Quantification of porcine circovirus type 2 (PCV2) transmission in pigs.

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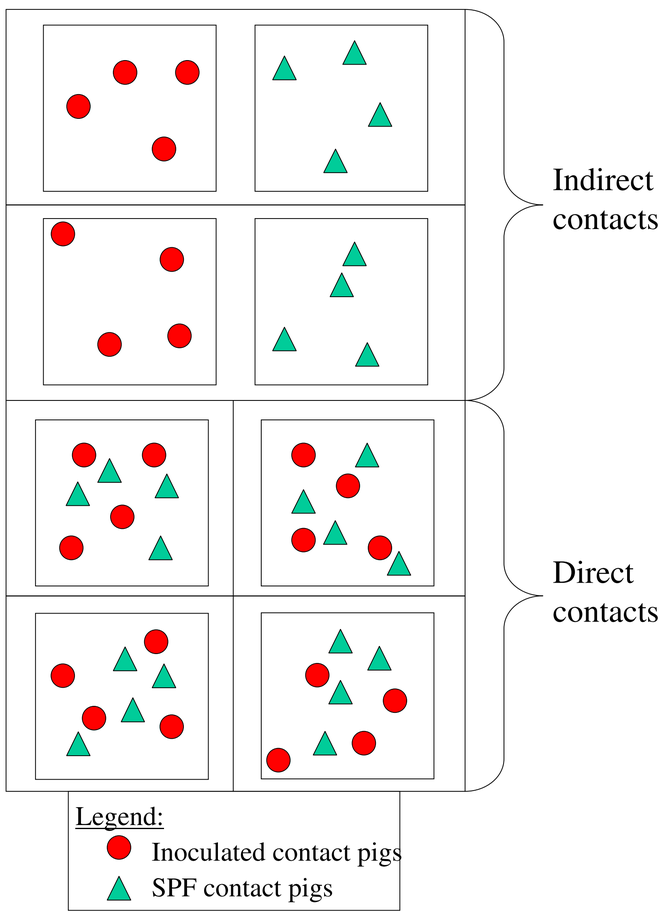
Objectives

- Estimation of epidemiological parameters to assess within- and between-pen transmission of PCV2 using experimental data:
  - ✓ Transmission rate parameters (β_w, β_b)
  - ✓ Basic Reproduction Ratios (R_0)
- Test the effect of different assumptions on the end of infectiousness:
  - ✓ Seroconversion (A1)
  - ✓ Seroconversion and decline in genome load (A2)
  - ✓ Permanent infectiousness (A3)

Material and methods

⇨ Experimental design



⇨ Estimation of transmission parameters

Method adapted from Klinkenberg *et al.*(2002) : Maximum likelihood method

Hypothesis:
- ✓Classic SEIR model
- ✓Fixed duration of latency period (6 days)
- ✓Three assumptions on the termination of infectiousness (A1, A2, A3)

➢ R_0 expression

Classic SEIR model $\Rightarrow R_0 = \frac{\beta}{\sigma}$

σ: inverse of the mean duration of the infectious period

➢ Estimation of σ

Regression for parametric survival model (function *Survreg in R software*)

➢ Transmission rate parameters

✓β_w, β_b: within- and between-pen transmission rates

✓π_w, π_b: within- and between-pen proportion of infectious animals

✓Probability to escape from infection between two sampling days

$$q = \exp\left(-d\left(\beta_w \pi_w + \beta_b \pi_b\right)\right)$$

- ✓ The number of new cases follows a binomial distribution *Bin(8,1-q_i)*
- ✓ Log-Likelihood expression

$$\sum_i \left[C_i \log\left(e^{d_i\left(\beta_w \pi_w^i + \beta_b \pi_b^i\right)} - 1 \right) - S_i\left(d_i\left(\beta_w \pi_w^i + \beta_b \pi_b^i\right)\right)\right]$$

where *i* represented the i^{th} sampling day and d_i the time interval.

Results

➢ Course of infection

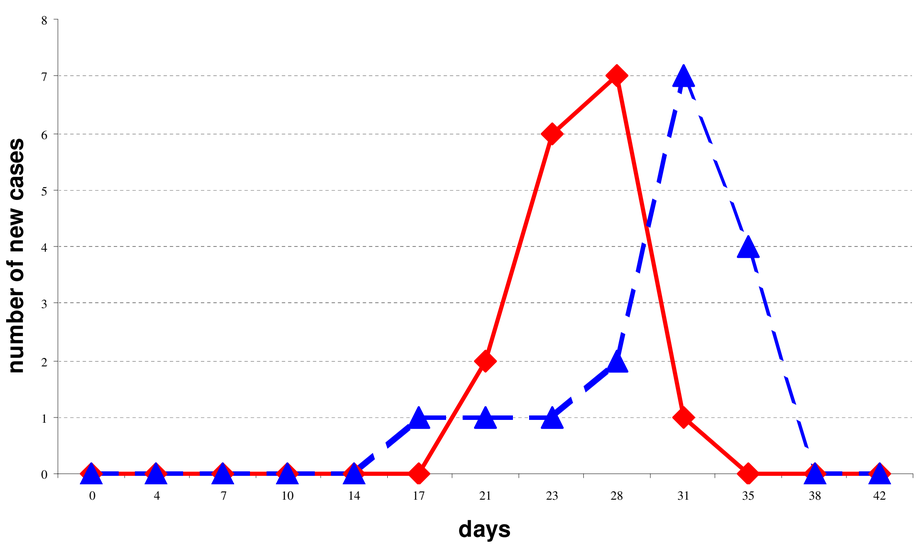


Figure 1.
Number of new infections (quantitative PCR in sera) recorded at each sampling day (dashed blue line : indirect contact pigs, red line: direct contact pigs)

➢ Within-pen parameter estimates

	Assumption 1	Assumption 2	Assumption 3
β	0.31 [0.20-0.45]	0.28 [0.18-0.42]	0.23 [0.14-0.36]
σ	0.06 [0.04-0.08]	0.03 [0.02-0.05]	-
$1/\sigma$	17.7 [13.1-24]	31.7 [22-45.7]	-
R_0	5.5 [3.3-9.0]	8.9 [5.1-15.4]	-

➢ Between-pen parameter estimates

	Assumption 1	Assumption 2	Assumption 3
β	0.03 [0.01-0.08]	0.04 [0.02-0.08]	0.04 [0.02-0.09]
σ	0.06 [0.04-0.08]	0.03 [0.02-0.05]	-
$1/\sigma$	17.7 [13.1-24]	31.7 [22-45.7]	-
R_0	0.58 [0.23-1.47]	1.2 [0.5-2.9]	-

Discussion

The within- and between-pen transmission rate parameters and the mean duration of infectiousness were estimated for three different assumptions on the end of infectiousness. These assumptions modified slightly transmission parameters but largely influenced the basic reproduction ratios estimation by increasing the mean duration of the infectious period. Whatever the assumption, the difference between within- and between pen was always significant.

This point suggests that the contact structure affects transmission of PCV2 and that the slower spread between pens should be taken into account in a modelling approach of the within-herd dynamics of infection. Hence, segregating pigs from different infectious status in different pens might be efficient to postpone infections to a later stage when pigs are less likely to be affected by PMWS, the disease related to PCV2 infection.

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