Integrated management: Influenza from a One Health Perspective

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One Health Approach

- Veterinary Medicine
- Nutrition
- Human Medicine
- Social Sciences
- Humanities
- Biology
- Ecology
- Engineering
- Earth Sciences

Animals
Humans
Environment
Emerging Infectious Diseases

- Majority are of animal origin (zoonotic)
- 75% of emerging zoonoses have wildlife origins
- Human activities at the interface are linked to EIDs (Nipah virus, SARS, Ebola)
- Annual population growth among highest in buffers to protected areas near wildlife
Drivers of Infectious Disease Emergence

- Land Use Change
- Climate Variability
- Markets and Trade
- Migration and Conflict
- Resource Extraction
- Water and Food Security
- Global Transportation
The “Ecology” of Disease Emergence.....
at the “animal-human-ecosystem” interface”
Evolutionary dynamics and global diversity of influenza A

• Increasing number of zoonotic infections of avian origin
• High fatality rates indicate increased urgency to better understand where and how novel pathogenic influenza strains emerge
• Need to better understand the factors driving evolution and diversity
Role of Host species?

- Migrating waterfowl are natural reservoirs
- Recent identification of unique subtypes in multiple bat species, others may be important reservoirs for diverse IAVs
- Increasing number of other IAV subtypes of animal origin in humans, particularly in individuals with a recent history of bird or swine contact
## Priority subtypes for Evolutionary Change Analyses

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<th>H1N1</th>
<th>H2N2</th>
<th>H3N1</th>
<th>H4N2</th>
<th>H5N1</th>
<th>H6N1</th>
<th>H7N1</th>
<th>H8N4</th>
<th>H9N1</th>
<th>H10N2</th>
<th>H11N1</th>
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</tbody>
</table>

* High priority subtypes are shaded

Rejmanek et al., 2015
Regional Evolutionary Rates of HA Genes

- H1N2
- H3N2
- H3N6
- H3N8
- H4N6
- H5N1
- H5N2
- H5N3
- H6N1
- H6N2
- H6N8
- H7N3
- H7N7
- H9N2

Nucleotide substitutions/site/year (x10^-3)

E. Asia
SE. Asia
S. Asia
W. Asia
Africa
Europe
N. America

Rejmanek et al., 2015
Understanding Global Diversity

- Evolutionary rates for several subtypes (H5N1, H5N2, H6N2) significantly greater in East Asia
- Practices such as mixed bird farming and live bird markets may serve as drivers
- Selection pressures individual subtypes important indicator of AIV evolution: strains specific to mammals (H3N2, H3N8-eq) exhibited higher selection pressures than bird specific strains
- Selection pressures may also increase following introduction of novel IAV subtype into a host population with no prior exposure
Influenza in Marine Mammals

- Interspecies transmission important for evolution
- Interspecies transmission between birds and marine mammals, seals and humans
  (Hinshaw et al., 1984; Webster et al., 1981)
- Seals can be infected and transmit influenza
- Widespread exposure globally to multiple subtypes
Northern Elephant Seals

Sampling dependent on life history and movements:

- December: Females come ashore to give birth
- February-March: Adult seals go to sea
- At sea feed off continental shelf: Oregon to Alaska
- April–May: Females return to shore to moult
- When on land limited access to humans
Timeline:

- N = 42 adult female seals sampled in 2010
- Handled to attach tags Feb-early March at Ano Nuevo
- Sampled upon return April 5-May 31
- 1st PCR + April 30 – Piedras Blancas
- 2nd PCR + May 6 – Ano Nuevo
- 1st Seropositive May 16
- VI and serology confirmed PCR results

Goldstein et al., 2013
Summary of Testing 2010-2011

Goldstein et al., 2013
Elephant Seal Distribution at Sea

Tracking data from 209 female Northern elephant seals from 2004-2010
Robinson et al., 2012
Pandemic H1N1

- First report of pH1N1 in marine mammals
- Suggest exposure may have occurred at sea
- No seals appeared ill
- Zoonotic risk to humans
Thank you

Mazet, McDermott and Goldstein, 2015