Biodiversity, globalisation and communicable diseases in Europe

Jonathan E. Suk, ECDC
Partner agencies
- EFSA
- EMA
- WHO
- European Commission

AMR
- Dominique Monnet

Food-borne diseases
- Johanna Takkinen

Vector-borne diseases
- Herve Zeller

Climate change
- Jan Semenza
• EU agency established 2005 – Stockholm
• Covering EU 28 & 3 EEA countries

• Staff: 300 approx.
• Most EU nationalities represented
Our mission

‘ECDC's mission is to identify, assess and communicate current and emerging threats to human health posed by infectious diseases’. (ECDC founding regulation 851/2004)

**Core functions:**
- Disease surveillance
- Epidemic intelligence
- Risk assessment
- Health communication
- Scientific advice and guidance
- Response support
- Preparedness and capacity strengthening
- Training

**Antimicrobial resistance and healthcare-associated infections**

- Emerging and vector-borne diseases
- Food- and waterborne diseases and zoonoses
- Influenza
- Microbiology
- Tuberculosis
- HIV, sexually transmitted infections and viral hepatitis
- Vaccine-preventable diseases
Preface: Major Recent Emerging and Reemerging Infectious-Disease Outbreaks

Severe acute respiratory syndrome (SARS)
Started in China

Chikungunya Outbreaks

Zika virus
Yap Island, Federated States of Micronesia

Cholera
Zimbabwe

Cholera
Haiti

H1N1 influenza
Pandemic

Measles
Democratic Republic of Congo

Middle East respiratory syndrome (MERS)
Outbreaks


Zika virus
French Polynesia

Brazil and Colombia

Ebola
Outbreaks in West Africa

Chikungunya
Outbreaks

Increasing trend in infectious disease outbreaks

Study of 33 year dataset of 12,102 outbreaks of 215 human infectious diseases:

- Total number and diversity of outbreaks, and richness of diseases have increased since 1980
- 65% of diseases were zoonoses
- Salmonellosis caused most outbreaks
“Blurred lines of emergent disease and ecosystem health”

Primary drivers of disease emergence associated with the past emerging zoonotic disease events

- Forest fragmentation in North America led to an increased risk of Lyme Disease in human
- Nipah virus was linked to intensification of pig farming and fruit production in Malaysia
- Japanese encephalitis virus (JEV) was linked to irrigated rice production and pig farming in Southeast Asia
- Rabies transmitted by vampire bats to cattle and human was linked to forest activities in South America
- Emergence of Bat-associated viruses emerged due to loss of bat habitat from deforestation and agricultural expansion
- Ebola outbreak in West Africa was a result of forest losses, leading to closer contacts between wildlife and human settlements
- Early human cases of SARS was associated with contact with civet cats either in the wild or in live animal markets
- Emergence of Avian Influenza was linked to intensive poultry farming

Created based on data from Jones et al. (2013)²

Biodiversity, wildlife, and humans

- Deforestation and urban sprawl force wildlife into new habitats
- Higher population densities lead to increased number of interactions between humans and animals
- Global trade and travel ensure that insects, animals, and humans will interact in novel settings
Climate change

Cumulative total anthropogenic CO₂ emissions from 1870 (GtCO₂)

Source: IPCC; http://www.climatechange2013.org/images/figures/WGI_AR5_FigSPM-10.jpg
Climate change

- Indirect exposures (vector-borne diseases, other infectious diseases)
- Direct exposures (heat stroke, drowning…)
- Socio-economic impacts (homelessness, refugees…)
- Health outcomes

Environmental consequences

- Climate change

CO₂
Biodiversity, globalisation and communicable disease in Europe

Image: NAP (2011) What you need to know about infectious disease
Vector-borne disease
Chikungunya in Europe, 2017

- 2 clusters of local Chikungunya transmission in August 2017
- 13 confirmed cases

Source: Calba et al., Eurosurveillance, 2017 22(39)
Chikungunya in Europe, 2017

- 239 confirmed and probable Chikungunya cases in Lazio
- 6 cases in Calabria

Climatic suitability for *Aedes albopictus*

Source: ECDC
Climate change and chikungunya in Europe

- Moderate expansion of climatic suitability across much of central Europe, notably in France and Italy.
- Large areas surrounding the Rhine and Rhone rivers in Germany and France, respectively, are also projected to increase in suitability.
- Some parts of the region of highest current suitability in northern Italy are projected to experience a decline in suitability due to increased summer droughts, which will reduce the habitat suitability for the vectors.

Source: Tjaden et al., 2017, Scientific Reports
Tick-borne diseases

Source: ECDC
## Climate related disease risks in Europe

<table>
<thead>
<tr>
<th>Strength of link with climate change in Europe</th>
<th>Vibrio spp. (except <em>V. cholerae</em> O1 and O139)*</th>
<th>Visceral leishmaniasis*</th>
<th>Lyme borreliosis*</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Campylobacteriosis</td>
<td>Chikungunya fever*</td>
<td>Dengue fever TBE*</td>
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<tr>
<td>CCHF</td>
<td>Tularaemia</td>
<td>Cryptosporidiosis</td>
<td>Rift Valley fever</td>
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<tr>
<td>Hepatitis A</td>
<td>Yellow fever</td>
<td>Giardiasis</td>
<td>Salmonellosis</td>
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<tr>
<td>Leptospirosis</td>
<td>Yersiniosis</td>
<td>Hantavirus</td>
<td>Shigellosis</td>
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<tr>
<td>Medium</td>
<td></td>
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<td>VTEC</td>
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<tr>
<td>Low</td>
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<td></td>
<td>West Nile fever</td>
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<tr>
<td>Anthrax</td>
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<tr>
<td>Botulism</td>
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<tr>
<td>Listeriosis</td>
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<tr>
<td>Malaria</td>
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<td>Medium</td>
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<tr>
<td>Low</td>
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</tbody>
</table>

### Weighted risk analysis of climate change impacts on infectious disease risks in Europe

CCHF, Crimean-Congo hemorrhagic fever. Candidates for suggested changes to disease-specific surveillance are in bold. Asterisks indicate diseases currently notifiable in some EU member states but not legally reportable to ECDC.

Understand risks in greater detail

- e.g. VectorNet
  
  Network of medical and veterinarians entomologists and public and animal health professionals, working in the field of vectors or vector-borne diseases;

- To carry out targeted entomological surveillance

- To collect information on the geographical distribution of the priority vectors for human and animal health:

- To deliver ad-hoc scientific advice to support ECDC and EFSA; => increase synergies

EFSA/ECDC joint project
Vector distribution maps in Europe and neighbouring countries

**Aedes albopictus** and **Aedes aegypti**

established/introduced/absent

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**Legend**

- Established
- Introduced
- Absent
- No data
- Unknown

**Countries/Regions not visible in the main map extent**

- Malta
- Morocco
- San Marino
- Gibraltar
- Lichtenstein
- Azores (PT)
- Canary Islands (ES)
- Madeira (PT)
- Jan Mayen (NO)

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**Aedes albopictus - current known distribution: April 2017**

**Aedes aegypti - current known distribution: April 2017**

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Communicating to professionals in hospitals and long-term care facilities

Up to half of all antibiotic use in hospitals is unnecessary. Antibiotic misuse in hospitals is a major driver of antibiotics resistance. What can be done?

View materials

#KeepAntibioticsWorking: join us on social media!

As a healthcare professional, what can you do to keep antibiotics working? What can a patient association do to contribute? What can policymakers do at European level? What can a parent do? Everyone can join the campaign on European Antibiotics Awareness Day—posting his/her own message, picture or video using the #KeepAntibioticsWorking hashtag. Tell the world what you do, in your professional or personal life, at individual or collective level, to use antibiotics responsibly and #KeepAntibioticsWorking!

Read about the #KeepAntibioticsWorking campaign

https://antibiotic.ecdc.europa.eu
e.g. Collaboration between EU agencies on surveillance of AMR and AMC

Surveillance of AMR and antimicrobial consumption in humans (EARS-Net, ESAC-Net, HAI-Net, FWD-Net)

Surveillance of antimicrobial consumption in animals (ESVAC)

Surveillance of antimicrobial resistance in animals and foods

Joint Interagency Antimicrobial Consumption and Resistance Analysis report (JIACRA)
First report published in January 2015
Second report published in July 2017
Joint Interagency Antimicrobial Consumption and Resistance Analysis (JIACRA): examples

**Poultry**
Quinolone consumption and probability of resistance to quinolones in *Campylobacter jejuni* from poultry, EU/EEA, 2014

OR = 2.71 [1.57 – 5.63], p < 0.001

**Humans**
Carbapenem consumption and probability of resistance to carbapenems in invasive *Klebsiella pneumoniae* from humans, EU/EEA, 2015

OR = 1.23 [1.08 – 1.42], p = 0.002

Environment outside of hospitals wards / hospitals

- 6 hospitals in Brooklyn, NY
- 15 ceftazidime-resistant Acinetobacter baumannii from environmental surfaces within a 0.5 mile radius from the hospital (vs none if >0.5 mile)
- Emergency room door, clinic door, restaurant door, bakery door, diner door, pizza parlor door, donut shop door, deli door, grocery door, internet cafe bathroom, internet cafe door, subway door, subway hand railing, ...

Public transportation (buses, metro)

- **Porto (Portugal)**
  - 36% of 199 buses with MRSA
  - 2 of 3 major clones are the same as in hospitals
  - Association between proportion of MRSA contamination and bus serving more than 3 hospitals

- **Midwestern U.S. (urban)**
  - 63% of 40 buses with MRSA

- **New York Subway**
  - *Acinetobacter baumannii* at 220/466 stations sampled

Mobile communication devices

- **Review of literature**
  - 9-25% mobile communication devices with pathogenic bacteria
  - 0-10% with MRSA

- **UK**
  - 16% of 390 mobile phones in 12 cities contaminated with *E. coli* (London School of Hygiene and Tropical Medicine and Queen Mary, University of London)

## International travel

<table>
<thead>
<tr>
<th>Date</th>
<th>Departure</th>
<th>Destination</th>
</tr>
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<tbody>
<tr>
<td>Today</td>
<td>14:10</td>
<td>MULTIDRUG-RESISTANT MICROORGANISMS</td>
</tr>
<tr>
<td>Today</td>
<td>14:35</td>
<td>MULTIDRUG-RESISTANT MICROORGANISMS</td>
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<tr>
<td>Today</td>
<td>14:40</td>
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<tr>
<td>Today</td>
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<tr>
<td>Today</td>
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<tr>
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<td>Holmen</td>
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<tr>
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<tr>
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<tr>
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<td>15:15</td>
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<tr>
<td>Today</td>
<td>15:15</td>
<td>Mørup</td>
</tr>
</tbody>
</table>
Frequency of fecal carriage of multidrug-resistant *Enterobacteriaceae* in international travellers, February 2012-April 2013

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Positive Carriers</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America</td>
<td>57/183</td>
<td>31.1%</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>93/195</td>
<td>47.7%</td>
</tr>
<tr>
<td>Asia</td>
<td>142/196</td>
<td>72.4%</td>
</tr>
</tbody>
</table>

3 carbapenem-resistant *Enterobacteriaceae*

Food-borne diseases
EU key collaborators for foodborne diseases

Food and Waterborne Diseases and zoonoses network (FWD-Net):
- EU and EEA countries
- EURL for Campylobacter, Sweden
- EURL for Salmonella, The Netherlands
- EURL for Listeria monocytogenes, France
- EURL for VTEC**, Italy

*RASFF = Rapid Alert System for Food and Feed
**EURL for VTEC=European Union Reference Laboratory for verotoxigenic E. coli
Trends in priority foodborne diseases, 2015

Salmonellosis

Listeriosis

ShigaToxin-producing *E. coli* (STEC)

STEC O104:H4

Campylobacteriosis

**S. Enteritidis multicountry outbreak cases by week of statistics** and case classification (n=584), EU/EEA 2015-2017, as of 05/05/2017

*Week of onset, or week of sampling or week of received date at reference lab level*
Multi-country outbreak

• RASFF: countries encouraged to perform MLVA on official non-human poultry product samples positive for S. Enteritidis since May 2016

• UK and NL: perform food chain distribution analysis on food outlets associated with cluster of confirmed cases
  
  => Identification of common origin of eggs from a large egg packing station in another country

• NL sampled 5000 eggs from the packing centre and identified positive eggs

• EU-wide trace-back and forward initiated
Improved signal detection and response to multi-country foodborne outbreaks

MLVA\(^1\) + PFGE\(^2\)

Weekly cluster reports

Joint ECDC-EFSA Rapid Outbreak Assessments

Urgent Inquiry: unusual increase of cases at national level

Whole genome sequencing (WGS) support since 2015

\(^1\)MLVA=Multi-Locus Variable number tandem repeat Analysis

\(^2\)PFGE=Pulsed-field gel electrophoresis
Trace-back investigation at EU level
Common themes

- Vector-borne disease
- AMR
- Food-borne disease

Image: NAP (2011) What you need to know about infectious disease
Common themes

Risk drivers
• Environmental and ecological factors
• Globalisation in trade and travel

Integrated analyses growing in importance
• Identifying, analysing and responding to communicable diseases requires multi-agency and multi-disciplinary collaboration
• ‘One Health’ needs to be operationalised

Cross-border action also growing in importance
• Disease risks and outbreaks cross borders and so must public health action (e.g. Decision 1082/2013/EU)
Benefits of cross-sectoral action

Illustrative Relationship between Time of Detection of Emerging Zoonotic Disease and Total Cost of Outbreak

Source: The World Bank (2012), People, pathogens and our planet: The economics of One Health
Earlier detection of risks

Early detection and control efforts reduce disease incidence in people and animals

Source: Karesh et al. (2012), UNEP
Effective public health response

- Environmental monitoring
- Early detection
- Rapid response

Control opportunities

Bar chart showing the distribution of control opportunities across different time periods.
Thank you!

jonathan.suk@ecdc.europa.eu