Arbovirus outbreaks perspectives for Europe

PREPAREing for (Re-)Emerging Arbovirus Infections in Europe

Herve Zeller, Emerging and vector-borne disease programme, ECDC, Stockholm, SE.

Surveillance and control of vector-borne diseases
Diseases under surveillance....

**Vector-borne diseases**
- Malaria
- **West Nile fever**, **Yellow fever**, Chikungunya, Zika...
- **Viral haemorrhagic fevers** (dengue, Rift valley fever, Crimean-Congo Haemorrhagic fever)
- Leishmaniasis, sandfly fevers
- **Tick-borne encephalitis**, Lyme borreliosis
- Rickettsiosis: Mediterranean spotted fever (*R. conorii*), anaplasmosis
- Louse borne diseases: LB relasping fever (*Borrelia reccurentis*), *Bartonella quintana*/trench fever, typhus
- Plague

**Zoonosis and others**
- Hantavirus, Q fever, tularaemia, rabies
- **Viral haemorrhagic fevers** (Ebola, Marburg, Lassa, other arenaviruses...)
- Poxviruses, Bornavirus, schistosomiasis...

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**Other vector-borne viral threats?**

Bluetongue
Culicoides?

Schmallenberg 2013 related to Akabane, Tinaroo, Aino, ...
Understanding the diseases

- Evidence based information (timeliness/quality)
- Support for early detection and response to outbreaks
- Modelling approaches => to assess the risks
- Predictive indicators which trigger outbreaks
- Human behaviours

Prevention and Control

- Preparedness plans, (include communication)
- Vector control: new strategies, expertise and training
- Cost-effectiveness analysis of vector control to contain disease outbreaks

Arbovirus surveillance and control challenges

Preparedness within public health

Prevention

- Risk factor assessment
- Cohort studies
- Epidemiological modelling
- Evidence-based medicine and systematic reviews

Preparedness

- Threat analyses
- Vulnerability and gap analyses
- Detailed cross-sectoral planning
- Crisis management and simulation exercises
- Monitoring and evaluation of plans

Early warning

- Epidemic Intelligence
- Rapid risk assessment
- Event Assessment
- Public Communication

Surveillance

- Routine surveillance
- Syndromic surveillance
- Laboratory surveillance

Outbreak Response Assistance

- Outbreak investigation
- Case-control studies

Recovery

- Crisis Mgt and Response Evaluation
- Lessons identified -> case studies

Prevention Prepare Response Recovery
West Nile risk assessment tool

West Nile fever

Strengthening Preparedness

• WN virus Risk Assessment tool: Support Member States in defining criteria for
  triggering an alert for potential WNV transmission to humans;
  defining an affected area with/at risk for WNV transmission to humans;
  declaring a transmission zone ‘free’ of further viral transmission.

• WN fever mapping tool: Provide Member States with
  timely and accurate information to support deferral decision-making;
  about risks related to local transmission and returning travellers;
  (at the smallest spatial level → to limit shortage of blood supplies)

• European Up-Front Risk Assessment tool (EUFRAT):
  • Aid Member States quantifying the risk of transmission of emerging infectious
diseases from blood transfusion during outbreak events
Madeira: Dengue 1 outbreak
October 2012-January 2013
Attack rate: 8.10/100,000
no severe cases
78 cases in mainland Europe

Cumulative incidence rate of probable and confirmed cases,
RAM 26 September 2012 – 03 March 2013 (n=2,090*)
Temperature and *Ae. aegypti* population

New generations of *Ae. aegypti*

- Temp > 18°C
- Temp > 13°C
- Temp > 22°C

MJ Hopp *et al.* Climatic Change 2001

Survival of *Ae. aegypti*

Dengue and Chikungunya: autochthonous transmission in the EU

Dengue:

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>2007</td>
<td>France, Croatia</td>
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<tr>
<td>2008</td>
<td>Madeira Portugal</td>
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<tr>
<td>2009</td>
<td>France</td>
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<td>2010</td>
<td>France</td>
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<td>2011</td>
<td>France</td>
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<td>2012</td>
<td>France</td>
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<td>2013</td>
<td>France</td>
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<td>2014</td>
<td>France</td>
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</table>

Chikungunya: Italy

- 2007
- 2011

France 2014:

- 4 autochthonous dengue cases
- 443 confirmed imported chikungunya cases
- 11 autochthonous chikungunya cases
- Sept-October (one neighbourhood)
Seasonality dengue fever

TESSy data

Airport-level final destination of international travellers from dengue affected areas
(Endemic and epidemic) by quarter for 2010, overlaid with the presence of *Ae. albopictus*, 2010.

Dengue: a concern in the EU

Strengthening surveillance and reporting of human cases:
• Harmonized EU case definition
• Early reporting
• Laboratory capacity building (EQA...)

Strengthening *Aedes* mosquito surveillance and control programmes
• For prevention of introduction and establishment of invasive mosquitoes
• For reduction of the risk of transmission in areas where invasive mosquitoes have become established

Importance of predictive models for preparedness

**Challenges:**
Sustainability of vector surveillance programmes
Vector control tools (=> needs for assessments of control measures)

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[Map of European countries showing distribution of *Aedes albopictus*]
ECDC Guidelines for the surveillance of invasive and native mosquitoes

Available online at
www.ecdc.europa.eu
www.parasitesandvectors.com

WHO Framework for surveillance

E³: European Environment and Epidemiology network

Epidemic intelligence and surveillance (ECDC, WHO)
Environmental and land-use data (e.g. EEA, SEIS, EDEN)
Demographic and socio-economic data (Eurostat)

Integrate
Merge
Analyse
Interpret

to promote geospatial infectious disease modelling in Europe and its integration in Public health.

Set of key information for risk assessment about Public Health threat in Europe.

Data depository

Modelled length of transmission season for Chikungunya in Europe (dynamic preview)

https://e3geoportal.ecdc.europa.eu/SitePages/Home.aspx
Tick vectors of CCHF


TICKS:
Modelling the candidate areas where active surveys should be performed to check for changes in the tick’s population status.

Map of West Nile fever outbreaks by year, Europe and neighbouring countries between 2002 and 2011

number of WNF presence notification by year over the study period (2002–2011).


Map of predicted probability of WNV infection based on environmental predictors, 2012 2013

Reported human cases in 2012 and 2013

Most of Europe is predicted unsuitable for dengue, but the red areas here, major towns and cities, indicate suitability for dengue.

Predictions mainly driven by both high human population densities in cities and thermal conditions that coincide with other places globally where dengue occurs.

Challenges for surveillance and control of diseases transmitted by *Aedes* invasive species

- Areas under surveillance
- Critical period
- Clinicians awareness
- Laboratory capacity
- Communication
- Vector control measures

### Risk matrix of scenarios for Zika virus in Europe

<table>
<thead>
<tr>
<th>Probability</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
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<tbody>
<tr>
<td>Impact</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
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- Increased frequency of sporadic entry of Zika infected travellers
- Sporadic autochthonous sexual Zika transmission
- Sporadic autochthonous transmission of Zika by *Aedes albopictus*
- Large autochthonous transmission of Zika by *Aedes albopictus*
# Description of scenarios

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>Increased frequency of sporadic importation of Zika cases</th>
<th>Sporadic autochthonous sexual Zika transmission</th>
<th>Sporadic autochthonous transmission of Zika by <em>Aedes albopictus</em></th>
<th>Large autochthonous transmission of Zika by <em>Aedes albopictus</em></th>
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<tbody>
<tr>
<td>Zika outbreak plateaus in Americas but increased frequency of travel to the Americas leads to increased importation of Zika-infected cases.</td>
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<td>European citizens with no travel history to the Americas acquire sexually-transmitted Zika virus infection.</td>
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<tr>
<td>Sporadic autochthonous Zika transmission in Europe in area of high <em>Ae. albopictus</em> abundance</td>
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<td>High vector abundance and vector capacity in conjunction with permissive climate leading to large outbreak of autochthonous transmission</td>
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<th>Risk drivers for monitoring / assessment</th>
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<td>Epidemic curve in Americas</td>
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<td>Air traffic passenger data from Zika outbreak regions</td>
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<tr>
<td>Number of Zika infected patients in Europe</td>
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<td>Time windows for Zika sexual transmission</td>
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<td>Anticipated vector abundance (based on climate forecasts)</td>
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<td>Monitor new scientific developments on vector competence/capacity</td>
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<td>Role of asymptomatics in Zika transmission</td>
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<tr>
<td>Vector resistance to biocides</td>
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<th>Media and public attention</th>
<th>Increased frequency of sporadic importation of Zika cases</th>
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<td>Moderate</td>
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<td>the plight of specific travellers raises concern about safety of travellers and the efficiency of healthcare systems for treating them.</td>
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<td>High</td>
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<td>concern about sexual Zika transmission (e.g. whether asymptomatics can also transmit)</td>
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<td>High (primarily in areas with active mosquito)</td>
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<tr>
<td>Very High</td>
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<td>(primarily in areas with active mosquito)</td>
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<tr>
<td>potential negative impact on tourism to European areas with <em>Ae. albopictus</em>;</td>
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Conclusions

- Vector-borne diseases: limited knowledge and growing concern
  Surveillance not uniform in EU, not always mandatory
- Diagnostic tools to improve
- Treatment/vaccine to develop
- Control issues: needs for more effective tools to prevent and control outbreaks
- Monitoring drivers of infectious diseases can help predict vector-borne disease threats

- Promote integrated approaches for a better understanding and knowledge on pathogen ecology in a changing environment to improve risk assessment and predictive models regarding potential threats, targeted preventive measures and control activities