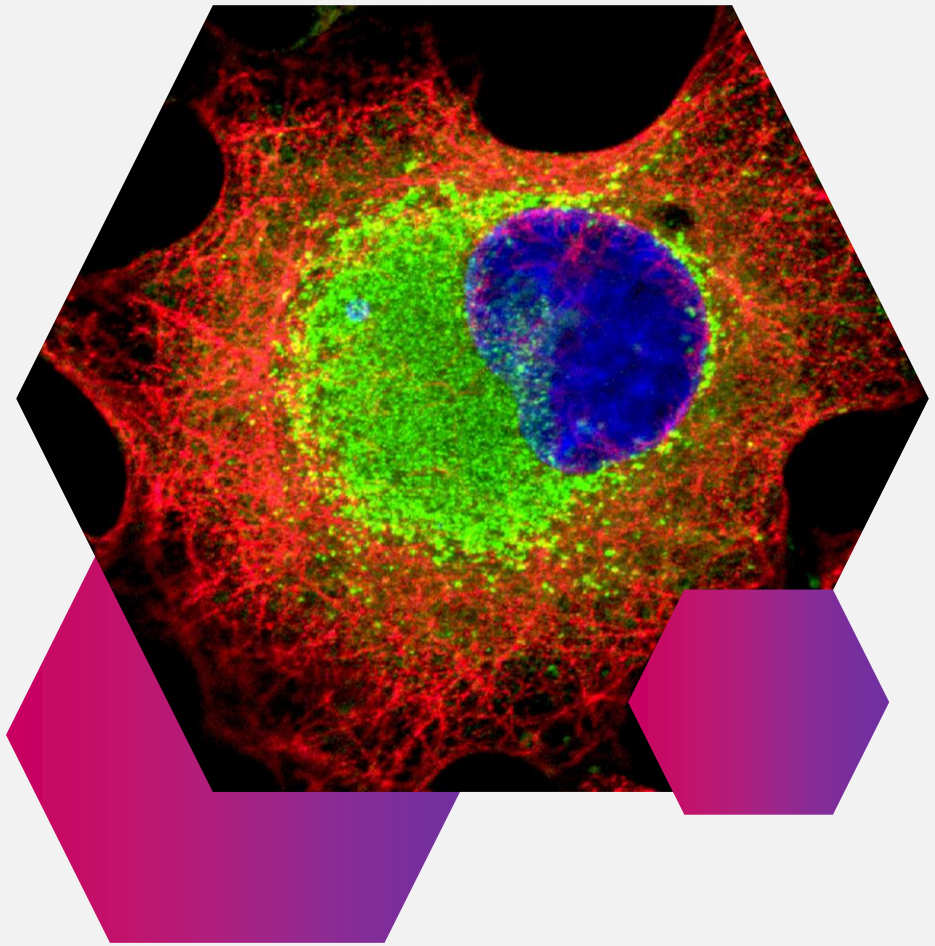

HPAI Vaccination & Surveillance: Principles, Benchmarks, and Strategic Approaches

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WEO Business Conference, Tenerife

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Biotechnology and Biological Sciences Research Council

Pirbright receives strategic funding from BBSRC UKRI

Global cost from HPAI

c200 million birds/pa died/culled

$4 bn/pa

3.4% (range 2.6-4.4%) global economy

Table 1. Impact of a widening of bird-bird flu
(% change in GDP, relative to the baseline)

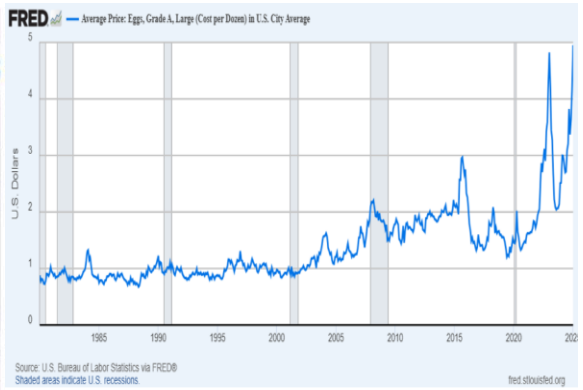
	Bird-bird [a]
World total	**-0.1**
High income countries	-0.1
Low & Middle-income countries	-0.4
East Asia and Pacific	-0.4
Europe & Central Asia	-0.4
Latin America &the Caribbean	-0.7
Middle East & North Africa	-0.4
South Asia	-0.4
Sub Saharan Africa	-0.3

Source : World Bank.
[a] Assumes that 12 percent of domestic birds in each region die from the disease or are killed in efforts to prevent its spread.

	US layers lost
2023	c12 million
2024	39 million
2025	31 million to date!

Egg supply impacts

Egg prices have soared in the U.S. thanks to Avian flu that has shorted the supply. The cost of a dozen eggs now sits at $4.95 (AP)



Here are the economic and social impacts of bird flu

The outbreaks South Africa has experienced have led to the culling of 7.5 million chickens. This is about 20-30% of the total chicken stock in the country

Bloomberg

Brazil to Nearly Double Egg Exports as US Reels From Shortages

BNN
Baltic News Network

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How many eggs can you send? US asks for help with egg shortage and to reduce soaring egg prices

BNN March 18, 2025

Bird flu outbreaks in Japan raise concerns over egg shortages, soaring prices

January 19, 2025 (Mainichi Japan) Japanese version

Bird flu outbreaks at multiple poultry farms across Japan from the end of 2024 to the beginning of this year are raising concerns over a possible repeat of the "egg shock" in 2023, where shortages resulted in record highs for egg prices.

On Jan. 2, Aichi Prefecture's first avian influenza

To vaccinate or not??

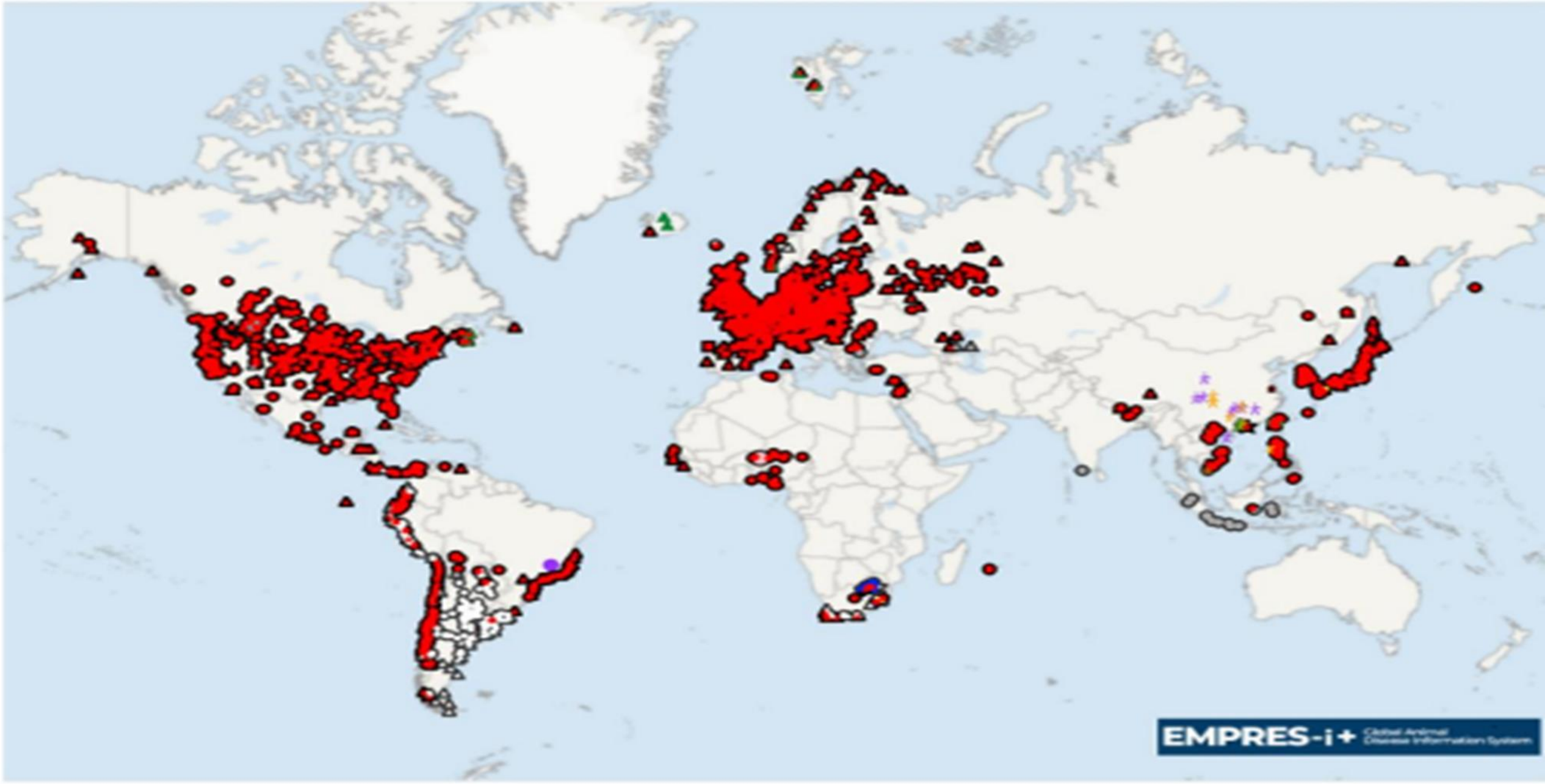
What has changed?

- Are current control approaches sustainable?
- Future risk and possible need for vaccination
- Benefits/cons
- Dispelling myths
- First principles of vaccination
- Barriers/challenges
- Practical considerations
- Activity to prepare/develop contingency

Why has risk increased to layer sector from HPAI?

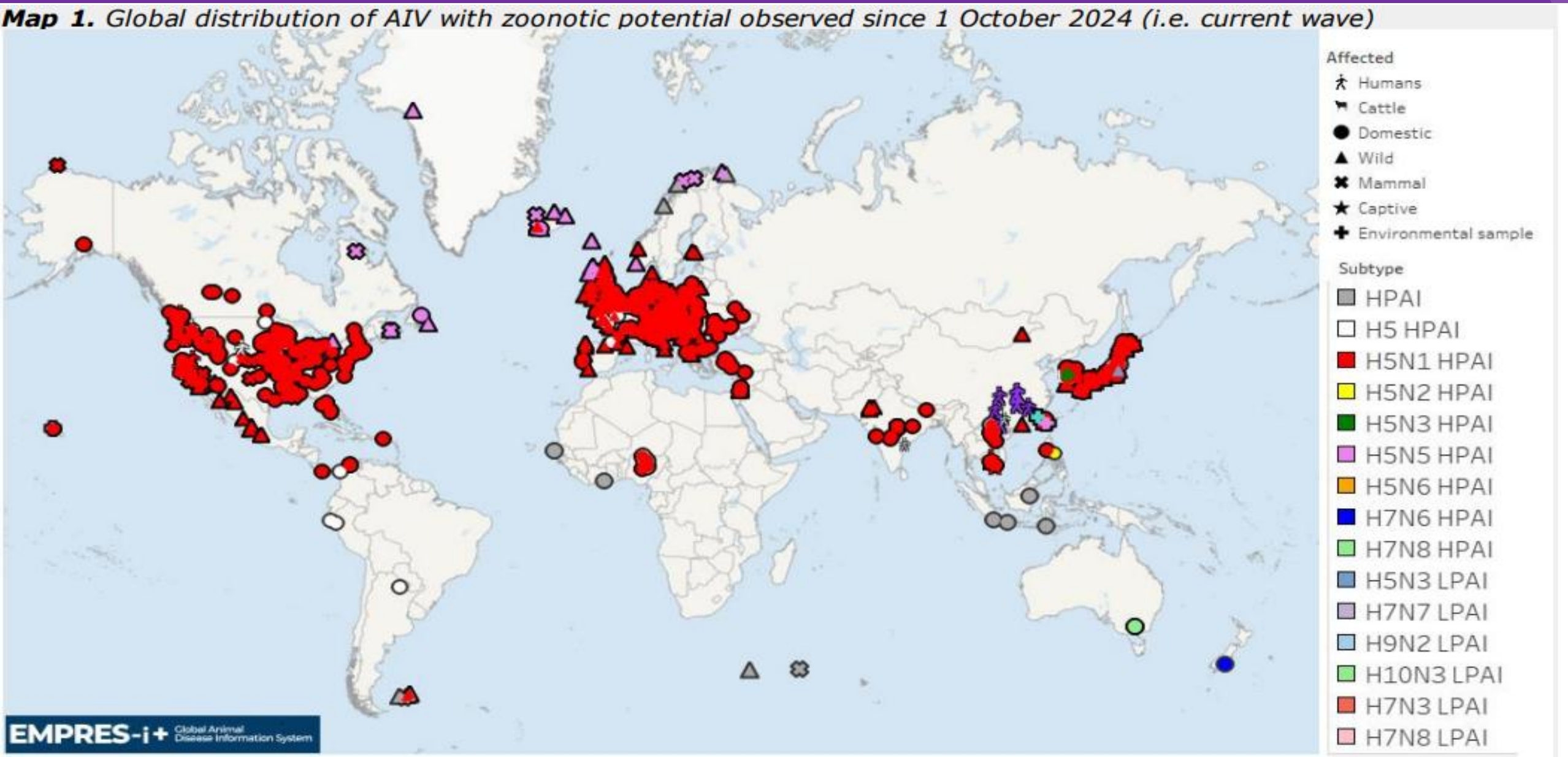
- Exceptional global spread; panzootic most continents affected
- High infection pressure
  - Increased spread to domestic birds/layers
  - High environmental contamination
  - Exposure to greater range of species of wild bird
- Mammalian infections: spillover to scavengers, some M2M transmission
- Dairy cattle infection in USA: sustained transmission non respiratory, back spill to domestic birds including layers
- H5 HPAI virus evolving with high ‘fitness’ traits

Confirmed Avian influenza events worldwide from 1 October 2022 to 30 September 2023

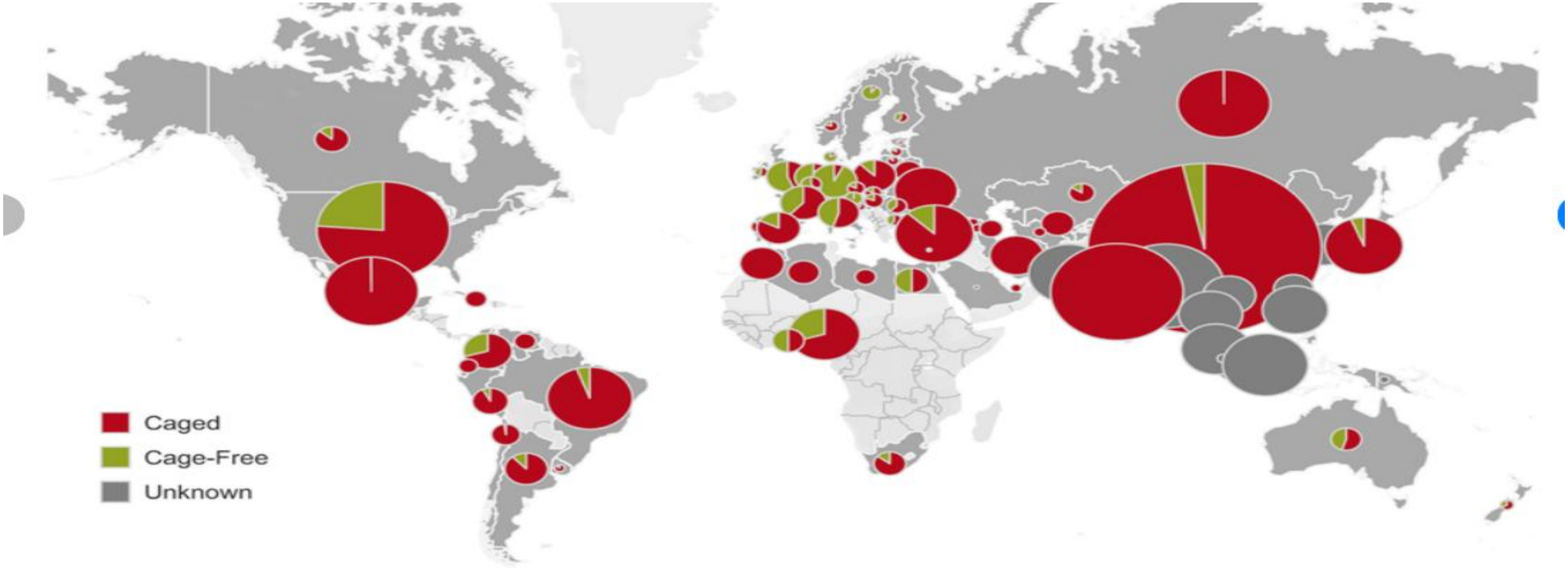


Note: Symbols may overlap for events in similar geographic locations

Global distribution of AIV since 1 October 2024 (i.e. current wave) ; H5 HPAI predominant



Global laying hens demographic



Global distribution of laying hens by housing system. Distribution of laying hens in caged (red: conventional; furnished) and cage-free (green: barns, aviaries, free-range) systems in 78 countries (dark grey) for which hen inventories are available. The size of circles is proportional to the hen population in the country. Dark grey circles: countries for which the hen population is known, but the proportion of hens in each housing system is unknown. An interactive version of this figure is available at http://hen-welfare.org/map, with further information available (by clicking on the pie charts) on data sources, proportion of hens in each system and layer populations. The

Wild bird species affected: >300 species/25+orders

Wild bird orders affected by Gs/Gd H5Nx HPAI

	Since 2021	
Accipitriformes (n=51)	Galliformes (n=19)	Psittaciformes (n=25)
Anseriformes (n=94)	Gaviiformes (n=3)	Rheiformes (n=1)
Caprimulgiformes (n=1)	Gruiformes (n=16)	Sphenisciformes (n=4)
Casuariiformes (n=1)	Passeriformes (n=49)	Strigiformes (n=18)
Cathartiformes (n=2)	Pelecaniformes (n=31)	Struthioniformes (n=1)
Charadriiformes (n=111)	Phoenicopteriformes (n=4)	Suliformes (n=25)
Ciconiiformes (n=6)	Piciformes (n=3)	Trogoniformes (n=1)
Columbiformes (n=7)	Podicipediformes (n=8)	
Falconiformes (n=13)	Procellariiformes (n=14)	

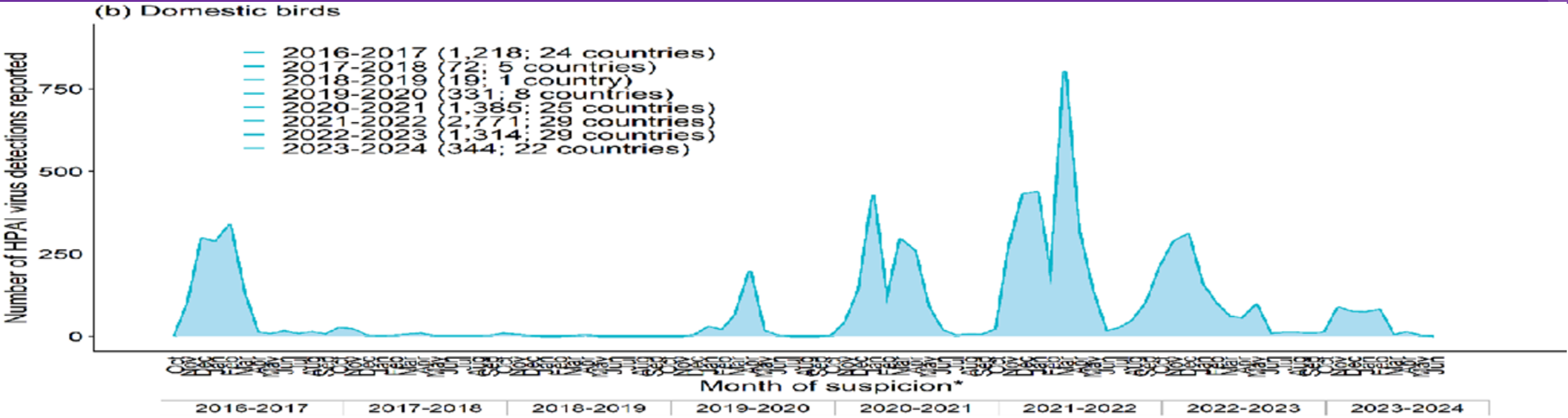
Wild bird species affected by Gs/Gd H5Nx HPAI
Since 2021

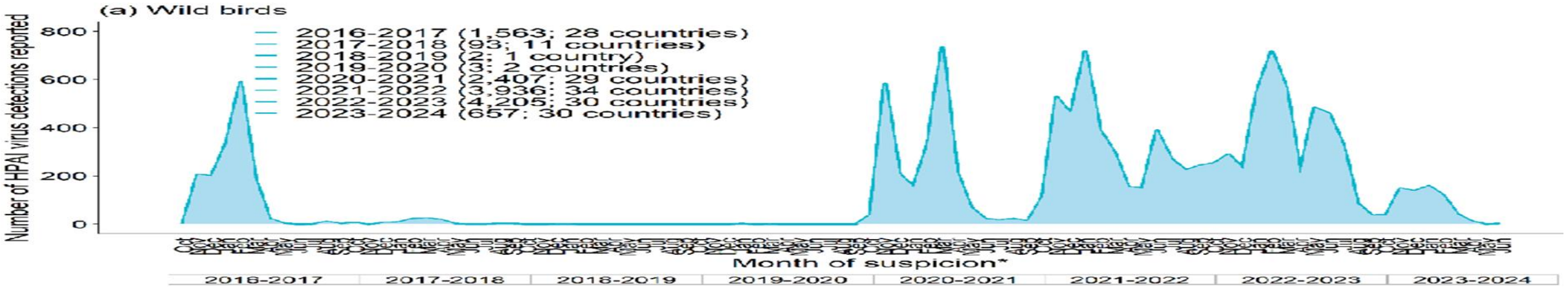
Anseriformes (n=40)
Amazonetta brasiliensis (Brazilian Teal)*
Anas cyanoptera (Cinnamon Teal)
Anas discors (Blue-winged Teal)
Anas flavirostris (Andean Teal)
Anas formosa (Baikal Teal)*
Anas fulvigula (Mottled Duck)
Anas rhynchotis (Australasian Shoveler)
Anas rubripes (American Black Duck)
Anser cygnoides (Swan Goose)*
Anser rossii (Ross's Goose)
Aythya affinis (Lesser Scaup)
Aythya americana (Redhead Duck)
Aythya baeri (Baer's pochard)*
Aythya valisineria (Canvasback)
Branta ruficollis (Red breasted goose)
Branta sandvicensis (Nene)*
Bucephala albeola (Bufflehead)
Bucephala islandica (Barrow's goldeneye)*
Chloephaga melanoptera (Andean Goose)
Chloephaga picta (Upland Goose)
Cygnus bewickii (Tundra swan)
Cygnus buccinator (Trumpeter Swan)
Cygnus melancoryphus (black-necked swan)
Dendrocygna bicolor (Fulvous whistling Duck)
Dendrocygna viduata (White-faced Whistling-Duck)
Lophodytes cucullatus (Hooded Merganser)
Mareca falcata (Falcated Duck)
Marmaronetta angustirostris (Marbled Teal)
Melanitta fusca (Velvet Scoter)
Melanitta nigra (Common Scoter)
Melanitta perspicillata (Surf Scoter)
Mergellus albellus (Smew)*
Mergus serrator (Red-breasted merganser)
Mergus squamatus (Scaly-sided merganser)*
Oxyura jamaicensis (Ruddy Duck)
Spatula cyanoptera (Cinnamon Teal)
Spatula puna (Puna Teal)*
Spatula querquedula (Garganey)
Tachyeres pteneres (Magellanic Steamerduck)
Tadorna ferruginea (Ruddy Shelduck)
Gaviiformes (n=3)
Gavia immer (Common Loon)
Gavia pacifica (Pacific Loon)
Gavia stellata (Red-throated Loon)
Sphenisciformes (n=3)
Eudyptes chrysocome (Southern Rockhopper Penguin)
Spheniscus humboldti (Humboldt Penguin)
Spheniscus magellanicus (Magellanic Penguin)
Ciconiiformes (n=3)
Ciconia boyciana (Oriental Stork)
Ciconia nigra (Black Stork)
Mycteria americana (American Wood Stork)
Procellariiformes (n=13)
Ardenna gravis (Great Shearwater)
Ardenna grisea (Sooty Shearwater)
Ardenna tenuirostris (Short-tailed Shearwater)
Fulmarus glacialis (Northern Fulmar)
Fulmarus glacialoides (Southern Fulmar)
Macronectes giganteus (Southern Giant Petrel)
Macronectes halli (Northern Giant Petrel)
Pachyptila desolata (Antarctic Prion)
Phoebastria irrorata (Waved Albatross)
Procellaria aequinoctialis (White-chinned Petrel)
Pterodroma macroptera (Great-winged Petrel)
Puffinus puffinus (Manx Shearwater)
Thalassarche melanophris (Black-browed Albatross)
Suliformes (n=18)
Fregata magnificens (Magnificent Frigatebird)
Fregata minor (Great Frigatebird)
Leucocarbo atriceps (Imperial Shag)
Morus capensis (Cape Gannet)
Nannopterum brasilianum (Neotropic Cormorant)
Phalacrocorax auritus (Double-crested Cormorant)
Phalacrocorax bougainvillii (Guanay Cormorant)
Phalacrocorax brasilianus (Neotropical Cormorant)
Phalacrocorax gaimardi (Red-legged Cormorant)
Phalacrocorax lucidus (White-breasted Cormorant)
Phalacrocorax magellanicus (Rock Shag)
Phalacrocorax neglectus (Bank Cormorant)
Phalacrocorax punctatus (Spotted Shag
Sula leucogaster (Brown Booby)
Sula nebouxii (Blue-footed Booby)
Sula sula (Red-footed Booby)
Sula variegata (Peruvian Booby)
Urile penicillatus (Brandt's Cormorant)
Pelecaniformes (n=13)
Ajaia ajaja (Roseate Spoonbill)
Ardea herodias (Great Blue Heron)
Bostrychia hagedash (Hadada Ibis)
Egretta caerulea (Little Blue Heron)
Egretta intermedia (Intermediate Egret)
Egretta thula (Snowy Egret)
Eudocimus ruber (Scarlet Ibis)*
Geronticus eremita (Northern Bald Ibis)
Pelecanus erythrorhynchos (American White Pelican)
Pelecanus occidentalis (Brown Pelican)
Pelecanus rufescens (Pink-backed Pelican)
Pelecanus thagus (Peruvian Pelican)
Plegadis chihi (White-faced Ibis)*

Galliformes (n=8)
Alectoris rufa (Red legged partridge)
Bonasa umbellus (Ruffed grouse)
Callipepla californica (California Quail)
Centrocercus urophasianus (Greater sage-grouse)
Coturnix coturnix (Common Quail)*
Cracidae (incognita)*
Lagopus lagopus (Willow Grouse)
Perdix perdix (Grey Partridge)*
Charadriiformes (n=78)
Alca torda (Razorbill)
Alle alle (Little auk)
Arenaria interpres (Ruddy Turnstone)
Arenaria melanocephala (Black turnstone)
Calidris alba (Sanderling)
Calidris alpina (Dunlin)
Calidris fuscicollis (White-rumped Sandpiper)
Calidris maritima (Purple sandpiper)
Calidris pusilla (Semipalmated sandpiper)
Cepphus grylle (Black Guillemot)
Charadrius hiaticula (Common ringed plover)
Charadrius mongolus (Lesser Sand Plover)
Charadrius nivosus (Snowy plover)
Chlidonias hybrida (Whiskered Tern)
Chroicocephalus maculipennis (Brown-hooded gull)
Chroicocephalus ridibundus (Black-headed Gull)
Fratercula arctica (Atlantic Puffin)
Gallinago gallinago (Common Snipe)
Gallinago stenura (Pin-tailed Snipe)
Gelochelidon nilotica (Common Gull-billed Tern)
Haematopus ater (Blackish Oystercatcher)
Haematopus ostralegus (Eurasian oystercatcher)
Haematopus palliatus (American oystercatcher)
Hydroprogne caspia (Caspian Tern)
Ichthyaetus melanocephalus (Mediterranean Gull)
Larosterna inca (Inca tern)
Larus atricilla (Laughing Gull)
Larus audouinii (Audouin's Gull)
Larus belcheri (Belcher's Gull)
Larus brachyrhynchus (Short-billed Gull)
Larus brunnicephalus (Brown-headed Gull)
Larus cachinnans (Caspian Gull)
Larus californicus (California Gull)
Larus crassirostris (Black-tailed Gull)
Larus delawarensis (Ring-billed Gull)
Larus dominicanus (Kelp Gull)
Larus genei (Slender-billed Gull)
Larus glaucescens (Glaucous-winged Gull)
Larus glaucoides (Iceland Gull)
Larus hyperboreus (Glaucous Gull)
Larus michahellis (Yellow-legged Gull)
Larus novaehollandiae (Silver Gull)
Larus occidentalis (Western Gull)
Larus philadelphia (Bonaparte's Gull)
Larus pipixcan (Franklin's Gull)
Larus schistisagus (Slaty-backed Gull)
Larus scopulinus (Silver Gull)
Larus smithsonianus (Arctic Herring Gull)
Larus thayeri (Thayer's gull)
Leucophaeus modestus (Grey gull)
Numenius phaeopus (Whimbrel)
Phalaropus lobatus (Red-necked phalarope)
Pluvialis dominica (American Golden Plover)
Pluvialis squatarola (Grey Plover/Black-bellied Plover)
Rissa tridactyla (Black-legged Kittiwake)
Rynchops niger (Black skimmer)
Scolopax rusticola (Eurasian Woodcock)
Stercorarius antarcticus (Brown skua)
Stercorarius chilensis (Chilean Skua)
Stercorarius parasiticus (Arctic Skua)
Stercorarius skua (Great Skua)
Sterna dougallii (Roseate Tern)
Sterna forsteri (Forster's Tern)
Sterna hirundinacea (South American Tern)
Sterna paradisaea (Arctic Tern)
Sternula albifrons (Little Tern)
Thalasseus acuflavidus (Cabot's Tern)
Thalasseus elegans (Elegant Tern)
Thalasseus maximus (Royal Tern)
Tringa flavipes (Lesser Yellowlegs)
Tringa melanoleuca (Greater Yellowlegs)
Tringa semipalmata (Willet)
Tringa totanus (Common Redshank)
Uria aalge (Common Murre)
Uria lomvia (Thick-billed Murre)
Vanellus chilensis (Southern Lapwing)
Vanellus vanellus (Northern Lapwing)
Xema sabini (Sabine's Gull)
Podicipediformes (n=6)
Aechmophorus occidentalis (Western Grebe)
Podiceps auritus (Horned Grebe)
Podiceps grisegena (Red-necked Grebe)
Podiceps major (Great Grebe)
Podilymbus podiceps (Pied-billed Grebe)
Spilornis cheela (Crested Serpent Eagle)
Spizaetus nipalensis (Mountain hawk-eagle)
Vultur gryphus (Andean condor)*
Cathartiformes (n=2)
Gymnogyps californianus (California Condor)
Sarcoramphus papa (King Vulture)

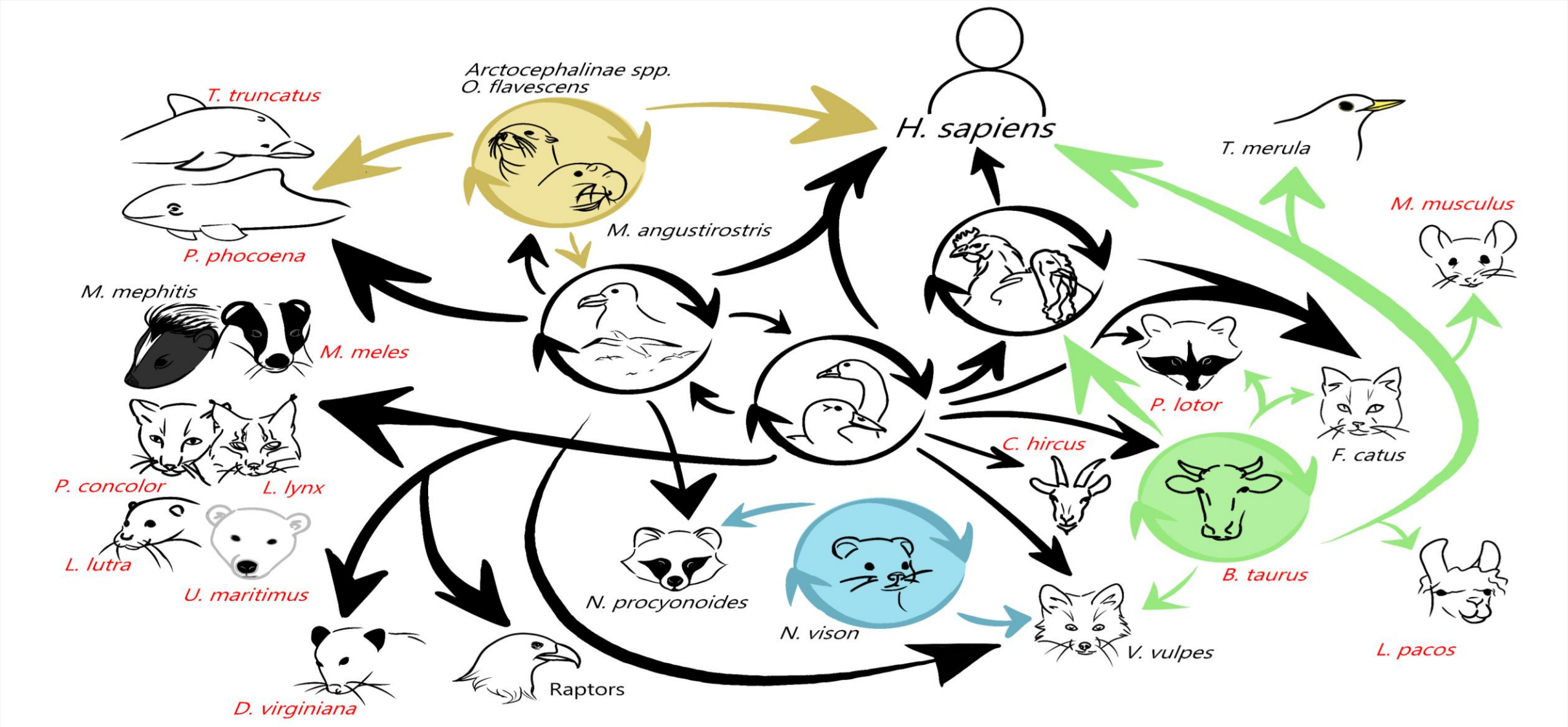
Phoenicopteriformes (n=2)
Phoenicopterus chilensis (Chilean flamingo)*
Phoenicopterus ruber (American Flamingo)*
Gruiformes (n=7)
Anthropoides virgo (Demoiselle Crane)
Balearica regulorum (Crowned crane)
Fulica americana (American coot)
Fulica armillata (Red-gartered Coot)
Grus canadensis (Sandhill Crane)
Grus leucogeranus (Siberian crane)*
Rallus aquaticus (Water Rail)
Psittaciformes (n=10)
Amazona farinosa (Southern mealy amazon)*
Amazona ochrocephala (Yellow-crowned Parrot)*
Amazona oratrix (Yellow-headed amazon)*
Ara militaris (Military macaw)*
Brotogeris versicolurus (White-winged Parakeet)*
Cyanoliseus patagonus (Burrowing Parrot)
Enicognathus ferrugineus (Austral Parakeet)
Enicognathus leptorhynchus (Slender-billed Parakeet)
Loriculus spp. (Hanging Parrot)*
Pycnonotus zeylanicus (Straw-headed bulbul)*
Falconiformes (n=8)
Caracara cheriway (Northern Crested Caracara)
Caracara plancus (Southern Caracara)
Falco biarmicus (Lanner Falcon)
Falco columbarius (Merlin)
Falco mexicanus (Prairie falcon)
Falco sparverius (American Kestrel)
Falco vespertinus (Red-footed Falcon)
Milvago chimango (Chimango Caracara)
Accipitriformes (n=30)
Accipiter brachyurus (New Britain Sparrowhawk)
Accipiter gularis (Japanese Sparrowhawk)
Accipiter striatus (Sharp-shinned Hawk)
Aquila audax (Wedge-tailed Eagle)
Aquila chrysaetos (Golden Eagle)
Aquila fasciata (Bonelli's eagle)
Aquila rapax (Tawny Eagle)*
Buteo lagopus (Rough-legged Hawk)
Buteo lineatus (Red-shouldered Hawk)
Buteo magnirostris (Roadside Hawk)
Buteo platypterus (Broad-winged Hawk)
Buteo polyosoma (Red-backed Hawk)*
Buteo regalis (Ferruginous Hawk)
Buteo swainsoni (Swainson's Hawk)
Buteogallus urubitinga (Great Black Hawk)
Cathartes aura (Turkey Vulture)
Circus assimilis (Spotted Harrier)
Circus cyaneus (Hen Harrier)
Circus pygargus (Montagu's Harrier)
Coragyps atratus (Black Vulture)
Geranoaetus melanoleucus (Black-chested buzzard-eagle)
Gypaetus barbatus (Bearded vulture)
Gyps africanus (White-backed vulture)*
Haliaeetus pelagicus (Steller's Sea Eagle)
Haliaeetus vocifer (African Fish Eagle)
Milvus migrans (Black Kite)
Milvus milvus (Red Kite)
Pandion haliaetus (Osprey)
Parabuteo unicinctus (Harris's Hawk)
Sagittarius serpentarius (Secretary Bird)
Strigiformes (n=6)
Aegolius acadicus (Northern Saw-whet Owl)
Megascops asio (Eastern Screech Owl)
Megascops choliba (Tropical Screech-owl)
Megascops kennicottii (Western Screech-Owl)
Strix nebulosa (Great grey owl)
Strix varia (Barred owl)
Caprimulgiformes (n=1)
Caprimulgus fossii (Mozambique Nightjar)
Columbiformes (n=2)
Columbina inca (Inca Dove)
Streptopelia turtur (European Turtle-dove)
Piciformes (n=3)
Dendrocopos major (Great spotted woodpecker)
Pteroglossus castanotis (Chestnut-eared aracari)*
Ramphastos cuvieri (white-throated toucan)*
Trogoniformes (n=1)
Harpactes erythrocephalus (Red-headed Trogon)
Passeriformes (n=22)
Agelaius phoeniceus (Red-winged Blackbird)
Carduelis carduelis (European goldfinch)
Carduelis chloris (European Greenfinch)
Corvus brachyrhynchos (American Crow)
Corvus caurinus (Northwestern Crow)
Corvus corone (Carrion Crow)
Corvus monedula (Western Jackdaw)
Corvus ossifragus (Fish Crow)
Cyanocitta cristata (Blue Jay)
Cyanocorax chrysops (Plush-crested Jay)
Garrulus glandarius (Eurasian Jay)
Junco hyemalis (Dark-eyed Junco)
Passer montanus (Eurasian Tree Sparrow)
Phylloscopus trochilus (Willow warbler)
Pica hudsonia (Black-billed Magpie)
Pygochelidon cyanoleuca (Blue-and-white Swallow)
Pyrrhula pyrrhula (Eurasian Bullfinch)
Quiscalus mexicanus (Great-tailed grackle)
Quiscalus quiscula (Common Grackle)
Tachycineta bicolor (Tree Swallow)
Turdus iliacus (Redwing)
Turdus migratorius (American Robin)

Direct correlation between infection in wild birds and poultry; highly relevant for new and emerging strains





The ‘new’ ecology of H5N1



Peacock et al, 2024 (Figure credit Ksenia Sukhova)

Infected dairy cattle are a risk to layer operations

Choose time period: Total Outbreak

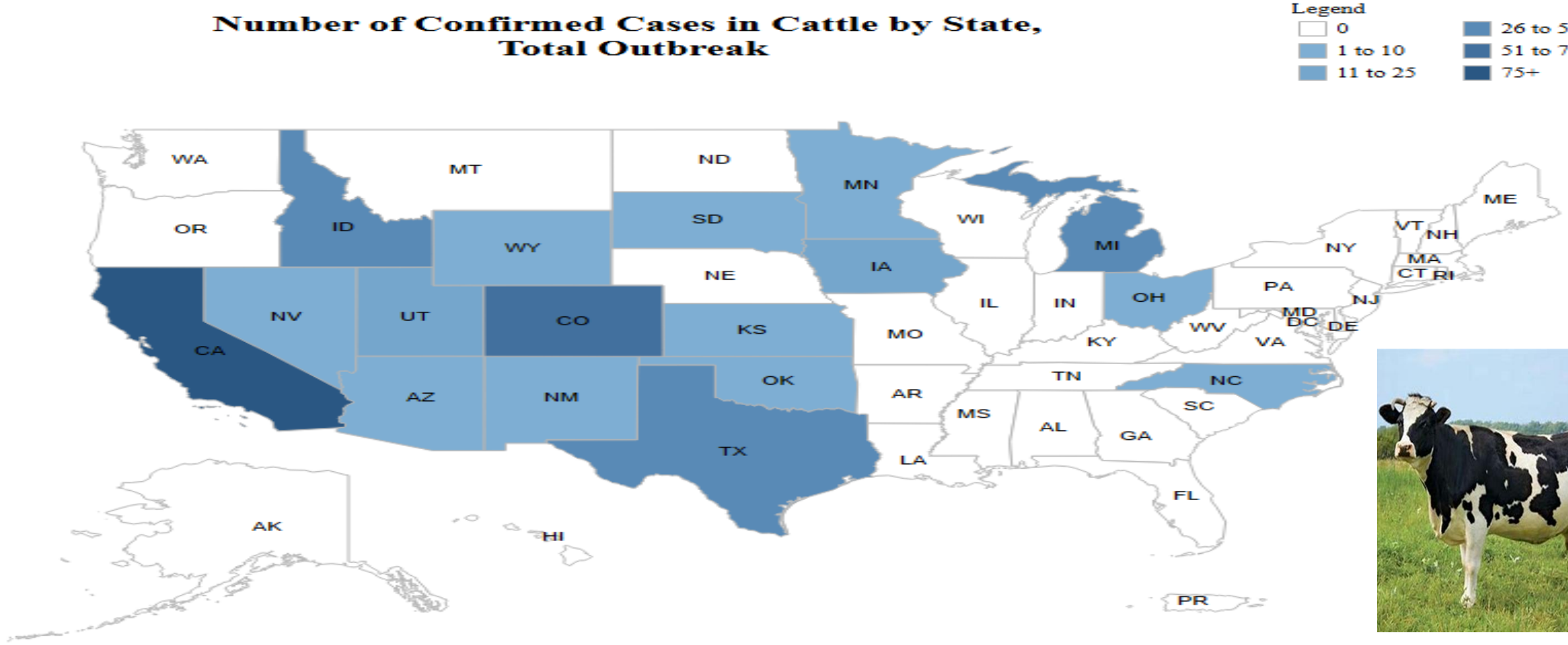
Choose species: Cattle

Click for International Exports

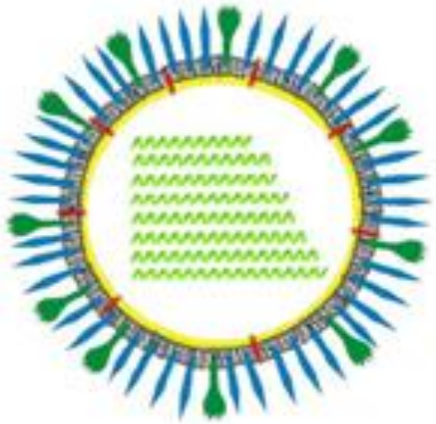
Situational Update

In the Total Outbreak, in Cattle, there were:
989 Confirmed Cases in **17** States

Number of Confirmed Cases in Cattle by State, Total Outbreak



The virus driving the impact!



The 2021-25 H5N1 HPAI viruses are the most infectious and dangerous of strains to date

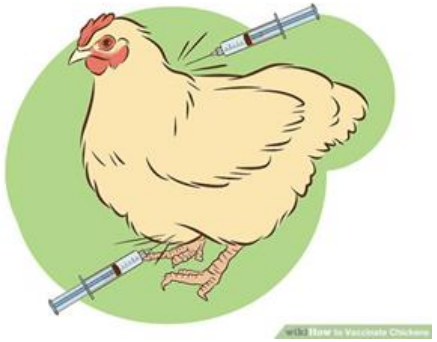
Could vaccination solve the problem?

Vaccination will only work when applied in combination with other measures

Vaccination is not a substitute for weak farm biosecurity

Considering vaccination as part of available avian influenza control measures

- **Protecting food security and layer sector likelihoods**
- **Prevention and control of outbreaks in vaccinated domestic bird populations** resulting in reduced virus circulation within and between flocks and lower risk of spillover to wildlife
- **Reduced economic losses**, both direct (e.g. bird deaths) and indirect (e.g. mass culling and trade disruption). When properly implemented, avian influenza vaccination is compatible with safe trade, according to WOAH international standards



- **Lower risk of human exposure to avian influenza viruses**, and thus of a potential pandemic, in line with the One Health
- **Minimised environmental impact** by reducing the risk of spill over to wild animals
- **Preventive or Emergency vaccination**

Define purpose of programme

- Protect food security
- Improve animal health and welfare (reduce culling)
- If trading in birds and their products assurance over freedom from disease in vaccinated populations (DIVA etc)
- Prevent disease incursion versus a changing virus
- Reduce spillover risk to humans and wildlife

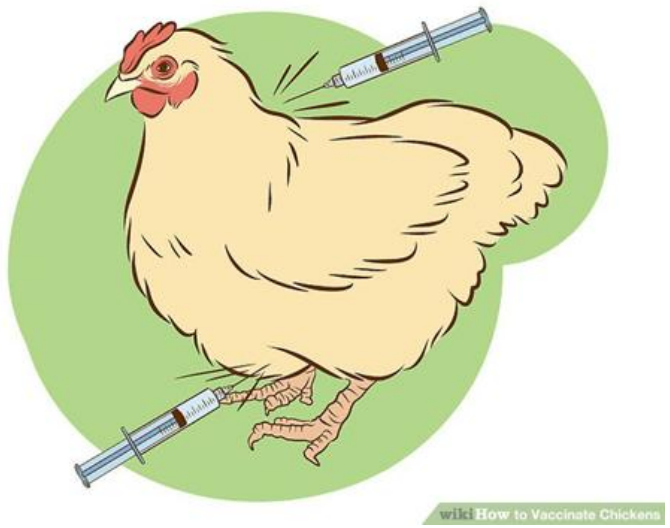
Desired results of vaccination against AI

Freedom from disease

No effect on production or other serious expense

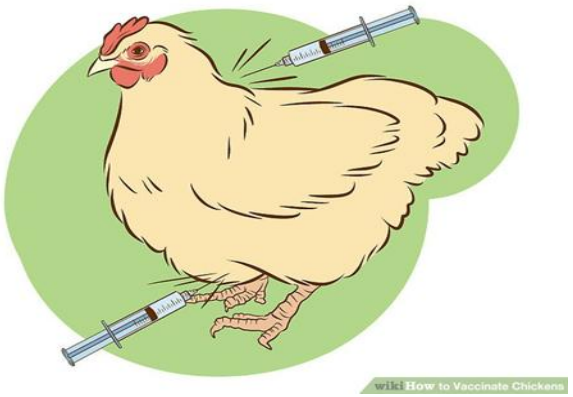
No trade embargoes

Eradication if enzootic infection



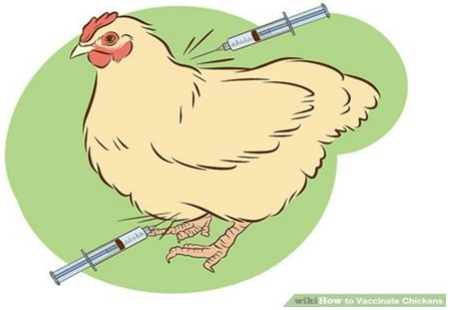
Avian influenza vaccination

- Protection against clinical signs/disease
- Decrease bird susceptibility to infection
- Reduction in virus shedding by infected birds
- Reduce transmission between birds/flocks



However …..Vaccinated flocks can become infected

Criteria for vaccine suitability



Swayne and Sims (2020) proposed 8 criteria

- Inexpensive
- usable in multiple avian species
- duration of immunity for life of bird (ideally provide protection after a single dose)
- can be applied by low-cost mass application methods
- allow easy identification of infected birds within the vaccinated population
- produce a protective immune response in the presence of maternal antibodies
- be applied at one day of age in hatchery or *in ovo*;
- Vaccine closely matched to field virus.

No current vaccine or vaccine technology meets all eight criteria so the user must select the licensed vaccine that best meets their needs.

WOAH Animal Health Code: 2022 adopted updated AI chapter

World Organisation for Animal Health
Founded as OIE

''*Vaccination* will not affect the high pathogenicity avian influenza status of a free country or *zone* if *surveillance* supports the absence of *infection*, in accordance with Article 10.4.28.,... ''

''*Vaccination* can be used as an effective complementary control tool when a *stamping-out policy* alone is not sufficient. Whether to vaccinate or not should be decided by the *Veterinary Authority* on the basis of the avian influenza situation as well as the ability of the *Veterinary Services* to implement the *vaccination* strategy,...''

Requirements to do surveillance in all vaccinated populations, zones or compartments to provide evidence of absence of infection

WOAH updated policy brief; December 2023

World Organisation for Animal Health
Founded as OIE

Policy brief

December 202

Avian influenza vaccination: why it should not be a barrier to safe trade

Executive summary

Since 2005, avian influenza has had a staggering toll, with over 500 million birds lost to the disease worldwide [1]. Its devastating impact extends beyond domestic and wild birds, threatening livelihoods, food security and public health. The recent shift in the disease's ecology and epidemiology has heightened global concern as it has spread to new geographical regions. It has also caused unusual die-offs in wild birds and led to an alarming increase in mammalian cases. The rapidly evolving nature of avian influenza and **changes in its patterns of spread** [2] require a review of existing prevention and control strategies. To effectively contain the disease, protect the economic sustainability of the poultry sector and reduce potential pandemic risks, all available tools must be reconsidered – including vaccination.

© wikoski

Trade essentials

Assurance required to trading partners that no infection is present in your vaccinated flocks

Even if your sector is not exporting the impact will be on others that do!

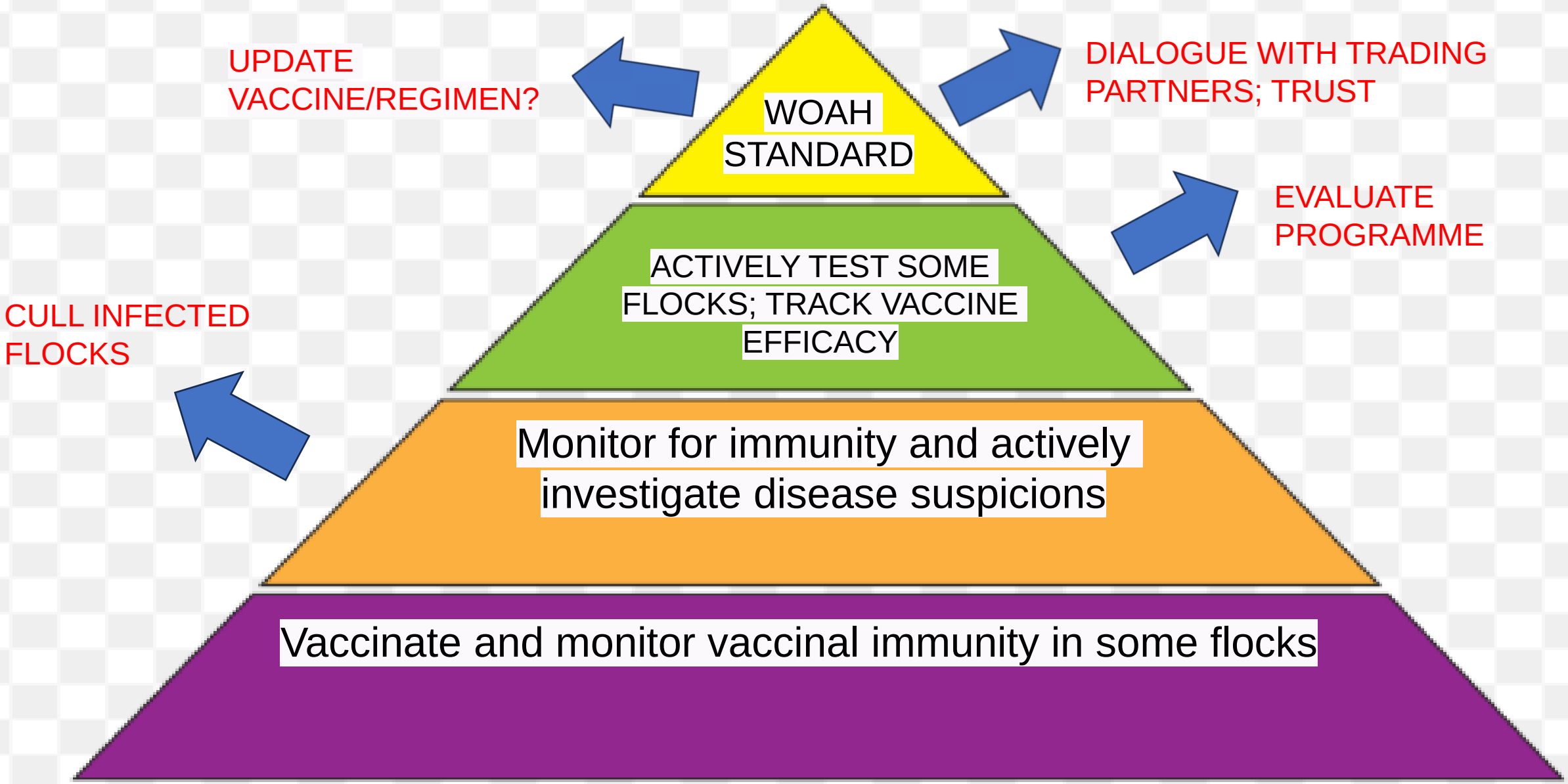
Differentiating **I**nfected from **V**accinated **A**nimals (DIVA)strategy is important for trade, but if more than one vaccine/vaccine type required, the surveillance testing approach will be more complex

WOAH principles: Launching a vaccination programme

When deciding whether to initiate a *vaccination* programme the *Veterinary Authority* and stakeholders should consider

1. The local/regional characteristics of disease
2. Probability that the disease cannot be rapidly contained by means other than vaccination
3. The level of disease or frequency of new events
4. Density of birds/farms/locations
5. Risk of exposure of ie production type – caged, barn, free range
6. *Vaccination* as an alternative to or an adjunct to other disease control measures such as culling
7. Risk of spread to humans from poultry
8. The existence of good record keeping systems on farm
9. The availability of a safe, effective and licensed vaccine
10. The availability of human, financial, and material resources
11. Cost-benefit analysis of the programme, including its impact on trade and public health

Vaccination programmes are not one size fits all! Adapt to the local drivers and needs



Avian Influenza vaccines types

Veterinary vaccines for H5 AI

- Inactivated or killed vaccines
  - Most widely used

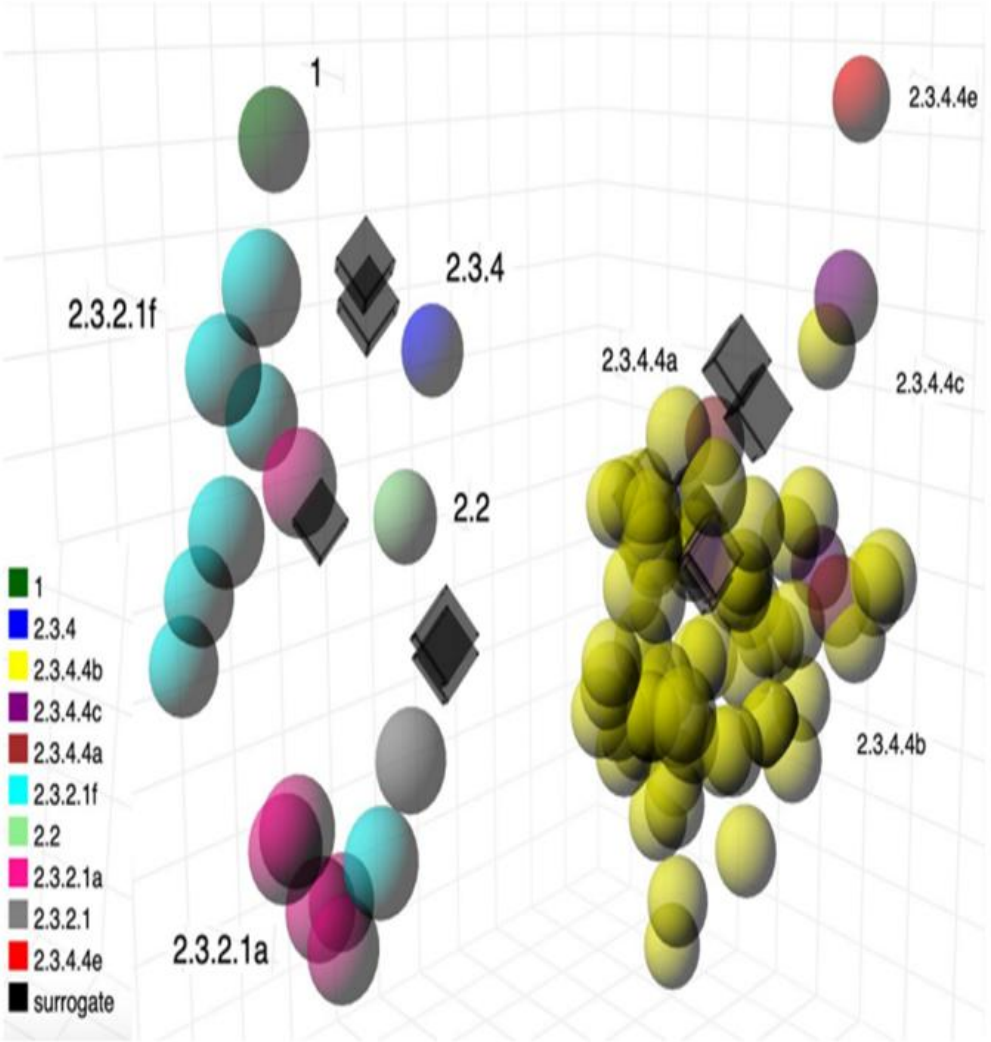
- Vectored vaccines (H5 insert into viral delivery vector)

- Virus protein based

- Genomic (ie mRNA like for COVID)

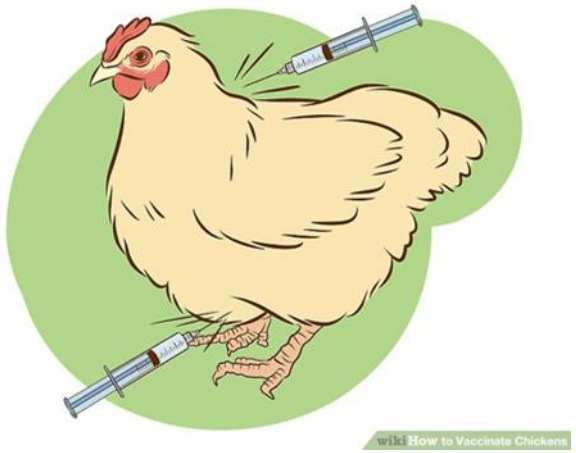
Vaccine strain matching

- New system for defining match amongst vaccine strains to field virus (AIM-OFFLU)
- International scanning for new threats/changes in virus
- Viruses from vaccinated birds rapidly characterised
  - Including any change in zoonotic risk profile
- Information fed into ongoing assessment of vaccine effectiveness
- Increased search for an ‘optimally designed broadly protective H5 vaccine’



Purpose of surveillance when using vaccination

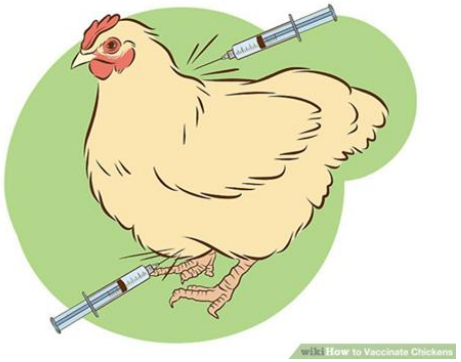
- Monitoring vaccine coverage and flock immunity
- Early detection of new/re-emerged disease outbreaks
- Following the trends of disease incidence
- Demonstrate freedom from HPAI infection
- Programme effectiveness



Demonstrate Freedom from Infection in Vaccinated Flocks

- Challenging with limited precedent despite widespread use of vaccine around the world

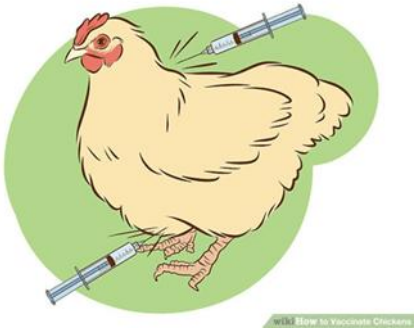
- Strategies adapted to local epidemiological situation



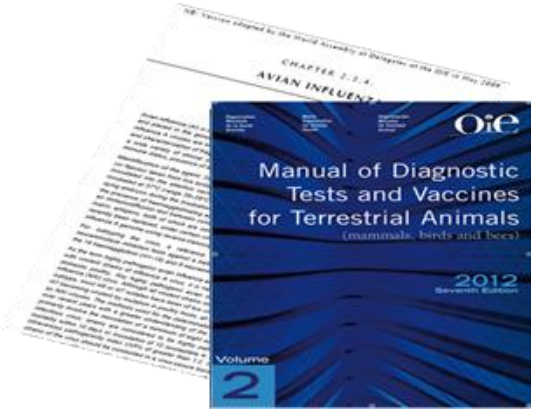
- Confirm vaccination is effective
- Expect few breakdowns with disease
- Surveillance efficacy (over represent poultry farms at greater risk of infection?)
- How are seropositive farms managed (is virus present)? Further testing/veterinary action

Tools and strategies of surveillance

- **Technical Tools**



Virological; detect virus circulating in flock/population
Serological: detect immune responses (Vaccination or natural infection)



Laboratory testing is ideally carried out according to the **WOAH Manual for Diagnostic Tests**

Surveillance type

Passive: tracks any visible manifestation of disease in a flock
Active: stratified plan in healthy looking birds

Surveillance requirements to meet trade requirements

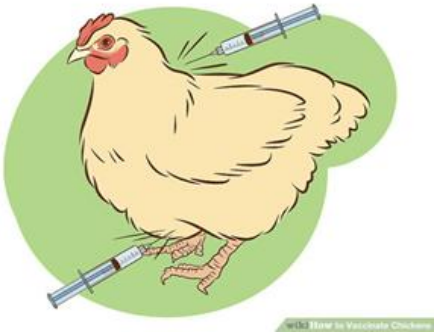
Currently major barrier to the affordability / cost effectiveness of the deployment of vaccines

- Development of effective vaccines for use as a preventive measure is now a key priority for many governments in partnership with industry.

- Vaccine selection, vaccination protocols and monitoring are critical components of a successful vaccination programme. The level of flock immunity required to prevent transmission hinges on several factors. Depending on the disease epidemiology, Veterinary Authorities – in consultation with the poultry sector – may decide to vaccinate only certain species in a selection of production systems

Responsibilities of countries opting for poultry vaccination

- Surveillance or monitoring capacity
- High quality and reliable registered vaccines
- Commitment of poultry producers
- Data collection from producers and veterinarians
- Traceability of the entire process



EU SPECIFIC CONDITIONS FOR PREVENTIVE VACCINATION OF HPAI
(SUBJECT TO REVISION)

1. **Type of vaccine to be used:** live attenuated avian influenza virus prohibited

2. **Reinforced surveillance to be implemented**

Costs to industry

Vaccine €/$/£??
Vaccination €/$/£??
Veterinary costs for inspection

2.1 enhanced passive surveillance shall be implemented in the vaccinated establishments by weekly virological testing of a representative sample of dead birds collected within one week;

2.2 after the start of vaccination, the following active surveillance has to be carried out by an official veterinarian in vaccinated establishments at least every 30 days to detect occurrence of infection with HPAI field virus:

Surveillance (DIVA): €3000 /month/epi group or farm

Weekly mortality: €234/week/epi group

a) a clinical examination that shall include a check of the production records and health records of the establishment in each epidemiological unit, including an evaluation of its clinical history and clinical examinations of the poultry or captive birds;

b) a collection of representative samples for serological or virological surveillance to enable detection of a prevalence of HPAI virus infection in the epidemiological unit of 5% with a confidence level of 95%, using appropriate methods and protocols that allow early detection of the virus and taking into account the specific characteristics of the vaccine used;

Thoughts on how to do monitoring evolving!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Vaccination of poultry against highly pathogenic avian influenza – Part 2. Surveillance and mitigation measures

Published: 18 April 2024 | **Adopted:** 25 March 2024

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GENERAL CONCLUSIONS FOR SURVEILLANCE

Conclusion and recommendations

- Testing dead birds have a higher probability of early detecting HPAIV than strategies based on testing live birds.
- Increasing the sample size above the numbers of 5, 10 or 15 dead birds provided does not increase the probability of HPAIV detection.
- The effectiveness of surveillance is increased by the repeated sampling in time.
- Sampling and testing dead birds should consist of dead birds found in the last 48h.

PREVENTIVE VACCINATION III: Conclusions and recommendations

Recommendations

- **For chicken layers,** a number of effective options have been identified to maintain a level of early detection sensitivity >92%, and probability of freedom >99%, by testing up to 15 dead birds
  - in 100% of the vaccinated establishments monthly; or
  - in 25% of the vaccinated establishments weekly .

https://efsa.onlinelibrary.wiley.com/doi/abs/10.2903/j.efsa.2024.8755

HPAI vaccination in layers: latest EU research

Study design

- Field pilot; birds immunised at day old, placed on farm and groups brought to secure lab for challenge to check how long immunity lasts

- Used 2 DIVA vaccines (Vector and mRNA)
- Vaccinated birds challenged with live virus assessed for disease signs, virus shedding, transmission and immune responses
- Data available so far for 8 and 24 weeks post vaccination
- 45 and 80 weeks post vaccination results expected March 2026

Study conclusions to date

- 8 weeks post vaccination highly effective (one vaccine/dose)

- 24 weeks post vaccination some bird death, virus shedding and transmission however …some improved benefits from prime boost strategy (two vaccines one to prime, another to boost)
- Immunity levels variable among vaccinated chickens, especially when the vaccine is mismatched from the field virus

- Study authors advise that full study results required for firm conclusions

- Layers will almost certainly need booster vaccinations to provide immunity for laying life of the bird

Further information/Next steps

- **Practical Guide to HPAI Vaccination in Laying Hens : available soon from WEO**

NL study:

Germeraad et al Wageningen/Royal GD/Utrecht Univ. Thank you to Francisca Velkers for information sharing.

https://research.wur.nl/en/publications/progress-report-transmission-study-testing-hvt-based-h5-vaccine-a

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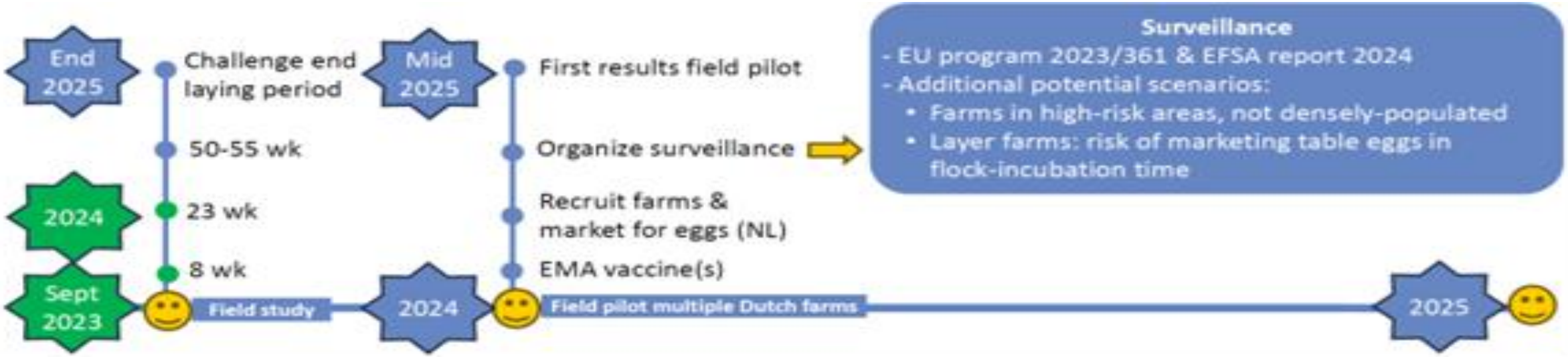

Key conclusions

H5 HPAI has become truly panzootic in the world affecting poultry and wild birds

- International frameworks and standards in place that support vaccination
- Vaccines available with proven utility in lab-based trials (DIVA compatible if needed)
- No one size fits dependent on local drivers
- Improved and faster deployment of next generation vaccines?
- Surveillance needs refinement to detect vaccine breakthrough at low cost
- Overcoming regulatory hurdles to incentivise vaccine updates
- Trust and assurance with trading partners
- Global risk increasing with vaccination having a role for threat mitigation/control
- Multi sector benefits

Thank you for your attention

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