EVALUATION OF MORTALITY TRIGGERS FOR DETECTING HPAI IN MEAT TURKEY PREMISES

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Background

- Observation of high mortality is a key detection mechanism for HPAI

- Mortality triggers are useful for timely initiation of diagnostic investigation
  - e.g., “mortality ≥5 birds per 1000 on 2 days” was a trigger in the 2003 H7N7 outbreak in the Netherlands

- Trade-off between early detection and false triggers

Application of Mortality Triggers

- For flocks scheduled to move in the near-term:
  - Mortality triggers supplement diagnostic testing
  - False triggers may result in delayed movement
- For turkey flocks not moving in the near-term:
  - Mortality triggers are critical for early detection given less frequent diagnostic testing
  - False triggers may burden outbreak resources
- Criteria to support further investigation when a trigger occurs are important

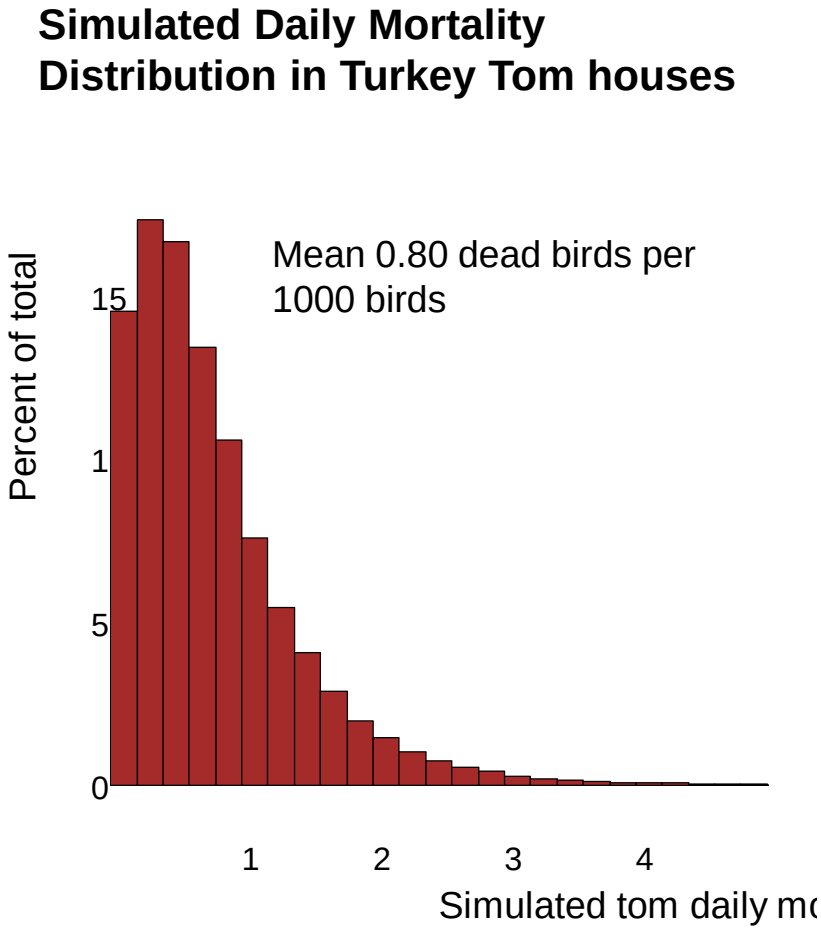
Objectives

- To perform a simulation study to inform the selection of a mortality trigger for HPAI in turkey flocks

- To evaluate further investigation options when a mortality trigger occurs
  - Based on mortality on the next day after a trigger occurs
  - Based on diagnostic testing on the next day after a trigger occurs

Methods: Simulation of Normal Mortality

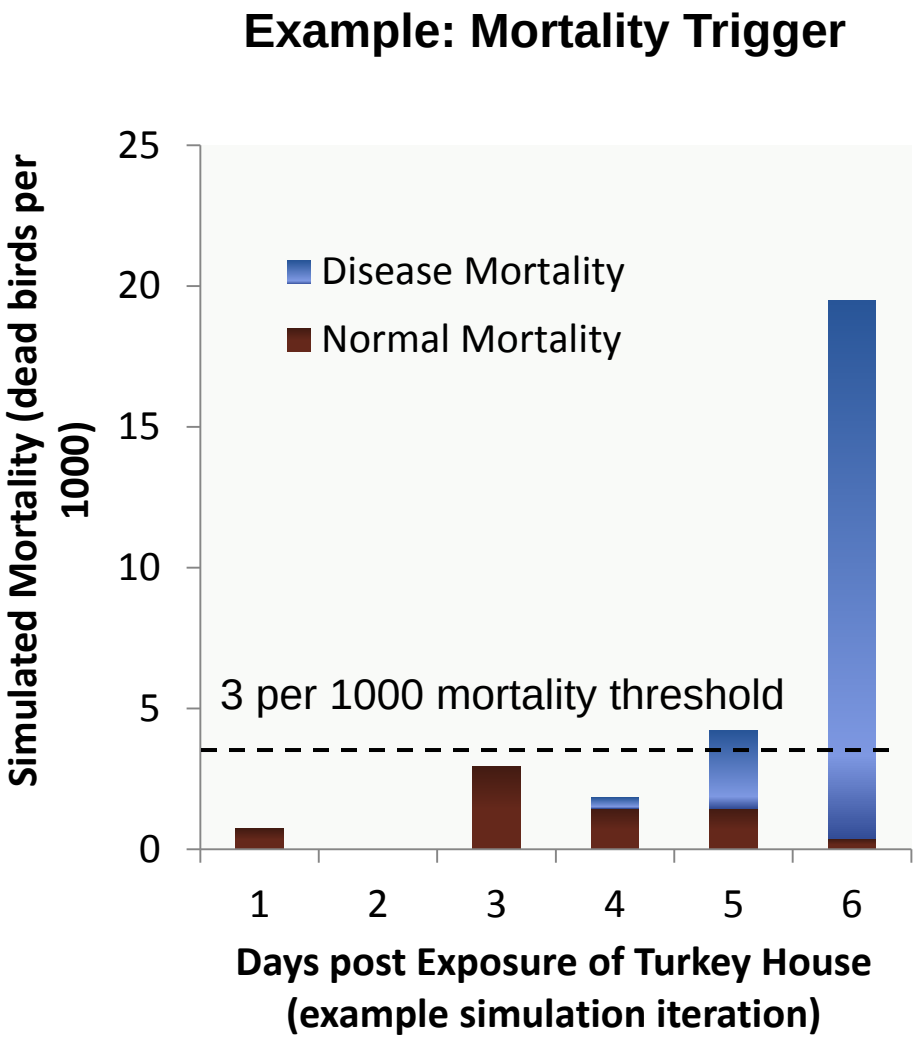
- Mortality data provided by industry:
  - Toms: 116 houses of weekly data and 26 houses of daily data
  - Hens: 48 houses of weekly data and 46 houses of daily data
- Available weekly and daily data used in simulation
  - Weekly mortality simulated with a lognormal distribution
  - Daily mortality pattern resampled from data and scaled to the chosen weekly mortality



Methods: Simulation of Overall Mortality

- Stochastic transmission model simulates HPAI spread in a house and predicts disease mortality overtime

- Disease mortality was superimposed over normal mortality to evaluate triggers

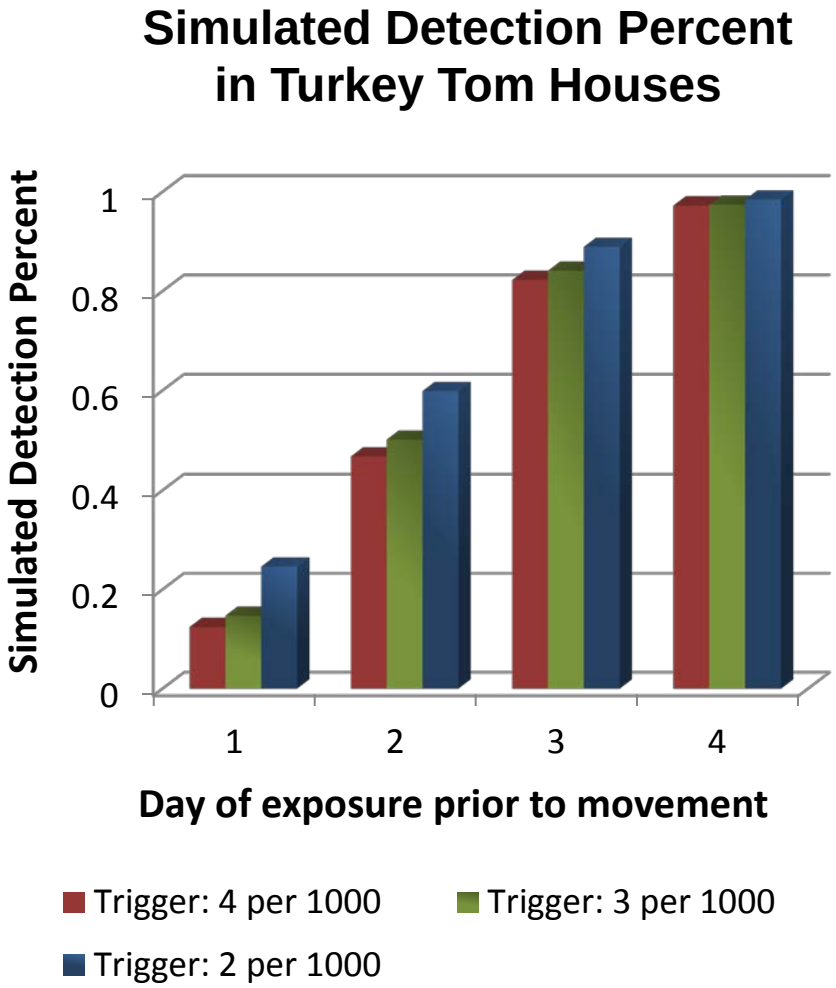


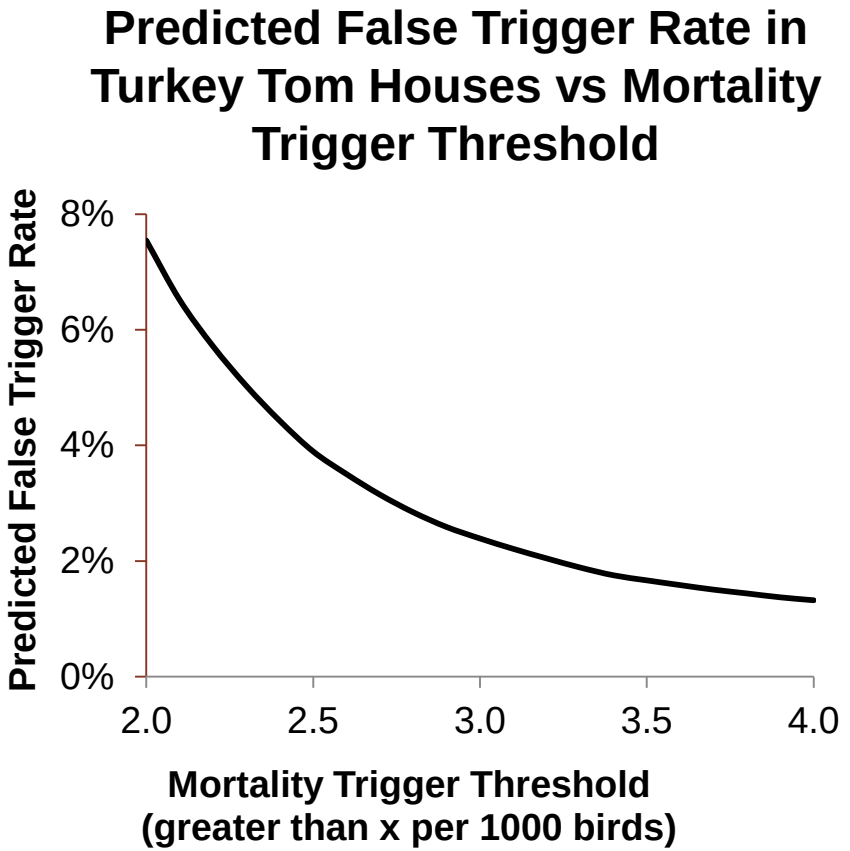
Evaluation of Mortality Triggers for Turkey Houses Loaded Out in the Near-Term

- Pre-movement testing of dead birds is the primary detection mechanism
  - Matrix gene RRT-PCR test (Spackman *et al.*, 2002)
  - One 5 swab pooled sample is tested for every 50 dead birds on two consecutive days

- Simulation model scenarios evaluated:
  - HPAI H5N2 (Pennsylvania 1983) strain scenario with an adequate contact rate ~ 4.2 per day
  - Detection time simulated for 3 mortality triggers

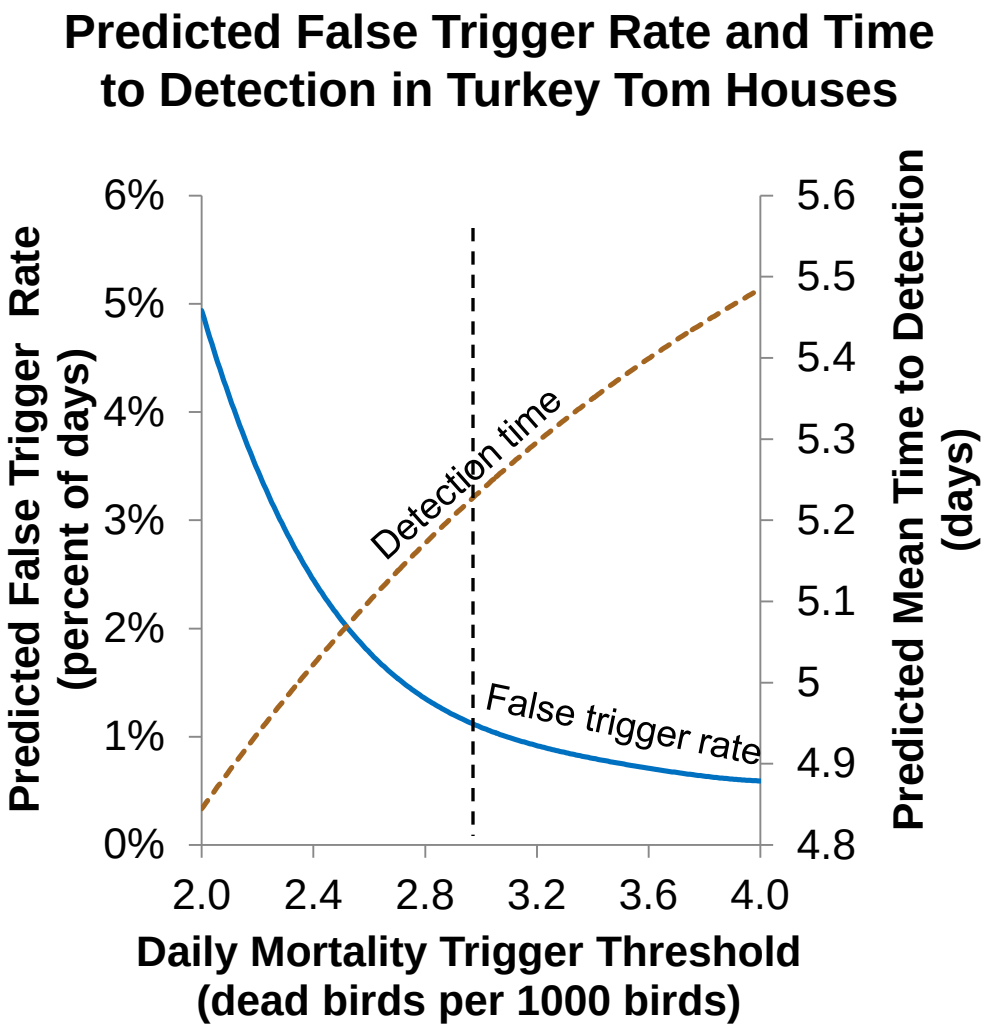
Results: Evaluation of Mortality Triggers for Turkey Houses Loaded Out in the Near-Term



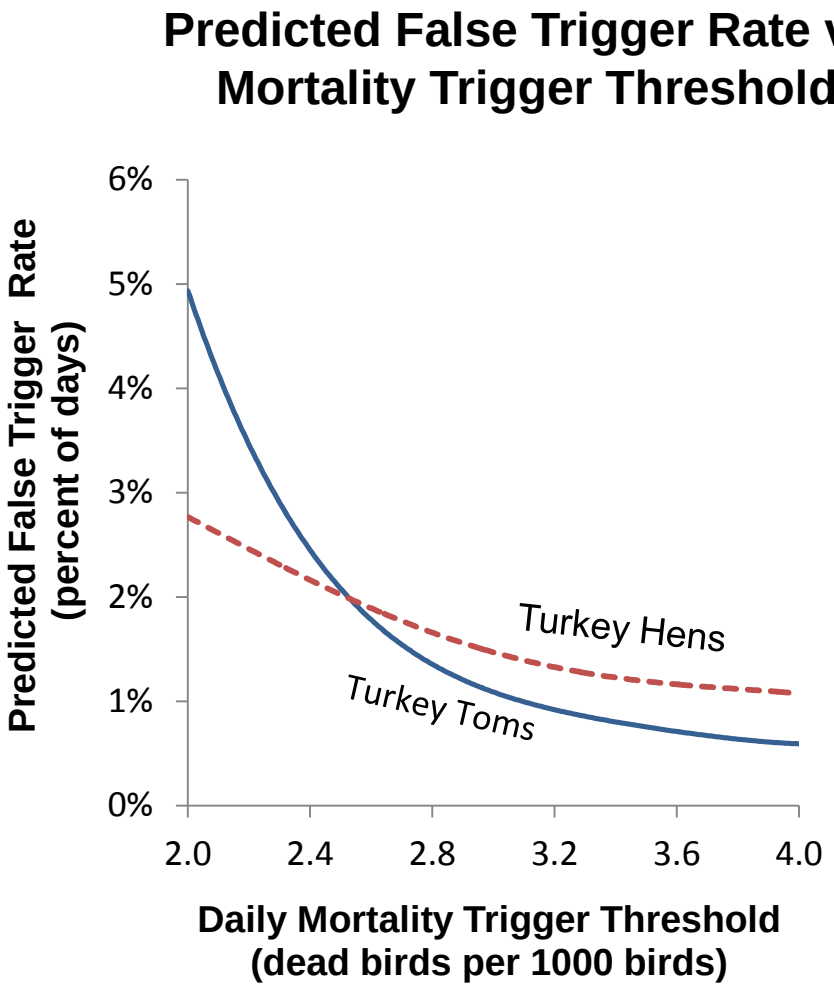


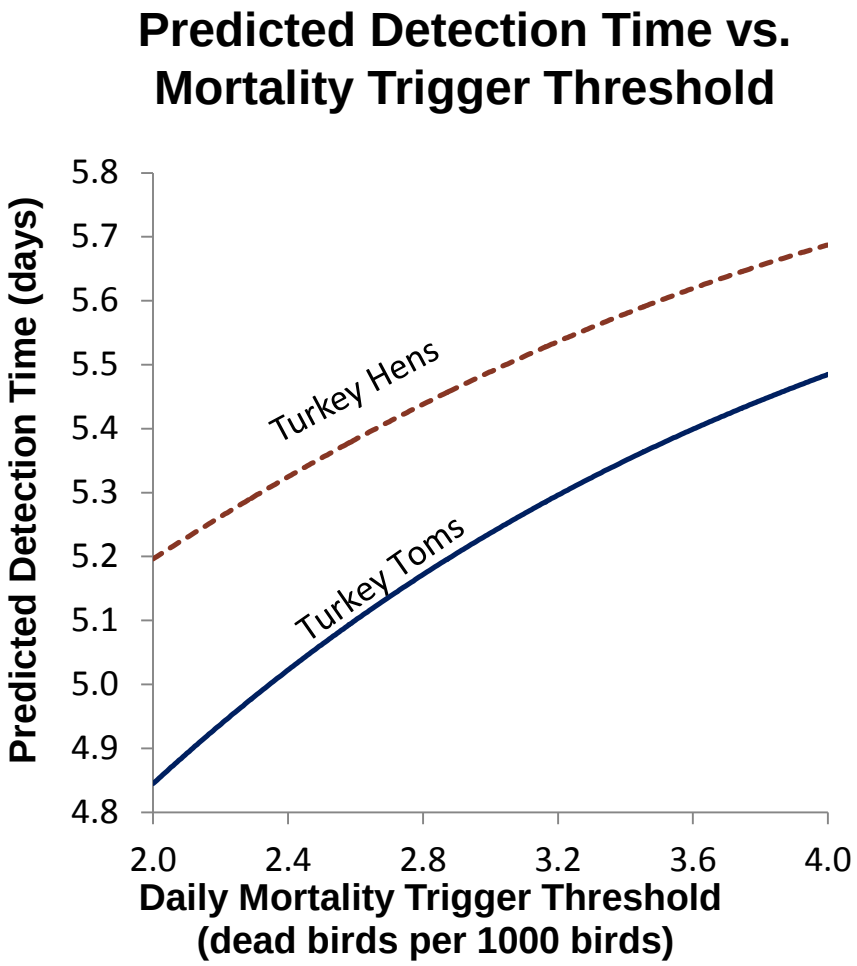
Results: Mortality Triggers for Turkey Tom Houses During Grow-Finish

- In houses not loaded out in the near-term:
  - Mortality triggers critical for early detection
  - False triggers do not result in movement delays
- Daily mortality ≥3 per 1000 per house was adopted as a trigger in the STS Plan



Results: Mortality Trigger Performance in Turkey Tom and Hen Houses During Grow-Finish





Analysis of Measures to Support Further Diagnostic Investigation

- Confirming or ruling out HPAI in a timely manner is important when a mortality trigger occurs

- Two options to support further diagnostic investigation evaluated. On the day following trigger activation:
  - Observe whether mortality stays above trigger threshold
  - Test 2 pooled samples of 5 swabs from dead birds for every 50 dead birds from the turkey house

Further Investigation: Monitoring Mortality on the Day after Trigger Activation

- Mortality likely to remain above threshold on next day if trigger occurred due to HPAI
- Under slow spread scenario, there is some likelihood that the trigger is not activated in a HPAI infected house

	Probability of mortality above 3 birds per 1000 trigger threshold on the next day
HPAI infected turkey tom house (baseline contact rate 4.2 per day)	0.99
HPAI infected turkey tom house (slow contact rate 1 per day)	0.92
HPAI free turkey tom house	0.06

Further Investigation: RRT-PCR Testing on the Day After Mortality Trigger Activates

- Results indicate HPAI would likely be detected via RRT-PCR testing on the next day when mortality trigger occurs
- Results indicate detection via RRT-PCR testing is less sensitive to adequate contact rate compared to mortality triggers

	Probability of detection via RRT-PCR testing on the next day
HPAI infected turkey tom house (baseline contact rate 4.2 per day)	0.99
HPAI infected turkey tom house (slow contact rate 1 per day)	0.98
HPAI free turkey tom house (99% specificity)	0.0199

Application of a Bayesian Approach to Support Further Investigation When a Trigger Occurs

- Hypothetical Scenario:
  - A turkey tom premises with 3 houses is located 0.5 km from a infected premises
  - Daily likelihood of exposure likelihood (0.0101) was based on a spatial kernel from Dorigatti et al., 2010
  - Mortality > 3/1000 threshold was observed on a day
  - RRT-PCR testing samples collected next day tested negative (2 pooled samples per 50 dead birds)

- Applying a Bayesian approach, the posterior likelihood of the premises not being infected with HPAI was 0.995 under this scenario

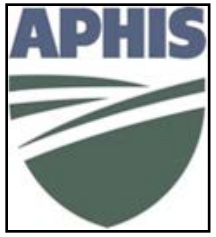
Overall Conclusions

- Stochastic simulation analyses are useful in the selection of mortality triggers for HPAI given the tradeoff between early detection and false trigger rate

- Daily mortality ≥3 birds per 1000 was selected as trigger rate in the draft USDA APHIS Secure Turkey Supply Plan

- RRT-PCR testing on the day after a mortality trigger occurs (2 five swab pooled samples for every 50 dead birds) can help confirm or rule out HPAI as part of further investigation

Questions?



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