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Current Efforts to Detect, Control and Mitigate HPAI in the U.S.

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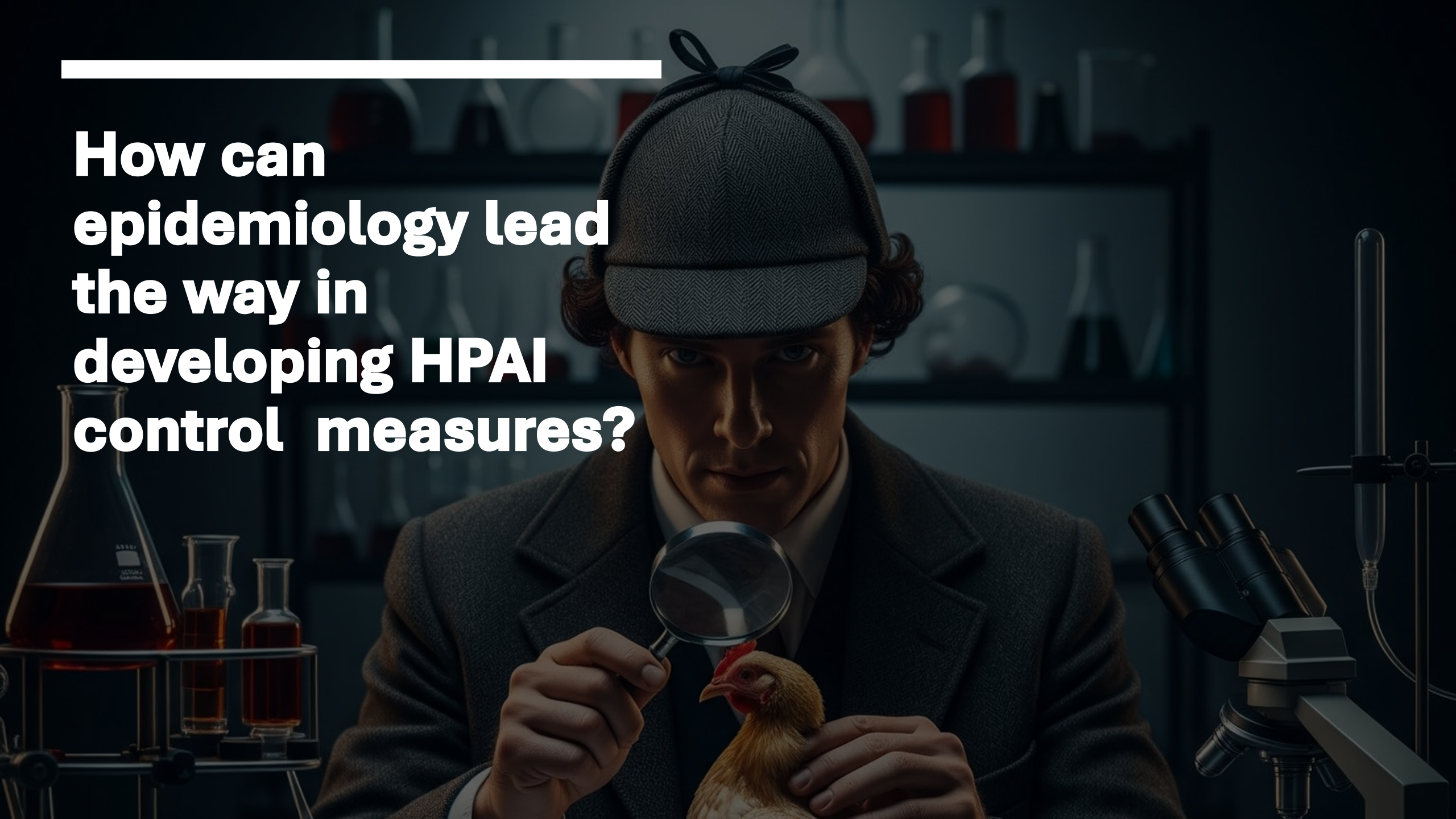
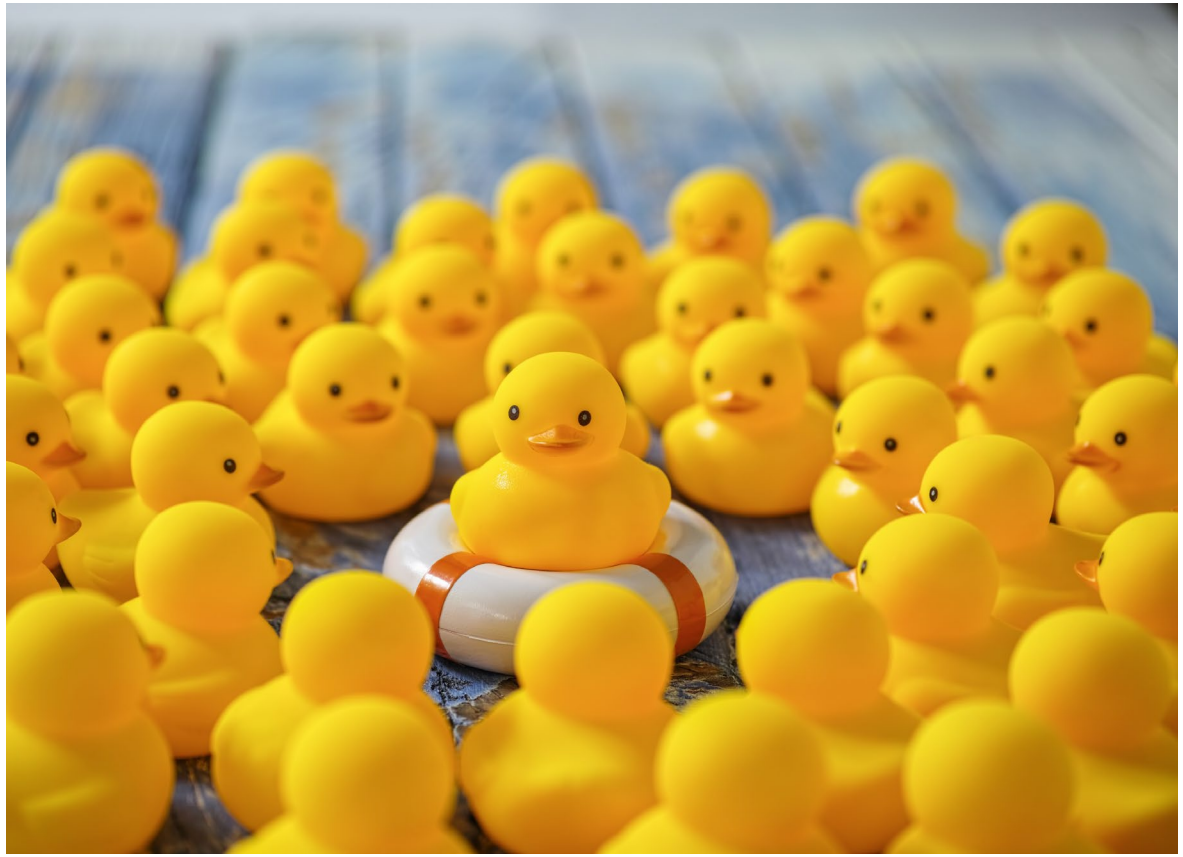
How can epidemiology lead the way in developing HPAI control measures?



Epidemiology



Study of Disease Patterns

Epidemiology involves studying disease patterns within populations to understand how diseases spread.

Frequency and Distribution

Epidemiologists examine the frequency and distribution of diseases to identify risk factors.

Determinants of Diseases

Identifying determinants of diseases helps in developing strategies for prevention and control.

Most important concept is that disease does not occur randomly.

Attribution and Root Cause

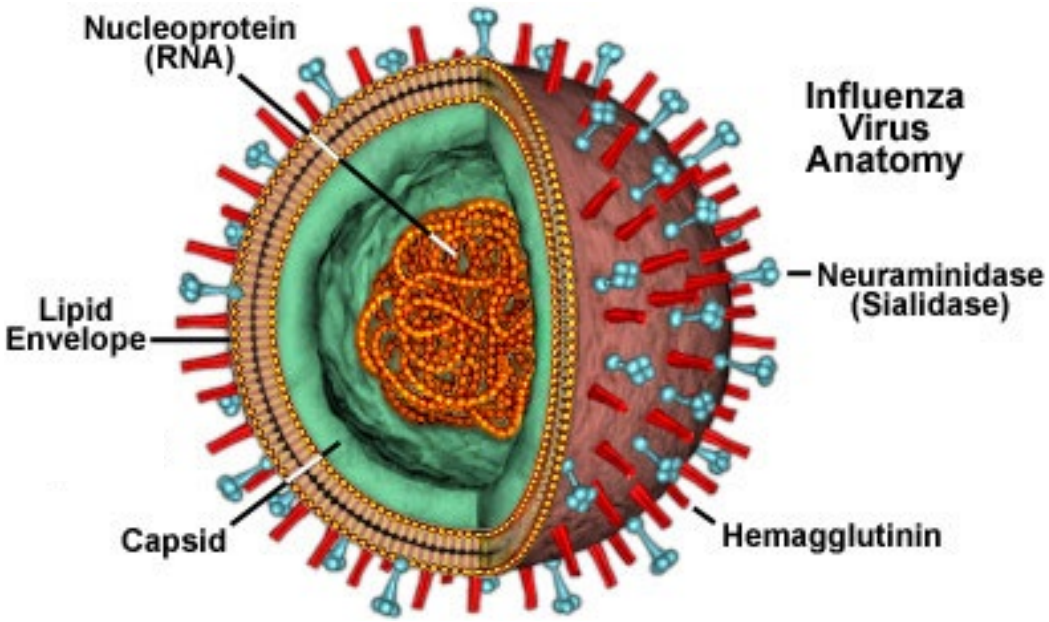
Attribution

- Where did it come from?
- How did it get there?
- When did it arrive?
- Where did it possibly go from the operation under investigation?

Root Cause

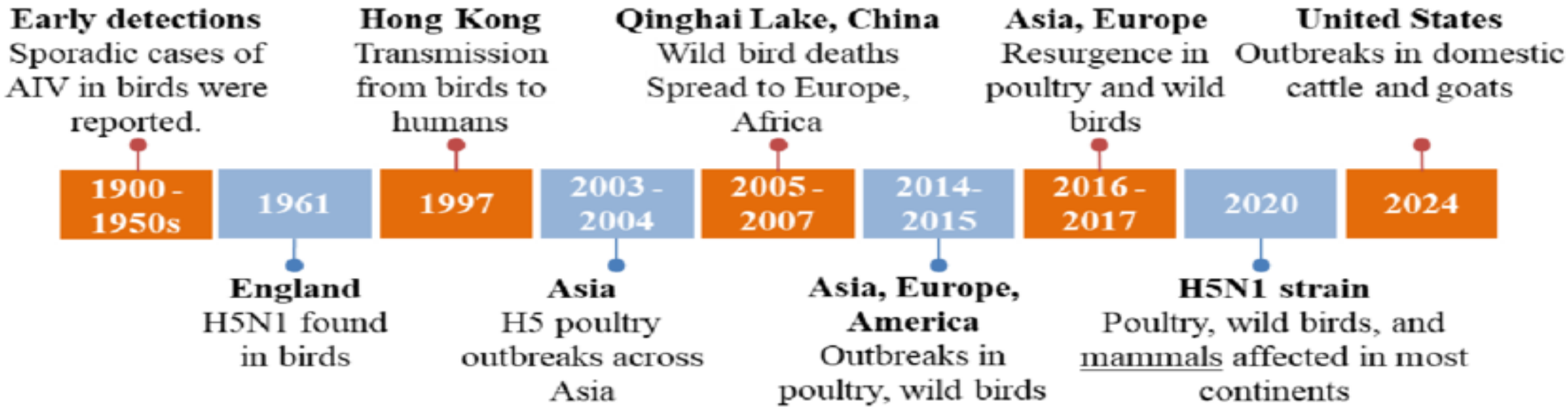
- What factors were associated with introduction of disease?
- temporal factors
- spatial factors
- management factors
- climatic factors
- social factors
- economic factors

The Culprit



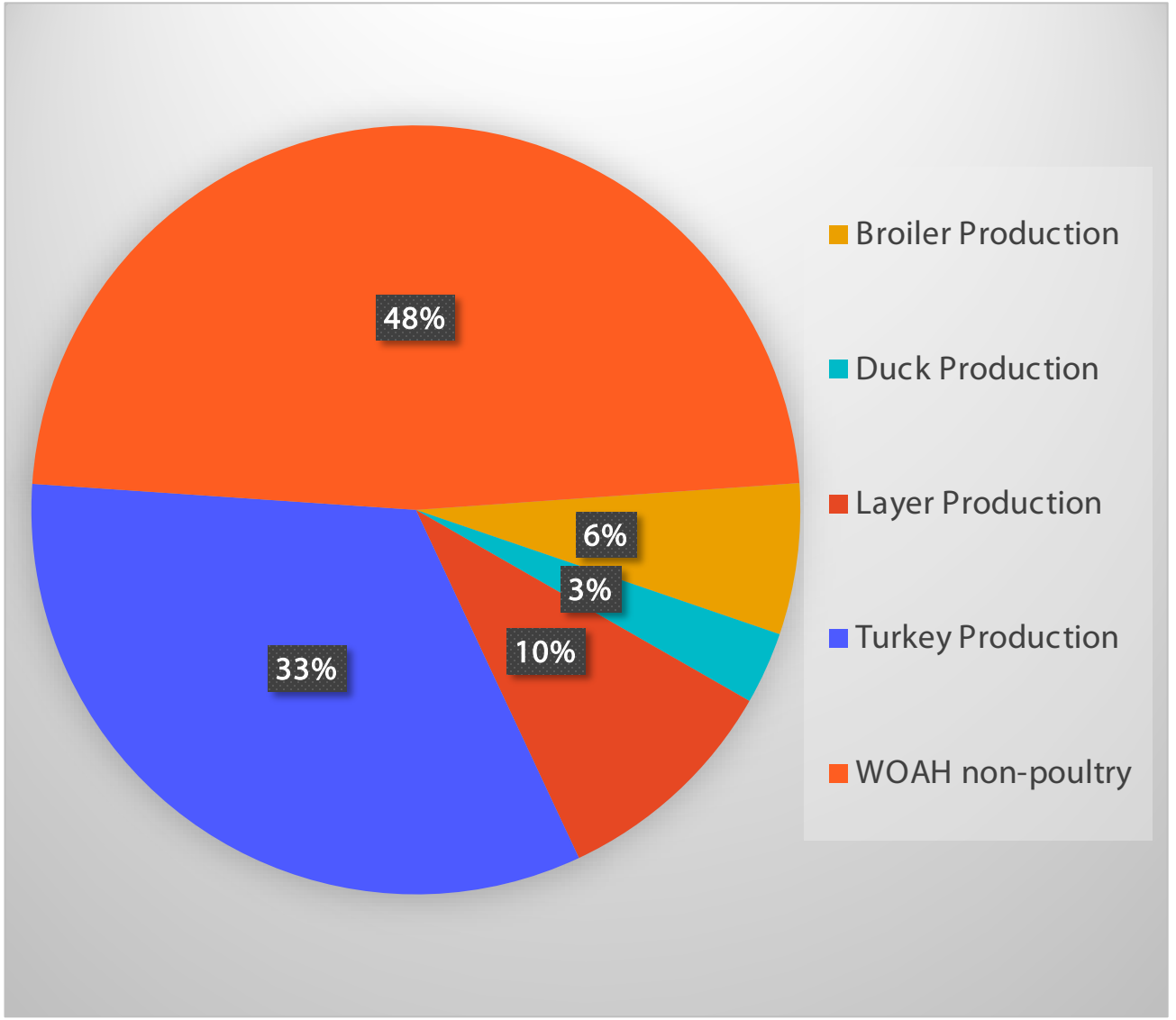
- *Nine different H types and 16 different N types (H5 and H7 are the bad ones)*
- *Rapid and frequent genetic mutations*
- *Mutations lead to adaption to multiple species*
- *Mutations lead to circumventing vaccines*
- *Mutations lead to changes in the virulence of the virus*

H5N1 pandemic



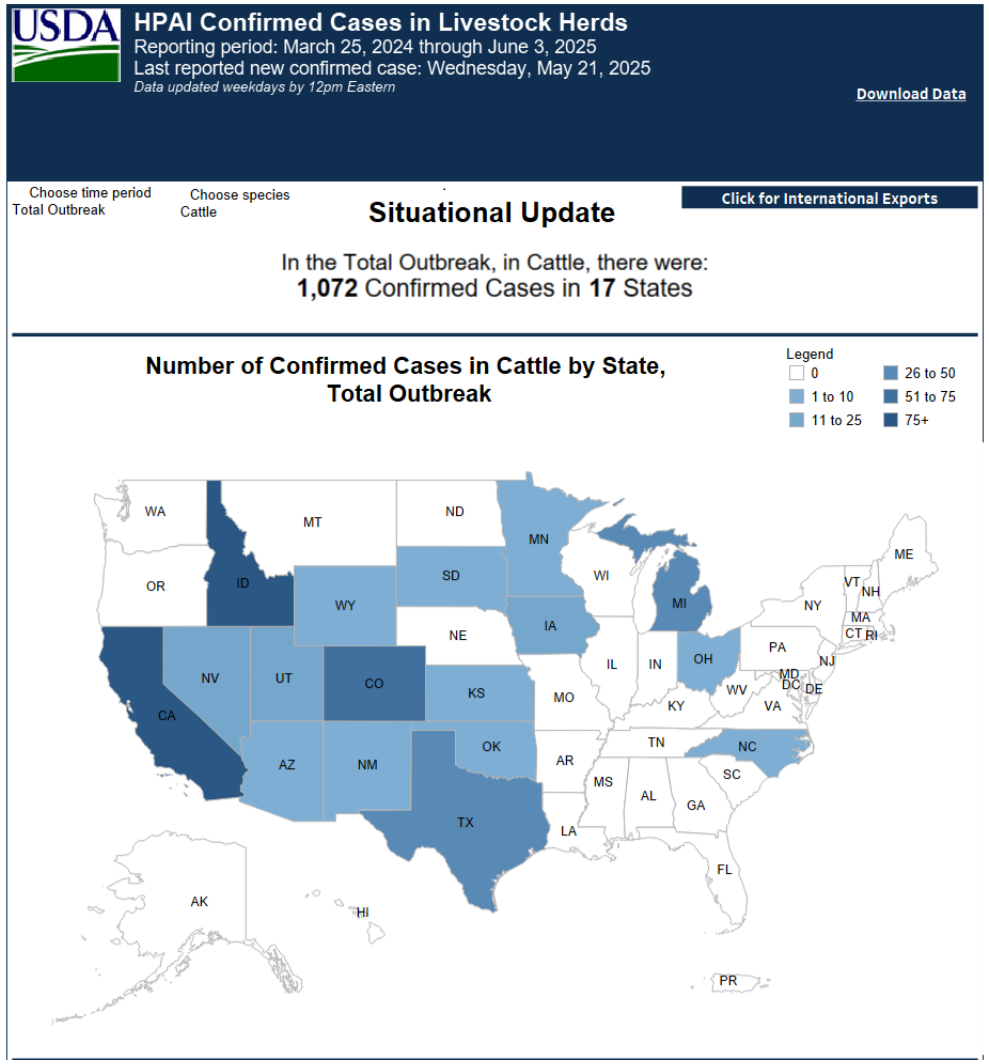
Cases of HPAI in U.S. poultry since February 2022

WOAH non-poultry: Defined by the World Organization of Animal Health as "birds that are kept in a single household, the products of which are used within the same household exclusively, provided that they have no direct or indirect contact with poultry or poultry facilities



Source: USDA, APHIS (https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/commercial-backyard-flocks)

H5N1 in Dairy Operations



Epidemiological Studies from the 2014-2015 H5N2 Outbreak

AVIAN DISEASES 60:460–466, 2016

Factors Associated with Highly Pathogenic Avian Influenza H5N2 Infection on Table-Egg Layer Farms in the Midwestern United States, 2015

Lindsey Garber,[AC] Kathe Bjork,[A] Kelly Patyk,[A] Thomas Rawdon,[B] Maria Antognoli,[A] Amy Delgado,[A] Sara Ahola,[A] and Brian McCluskey[A]

[A]United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Science Technology and Analysis Services, Center for Epidemiology and Animal Health, 2150 Centre Avenue, Building B, Fort Collins, CO 80526
[B]Incursion Investigation and Surveillance Team, Investigation Diagnostic Centres and Response Directorate, Ministry for Primary Industries, 66 Ward Street, Wallaceville, Upper Hutt 5040, New Zealand

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Results from farm-level analysis

Characteristic	% Case farms	% Control farms	Odds Ratio	p value
In an existing control zone	50	10	32.0	0.002
Rendering trucks near barn	29	3	23.3	<0.001
Garbage trucks near barn	61	23	14.7	<0.001
Visitors change clothes	77	93	0.08/12.6	0.01
Service person visit in last 14 days	50	19	5.0	<0.001

Results from barn-level analysis

Characteristic	% Case farms	% Control farms	Odds Ratio	p value
Barn entry with hard surface entry pad cleaned and disinfected	28.6	53.6	0.16/6.9	0.01
Disposing of dead birds near a barn (27 m)	60.7	35.5	2.8	0.02
Having ceiling or eaves inlet ventilation type (compared with curtain, sidewall, or tunnel types)	48.2	67.7	0.33/3.0	<0.001

Epidemiological Studies from the 2025 H5N1 Outbreak

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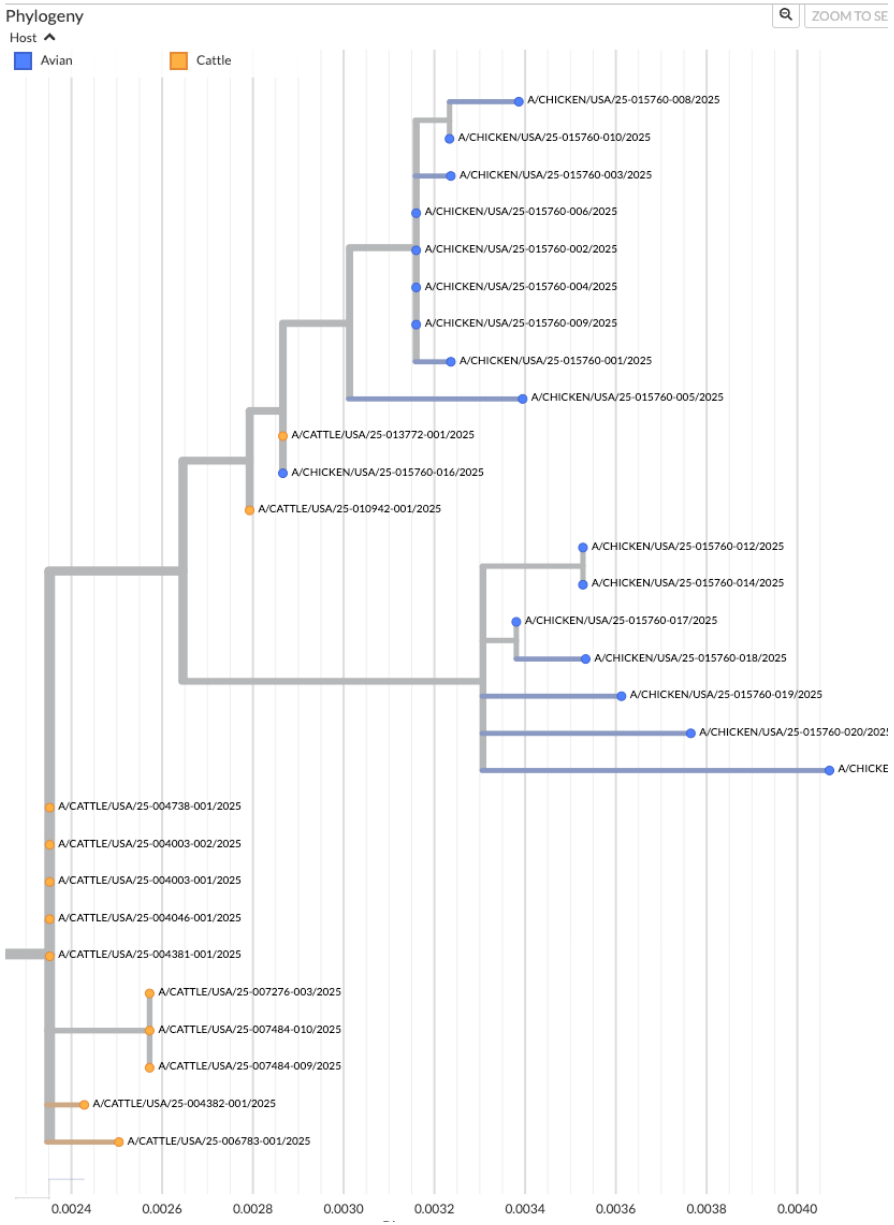
Green AL, Branan M, Fields VL, Patyk K,

Investigation of risk factors for introduction of highly pathogenic avian influenza H5N1 virus onto table egg farms in the United States, 2022: a case–control study

Alice L. Green[1]*, Matthew Branan[1], Victoria L. Fields[1], Kelly Patyk[1], Stephanie K. Kolar[1], Andrea Beam[1], Katherine Marshall[1], Rachel McGuigan[1], Matthew Vuolo[1], Alexis Freifeld[1], Mia Kim Torchetti[2], Kristina Lantz[2] and Amy H. Delgado[1]

Results from operation-level analysis

Characteristic	Odds Ratio	p value
Flock Size (>500,000)	2.6	0.59
Farm in existing control zone	10.3	0.09
Wild waterfowl or shorebirds in closest crop field during 14-day reference period	5.8	0.12
Was there a gate at the farm entrance	3.8	0.21
Were there always different personnel working in different barns	6.2	0.34



Molecular Epidemiology

- Comparing viruses across operations
- Comparing viruses across species
- Comparing viruses across time

Epidemiological Evidence of Airborne Transmission

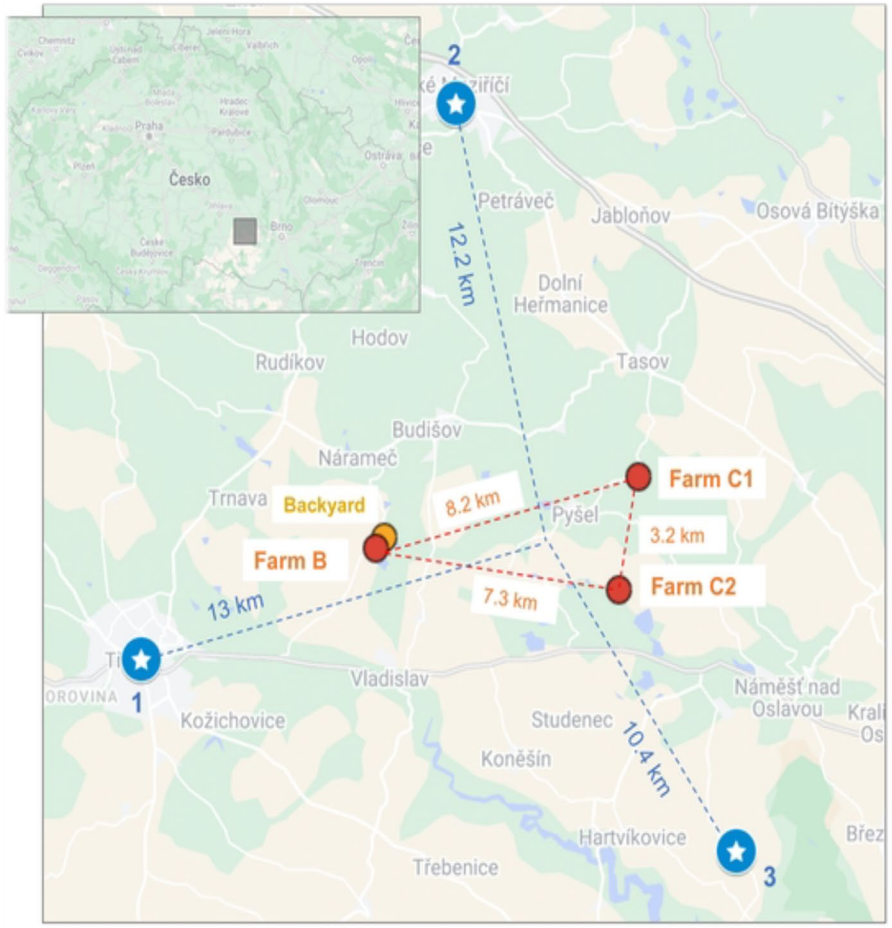


Figure1

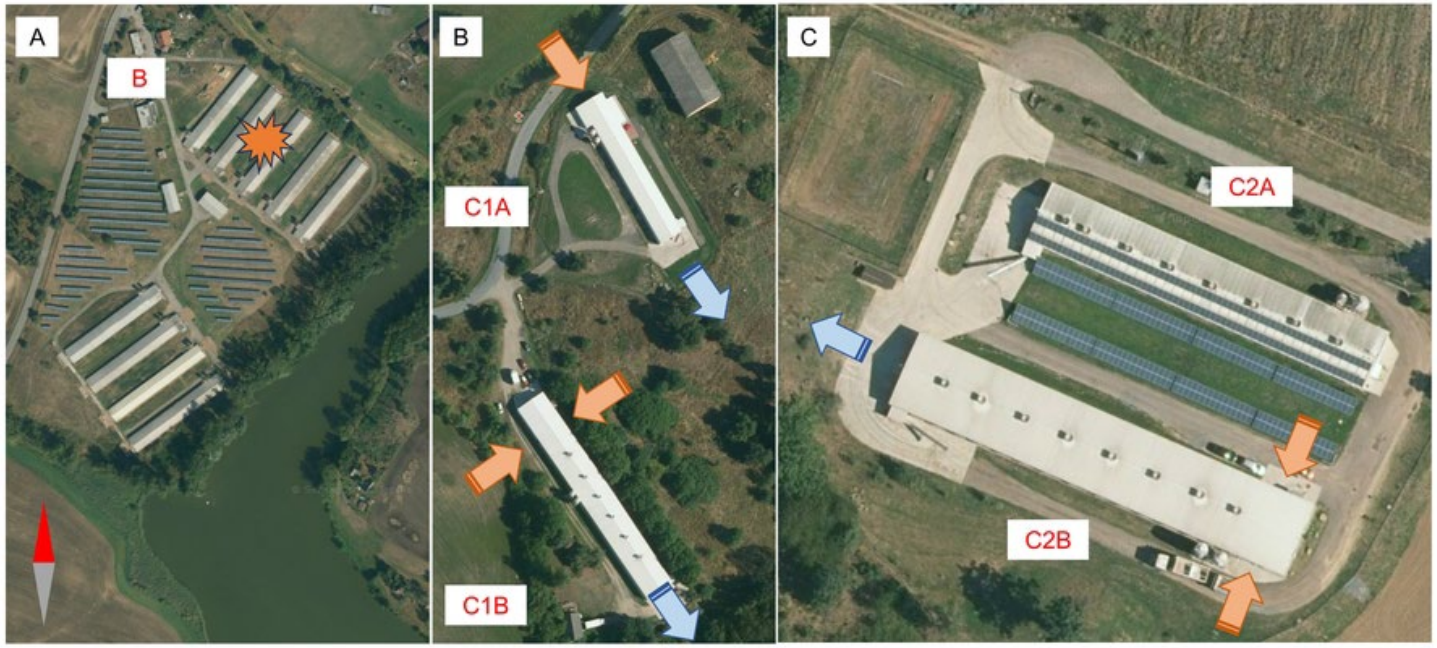


Figure2

Nagy et al., Genetic data and meteorological conditions: unravelling the windborne transmission of H5N1 high-pathogenicity avian influenza between commercial poultry outbreaks, bioRxiv, 2025

New technologies for improving detection, control and mitigation of HPAI

Surveillance

Improving surveillance through rapid detection

Airborne Transmission

Mitigating potential airborne transmission pathways

Biosecurity

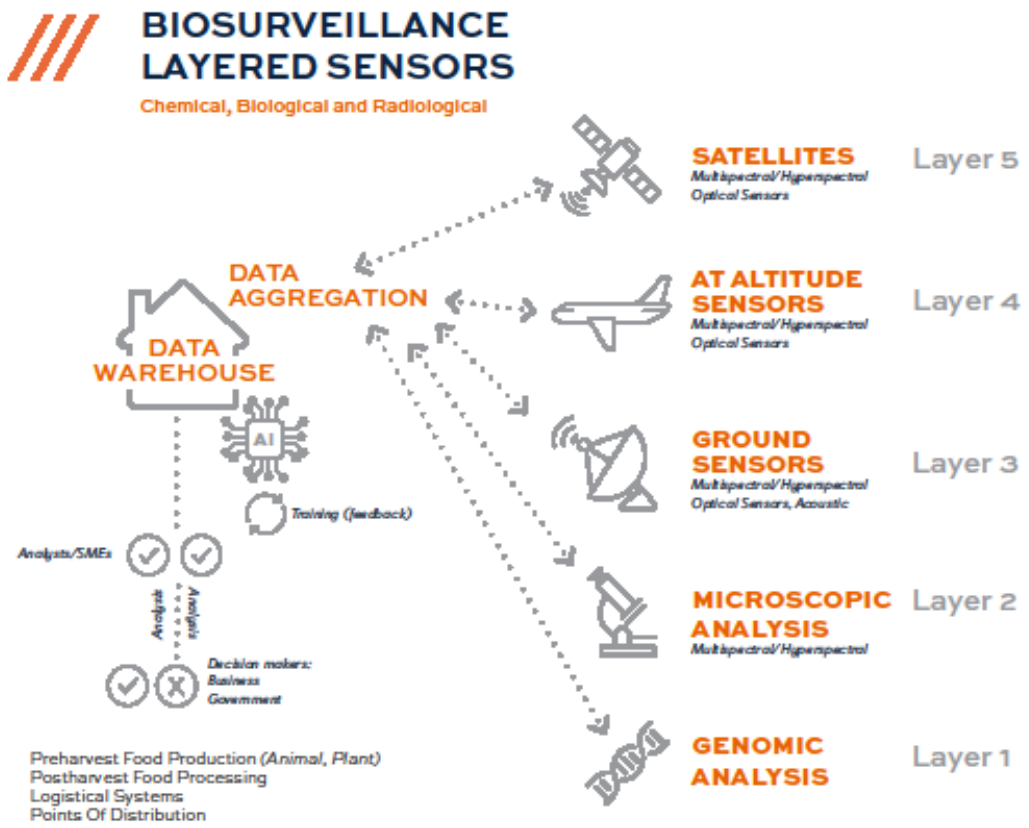
Improving current biosecurity practices

Vaccination

Controlled and monitored use of effective vaccines

Hyperspectral imaging

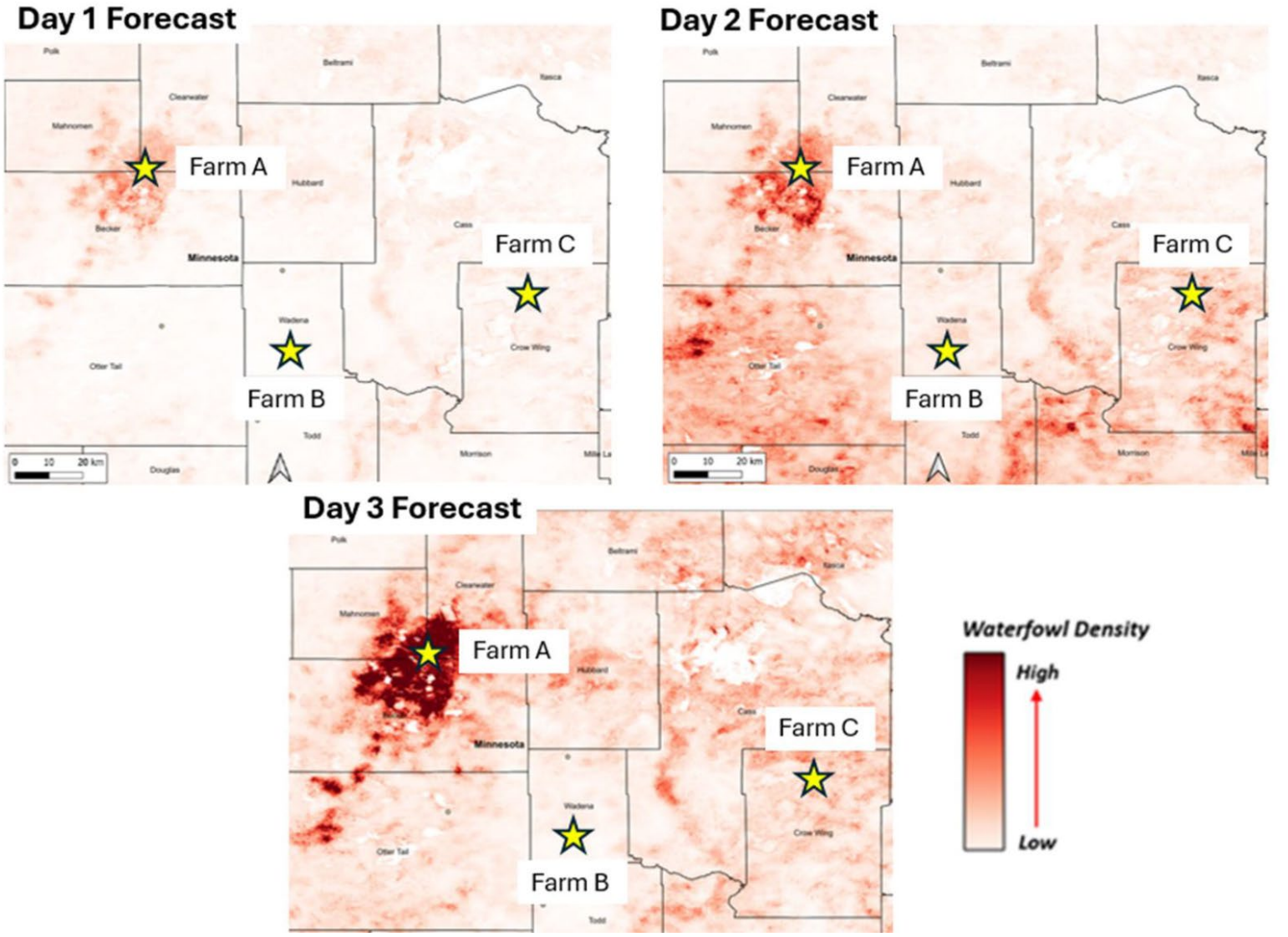
Multiple layers of sensors from the ground to space systems feed near real-time data to an algorithm trained to identify the genomic signatures of known diseases. This system is composed of sensor inputs from the microscopic and genomic to space-based hyperspectral imagery.



Graphic courtesy of Dr. Cris Young, Auburn University

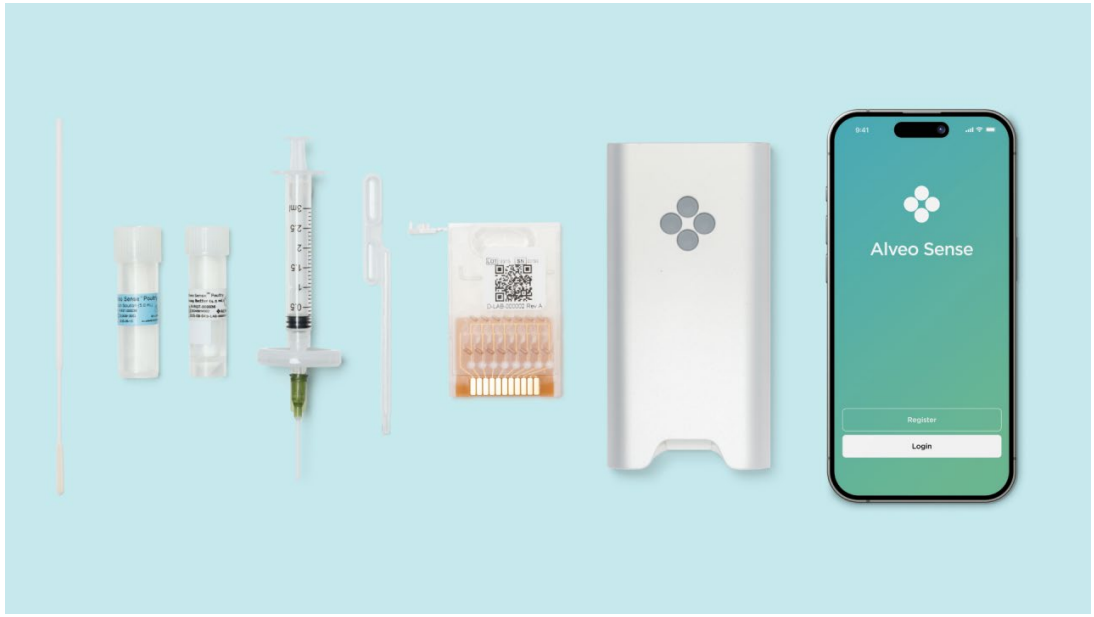
Waterfowl Alert Network

- Daily roosting models from November to end of March
- Models track presence/absence of waterfowl & density
- Daily and seasonal waterfowl ranking for farms
- High resolution (up to 250m granularity).
- Farm location integrated into maps
- Alerts for farms within counties of HPAI detections

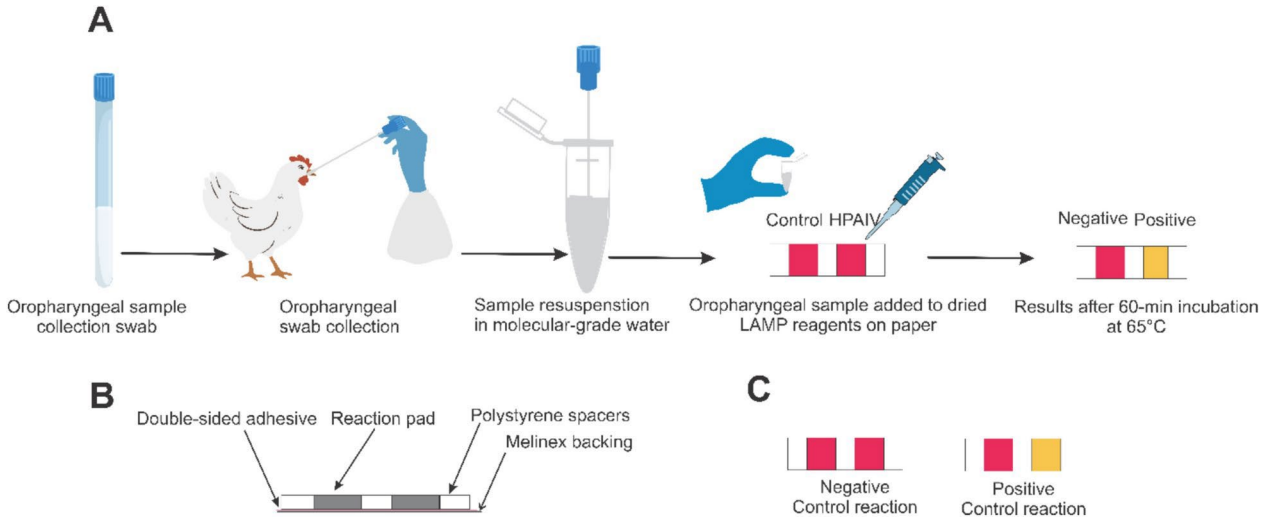


Graphic courtesy of Matt Hardy at the Agrinerds Network

Point of Care or Barn-side Diagnostics

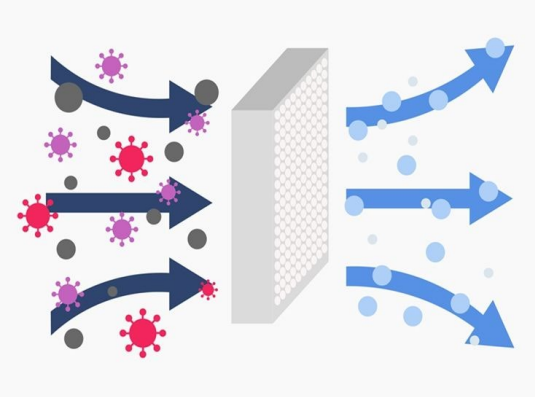


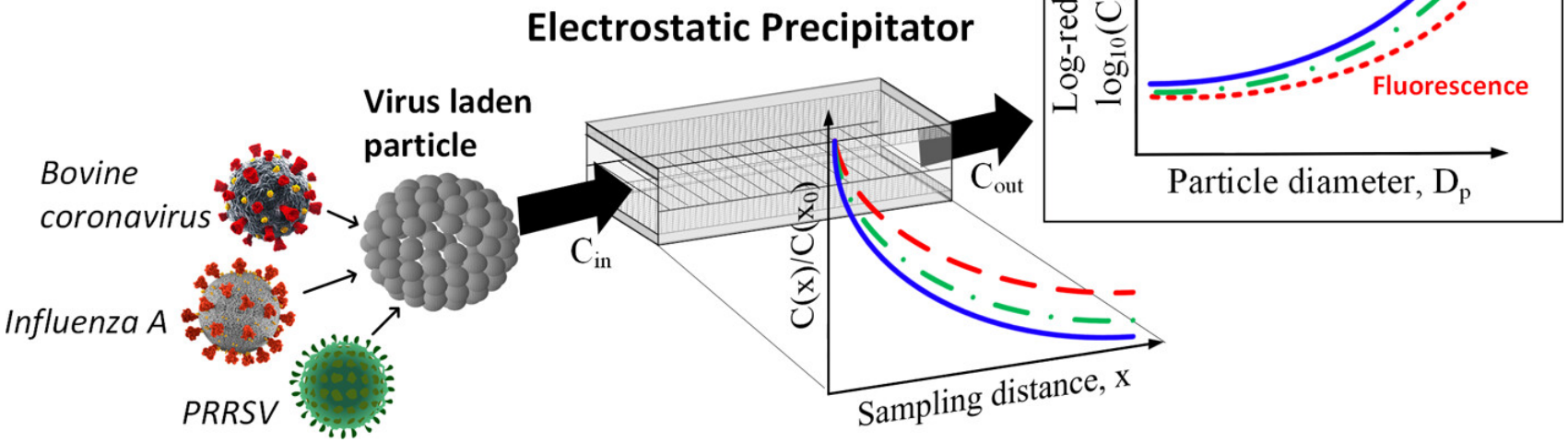
*Point of care" or field-based tests move more definitive, **but still presumptive**, diagnostic power out of the lab (totally under official control) and into the field.*



Mitigating airborne transmission

- Air filtration
- UV-C light
- Electrostatic precipitation





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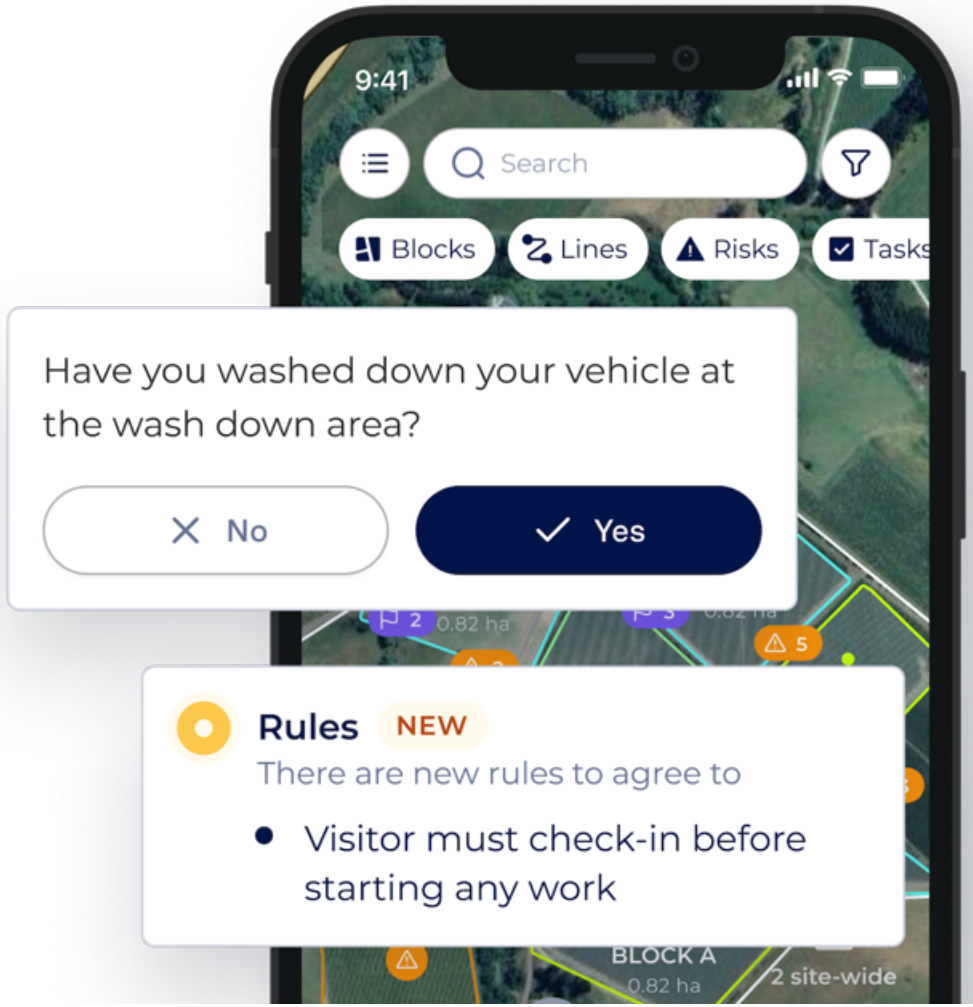

Improving Biosecurity through Monitoring

- Check-in rules
- Check-in questions
- Tracing dashboard

Vaccination

- HPAI vaccination would serve as a complementary tool to existing biosecurity practices
- Increase resistance to becoming infected with H5N1
- Reduce virus shedding
  - Decreases environmental contamination
  - Reduces potential transmission
  - Reduces new outbreaks

Keys to Vaccination Success

- Define vaccination zones by state or county through risk-based prioritization program
- Surveillance of vaccinated flocks
  - Measure vaccine effectiveness to ensure immunity
  - Detection of any potential active virus infections
  - Monitor changes in the virus
- Use of safe, pure, potent, efficacious USDA licensed vaccines

World Organisation for Animal Health

"Vaccination is compatible with the pursuit of safe trade in poultry and poultry products."

Thank you for your attention

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