Mixed treatment comparison meta-analysis of three commercial porcine circovirus type 2 (PCV2) vaccines available in the USA

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Introduction

Porcine circovirus type 2 (PCV2) vaccination is one of the most commonly used intervention strategies in growing pigs. Multiple trials have described the efficacy of individual PCV2 vaccines relative to non-vaccination. Few studies provide product-to-product comparisons of efficacies. Information about the comparative efficacy of available vaccines is more relevant to producers and veterinarians than comparison to non-vaccination.

Objective

Primary objective: provide comparative estimates of changes in ADG effect associated with the use of the three PCV2 vaccines in the USA. Statistical approach mixed treatment comparison meta-analysis (MTC) in Bayesian framework.

Secondary objective: answer questions of interest in MTC context.

1. Which is the best treatment based on ADG?
2. Rankings of treatments based on ADG
3. Probability to be equivalent
4. PRRSV status
5. Conclusion

Extracted data

- Most of the trials with pairwise comparison
- 20 trials in total
- Data for MTC, average daily gain and standard error of the mean

Model ADG

\[ Y_{ij} | \theta_i \sim N(\theta_i, \tau_i^{-1}) \]
\[ E(Y_{ij}) = \theta_i = \alpha + \delta_{i,k} + \mu + \beta \text{PRRSV} \]
\[ \alpha \sim N(650, 100^2) \]
\[ \beta_1 \sim N(0,1000) \]
\[ \beta_2 | \text{N}(0, \tau_2^2) \]
\[ \delta_{i,k} | \text{N}(0, \tau_3^2) \]
\[ \delta_{i,k} = d_{i,k} \sim \text{N}(0, \tau_4^2) \]
\[ \text{ADG in trial i for treatment k} \]
\[ \text{standard deviation of the treatment effect, } \sigma \]
\[ \text{is the effect in a trial i} \]
\[ \text{is the overall mean for the ADG} \]
\[ \text{are the trial-specific relative effects of treatment k} \]
\[ \text{is the effect of PRRSV status on the mean ADG} \]
\[ d_{i,k} \sim \text{N}(0,100^2) \]
\[ \tau_i \sim \text{Gamma}(10^{-3}, 10^{-3}) \]

Results

Table: Results of consistency and inconsistency models for main model (using precision based on SEM) and additional model (using precision based on sample size)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rankings model-SEM</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.97</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Circumvent</td>
<td>0.12</td>
<td>0.43</td>
<td>0.43</td>
<td>0.43</td>
<td>0.43</td>
</tr>
<tr>
<td>Ingelvac</td>
<td>0.12</td>
<td>0.43</td>
<td>0.43</td>
<td>0.43</td>
<td>0.43</td>
</tr>
<tr>
<td>Synvax</td>
<td>0.03</td>
<td>0.73</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Conclusions

- All PCV2 vaccines are likely associated with increased ADG from wean to finish in swine.
- The Synvax® PCV / Fostera product was associated with the lowest estimate of ADG and the greatest uncertainty.
- Few differences between the Circumvent® PCV and Ingelvac® CircoFLEX® products with respect to ADG from wean to finish.
- Base on ranking information Control group is the worst treatment and Circumvent® PCV and Ingelvac® CircoFLEX® are in the first or second place.
- Based on equivalence test Ingelvac® CircoFLEX® have a 0.95 of probability of being equivalent for a tolerance of 12 grams per day. All the treatments are equivalent with a probability of 1 for tolerance levels bigger than 40 grams per day.