A worldwide overview on the recent multiple incursions of AI viruses in poultry

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G7 CVOs meeting, Rome 4th October 2017
Disease Impact

• Increasingly important disease of poultry
  – Societal impact in some developing countries
  – >600? million poultry culled/killed due to H5N1, H5Nx
  – >$25?? billion to global economy

• Global changes in distribution
  – Uncontrolled spread
  – Endemnicity in several countries/regions
  – Emergence of new clades/waves of infection

• Zoonotic infection
  – Implications for pandemic preparedness

• Spread to other host populations
Epidemiology of avian influenza

• Conventional
  – wild bird reservoir of LPAI
  – spread to poultry
  – some LPAI viruses mutate to HPAI

• Panzootic LPAI
  – H9N2

• HPAI H5N1, then since 2013 H5N2, H5N3, H5N8…..
  – completely different including wild bird reservoirs
LPNAI (H5 & H7 AIVs) entry into farmed poultry
HPAI outbreaks 2005-2017
HPAI outbreaks 2015
HPAI outbreaks 2016
HPAI outbreaks 2017
Primary incursion
YES but NOT always
EURASIAN H5 HPAI
HPAI H5N1 ancestral virus
Goose/Guangdong/96
### Infection dynamics in poultry - HPAI

<table>
<thead>
<tr>
<th>LD&lt;sub&gt;50&lt;/sub&gt; (log&lt;sub&gt;10&lt;/sub&gt;)</th>
<th>MID&lt;sub&gt;50&lt;/sub&gt; (log&lt;sub&gt;10&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5</td>
<td>H5</td>
</tr>
<tr>
<td>3.7</td>
<td>4.3</td>
</tr>
<tr>
<td>&lt;1</td>
<td>2.3</td>
</tr>
<tr>
<td>2.5</td>
<td>&gt;6.0</td>
</tr>
</tbody>
</table>

Aldous et al. 2010

Relationship between husbandry/ecosystems for maintenance of HPAI
Epidemiology of HPAI H5 (‘Guangdong-lineage’)  

- Waves of infection especially in countries with:  
  - extensive trade in live poultry through live bird markets  
  - free ranging ducks  
  
- Virus spread through poor biosecurity within the poultry sectors (3 & 4); lack of preventative measures  
  - Extensive small holder poultry production  
  
- Maintenance and spread via wild birds  
  
- Virus evolution, changing molecular epidemiology and diversity add complexity  
  - Challenges for appropriate vaccination
Multiple waves new strains – virus constantly evolving (Goose/Guangdong lineage)

• Antigenetic change – H or HA
  • Accumulated changes

• Genotypic variation
  • Genetic reassortment

• 1997- H5N1 multiple clades (0, 1, 2, 7)
  • 2.2 spread to Europe/Africa
  • 2.1 spread to Indonesia

• 2009 – H5N1, selection of clades with greater fitness for birds
  • Le clade 2.3.2.1

• 2013 – H5N2, H5N8
  • Le clade 2.3.4.4
Possible HPAI H5N1 Dispersal Routes (2005 - 2006)
(Note: Arrows indicate apparent sequence of geographic spread over time)
Evolution of H5 HPAI viruses

Slide courtesy of T. Davis, CDC, Atlanta

Clades in green include human cases
Clades in blue include only avian viruses
Extinct clades are shown with no color

HA Clade of H5 HPAI viruses isolated in October 2014 – August 2017
Temporal global spread of related viruses – wild bird mediated

Figure 2. Indicative transmission routes of HPAI A(H5N8) through birds migrating into Europe

Group A: comprises Chinese, Russian, South Korean, Japanese, European and North American A(H5N8) 2.3.4.4 viruses representing intercontinental group A. Subgroup A1: composed of A(H5N8) viruses from Europe and Russia from late 2014 and three viruses detected in Japan in December 2014; Subgroup A2: composed of A(H5N8), as well as H5 clade 2.3.4.4 North American HPAIV reassortants (A(H5N2) and A(H5N1)) detected in North America starting in late 2014 and a Japanese virus, A/crane/Kagoshima/KU1/2014(H5N8), detected in November 2014; Subgroup A3: composed of A(H5N8) viruses isolated in Japan in December 2014 and Korea in January 2015 [28].

Recent expansion in number of wild bird species affected but similar orders of Aves

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of events</th>
<th>%</th>
<th>High risk species not detected positive to date in the current epidemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mute swan (Cygnus olor)</td>
<td>252</td>
<td>20%</td>
<td>Black-necked Grebe (Hirundo rustica)</td>
</tr>
<tr>
<td>Swan spp.</td>
<td>253</td>
<td>19%</td>
<td>Bewick’s Swan (Cygnus columbianus)</td>
</tr>
<tr>
<td>Duck spp.</td>
<td>140</td>
<td>10%</td>
<td>Barnacle Goose (Branta leucopsis)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>140</td>
<td>10%</td>
<td>Ruff Goose (Branta ruficollis)</td>
</tr>
<tr>
<td>Goose spp.</td>
<td>140</td>
<td>10%</td>
<td>Red-breasted Goose (Branta ruficollis)</td>
</tr>
<tr>
<td>Gulls spp.</td>
<td>84</td>
<td>6%</td>
<td>Gadwall (Anas strepera)</td>
</tr>
<tr>
<td>Tufted duck (Aythya fuligula)</td>
<td>25</td>
<td>2%</td>
<td>Black Tern (Sterna hirundo)</td>
</tr>
<tr>
<td>Whooper swan (Cygnus cygnus)</td>
<td>79</td>
<td>6%</td>
<td>Northern Harrier (Cryidae)</td>
</tr>
<tr>
<td>Common buzzard (Buteo buteo)</td>
<td>25</td>
<td>2%</td>
<td>Red Kite (Milvus milvus)</td>
</tr>
<tr>
<td>Greylag goose (Anser anser)</td>
<td>21</td>
<td>2%</td>
<td>Black Kite (Milvus migrans)</td>
</tr>
<tr>
<td>Mallard (Anas platyrhynchos)</td>
<td>41</td>
<td>3%</td>
<td>Eurasian Marsh Harrier (Cryidae)</td>
</tr>
<tr>
<td>Hen harrier (Larus argentatus)</td>
<td>27</td>
<td>2%</td>
<td>Grey-backed Shrike (Lanius excubitor)</td>
</tr>
<tr>
<td>Black-headed gull (Larus ridibundus)</td>
<td>23</td>
<td>2%</td>
<td>Red-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>White-tailed eagle (Haliaeetus albicilla)</td>
<td>21</td>
<td>2%</td>
<td>Eurasian Golden Plover (Pluvialis apricaria)</td>
</tr>
<tr>
<td>Greylag goose (Anser anser)</td>
<td>21</td>
<td>2%</td>
<td>Ruff (Philomachus pugnax)</td>
</tr>
<tr>
<td>Eurasian wigeon (Anas penelope)</td>
<td>20</td>
<td>2%</td>
<td>Northern Lapwing (Vanellus vanellus)</td>
</tr>
<tr>
<td>Heron spp.</td>
<td>16</td>
<td>1%</td>
<td>Purple Swamphen (Porphyrio porphyrio)</td>
</tr>
<tr>
<td>Great cormorant (Phalacrocorax carbo)</td>
<td>15</td>
<td>1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Great crested grebe (Podiceps cristatus)</td>
<td>12</td>
<td>1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Great black-backed gull (Larus marinus)</td>
<td>11</td>
<td>1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Greater white-fronted goose (Anser albifrons albirosa)</td>
<td>9</td>
<td>1%</td>
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<tr>
<td>Common pochard (Aythya ferina)</td>
<td>8</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Common coot (Fulica atra)</td>
<td>8</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Peruvian pelican (Pelecanusargentatus)</td>
<td>5</td>
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<tr>
<td>Canada Goose (Branta canadensis)</td>
<td>5</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Little grebe (Tachybaptus ruficollis)</td>
<td>4</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Common merganser (Mergus merganser)</td>
<td>4</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Lesser white-fronted goose (Anser erythropus)</td>
<td>4</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Ovall quack</td>
<td>4</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Eurasian teal (Anas crecca)</td>
<td>3</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Hooded crow (Corvus cornix)</td>
<td>3</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>White woodcock (Scolopax rusticola)</td>
<td>3</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Falcon spp.</td>
<td>3</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Hawk spp.</td>
<td>3</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Buzard spp.</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Common gull (Larus canus)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Common merganser (Mergus merganser)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Red-crested pochard (Netta rufina)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Common tern (Sterna hirundo)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Shelduck (Tadorna tadorna)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Song Thrush (Turdus philomelos)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Common kestrel (Falco tinnunculus)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Wood pigeon (Columba palumbus)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Bank (Rallus aquaticus)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Carrion crow (Corvus corone)</td>
<td>2</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Common eider (Somateria mollissima)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
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<tr>
<td>Common eider (Somateria mollissima)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Common raven (Corvus corax)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Curlew (Numenius arquata)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Eagle (sp., unspecified)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Eurasian eagle-owl (Bubo bubo)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Eurasian sparrowhawk (Accipiter nisus)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Eurasian white-fronted goose (Anser albirosa)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Green sandpiper (Tringa ochropus)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Lesser black-backed gull (Larus marinus)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Wigeon spp.</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Common blackbird (Turdus merula)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Pink-footed goose (Anser brachyrhynchus)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Eurasian collared dove (Streptopelia decaocto)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
<tr>
<td>Crested cock (Cuculus canorus)</td>
<td>1</td>
<td>&lt;1%</td>
<td>Black-tailed Godwit (Limosa limosa)</td>
</tr>
</tbody>
</table>

Note: Several events involved different species: Bird species in bold are on the list of high risk species.
Duck sector production and spread of H5 HPAI
Two major epizootics in SW France
2015-16 H5 HPAI ‘classical’ European
2016-17 H5N8 (clade 2.3.4.4)

Practices of rearing ducks in the Foie Gras industry and conducive for spread of virus!
Emergence and spread of clade 2.3.4.4 viruses
12/8/2014 to 6/17/2015 – H5 HPAIV in wild bird, backyard poultry and commercial poultry

Slide courtesy of David Swayne, SEPRL

311 detections (4 captive WB; 21 backyard; 211 commercial flocks, 75 WB)

- 21 states affected; 15 states with wild bird cases
- 50.4m poultry: chickens (~ 43m) > turkeys (~ 7.5m)
- Direct cost $1.6b; economy wide $3.3b
- Federal taxpayer - $850m (~$200m indemnity, ~$650m response cost)
H5N8 HPAI epizootic in Europe/Central Asia/Africa 2016-17

- 2,765 outbreaks/events of H5N8 Highly Pathogenic Avian Influenza have been reported in poultry (1,149), wild birds (1,562) and captive birds (54) from 29 European countries

- 20 outbreaks/events of H5N5 Highly Pathogenic Avian Influenza have been reported in poultry (5), wild birds (14) and captive birds (1) from 11 European countries

- Central Asia (Russian Federation, India, Iran, Kazakhstan), Middle East (Kuwait, Israel) and Africa (Egypt, Tunisia, Nigeria, Cameroon, Uganda, DR Congo, Zimbabwe, South Africa)

- Further reassortment in region
  - H5N5 HPAI in poultry & wild birds from 7 European countries.
  - H5N6 HPAI in poultry (1) in Greece
European epidemic curve HPAI in domestic and wild birds (source: ADNS data available 19th October 2016 – 3rd August 2017)
Key characteristics of H5N8 epizootics

- Epidemiological patterns
  - Seasonality – wild bird migratory pathways
  - Host populations
  - Secondary spread especially in domestic waterfowl
  - Captive birds and backyard flocks

- Clinical presentation
  - Severe all hosts; no human cases

- Heavy infection pressure
  - Wild birds and environment

- Virus persistence/introduction
  - Fastidious
  - Fomite pathways - multiple

- Virus evolution
  - Limited change in HA
  - Second generation reassortants
Host susceptibility/infection outcome

- **Galliformes - severe**
  - Chickens and turkeys
  - Guinea Fowl

- **Galliformes – intermediate**
  - Phasianidae

- **Domestic anseriformes**
  - Severe/moderate
  - Experimental infection of ducks; birds recover, seroconvert (APHA unpub)
  - Outdoor birds protective effect of prior exposure to heterologous virus

- **Others – susceptible**
  - Ratites, pigeons
Incursion pathways for contemporary H5 HPAI

Migratory wild birds

Resident and local wild birds

Environment

Commercial Poultry

LBM, Backyard or ‘captive’ birds
Spread and maintenance in ducks

Can be more limited in other production systems
Anseriforme reservoirs?

• H5N8 disease spectrum dependent on age/breed
• Minimum infectious dose less than 2 logs
  • Age dependent
• Shed ~5 logs virus/gram of faeces

• Attenuation of virus for anseriformes as it adapts??

• Implications for surveillance in both wild and domestic birds
Phylogeny of the HA gene of H5 HPAI
Europe/Asia/Africa 2016-17

Common ancestral virus to Russian Federation/wild bird/May 2016
TMRCA January 2016
Virus continually evolving/changing – new traits and fitness

Reassortment with LPAI in wild birds: can be all gene segments
Environmental survival

Key risk factor leading to fomite introduction and maintenance in wild birds
AIV survival and infectivity – H5N8
APHA unpublished prelim data

c48-60 days to reduce below infectious levels for poultry
Survival Kinetetics of HPAI in Different Substrates

$D_T$ value, in days, for log$_{10}$ reduction in virus infectivity over time measured at 4°C and 20°C, standard error mean (SEM)

<table>
<thead>
<tr>
<th>Virus</th>
<th>Tissue</th>
<th>Temp °C</th>
<th>Faeces</th>
<th>Litter</th>
<th>pH5*</th>
<th>pH7.2</th>
<th>pH9</th>
<th>Distilled water</th>
<th>Salted water</th>
<th>UVB Exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>H7N1 HPAI</td>
<td>Muscle</td>
<td>20</td>
<td>0.83</td>
<td>&lt;5min</td>
<td>34.76sec*</td>
<td>18.46</td>
<td>8</td>
<td>21.28</td>
<td>14.42</td>
<td>2.63hrs</td>
</tr>
<tr>
<td></td>
<td>Feather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H5N1 HPAI</td>
<td>Muscle</td>
<td>4</td>
<td>3.33</td>
<td>&lt;5min</td>
<td>24.99sec</td>
<td>20.61</td>
<td>12.36</td>
<td>32.66</td>
<td>19.94</td>
<td>not tested</td>
</tr>
<tr>
<td></td>
<td>Feather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>4</td>
<td>12.05</td>
<td>&lt;10min</td>
<td>33.62sec</td>
<td>37.89</td>
<td>40.3</td>
<td>72.81</td>
<td>74.78</td>
<td>not tested</td>
</tr>
</tbody>
</table>

*half-life in seconds

Sample matrix $DT$ value in days (unless specified) for log10 reduction in virus infectivity (* half-life in seconds) over time measured at 4°C and 20°C
Vaccination as a tool for prevention/control
Vaccine development for veterinary use

- Although many current vaccines have used few have proven utility against H5 HPAI leading to effective control/eradication
- Lack ease of delivery and efficacy versus a diverse family of viruses
- Innovations in vaccine design have largely not been invested in for AI sufficient for global application
- Target hosts: anseriformes present greatest challenge
- Differentiating Infected from Vaccinated Animals
- Produced in accord with international standards (OIE)

- Other approaches genetic resistance in poultry lines??
Other threat viruses: H7N9?

- H7N9: exists in LP and HP form in China but worrying changes in disease pattern – vaccination being applied
  - Currently lacks capability to infect migratory waterfowl but spread via humans a real risk
  - Major zoonotic risk
  - Global travel in people (returning travellers from Far East/Africa stay off poultry farms!)??
- How long before these viruses are detected beyond China?

Map 1. Human cases and positive findings in birds or the environment

Note: Human cases are depicted in the geographic location where they were reported; for some cases, exposure may have occurred in a different geographic location. Precise location of 24 human cases in Anhui (2), Beijing (2), Guangdong (1), Guangxi (1), Hubei (3), Hunan (1), Sichuan (1), Jiangsu (1), Jiangxi (6), Zhejiang (3) Provinces are currently not known, these cases are therefore not shown on the map.

Number of confirmed human H7N9 cases and deaths, as reported to WHO by week, as of 2017-7-24
Other HPAI 2016-17

- Mexico H7N3
- Italy H7N7
- USA
  - H7N8 (2016)
  - H7N9 (2017)
H5/H7 LPAI 2016-2017
Active surveillance for LPAI – consequences!

Is surveillance for LPAI, its consequences via interventions and impacts ie trade still fit for purpose. Is risk mitigated for HPAI??
H9N2 is ubiquitous throughout the world

• Often the most frequently detected influenza subtype in chickens
  • Wide spectra of disease signs
  • Economic impact on production
  • New epizootics in Europe, Africa, Asia
  • Subject to control through vaccination in many countries
• Cocirculation with H5 HPAI
  • Attenuation of clinical presentation
Zoonotic avian influenza

- Aquatic bird reservoir to poultry
  - Maintenance host: domestic ducks?
- Spill over to humans via poultry interface
  - ie live bird markets
- These viruses can cause clinical outcomes/death
  - Replication in lower respiratory tract only in severe cases
- Viruses lack transmissibility in mammalian species including humans
  - Due to lack of replication in upper airway of these hosts
- Current global H5N8 HPAI epizootic (3 continents)
  - Risk to humans low (no recorded cases to date)
  - Still essentially avian virus without humanising mutations
Current global threat viruses : H5 HPAI

• H5 HPAI circulate widely and some strains maintain in wild aquatic birds
• These H5 viruses are continually evolving
  • Reassortment H5N5
• 2017 H5N8 spreads south of equator for first time
  • DRC, Uganda, Zimbabwe, South Africa
  • Prospects for eradication poor
• Autumn/winter 2017/8 - further global waves with H5N8??
• c2015- present: H5N6 East Asian flyway
  • Established in wild birds mediating spread

COULD THIS VIRUS WHICH CARRIES GREATER ZOONOTIC THREAT BE THE NEXT STRAIN THAT SPREADS TRANS-CONTINENTALLY???
Future perspectives

• Understanding pathways for introduction
• Virus variability; correlates for infection risk
• Seasonality: predict future incursions
  • Rapid data sharing in real time
• Maintenance reservoirs
  • Long term dynamic/surveillance design
• Globally at risk of further outbreaks?
• Societal behaviours - education
• Spread to Central and South America?
• Trade impacts and risks
• **Solutions at global scale for better interventions**
  • Better veterinary vaccines
Key conclusions

• H5 HPAI has become truly panzootic affecting poultry and wild birds
  • Significant evolutionary trends and epidemiology
  • New threats to poultry production and wildlife
  • Dispersal for primary introductions through migratory waterfowl
  • Endemicity in some areas; reincursions in others- prospects for immediate control poor!

• We can expect further outbreaks with H5 HPAI in the next months/years

• In developed countries strong surveillance detects many LPAI incursions and HPAI early
  • Future requirements: OIE engagement

• Continued and future threat to global food security/human health
10th International Symposium on Avian Influenza
Avian Influenza in Poultry and Wild Birds
15 - 18 April 2018, The Grand Hotel, Brighton, UK

Poultry sessions will include:
- Global reports on AI
- Surveillance for AI
- LPAI outbreaks
- Diagnostics
- Vaccines & vaccination
- Pathobiology
- Field epidemiology
- Field control
- Education & risk communication
- Zoonoses

Wild bird sessions will include:
- Surveillance
- Ecology
- Pathobiology
- H5N1 HPAI

Important dates
Registration opens: 11 September 2017
Abstract deadline: 13 November 2017

Co-chairs: Ian Brown (UK) ; David Swayne (USA) ; Thijs Kuiken (NL)
For further information visit: www.flu-lab-net.eu
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Thank you for your attention

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