To an improvement of RVF surveillance: what do we need as early detection tools?

V. Chevalier, F. Roger

UR “Epidemiologie et Ecologie des maladies animales
CIRAD-Emvt
INTRODUCTION

- Rift Valley Fever = emerging arthropod-borne zoonosis
- Hemorragic fever and abortions in small ruminants
- Flu like syndrome in humans but sometimes very severe
- Transmitted from one animal to another by mosquitoes, particularly those belonging to the *Culex* and *Aedes* genera.
- endemic in West Africa
- More recently in the Middle East

- Still expanding despite existing surveillance networks
- Need to understand why the existing networks are not efficient enough
- To improve these networks in terms of data collection, diagnostic tools.
The Ferlo area

- Sahelian area
- A succession of long dry and short rainy seasons
- A temporary pond system
- Water and grassland attract a massive flood of human populations and livestock

© Chevalier, V
Methodology

- 7 ponds were selected
- 2 sampling sessions: August / mid-December
- Plaque reduction neutralization test
- Abortions reported by farmers
- Rainfall recorded with a rain gauge in Barkedji
Results

1\textsuperscript{st} sampling session:
- 610 small ruminants
- Anti-WN antibodies positive dams: 1%
- Anti-WN antibodies positive offspring: 0%

2\textsuperscript{nd} sampling session
- 379 animals
- High missing rate (38%)
- Many abortions recorded (76)
- Observed incidence rate: 5.4%
- Large between-pond differences: 0 - 20.3%
- Annual cumulative rainfall marked a deficit of 5% vs a 30-years average

http://www.cdc.gov/ncidod/EID/vol11no11/05-0193.htm
Discussion (1)

- Intense circulation of the virus in 2003
- Many abortions => probably an outbreak?
- No transmission during the dry season
- Annual cumulative rainfall marked a deficit
  => Rainfall level: not a relevant predictor for the occurrence of RVF outbreaks in the Ferlo
The RVF Surveillance Network

Since 1987
12 locations
2 or 3 sampling during the rainy season
Seroneutralization
Based on abortion report
Discussion (2)

- In Senegal, 5 outbreaks were recorded in 2003,
- Nothing was notified in the Ferlo
- Outbreak detected at a national level only
- Disease warning issued in November when transhumants farmers had already left the area

=> high risk of dissemination
What do we need in terms of surveillance?

Seromonitoring

- SN + → Sp? Se? → IgM ELISA?
- SN - → Sp? Se?

Abortion

- SN +
- SN -

No abortion

Antigen test? RT PCR?

Based on abortion report

When abortions occur, the cycle has already been amplified
IgM Seroconversion: best indicator?
What do we need in terms of surveillance?

- To provide evidence of virus circulation before the outbreak
  - New diagnostic tools
    - Easy use in the field: sampling on filter paper?
    - Quick availability of the results: PCR?
- To be sure of our results
  - To measure the Se/Sp results of diagnostic tests
Efficient diagnostic tests are not enough

- To provide evidence of virus circulation before the outbreak
  - To take epidemiological studies and risk factor identification into account to define hot points, where a more stringent surveillance would be implemented ⇒ **targeted surveillance**
  - Training of veterinarian technicians ⇒ **quick** reaction and **quality** of samples
  - To increase awareness of breeders

- To be as sensitive as possible
  - To increase the number of sentinel flocks and the number of sampling locations
Evaluation of a surveillance network

- firstly implemented to assess the absence of a disease in a country.
- may be used to assess the efficiency of a surveillance network and focus on « weak » points
- assumption: a surveillance network is a complex system where informations or data may come from several origins and are combined:
  - Lab results
  - Slaughter houses reports
  - Veterinary services reports
  - Livestock movements reports
  - Epidemiological data
  - Rumors
Current approaches

- Statistically valid survey
  - Money and time consuming
  - Based on lab tests
  - Does not take into account human being failures, and uncertainty

- Global and qualitative evaluation by an expert panel
  - Cheaper because of existing data
  - Accurate: diversity of data origins
  - Durable: global analyses
  - More secure

but

Subjectivity of expert
Non reproducible
historical data

« Only » qualitative
New approach

- A quantitative approach combining the two previous methods
- Based on risk analyses methodology

- To describe all the components of the network
- To calculate or to estimate the sensitivity of these components
- To compare the components between each other
- To perform a sensitivity analyses and identify the critical steps of the network

=> To combine the sensitivities of these components and calculate a global sensitivity of the system
Example

Status of the region

- Infected
  - p₁
  - Abortion
    - p₂
      - Abortion noticed
        - p₃
          - p₅
            - Good quality
              - Se
                - SN +
                - 1 - Se
          - Bad quality
    - p₄
      - Abortion not noticed
        - 1 - p₃
          - 1 - p₅

- Non infected
  - 1 - p₁

p₂ : is there an outbreak? Are there any other disease leading to sheep abortions?

p₃ depends on the awareness of breeders (compensation?) and vet technicians

p₄ depends on vet technicians ability and logistic constraints

p₅ depends on vet technicians ability and logistic constraints
Evaluation of the sensitivity of the network

- The sensitivity of the network is:
  \[ p_1 \times p_2 \times p_3 \times p_4 \times p_5 \times Se \]

- But some \( p \) can not be calculated.

All probability distributions can be combined
=> global distribution of the sensitivity of the network
Example

- Introduction of uncertainty and variability in the decision tree
  - When abortions occur, how many breeders are going to declare them??
  - What proportions of abortions are declared? Sampled? Arrive in the laboratory?

- Evaluation of the Sensitivity of the network
  - Identification of the key points = sensitivity analyses
    - What happens if the number of vet technicians increases?
    - What happens if the sensitivity of the test is increased?
    - Is technicians training efficient?
    - Which measure is the most efficient?
    - And what about the cost?
Conclusion

Abortion ↓
Declaration ↓
Sampling ↓
Test ↓
Result +/-

Sensitivity
Specificity

Positive and negative predictive values