Health Disaster Risk Reduction

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Local conservation.
Global health.
One Health

- Veterinary Medicine
- Comparative Medicine
- Human Medicine
- Social Sciences
  - Humanities

- Animals
- Environment

- Biology
- Ecology
- Engineering
  - Earth Sciences
One Health Relevance

Most known human infectious diseases are shared with animals

- Rabies
- Influenza A
- Ebola
- SARS
- Q Fever
- Toxoplasmosis
- Salmonella
- Brucellosis
- Hendra
- Echinococcosis
- Anthrax
- T. parva
- Nipah
- Psittacosis
- Puumala
- Plague
- Bas Congo
- Monkeypox
- Rift Valley
- Leptospirosis
- Schistosomiasis
- Leishmaniasis
- Chagas disease
- Hantavirus
- Japanese B encephalitis

Resulting in over 1,000,000,000 human cases every year

Karesh and Machalaba, The Huffington Post
EID events have increased over time, correcting for reporter bias (GLM_{P,JID} F = 86.4, p <0.001, d.f.=57)

- ~5 new EIDs each year
- ~3 new Zoonoses each year
- **Zoonotic EIDs from wildlife** reach highest proportion in recent decade

*Jones et al. 2008*
Economic Impact of Selected Infectious Disease Outbreaks

- **SARS**
  - China, Hong Kong, Singapore, Canada
  - Estimated Cost: $30-50bn

- **H1N1**
  - Worldwide
  - Estimated Cost: $45-55bn

- **H5N1 Avian Flu**
  - Worldwide
  - Estimated Cost: $30bn

- **Foot & Mouth**
  - Taiwan, $5-8bn

- **BSE**
  - UK, $5bn

- **Nipah**
  - SE Asia
  - Estimated Cost: $550-650m

- **Lyme Disease**
  - US, $200m

- **BSE**
  - US, $3.5bn

- **BSE**
  - Canada, $3bn

- **E. Coli O157:H7**
  - US, $1.8bn

- **MRSA**
  - US, $5-10bn

- **Ebola**
  - West Africa, $10bn

- **Zika**
  - Latin America & the Caribbean
  - Estimated Cost: $7-18bn

Figures are estimates and are presented as relative size. Based upon bio-era, World Bank, and UNDP data. Chart updated by EcoHealth Alliance.
SARS, 2002 - 2003

- ~800 deaths
- Unpaid leave (e.g. airlines) and est. 3 million jobs lost in tourism sector
- Cancelled flights

China (Mainland)

1.05% GDP loss

Affected sectors (examples)

- Medical and public health sector costs
- Market shutdowns and response
- Travel and tourism losses
- Public space/event avoidance (e.g. malls, concerts, restaurants)
- Exports/trade and productivity losses

Impacts (examples)

- ~5,300 cases
- Investigation costs
- $241 million fund for treating farmers and poor urban residents
- Emergency research fund
- Reduced local trade
- Civet culling at markets and breeding farms (10,000 animals)
- Beijing: 25% fewer arriving airline passengers
- ~1.5 million fewer foreign visitors
- 13% decline in bus usage
- Beijing: Declines in leisure activities (government order closed all movie theaters, internet cafes and other entertainment venues on 28 April)
- Schools and universities closed (1 month)
- Guangzhou: 12% attendance at Trade Fair compared to prior year
Historical patterns in EID events

Jones et al. 2008
### RISK of a new zoonotic EID

#### Relative Influence (%)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Relative Influence (%)</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>population</td>
<td>27.99</td>
<td>2.99</td>
</tr>
<tr>
<td>mammal diversity</td>
<td>19.84</td>
<td>3.30</td>
</tr>
<tr>
<td>change: pop</td>
<td>13.54</td>
<td>1.54</td>
</tr>
<tr>
<td>change: pasture</td>
<td>11.71</td>
<td>1.30</td>
</tr>
<tr>
<td>urban extent</td>
<td>9.77</td>
<td>1.62</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

#### Chart

![Chart showing relative influence and standard deviation for various variables](chart.png)

- **pop**: 20.00
- **mamdiv**: 19.84
- **pop_change**: 13.54
- **past_change**: 11.71
- **urban_land**: 9.77
- **past**: 7.30
- **crop_change**: 1.54
- **crop**: 0.20

- **rel.inf.mean** range: 0 to 20

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EcoHealth Alliance
Drivers of Disease Emergence in Humans

E. Loh et al. 2015. Vector-borne and Zoonotic Diseases 15(7)
Drivers are Intensifying

All drive habitat change
Increasing chemical use/environmental dissemination
Pressure on land and water quality

Expanding Settlements + Increasing domestic animal production + Increasing crop production + Increasing natural resource extraction =

- Increasing animal-human contact and spillover rate
- Increasing toxin exposure
- Health-benefitting ecosystem services threatened

Global Health Security and Development
Country-Level Drivers of Disease Emergence

Pie chart showing the percentage distribution of different factors contributing to disease emergence:
- Land use changes: 26%
- Agricultural intensification: 18%
- Antimicrobial agent use: 13%
- Human susceptibility to infection: 13%
- Food industry changes: 7%
- Bushmeat: 4%
- War and famine: 2%

Map showing the geographic distribution of these factors across different countries.
1,000,000,000 Kgs / Year
(Central Africa)
Reactive vs. Preventive

Ebola, 2014-, DRC and West Africa Outbreaks

**Preventive/Early Warning**

- Monitoring/early detection: $
- Health burden:
  - 66 cases
  - DALYs
- Deaths: 49
- Duration: <90 days
- Perceptions: Confidence in preparedness infrastructure
- Operations: Multidisciplinary

**Reactive**

- Response/Control: $$$
  - Est. US$10 billion+
  - 12% GDP growth loss (combined, 3 heavily affected countries)
- Health burden:
  - 28,616+ cases
  - DALYs
- Deaths: 11,310+
- Duration: >820 days
- Perceptions: Vulnerability fears and lack of predictive value
- Operations: Sole-discipline

Original graphic from Karesh et al. 2012, *The Lancet*
Disease don’t have to arise, they can arrive.

Hosseini et al. (in review)
Increased risk of Rift Valley Fever outbreaks

Starving marine mammals and birds, floods and landslides

Increased risk of Cholera, Dengue Fever

Forest fires from dry conditions, haze and smoke, increased respiratory disease

Increased risk of Mosquito-borne diseases

Risk of fisheries collapse

Drier than normal, decreased crop yields

Increased risk of West Nile Virus, Hantavirus, Plague

Examples of likely health effects from El Nino, 2015-2016. Background map of average rainfall anomalies from Dr. Assaf Anyamba, et al., PLOS Neglected Pathogens, 2012. Shades of yellow to red indicate below normal rainfall and blue to green indicate above normal.
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