West Nile Fever – A European perspective

Agnès LEBLOND
INRA, VetAgro Sup, Marcy l’Etoile, France
Emerging Vector-borne diseases (VBDs)

• ~ 29% of emerging infectious diseases

• Number can still increase due to:
  • Global warming
  • Change of habitats
  • Increasing number of transports and global trade

• European concern
Provide an early warning for prevention of human cases?

VBDs need specific surveillance systems

- Complex transmission cycles
  - Several hosts
  - Several vectors

- Strong spatiotemporal variations
  - Climatic factors
  - Environmental factors

Japanese encephalitis
- Dead-end hosts
- Enzootic vector (Culex spp.)
- Amplification/reservoir hosts

West Nile fever
- Dead-end hosts
- Amplification/reservoir hosts

Lyme disease
- Eggs
- Larvae
- Nymphs
- Adults
- Engorged female laying eggs

How to improve the early detection of emerging VBDs?
West Nile Virus, a mosquito-borne Flavivirus

**Reservoir:** wild avifauna

**Vector:** *Culex* mosquitoes

**Horses and humans:** dead-end hosts

**Interindividual transmission in humans (WNV)**

**WNND** (neuro-invasive disease, 1-10%)

- Blood transfusion
- Organ transplantation
- Breast feeding

Intervention:

- Blood transfusion
- Organ transplantation
- Breast feeding

20%
Assessing the probability to have an outbreak of WNV

I. Risk assessment
II. Syndromic surveillance
III. Risk combination

- Probability that the disease is introduced
- Probability that the disease is transmitted: signs on the field
- Combined probabilities
Syndromic surveillance on horses

Real-time surveillance
- Veterinary practitioners and health authorities
- Electronic-based transmission of data to a secure website

Syndromic surveillance = neurological diseases in horses

Laboratory tests: IgG, IgM

➔ Early warning - Camargue area
- Dead birds
- Sentinel birds
- Mosquitoe sampling
Syndromic surveillance of nervous cases in horses at the national level

45 to 90 declarations per year in horses

*Warning* is provided when the number of declarations per week exceed a defined threshold = 3 declarations per week
Assessing the probability to have an outbreak of an emerging VBDs in horses

- Probability that the disease is introduced
- Probability that the disease is transmitted: signs on the field
- Combined probabilities

I. Risk assessment
II. Syndromic surveillance
III. Risk combination

Multi-species and integrated surveillance

Combine syndromes time series
Improving syndromic surveillance

Multivariate syndromic surveillance

Declarations from sentinel vets
2006 - 2013

Data collected by rendering companies
2011 - 2014

Data collected by hunters, technicians from hunting federations, and environmental inspectors from ONCFS
2007 - 2013

Nervous symptoms in horses

Mortality in horses

Mortality in wild birds
ROC curves

Area under the ROC curve = System’s performances

![ROC curve graph]

- Sensitivity
- 1 - Specificity

---

VetAgro Sup
Assessing the probability to have an outbreak of an emerging VBDs in horses

I. Risk assessment
- Probability that the disease is introduced

II. Syndromic surveillance
- Probability that the disease is transmitted: signs on the field

III. Risk combination
- Combined probabilities

Multi-species and integrated surveillance

Combine risk indicators = Joint Risk Score

Risk mapping
Environmental data

- SPOT-4 satellite image
  (DataBase ISIS from CNES-MEDIAS)
  
- Area 50 x 50 km,
- 20 meters resolution
- Low temporal resolution
Environmental data

- Definition of landscape categories
  - Association with mosquitoes, birds, and horses abundances

- Classification and modeling for identification of at risk area
Preparedness: definition of at-risk areas

Pluridisciplinary approach: identify sites with ecological factors favorable for mosquito breeding sites and wild birds presence

Variables: land use and landscape structure (IJI, heterogeneous agricultural areas)

Pradier et al, 2008

Prior odds (Opri) \( \frac{P(D+)}{P(D-)} \) \times \text{Value of Evidence (V)} \( \frac{P(n|D +)}{P(n|D -)} \) = Joint Risk Score (Opost) \( \frac{P(D + | n)}{P(D - | n)} \)
Conclusions

- Many European countries are facing WNV outbreaks in humans and horses
  - Surveillance capacities should be reinforced and more risk-based oriented
  - Each situation is different - local studies needed

Perspectives:

- Need to get a better knowledge on the epidemiology of the virus and risk factors for an outbreak
- Need for the collaboration of numerous specialists, each one in its field of competence!