Towards the development of optimal vaccination strategies for Rift Valley fever (RVF) in East Africa

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RVF vaccination – gaps

• New vaccines being developed – not much attention on vaccination strategies
• Current strategy – reactive vaccination which often fails to achieve required coverage
• RVF vaccines often delivered through state financing – can value chain actors cost share? Are they willing to pay? What influences acceptance?
• One Health dimension – economic benefits of vaccination in livestock?
Activities and their schedules timing

- Antibody decay study
- Livestock pop dynamics
- Socio-economics
- Development of vaccination strategies
- Refine decision support tools

Time
Stakeholder consultations – regional workshop

Objectives

- Review RVF status in East African region
- Design RVF vaccination strategies in livestock
- Identify institutional arrangements, capacities and networks required for their implementation

WORKSHOP ON DEVELOPING VACCINATION STRATEGIES FOR RIFT VALLEY FEVER IN EAST AFRICA
- 4-5 OCTOBER, 2017 – NAIVASHA COUNTRY CLUB, NAIVASHA, KENYA
Workshop recommendations: vaccination strategies

(i) Routine vaccination in high risk areas (annual)
- This should be based on RVF risk map. However, Uganda – no formal risk map
- This should target all animals of all ages
- Subsequent vaccinations should target animals not vaccinated -- animal identification is an issue to follow up

(ii) Vaccination ahead of predicted outbreak (During alert/ Emergency)
- Issues to consider:
  • procurement of vaccines,
  • sensitivity and accuracy of predictions,
  • resources are and how to mobilize them on short notice

(iii) Intermittent multiyear vaccination
- Once every 3 years in high risk areas
- Vaccinate yearlings once every 3 years and maintain a some level of herd immunity because vaccination is a very costly exercise

(iv) Use of multivalent vaccines
- For each of the above strategies, analyse costs and logistics of using multivalent vaccines
Objectives

• To determine the longevity of anti-RVF virus response in cattle, sheep, goats and camels

• To determine the effect of livestock population turnover on herd immunity against RVF in cattle, sheep, goats and camels

• To collect demographic and socio-economic data that can be used to estimate parameters for modelling livestock population dynamics in a pastoral production system
What do we know about longevity of RVF response?
Vaccination study – Sampling design

• Two sampling designs:
  – Longitudinal study using 30 cattle, 30 sheep/goats and 30 camels
  – Repeated cross sectional sampling of 22 herds from which these animals come from

• Sample size considerations
  o 75% of the animals develop neutralizing Abs following vaccination and about 50% retain protective levels after 1 year
  o One sample comparison of proportions
  o Clustering in herds, assume correlation coefficient of 0.04
  o Level of confidence 95% and a power of 80%

• Vaccinate all the animals with Smithburn vaccine at day 0
Smithburn RVF vaccine

N = 30

- Collect WBC at early time-points for transcriptomics
- Collect sera at all time-points
  - cELISA
  - VNT

Time plan [days]

- Collect WBC at early time-points for transcriptomics
- Collect sera at all time-points
  - cELISA
  - VNT
Vaccination study – Data collection

- Baseline sampling – all animals
- Vaccination with Smithburn – all animals
- Sampling – longitudinal
- Population changes – entries and exits
- Drug use
Modelling tool is available

Modelling Vaccination Strategies against Rift Valley Fever in Livestock in Kenya

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Abstract

Model structure – explicit livestock, mosquitoes and rainfall dynamics

Improve and expand models – epi and econ
Modelling

Impacts – vaccination coverages vs time to outbreak

Impacts a function of coverage, time to outbreak and perhaps the host spp ecology

Fig 4. Estimated proportion of cases averted for different vaccination coverages and at different times to the outbreak in cattle (top panel) and sheep (bottom panel).
Modelling

Impacts – vaccination coverages at outbreak onset

Proportional reduction (%) in cumulative incidence

Vaccination coverage

Cattle  Sheep
Modelling

Impacts – biannual and annual vaccination strategies

Fig 6. Expected impacts of biannual (Panel A) and annual (Panel B) periodic vaccination scenarios on the cumulative incidence of RVFV using a perfect vaccine and a vaccine with 50% efficacy.
Quantifying vaccine doses by strategy

- Decision support framework
  - Quantifying vaccine quantities
  - Coordination of campaigns

- Risk maps
  - Impacts:
    - 33% of East Africans
      (51.5 out of 155 million in high risk areas)
A lot of work still needed to collate reliable livestock numbers for analysis and planning.
Crude estimates of livestock numbers by risk

Crude numbers of livestock species by risk level that can be used to guide estimation of the number of RVF vaccine doses in East Africa

<table>
<thead>
<tr>
<th>Risk</th>
<th>Cattle</th>
<th>Goats</th>
<th>Sheep</th>
<th>Camels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>High risk (≥60%)</td>
<td>2,153,761</td>
<td>5</td>
<td>1,940,620</td>
<td>5</td>
</tr>
<tr>
<td>Moderate risk (≥30-60%)</td>
<td>11,500,000</td>
<td>26</td>
<td>8,705,384</td>
<td>21</td>
</tr>
<tr>
<td>Low risk (&lt;30%)</td>
<td>31,300,000</td>
<td>70</td>
<td>31,300,000</td>
<td>75</td>
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<tr>
<td></td>
<td>44,953,761</td>
<td></td>
<td>41,946,004</td>
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</tbody>
</table>

Potential sources of bias:
- RVF risk is underestimated in Uganda
  efforts to develop the risk map in Uganda on-going
- Livestock estimates for Tanzania generally poor
  Project will convene Workshops to obtain more accurate livestock numbers
Acknowledgements

• Range of stakeholders including those involved in designing the studies during the inaugural workshop

• Pastoralists participating in the longitudinal study in Isiolo, Kenya

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