



Application of Systematic Review Methodology to *Salmonella* Intervention Strategies in Broiler Production and Processing

Advances in Post-Harvest Reduction of Salmonella in Poultry
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Premise

- Production of safe food involves intervention strategies to be implemented at all stages of production, from farm to fork
- Decision makers need information
- Scientific literature is a resource for this information

Premise

- Use of scientific literature to make informed decisions
 - Stumbling blocks
 - Lack of literature – difficult to find on a particular topic
 - Large body of literature – overwhelming quantity, conflicting conclusions



Systematic Reviews

- Method of identifying effective treatments or processes based on the available evidence from a variety of sources
 - Differ from traditional narrative or critical reviews of literature
 - Use transparent and replicable scientific methodology to collect, assess, and synthesize all available information on a subject.
 - Reproducible



Food Safety Research and Response Network - USDA CSREES National Research Initiative

Systematic Reviews

Systematic reviews provide a rigorous and replicable method of identifying, evaluating, and summarizing scientific evidence to address healthcare-related issues such as disease treatment, prevention, diagnosis, and risk factor assessment. The steps involved in conducting a systematic review include: (1) development of a focused study question; (2) identification of all potentially relevant primary research using a structured search strategy; (3) screening of abstracts for relevance to the study question; (4) quality assessment of the relevant literature; (5) extraction of data from articles of sufficient quality; and (6) synthesis of data from those studies using qualitative or quantitative approaches.

Download:
A Guide to Conducting Systematic Reviews in Agri-Food Public Health.
Guide pour les analyses systématiques dans le domaine de la santé publique agroalimentaire.

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Salmonella Interventions

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**Annette O'Conner &
Jim McKean**
- Iowa State University

Hart Bailey & Bob Wills
- Mississippi State University

A Guide to Conducting Systematic Reviews in Agri-Food Public Health

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Rationale and Significance

- Used primarily to identify effective interventions to reduce disease burden.
- May also be used to
 - identify knowledge gaps that target additional research
 - identify methodological strengths/weaknesses in the available research
 - encourage “best study practices” development for intervention research.



Systematic reviews in health science

[Abdominal decompression for suspected fetal compromise/pre-eclampsia](#)
[Abdominal decompression in normal pregnancy](#)
[Absorbable staples for uterine incision at caesarean section](#)
[Absorbable synthetic versus catgut suture material for perineal repair](#)
[Absorbent products for containing urinary and/or faecal incontinence in adults](#)
[Acellular vaccines for preventing whooping cough in children](#)
[Acetaminophen for osteoarthritis](#)
[Acetyl-L-carnitine for dementia](#)
[Aciclovir or valaciclovir for Bell's palsy \(idiopathic facial paralysis\)](#)
[Active chest compression-decompression for cardiopulmonary resuscitation](#)
[Active placebos versus antidepressants for depression](#)
[Active versus expectant management in the third stage of labour](#)
[Acupuncture and electroacupuncture for the treatment of RA](#)
[Acupuncture for Bell's palsy](#)
[Acupuncture for chronic asthma](#)
[Acupuncture for idiopathic headache](#)
[Acupuncture for induction of labour](#)
[Acupuncture for lateral elbow pain](#)
[Acupuncture for low-back pain](#)
[Acupuncture for smoking cessation](#)
[Acyclovir for treating varicella in otherwise healthy children and adolescents](#)
[Addition of anti-leukotriene agents to inhaled corticosteroids for chronic asthma](#)
[Addition of intravenous aminophylline to beta2-agonists in adults with acute asthma](#)
[Adenotonsillectomy for obstructive sleep apnoea in children](#)
[Adhesives for fixed orthodontic brackets](#)
[Adjuvant chemotherapy for localised resectable soft tissue sarcoma in adults](#)
[Adrenaline for prevention of morbidity and mortality in preterm infants with cardiovascular compromise](#)
[Adrenergic drugs for urinary incontinence in adults](#)
[Advanced trauma life support training for ambulance crews](#)
[Advanced trauma life support training for hospital staff](#)
[Advice on low-fat diets for obesity](#)
[Advice to reduce dietary salt for prevention of cardiovascular disease](#)
[Advice to stay active as a single treatment for low-back pain and sciatica](#)
[Aerobic exercise for women during pregnancy](#)
[Aerobic exercise interventions for adults living with HIV/AIDS](#)
[Aerosolized diuretics for preterm infants with \(or developing\) chronic lung disease](#)
[Air versus oxygen for resuscitation of infants at birth](#)

Lots!!

Systematic reviews in public health

A Meta-Analysis of Fear Appeals: Implications for Effective Public Health	2001	Eng	FR	
Antenatal Education for Childbirth/Parenthood	2001	Eng		
Anticipatory Care Interventions for Community-Dwelling Elderly	2000	Eng		
Bioterrorism Preparedness	2003	Eng		
Child Pedestrian Safety	2003	Eng		
Coalitions in Heart Health Promotion, Tobacco Use Reduction, and Injury Prevention	1999	Eng	FR	Review
Community-Based Heart Projects	1999	Eng	FR	Review
Community-Based Interventions to Improve Child Mental Health: Review of Reviews	2002	Eng	FR	Review
Community-Based Strategies to Promote Cervical Cancer Screening	2000	Eng		Review
Effect of Exercise Training on Bone Mass Among Pre- and Postmenopausal Women	2001	Eng		
Effective of Patient Reminder/Recall Interventions on Immunization Rates	2001	Eng	FR	
Effectiveness of Day Care Center Infection Control Interventions	1999	Eng	FR	Review
Effectiveness of Dust Mite Control to Reduce Asthma Symptoms	2001	Eng		
Effectiveness of Environmental Awareness Interventions	1999	Eng	FR	Review
Effectiveness of Folate Supplementation for the Prevention of Neural Tube Defects	2002	Eng	FR	
Effectiveness of Food Safety Interventions	2001	Eng		Review
Effectiveness of Health Promotion Interventions in the Workplace	2001	Eng	FR	
Effectiveness of Home Based Support for Older People	2001	Eng	FR	
Effectiveness of Interventions to Promote Healthy Eating in Pre-school Children Aged 1 to 5 Years	2001	Eng		
Effectiveness of On-line Health Information for Consumers	2002	Eng	FR	
Effectiveness of Parenting Groups With Professional Involvement In Improving Parent and Child Outcomes	1999	Eng	FR	Review

Quite a few!!

Systematic reviews in microbial food safety

Use of a systematic review to assist the development of *Campylobacter* control strategies in broilers

- Adkin et al., 2006

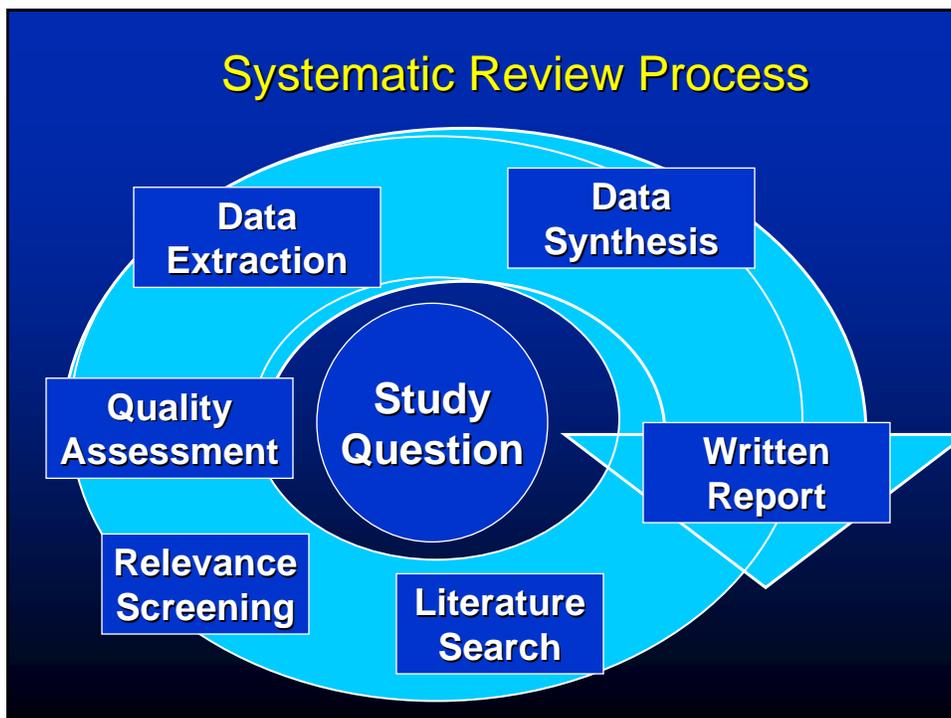
Very few!!

Systematic vs Traditional Review

- More focused study question
- Explicit and comprehensive search strategy
- Articles are selected according to uniformly applied and specified criteria
- Quality of articles is formally, rigorously and consistently assessed
- Quantitative summary if possible



Systematic Review Process



Development of a Focused Study Question

- Question clearly defined *a priori*
 - Population
 - Intervention
 - Outcome
 - Specifies the system level or sector of agriculture to be reviewed



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Development of a Focused Study Question

- Form a panel of content experts.
- The subject of interest is formulated into a specific, answerable question.



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Literature Search

- Generate a complete list of all primary research that is relevant to the question
 - Search terms based on
 - Population
 - Intervention
 - Outcome
 - Agricultural sector



Literature Search

- Published literature
 - Searched using exhaustive list of search terms in multiple electronic databases
 - Hand searching of journals
- “Gray” literature (completed but unpublished)
 - Scanning the internet
 - Electronic and hand searching conference proceedings
 - Contacting researchers, national and international experts in the field



Screening Abstracts for Relevance

- Determine if an article has potential to answer study question through a relevance screening tool
- *A priori* criteria for subject relevance and inclusion of material into the review
- Series of questions are answered based on information in abstract
- At least two reviewers independently access each article



Reviewing

Reviewing of Level 1

Ref: 2589, M. L. Rybot, R. W. Wille and R. H. Bailey, Use of Secondary Enrichment for Isolation of Salmonella from Naturally Contaminated Environmental Samples, *Poultry Science*, 84(7), 2005, p. 992-997
State: OK, Level 1

Keywords: **SP/CL/EPIC (Poultry)**

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Abstract:

Since the implementation of Hazard Analysis Critical Control Point (HACCP), the need for on-farm food safety risk assessment and management has greatly increased. In order to provide accurate risk assessments, attention should be focused on better characterization of the Salmonella isolation and identification techniques. In this work, we compared the isolation ability of 4 Salmonella-specific protocols: immunomagnetic separation (IM), tetrathionate (TT) broth, Rapaport-Porter's (RP) broth, and a secondary enrichment (SE) procedure as well as 2 selective solid media (brilliant green agar, BG, and xylose-lysine deoxycholate, XLD). All 4 methods were compared in litter and drag swab samples that were collected weekly during the broiler grow out period in 7 houses. There were 65/26 (57.6%) pooled litter samples positive and 11/504 (2.2%) drag swab samples positive for Salmonella by at least one method. Of the 65 positive litter samples, IM, RP, and TT isolated 1 (2.7%), 21 (47.7%), and 23 (35.4%) of the samples as positive when using BG agar, respectively. The IM protocol identified 83.1% (54/65) of the positive samples as positive when using BG agar. In the drag swab samples, IM did not identify any samples as positive, whereas TT and RP found 26/25 (7%) and 26/23 (7%) of the 100 samples to be positive when using BG agar, respectively. Again, the IM protocol identified the highest percentage of positive samples (58.5%). An analysis of agreement, κ^2 , revealed that IM and RP did not always agree on which samples were positive, although the number of samples identified as positive by both were not different. A comparison between the 2 agar plates used, BG and XLD, showed that they had high agreement when the secondary enrichment protocol was used, but agreement was only moderate to low when the other 3 methods were used. [ABSTRACT FROM AUTHOR]

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1. What type(s) of poultry does this reference address?

Broiler chickens
 Layer chickens
 Turkeys
 None of the above
 Can't tell

2. In which segment(s) of the poultry production continuum was the intervention strategy or management or production practice applied?

Breeding
 Hatchery
 Grow-out
 Transportation
 Processing
 Retail
 Table eggs
 Other
 Can't tell
 None

3. Which intervention strategies or management and production practices that influence Salmonella prevalence in the poultry production continuum does this reference discuss?

Antibiotic usage (live bird)
 Bacteriocins
 Biosecurity
 Chilling and post-chilling
 Competitive exclusion
 Feed
 Housing
 Insect control
 Litter
 Rodent control
 Prevalence only
 Sanitation

Mississippi State University

Quality Assessment of the Relevant Literature

- Second, stricter level of screening using full copies of articles
- Standardized procedure for each type of study design is used to evaluate each article
- All relevant literature is reviewed by at least 2 members of the panel using the standardized protocol



Quality Assessment of the Relevant Literature

- Basis of Assessment
 - Study objectives
 - Population
 - Intervention
 - Outcome assessment
 - Withdrawals
 - Data analysis
 - Conclusions



Levels of Evidence

1. Systematic reviews
2. Randomized clinical trials
3. Cohort studies
4. Challenge studies
5. Case-control studies
5. Cross-sectional studies
6. Descriptive studies, case reports, expert committees



Data Extraction

- Data from papers deemed acceptable is extracted and used to assess the overall evidence for the efficacy of the intervention(s) under evaluation.
- Development of a data repository for the qualified articles so that the data can be summarized and/or analyzed



Data Extraction

- Extracted information
 - Descriptive data
 - Study characteristics
 - Study results

FORM 5
DATA EXTRACTION FORM FOR SAMPLE REVIEW ON THE USE OF
PROBIOCS FOR REDUCING E. COLI O157 IN RUMENANTS.

Data Extraction Form	Y/N	Explanation
General Information		
Author(s)	Included in CV	
Title	Included in CV	
Journal title, volume, pages	Included in CV	
Year	Included in CV	Journal, Proceedings etc.
Year of data extraction	Included in CV	When type was set
Year of publication	Included in CV	When type was assessed
Year of data extraction	Included in CV	
Year of publication	Included in CV	
Language of publication	English	Including papers in another language, otherwise blank
Year of the study	1. Yes (date of commencement) 2. No	
Study design, check one	A. Randomised controlled trial B. Challenge study C. Case-control D. Case-reports E. Case study F. Other design study	The answer indicates the level of evidence provided by the study
Population		
Country where study subjects were treated	1. USA 2. Canada 3. Europe 4. South America 5. Other	List all that apply in alphabetical order
Place where the study was performed?	A. Single farm B. Multiple farms - experimental station or University C. Other (if farm) D. Not described	External validity
How type of sampling was used to select the farms?	A. Convenience B. Purposive C. Random sample D. Not described E. Not applicable (CC, Challenge trial)	Internal validity

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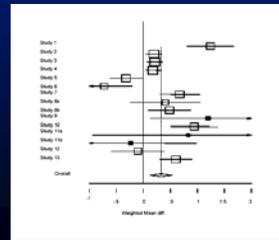
Data Synthesis

- Summarization of results from primary studies that met quality assessment
 - Qualitative methods
 - Quantitative methods when possible

Data Synthesis

- Data is presented so that similarities and differences between the studies and the level of evidence can be visualized
- Results are presented to show if intervention is consistent and effective

Study	Intervention	# Farms	# Pigs	# Animals	Unit of allocation	# Units /n	Blind	Drop	Results
Author 1 et al. 1997	1x AAU antibiotic	1	20	200	Pigs	10	Y/N	100	NS
Author 2 et al. 2004	1x BB vs antibiotic	100	400	4000	Pigs	200	Dependent	10	Pos
1x BB vs ynone antibiotic	100	400	4000	Pigs	200	Dependent	10	NS	



Article and Data Management

- Data management challenge
 - Initial large volume of abstracts
 - Movement of literature through multiple stages of evaluation
 - Use of reviewers from multiple institutions
- Web-based systematic review project management software is very useful (essential?)
 - SRS Version 3.0 Powered by TrialStat

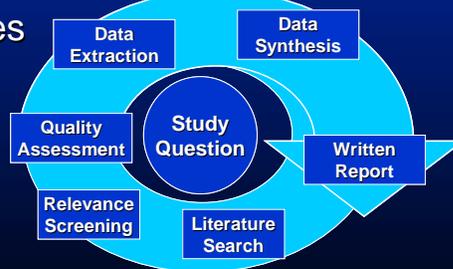
Article and Data Management

- Data from literature searches loaded into a web-based program
- Program contains the standardized protocols
 - Abstract screening
 - Quality assessment
 - Data extraction
- Individual reviewers
 - Unique login
 - System provides reviewers with a list of abstracts or articles to review



Article and Data Management

- As reviewers complete tasks, the system
 - Automatically tracks the movement of articles through the system
 - Tracks progress of individual reviews
 - Identifies discrepancies in responses between reviewers



Current initiatives: Systematic reviews

- Development of a structured format for conducting systematic reviews for microbial food safety research, develop a “how to” manual (FSRRN)
- On-farm interventions for Salmonella in pork, Iowa State (FSRRN)
- Pre- and post-harvest interventions for Salmonella in broilers, Mississippi State (FSRRN)
- On-farm interventions for E. coli O157 in cattle, McMaster University (PHAC)
- Evidence for association between Johnes and Crohn's disease, PHAC (PHAC)



Dr. Jan Sargeant
McMaster's University

Systematic Review of Intervention Strategies in Broilers

- Objective
 - Determine which intervention strategies, management practices, or production practices throughout the production continuum will reduce or eliminate *Salmonella* in broilers
- Multiple study questions
 - “Does ... [Intervention] ... reduce or eliminate *Salmonella* in broilers at ... [Stage of Production or Processing] ... ?



Systematic Review of Intervention Strategies in Broilers

- Search terms
 - Salmonella and (broiler or layer or laying or poultry or chicken) = 13,099 citations
 - Salmonella and (broiler or layer or laying) = 3,729 citations
- Databases
 - 18 electronic databases
- “Gray” Literature
 - Specific journals, conference proceedings, symposia



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- Turkeys
- None of the above
- Can't tell

2. In which segment(s) of the poultry production continuum was the intervention strategy or management or production practice applied?

- Breeding
- Hatchery
- Grow-out
- Transportation
- Processing
- Retail
- Table eggs
- Other
- Can't tell
- None



3. Which intervention strategies or management and production practices that influence Salmonella prevalence in the poultry production continuum does this reference discuss?

- Antimicrobial usage (live bird)
- Bacteriocins
- Biosecurity
- Chilling and post-chilling
- Competitive exclusion
- Feed
- Housing
- Insect control
- Litter
- Rodent control
- Prevalence only
- Sanitation
- Storage/temperature control
- Transportation
- Vaccination/immunoprophylaxis
- Water
- Other
- Can't tell
- None
- Pre-Chilling

4. Is this primary research (as opposed to a review)?

- Yes
- No
- Can't tell



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- USDA Food Safety CAP
 - Dr. Mary Torrence



