Risk Assessment of HPAI Spread via Movement of Broilers to Processing

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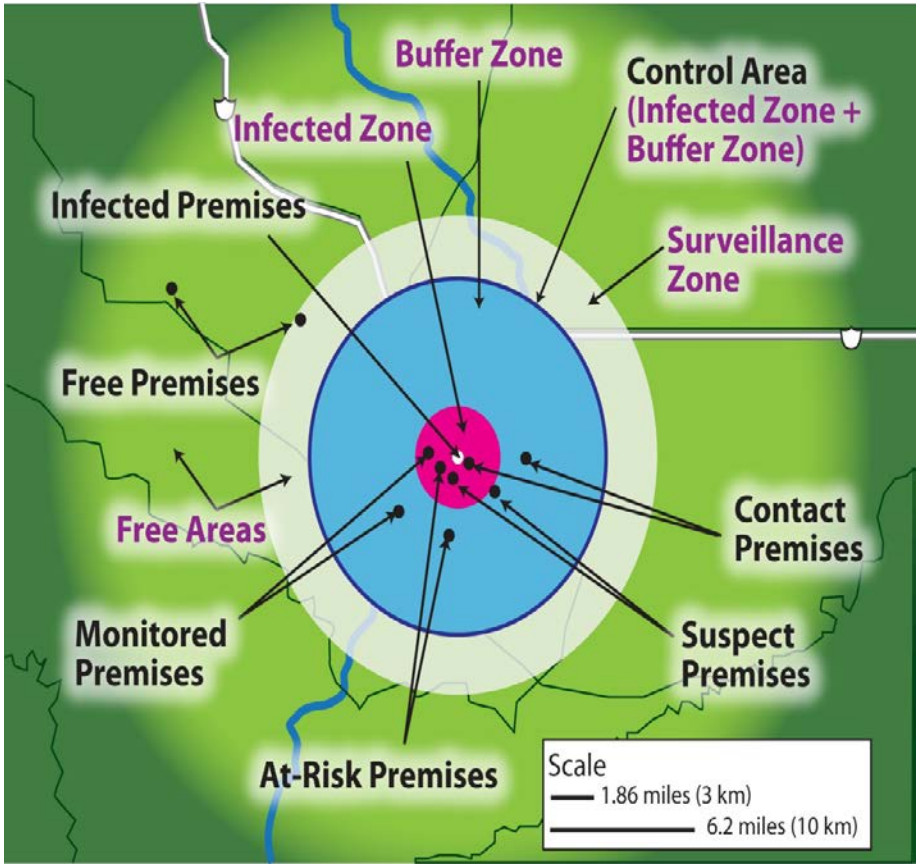
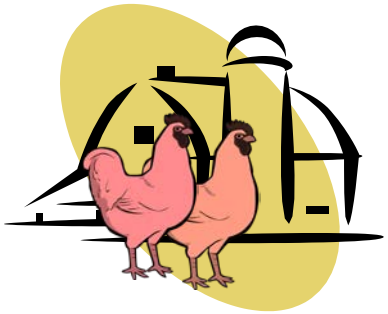
Introduction

Risk assessment for HPAI spread via movement of broilers to processing

- Evaluates potential movement of infected and undetected flocks
- Considers current practices and outbreak measures
- Supports risk management and further on-scene evaluation in an outbreak

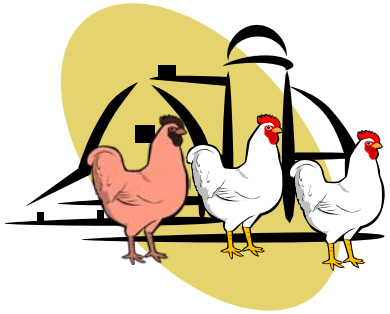


Release Pathway for the Potential Movement of HPAI Infected Birds



Step 1: Premises in Control Area becomes infected

Vehicles, people, i.e. local area spread

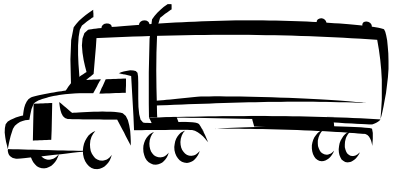


Mitigation for Step 1: Biosecurity and distance

Step 2: HPAI infection is **not** detected before movement

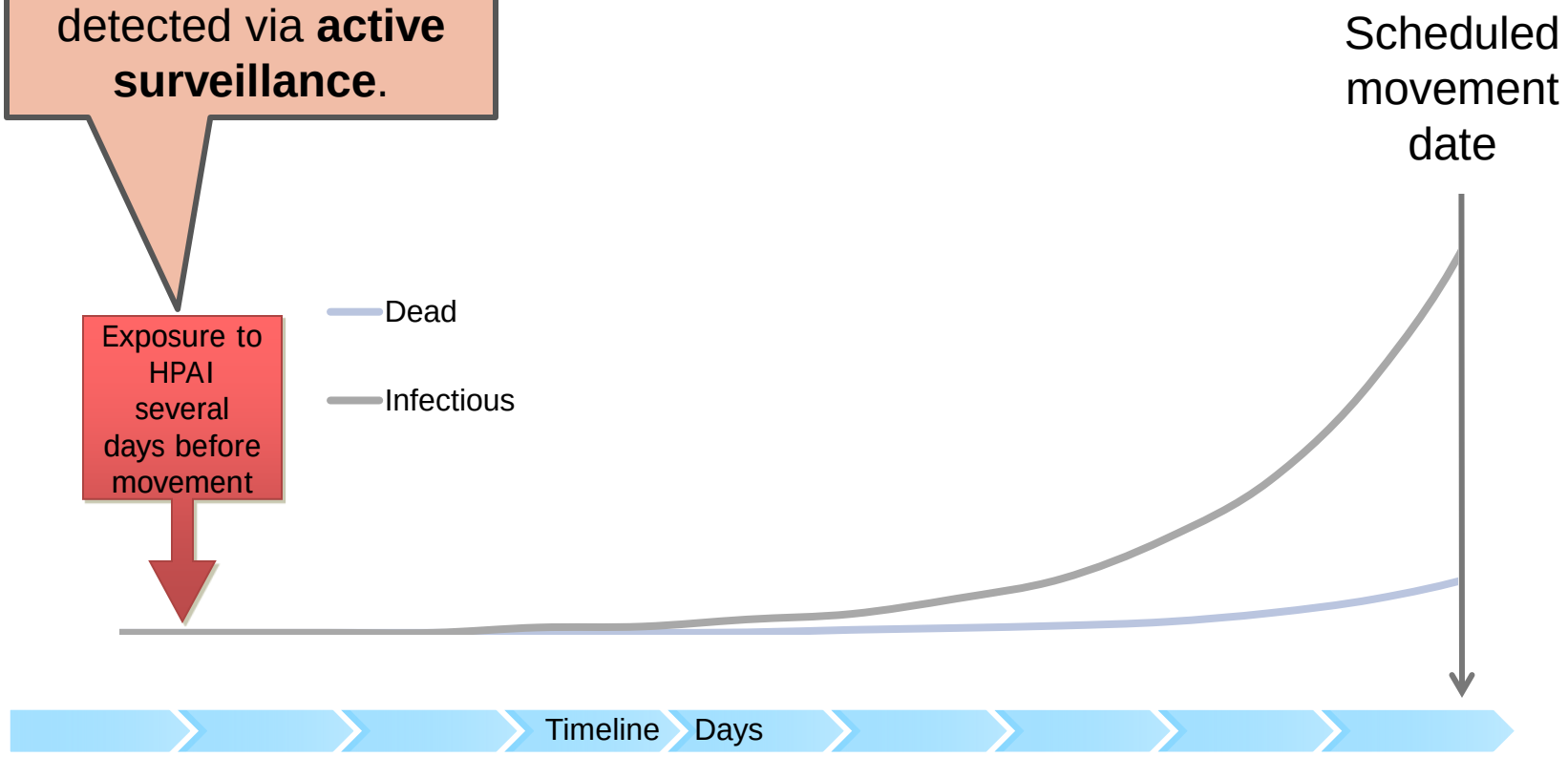
Mitigation for Step 2: Active surveillance

Possible movement of HPAI infected birds



Impact of Pre-movement Isolation Period (PMIP)

If the house is infected several days before movement, it would likely be detected via **active surveillance**.



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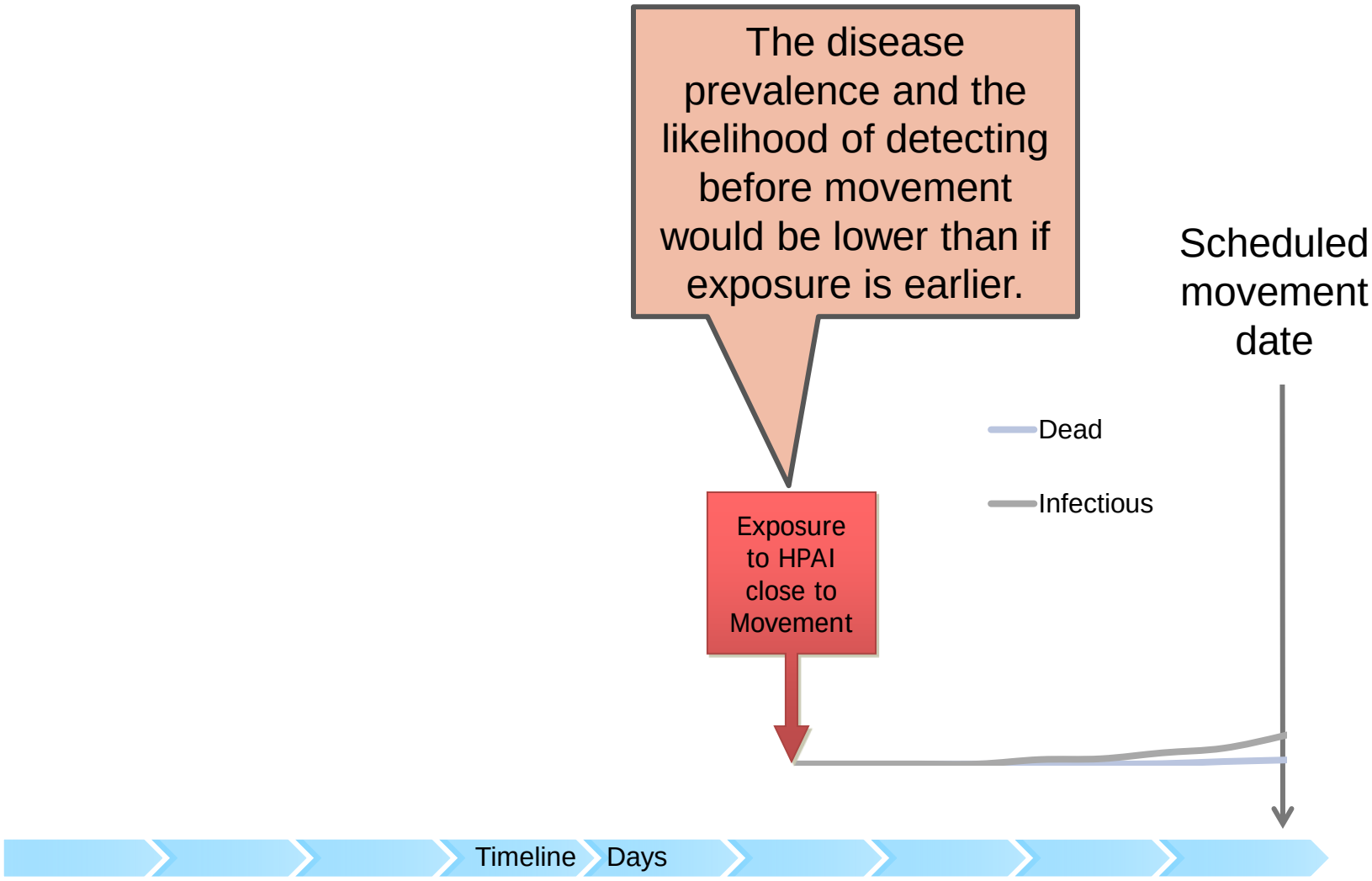

Impact of Pre-movement Isolation Period (PMIP)

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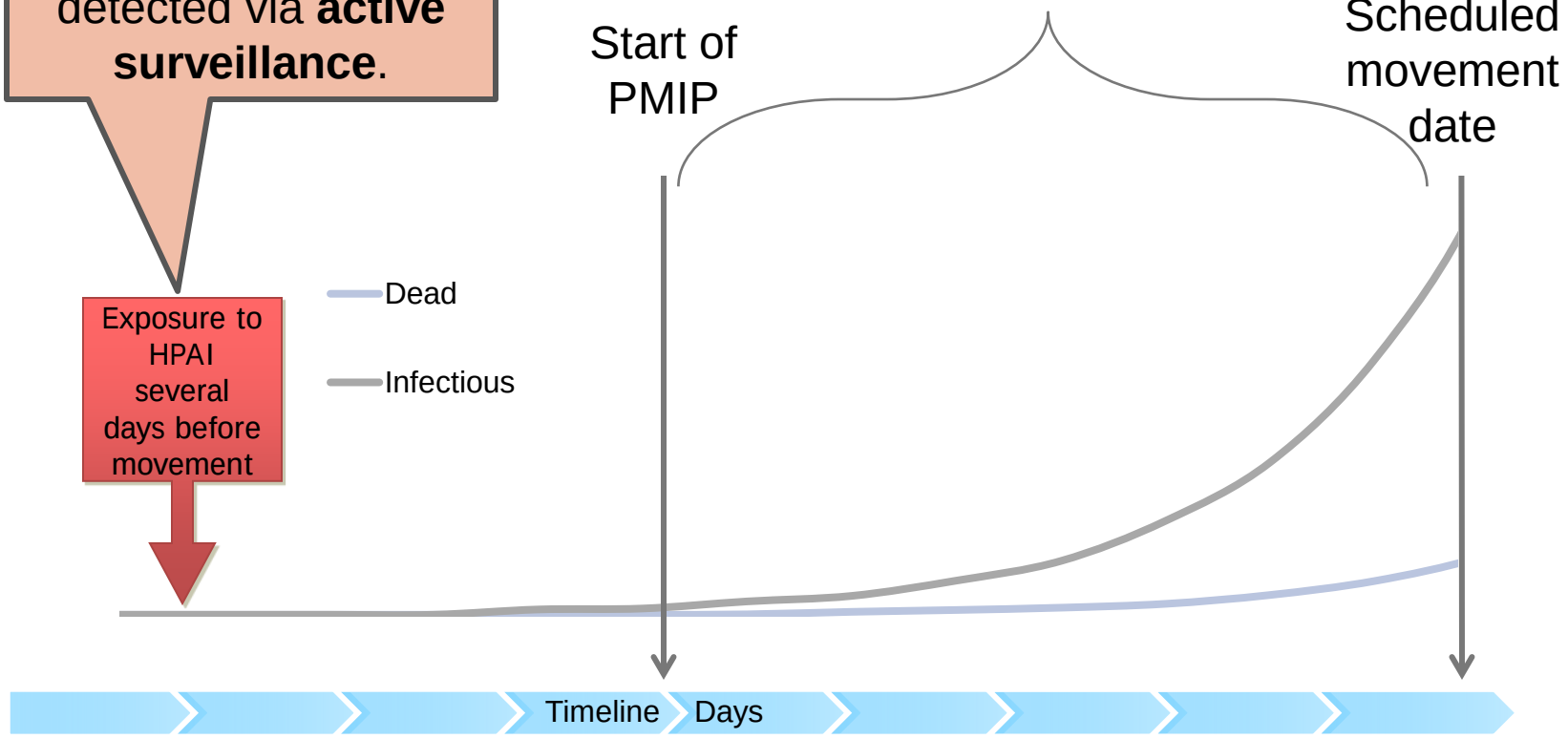
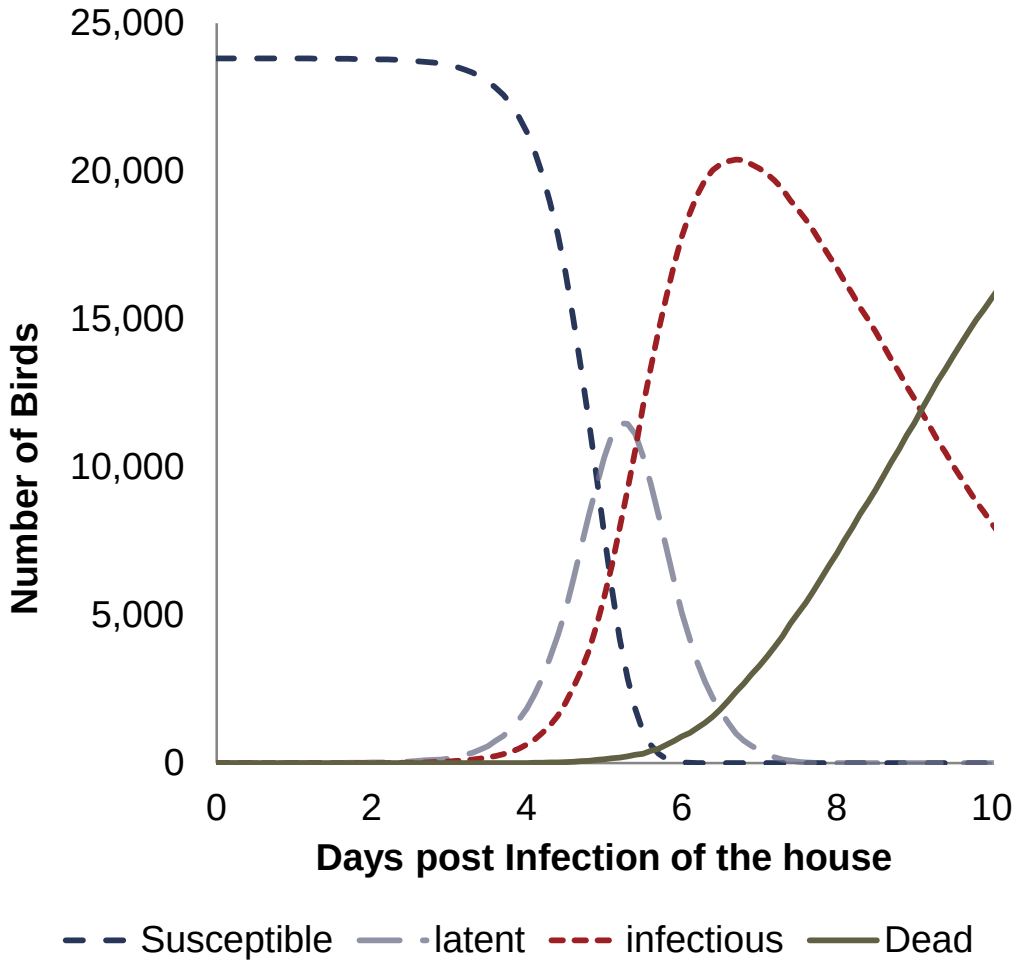
Exposure risk close to the time of movement is reduced by **PMIP biosecurity**



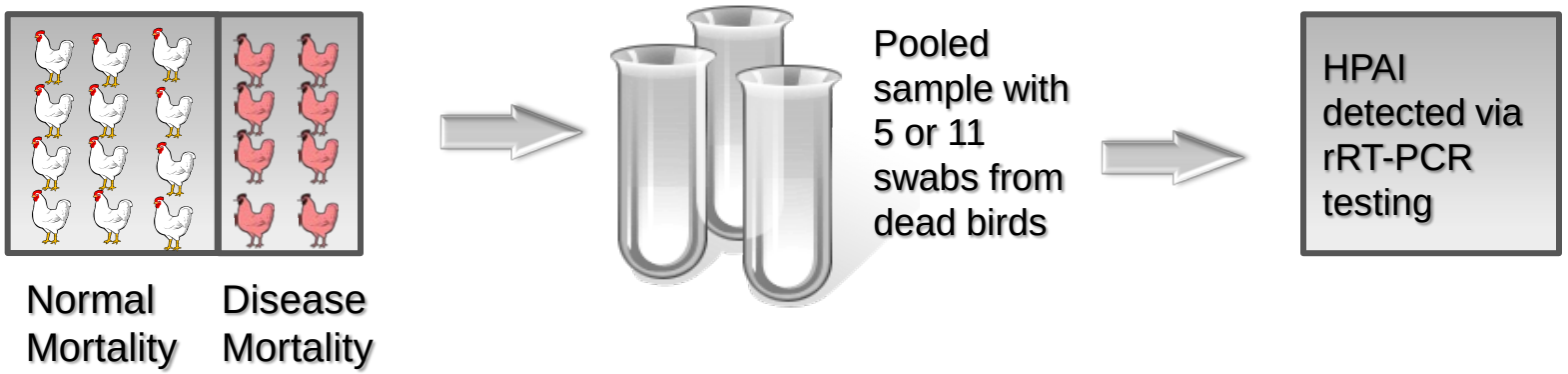
Methods: Disease Transmission Model

Stochastic chain binomial disease transmission model

- Simulates spread of HPAI among birds in a house
- Predicts susceptible, latent, infectious and dead birds over time
- Considerable uncertainty in parameters such as effective contact rate, infectious and latent periods



Methods: Active Surveillance Model



Active surveillance model simulates detection of HPAI

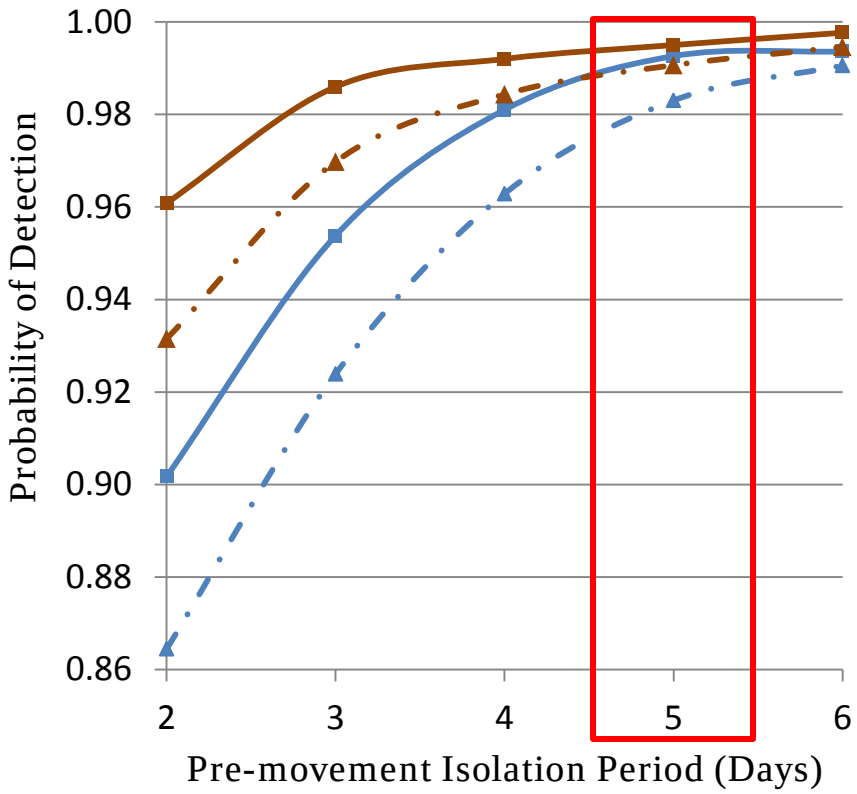
- Chances of a swab from a diseased bird being included in the pooled sample taken randomly from daily mortality
- Detecting a virus positive pooled sample given diagnostic sensitivity
- Considers the variability in normal and disease mortality

Probability of Detecting HPAI Under Various Pre-movement Isolation Period (PMIP) Durations

Active surveillance options: testing a pooled sample on two consecutive days before movement with rRT-PCR

Scenario	Pooled sample size for testing dead birds	HPAI Strain
Scenario A	5 swabs	H5N2
Scenario B	11 swabs	H5N2
Scenario C	5 swabs	H5N1
Scenario D	11 swabs	H5N1

Simulation results on detection probability if the flock became exposed before PMIP

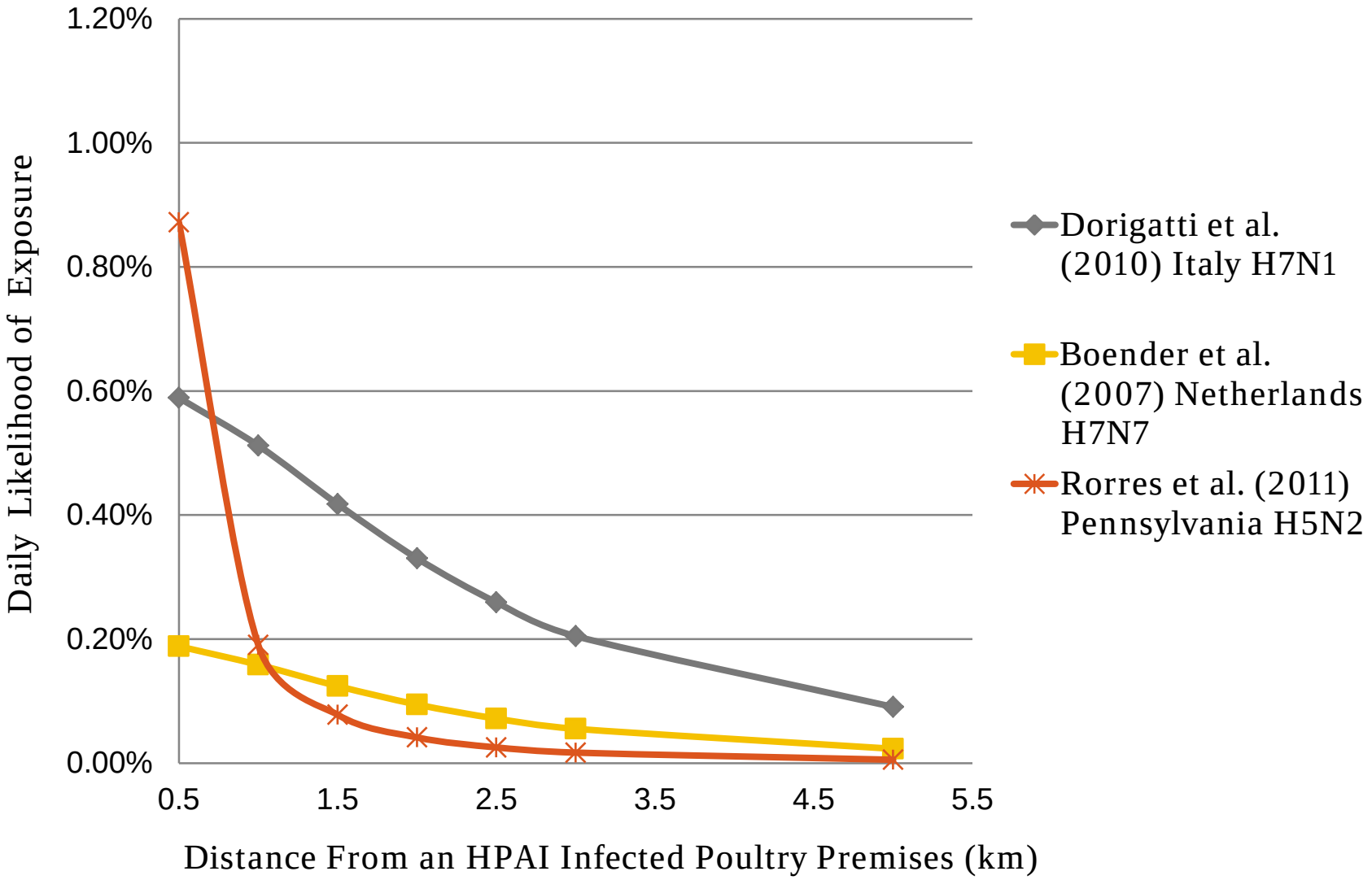


The Likelihood of a Premises Becoming Infected with HPAI

- Quantitative spatial analysis
  - Transmission parameters estimated in literature are for all spread mechanisms combined
  - Provides conservative estimates of the likelihood of spread compared to when PMIP measures are followed

- Qualitative assessment
  - Individual pathways are evaluated: critical operational visits (e.g., feed delivery, repairmen), dead bird disposal, farm personnel, wildlife, insects, and aerosol
  - Impact of PMIP biosecurity measures
  - Literature review, outbreak reports and expert opinion

Likelihood of Exposure of a Poultry Premises as a Function of Distance From an HPAI Infected Premises Based on Spatial Transmission Models



Quantitative Simulation Results on the Likelihood of a Flock (1) Becoming Infected with HPAI Virus and (2) Moving Infectious Birds Before Detection

Predicted likelihood of a broiler flock (house) being infected and undetected at movement from simulation results (conservative approach)

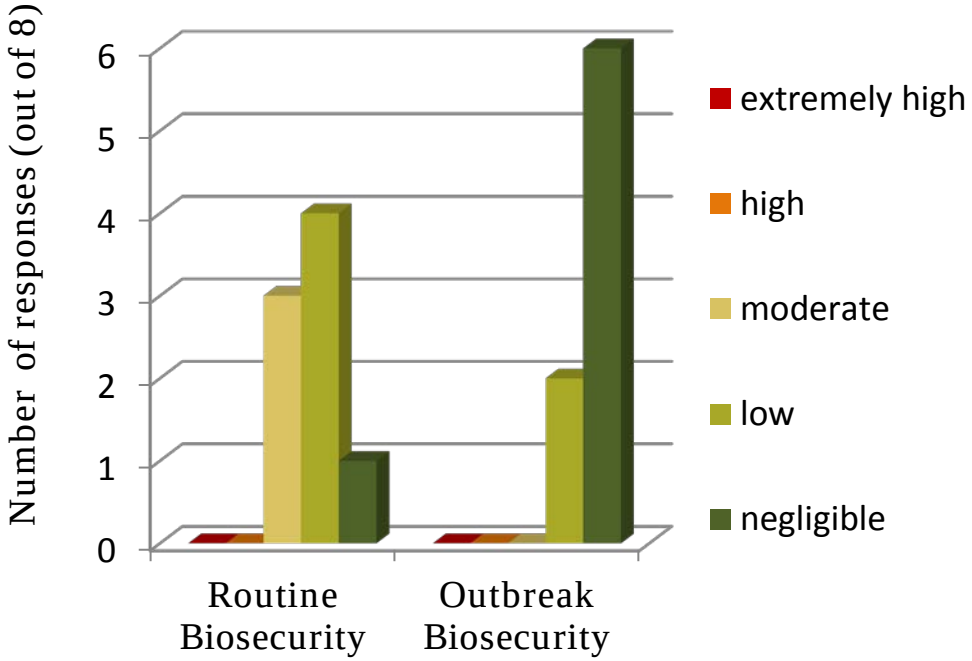
Distance from an infected premises (km)	Spatial transmission model used		
	Dorigatti (2010) Italy HPAI H7N1	Boender (2007) Netherlands HPAI H7N7	Rorres (2011) Pennsylvania HPAI H5N2
1.5	1.10(1.25)%	0.34(0.38)%	0.14(0.24)%
2	0.88(1.0)%	0.26(0.29)%	0.01(0.13)%
3	0.55(0.63)%	0.15(0.17)%	0.00(0.05)%
5	0.25(0.28)%	0.06(0.07)%	0.00(0.02)%

rRT-PCR pooled sample sizes of 11 or 5 dead birds (in parentheses) with testing on two consecutive days before movement were evaluated

Qualitative Evaluation: Likelihood of Transmission via Feed Delivery

- A risk factor in some outbreak studies
  - Odds ratio was not large
- Driver biosecurity and vehicle C&D
  - Driver not entering the henhouse
  - Effectiveness of PPE protocols with footwear, gloves and hand hygiene
- Likelihood of transmission was rated to be *negligible to low* given Secure Broiler Supply plan measures

Expert opinion on feed movement as a risk factor for introducing HPAI
(by veterinarians with field AI experience)



Exposure Assessment

- Estimates the likelihood of susceptible poultry becoming exposed to HPAI due to movement of broilers

- Likelihood of moving infectious birds was rated to be *negligible to low* when the premises is 2-3 km from infected premises, given PMIP biosecurity and active surveillance

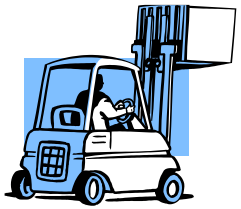
- Potential exposure pathways include
  - Manure, dust or feathers to premises on route
  - Load out crew, equipment or live haul vehicles
  - Plant employees, waste water
  - Offal movement from processing plants

Live Haul and Load Out Equipment Exposure Pathway

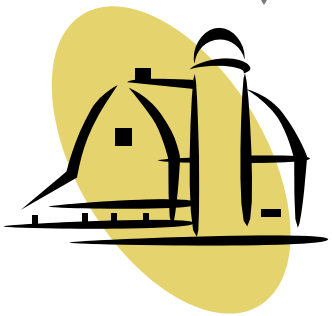
Step1: Previous farm was infected and undetected at load out

Conservative quantitative estimates: Likelihood of 0.0005-0.01 per movement, 2-3 km from infectious premises

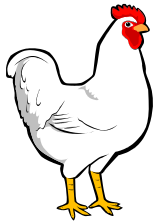
Qualitative evaluation: *negligible to low* likelihood, 2-3 km from infected premises



Step2: HPAI Virus is introduced into a house on another premises at next load out



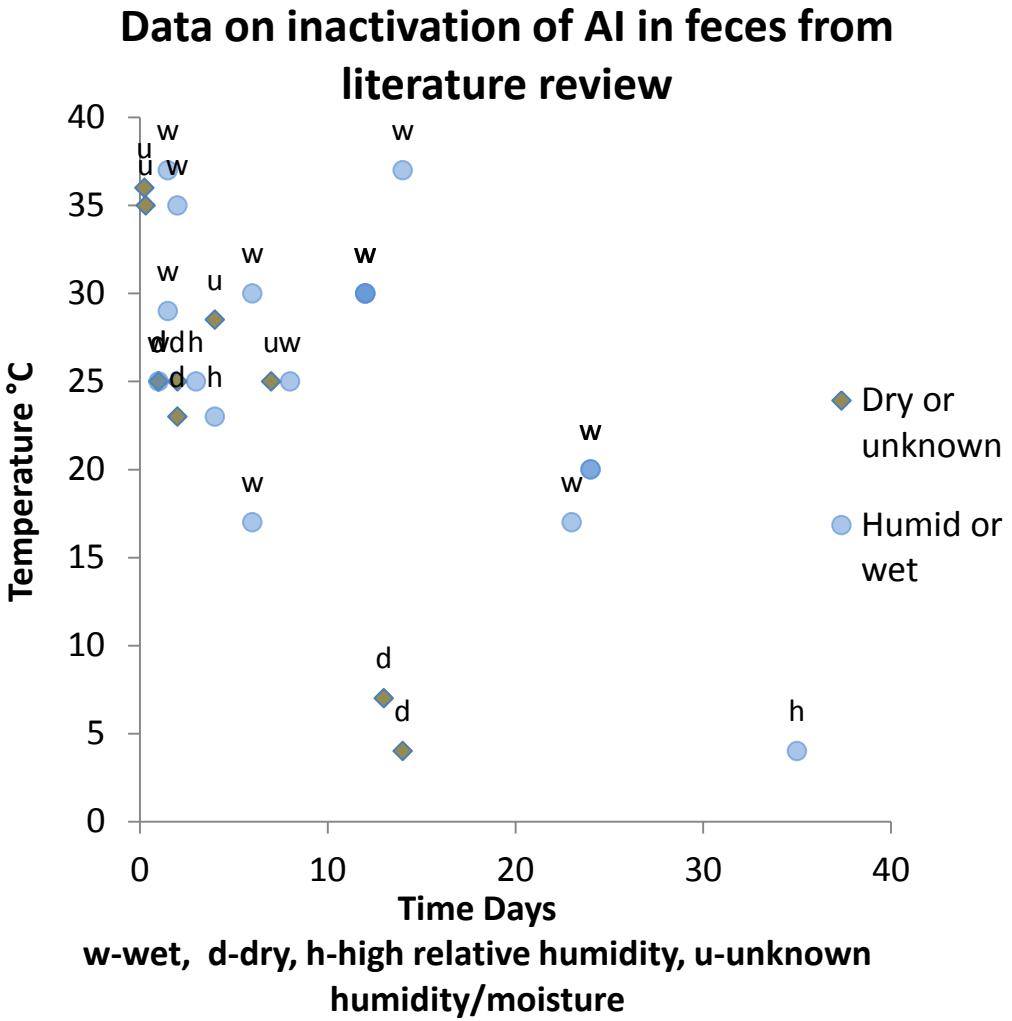
Step 3: Virus is not inactivated during downtime



Step 4: Next flock introduced into the house becomes infected

Live Haul And Load Out Equipment Exposure Pathway (Impact of Downtime)

- In rare cases, when release occurs, 31 (90% P.I., 1-135) infectious birds were predicted to be present in a house with 24,300 birds
- Impact of extended down time (21 days) or heating to 40.6°C for 2 days
- Preheating floor temperature (usually 85-95°F for 24 hours)
- Non-brooding areas are not utilized for 1 to 2 weeks



Preliminary Results

Release or exposure assessment pathway step (following SBS measures)	Qualitative likelihood ratings	
	Broiler premises 2 km from IP	Broiler premises 3 km from IP
Broiler flock is infected and undetected at movement (release)	*Low*	*Negligible to low*
Release occurs and susceptible poultry become exposed to HPAI via live haul or load out equipment	*Negligible to low*	*Negligible*
Release occurs and susceptible poultry flocks adjacent to the route become exposed (1000 m away from road)	*Negligible*	*Negligible*

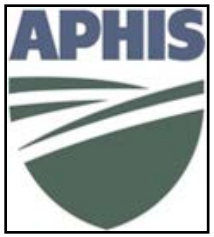
Conclusion

- Active surveillance, pre-movement biosecurity and distance from infected premises can provide confidence that HPAI infected and undetected broilers are not moved to processing.

- Secure Broiler Supply measures such as complete load out and vehicle routing would further limit HPAI spread to susceptible poultry.

- Proactive risk assessment supports the managed movement of broilers by providing scientific evaluation to inform movement permitting decisions and emergency response planning.

Questions?



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