Does long-term vaccination eliminate leptospiral shedding?

A “test of concept” study in pastoral dairy cattle

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This presentation

• Background
  – Lepto in NZ livestock
  – Vaccine and Vaccination programme efficacy

• Test of concept study
  – Elimination of lepto in dairy cattle?
Leptospirosis in New Zealand livestock

- Dairy cattle
  - 1970s, most herds +, ~80% cows (prior to vaccination)
  - **BUT**: No recent data
    - Should be low due to vaccination

- Beef cattle, sheep and deer
  - >80% farms, ~50% animals

- Vaccination
  - Dairy
    - ~95% herds:
      - some for >30 years
  - Beef and deer
    - ~10% herds
Are vaccines efficacious? - *Urine shedding*

- **2012 review**: 25 studies: Cattle (22), deer (2), Sheep (1)
  - Variable
    - Challenge
      - Artificial and natural
    - Routes
    - Doses
    - Serovar/s
    - Timing and time intervals
    - Vaccines
    - Animal numbers
    - Age
    - Prior exposure
    - Detection method
    - Etc.!!!

A typical meta-analysis!
Are vaccines efficacious? - Urine shedding

- Review range: 0 - 100%!!!
- \( \geq \sim 70\% \) in natural challenge situations
- **Cattle and Deer (NZ)**
  - Infected herds
    - Deer: 44% ↓ no. shedding, Cattle: 38%
  - If animals vaccinated before natural challenge
    - Zero shedding in some studies

The real question is effectiveness of **long-term vaccination programmes** rather than vaccine *per se*
Does dairy cattle vaccination reduce human disease?

- Difficult question because of confounding
- Reduced incidence after vaccination
  - from late 1970’s
- 1980’s surveys
  - Lower rate in workers with vaccinated herds
  - Lower rate in regions where dairy companies mandated vaccination
- Smaller proportion of current cases are dairy farmers
- Dairy-only vets at lower risk of sero-positivity

Cattle vaccination appears to reduce human disease. Likely due to reduced shedding.
Does long-term vaccination eliminate shedding?

Pilot study: Methodology

- 44 dairy herds, 2 seasons
  - Vaccination 5 – 25 years
    - 4 vaccine formulations
  - 3 regions
- 10 (8 – 12) urine samples/herd
  - Adult cows
  - Opportunistic mid-stream urination
- RT-PCR (all samples) and DFM (34 herds)
- Questionnaire
  - Farm/herd details, vaccine and vaccine use
## Results:
**Urine DFM and PCR**

<table>
<thead>
<tr>
<th></th>
<th>DFM</th>
<th>RT-PCR</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herds</strong></td>
<td>6/34</td>
<td>8/44</td>
<td>13/44</td>
</tr>
<tr>
<td><strong>Cows</strong></td>
<td>6/347</td>
<td>12/445</td>
<td>18/445</td>
</tr>
<tr>
<td><strong>Pos. cows in pos. herds</strong></td>
<td>6/62</td>
<td>12/82</td>
<td>18/134</td>
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Multivariable analysis: probability of shedding

- Not associated with:
  - Vaccine brand name or type
    - bivalent/trivalent/7-in-1
  - No. of serovars in vaccine (2 or 3)
  - Booster interval
  - Herd size
  - Other animal species
  - Biosecurity

- **BUT:** Associated with **timing** of first vaccination
Probability of shedding vs, timing of first vaccination

Approximately 6x higher probability of shedding if vaccination starts ~6 months c.f. < 3 months (p = 0.04)
Discussion: study robustness

- Pilot: test of concept study
- Limited power
- Non-random selection of herds/animals
- Accuracy of farmer recall/response
  - E.g. unknown vaccine type
- No culture for serovar identification
- PCR and viable/non-viable urine leptospires

But:
- *Positive samples in both years*
- *Plausible effect of age at first vaccination*
Conclusions

• Evidence of shedding
  – Despite long-term vaccination
  – Low incidence
  – Vaccines *per se* not implicated

• Hypothesis generated:
  – Timing of vaccination is critical

• Result prompted vet/industry re-think
  – What is needed to achieve a better result?
  – Best practice guidelines: holistic approach

Essential data:

• *Maternally derived antibody* w.r.t. vaccine timing
• *On-farm confirmation that early vaccination actually works!*