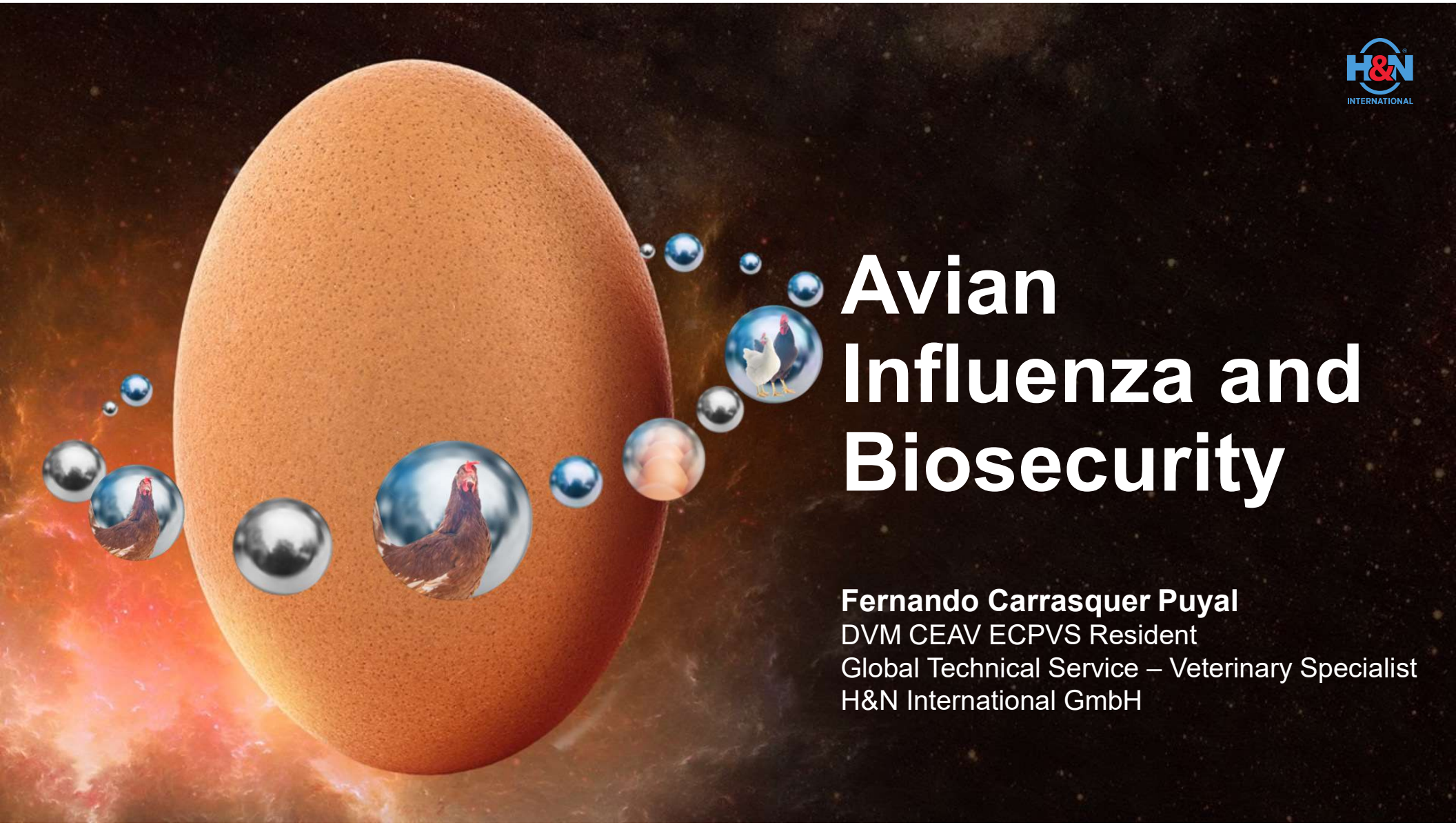


Avian Influenza and Biosecurity

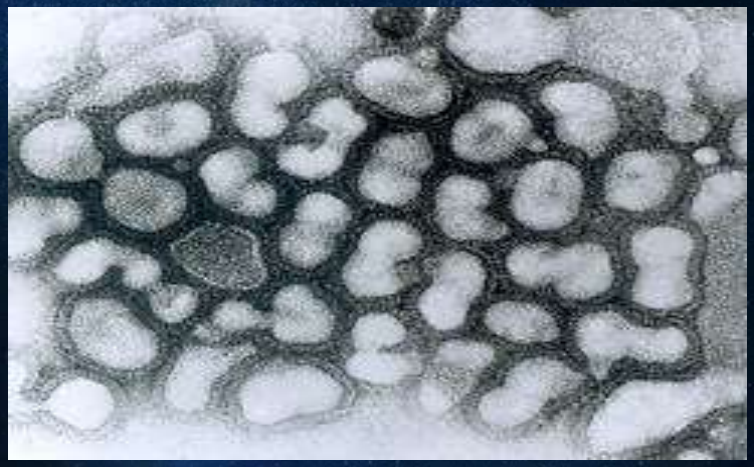
Fernando Carrasquer Puyal
DVM CEAV ECPVS Resident
Global Technical Service – Veterinary Specialist
H&N International GmbH

Highly Pathogenic Avian Influenza

TAXONOMICAL CLASSIFICATION

- **Realm:** *Riboviria*
  - **Kingdom:** *Orthornavirae* Realm: *Riboviria*
    - + **Phylum:** *Duplornaviricota* Kingdom: *Orthornavirae*
    - + **Phylum:** *Kitrinoviricota* Kingdom: *Orthornavirae*
    - + **Phylum:** *Lenarviricota* Kingdom: *Orthornavirae*
    - − **Phylum:** *Negarnaviricota* Kingdom: *Orthornavirae*
      - − **Subphylum:** *Haploviricotina* Phylum: *Negarnaviricota*
        - + **Class:** *Chunqiuviricetes* Subphylum: *Haploviricotina*
        - + **Class:** *Milneviricetes* Subphylum: *Haploviricotina*
        - + **Class:** *Monjiviricetes* Subphylum: *Haploviricotina*
        - + **Class:** *Yunchangviricetes* Subphylum: *Haploviricotina*
      - − **Subphylum:** *Polyploviricotina* Phylum: *Negarnaviricota*
        - + **Class:** *Ellioviricetes* Subphylum: *Polyploviricotina*
        - − **Class:** *Insthoviricetes* Subphylum: *Polyploviricotina*
          - − **Order:** *Articulavirales* Class: *Insthoviricetes*
            - + **Family:** *Amnoonviridae* Order: *Articulavirales*
            - − **Family:** *Orthomyxoviridae* Order: *Articulavirales*
              - − **Genus:** *Alphainfluenzavirus* Family: *Orthomyxoviridae*
                - **Species:** *Alphainfluenzavirus influenzae* Genus: *Alphainfluenzavirus*
              - + **Genus:** *Betainfluenzavirus* Family: *Orthomyxoviridae*
              - + **Genus:** *Deltainfluenzavirus* Family: *Orthomyxoviridae*
              - + **Genus:** *Gammainfluenzavirus* Family: *Orthomyxoviridae*
              - + **Genus:** *Isavirus* Family: *Orthomyxoviridae*

ICTV



Picture: Wikipedia

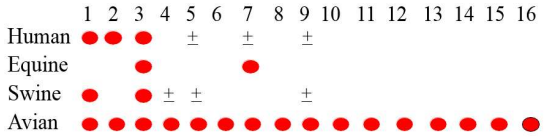
Family: Orthomyxoviridae
Genus: Alphainfluenzavirus
Specie: Alphainfluenzavirus influenzae

Highly Pathogenic Avian Influenza

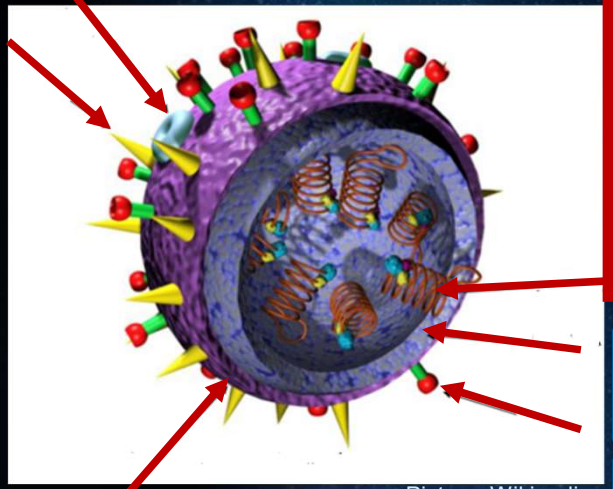
AIV STRUCTURE

M2 protein

Hemagglutinin



Lipid envelope

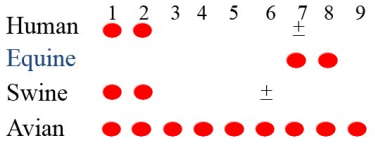


Picture: Wikipedia

Segmented RNA

M1 protein

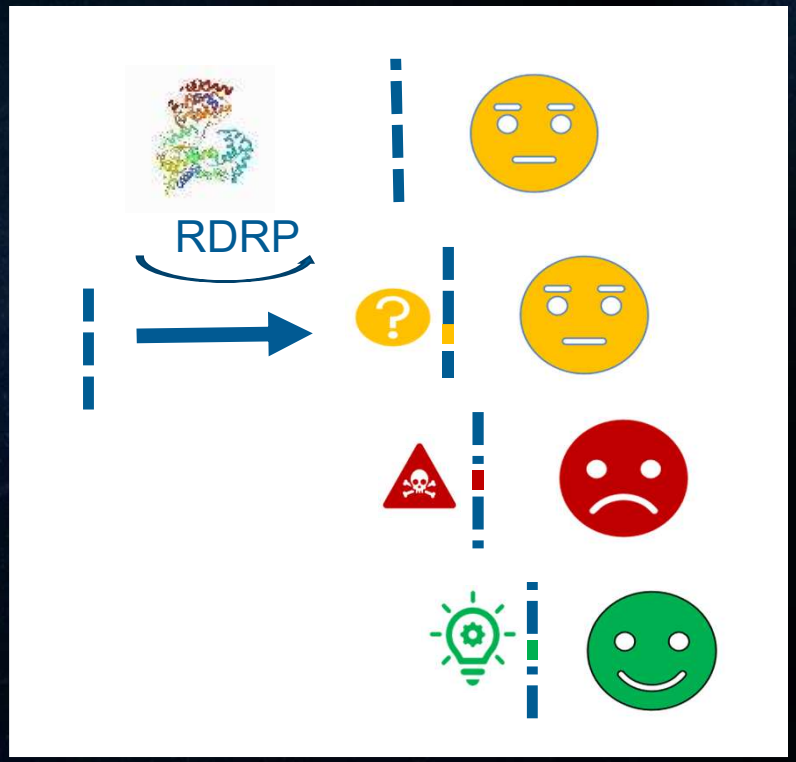
Neuraminidase



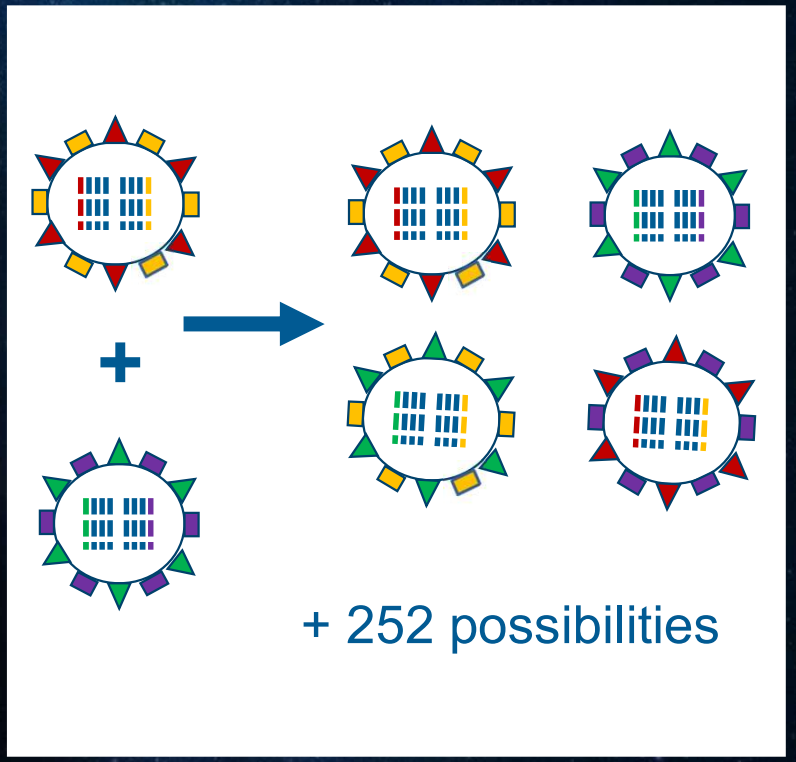
Highly Pathogenic Avian Influenza

A BREAKAWAY ARTIST...

Antigenic drift



Antigenic shift



Highly Pathogenic Avian Influenza

INFLUENZA IN OTHER SPECIES

H3, H7

H10

H4, H7, H13

H5

H1 – H16

H1,H2,H3

(H7?)

(H5,H7)

H5,H7,H9

H1,H2,H3
(H5, H7)

Wahlgren 2011

Picture: Wikipedia

Highly Pathogenic Avian Influenza

52 OUTBREAKS SINCE 1963: 7 ACTIVE, 3 ENTRECHTED

Source:
WOAH 2025

Highly Pathogenic Avian Influenza

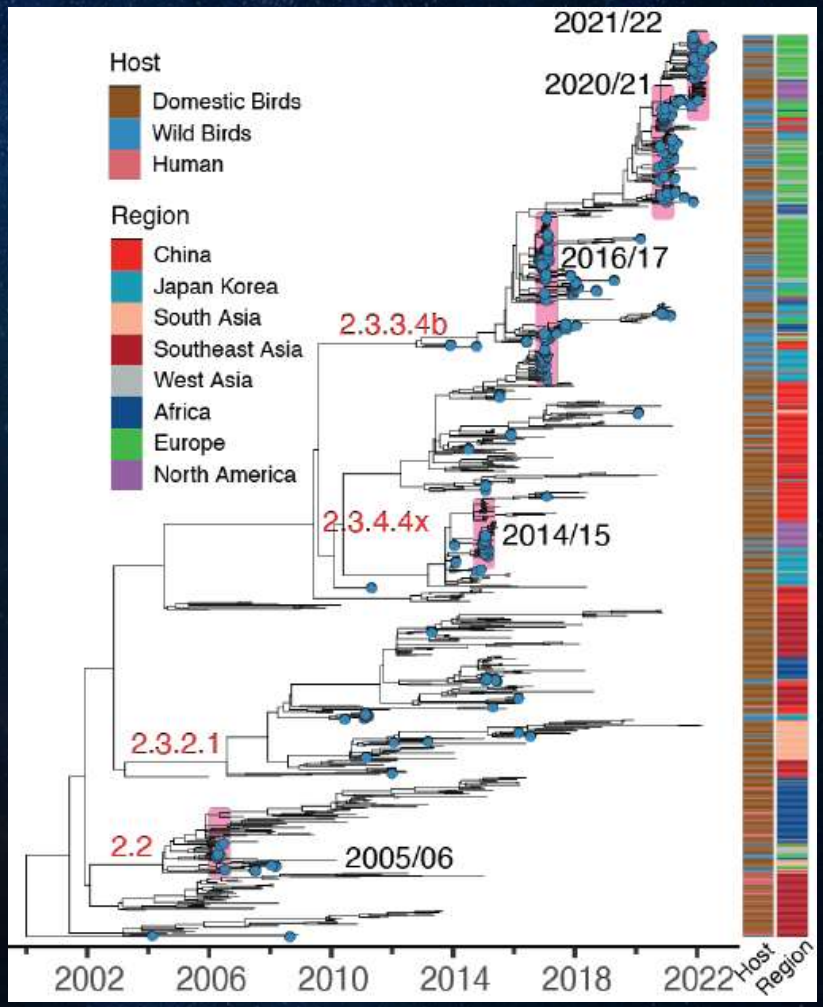
LINEAGE H5Nx Gs/GD A/goose/Guangdong/1/96-like

It originated from geese in Guangdong Province, China in 1996.

High capacity for evolution

High adaptability to different birds and mammals

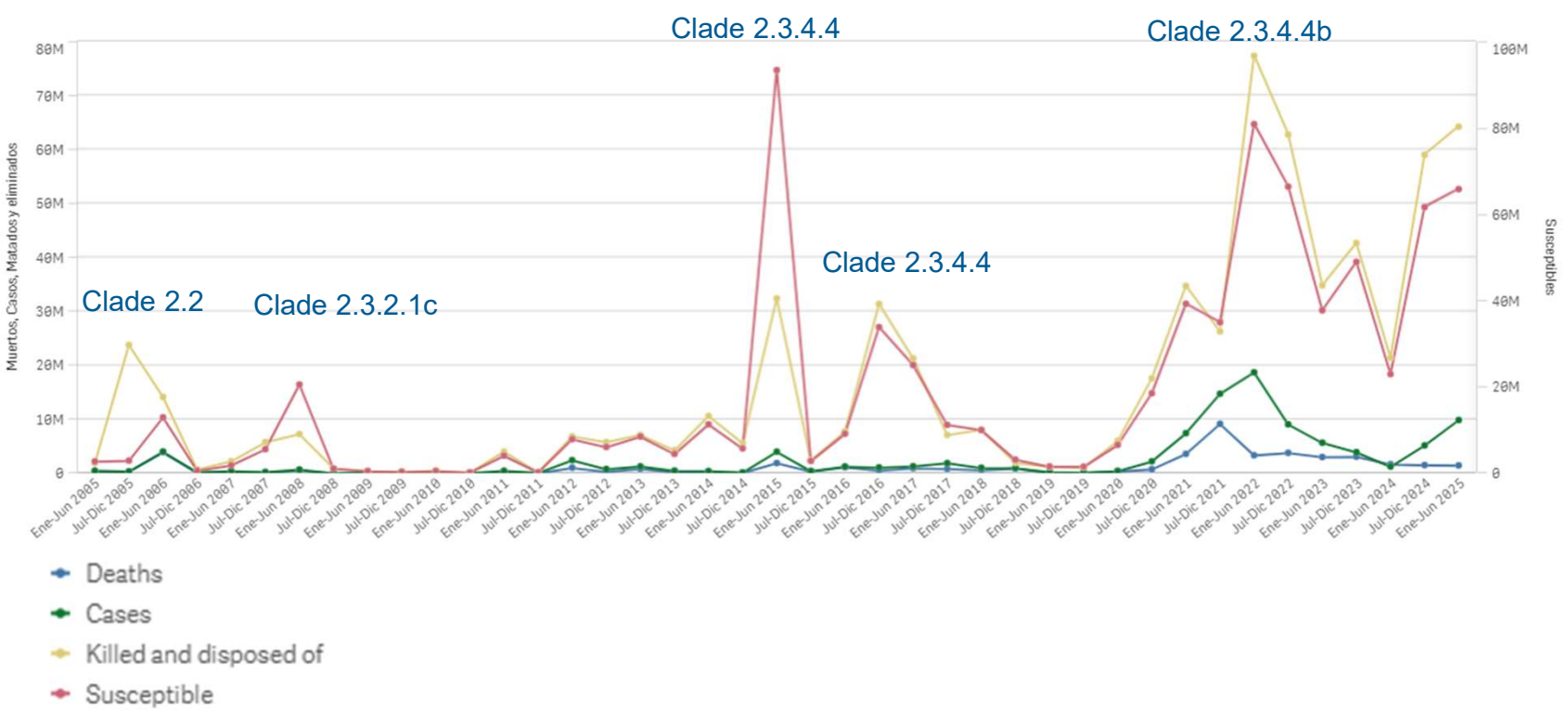
5 waves reported in recent years



Source: Ruopeng 2022

Highly Pathogenic Avian Influenza

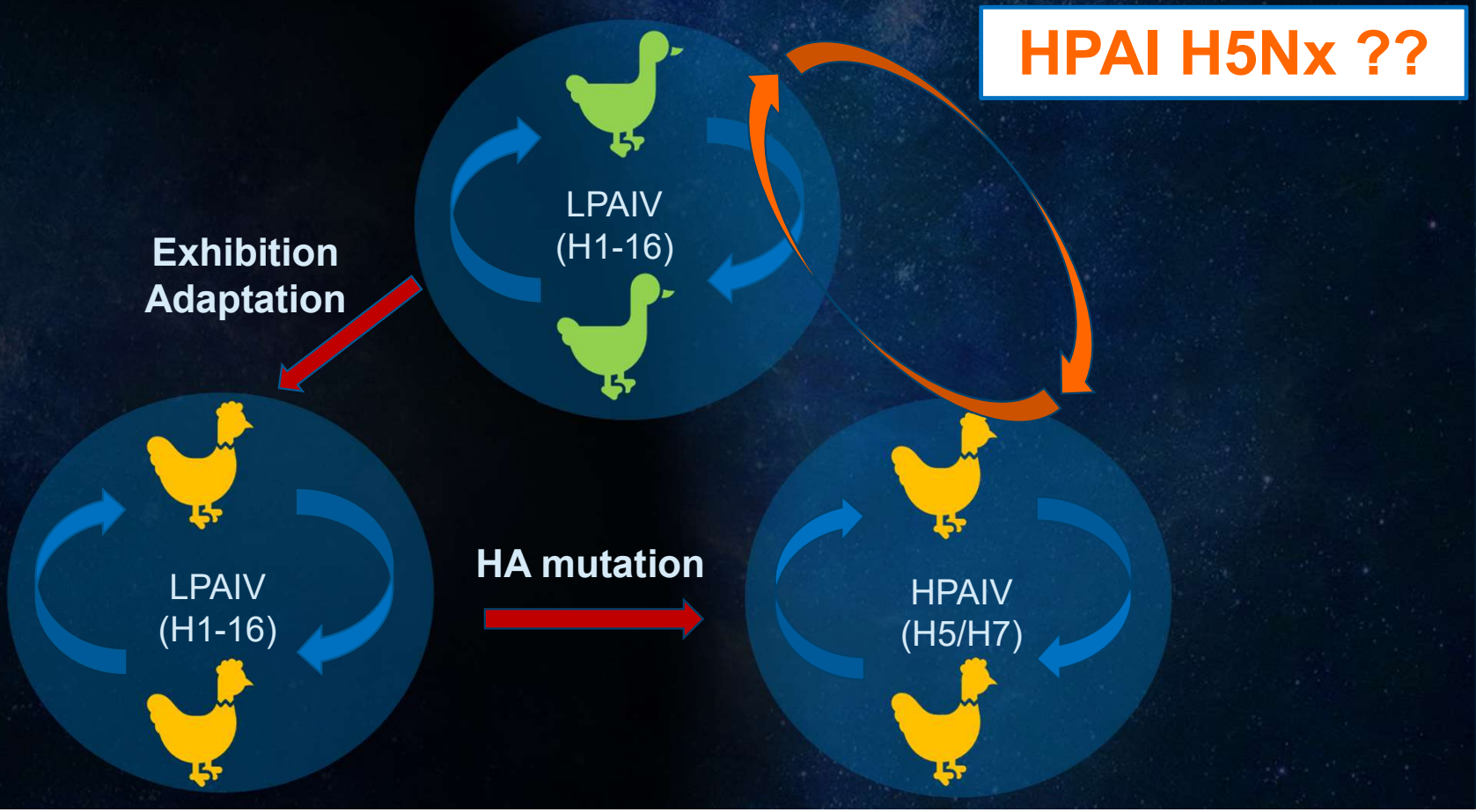
HPAI H5N1 2.3.4.4b: EVOLUTION AND WAVES



Source:
WOAH 2025

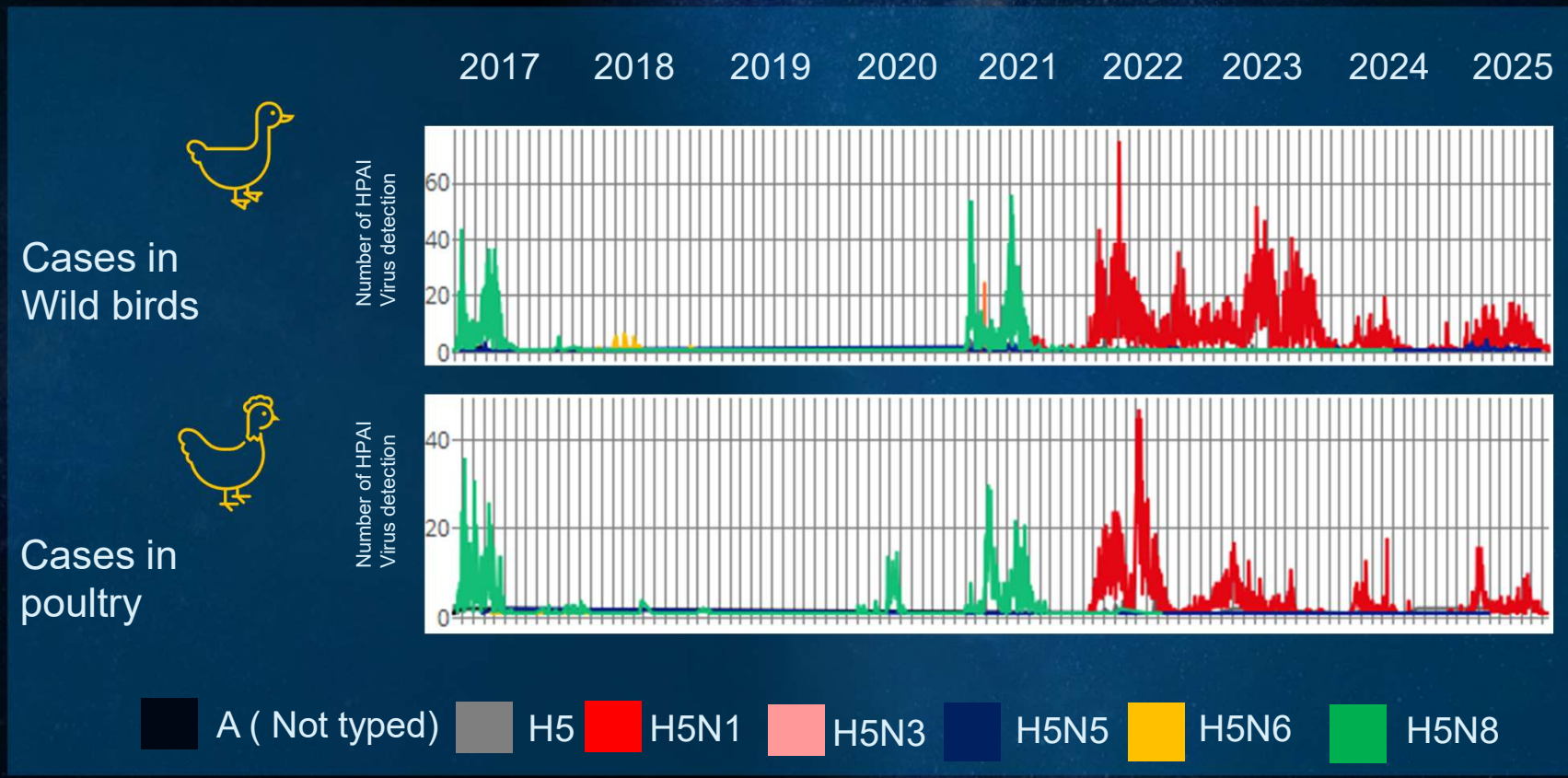
Highly Pathogenic Avian Influenza

INFECTION ROUTE



Highly Pathogenic Avian Influenza

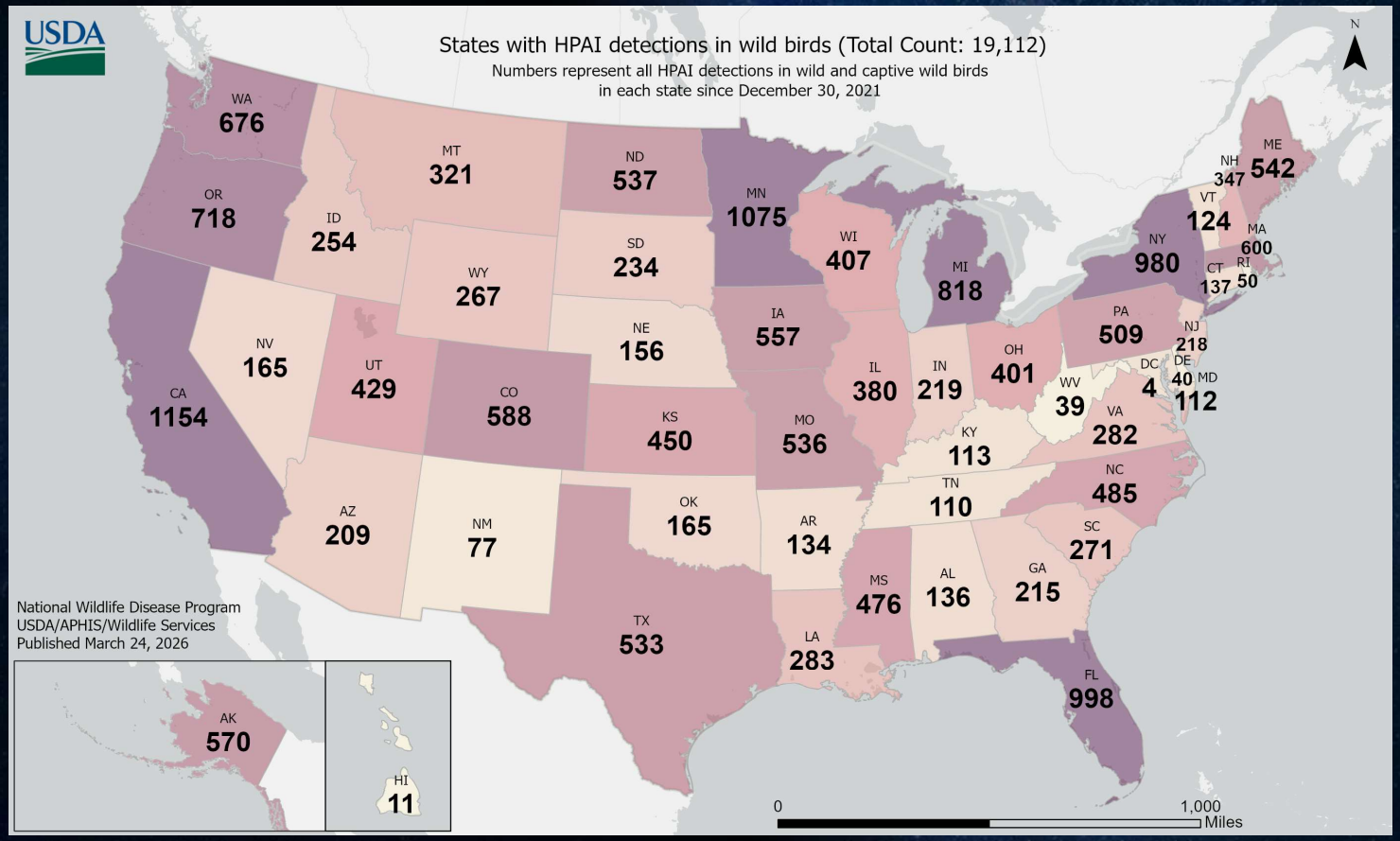
SURVEILLANCE IN WILD BIRDS IN EUROPE



Sources:
EFSA 2025

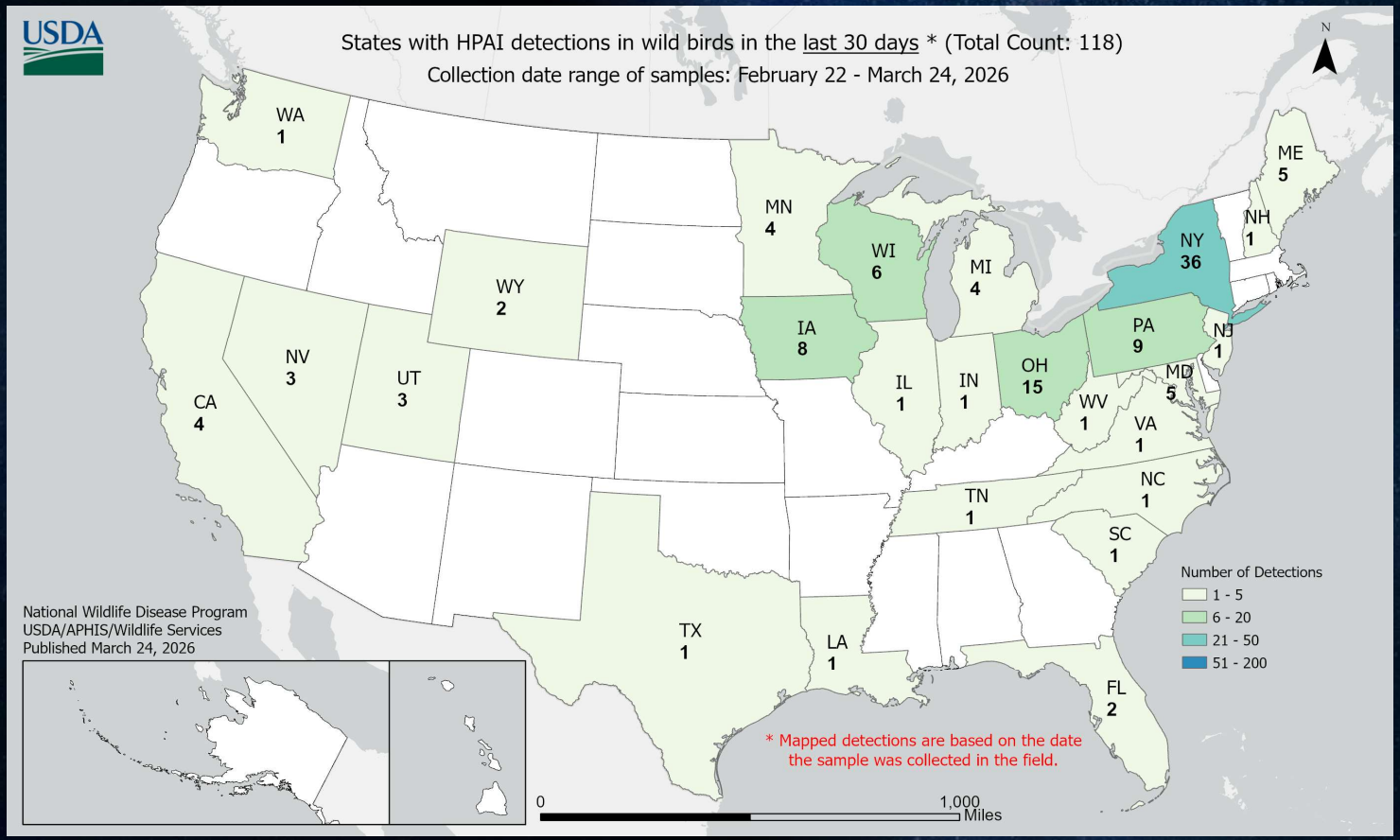
Highly Pathogenic Avian Influenza

SURVEILLANCE IN WILD BIRDS IN UNITED STATES



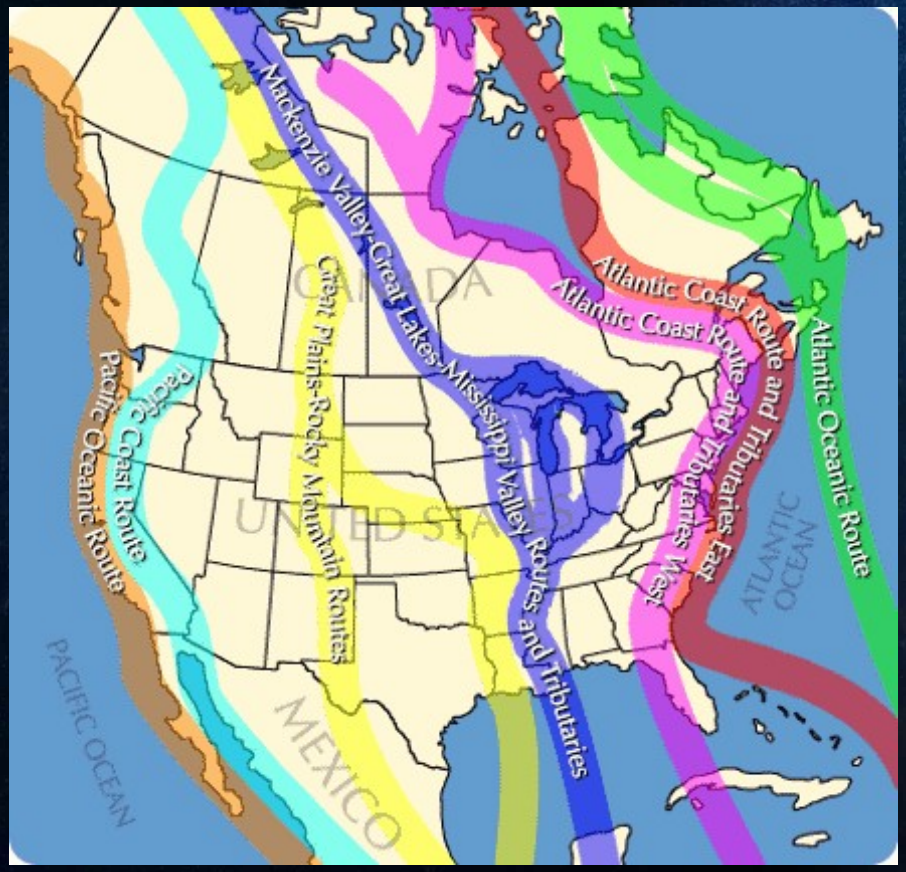
Highly Pathogenic Avian Influenza

SURVEILLANCE IN WILD BIRDS IN UNITED STATES



Highly Pathogenic Avian Influenza

MIGRATORY BIRDS FLYWAYS IN NORTH AMERICA



Spring Migration (Northbound):

Starts as early as February for birds like Red-winged Blackbirds and waterfowl (ducks, geese). By April and May, massive migrations of songbirds and hummingbirds arrive in the northern U.S. and Canada.

Fall Migration (Southbound):

Begins surprisingly early, with some shorebirds moving in July and many others starting by August. The migration continues through October and into early November for many species.

Highly Pathogenic Avian Influenza

BIRD SPECIES AFFECTED BY ORDERS

Anseriformes
Total 100
New* +47

Charadriiformes
Total 124
New* +90

Passeriformes
Total 65
New* +34

Gaviiformes
Total 4
New* +4

Galliformes
Total 18
New* +8

Accipitriformes
Total 59
New* +38

Sphenisciformes
Total 8
New* +6

Pelecaniformes
Total 35
New* +15

Psittaciformes
Total 25
New* +10

Procellariiformes
Total 18
New* +18

Suliformes
Total 28
New* +18

Falconiformes
Total 13
New* +8

Gruiformes
Total 16
New* +7

Columbiformes
Total 9
New* +4

Podicipediformes
Total 8
New* +5

* New species of affected birds by HPAI H5Nx since 2021

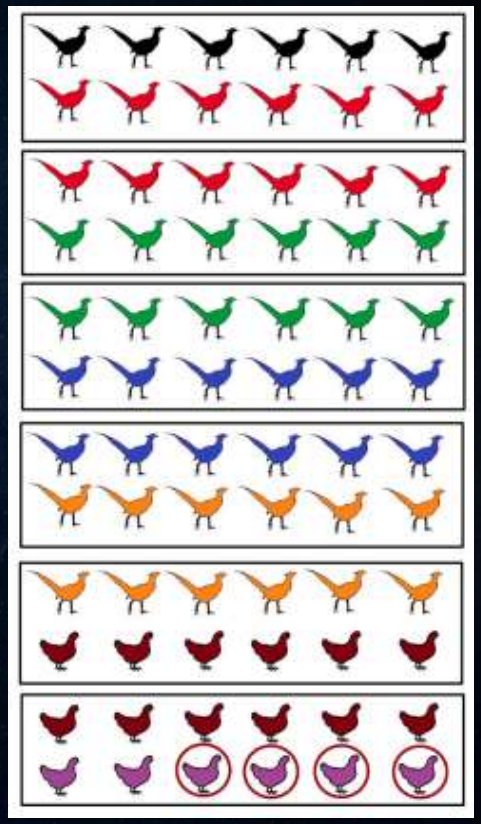
Update:

9/21/2025

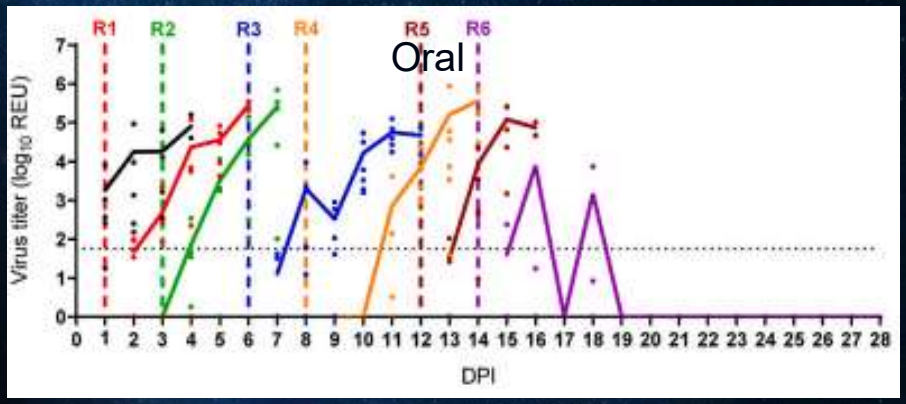
Source:
FAO 2025

Highly Pathogenic Avian Influenza

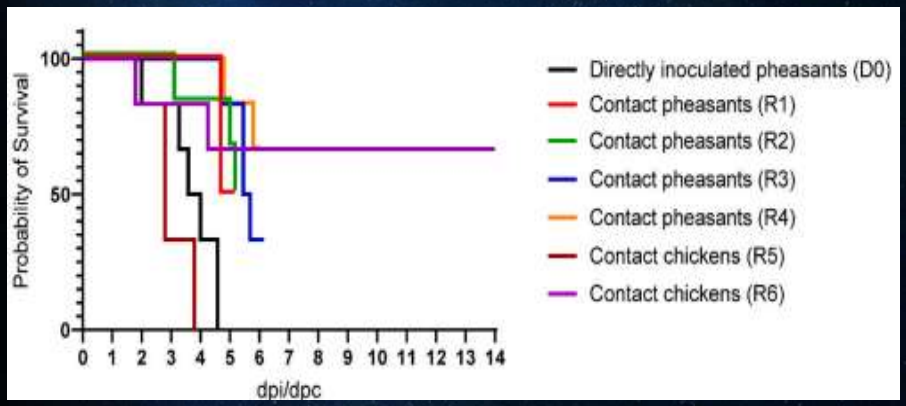
HPAI H5N1 2.3.4.4b: INFECTIONS IN PHEASANTS AND CHICKENS



Viral excretion



Mortality



Source:
Liang 2022

Highly Pathogenic Avian Influenza

HPAI H5N1: DOMESTIC BIRD SPECIES AFFECTED

Gallus gallus (Chicken)

Meleagris gallopavo (Turkey)

Anas platyrhynchos (Duck)

Anserinae sp. (Goose)

Numida meleagris (Guinea fowl)

Phasianus colchicus (Common pheasant)

Coturnix coturnix (Common quail)

Columba livia (Domestic pigeon)

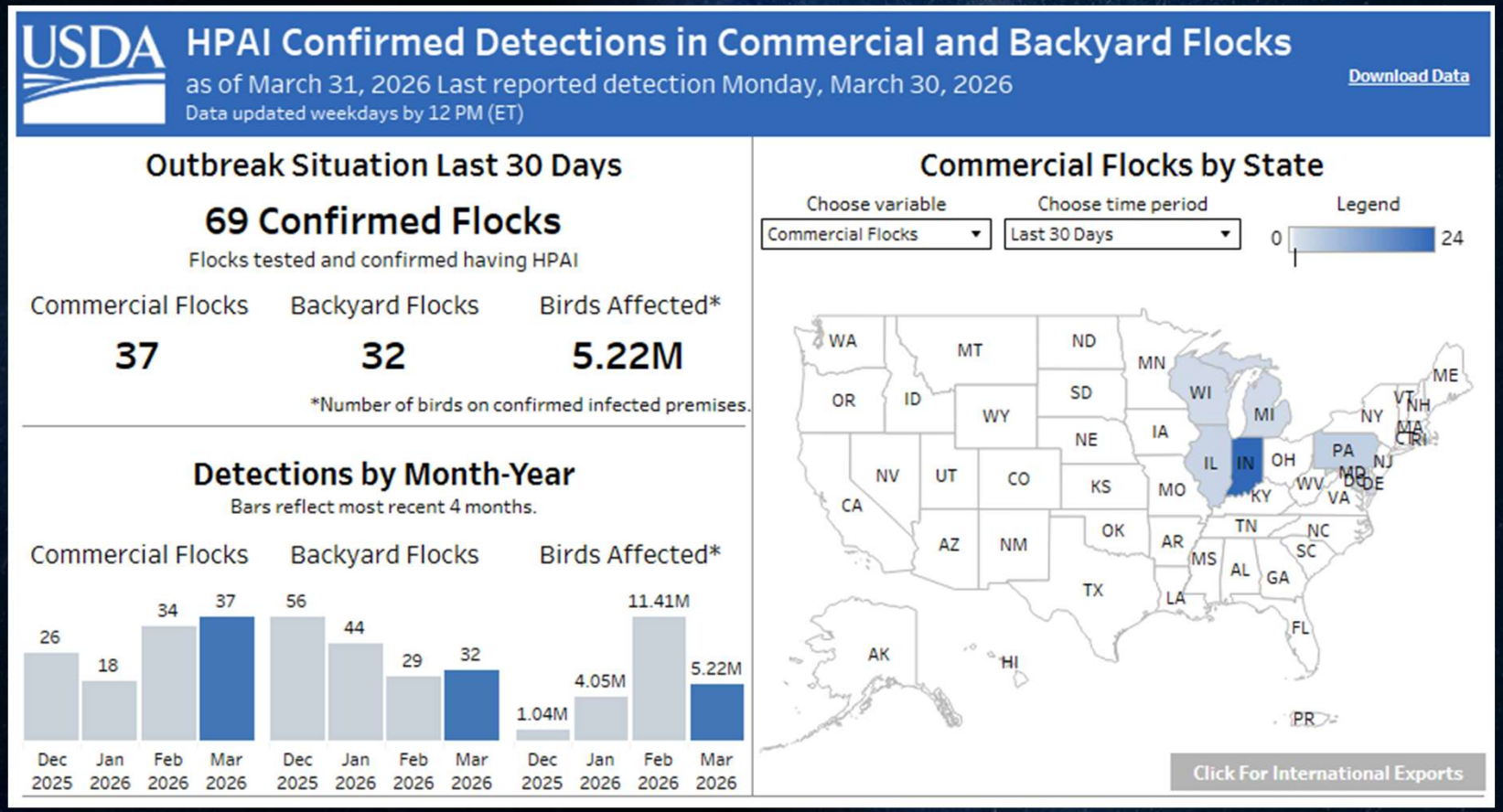
Others:

- Pavo cristatus (Peacock)
- Struthio camelus
- (ostrich)
- Colinus virginianus
- (Northern quail)
- Coturnix japônica (Japanese quail)
- Dromaius novaehollandiae (Emu)

Source: FAO 2025

Highly Pathogenic Avian Influenza

OUTBREAK SITUATION IN UNITED STATES



Source: USDA 2025

Highly Pathogenic Avian Influenza

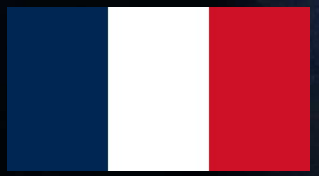
ROLE OF BACKYARD BIRDS

(Bavinck et al., 2009).

HPAI H7N7 (Netherlands, 2004)
Backyard flocks played a marginal role in the spread of diseases

(Tiensin et al., 2005)

HPAI H5N1 (Thailand, 2004)
Backyard flocks (chickens and ducks) played an important role in the epidemic.

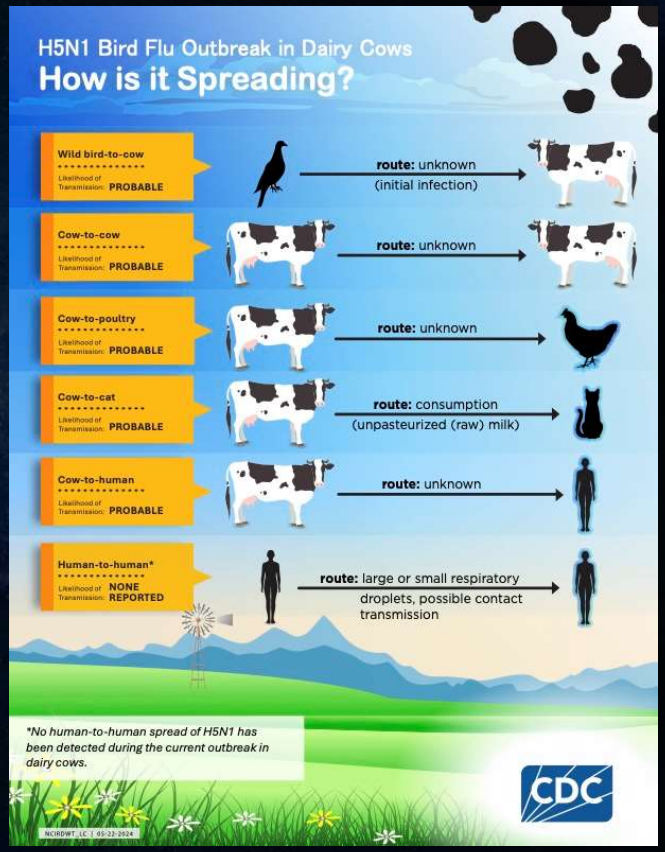


(Souvestre et al., 2019)

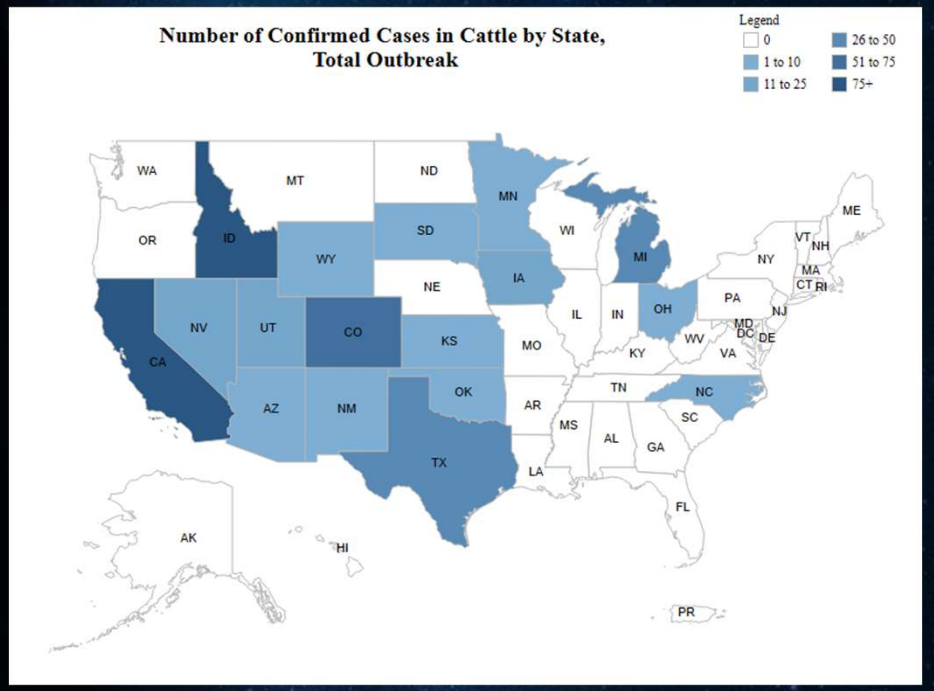
HPAI H5N8 (France, 2017)
Backyard flocks played a minor role in the spread of the disease if biosecurity errors did not occur.

Highly Pathogenic Avian Influenza

HPAI H5N1 2.3.4.4b IN COWS



First case reported in March 2024
1073 cases in 17 states (10/09/2025)

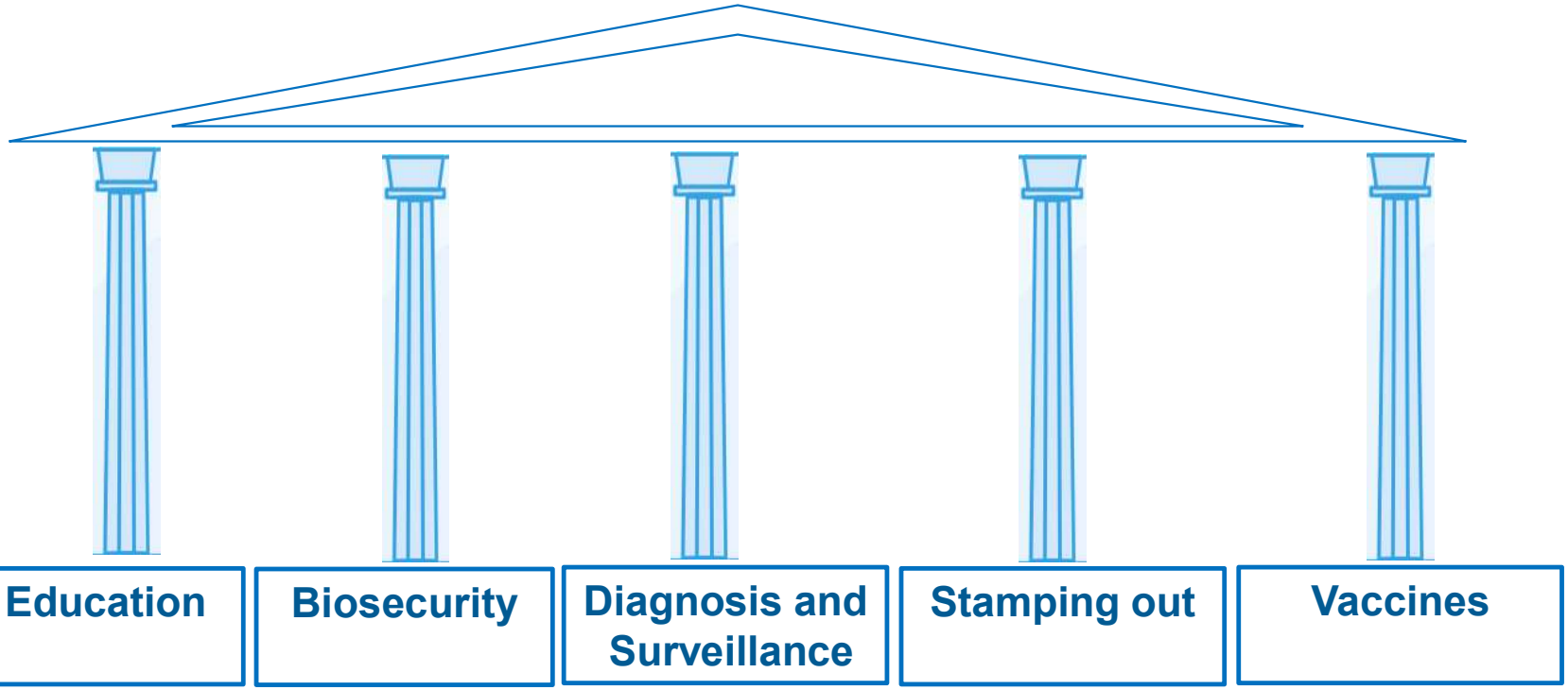


Source:
CDC 2025

AND ... WHAT DO WE DO NOW?

RESISTANCE IS FUTILE, MY YOUNG DUCKAWAN

Avian Influenza Control Programs



Avian Influenza Control Programs

STRATEGY #1: VIGILANCE + STAMPING OUT

Education	++
Biosecurity	++
Diagnosis and Surveillance	++
Stamping out	++
Vaccine	-

Countries using this strategy:

\+

- It allows the country to regain AI-free status.
- Prevents the spread of a disease in the country.

\-

- Expensive and needs a legal framework.
- Needs prior preparation to be implemented correctly

Avian Influenza Control Programs

STRATEGY #2: VACCINATION ONLY

Education	+/-
Biosecurity	+/-
Diagnosis and Surveillance	-
Stamping out	-
Vaccine	+++

Countries using this strategy:

+

- Reducing losses due to the disease
- Quick and easy deployment

-

- The disease remains endemic
- **Export bans**

Avian Influenza Control Programs

STRATEGY #3: SURVEILLANCE + STAMPING OUT + VACCINE

Education	++
Biosecurity	++
Diagnosis and Surveillance	+++
Stamping out	+
Vaccine	+

Countries using this strategy:

 (Only in ducks)

 (In the past)

\+

- Use all available means for control
- Prevents the spread of a disease in the country.

\-

- Extremely expensive and difficult to implement.
- Export bans ?

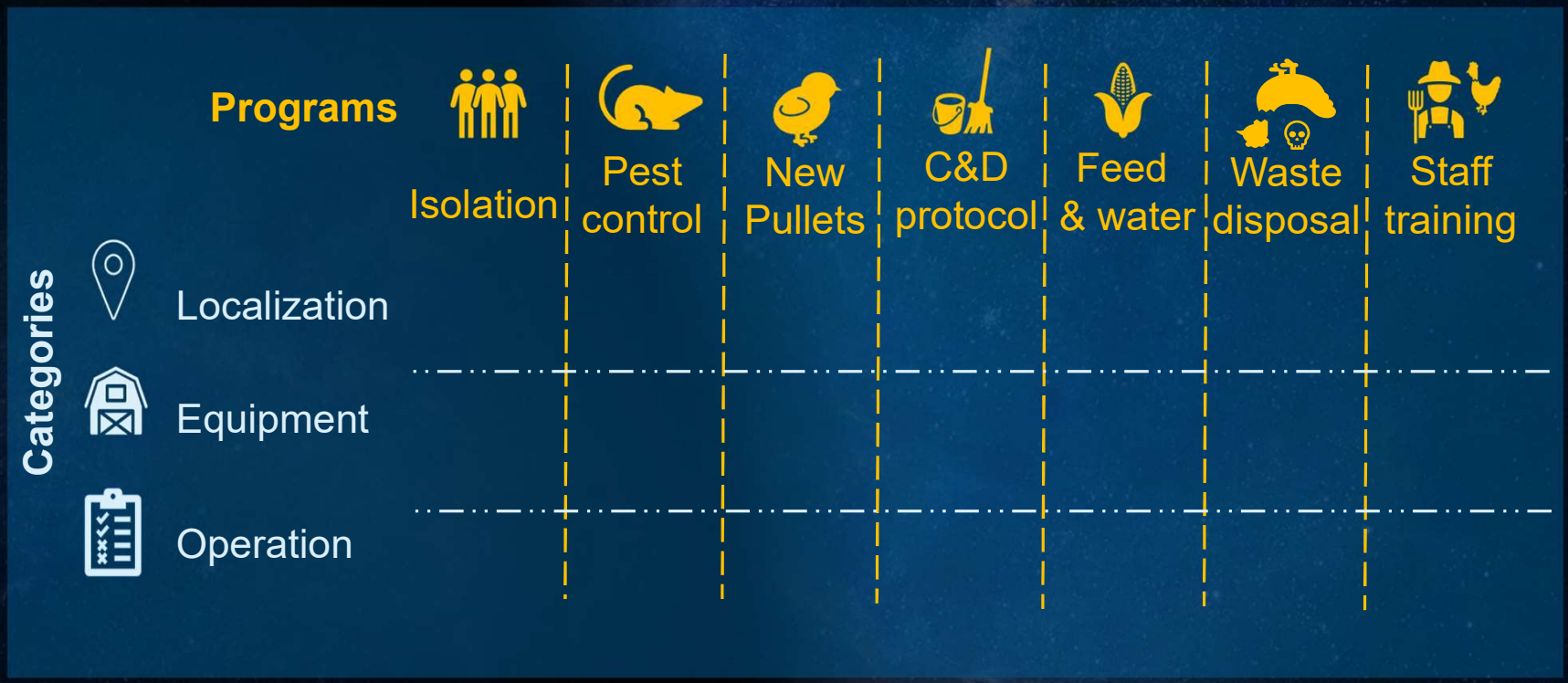
Understanding Biosecurity

A CLEAR DEFINITION

A set of **management and physical measures** designed **to reduce the risk** of **introduction, establishment and spread** of animal **diseases, infections or infestations** to, from and within an **animal population**.

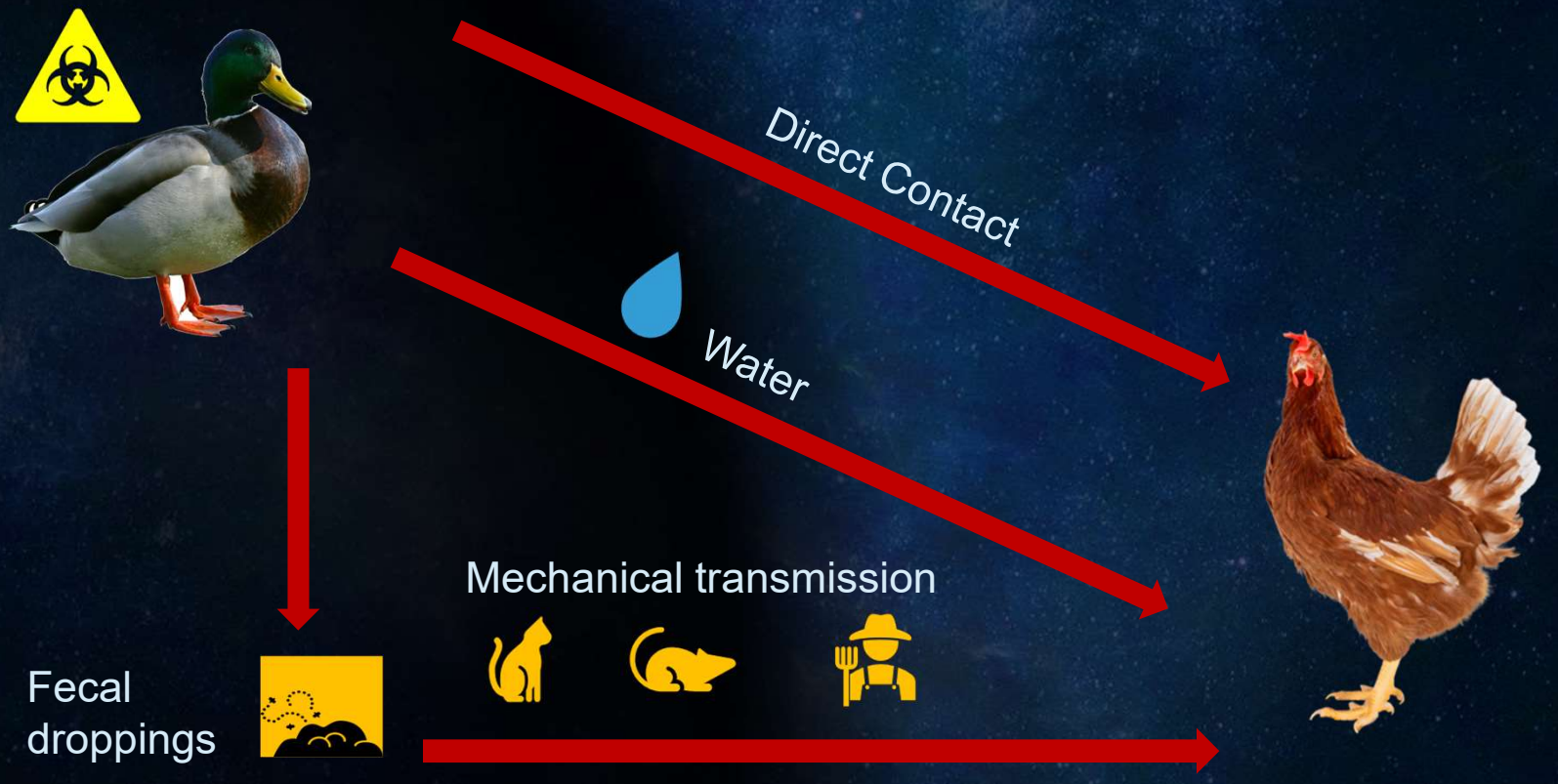
WOAH Terrestrial Animal Health Code

H&N Biosecurity Concept



Epidemiology

TRANSMISSION FROM MIGRATORY BIRDS



Bioseguridad

TOXIC RELATIONSHIPS

Biosecurity

WILD BIRDS: THE FLYING RODENTS (EVEN WORSE)

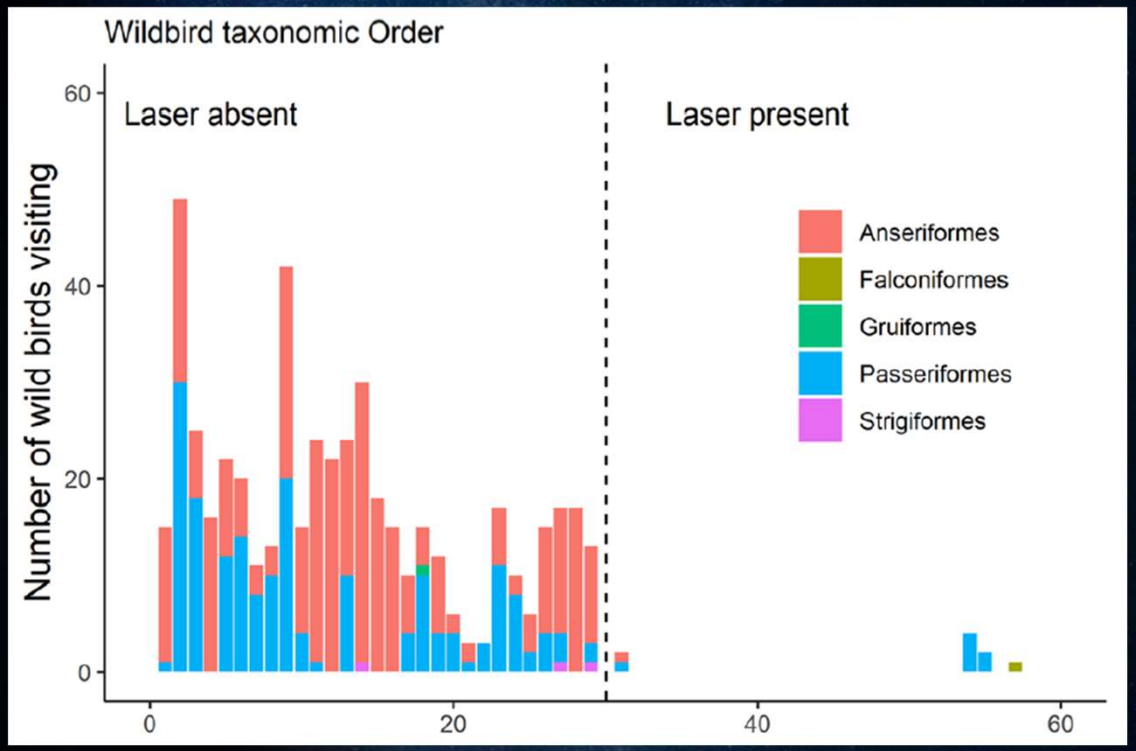
Poultry houses MUST be bird-proof

Do not attract birds by feed spillage or others

Do not allow birds to nest in your premises

Biosecurity

DUCK WARS: A NEW HOPE?



Source:
Armin 2021

Biosecurity

WATER: HOME SWEET HOME FOR AVIAN INFLUENZA VIRUS

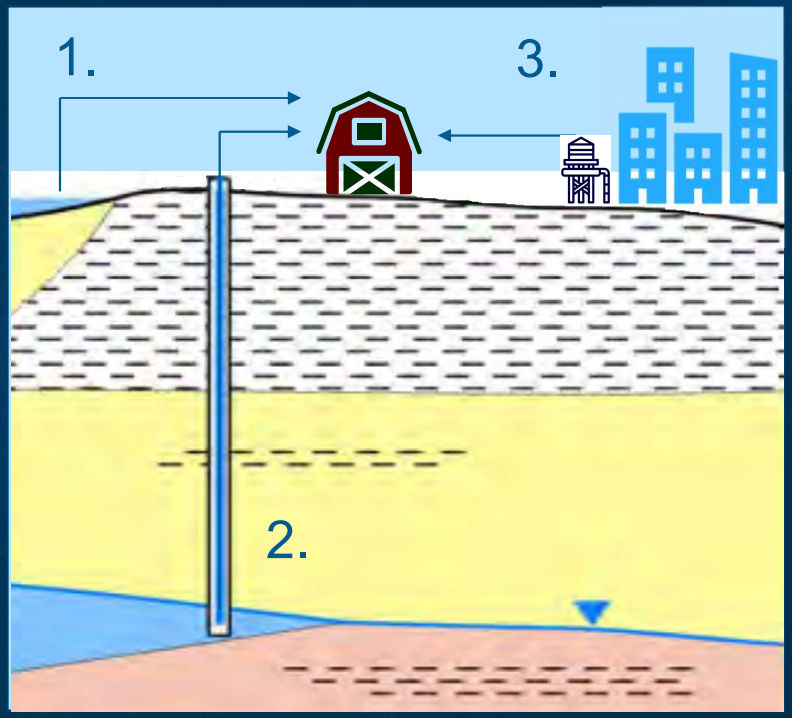
Persistence of a H5N1 HPAIV strain at the dose 10^4 TCID50/ml in different types of water

	Distilled	Pond	River mouth	Seawater
4°C	> 60 days	> 60 days	> 60 days	>60 days
10°C	> 60 days	38 days	42 days	42 days
20°C	> 60 days	21 days	32 days	60 days

Source: Domanska-Blicharz 2010

Biosecurity

WATER SOURCE REALLY MATERS



1. **Surface waters**
2. **Well**
3. **Public water network**

- Microbiological quality
- Chemical Quality
- Pre-treatment

Biosecurity

DO NOT FORGET ABOUT YOUR WATER RESERVOIR

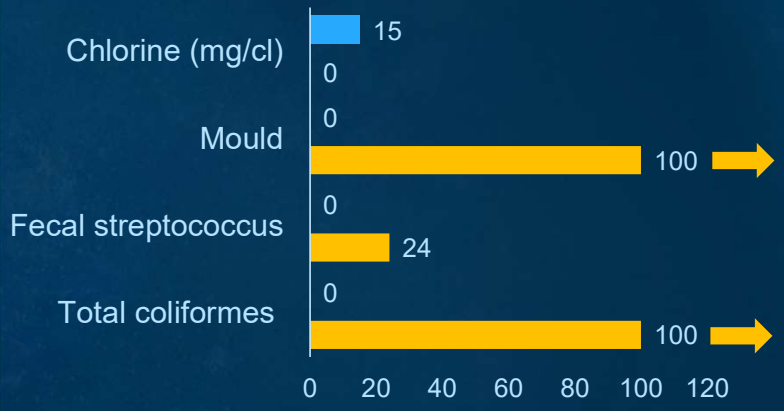
Bird-proof water tank is a MUST

- Closed water tank
- No holes or crevices
- Mesh-protected overflow pipe
- Anti-perch spikes installed
- Clean perimeter
- Regular Inspection Routine

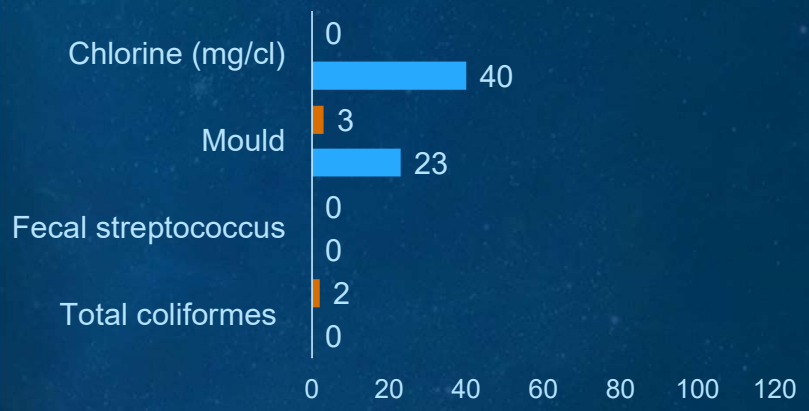
Biosecurity

WATER SANITATION IS ALSO A MUST IN ANY CASE

Farm 1 — Public network water, No treatment @ farm



Farm 2 — Well water, Chlorine @ farm



Collection point

End of the pipeline

Biosecurity

EVAPORATIVE COOLING SYSTEM ALSO USE WATER

Keep the cooling system clean and clear of birds

- No water leakage
- No puddles in the surrounding area
- Use a netting covers (mesh size ≤ 2 cm)
- Keep good maintenance

Biosecurity

BASIC RULES FOR POULTRY WORKERS

No visit to other farms.

No keeping backyard poultry at home.

No bird related hobbies.

Biosecurity

ENTRANCE TO A FARM (IDEALLY)

Logbook

Locker

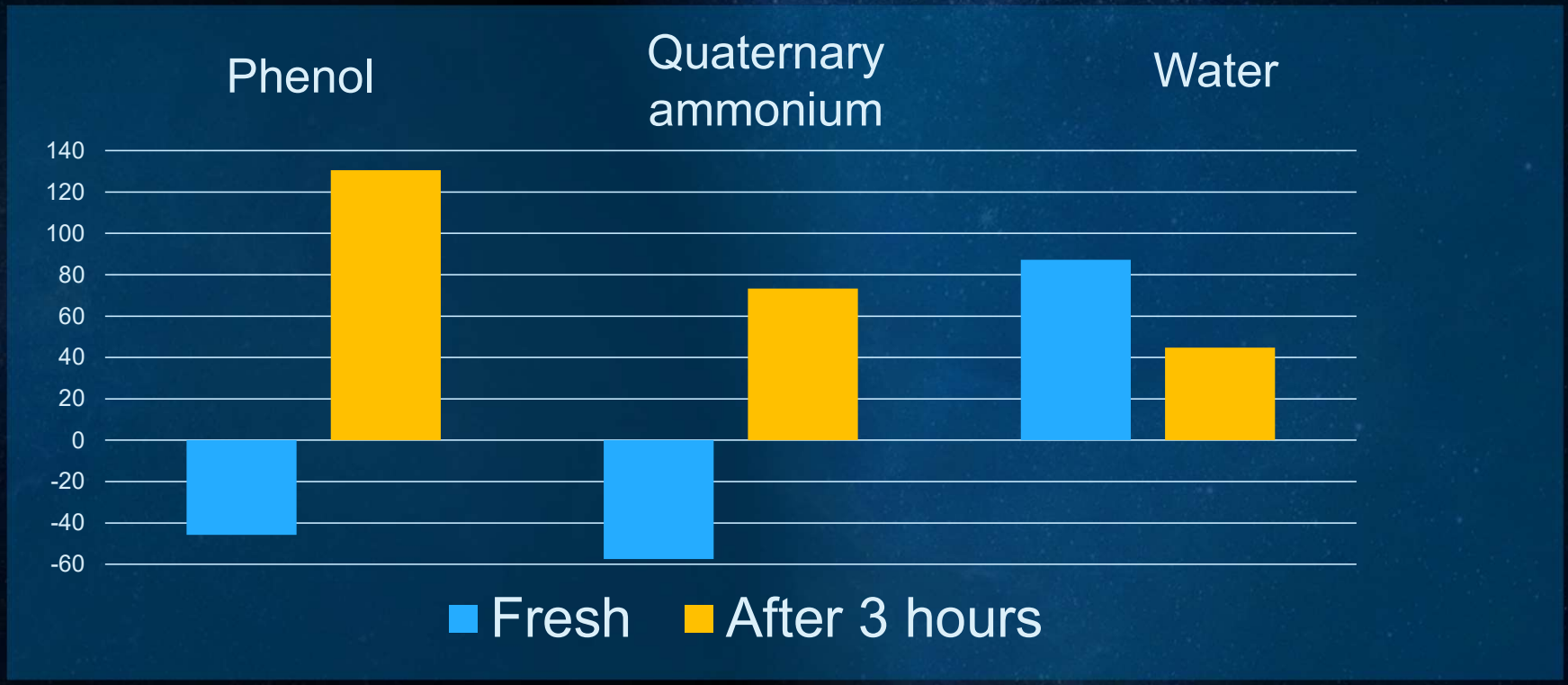
Shower

Farm Cloths

Hygiene block

Biosecurity

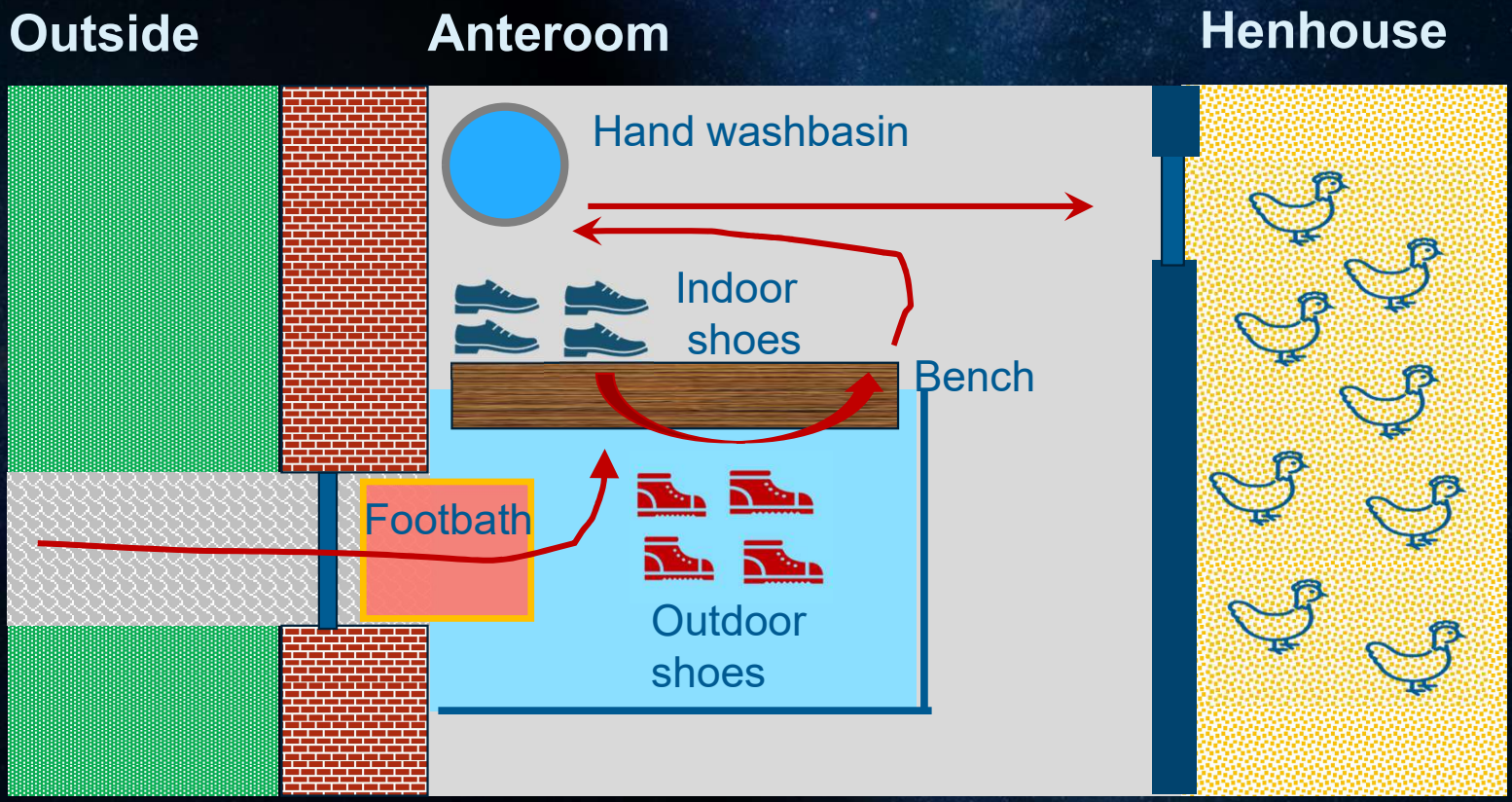
% change in total bacteria counts in shoe swabs after being footbathed in a hatchery



Source:
Owen 2006

Biosecurity

SANITARY BLOCK / DANISH BARRIER / BENCH SYSTEM



Biosecurity

STAFF NEEDS FOR GOOD BIOSECURITY PRACTICES

Knowledge

Commitment

Easy-to-follow

Biosecurity

BIOSECURITY ERRORS WHEN ENTERING AND LEAVING POULTRY HOUSES

Not respecting the delimitation between dirty and clean areas	Odds ratio
Footbath VS Bench System	13.16
Short visit (< 17m) VS long visit	2.41
Observer in the room	4.61

Not signing the logbook	Odds ratio
Short visit (< 17m) VS long visit	5.74
Observer in the room	5.70

Source:
Racicot 2011

Biosecurity

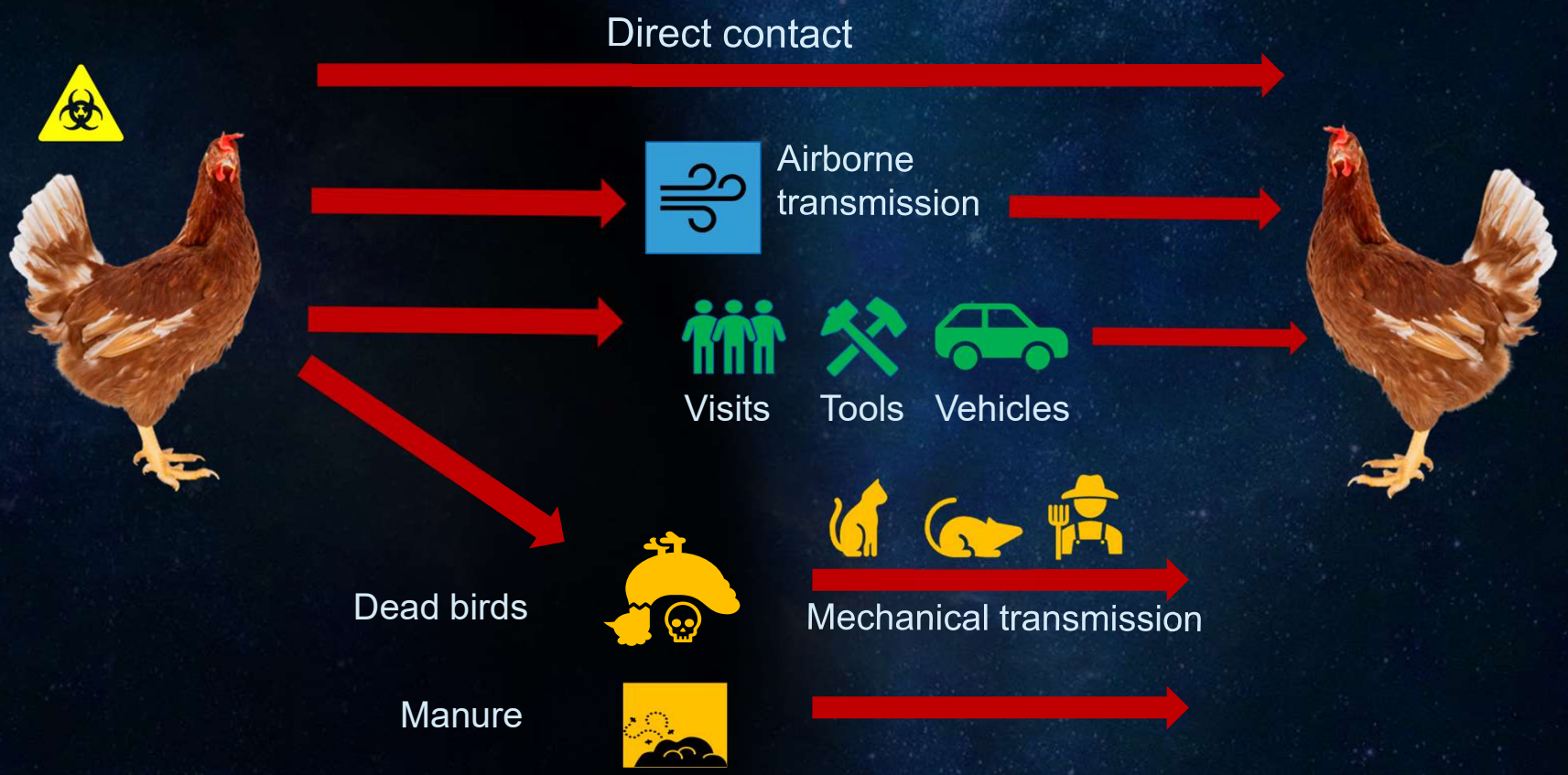
RODENTS: WE CANNOT COEXIST!

- Erysipelas (Meerburg 2012)
- Salmonellosis (Meerburg 2012)
- Fowl Cholera (Meerburg 2012)
- ...

\+ **Mechanical transmission**

Biosecurity

TRANSMISSION FROM INFECTED POULTRY

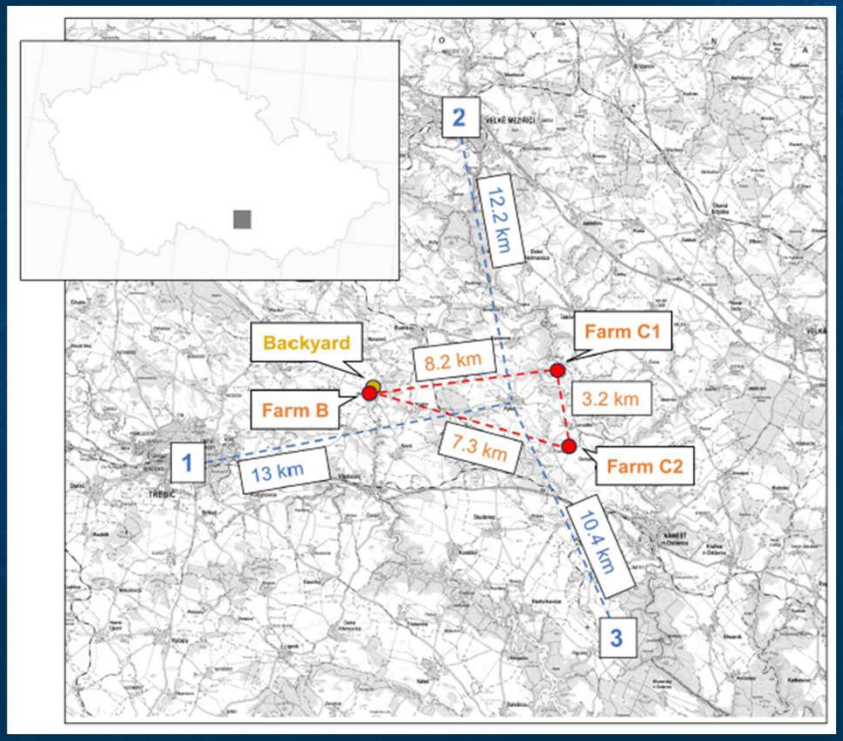


Biosecurity

FARM LOCATION MATTERS

Biosecurity

HPAI TRANSMISSION BY WIND



Molecular surveillance identified identical H5N1 strains among a group of unrelated commercial farms about 8 km away in the Czech Republic.

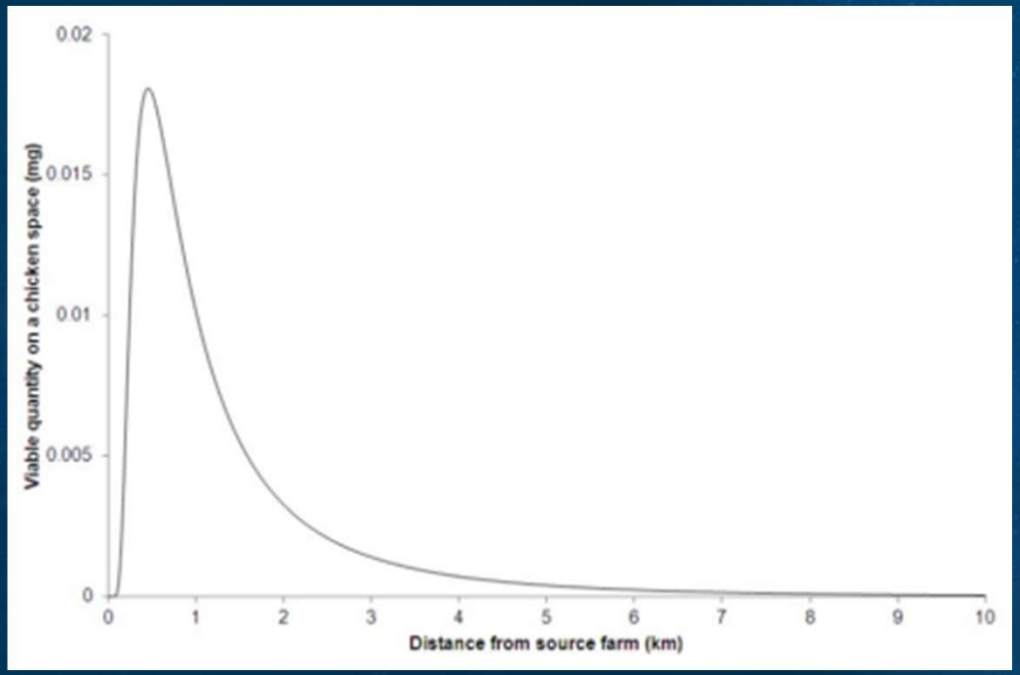
Main suspicion of the source of infection:

VIRAL PARTICLES CARRIED BY THE WIND

Source:
Nagy 2025

Biosecurity

SPREAD OF HPAI BY DUST



Amount of contaminated dust present in a square space of 13 ft according to the distance from the source

Some parameters taken into account:

Wind Speed:
12 ft/s
Flock size:
10000 birds

Source:
Ssematimba 2012

Biosecurity

VISITOR POLICY (The easiest and best to apply)

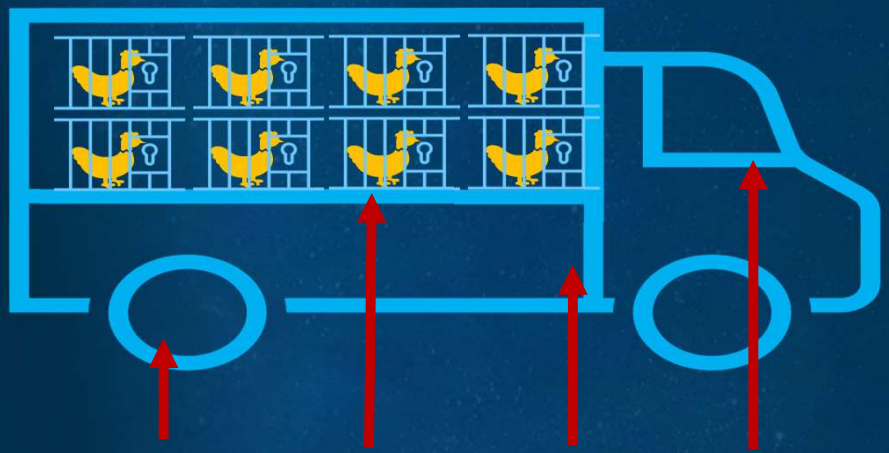
Biosecurity

A DECISION TREE FOR ACCEPTING VISITORS

Biosecurity

Detection of Avian Influenza in trucks used for duck farms depopulation during the 2021 HPAI outbreak in France

Detection of the AIV **genome** was carried out by r-RT-PCR for type A influenza virus



	Wheel	Crates	Outside	Cabin
Before C&D protocol	38% n=8	75% n=79	87% n=8	62% n=8
After C&D protocol	12% n=8	29% n=80	22% n=8	38% n=8

Source: Huneau-Salaun 2022

Biosecurity

THE VEHICLES ARE NOT FOR DRIVING ON THE FARM

External parking

No entrance to all avoidable vehicles

Complete disinfection for all entering vehicles

Biosecurity

TOOLS AND PERSONAL BELONGINGS STAY OUT

Leave your personal belongings outside…

Disinfect any items before bringing them into the farm.

Stuff coming from other farms MUST be rejected

Biosecurity

DEAD BIRDS ARE NOT A BYPRODUCT
THEY ARE A BIOLOGICAL RISK

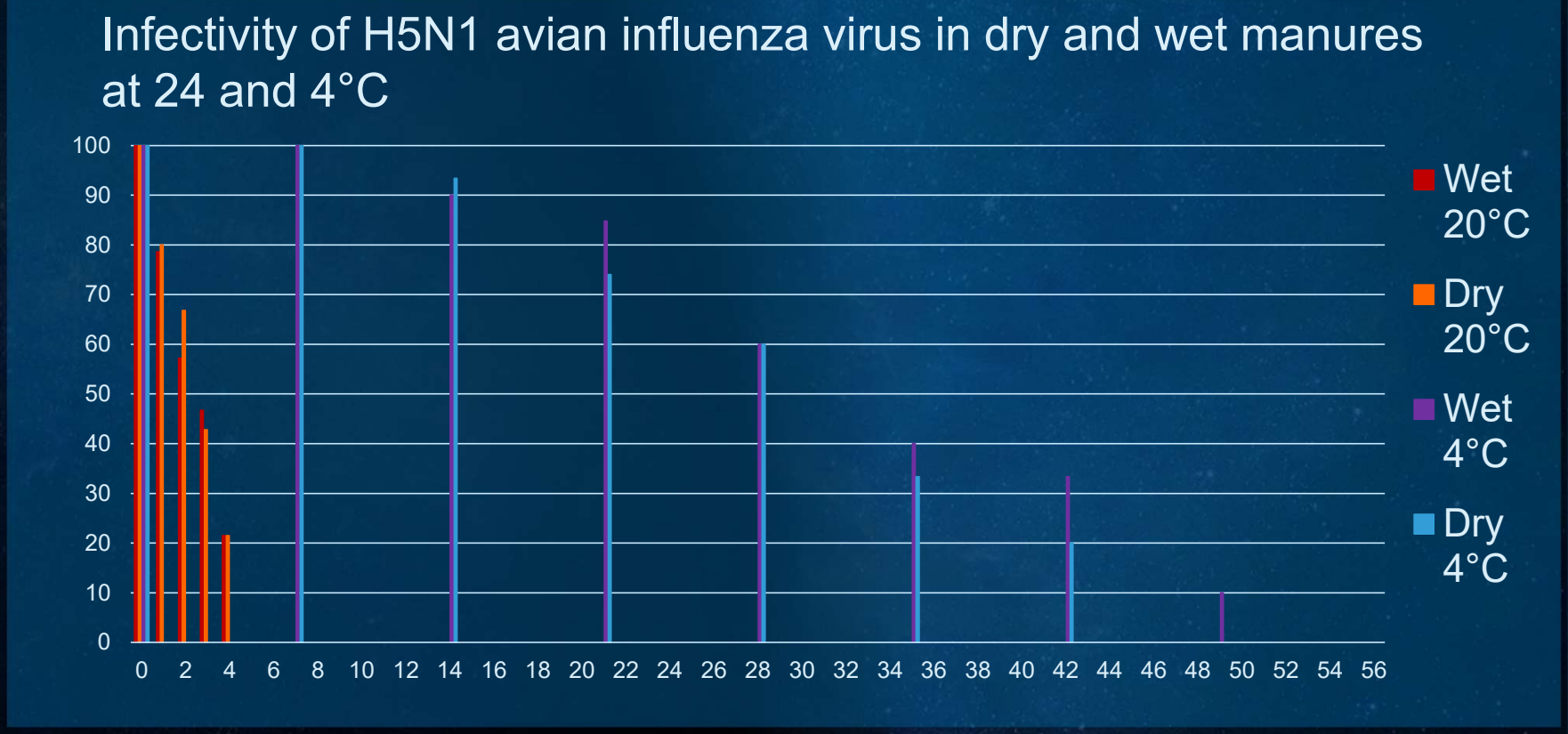
Remove all dead birds from the house daily

Store them in a correct container

Destroy them totally as soon as possible

Biosecurity

MANURE IS ALSO HOME SWEET HOME FOR HPAI



Source
Kurmi 2010

Biosecurity

MANURE IS A BYPRODUCT
BUT IT IS STILL A BIOLOGICAL RISK

Remove it from the house as soon as possible

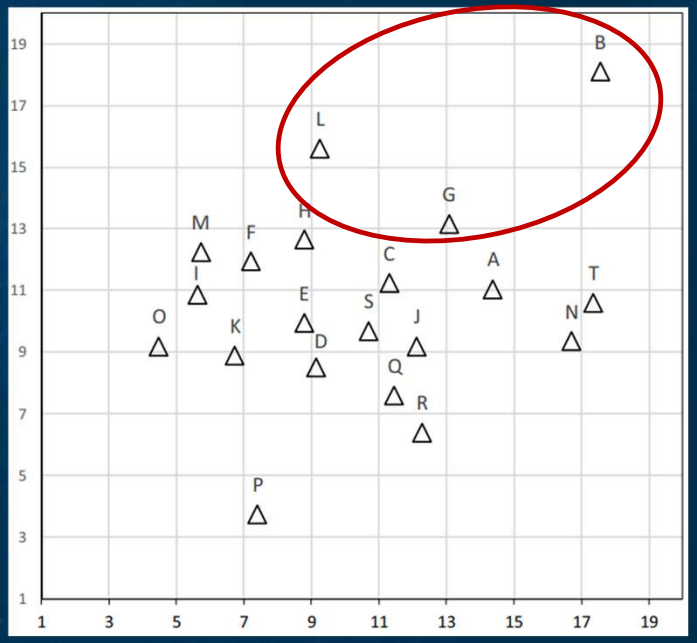
Treat the manure before spreading it on the fields.

Do not spread poultry manure around other poultry houses

Biosecurity

THE BIG 3

Average ranking of 21 biosecurity measures for avoiding the introduction on commercial chicken holding with indoor housing



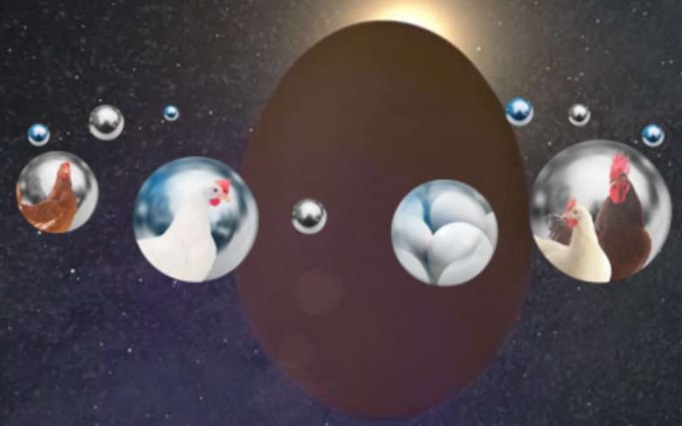
B: Prevent direct wild bird contact

L: Hygiene lock to production unit

G: Restricted access to visitor

EFSA 2017

Thank you for your attention



H&N International – Making your success the center of our universe

Follow us on LinkedIn
H&N International GmbH

Find out more about
KAI farming assistant