Securing the Future

The Human-Climate-Wildlife Nexus

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Zoonotic Diseases

75% of recently emerging human infectious diseases have an animal origin

80% of animal pathogens can circulate between humans and animals

60% of all known pathogens are multi-host
The Role of Climate

- Temperatures
- Heavy precipitation
- Extreme weather events
- Drought
- Climate change will disturb these systems
Diseases

- waterborne
- food-borne
- vector-borne
  (Transmitted by insects or arthropods)

- Zoonotic
  (Transmitted by animals)
Outline

- The Situation
  - Zoonotic diseases past and present

- The Problem
  - Human activity and the role of Climate Change

- The Solution
  - Current efforts and 5 recommendations to increase preparedness
A Deadly Past

- Plague
- Influenza
- Malaria
- West Nile Virus
- Dengue
- Ebola
- HIV
- SARS
- Rabies
- Anthrax
The Black Plague

- *Yersinia pestis*
- Transmitted by fleas on infected rats
- 200 million deaths
- 1/3 of Europe’s populations
- Enormous cultural implications
HIV/AIDS

- Traced back to chimpanzees in Cameroon
- 25 million deaths since 1981
- Leading cause of death among ages 15-59 around the world
- $500 billion dollar price tag
Influenza

- Natural reservoir in birds and mammals
- Cause of several major pandemics

<table>
<thead>
<tr>
<th>Name of Pandemic</th>
<th>Years</th>
<th>Deaths</th>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>Spanish Flu</td>
<td>1918-1920</td>
<td>20-100 million</td>
<td>H1N1</td>
</tr>
<tr>
<td>Asian Flu</td>
<td>1957-1958</td>
<td>1-1.5 million</td>
<td>H2N2</td>
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<tr>
<td>Hong Kong Flu</td>
<td>1968-1969</td>
<td>0.75-1 million</td>
<td>H3N2</td>
</tr>
<tr>
<td>Swine Flu</td>
<td>2009-?</td>
<td>11,000 to date</td>
<td>H1N1</td>
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West Nile Virus

- 2001-2005 study linked outbreak to higher temps, humidity and rainfall that increased mosquito populations
- Linked closely to El Nino/La Nina cycles
Dengue Fever

- Resurgence mediated by climate change
- Longer season
- Expanded range
- Faster virus replication
- More frequent bites
Human Activity

- Human activity facilitates the spread of disease
- Industrial food production in areas of high biodiversity
  - Nipah Virus in Malaysia
- Wildlife trade!
$10 billion/yr legal trade (not including fish or timber)

$5-20 billion/yr illegal trade (largest illicit trade after drugs and arms)

U.S. one of largest importers: >1 billion live individuals between 2000-2004
Risks of Trade

- Largely unregulated
  - “Broken Screens”
- Invasive species
  - 2000-2004: 2,241 of 2,726 live species imported into U.S. are non-native
- Spread of disease

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<tbody>
<tr>
<td>Infectious Agent</td>
<td>Most Recent Documentation</td>
<td>Imported Host</td>
<td>Known Carrier Hosts</td>
<td>Infected Animals</td>
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<tr>
<td>Exotic Newcastle’s Disease&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1999</td>
<td>Various avian species</td>
<td>Various avian species</td>
<td>Poultry</td>
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<tr>
<td>Heartwater&lt;sup&gt;4&lt;/sup&gt;</td>
<td>2000</td>
<td>African tortoise tick</td>
<td>Lizards, snakes, and tortoises</td>
<td>Domestic livestock, white-tailed deer</td>
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<tr>
<td>Malignant Catarrhal Fever&lt;sup&gt;6&lt;/sup&gt;</td>
<td>2002</td>
<td>Ankoli cattle</td>
<td>Wildebeest</td>
<td>Ruminant species</td>
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<tr>
<td>Monkeypox Virus&lt;sup&gt;9&lt;/sup&gt;</td>
<td>2003</td>
<td>Giant Gambian rats</td>
<td>Giant Gambian rats</td>
<td>Humans, prairie dogs</td>
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<tr>
<td>Viral Hemorrhagic Disease of Rabbits&lt;sup&gt;7&lt;/sup&gt;</td>
<td>2005</td>
<td>European rabbit</td>
<td>European rabbit</td>
<td>European rabbit</td>
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<td>Chytridiomycosis&lt;sup&gt;8&lt;/sup&gt;</td>
<td>2006</td>
<td>American bullfrog</td>
<td>American bullfrog, African clawed frog</td>
<td>Amphibians</td>
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<td>Ranavirus&lt;sup&gt;10&lt;/sup&gt;</td>
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Monkeypox Virus

- U.S. outbreak in 2003
- Traced to infected Gambian rats in pet distribution facility
- Rats → prairie dogs → humans
- CDC ban on African rodent imports following the outbreak
“Hot spots” of emerging infectious diseases
A Growing Understanding

- GLEWS
  - FAO, OIE and WHO
  - Online platform for information sharing
  - Ad-hoc scientific panels
  - Disease priority list

- USGS
  - National Wildlife Health Center
  - Invasive wildlife pathogens and emerging diseases
  - Wildlife Disease News Digest
What Needs to be Done?

- Create and fund one centralized, public repository for surveillance data from both humans and animals that can harbor zoonotic pathogens.

- Establish clear jurisdictional guidelines regarding who will enforce rules and regulations associated with human-animal interaction threats.

- Establish better communication channels between veterinarians, physicians, nurses, public health officers and wildlife managers.

- Diversify and unite disparate communities.  
  One Health Initiative = will unite human and veterinary medicine

- Expand public education about the threats and risks that the consequences of climate change pose to human health.
“Frankly, I think we’ll regret introducing these organisms into the environment.”