Now what? Surveillance options to monitor low pathogenicity avian influenza (LPAI) disease progression in a poultry flock and implications for monitoring diseases where animals can recover

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Introduction

- Flocks participating in the National Poultry Improvement Plan are regularly screened for H5/H7 LPAI
- Surveillance protocols are at the discretion of the states, but conform to standards in CFR § 145.15
- The official determination of a flock as positive for the H5 or H7 subtypes of avian influenza made only by NVSL.
Introduction

• Options for marketing or disposal of LPAI infected flocks are important to provide flexibility to risk managers

• Off-site disposal or marketing may be advantageous in specific situations
  – e.g., controlled slaughter, rendering, off-site burial, landfill
  – Reduced disposal cost, recovery of valuable protein

• Off-site disposal may represent a risk for disease transmission from the farm or during transport
Objectives

• Evaluate the value of diagnostic tests to monitor the stage of LPAI infection in broiler-breeders and predict:
  – Remaining duration of virus shedding in the flock
  – Prevalence of infectious and seropositive birds

• Discuss the application of the results to inform decisions pertaining to disposal or marketing of LPAI infected flocks

• Consider potential applicability in other animal species-disease pairings where animals are likely to recover
Surveillance Protocol Options for Monitoring an LPAI Infected Flock after Initial Detection

• Serological tests alone
  – 30 samples per-house are tested by AGID

• Serological tests in combination with rRT-PCR tests\(^1\)
  – 30 samples per-house are tested by AGID
  – 3 pooled samples of 11 oropharyngeal swabs per-house are tested with rRT-PCR
    • Available dead birds swabbed first, followed by live birds as necessary to get 33 swabs
      – Assumed that test day could be 1-65 days post flock exposure

\(^1\) Personal communication, Mia Torchetti, Carol Cardona, Dave Halvorson
Prevalence of Infectious and Seropositive Birds Over Time: Within-Flock Disease Spread Model
Useful model outputs- where are we in the spread of virus throughout the flock?

• Provides a snapshot of disease progression:
  – What proportion of AGID tests are positive at a given time?
  – What proportion of PCR pools are positive at a given time?

• Assess the stage of LPAI disease progression and predict:
  – Remaining duration of virus shedding in the flock (house)
  – Prevalence of infectious and seropositive birds
Probability of Observing a Specific Number of Positive AGID Test Results Over Time in the Fast Spread Scenario

Observing 1 (+) of 15 is more likely within a few days post-exposure

Observing 14 (+) of 15 is more likely on later days post-exposure
What proportion of birds are currently shedding?

- Would you want to bring a depop crew in now?

- How about move birds down the road?

- 3 pooled samples of 11 oropharyngeal swabs per-house are tested with rRT-PCR
Prevalence of Infectious Birds in the Flock Given AGID Test Results and rRT-PCR Test Results (Baseline Contact Rate)
When will the flock stop shedding?

- Depends on contact rate—faster spread means entire flock will be infected sooner and seroconvert sooner relative to a slower contact rate.

- Monitoring both seroconversion and PCR can tighten the predicted interval when you can say shedding will no longer be significant risk.
Number of Days to Stop Shedding (After Test Day) Given AGID Test Results and rRT-PCR Test Results (Baseline Contact Rate)
Results Summary

• Diagnostic testing is valuable to establish the stage of disease progression in LPAI infected flocks

• A high proportion of positive serological tests (AGID) indicates
  – A shorter remaining duration of shedding
  – Fewer actively shedding birds at the time of testing
  – A higher proportion of recovered birds

• A combination of rRT-PCR and serological (AGID) testing can reduce the uncertainty in the estimated remaining duration of virus shedding
Future Work (1): Economic Considerations for Off-site Disposal Options

- Composting broiler breeder flocks can be difficult depending on house design and potentially increases downtime for premises
- Cost and availability of carbon sources are not consistent
- Off-site disposal or marketing options may be advantageous in specific situations to reduce disposal costs
  - The value of rendered or marketed birds may partially offset transportation costs
  - Alternative marketing channels can potentially utilize protein
Future Work (2): Other animal-pathogen combinations

- Foot and Mouth Disease in ruminants, swine
- Virulent Newcastle Disease in vaccinated poultry
- PRRSV in swine
- Senecavirus A in swine
- Influenza A Virus of Swine

- Additional surveillance tools, such as lesion aging or presence of clinical signs
Example: Value of Combining AGID results with Number of PCR (+) Pooled Samples (Baseline Contact Rate)
Conclusion

- A combination of antigen and antibody tests can be useful to establish the stage of LPAI infection and inform disposal or marketing options along with other risk management considerations.

- LPAI in poultry is a potential model for developing disease progression models in other species-pathogen combinations where animals can recover.
Thank You

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