From Forecasting to Control of Zoonotic Diseases: Linking Animal and Human Systems

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Paris, France, 24 February 2011
Epidemics and Pandemics have shaped our history...
Our World is changing

- The way we live
- 2025: 5 Billion in urban centres
- Microbes evolve
- New threats emerge
Countries with a critical shortage of health service providers (doctors/nurse/midwives)


Selected major wilderness areas
Selected terrestrial biodiversity hotspots
Country with critical shortage
Country without critical shortage

30 millions habitants and more
15>29.9 millions habitants
10 >14.9 millions habitants
7 >9.9 millions habitants
61% of Emerging Infectious Diseases (EID) are Zoonoses affecting Humans

- Frequency of all EID events has significantly increased since 1940, reaching a peak in 1980-1990
- 61% of EID events are caused by the transmission from animals (zoonoses)
- 74% of these from wildlife.
- Zoonotic EIDs from wildlife reach highest proportion in recent decade

Infectious Diseases at the Human Animal interface: from forecasting to outbreak response
Emerging Infectious Disease outbreak alert and response

- Wildlife
- Domestic Animal
- Human outbreak

NB: Yellow areas represent cases that can be prevented with control operations

First cases In Animals
Climate Vegetation Environment
Animal Amplification

Late Detection
Delayed Response
Control Opportunity

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Emerging Infectious Disease coordinated outbreak alert and response

1. Mitigate
2. Alert
3. Control
4. Learn
Drivers of epidemics

**Globalization**
- Global travel: people, animals, vectors
- Global trade: animal and their products, vaccines, medical products, etc.

**Amplification**
- Urbanization
- Population density
- Agricultural Intensification
- Technology And Industry
- Vector distribution and densities
- Transmission in health care centers
- Successful A2H, V2H and H2H transmission

**Emergence**
- Human encroachment, Ex situ contact,
- At-risk behaviour
- Ecological pressure
- Exploitation
- Translocation of wildlife
- Climate variability, vector density & distribution
Infectious Diseases at the Human Animal interface: Risk mapping and Forecasting

Some examples
Modeling EID events: Relative risk of an EID

Hot Spots: global distribution of relative risk of an EID event caused by zoonotic pathogens from wildlife, (*Jones et al. Nature, 2008*).
Modeling EID events: CCHF risk map

Courtesy David Roger, Oxford University, Department of Zoology, Oxford, UK
Forecasting EID emergences

Ebola surveillance in Central Africa

Collaborators: WCS, CIRMF, IRD, ECOFAC, MoH, National Park Boards, MSF, WHO.
Climatic and Ecological Conditions for RVF Risk during November 2006

El Niño effect, October 2006

NDVI anomalies, November 2006
Mapping of the RVF human case locations shows that

- 64% of the cases were reported in areas at risk within the RVF potential epizootic area,
- 36% were reported in areas not thought to be at risk of RVF activity
Risk mapping and forecasting

- Enhance collaboration with MoH, MoA, Vet services, NGOs working in conservation for surveillance of animal outbreaks that precede human cases (CCHF, RVF, Ebola, Yellow Fever, Nipah Hendra, Hantavirus..)
- Generating more accurate risk map to improve forecasting models. WHO, FAO OIE and partners to develop spatial & temporal database of emerging sites
- Developing more specific and less sensitive forecasting models improved with soil type data, elevation data, vector ecology maps, domestic ruminant maps, geolocation of major RVF outbreaks
- Future: couple models to buy time (6 month) and precision (IOD, SST, NDVI, flood-based risk maps,...)
Infectious Diseases at the Human Animal interface: detection and assessment
The International Health Regulations

- Strengthened national capacity for surveillance and control, including in travel and transport
- Prevention, alert and response to international public health emergencies
- Global partnership and international collaboration
- Rights, obligations and procedures, and progress monitoring
WHO Alert and Response Department

- **24 hours / 7 days** a week.
- **900 events** of potential international importance verified, in all countries, in last 5 years.
- **>400** advice/assistance provided.
- **More than 50** international outbreak response coordinated through the Global Outbreak Alert & Response Network (GOARN).
- Numerous Outbreak News update on WHO website.
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Formal
WHO laboratory networks, (sub-)regional networks, WROs & MoH, UNOs

Official Sources
e.g. WRO, MoH

Informal
Global Public Health Intelligence Network (media), NGOs

Epidemic Intelligence

Verification

GLEWS
FAO, OIE, WHO
Global Early Warning System

Risk Assessment

Response strategy and Operations

GOARN

Social Mobilization
Health Education
Medical Anthropology

Logistic Security Communications

Coordination Technical & Operational Medias - Information Finances

Epidemiological Investigation Surveillance Laboratory

Case management Funerals Infection Control
Current events 23 February 2011
Global Alert and Surveillance: perspectives

- Surveillance of infectious diseases is improving
- Coordinated assessment of events is key
- Intensified collaboration with animal disease sector: domestic and wildlife
  - GLEWS with FAO and OIE
  - Formal collaboration with wildlife disease experts
  - Support vector borne network (bats, rodents, birds, primates, ticks, entomology)
  - Connect the human and animal lab networks
Infectious Diseases at the Human Animal interface: response
General strategy for controlling outbreak

(* COMBI = communication for behavior change)
GOARN: Global Outbreak Alert and Response Network

- **Assist countries with disease control efforts** by ensuring rapid appropriate technical support to affected populations.
- **Investigate and characterize events and assess risks** of rapidly emerging epidemic disease threats
- **Support national outbreak preparedness** by ensuring that responses contribute to sustained containment of epidemic threats
GOARN: Global Outbreak Alert and Response Network
Outbreak control: Emerging and Dangerous Pathogens Laboratory Network

- A network of high security diagnostic laboratories able and willing to collaborate and share their knowledge, biological materials and experimental research results in a real time framework to detect, diagnose and control novel disease threats.

- Human and Animal High Security Laboratories BSL-4 and selected BSL-3
Outbreak control: Ecological studies

Wildlife knowledge is crucial to understand the epidemiology of Zoonoses

- Monkeypox
- West Nile
- SARS
- Avian Influenza
- Nipah

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Infectious Diseases at the Human Animal interface: conclusion
Conclusion (1)

- Globalization is a fact!
  - Benefits
  - Risks
- Our Weaknesses can be our strengths!
  - Inter-connectedness
  - Inter-dependance
- Risks are Manageable!
  - All Hazards
  - All Sectors
- We need Systems/Tools/Networks/People!
Conclusion (2)

- **Outbreak detection**: better than in the past but could be improved
  - To intensify collaboration between wildlife, domestic animals and human health sectors
  - To improve forecasting models

- **Outbreak response**: improve quality to ensure acceptance by the affected populations (relational behavior with the patients, respect of the local culture and beliefs, respect of funeral customs, etc...).
Conclusion (3)

- Today’s technologies can help to better detect, manage and contain the international spread of emerging diseases

  ⇒ NOT Enough

- Key points remain high level governments commitment and international collaboration.
From forecasting to control of zoonotic diseases....

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Thanks!

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