EPIDEMIOLOGY OF RECENT HPAI/LPAI OUTBREAKS

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Approximate Number of Birds Affected in the Southeastern United States, by State and Production Type
Epidemiologic Investigations

HOW DID THE VIRUS GET ONTO THESE FARMS?
Two Epidemiologic Studies

CASE SERIES
All H7N9 infected premises eligible

EXPERT ELICITATION
Group of poultry experts actively involved in the outbreak (cases and controls)
Descriptive Case Series: Protective Factors
• No outside access
• Clean/dirty line
• Stay off farm after exposure
• No poultry ownership
• No waterfowl
• No other poultry
• Municipal water
Descriptive Case Series:
Risk Factors:
• Company service person visit
• Shared vehicles with other farms
• Water body (<350 yds)
• Shared equipment (egg racks/pallets)
• Composting as dead bird disposal
Expert Elicitation Case-Control: Risk Factors:

- Habitat disruption (wildlife congregation) (LR>3)
- Multi-age class (LR>3)
- Enclosure condition (defects) (LR>3)
- Poultry farming density (dense or moderate) (LR=2)
- Indicators of mesopredators (raccoons, possums, skunks) (LR=4)
- Heavy rodent population (LR>2)
Phylogenetics: AM H7N9

- Multiple point source introductions with LPAI>HPAI mutation in a single flock with secondary spread to one site.
- Data from a highly similar wild bird virus collected in WY 9/2016 (8/8 genes) allows estimate for timing and frequency of introductions, and is supported by epidemiologic data.

Timeline of virus detections in wild birds

Month of Date Collected

Timeline of H7 viruses recovered from wild bird surveillance

Timeline of influenza A detections by IAV-M PCR from wild bird surveillance

|-----------|-----------|-------------|----------------|--------------|---------------|---------------|--------------|--------------|------------|------------|----------|-----------|----------|-------------|-----------------|----------------|--------------|---------------|-------------|---------------|----------|
Risk in context
Historical Precedent

2009 H7N9 in two operations in TN*
  ◦ Same counties in TN
  ◦ Same time of year
Moved up North
  KY, IL and MN (turkeys)

*H7N9 virus differed between 2009 and 2017
Epidemiologic Patterns: Southeast 2017
Epidemiologic Patterns: Upper Midwest 2015
Epidemiologic Patterns: Indiana 2016
## Risk Factors

<table>
<thead>
<tr>
<th>2014/15 MN (case control -- turkeys)</th>
<th>2014/15 IA (case-control layers)</th>
<th>2016 (case-control)</th>
<th>2017 (case series and expert elicitation)</th>
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</thead>
<tbody>
<tr>
<td><strong>Risk</strong></td>
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<td>▪ Close proximity of farms</td>
<td>▪ Farm in control zone</td>
<td>▪ Older birds</td>
<td>▪ Dead bird disposal near barn</td>
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<td>▪ Tilled fields</td>
<td>▪ Rendering and garbage trucks coming near barn</td>
<td>▪ Wild mammals</td>
<td>▪ Company service person visit</td>
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<tr>
<td>▪ Rendering as a disposal method</td>
<td>▪ Dead bird disposal near barn</td>
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<td>▪ Shared vehicles and equipment between farms</td>
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<td>▪ Non-asphalt roads</td>
<td>▪ Company service person visit</td>
<td>▪ Visitors (vet., service person, catch crew)</td>
<td>▪ Mesopredators</td>
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<td></td>
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<td>▪ Barn enclosure defects</td>
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<td>▪ Operation density</td>
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Summary

Every study of an outbreak contributes to our knowledge. Continue to learn as more information becomes available on:

- Different strains
- Different susceptible populations
- Risk and protective factors in context

Context of the outbreak is going to always be important (host, environment, and pathogen)
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