Controlling Avian Flu and Protecting People’s Livelihoods in the Mekong Region, Africa and Indonesia

Disease Risk
Main Research Findings, Implications and Policy Conclusions for different Epidemiological Situations

FAO - APHCA - DFID

International meeting on Pro-Poor HPAI Risk Reduction:
Lessons from Southeast Asia and Africa,
Phuket, Thailand
October 25-27, 2010
Disease Risk

1. Background on HPAI H5N1
   1.1 Ecology/biology of HPAIV H5N1
   1.2 Poultry production sector and wild birds

2. Epidemiology of HPAIV H5N1
   2.1 Spatial and temporal patterns of HPAI H5N1 occurrence
   2.2 Risk of between-flock transmission of HPAIV and from poultry to humans
1. – BACKGROUND ON HPAI H5N1
1.1 - ECOLOGY/BIOLOGY OF HPAIV H5N1
Ecology of HPAIV H5N1

- Key Messages

• small genome with eight gene segments
• evolution of influenza viruses influenced by
  – high virus mutation rates, natural selection and host population characteristic, such as species susceptibility and population contact structure
    • antigenic drift
    • antigenic shift or genetic reassortment
      – exchange of antigens between different influenza A virus sub-types co-infecting a host
Ecology of HPAIV H5N1
- Key Messages

• avian influenza viruses (AIVs) unrivalled in evolutionary capacity to adapt to new hosts and changing environments

• AIV ubiquitous in wild waterfowl
1.2 – POULTRY PRODUCTION SECTOR AND WILD BIRDS
Wild Bird Flyways

Controlling Avian Flu and Protecting People’s Livelihoods
2. - EPIDEMIOLOGY OF HPAIV H5N1
2.1 - Spatial and Temporal Patterns of HPAI H5N1 Occurrence – Key Messages

• HPAIV H5N1 introduced into GMS countries from southern China during late 2003 to early 2004

• initial epidemic outbreak wave in 2004
  – affected very large number of poultry flocks in central Thailand and northern and southern Viet Nam
  – low incidence in Cambodia and Lao PDR

• subsequent massive control efforts by Thailand and Viet Nam reduced outbreak incidence substantially, but could not totally eliminate infection
2.1. - Spatial and Temporal Patterns of HPAI H5N1 Occurrence – Key Messages

- Viet Nam
  - HPAI H5N1 continues to occur in same areas as in early epidemic waves
    - high density of both chickens and ducks, typically kept in semi-intensive commercial units
    - in or in vicinity of areas of high human population density
      - high frequency of live poultry movement
      - live bird markets have role in maintenance of infection

- Lao PDR and northern Viet Nam
  - influence of cross-border trade with southern China

- Cambodia
  - overflow from southern Viet Nam
Spatial and Temporal Patterns of HPAI H5N1 Occurrence – Key Messages

• Indonesia
  – large-scale outbreaks since 2004 - first also in commercial farms – now endemic infection and outbreaks in backyard and semi-intensive poultry farms

• Nigeria
  – large scale outbreaks between 2006 and 2008 in backyard and semi-intensive poultry farms

• Ghana
  – small-scale outbreaks in 2007 in backyard and semi-intensive poultry farms associated with cross-border trade

• Kenya and Ethiopia reported no outbreaks
HPAI H5N1 Outbreaks in Wild Birds and Poultry (2003- Oct 2010)

Source: EMPRES-I, FAO
HA Clades of HPAIV H5N1 around Asia, Africa and Europe 2003-08

From: Pfeiffer et al - Under review
Temporal Pattern of Reported AI Outbreaks in GMS between 2004 and Oct 2010
Cumulative Density of Reported HPAI H5N1 Outbreaks between 2004 and Oct 2010 in Greater Mekong Sub Region
HPAI H5N1 Outbreaks in GMS in 2007
HPAI H5N1 Outbreaks in GMS in 2008
HPAI H5N1 Outbreaks in GMS in 2009
HPAI H5N1 Outbreaks in GMS in 2010
Within-country experts:
Indonesia – Syafriason Idris, Maria Fatima Palupi, Elly Sudiana, Elly Sawitri
Viet Nam - Do Huu Dung
Thailand - Suwicha Kasemsuwan, Chaithep Poolkhet, Karoon Chanachai

In close collaboration with:
ILRI (Bernard Bett, Paulo Duarte, Fred Unger, Frank Hansen, Jeff Mariner, Acho Okike, Amos Omore, Tom Randolph, Wachira Theuri, Russ Kruska, Delia Grace, and Saskia Hendrickx)
Royal Veterinary College (Apisit Prakarnkamanant, Solenne Costard, Will de Glanville, Kim Stevens, Guillaume Fournié, Raphaëlle Métras, Dirk Pfeiffer)

RISK ASSESSMENTS
<table>
<thead>
<tr>
<th>Country</th>
<th>Risk Questions</th>
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<tbody>
<tr>
<td>Indonesia</td>
<td>For district and municipality of Bogor:</td>
</tr>
<tr>
<td>(QualRA &amp;</td>
<td>- between sector 3 farms</td>
</tr>
<tr>
<td>QuantRA)</td>
<td>- from sector 3 to 4 farms</td>
</tr>
<tr>
<td>Kenya</td>
<td>- between sector 4 farms</td>
</tr>
<tr>
<td>(QualRA)</td>
<td>- from sector 4 to 3 farms</td>
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<tr>
<td></td>
<td>- from sector 3 to 4 farms through sale of live birds</td>
</tr>
<tr>
<td>Nigeria</td>
<td>- from sector 3 to 4 farms</td>
</tr>
<tr>
<td>(QualRA)</td>
<td></td>
</tr>
<tr>
<td>Ghana</td>
<td>- from BF, Cl and Togo via cross-border trade</td>
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<tr>
<td>(QualRA)</td>
<td></td>
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<tr>
<td>Ethiopia</td>
<td>- legal or illegal trade of wild birds transiting through country</td>
</tr>
<tr>
<td>(QualRA)</td>
<td>- between sector 2 and 3 farms</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>- from live bird markets to sector 3-4 farms</td>
</tr>
<tr>
<td>(QualRA)</td>
<td></td>
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<tr>
<td>Thailand</td>
<td>For 1km buffer zone around compartmentalised farms:</td>
</tr>
<tr>
<td>(QualRA &amp;</td>
<td>- to sector 3-4 farms through any activity (qualRA)</td>
</tr>
<tr>
<td>QuantRA)</td>
<td>- to sector 3-4 farms through cock fighting (quantRA)</td>
</tr>
</tbody>
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Holidays and Epidemics in Viet Nam

National vaccination campaigns

Updated from Pfeiffer et al 2007: The Veterinary Journal
HPAI Risk Map for Greater Mekong Sub Region and Viet Nam

From: Gilbert et al 2008 – *PNAS*

From: Pfeiffer et al 2007 – *The Veterinary Journal*
HPAI H5N1 Outbreaks 2006-10 in Southern Viet Nam and Pct Aquaculture Area

Controlling Avian Flu and Protecting People’s Livelihoods
HPAI H5N1 Outbreaks 2006-10 in Southern Viet Nam and Duck Density
HPAI H5N1 Outbreaks 2006-10 in Northern Viet Nam and Chicken Density
HPAI Risk & Flock Size (Viet Nam)

From: Otte et al 2009 *Project Report*
Poultry Trade in Northern Viet Nam

From: Magalhaes et al 2010 *BMC Vet Research*
Network Analysis of Poultry Trade in Northern Viet Nam

From: Magalhaes et al 2010 BMC Vet Research
Social Network Analysis of Poultry Trade in Northern Viet Nam cont.

- Giant weak component
- Second component
- Other components

From: Magalhaes et al 2010 BMC Vet Research
HPAI H5N1 Clade Distribution from 2004-08 in GMS

1, 2.3.4

1, 2.3.2, 2.3.4, 5

Also 0, 3, 8

2.3.4
2.2. - Between-flock HPAI Transmission Risk - Key Messages

• for most risk pathways, overall risk assessed as negligible to very low
  – mainly because background HPAI prevalence estimated negligible / very low
  – only partially as a consequence of preventive or control measures

• risk of within-region spread due to wild birds negligible to very low
2.2. - Between-flock HPAI Transmission Risk - Key Messages

• poor biosecurity at backyard and semi-commercial poultry farms

• poor biosecurity throughout value chain
  – movements of poultry associated with trade through live bird markets likely to have significant role in spread and maintenance of HPAI H5N1 infection
    • effect exacerbated through involvement of domestic waterfowls which may not show clinical disease
    • illegal transboundary trade

• under-reporting, slow reporting and low compliance with biosecurity/control measures
2.2. - Transmission from Poultry to Humans - Key Messages

• extremely low risk of human infection with HPAI H5N1 as result of exposure to infected poultry
  – even on poultry farms or at live bird markets

• but need to minimise risk of human exposure to infection
  – consequences of infection
    • potentially fatal
    • infection may result in reassortment with AI viruses transmissible between humans
Transmission of HPAIV H5N1

adapted from V. Martin, FAO-AGA
KNOWLEDGE-DRIVEN RISK FACTOR MODELLING
Suitability for Occurrence of HPAI H5N1 in Africa

From: Stevens et al 2009 Project report
Risk/Likelihood of Spread of HPAI H5N1 in Indonesia

From: De Glanville et al 2008 Project report
Suitability for Introduction and/or Persistence of HPAIV H5N1

Suitability of an area in Asia for the introduction and/or persistence of HPAI H5N1

- Suitable for neither
- Suitable for introduction only
- Suitable for persistence only
- Suitable for both

From: Stevens et al – In preparation
Suitability for Introduction and / or Persistence of HPAI H5N1 (shown with reported Outbreaks)
MATHEMATICAL / DYNAMIC DISEASE MODELLING
Dynamic Modelling – Simulation of Spread of Disease and Prediction of High Risk Areas for Nigeria

- consistently predicts areas of
  - low risk of outbreaks and few dead chickens (circles)
  - high risk of outbreaks and many dead chickens (squares)

From: Hansen et al – In preparation
Conclusions – Ecology/Epidemiology

- ecology/biology of HPAIV H5N1
  - high mutation rate of AIV
    - antigenic drift/shift

- epidemiology of HPAIV H5N1
  - within-region spread
    - importance of live bird trade
      - particularly semi-intensive poultry producers
    - increased risk in rice-duck-(fish) production systems
    - wild birds relatively unimportant
  - between-region spread
    - live bird trade
    - wild bird migration