GOOD CORRELATION BETWEEN VACCINE MATCH IN POTENCY TESTS AND r_1-VALUE

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Objective

- How should we interpret r_1-values
- Is the current traffic light reporting adequate?

- No we should take vaccine quality into account

South-America

- Old vaccine strains
  - O_1 Campos Br/58
  - A_{24} Cruzeiro Br/55
- Cross-protection against newly evolved isolates

  Duque, H., Naranjo, J., Carrillo, C., Burbano, A., Vargas, J., Pauszek, L., Olesen, I., Sanchez-Vazquez, M. J., Cosivi, O., Allende, R. M. 2016. Protection induced by a commercial bivalent vaccine against Foot-and-Mouth Disease 2010 field virus from Ecuador. Vaccine 34(35); 4140-4144.
- Cross-protection against strains from another continent

  Galdo Novo, S., Malirat, V., Maradei, E. D., Pedemonte, A. R., Espinoza, A. M., Smitsaart, E., Lee, K. N., Park, J. H., Bergmann, I. E. 2018. Efficacy of a high quality O1/Campos foot-and-mouth disease vaccine upon challenge with a heterologous Korean O Mya98 lineage virus in pigs. Vaccine 36(12); 1570-1576.

Type A good protection even with low r_1-value

Virus / Vaccine	A 22 Irak	A 24 Cruzeiro	A Iran 96	A Iran 99
A 22 Irak	>32 PD_{50}	3 PD_{50}	r1 = 0.09 6 PD_{50}	r1 = 0.04 4 PD_{50}
A 24 Cruzeiro	n.d.	14 PD_{50}	n.d.	n.d.
A Iran 96	r1 = 0.1 2 PD_{50} 8 PD_{50}	n.d.	>32 PD_{50}	r1 = 0.12 11 PD_{50}
A Iran 99	r1 = 0.1 14 PD_{50}	n.d.	r1 = 0.23 19 PD_{50}	>32 PD_{50}

A22 vaccine – A Egypt 06: 11 PD_{50}

Cross-protection

- Good vaccine should provide cross-protection
- Test for cross-protection
  - Potency test with homologous challenge (serology?)
  - Potency test with heterologous challenge

Material and methods

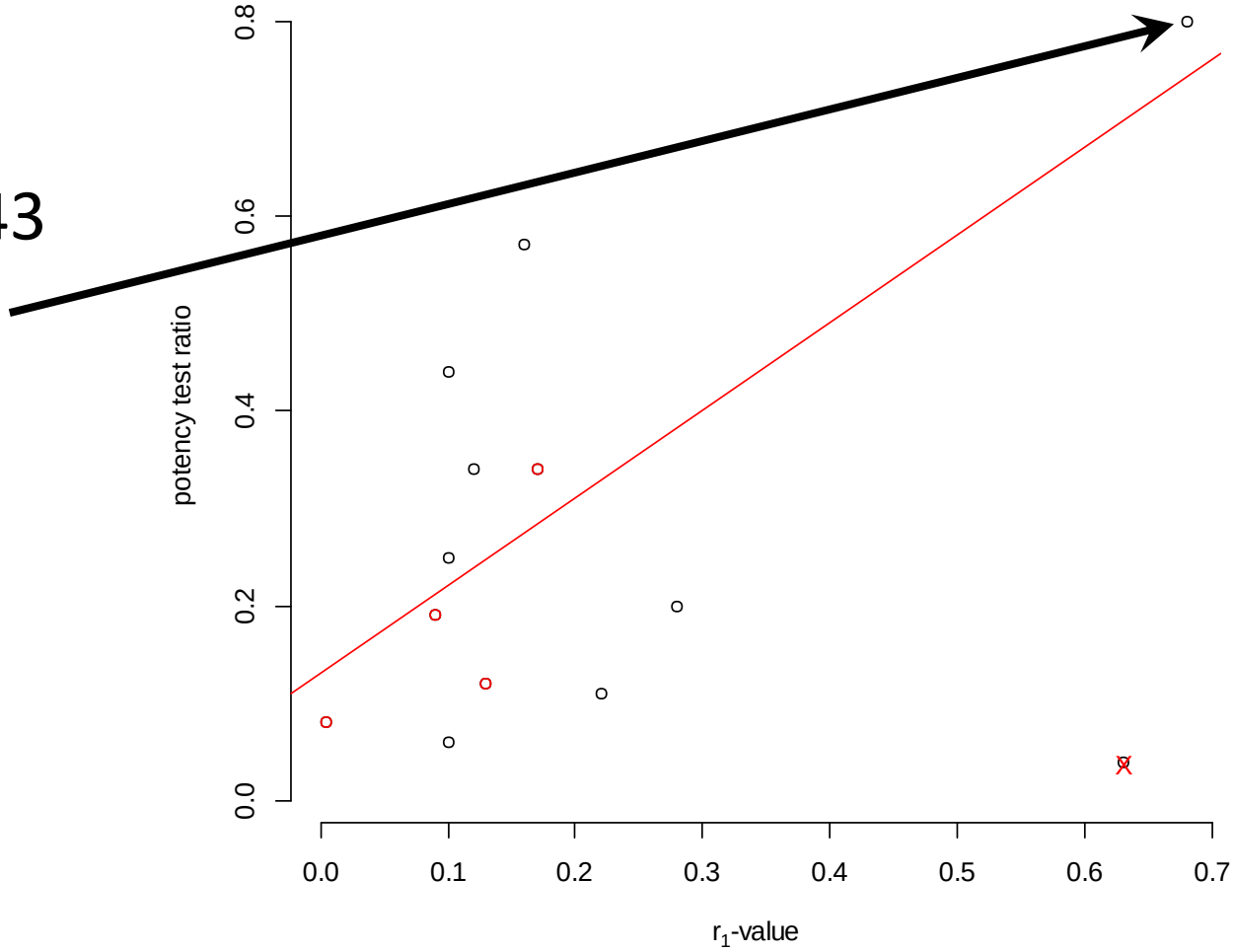
- Literature search on quantitative cross-protection studies
- Calculate potency ratio
- $$\text{Potency ratio} = \frac{\text{Heterologous potency}}{\text{Homologous potency}}$$
- Average and 95% CI of the r_1-values from same topotype (TPI)

Results

- Scopus search resulted in 53 papers of which 5 were valid
- 3 additional studies found
- Several experiments with homologous potency >32 PD_{50}/dose
- One study reported the antigen amount needed for 1 PD_{50}, not the volume (excluded from the regression)
- Not all combinations of vaccine and field strain tested at TPI

Good relation potency ratio r_1-value

- p = 0.01
- Slope 0.9
- R-squared = 0.43
- High leverage



More studies are needed
Include strains with r_1-value = 1?

Serotype	species	Vaccine strain	Challenge strain	Potency ratio	r_1-value	95% CI	
A	Pig	A/WH/CHA/09	A/GDMM/CHA/2013	0.8	0.68	NA	NA
O	Cattle	O Manisa	O Campos	0.04	0.63		
A	Cattle	A_{22} IRQ	A Iran 96	<0.19	0.09	0.06	0.15
A	Cattle	A_{22} IRQ	A Egypt 06	<0.34	0.17	0.04	0.70
A	Cattle	A_{22} IRQ	A Iran 99	<0.12	0.13	NA	NA
A	Cattle	A_{22} IRQ	A_{24} Cruziero	<0.08	0.004	0.000	0.043
A	Cattle	A Iran 99	A_{22} IRQ	<0.44	0.1	NA	NA
A	Cattle	A Iran 99	A Iran 96	<0.57	0.16	NA	NA
A	Cattle	A Iran 96	A_{22} IRQ	<0.06	0.1	NA	NA
A	Cattle	A Iran 96	A_{22} IRQ	<0.25	0.1	NA	NA
A	Cattle	A Iran 96	A Iran 99	<0.34	0.12	NA	NA
O	Cattle	O Manisa	O/ALG/3/2014	0.2	0.28	0.09	0.87
A	Cattle	A MAY/97	A IRN 22/2015	ND	0.19	0.12	0.30
SAT2	Cattle	SAT2 SAU/00	SAT2 BOT	0.01	ND	NA	NA
SAT2	Cattle	SAT2 SAU/00	SAT2 LIB/40/2012	0.11	0.22	NA	NA

Consequences

- 3 PD_{50}/dose against the outbreak strain is sufficient
- If r_1-value is 0.1 ➔ potency ratio is 0.22
- Vaccine should have a homologous potency of:

  > 14 PD_{50}/dose

Conclusion

- r_1-values correlate with protection
- Can we reduce variation in r_1-value?

- Advise on vaccine strain should take vaccine quality into account