Moving Manure Off a Monitored Premises in Control Area During a Highly Pathogenic Avian Influenza Outbreak

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Background

- Majority of the manure from egg-layer operations is land applied to fields as fertilizer
- In a HPAI outbreak, known infected premises would be depopulated
- Manure movement from uninfected premises in a Control Area is critical for business continuity
  - Limited storage capacity in some operations

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Background

- Movement and land application of manure is a known risk factor for HPAI
- We evaluated active surveillance and sequestration as mitigations for movement of manure off egg layer farms with manure belt systems
- Sequestered manure refers to removal from the house to a secure storage site without addition of or contact with fresh manure

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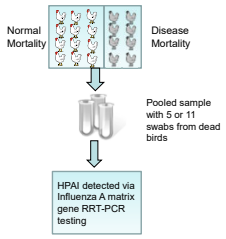
Targeted Active Surveillance for HPAI

- Targeted active surveillance involves prioritizing dead and sick chickens for testing
  - Significantly improves detection relative to random sampling
  - Test all barns that contributed to the sequestration storage pile
- Protocols evaluated were based on daily dead bird testing at the barn level
  - 5 or 11 swab pooled sample for every 50 dead birds in a barn



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Manure Handling in Caged Layer Houses with Belts

- Manure drops onto a conveyor belt and is moved to the end of the house every 1-3 days
- Manure is then moved out of the building and may be
  - Land applied
  - Moved to onsite or off-farm storage
  - Heat treated or composted

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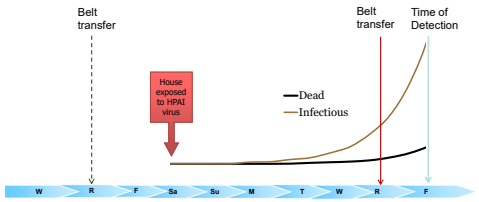
Example Timeline: Manure Movement from Belt Cage Houses with a Sequestration Period

With a 7-day sequestration, only manure removed a week prior (with reduced chances of HPAI contamination) could be moved before detection

With no sequestration manure removed on Thursday before detection (with a higher contamination risk) could be inadvertently moved to a field



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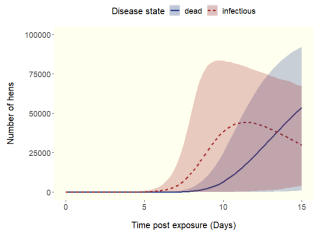
Methods: Disease Transmission Simulation Model

- Disease transmission model simulates HPAI spread within a layer barn
- Predicts susceptible, latent, infectious and dead birds over time
- Individual based model that enables flexible disease state duration inputs



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Adequate Contact Rate Scenarios

- Adequate contact rate is a key model parameter that impacts the rate of within flock disease transmission
- During the 2015 HPAI outbreak, some pullet flocks had mortality patterns that indicated slow spread. Available data from the 2022 outbreak did not indicate slow spread in layers
- We evaluated two scenarios for this parameter
  - Uniformly distributed: (1,5) birds per day under typical spread scenario
  - Uniformly distributed: (0.27,0.53) birds per day under slow-spread scenario

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Predicting the Likelihood of Moving Contaminated Manure Off a Premises

- The amount of HPAI virus in an 8000 kg manure load before detection was predicted given the:
  - Time to detection and sequestration holding time
  - HPAI virus concentration in feces from infectious hens (10^7 EID_{50} per-gram)
  - Number of infectious birds from transmission model
- Assumed daily removal of manure via belts
- Evaluated 0-, 3-, 5-, 7- and 10-day sequestration


Regular Article—

Surveillance and Sequestration Strategies to Reduce the Likelihood of Transporting Highly Pathogenic Avian Influenza Virus Contaminated Layer Manure

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Results: Likelihood of Moving HPAI Contaminated Manure Off the Premises Before Detection

Adequate contact rate scenario	Pool size for Daily RRT-PCR testing	Percentage of model runs where HPAI virus contaminated manure was moved off the premises				
		Sequestration period (days)				
		0	3	5	7	10
Typical	5	99	65	18	4	<1
	11	99	48	8	1	<1
Slow	5	99	88	69	50	28
	11	99	78	49	27	11

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Results: Mean HPAI Virus Concentration in Manure Loads Moved Off the Premises Before Detection

Adequate contact rate scenario	Pool size for Daily RRT-PCR testing	Mean H5N2 HPAI virus concentration (log_{10} EID_{50} per-gram) in an 8 metric ton load (8000 kg) of manure moved				
		Sequestration period (days)				
		0	3	5	7	10
Typical	5	3.7	2.5	2.2	2.2	2.1
	11	3.4	2.3	2.1	2	1.4
Slow	5	3.2	2.9	2.8	2.7	2.6
	11	3	2.7	2.6	2.5	2.4

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Results Summary

- Longer sequestration periods (3-10 days) reduced the likelihood of moving contaminated manure loads and the quantity of feces from HPAI infected birds
- Active surveillance protocols with 11-swab pooled samples had a lower likelihood of moving HPAI contaminated manure relative to using 5-swabs per pool
- Likelihood of moving contaminated manure was higher under slow spread scenarios compared with the typical contact rate scenarios modeled

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Conclusion

- Sequestered storage in conjunction with active surveillance can significantly reduce the likelihood and quantity of HPAI contaminated manure from infectious hens that is moved before detection
- The study results were used to inform Secure Poultry Supply plan permit guidance together with other applicable biosecurity measures
- This work has raised the possibility for assessing risk using similar testing and time mitigations for movement of other poultry products off of positive premises

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Management of Eggs in a Storage Cooler on an HPAI infected premises

- Currently eggs in storage on a HPAI infected premises are composted or disposed in a landfill as part of the depopulation process.
- The likelihood of contamination of stored eggs may depend on the source and timing of collection.
  - Eggs from uninfected premises
  - Eggs from test-negative barns on the infected premises
  - Eggs laid by infected flocks several days before detection
  - Eggs laid by infected flocks close to detection (these are disposed)

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Future work: Risk Assessment for Movement of Eggs in Storage on a Positive premises

- We seek input regarding potential risk assessment for moving eggs (from test negative barns) segregated and stored on an HPAI infected premises with appropriate mitigations.
- The assessment would help evaluate the role of active surveillance and minimum storage time as potential mitigations
- Evaluate the risk for movement of eggs on a positive premise for further processing (i.e. liquid egg) and other market channels

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Parameter estimates for the HPAI transmission model and active surveillance simulation scenarios

Parameter name	Parameter description	Distribution/Value
Latent period distribution	Length of the latent period	Gamma distributed: mean 0.71 days; standard deviation 0.48 days; shape 2.21; scale 0.32
Infectious period distribution	Length of the infectious period	Weibull distributed: mean 3.76 days; standard deviation 1.99 days; shape 1.97; scale 4.24
Manure production rate	Amount of manure per-hen per-day	80 grams per-hen per-day
House size	Number of layer hens per-house	100,000 birds
rRT-PCR test sensitivity	Probability of detection given that at least one swab from an infectious bird is included in the pool	Beta distributed: 0.865

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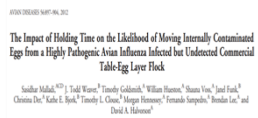
Application of Active Surveillance and Holding Time for Other Poultry Product Movements From a Control Area

- Similar to manure sequestration holding time also reduces the number of contaminated eggs moved before detection
- A 2-day hold is required for several movements in the SES plan
  - Washed and sanitized shell eggs
  - Nest run eggs
  - Broiler, turkey and layer hatching eggs


AVIAN DISEASES 56:897–904, 2012

The Impact of Holding Time on the Likelihood of Moving Internally Contaminated Eggs from a Highly Pathogenic Avian Influenza Infected but Undetected Commercial Table-Egg Layer Flock

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