Evaluating vaccination strategies to control foot-and-mouth disease: a model comparison study

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Introduction

- Vaccination is being recognised as an option for containing and eradicating FMD in previously disease-free countries
- For major exporting countries implications of vaccination, including management of vaccinated animals, will require careful consideration
- Simulation models ideal for situations where data is scarce but country specific context is vital
- Well designed collaborative studies can inform policy development
Study Objectives

• Compare vaccination strategies for FMD outbreak control
• What factors affect impact of vaccination
  – Time of deployment
  – Deployment strategy (outside-in, inside-out, …)
  – Size of vaccination zone
  – Approach to vaccination (Suppressive or Preventative)
• Simulate scenarios in different models and compare results
• Understand and explain the differences occurring between the scenarios
Model Comparison Approach

• Multiple countries and models participating
• Shared problem approach
  – All countries have same starting data
  – Multi-focal hypothetical outbreak
• Transmission parameters harmonised across models
  – Some compromises needed where models incompatible
• Comparison metrics for simulation results
  – Total number of infected premises (IPs)
  – Duration of outbreak (days)
  – Geographical distribution of IPs
# Vaccination Strategies Investigated

<table>
<thead>
<tr>
<th>Vaccination Approach</th>
<th>Vaccination zone size (km)</th>
<th>Timing of Vaccine delay (days)</th>
<th>Species vaccinated</th>
<th>Retrospective (R) or Prospective (P)</th>
<th>Order of vaccine deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stamping Out</td>
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<td>V1</td>
<td>SV</td>
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<td>14</td>
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<td>P</td>
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<tr>
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<td>SV</td>
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<td>28</td>
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<td>14</td>
<td>Cattle only</td>
<td>P</td>
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<tr>
<td>V9</td>
<td>PV</td>
<td>3-7</td>
<td>14</td>
<td>All</td>
<td>P</td>
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<td>R</td>
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<tr>
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<td>PV</td>
<td>5-10</td>
<td>14</td>
<td>All</td>
<td>P</td>
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</tbody>
</table>
Results – Epidemic Size (Number of IPs)

Median (5-95) number of IPs

AusSpread
Netherlands
Exodis
InterSpread Plus
NAADSM

1 Km
Cattle Only

0 100 200 300 400 500 600 700

SO V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 V11
Results – Epidemic Duration (Days)

Median (5-95) epidemic duration (days)

Control strategy

- AusSpread
- Netherlands
- Exodus
- InterSpread Plus
- NAADSM

1 Km
Cattle Only
Discussion

• All results are in the context of this specific outbreak
  – All vaccination scenarios result in significantly smaller and shorter outbreaks than stamping out alone
  – Certain vaccination scenarios are robust to substantial differences in models design

• Vaccination use has implications
  – Time to disease freedom declaration

• Implications of vaccinated animals in population
  – Tracking & identification of vaccinated animals
  – Animal products and by-products of vaccinated animals
  – Further economic impact assessment
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