Avian influenza viruses from the global perspective

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SARI Surveillance in the Americas (SARInet) Meeting
28-30 April 2015 • Cancun, Mexico
Complex modern world

- Increasingly crowded
  - Growth in population of people, poultry and pigs
  - Growth of megacities

- Increasingly connected
  - Increase in amount and speed of global travel
  - Increase in attendance in mass global gatherings

- Increasingly convergent
  - Instant information and changing technologies
  - People, pigs, poultry → pandemics
Increasingly crowded

- 1 Billion people in 1804; 2 B in 1927; 7 B in 2011; 11 B by 2050
  - Over 80% of increase in developing countries
  - By 2050, > 80% of population will live in Asia and Africa
- Substantial growth in cities with over 10 M inhabitants or “megacities” with younger and poorer populations
  - Now have 23 megacities including Lagos, Dhaka, Shenzhen, Karachi, Mexico City, Cairo and Sao Paulo
- Poorer megacities face healthcare, public health infrastructure, air pollution and stressed agricultural supply chains
Avian Influenza from Global Perspective • W. Zhang
28 April 2015 • Cancun (via WebEx) • PAHO SARI net Meeting
Annual epidemics

- Influenza A (18 HA subtypes)
  - In humans
    - Influenza A H1 and H3
    - Influenza B

- Minor changes in virus surface protein
  - Antigenic drift: require adaptation of influenza vaccine
Emergence of novel influenza virus
- No immunity in humans
- Efficient human-to-human transmission

Pandemic H1N1 2009 – most recent pandemic

Threat persisting: repeated zoonotic transmission to humans
- Avian viruses: H5, H7, H9
- Variant viruses
Summary of zoonotic influenza infections

- **H5N1**
  - Since 2003, 840 cases with 441 deaths (CFR: 53%)
  - Since Jan 2014, 177 cases with 55 deaths (CFR: 31%)
  - Since Jan 2015, 125 cases with 33 deaths (CFR: 26%)
  - Most recent cases occurred in Egypt (165 cases from Oct 2014 – 23 April 2015)

- **H5N6 since 2014**
  - 3 cases with 2 deaths from China

- **H7N9**
  - Since 2013, a total 651 cases with 257 deaths (39%)

- **Other non-seasonal viruses since 2014**
  - H9N2: 3 (China (2) and Egypt)
  - H10N8: 1 (China)
  - H1N2v: 2 (Sweden)
  - H3N2v: 3 (USA)
Influenza A(H5)
Influenza A(H5) outbreaks in animals
(Since 2014)
Influenza A(H5) outbreaks in animals
(Since 2014)

- Egypt: increase in HPAI H5N1 outbreaks in poultry (H5 clade 2.2.1)

- Spread of H5 clade 2.3.4.4 viruses:
  - North America: HPAI H5N1, H5N2, and H5N8 in wild and domestic birds
    - A reassortant H5N1 virus with genes from the Eurasian H5N8 and from the North American LPAI wild bird lineage of viruses
  - Europe: HPAI H5N8 in wild and domestic birds
  - Asia: HPAI H5N2, H5N3, H5N6 and H5N8 in wild and domestic birds

- Nigeria: since 2015 increase in HPAI H5N1 outbreaks in poultry (H5 clade 2.3.2.1c)
Influenza A(H5N1) infection in humans
(Since 2003)

Number of Confirmed Human H5N1 Cases
by month of onset as of 2016-04-20

- Year 2004: Azerbaijan (8), Bangladesh (7), Cambodia (56), China (52), Egypt (32), Iraq (3), Laos (2), Myanmar (1)
- Year 2005: Pakistan (3)
- Year 2006: Thailand (25), Turkey (12), Viet Nam (127)
- Year 2007: China (199), Nigeria (1)
- Year 2008: Indonesia (199)

Month of onset
Number of Cases
Genetic evolution of clade 2.2.1 HA genes

2013-2015 human viruses
Antigenic properties of clade 2.2.1 viruses

Haemagglutination inhibition reactions of influenza A(H5N1) clade 2.2.1 viruses.

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Genetic evolution of clade 2.3.4.4 HA genes
### Antigenic properties of clade 2.3.4.4 viruses

**Haemagglutination inhibition reactions of influenza A(H5) clade 2.3.4.4 viruses.**

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Influenza A(H7N9)
Influenza A(H7N9) infection in humans

(Epidemiologic curve and geographical distributions)
## Influenza A(H7N9) infection in humans
(Virological summary)

### Hemagglutination Inhibition Reactions of H7N9 Viruses (2/11/15)

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Influenza A(H7N9) infection in humans
(Virological summary)
Not forgetting other zoonotic influenza viruses infecting humans:

- H9N2
- H10N8
- Variant H1N2 and H3N2
What does this mean

- **We know** there will be a next pandemic.
  - Repeated signals from zoonotic infections
  - Each time is one step closer

- **We do not know** when, from where, what virus …
  - Dynamic influenza virus world – evolving, reassorting, adapting..
  - It can start anywhere

- **We know** once a pandemic virus emerges, it can spread rapidly…
  - May not be so lucky as mild as 2009 H1N1 pandemic
Pandemic preparedness

- Prepare in peace time
  - Through response to influenza epidemics

- Global coordination is essential on influenza
  - GISRS – PIP Framework to strengthen this global platform
  - WHO PIRM (Pandemic Influenza Risk Management) Framework
  - Technical front preparation
    - Influenza pandemic risk assessment
    - Pandemic influenza severity assessment
    - Vaccines:
      - Production capacity
      - Zoonotic influenza vaccines
      - Pandemic vaccine response
      - SMTA2/PIP Framework
Pandemic preparedness

- National capacity is the foundation
  - A *unique* opportunity: "peace time", PIP Framework PC
  - *Fast* detection
    - Alert at unusual events
      - Awareness among healthcare practitioners
    - Quality sensitive surveillance
      - SARInet in PAHO could fit in so well
    - Strong laboratory
  - *Rapid* reporting – IHR requirement
  - *Timely* sharing
    - Information
    - Virus specimens - advanced characterization in WHO CCs
      - Risk assessment
      - Risk response e.g. vaccine virus development
Key messages

- Influenza is a virus problem, a global issue – long standing
  - Understanding and knowledge still limited e.g. virus evolution
  - Speed-up research

- Pandemic threat hovering ominously, persistent
  - Visible
    - Endemic of zoonotic influenza viruses in poultry in parts of world
    - Dynamics currently of avian influenza viruses – multi-subtypes, multi-clades
  - Can be any moment

- Next pandemic may not be as mild as 2009 H1N1 pandemic
  - No excuse. No complacent.

- Pandemic preparedness
  - National capacity key
  - Global coordination essential

- Surveillance is the foundation of response
  - Quality of surveillance → outcome of response

Time is running out … get better prepared!