Salmonella enteritidis (SE) Surveillance Program: Applications and Lessons Learned

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Diamond V
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SE Applications and Lessons Learned

- History of SE in the US
- Response by USDA
- Response by industry
- Response by FDA
Salmonella Enteritidis Risk Reduction in Commercial Layers

The report that started the ball rolling

“The emergence of grade A eggs as a major source of Salmonella enteritidis infections. New implications for the control of salmonellosis.”

JAMA 1988; 259: 2103-2107.

M. E. St Louis; D. L. Morse; M. E. Potter; T. M. DeMelfi; J. J. Guzewich; R. V. Tauxe; P. A. Blake
Salmonella Enteritidis Risk Reduction in Commercial Layers

- SE found to be transmitted within the egg and not due to shell borne transmission
- Northeastern states first region to experience a significant increase in SE cases
Breeder sources first to be examined

National Poultry Improvement Plan (NPIP) initiated US SE Clean Program for egg-type breeders in 1989
NPIP US SE Clean Program

- Parents hatch from SE negative stock
- Parent flock manure tested once a month for life beginning the first month of life
  - 4 manure drag swabs per house
  - 2 nest/egg belt samples once in the lay house
- 300 Pullorum-Typhoid blood tests @ 4 months of age
NPIP US SE Clean Program

- 19 parent flocks have tested positive for SE since 1989
- 1 positive in 2005
- 1 positive in 2006
- 4 positive in 2007

Source: A.R. Rhorer, USAHA 2007 Proceedings
Breeder – Best Management Practices

- Biosecurity
- Feed ingredients
- Vaccination
- Hatch egg sanitation
Breeder – Best Management Practices

- Breeder flock biosecurity practices used to prevent SE
  - Rodent control
  - Traffic control
  - Bird movement equipment sanitation
  - Clean worker and visitor footwear, clothing, and headgear plus hand sanitation
Breeder – Best Management Practices

- **Breeder vaccination**
  - Used by the major breeder in the US
  - Must keep 300 non-vaccinates for testing at 4 months

- **Hatch egg sanitation**
  - Used by some operations
  - Spray at time of collection
Salmonella Enteritidis Risk Reduction in Commercial Layers

- Hatcheries
  - Hatch only eggs from breeder flocks on NPIP SE Clean Program
  - Use standard sanitation practices
SE Outbreaks by state, 1985-1999

CDC data
FIGURE 2

S. Enteritidis isolation rates per 100,000 population by region: 1970 - 2006

CDC
Salmonella
Annual
Summary
2006
Salmonella Enteritidis Risk Reduction in Commercial Layers

1992 - US Secretary of Agriculture declared SE and emergency

1992-93 – SE Pilot Project Begun

1994 – The Pennsylvania Egg Quality Assurance Program (PEQAP) initiated
Salmonella Enteritidis Risk Reduction in Commercial Layers

- Three critical control points correlated with SE positive layers found by the SE Pilot Project
  1. Positive pullets
  2. Rodent population
  3. C&D of house between flocks
Salmonella Enteritidis Risk Reduction in Commercial Layers

- Developed by Pennsylvania scientists
- Published in 1997
- Covers all aspects of SE control
- Available on PSU website - http://pubs.cas.psu.edu/FreePubs/pdfs/AGRS72.pdf
Egg Quality Assurance Programs (EQAPs)

- Best Management Practices
- Education/Training
- Record keeping
- Verification
Egg Quality Assurance Programs

- Pennsylvania
- Maryland
- California
- New York
- South Carolina
- Ohio
- New England
- United Egg Producers
- Company programs
Egg Quality Assurance Programs

- All EQAPs have Best Management Practices
  - Chicks from NPIP SE Clean breeders
  - Biosecurity
  - C&D of houses between flocks
  - Rodent control
  - Egg sanitation
  - Egg holding conditions
Egg Quality Assurance Programs

- Rodent control found to be highly correlated to SE infection in layers
- Rodent index formulated in PA
- Twelve live traps (Tin-Cats) placed in layer house
- Mice counted after 7 days
# Egg Quality Assurance Programs

<table>
<thead>
<tr>
<th>Rodent Index</th>
<th>No. of mice caught</th>
<th>Description</th>
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<tbody>
<tr>
<td>0 to 10</td>
<td>1</td>
<td>Low</td>
</tr>
<tr>
<td>11 - 25</td>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>26+</td>
<td>3</td>
<td>High</td>
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</tbody>
</table>

An index of 1 or less is acceptable
Egg Quality Assurance Programs

- Training/education
  - Meetings
  - Written materials
  - 3rd party audit visits (Pennsylvania Dept of Ag)

- Record keeping
  - Rodent control log
  - Vaccinations
  - C&D
  - Testing
Sampling Chick Box Papers
<table>
<thead>
<tr>
<th>Verification Tests</th>
<th>Required by Programs</th>
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<tbody>
<tr>
<td>Chick box paper testing</td>
<td>PA, MD, NY</td>
</tr>
<tr>
<td>Pullet manure testing, 12w</td>
<td>PA, MD, NY</td>
</tr>
<tr>
<td>Young layer manure testing (30 weeks)</td>
<td>PA, MD</td>
</tr>
<tr>
<td>Mid-lay manure testing (45 weeks)</td>
<td>PA, MD</td>
</tr>
<tr>
<td>Post-molt manure testing</td>
<td>PA, MD, NY</td>
</tr>
<tr>
<td>Pre-moveout testing (within 8 weeks of moveout)</td>
<td>NY, OH, SC, UEP</td>
</tr>
</tbody>
</table>
Manure Drag Swab Sampling – High-rise House
Swabbing A Cage-free House
Egg testing of manure positive flocks

- **Initial test**
  - 1000 eggs
  - Pools of 20 eggs
  - 2 week interval
  - 4 tests

- **Continued testing**
  - 1000 egg sample, once a quarter
Egg Quality Assurance Programs

- Diversion of eggs to pasteurization or hard-cooking
  - Required if any egg pool is positive
  - PA, MD, NY
Chance of an Egg Positive Flock

**In PEQAP**

- On average for the last 5 years, approximately 33% of manure positive flocks have tested egg positive.
Vaccines

- Not required by any EQAP
- Used by producers to aid in remaining SE negative, egg test negative
- Only one egg positive flock in PEQAP where SE bacterin has been used
Vaccines

- Vaccination
  - SE bacterin
    - Usually 1x at 13 to 15 weeks
  - Live ST vaccines
    - 3 applications – 2, 6, and 12 weeks
  - Bacterin + live vaccine
    - Live vaccine - 2 and 6 weeks
    - Bacterin – 13 to 15 weeks
# SE Reduction by EQAPs

## PEQAP Success

<table>
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<tr>
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<tbody>
<tr>
<td>+ Manure Samples (LY-1, LY-2, and LY-3)</td>
<td>23%</td>
<td>1.5%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Manure Positive Flocks</td>
<td>38%</td>
<td>4.4%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Egg Positive Flocks</td>
<td>1.9%</td>
<td>2.4%</td>
<td></td>
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# SE Prevalence Ohio

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Houses Tested</th>
<th>No. SE Positive Houses</th>
<th>Percent Positive</th>
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<tbody>
<tr>
<td>2009</td>
<td>386</td>
<td>22</td>
<td>5.6</td>
</tr>
<tr>
<td>2010</td>
<td>435</td>
<td>21</td>
<td>4.8</td>
</tr>
<tr>
<td>2011</td>
<td>473</td>
<td>10</td>
<td>2.1</td>
</tr>
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</table>
From CDC report, 2004
SE Illnesses per 100,000 persons

Egg Safety Center SE Update 2009
Salmonella Human Prevalence – EU vs. US

Dr. Jean Guard, USDA-ARS: US – Foodnet data; EU – EFSA data
Dr. Jean Guard, USDA-ARS: US – Foodnet data; EU – EFSA data
1998-2002 CDC Outbreak Data for *Salmonella* Enteritidis (as Percent of total cases)
Broiler Meat and SE

2004 FoodNet case-control study

“"A new risk factor for *Salmonella enteritidis* incidence is eating chicken prepared outside the home”.”
Number of SE + Broiler Carcass Rinses By Establishment

Emerging Infectious Diseases, www.cdc.gov/eid, Dec08
FDA Egg Safety Rule

- First proposed in 2004
- Shelved in 2008 with new administration
- Re-submitted in 2009
- Announced Final Rule on July 7, 2009

Implementation

- July 2010 for farms over 50,000 layers
- July 2012 for farm between 3000 and 50,000 layers
- Farms under 3000 layers exempt
FDA Egg Safety Rule

- Contains components of the successful EQAPs
  - Monitoring and control program for rodents and flies
  - Written SE on-farm program
  - Training of on-farm person in charge of program
  - Cleaning and disinfection of houses between flocks
  - Chicks from NPIP SE Clean breeders
  - Manure testing of pullets – 14 to 16 weeks of age
  - Manure testing of layers
  - Refrigeration at 45F within 36 hours of collecting
FDA Egg Safety Rule

- **Manure testing of layers**
  - 40 to 45 weeks of age
  - 4 to 6 weeks post-molt

- **Egg testing if manure is SE +**
  - 1000 eggs at 2-week intervals, 4 tests
  - If all negative, no further testing and remains on shell market
  - If positive, must divert to pasteurization or hard-cooking
FDA Egg Safety Rule

- Challenges for a national program
  - Diversion of eggs very difficult in many parts of the US. Producers may have to destroy flocks without compensation.
  - Laboratory testing capabilities are lacking in many states
  - Laboratories will need to purchase equipment not now required
  - More laboratory people will be needed for egg testing
FDA Egg Safety Rule

- **Challenges (continued)**
  - FDA and molecular lab methods may be much more sensitive than present leading to more egg testing and diverted flocks
  - FDA methods more time consuming and may lead to delays in diversion
  - Many states not willing to subsidize costs of program
    - Testing
    - Auditing
  - Private laboratories are much more expensive
FDA Egg Safety Rule

- Challenges (continued)
  - Farm packed eggs now refrigerate at 55F
  - Will need to add cooler capacity
  - May lead to more thermal checks