Risk Assessment as a Tool for the Control and Prevention of Rift Valley Fever Outbreaks

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Outline

- background
  - Rift Valley fever
  - risk analysis
- Rift Valley fever risk assessments for following scenarios
  - endemically infected
  - free from infection
- conclusion
Rift Valley fever (RVF)

- *Phlebovirus* genus within family *Bunyaviridae*
- vector-borne infection
  - wide range of arthropod species
- domestic ruminant species
  - peracute and acute disease in domestic ruminant species
  - high mortality among new-born animals
  - abortion in adult females
- humans
  - influenza-like illness
  - fatalities occur

Reported RVF Outbreaks in Africa and Arabian Peninsula

- Saudi Arabia, Yemen 2000
- Somalia 1997-8
- Tanzania 1997-8
- Mozambique 1969
- Madagascar 1979, 1990-1
- South Africa 1950-3, 1974-5, 1999
- Namibia 1955, 1974-6
- Tanzania 1997-8
- Mozambique 1969
- Madagascar 1979, 1990-1
- South Africa 1950-3, 1974-5, 1999
- Namibia 1955, 1974-6
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- Mozambique 1969
- Madagascar 1979, 1990-1
- South Africa 1950-3, 1974-5, 1999

From: EFSA RVF risk assessment report 2005
Epidemiology of Rift Valley Fever

Endemic Cycle

- Climates factors (heavy rainfall associated with ENSO)
- Human irrigation practices
- Dry Season
- Temporary ponds
- Rainy Season
- Floodwater Aedes
- Neomelaniconion
- Aedimorphus

Epidemic Cycle

- Floodwater Aedes + others ie Culex spp + direct transmission (aerosol, contact)
- Amplification

From: EFSA RVF risk assessment report 2005

Risk Analysis

- science-based and transparent approach to risk management
- estimate, evaluate and discuss risk of adverse events and their mitigation
  - structured approach
- contains several components
- qualitative and/or quantitative approach
- express and communicate risk as well as uncertainty!!!
Risk Analysis Components

- Hazard Identification
- Risk Assessment
- Risk Management
- Risk Communication

after OIE Animal Health Code

Risk Assessment Models

- risk pathway diagrams
- release, exposure and consequence assessment
- model implementation
- qualitative or quantitative
- data- or knowledge driven
  - statistical models derived from empirical data
  - static or dynamic models
    - based on expert opinion and published information
RVF Risk Assessment in Country with Endemic Infection: Senegal

RVF in Ferlo Area of Senegal

- Sahelian climate
- temporary pond system
  - *Aedes vexans*
  - *Culex poicilipes*
- massive movement of nomadic herds during rainy season into Ferlo
- endemic RVF infection
  - no mosquitoes during dry season
=> maintenance mechanisms?
RVF Release Assessment for Ferlo Area, Senegal

- Infection present in source population
- Infection present in in-contact populations during seasonal migration
- Infected animal arrives in Ferlo

Detection of infection or disease

Prevalence data

Infected ruminants selected for seasonal migration or exposed to infection during migration

Survival

Outside Ferlo

Inside Ferlo

RVF Exposure and Consequence Assessment for Ferlo Area, Senegal

- Infected animal arrives in Ferlo
- Infected animal develops viraemia
- Vector density
- Competent vector populations present
- Disease incidence in previous year
- Susceptible ruminant populations
- Establishment in Ferlo vector population
Conclusions from Risk Assessment for Ferlo Area, Senegal

- low risk of release through nomadic animal movements
- high risk of maintenance through trans-ovarial transmission amongst vectors
  - mosquito density heterogeneous in space and time
    - pond type
    - vegetation cover
    - rainfall rhythm

Recommendations from Risk Assessment for Ferlo Area, Senegal

- risk management
  - larvicides and/or artificial ponds
- research
  - validate results
  - quantify key parameters such as vector capacity
  - assess linkages between ecological factors and mosquito densities
Data-Driven Model: RVF Risk in March-August

From: Clements 2005

RVF Risk Prediction by DoD-GEIS

from: Department of Defense Global Emerging Infections Surveillance and Response System
Risk of RVF Introduction to European Union

- qualitative risk assessment
- conducted by European Food Safety Authority
  - independent from risk managers (European Commission)
- involved experts from Europe and Africa

Risk Pathways for RVF Release Assessment

Prevalence in source region

Stability of virus

Potential route of entry

Safeguards / Trading Requirements

Illegal imports

Live animals

Animal products

Vectors

Humans

Fomites

Vaccines

EU Border

Virus introduced to EU

Adapted from: EFSA RVF risk assessment report 2005
Risk Pathways for RVF

Exposure Assessment

Virus introduced to EU

Virus arrives in vaccine

Virus arrives in competent vector

Virus arrives by any other route including infected livestock, humans, or as contaminant on animal products or fomites

Infection of EU livestock

Infection of competent vector within EU

Adapted from: EFSA RVF risk assessment report 2005

Risk Pathways for RVF

Consequence Assessment

Infection of EU livestock

Infection of competent vector within EU

Climate, suitable environment

Infection in humans working in meat-related industry

Establishment in EU vector population

Adapted from: EFSA RVF risk assessment report 2005
Conclusions from RVF Risk Assessment for EU

- release assessment
  - greatest risk through aerial movement of infected vectors
  - negligible risk during inter-epidemic periods in source country
  - low-to-moderate risk during epidemic periods in source country
- exposure and consequence assessment
  - higher than negligible risk of
    - livestock exposure within EU to infected vectors
    - development of endemic foci of infected vector populations
      - particularly with vectors having potential for trans-ovarial transmission

From: EFSA RVF risk assessment report 2005

Recommendations from RVF Risk Assessment for EU

- establishment of targeted surveillance
- model predictions should be incorporated into RVF early-warning surveillance systems
- research activities aimed at filling existing data gaps

From: EFSA RVF risk assessment report 2005
Conclusion

- risk analysis effectively separates risk assessment from risk management
  - risk assessment provides structured framework for describing risk and uncertainty
- RVF risk management particularly suitable for taking account of modelling predictions
  - dependence of vector densities on environmental variables
  - need to improve validity of model predictions
  - consider model outputs for defining risk-based surveillance activities

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