Influenza at the Animal-Human Interface

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2016.isirv.org
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I have financial relationship(s) with:
Merial, Inc. (Sanofi)
and Type of Financial Relationship:
Grant/Research
AND

My presentation does not include discussion of off-label or investigational use
1. OFFLU: Animal Influenza Expertise Network
2. Influenza A Virus at the Animal-Human Interface
3. Specific Strategies:
   1. Animal Influenza Surveillance – Ex. USA Swine Influenza Surveillance
   2. Pandemic Preparedness Vaccines
   3. Education for Proper Home Poultry & LPM slaughter
1. OFFLU Network of Animal Influenza Experts

OIE (World Organization for Animal Health) and FAO (Food and Agriculture Organization of the United Nations)

Animal InFLUenza Network: 6 continents, 26 countries, 60 experts

Avian (poultry and wild birds), equine and swine influenza expertise including OIE Reference Laboratories and FAO Reference Centres for Avian Influenza, OIE Reference Laboratories for Equine Influenza, OIE Collaborating Centres, OFFLU regional laboratory contacts for avian influenza, current members of OFFLU swine influenza group, and specific staff at OIE and FAO with responsibilities to OFFLU
• Provide expertise for early recognition and characterization of emerging influenza viral strains in animal populations, and effective management of known infections, thereby better managing the risk to human health and promoting global food security, animal health and welfare, and other community benefits derived from domestic animals and wildlife.

• Collaborate with the WHO and other public health organizations on issues relating to the animal-human interface, including pandemic preparedness for early preparation of human vaccine.
www.oflu.net

OIE/FAO
Network of expertise on animal influenza

OFFLU is the OIE-FAO global network of expertise on animal influenza working to reduce the negative impacts of animal influenza viruses by promoting effective collaboration between animal health experts and with the human health sector.

NEWS

12.08.13 New experts join OFFLU management Committee
Changes in the OFFLU Steering and Executive Committee
More +

30.04.13 The OIE press release
OIE expert mission finds live bird markets play a key role in poultry and human infections with...
More +

05.04.13 FAO press release on avian influenza A(H7N9) virus in China
Strong biosecurity measures required in response to influenza A(H7N9) virus
More +

PUBLICATIONS

OFFLU Annual Report 2012
More +

EVENTS

Avian Influenza A(H7N9) virus
For the latest information visit the Guidance and Resource Centre section at the top of our page

OFFLU RESEARCH AGENDA
More +

OFFLU SURVEILLANCE STRATEGY
More +

WAVIH
World Animal Health Information Database
www.oie.int/wahid

EMPRES
Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES)
www.fao.org/EMPRES
2. Influenza A Virus: Animal-Human Interface

- Primordial reservoir of IAV genes
- Endemic IAV in animals
  - Global
  - Regional/National

Sporadic IAV animals
Infrequent transfer of whole viruses to humans
Animal-Human interface

Zoonotic Potential in Farmed Animals

An aspirational proposition?

Where animals are farmed to meet the needs of society, an informed society will require that the farming of these animals will not result in a health threat to people.
Is animal influenza a threat to humans?

- Highly pathogenic avian influenza H5Nx ... 854 human infections (450 deaths)
- Variant H3N2 in North American pigs ... 353 (0)
- Avian influenza A(H7N9) in China ... 793 (319)
- Low pathogenicity avian influenza A(H9N2) in Asia .... 16 (0)
- Pandemic H1N1 2009 globally .... ongoing

Often identification of an infectious agent occurs in humans after human-to-human spread has begun, rather than in the animal from which it comes, and opportunities for control in animals and prevention of human infection are lost.

(Chatham House (2010) Shifting from Emergency Response to Prevention of Pandemic Disease Threats at Source)
The threat to be managed…

• Possible emergence of a zoonotic influenza virus with the potential to cause a pandemic
• Identify the scenarios for emergence that would most likely enable animal influenza virus to cross to humans
• Take fair and rapid action
The main determinant of infectious animal disease is .......

HUMAN BEHAVIOR

Human behaviors (farming, marketing, etc.) allow the spread and transmission of infectious agent to succeed (anywhere along the “value chain”)
Objectives (Benefits) of Surveillance

• Early detection of animal influenza to facilitate control
• Early detection of genetic changes altering risks to human or animal health
• Early detection of phenotypic changes (antigenic, antiviral susceptibility, etc.) with implications for human or animal health
• Management of disease control programs
• Improved knowledge of viral epidemiology and disease pathogenesis
• Monitoring the performance of diagnostic tools
• Managing infections for more efficient animal production
• Detecting new infections (with modern technology)

(Much excellent work is already being done)

(OFFLU Surveillance Strategy: http://www.oflul.net)
Factors that could contribute to inadequate surveillance
(the under assessment and under reporting of disease)

1. Inability
   - Inability to detect lack of awareness of benefits
   - Inability to test lack of sampling and testing capacity
   - Inability to report No effective reporting and response chain

2. Unwillingness
   - Cost and lack of financial advantage or cost recovery
   - Negative consequences trade restrictions, movement bans
   - Compulsory slaughter/no compensation
   - Loss of reputation national (loss of tourism), local (victimization)
   - No incentives no positive feedback or response plan

(World Bank 2010, People, Pathogens and Our Planet
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Possible surveillance issues for farmers

1. Who carries the cost?
   - Society? The whole value chain? Consumers?

2. What will be the response to findings?
   - Regulatory issues affecting business continuity
   - Public perception issues relating to profitability

There is still too much uncertainty!

The informed debate is yet to be had,
The policy settings are yet to be developed.
3.1. How do we know what’s out there?

Example: SIV in USA

Surveillance Pyramid

- Whole Genome Sequencing
- Sequencing HA/NA and Genetic Characterization
- PCR Detection / Subtyping

Monitor genetic and antigenic evolution
Inform animal and public health stakeholders
Update diagnostics reagents and vaccines
Identify relevant strains for research
Development of intervention strategies

USDA IAV-S Surveillance

- USDA APHIS Veterinary Services system, active since 2009
- All virus isolates have HA, NA and M sequenced, WGS done for subset (800)
- Sequences in GenBank: USDA barcode A/swine/Arkansas/A01840698/2015
  Email your request to: NVSL_Userfee@aphis.usda.gov

NADC partners to do genetic, antigenic, and phenotypic characterization on viruses of interest
### National Trends

- Dominant viruses detected in FY15 were gamma H1N1, delta-1 H1N2, Cluster IV-A H3N2, and delta2 H1N2.
- All viruses characterized in FY15 contained the pandemic-lineage M gene.
- The emerging human-like H3N2 continued to be detected with slightly increased frequency and spread to additional states (MO, AR, IA, MN, IN, IL, OH).
- Smattering of rare clades that don’t get replaced by the dominant clades.

#### Percentage of HA and NA combinations – Oct 2014 to Sept 2015

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*Rasna Walia*
Regional Trends

H1

H3

Rasna Walia
Regional patterns of HA/NA combinations

- Common HA/NA combination across all regions
- Combinations more unique to a region
- Some regions demonstrate marked differences between states (not shown)

Rasna Walia
Antigenic Analysis

6 amino acid sites in the HA are correlated with antigenic drift of swine H3N2

Lewis et al., Journal of Virology
Antigenic diversity of swine H1

Daniela Rajao, unpublished
Swine Risk Assessment Pipeline

1. Generate/distribute ferret and swine antisera
2. HI assays with swine IAV antigens
3. Antigenic cartography

Step 1. Determine antigenic distance from human seasonal strains by cross-HI

Step 2. Assess population immunity by HI with human sera

Step 3. Additional RA studies

Step 4. Public Health Action

- Vaccine seed stock production
- Intensified surveillance
- Control measures in swine population

CRIP
3.2 Public Health Mitigation: Pandemic Preparedness Vaccine

H5N1 (N6) Gs/GD HPAIV

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<th>2003-2009* deaths</th>
<th>2010-2014** cases</th>
<th>2010-2014** deaths</th>
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*(As of 7/19/16, WHO)*
Highly Pathogenic Avian Influenza (H5N1) Human Cases and Deaths, 2003 - 2014
• Every six months OFFLU gather and analyse information on animal influenza viruses of public health concern and share that information during the WHO Vaccine Composition Meetings

• OFFLU contribution includes:
  – Overview of epidemiologic situation for HPAI H5N1 in animals
  – Phylogenetic trees for HPAI H5N1
  – Antigenic testing of specified isolates using ferret derived antisera
  – Information for other animal influenza viruses considered to be of public health concern such as H9, H7 and other H5 subtypes

• Information assists WHO in the selection of most appropriate circulating viruses for updating human vaccines for pandemic preparedness
<table>
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<tr>
<th>VCM meeting</th>
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<th>Countries</th>
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Influenza

Antigenic and genetic characteristics of zoonotic influenza viruses and candidate vaccine viruses developed for potential use in human vaccines

25 February 2016

This summary provides a review on the zoonotic influenza virus activity and virus characterization, and describes the current status of the development of candidate vaccine viruses for pandemic preparedness purposes. It is meant to provide guidance for national authorities and vaccine companies on the selection of candidate viruses for use in vaccine development.

February 2016
pdf, 618kb

Previous summaries

September 2015
pdf, 2.14Mb

February 2015
pdf, 509kb

September 2014
pdf, 283kb

February 2014
pdf, 600kb

September 2013
pdf, 761kb

February 2013
3.3 Education to Mitigate Zoonotic Influenza Exposure and Transmission

- 854 human cases & 450 deaths from H5N1 (N6) HPAI
  (http://www.who.int/influenza/human_animal_interface/Influenza_Summary_IRA_HA_interface_07_19_2016.pdf?ua=1)

- Most human cases have exposure to poultry, primarily through wet markets in developing countries or household poultry production & slaughter

- Egypt, most cases in women and children, who are primary caretakers and slaughter poultry
### Home Slaughter Simulation: Airborne Virus Generation

<table>
<thead>
<tr>
<th>Isolators</th>
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<tr>
<th>Processing Table</th>
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8.3 air changes/hr (340 m³/hr)
Outcomes

Developed simulated home halal slaughter method to evaluate airborne transmission

- 5 steps in halal slaughter process
  - Kill (tranquilized)
  - Hard-scald
  - Defeathering
  - Evisceration
  - Clean-up
Outcomes

• Processing of asymptomatic H5N2 infected chickens:
  – Recovered virus from air samples in the room
  – Transmitted the virus to chickens and ferrets exposure to same air space

• Mitigations:
  – Vaccinated birds
  – Do the processing in plastic bag, bucket with lid or Halal pot
Education: Mitigation Strategies

- Developing a educational poster for communicating the new process in English and Arabic
- Used in joint FAO/Egyptian NGO education program
- Transmitted material to CDC Bangladesh Project
Conclusions

• OFFLU serves as interface with public health on Animal Influenza Expertise

• On going exchange of IAV genes and viruses between farmed animals and humans

• Specific Strategies contributing to animal influenza control:
  – Surveillance to inform risk assessment and risk management
  – Pandemic Preparedness Vaccines
  – Education for proper home/LPM poultry slaughter
OFFLU, avant tout un réseau de personnes...