Most EIDs are Zoonotic

~ 50% of known human pathogens are zoonotic

73% of emerging human pathogens are zoonotic, most originate in wildlife.

Rate of disease emergence is increasing (not just detection)

Complex process!

Current Surveillance Systems focus on human or livestock outbreaks

Global Challenges to Wildlife Surveillance and Response to Emerging Zoonoses

There is no agency responsible for global wildlife disease surveillance

Laboratories in developing countries are unable to detect/diagnose wildlife disease or known zoonoses

Developing countries often lack expertise in wildlife health/disease

Inter-ministerial cooperation/comunication (Health, Agriculture, and Environment (wildlife)) is lacking
Anthropogenic Drivers of Zoonotic Disease Emergence

- Agriculture – H5N1, Nipah virus
- Bushmeat hunting – HIV, Ebola
- Travel – SARS, WNV
- Trade – Monkeypox, SARS
- Urbanization – Rabies, Lyme, others…?

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Field Limitations

- Remote locations
- Difficult to maintain cold chain
- Storage and transport

Zoonotic pathogens often don’t cause disease in natural hosts

- Hantavirus in mice
- Nipah virus in bats
- Herpes B in macaques
- Marburg virus in bats

These pathogens cause severe disease in humans and other animal hosts

**Surveillance of “healthy” animals is important for identifying known or potential zoonotic agents**

Photo credits: John Wood
Viruses can cause disease in non-reservoir animal species

Ebola virus
Bats are putative reservoir
Hemorrhagic disease in gorillas
95% mortality
Gorilla die-offs preceded human outbreaks in Congo

Understanding the Ecology of Nipah Virus
Disease in Swine

- High morbidity, low mortality
- Abortions
- Respiratory disease – loud barking cough
- Paralysis, ataxia, fever
- Virus mainly in respiratory epithelium and meninges

Nipah virus in Malaysia, 1998-1999

Human encephalitic cases

Perak

Selangor

Negeri Sembilan

Week of onset of illness
Nipah virus in Malaysia, 1998-1999

- Most human cases worked on infected pig farms
- > 1 million pigs culled
- 800 pig-farms demolished
- 36,000 jobs lost
- > $300 (US) million exports lost

Two hypotheses for emergence:

- Climatic factors (1997 ENSO) and wildfires brought infected bats to Ipoh (Chua et al, 2002)

- Nipah virus is enzootic and widely distributed in Pteropus spp., and agricultural Intensification (large-scale pig farming) drove emergence
Agricultural Intensification

Index farm:
30,000+ pigs
adjacent to primary forest, fruit bat habitat

Network of other large farms close by
Nipah Virus Emergence in Malaysia

Complex!

Driven by pig farm expansion / intensification

Availability of cultivated fruit on farms

Size and structure of pig farm was critical to emergence

Simple solution – remove fruit trees from pig farms (no new outbreaks)
• Influenza
• HIV/AIDS
• SARS
• West Nile virus
• Nipah virus
• Ebola virus
• Undiagnosed outbreaks
• New human infections
• Wildlife die-offs
• Silent human infections
• Unknown pathogens

Aleksei Chmura,
Wildlife Trust

Relative risk of a new zoonotic EID from wildlife

Global distribution of relative risk of any EID event
0 – green to 1 – red
Jones et al. in review
Temporal patterns in EID events

- Significant increase since 1940 (controlling for reporting effort), reaching a peak in 1980s – AIDS/HIV?
- Zoonotics from wildlife are causing the majority of events in recent decade and are significantly increasing

Jones et al. 2008 Nature

Drivers of EIDs
Top 16 mammal Genera, # of viruses shared with humans

# of shared human viruses

<table>
<thead>
<tr>
<th>Genus</th>
<th># of shared viruses</th>
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<tbody>
<tr>
<td>Bos</td>
<td>16</td>
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<tr>
<td>Equus</td>
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<td>Sus</td>
<td>10</td>
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<tr>
<td>Peromyscus</td>
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<tr>
<td>Thomomys</td>
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</tr>
</tbody>
</table>

Olival et al. in prep

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Map showing distribution across various locations.
Outbreaks Near Me
Information Flow –
Zoonotic Disease Surveillance in Wildlife

Farm Foundation: Zoonoses: Understanding the Animal Agriculture and Human Health Connection

William B. Karesh, D.V.M.
23 September 2010

Local conservation.
Global health.