Infectious Diseases in a Borderless World
Prof. Dr. Leo Visser, Leiden University Medical Center, The Netherlands
Broadcast live from the 2017 Infection Prevention Society conference

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Plague

- Evolutionary genetic adaptation
  Yersinia pseudotuberculosis
- High host plasticity as vector-borne disease with rodent reservoir
- Catalyzing changes in climate and socio-economic conditions
- Trade and travel

http://radar.zhaw.ch/worldwide.html

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![Image of Earth and Moon with a distance of 5,561,171,753,059 km]

**Table 1. Population of the World and Major Areas, 2015, 2030, 2050 and 2100, According to the Medium-Variant Projection**

<table>
<thead>
<tr>
<th>Major area</th>
<th>2015</th>
<th>2030</th>
<th>2050</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>7,349</td>
<td>8,501</td>
<td>9,725</td>
<td>11,213</td>
</tr>
<tr>
<td>Africa</td>
<td>1,186</td>
<td>1,679</td>
<td>2,478</td>
<td>4,387</td>
</tr>
<tr>
<td>Asia</td>
<td>4,393</td>
<td>4,923</td>
<td>5,267</td>
<td>4,889</td>
</tr>
<tr>
<td>Europe</td>
<td>738</td>
<td>734</td>
<td>707</td>
<td>646</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>634</td>
<td>721</td>
<td>784</td>
<td>721</td>
</tr>
<tr>
<td>Northern America</td>
<td>358</td>
<td>396</td>
<td>433</td>
<td>500</td>
</tr>
<tr>
<td>Oceania</td>
<td>39</td>
<td>47</td>
<td>57</td>
<td>71</td>
</tr>
</tbody>
</table>


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• How do new infections emerge?
• What have we learned from epidemics of 21st century?
• What will the future bring in this borderless world?

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Nature 2007;447:279

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2034

- China
- US
- India
- UK
- Brazil
- Indonesia
- Spain
- Germany
- Japan
- France

7.7 x 10^9

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SARS (2003)

- Cross-species transmission CoV
- One Health movement
- Initial delay reporting
- International Health Regulations 2005
- Superspreading events (health care facilities)
- Rigorous infection control practices
- WHO global network virology
- National capacity building

H5N1 (1997)

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**H1N1 (2009)**

- Reassortment virus in swine
- Surveillance in pigs (and man)
- Unexpected time and geographic region
- Early warning systems <10% IHR countries
- Vaccine production too late, too little
- New cell-culture based influenza vaccine
- Unequal access to vaccines and drugs
- Revision vaccine distribution

**Effective Distance (D_{eff})**

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MERS-CoV (2012)

Global legal controversy over ownership and sharing of dangerous viruses

Revision of 2011 Pandemic Influenza Preparedness Framework
- to include non-influenza viruses with pandemic potential
- to include genome sequence data

MERS-CoV (2015)

<table>
<thead>
<tr>
<th>Medical shopping</th>
<th>Late diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crowding ER and culture of family care-giving</td>
<td>Restrict hospital visitors</td>
</tr>
<tr>
<td>Quarantine failure of superspreaders</td>
<td>Hospital hygiene and infection control</td>
</tr>
<tr>
<td>Poor communication and failure to build trust</td>
<td>Risk communication</td>
</tr>
</tbody>
</table>

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Ebola (2013)

“The Ebola epidemic has shown how connected we are as a global community; we are only as safe as the most fragile states.”

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Zika (2015)

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Global change for microbes

The clinical class 1 integron illustrates how human activities affect the abundance and distribution of genes and microorganisms. Driven by antibiotic selection, it has colonized different bacteria, vertebrate hosts, and continents. Its spectacular rise in abundance has been driven by antibiotic selection. Large numbers of integron copies are now being shed back into the environment, driving the spread of antibiotic resistance. See supplementary materials for data sources.

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Copies per gram feces</th>
<th>Grams of feces per day</th>
<th>Size of population</th>
<th>Total copies released per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>10^9 – 10^11</td>
<td>570</td>
<td>1 x 10^9</td>
<td>10^19 – 10^23</td>
<td></td>
</tr>
<tr>
<td>10^9 – 10^10</td>
<td>20</td>
<td>1 x 10^10</td>
<td>10^19 – 10^21</td>
<td></td>
</tr>
<tr>
<td>10^8 – 10^9</td>
<td>3000</td>
<td>1.4 x 10^9</td>
<td>10^19 – 10^20</td>
<td></td>
</tr>
<tr>
<td>10^7 – 10^8</td>
<td>160</td>
<td>7.6 x 10^9</td>
<td>10^18 – 10^19</td>
<td></td>
</tr>
</tbody>
</table>

Major increase in human monkeypox incidence
30 years after smallpox vaccination campaigns cease in the Democratic Republic of Congo

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Recent epidemics showed how densely connected we are as a global community; we are only as safe as the most fragile states.

Air travel, population growth, encroachment on previously sparsely populated areas in Africa and Asia, climate change, civil unrest and conflict amplify the risk of outbreaks and epidemics.
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- Be prepared for the unexpected
  Make infectious control practices work
- Strengthen existent public health surveillance systems and infrastructure
- Support low-income countries to implement 2005 International Health regulations
- Adapt the Pandemic Influenza Preparedness Framework to other pathogens

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September 28, 2017
Speaker: Prof. Elaine Larson, Columbia University, Mailman School of Public Health

October 5, 2017
Speaker: Prof. Bjerg Marit Andersen, Oslo University Hospital

October 12, 2017
Speaker: Prof. Shaheen Mehtar, Infection Control Africa Network, and Stellenbosch University, Cape Town

October 26, 2017
Speaker: Jennifer Amyotte, City of Greater Sudbury Paramedic Services, Canada

October 31, 2017
Speaker: Prof. Dr Angela Dramowski, Stellenbosch University, Cape Town

November 9, 2017
Speaker: Prof. Makeda Semret, McGill University, Montreal

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