, sodium chlorate, and competitive exclusion, the results were less consistent. The lack of studies on the effectiveness of on-farm bio-security practices was observed although such practices are often recommended to producers, e.g. clean-up and disinfection. At the processing level, more consistent, beneficial effects in controlling Salmonella in pork were observed for carcass treatment with lactic acid, water, chlorine and chilling. It is also evident that lairage in abattoir holding pens contributed significantly to an increase in the prevalence of Salmonella shedding.

Understanding Salmonella prevalence

A Meta-Analysis Approach

Summary

SR-MA was applied to investigate factors affecting reported prevalence of Salmonella in swine. All relevant published literature reporting Salmonella prevalence in swine from 1998 to 2005 was assessed and appraised. Variables related to reported study design and assessed study quality were created and evaluated in meta-regression models. From 2,396 citations 104 were suitable for meta-analysis, reporting prevalence estimates for 87 and 158 herd and animal populations, respectively. Figure 3 shows the cumulative distribution of prevalence at the animal and herd levels. Prevalence estimates based on cultured feces or tissues were 12-27% lower than estimates obtained from serological tests; estimates based on convenience sampling were 10% higher than from random sampling (Figure 2). In herd-level models, diagnostic protocols explained the largest percentage of the between-herd prevalence (Figure 3). Sample size and source of data (targeted surveys vs. surveillance programs) were also significantly associated with the herd-level Salmonella prevalence.

Figure 2

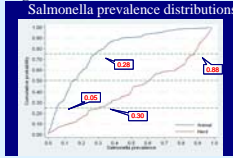


Figure 3

Model	Herd-level		Animal-level	
	Model	var	Model	var
Sample size	0.00	0.01	0.00	0.01
Source data	0.19	0.09	0.05	0.01
Study type	0.14	0.06	0.07	0.02
Sampling design	0.18	0.04	0.04	0.03
Study population	0.08	0.01	0.01	0.07
Herd type	0.07	0.02	0.00	0.05
Sampling group	0.00	0.00	0.00	0.02
Diagnostic procedure	0.11	0.10	0.12	0.20
On-farm prevalence	0.04	0.00	0.00	0.05
Other procedure	0.00	0.00	0.00	0.00

What works in Ontario?

A Systematic Risk Assessment

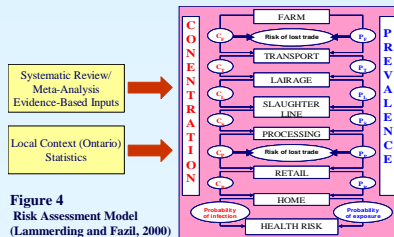


Figure 4

Risk Assessment Model (Lammerding and Fazil, 2000)

Summary

Evidence-based inputs from the SR-MA were refined through expert-panel and incorporated into a QRA (Figure 4) to investigate the effect of vaccination, feed strategy, carcass decontamination and 'package' intervention approach comprising of vaccination, reduction in transport and lairage stress, slaughter practices that reduce cross-contamination, and a decontamination stage. These scenarios were tested by computer simulation and compared to a baseline situation. A vaccination strategy was estimated to reduce Salmonella prevalence, compared to the baseline scenario, by approximately 90% for pigs leaving the finishing farm; ultimately, the prevalence of contaminated carcasses exiting the abattoir is reduced by approximately 61%. Feeding strategies were estimated to reduce the prevalence by approximately 72% for pigs exiting the finishing farm, which translates to a 41% reduction in prevalence leaving the abattoir. In the decontamination scenario the prevalence at the end of the abattoir is estimated to be 43% less than the baseline scenario. A package of interventions produced the largest overall prevalence reduction at the end of slaughter with a 93% reduction (Figure 5).

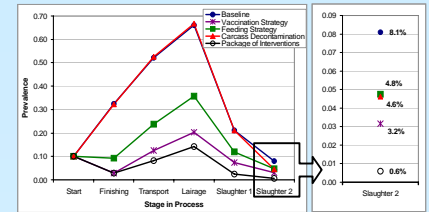


Figure 5

Opportunities

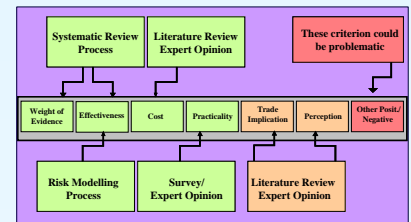
- SR-MA and QRA are powerful methods, when appropriately used.
- These tools identify the most effective interventions in a transparent way.
- These tools are particularly useful in identifying methodological strengths and weaknesses of available research and knowledge gaps for targeting further research.
- SR-MA are useful for generating transparent evidence-based inputs for risk-based analyses.

Challenges

- Organizational
 - Time, resources
 - Multi-disciplinary expertise
- Methodological
 - Existing SR-MA formats more suitable for interventions
 - Lack of studies of acceptable quality
 - Lack of experimental and field studies
 - Still must rely on experts!

New Initiative

Multi-Criteria Decision Analysis



Adopted from Fazil et al., 2006 ISVEE Proceedings

Acknowledgements

We would like to thank Ontario Ministry of Agriculture, Food and Rural Affairs, Ontario Pork and Public Health Agency of Canada for funding.

