Anticipating emerging infectious disease epidemics

1-2 December 2015
Geneva, Switzerland
Session 2

Future epidemics: moving and blurry targets
Dr Malik Peiris

Director, Division of Public Health Laboratory Sciences, University of Hong Kong School of Public Health, China

Clinical and public health virologist who works on newly emerging viral infections, especially those emerging from animals to humans.

Investigated the diagnosis, ecology, epidemiology, transmission and pathogenesis of avian influenza H5N1 since 1997, SARS in 2003, the Pandemic (H1N1) 2009, and more recently, avian influenza H7N9 and MERS-CoV

Currently Director of the School of Public Health; co-directs the WHO H5 reference laboratory and the HKU-Pasteur Research Pole, at The University of Hong Kong
Stages of Epidemic Emergence

Stage 3: Pandemic emergence
- International travel and trade
- HIV/AIDS
- Severe acute respiratory syndrome

Stage 2: Localised emergence
- Expansion of the wildlife-human being interface
- Nipah virus
- Ebola virus

Stage 1: Pre-emergence
- Encroachment into wildlife habitat
- Change in land use

Morse SS et al Lancet 2012; 380: 1956-65
Dr Monique Eloit
*Deputy Director, World Organization for Animal Health, France*

- The most important thing is to identify the first cases, i.e. the first clusters, and then to have the capacity to act and to limit the spread of the disease.

- Important to improve the capacities for an early detection and for the notification of sanitary events observed in animals. That means better knowledge of pathogens through research programmes and development of laboratory network etc. But it is also very important to connect with the people who are in contact with animals.

- It is necessary to combine sophisticated scientific works, studies of predictive epidemiology and field work to obtain good quality data and to organize the broadcast network of these data.
Topic 2
Managing the risks of emergence at the animal level

Dr Julio Pinto
Animal Health Officer, FAO HQ, Italy
• Tackling disease at source (endemicity)
• Understanding the drivers of disease emergence, persistence and spread
• Epidemiological intelligence and disease ecology
• Food production practices and value chains
• Socio-economic factors and issues
• Strengthening animal health systems and resilience
• Promoting cooperation – institutional and cross-sectoral
• Capacity developed for inter-sectoral and interdisciplinary approaches
- Gut microbiota have co-evolved symbiotically with the host with functions ranging from absorption of nutrients and contribution to development of the immune responses.

- Various roles of the microbiota: modulating vaccine efficacy, disruption of microbiota by antibiotics and resultant pathogen colonization including resistant species, and role on arthropods competence.

- Examples of development of therapeutic or preventive applications that are demonstrating efficiency, e.g. diagnostic methods to predict metabolic disorders; nutrition complements to stimulate immunity; or fecal transplantation to treat infections.
Session 2

Topic 4

From science to action: microbiome and respiratory diseases

Dr David Murdoch

*Head of Department, Department of Pathology, New Zealand*
Ecological Determinants of the Respiratory Microbiome

**Microbial Immigration**
- Microaspiration
- Inhalation of bacteria
- Direct mucosal dispersion

**Microbial Elimination**
- Cough
- Mucociliary clearance
- Innate and adaptive host defenses

**Regional Growth Conditions**
- Nutrient availability
- Oxygen tension
- Temperature
- pH
- Concentration of inflammatory cells
- Activation of inflammatory cells
- Local microbial competition
- Host epithelial cell interactions

**Immigration and Elimination**

**Health**

**Severe Lung Disease**

Dickson RP, Huffnagle GB. *PLoS Pathog* 2015; 11(7): e1004923
Dr Dennis Carroll

*Director Pandemic Influenza and other Emerging Threats Unit, USAID, USA*
Preventing Disease Emergence

Drivers of Zoonotic Disease Emergence

Ecological Drivers
- Land Use
- Climate Change
- Natural Resource Extraction
- Economic Development
- Migration

Behavioral Drivers
- Bush meat consumption
- Animal production & marketing
- Animal-human interfacing
- Globalization

Biological Drivers
- Re-assortment
- Genetic drift
- Host factors

Source: Adapted from USAID/Predict

Figure 3. Hotspots II Map: Predicted relative risk of EID occurrence after adjusting for reporting bias. ‘Heat map’ scale Blue = lower risk through to Red = higher risk

Source: USAID/Predict-EcoHealth Alliance

Source: FAO, V. Martin et al. (2011)

LBM Networks in Guangxi, Yunnan and Hunan

Source: FAO, V. Martin et al. (2011)
## Framework: Influenza Risk Assessment Tool (IRAT)

<table>
<thead>
<tr>
<th>Category</th>
<th>Risk element</th>
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<tbody>
<tr>
<td>Virus properties</td>
<td>• Genomic variation&lt;br&gt;• Receptor binding&lt;br&gt;• Transmissibility in animal models&lt;br&gt;• Antiviral susceptibility</td>
</tr>
<tr>
<td>Host properties</td>
<td>• Population immunity&lt;br&gt;• Disease severity&lt;br&gt;• Antigenic relationship to existing vaccines</td>
</tr>
<tr>
<td>Ecology and epidemiology</td>
<td>• Human infections&lt;br&gt;• Infection in animals&lt;br&gt;• Distribution in animals</td>
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*Trock SC et al Emerg Infect Dis 2015; 21: 1372-8*