Modeling and Quantitative Risk Analyses to Support Business Continuity

Sasidhar Malladi[1], Peter Bonney[1], J. Todd Weaver[2], Amos Ssematimba[1], Carol J. Cardona[1]

[1]University of Minnesota, College of Veterinary Medicine

[2]U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services

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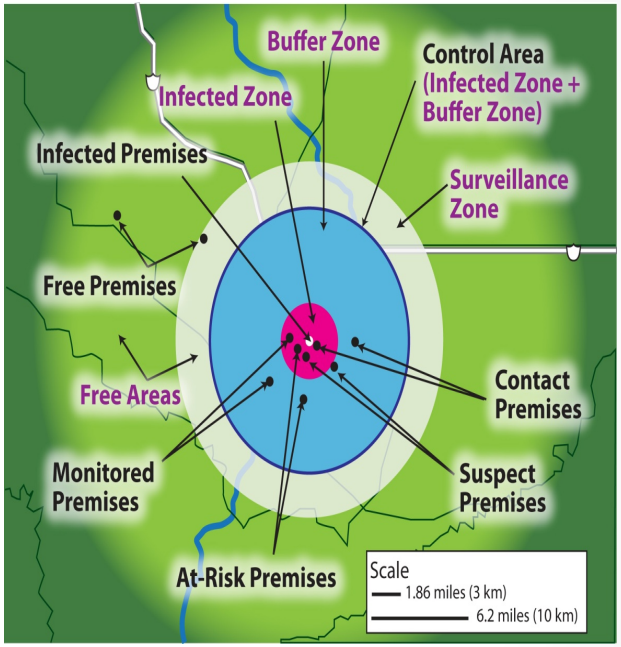
UMN Secure Food System Team
Food system solutions through risked based science

Quantitative Risk Analyses and Modeling to Support Business Continuity Planning

- Quantitative approaches support
  - Choice of mitigation measures
  - Risk evaluation
  - Proactive risk assessments
  - Movement permitting decisions
- Quantitative results are provided to
  - Secure Food Supply workgroups
  - Federal, State and Industry stakeholders



Quantitative Approaches in Proactive Risk Assessment

- Risk of moving infected, undetected products or animals from Monitored Premises
  - Likelihood of event given active and passive surveillance
  - Prevalence of infection and degree of contamination
  - Movement biosecurity
- Some examples from Secure Food Supply Plans
  - FMDv concentration in milk
  - Impact of holding time on the movement of shell-eggs
  - Mortality triggers for HPAI detection
  - Live bird movement protocols

Modeling Activities During the 2015 HPAI Outbreak

- Supported HPAI outbreak investigations
  - Role of aerosol transmission and proximity
  - Inactivation of HPAI virus in feed ingredients
- Questions on pre-movement active surveillance
  - Number of swabs per pooled sample?
  - Timing of sample collection relative to movement?
  - Protocols for live bird transfer movements?
- Supported HPAI outbreak response
  - Optimized HPAI disease mortality triggers
  - Predicted the time to detect HPAI

Modeling Activities During the Outbreak: 3 Examples

1. NASAHO permit group request to evaluate active surveillance protocol options for permitted movements
2. Evaluating the Pre-movement Isolation Period (PMIP) duration based on new HPAI virus strain characteristics
3. Active surveillance protocols for moving pullets to egg-layer operations

Example 1: NASHAO Active Surveillance Evaluation

- National Assembly Permitting Workgroup requested information on active surveillance options considering the EA/AM HPAI strain characteristics
- Evaluation was requested for comparing RRT-PCR dead bird testing options for moving live birds:
  - 2 pooled samples of 5 swabs each
  - 1 pooled sample of 11 swabs each
  - 2 pooled samples of 11 swabs each
- Evaluation was also requested on the timing of collecting pooled samples relative to movement

Example 1: Determining HPAI Model Parameters for EA/AM HPAI H5N2 in Turkeys

Time to Death (Days) Mean (95% P.I.)

A/NorthernPintail/WA/2014 H5N2[A]

Mean 4.90 (3.59 to 6.37)

A/chicken/IA/2015 H5N2[B]

Mean 5.18 (2.23 to 9.11)

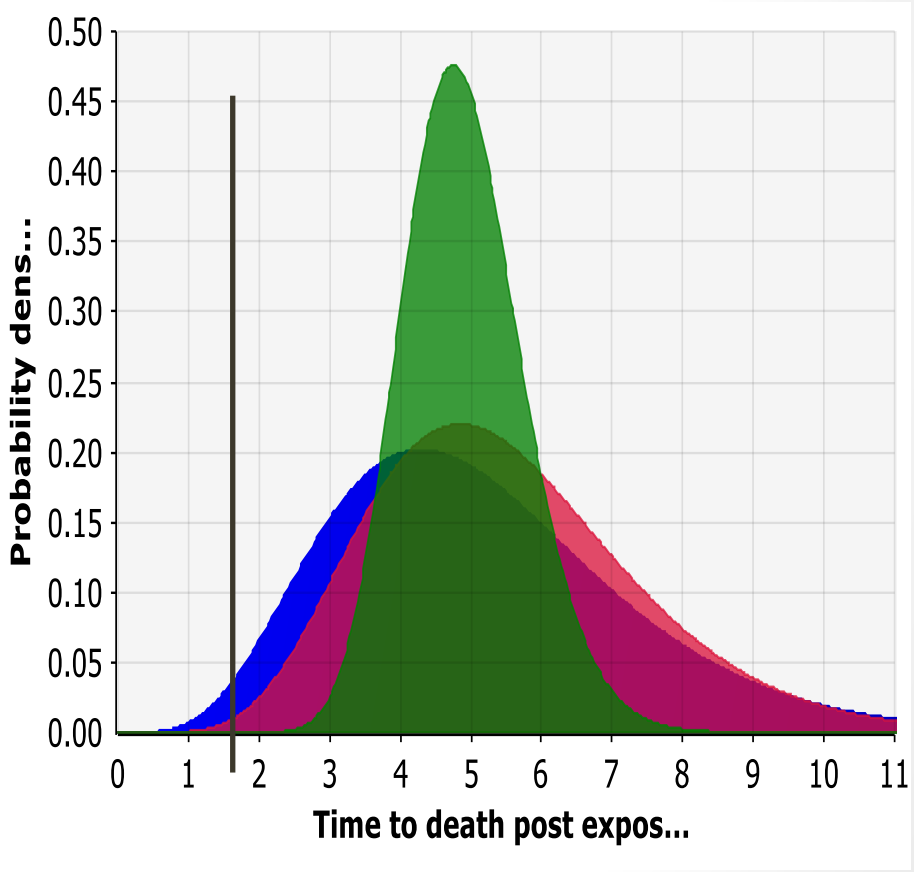
A/turkey/MN/2015 H5N2[C]

Mean 5.51 (2.79 to 8.99)

A/ostrich/Italy/2000 H7N1[D]

Mean 1.88 (0.75 to 3.25)

(Only the mean is shown)

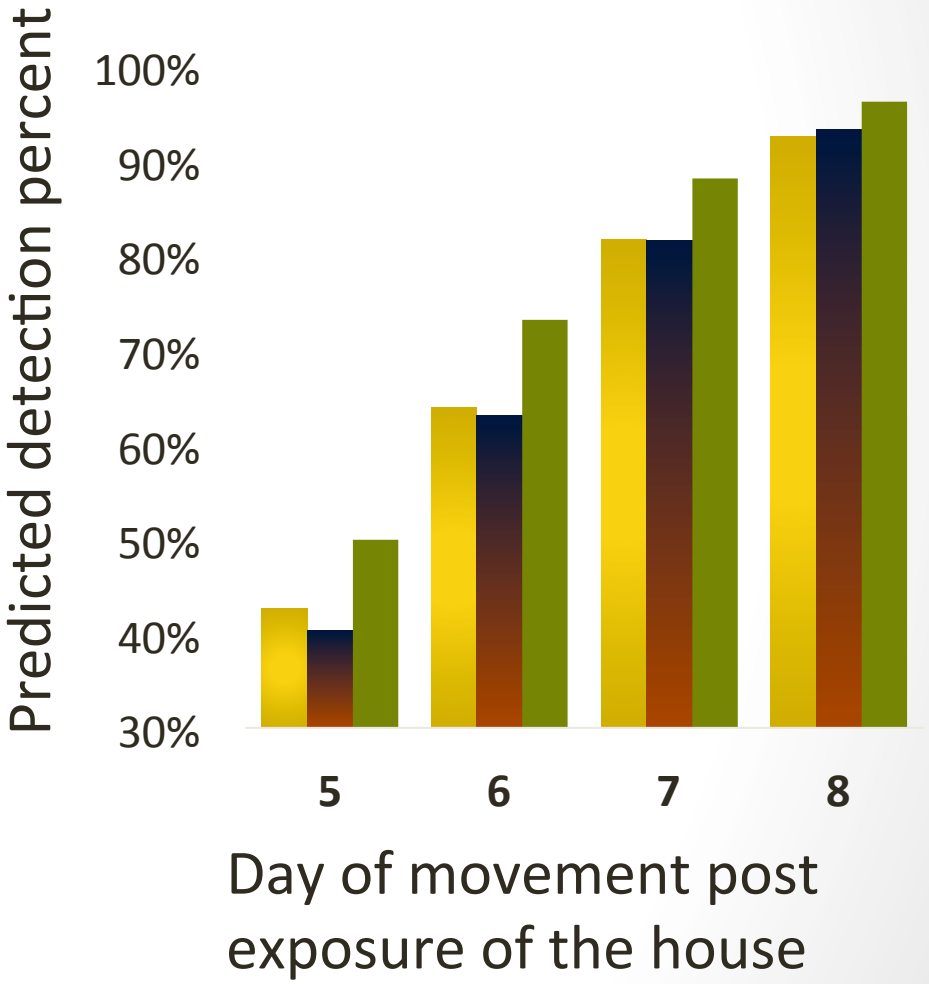


[A ,B, C] **Spackman et. al, ARS SEPRL**

[D] **Saenz et.al., (2001)**

Example 1: Impact of the Number of Pooled Samples and the Number of Swabs per Pooled Sample

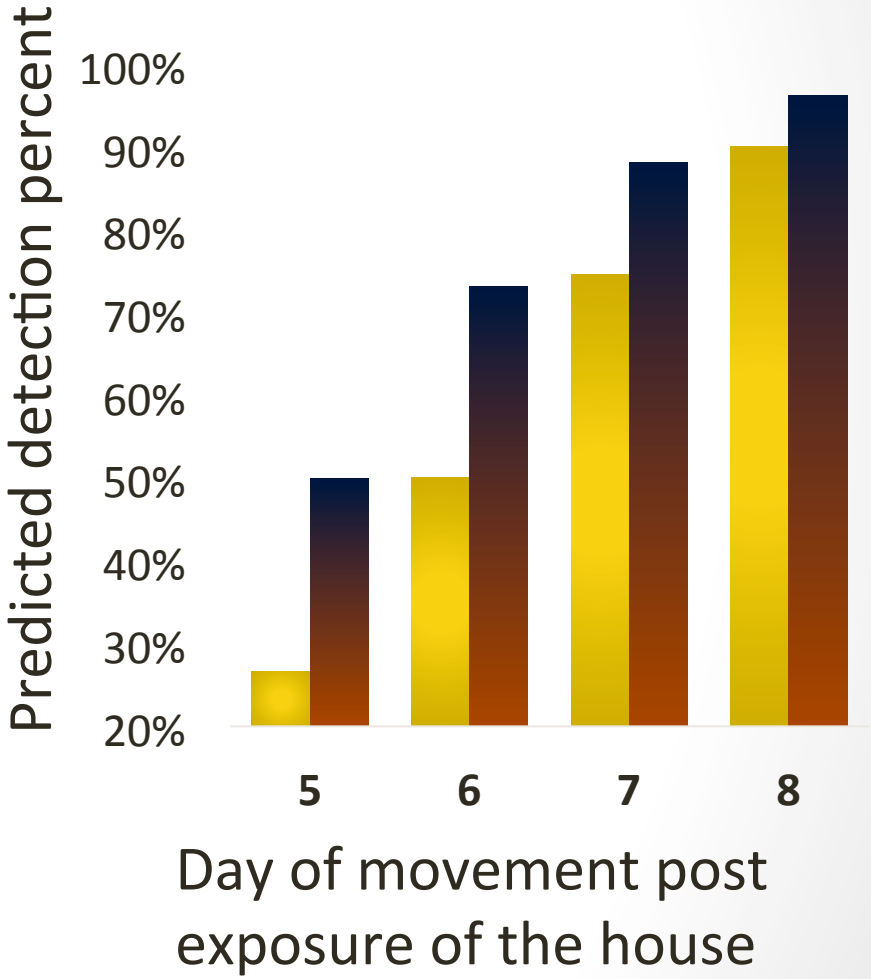
Number of pooled samples per 50 dead birds on each test day prior to movement		
Swabs per pooled sample	Day(1) 42 hrs prior	Day (2) 18 hrs Prior
11	0	1
5	1	1
11	1	1



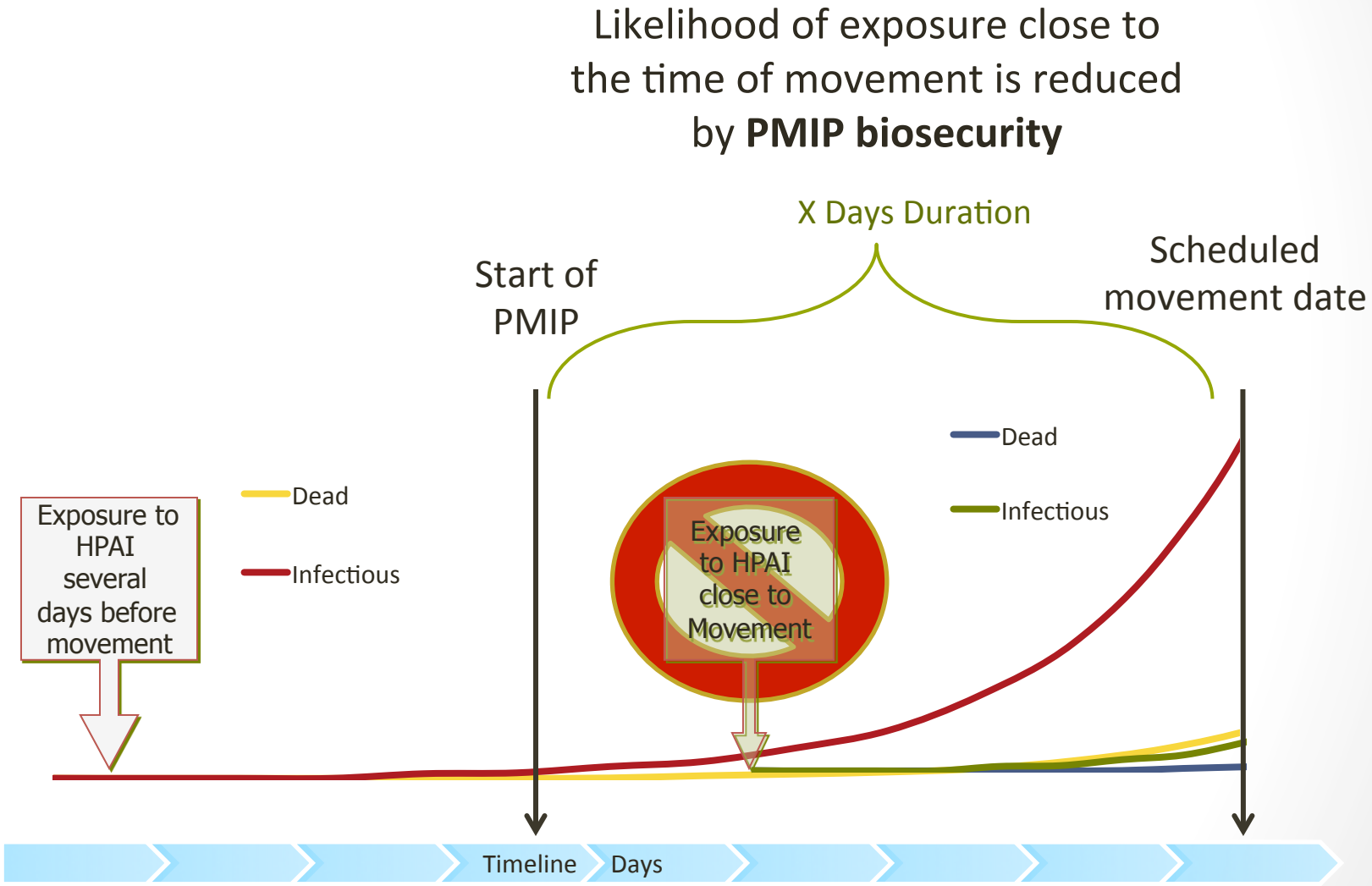
Example 1: Timing of Sample Collection Relative to Movement

Results highlight the importance of testing close to the time of movement

Number of 11 pooled samples per 50 dead birds at various time points prior to movement		
66 hrs prior	42 hrs prior	18 hrs Prior
0	**1**	**1**
1	**1**	**0**



Example 2: Impact of Pre-movement Isolation Period (PMIP) Duration



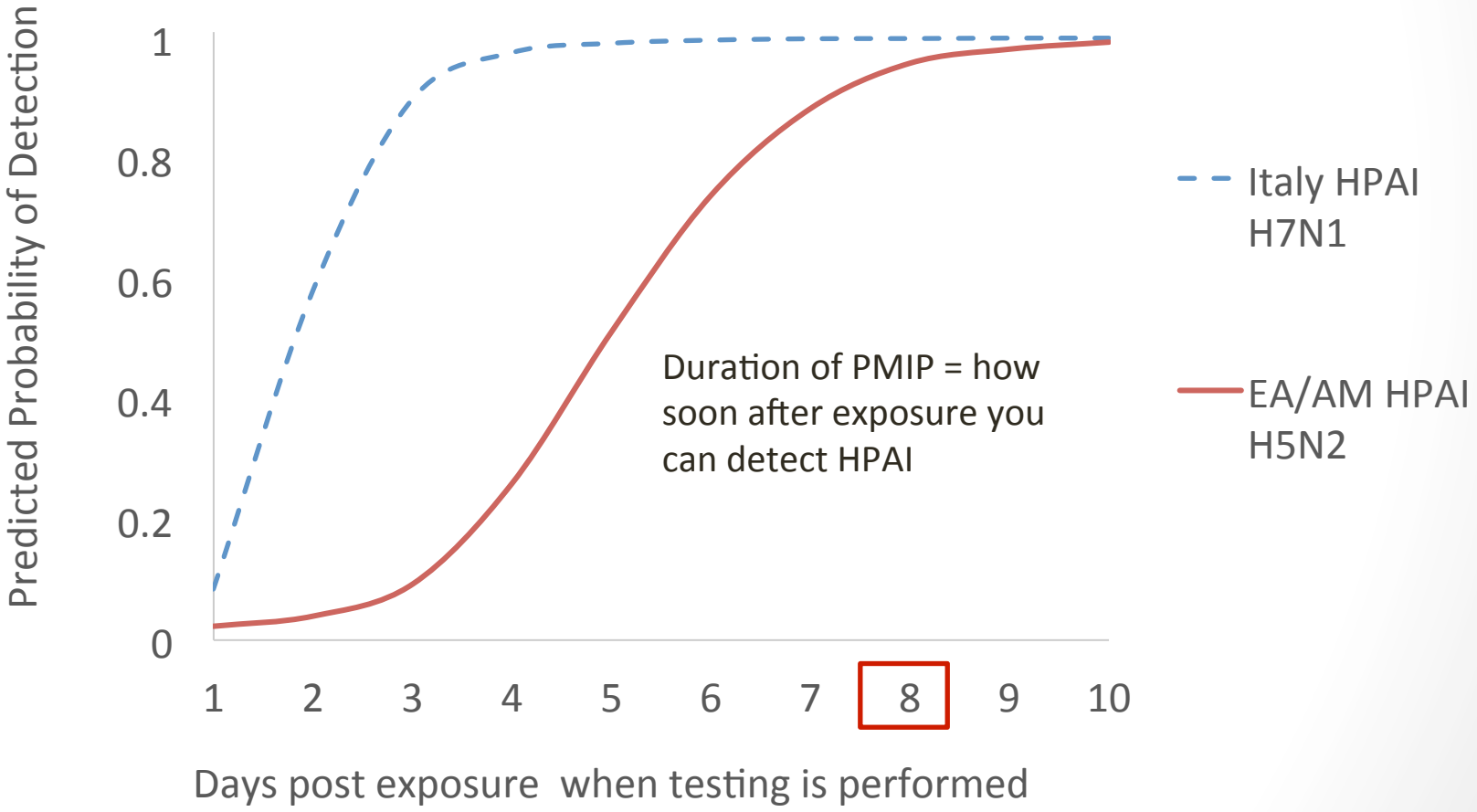
Example 2: Stringent Biosecurity Protocols Critical to Movements During PMIP

Broilers to Market:

- No live or dead poultry will be moved onto or off the premises
- Only critical operational visits to the premises will continue
- Manure, litter, and garbage will not be removed from the premises
- Enhanced biosecurity for people and vehicles; no off-site equipment will be pre-staged

Example 2: Evaluating PMIP Duration Moving Turkeys to Market

Testing of one 11 swab pooled sample from dead birds on 2 consecutive days prior to movement

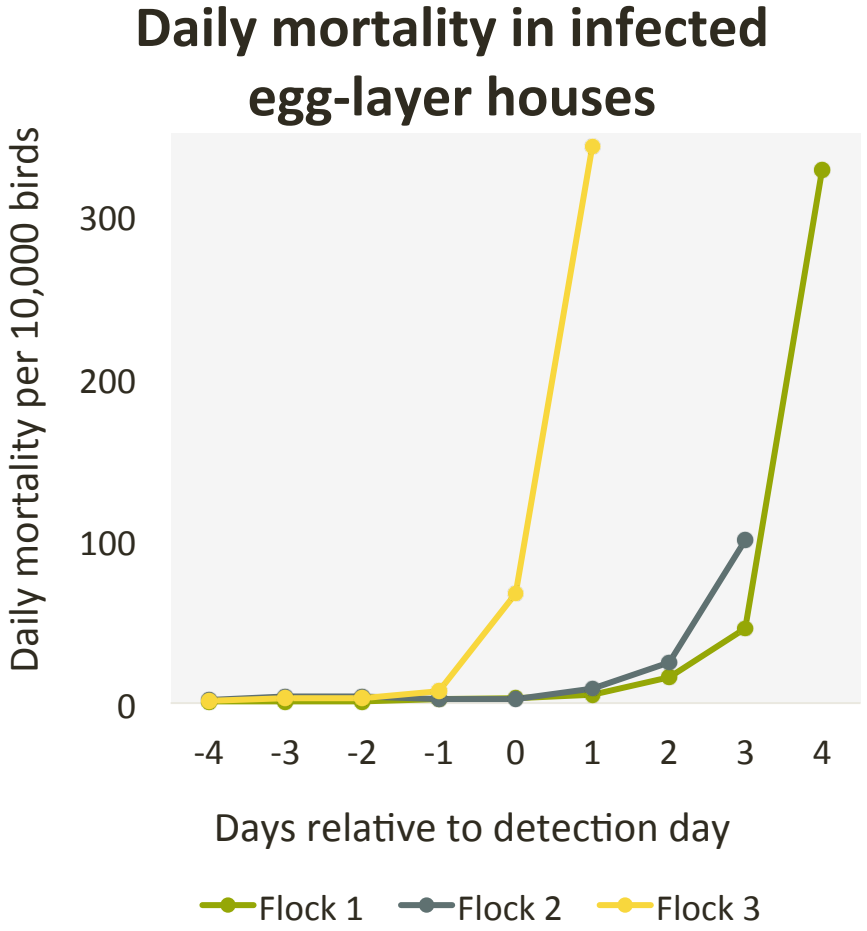


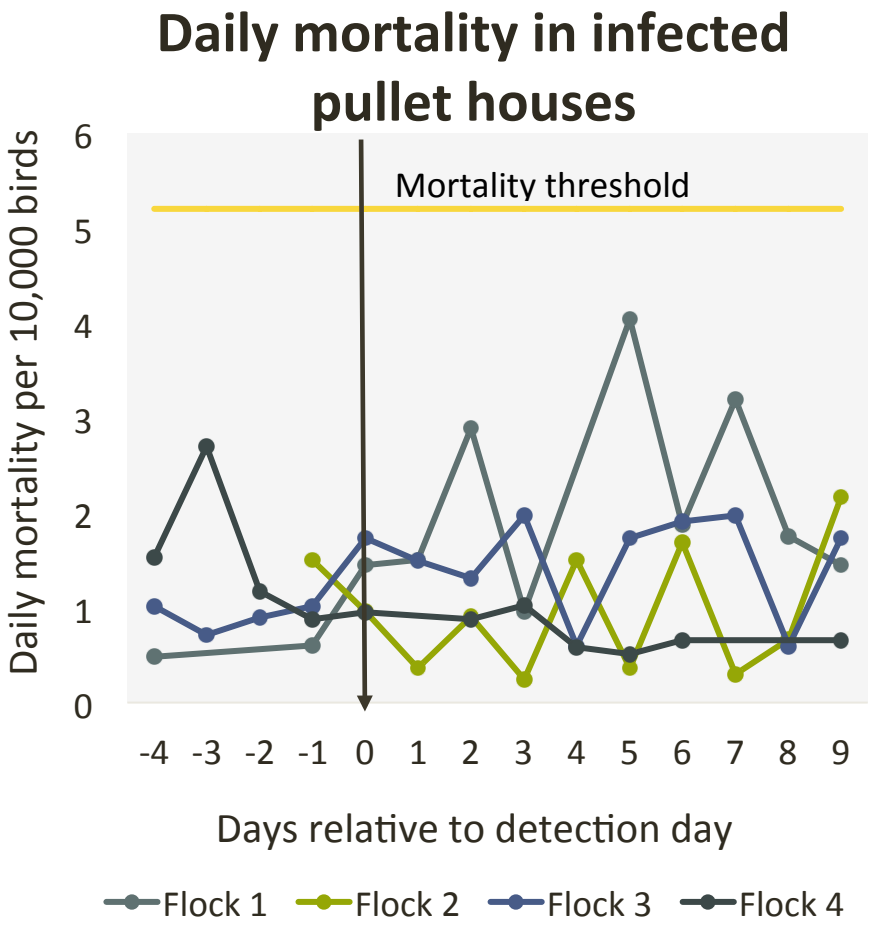
Example 3: Live Bird Movement from Pullet to Egg-layer Operations During an HPAI Outbreak

- High consequence movement
  - Risk of HPAI spread to large egg-layer operations
  - Moving even a single infected and undetected bird may have substantial consequences

- Industry stakeholders requested active surveillance options evaluation

Example 3: Daily Mortality in HPAI Positive Egg-layer and Pullet Houses During the 2015 Outbreak





Example 3 : HPAI Simulation Model Output
Slow-spread Scenario is Consistent with Field Observations

- Delayed onset or no increased HPAI mortality several days after detection
- Intermittent positive RRT-PCR tests on progressive days

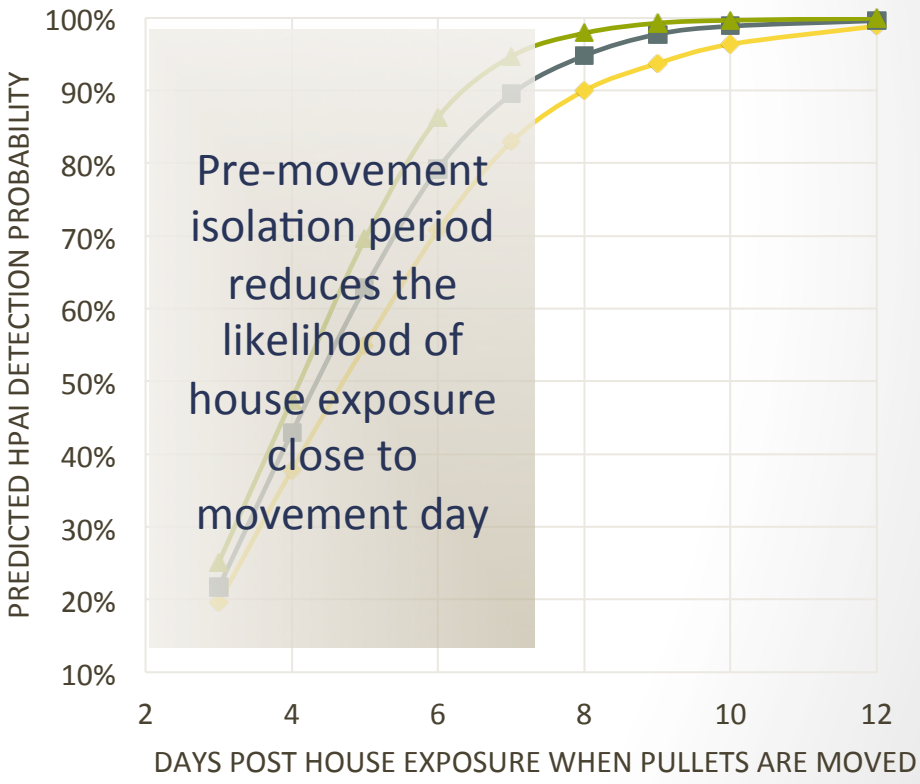
Predicted HPAI disease mortality on various days post exposure of a pullet flock: Four simulation iterations in a slow-spread scenario														
Simulation number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	1	0	1	0	2	2	3	4	6	7	8	14
2	0	0	0	0	0	0	0	0	2	0	0	2	2	1
3	0	0	0	0	2	0	0	0	0	0	4	1	0	1
4	0	0	1	0	1	0	1	0	0	0	0	0	0	0

Example 3: Pullet Movement Slow Spread Scenario

Daily RRT-PCR testing for 10 days prior to movement day

Number of 11-swab pooled samples per 50 dead birds on each test day	
Tracheal swabs	Cloacal swabs
1	---
2	---
2	2

A Pre-movement Isolation Period (PMIP) substantially reduces the risk of moving an infected, undetected flock



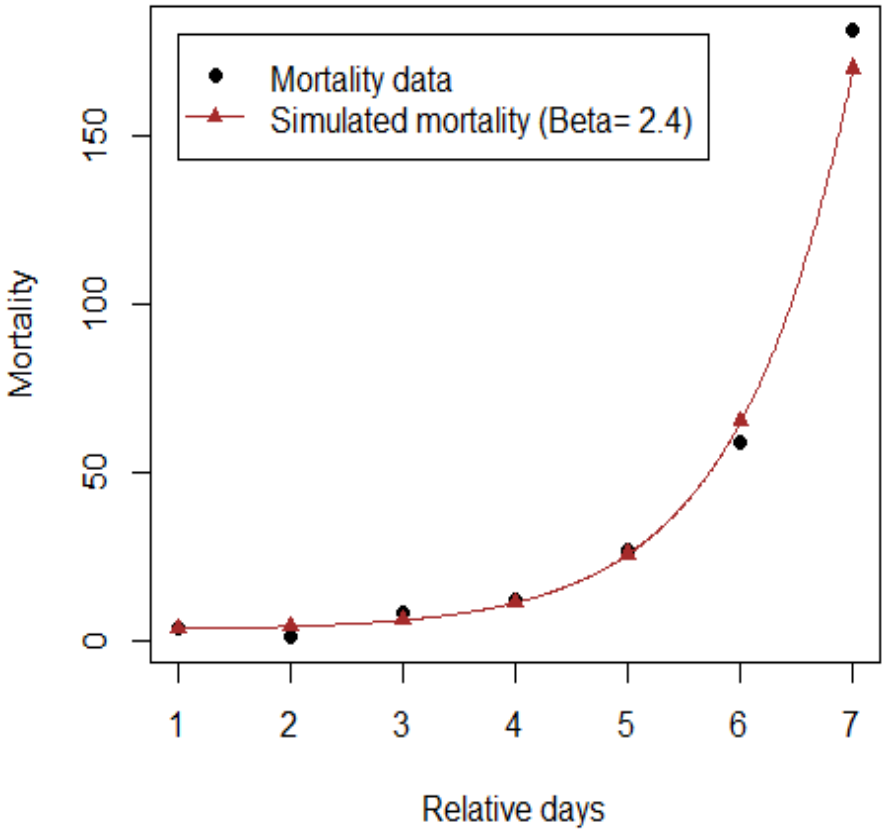
Current Modeling Activities (After the 2015 HPAI Outbreaks)

- Supporting Secure Poultry Supply plan development
  - Manure movement protocols
  - Turkeys, broilers to market: Load-out protocol evaluation
  - Harmonizing active surveillance protocols
- Impact of early depopulation on HPAI virus levels in the environment (USAHA Resolution 21)
- Moving embryonated eggs to human influenza vaccine production (Sanofi Pasteur)
- Risk of wild birds being exposed to HPAI virus via landfill leachate (Lori Miller, APHIS VS)

Future Modeling Activities (2016 and Beyond)

- Estimate HPAI disease transmission parameters from outbreak data
- LPAI surveillance: guidelines for use of antigen capture tests
- Evaluation for pre-emptive culling/early marketing
- Drinker sampling protocol evaluation

Mortality data from HPAI infected turkey houses
Predicted mortality with best fit β



Conclusion

- Quantitative approaches and simulation modeling are valuable tools used to inform HPAI preparedness and business continuity planning
  - In the 2015 HPAI outbreak, losses to industry and costs of cleanup would have been larger without continuity of business planning.
  - Products from Monitored Premises don't use disposal resources
- We provided practical examples of the application of models used to address questions from regulatory and industry stakeholders **during** the 2015 HPAI outbreak
  - We have provided decision support to stakeholders engaged in business continuity planning **since 2007**
  - Currently working with decision makers to prioritize requests for future projects

Questions?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