Second FAO/OIE/WHO joint scientific consultation on Influenza and other emerging infectious diseases at the human-animal interface, 27-29 April 2010, Verona

Focus on importance of the interface and practical significance of this consultation’s work
Jan Slingenbergh (FAO)

Excerpt: “There is an urgency to address the pressures on the environment that cause new diseases and threaten world health.”

EID events as indicators of imbalances in the landscape.
The effects of humans on the earth terrestrial surface area:

- climate change
- deforestation
- loss of biodiversity
- loss of soil fertility
- fresh water availability
- pests and diseases (plants, animals and humans)

Agricultural modifications of hydrological flows create ecological surprises

Line J. Gordon¹, Garry D. Peterson² and Elena M. Bennett³
the weight of agriculture and land pressures...........
Encircled are regions where deforestation and irrigation already have modified evapotranspiration, and where they coincide with area where soil moisture has been suggested to have a substantial impact on rainfall.

Equilibrium between pathogen invasiveness and the invasibility of the host environment

ecological dynamics

pathogen genetic evolution
disease

Equilibrium between invasiveness and the invasibility of the host environment
Human living environment

Fauna in (protected) ecosystems

Food and agriculture

dynamics at the interfaces
Human living environment

Fauna in (protected) ecosystems

Food and agriculture

Changes in host domain size

Changes in the landscape as habitat
2008 rabies cases in wildlife mapped at NUTS 3 level
(source: Rabies Bulletin Europe)

Rabies cases in Belarus by animal type, 1990 to 2008

Source: Rabies Bulletin Europe
Rabies Cases in Russia, 1990-2008

Rabies Cases in Lithuania, 1990-2008
<table>
<thead>
<tr>
<th>Urban agglomeration, Country</th>
<th>Projected 2025 population (millions)</th>
<th>Estimated percent of UFW available to scavengers</th>
<th>Predicted 2025 daily UFW available to scavengers (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mumbai, India</td>
<td>26.4</td>
<td>46%</td>
<td>3,080</td>
</tr>
<tr>
<td>Dhaka, Bangladesh</td>
<td>22.0</td>
<td>54%</td>
<td>3,084</td>
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<td>Kinshasa, D.R. of the Congo</td>
<td>16.8</td>
<td>70%</td>
<td>3,012</td>
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<td>Delhi, India</td>
<td>22.5</td>
<td>46%</td>
<td>2,688</td>
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<tr>
<td>Kolkata, India</td>
<td>20.6</td>
<td>46%</td>
<td>2,456</td>
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<td>Karachi, Pakistan</td>
<td>18.1</td>
<td>46%</td>
<td>2,296</td>
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<tr>
<td>Lagos, Nigeria</td>
<td>15.8</td>
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<td>1,845</td>
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<tr>
<td>Shanghai, China</td>
<td>19.4</td>
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<td>Manila, Philippines</td>
<td>14.4</td>
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<td>Cairo, Egypt</td>
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<td>Lahore, Pakistan</td>
<td>10.5</td>
<td>46%</td>
<td>1,264</td>
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<td>Chennai, India</td>
<td>10.1</td>
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<td>São Paulo, Brazil</td>
<td>21.4</td>
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<td>Mexico City, Mexico</td>
<td>21.0</td>
<td>17%</td>
<td>1,100</td>
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<td>Jakarta, Indonesia</td>
<td>12.9</td>
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<td>Beijing, China</td>
<td>14.5</td>
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<td>Bangalore, India</td>
<td>9.7</td>
<td>46%</td>
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<td>Hyderabad, India</td>
<td>9.1</td>
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<td>Chittagong, Bangladesh</td>
<td>7.6</td>
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<td>Kabul, Afghanistan</td>
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<td>Hô Chi Minh City, Viet Nam</td>
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<td>45%</td>
<td>967</td>
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<td>Guangzhou, Guangdong, China</td>
<td>12.8</td>
<td>28%</td>
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<td>Addis Ababa, Ethiopia</td>
<td>6.2</td>
<td>50%</td>
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<td>Nairobi, Kenya</td>
<td>5.7</td>
<td>46%</td>
<td>916</td>
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</tbody>
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Human living environment

Fauna in (protected) ecosystems

Food and agriculture

Changes in host community composition and numbers
Poultry, Human and Livestock Mammal Populations

Source: FAOSTAT and UN Population Division

Poultry in the World

Poultry density map matching FAOSTAT 2005 (modelled)

Animal Production and Health Division

slide 5
feed surplus/deficit – soymeal

animal agriculture has become globalised; feed, live animals and products

Ad hoc host incursions across host domains:
- Humans in forest: Lyme, Hanta or TBE;
- Red foxes coming to town: rabies
- Fruit bats to mango trees: Nipah
Equilibrium between pathogen invasiveness and the invasibility of the host environment

Ecological dynamics

Disease

Pathogen genetic evolution

What does pathogen evolution entail?

Pathogens

- display natural plasticity (Ro adjustment, no new pathogen)

3 new patterns may evolve:

- new host = species jump (host range)
- new infection process = virulence jump (host body)
- new transmission pattern (host population / landscape)
### Emerging new pathogen - typologies

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>-species jump</strong></td>
<td><strong>- virulence jump</strong></td>
<td><strong>- new transmission pattern</strong></td>
</tr>
<tr>
<td>- change in contact / exposure host species</td>
<td>- aggressive spread sustainable</td>
<td>- new host landscape / new subpopulations</td>
</tr>
<tr>
<td>- (long) incubation (lengthening of chain)</td>
<td>- shorter incubation</td>
<td>- more instant</td>
</tr>
<tr>
<td>- unchecked</td>
<td>- SLIR modulated</td>
<td>- gradual but progressive</td>
</tr>
</tbody>
</table>

3 distinct ecological invasions

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**species jump;**

1 + 2 + 3 almost evolving in sync

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HIV

1 host range adjustment

2 new course of infection

3 adjustment transmission mode / pattern

---

SARS

1

2 X, aborted

3

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pH1N1

1

2

3 (2009)
Virulence jump

- H5N1 (panzootic)
  1. new course of infection
  2. new host type
  3. new transmission features

- Gumboro (hypervirulent)
  see above

- NDV (velogenic)
  see above

- BTV8
  new transmission features

- RVFV
  see above

- ASFV
  see above
A - species jump
B - virulence jump
C - transmission

quest for food: mass rearing: new landscape:
- bushmeat (HIV) - poultry - land use
- wet market (SARS) - shrimps - climate change
- recycling ruminant cadavers (BSE) - sterile insects - trade + traffic

rare events - scaling up - invasion
becoming common 'clones' new ecology

pathogen type / transmission modes:
- unknown pathogens - common bugs - existing bugs
respiratory agents - fecal-oral
body fluids - water, food
encephalopathy - skin - arbo-viruses

Number of infected hosts
time

Number of infected hosts
time

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time

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time

Number of infected hosts
time

Number of infected hosts
time

Number of infected hosts
time

Number of infected hosts
time
15

EID events – SLIR demographics and invasion ecology

Number of infected hosts

SARS  BSE

E = genetic diversity build up / consolidation as new pathogen

A  B  C

new host species / type

new, more severe infection process

new transmission features

Pathogens in the new niche
FAO in One Health/ Emerging Pandemic Threats:

- ‘One Flu’ type concept (including wild birds, aquatic + terrestrial)
- Regional AH Centres,
  - AH (OFFLU/GLEWS)
  - VPH
  - sustainable animal agriculture
  - nrm / wildlife health
  - impact assessment
  - partnerships;
- social resilience: DALY equivalents in terms of food security / livelihood effects

grams of protein not generated in a given smallholder production system because of local disease burden

Influenza A host radiation – main agricultural encroachment

*: so far not sustained; spill-over only

slide 4
Can we fix the emerging disease challenge?

Yes, provided we start respecting the landscape – pathogen linkages

...and smartly blend productivity and sustainability