Interrupting LSD virus transmission: Role of vaccines and the evaluation of control programmes

Nick Lyons
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Vaccines and protection

Susceptible → Infected → Diseased → Recovered/immune

INFECTIOUS

TRANSMISSION

Vaccines and protection
Vaccines and protection

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Vaccines may *protect* against:
- Disease

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- Infection
Vaccines and protection

Vaccines may *protect* against

- Disease
- Infection
- Infectiousness

Examples:
- Polio – OPV vs IPV
- Tuberculosis – BCG
- FMD – killed vaccines

Protective effects are not necessarily absolute..... Animals that have less severe disease may be less infectious...
**Direct versus Indirect protection**

**Direct protection** – does the vaccine protect the individual that is vaccinated

**Indirect protection** – does vaccination protect those that are not vaccinated due to reduced incidence in whole population
Direct versus *Indirect* protection

**Direct protection** – does the vaccine protect the individual that is vaccinated

**Indirect protection** – does vaccination protect those that are not vaccinated due to reduced incidence in whole population
Direct versus Indirect protection

Indirect protection – does vaccination protect those that are not vaccinated due to reduced incidence in whole population

Indirect protection:
• So called “herd effect”
• Vaccine must not just prevent against disease
• These combined effects inform our understanding of the “herd immunity threshold”..i.e. the coverage needed to eliminate infection
Vaccine *efficacy* versus *effectiveness*

Important to have a *consistent definitions* to evaluate vaccines

\[ \text{Vaccine efficacy} = 1 - \frac{\text{Incidence in vaccinated}}{\text{Incidence in unvaccinated}} \]

1. Performed under “ideal” conditions
2. Assumes equal exposure in vaccinated and unvaccinated populations
3. Usually a randomised controlled trial

*Vaccine effectiveness*: same calculation but under field conditions

....how effective is your vaccination *policy* rather than how efficacious is the vaccine....
Vaccine effectiveness – example from Ethiopia

<table>
<thead>
<tr>
<th>Disease</th>
<th>Vaccination</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>274 (16.2%)</td>
<td>23 (25.0%)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1413 (83.8%)</td>
<td>69 (75.0%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1687</td>
<td>92</td>
<td></td>
</tr>
</tbody>
</table>

Incidence in vaccinated = 274/1687 = 16.2%
Incidence in unvaccinated = 23/92 = 25.0%
Vaccine effectiveness = 1 – (16.2/25.0)
= 1 – 0.65
= 0.35 or 35% (95%CI 3-56%)

Unpublished data used with permission from Dr Getachew Gari, NAHDIC
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Vaccine effectiveness will often vary in different settings

This estimate is UNADJUSTED for confounders such as age, number of lifetime doses, and previous disease

= 0.35 or 35% (95%CI 3-56%)
Effectiveness studies – a few key points

• **Confounders** - for observational studies it is essential to adjust for exposure risk and previous disease (i.e. age)
• **Selection bias** – how are areas/farms chosen in the analysis
• **Ecological studies** - Comparing groups or regions is complicated as it is difficult to say all farms are at equal exposure risk...unless this is adjusted for in the analysis
• **Vaccines doses** – should consider the total number of lifetime doses, and the timing of the last dose
• Important to consider the impact of **maternal immunity**
Other transmission blocks

Other control measures:
- Clean needles for vaccination/treatment
Other transmission blocks

Susceptible  →  Infected  →  Diseased  →  Recovered/immune

Other control measures:
- Insecticide?

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Evaluation of other interventions

• **Insect control**
  • Various insects implicated....but which are the most important?
  • Tick control?
  • Lessons from *Bluetongue*...?
      • Sudan
      • Cross sectional study, random sampling
      • Questionnaires, blood samples
      • Multivariate analysis – Individuals from farms using vector control at lower risk of seropositivity
Evaluation of other interventions

• **Insect control**
  
  • Lessons from *Bluetongue*
    
      
      • Bulls on a stud farm in Germany. Permanently housed.
      • Ear-tags (permethrin) and regular pour-ons
      • Looked at various haematophagous insects
      • Assessed their feeding activity
      • Still saw high feeding rates in Culicoides and Aedes/Anopheles species
Evaluation of other interventions

- **Insect control - summary**
  - The effectiveness of different interventions for insect control is likely to be highly variable between different settings depending on:
    - Vector types present
    - Density of different vectors
    - Resistance to insecticides
    - Prevalence of LSDV
    - Climate
Evaluation of other interventions

• Insect control – summary
  • There is potential for insecticides to be useful for LSD
  • Suggest that observational studies in the field should be performed in the first instance to see how effective they might be for LSD
  • Cluster randomised trials would be an optimal study design for assessing any interventions
Thank you for your attention
Any questions?

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