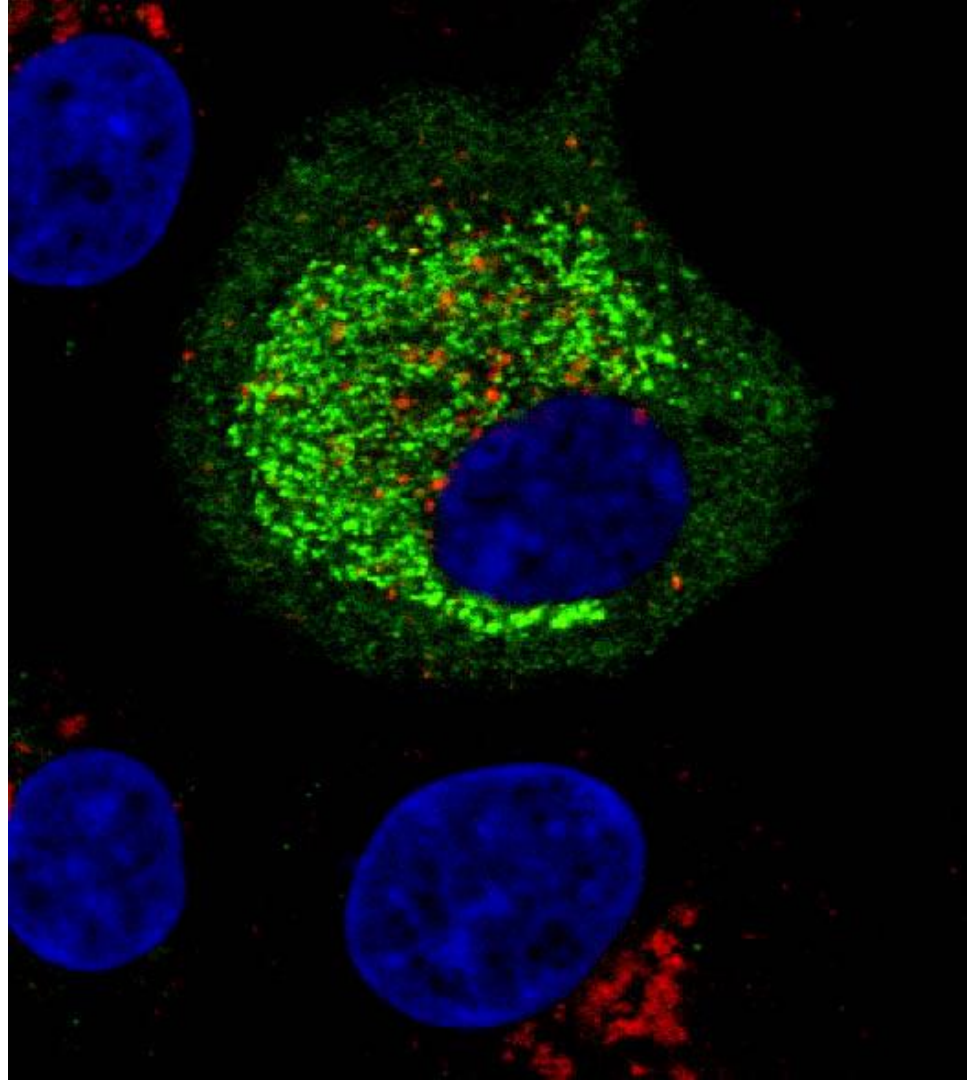




Foot-and-Mouth disease and One Health: application of tools developed for animal health to a global pandemic

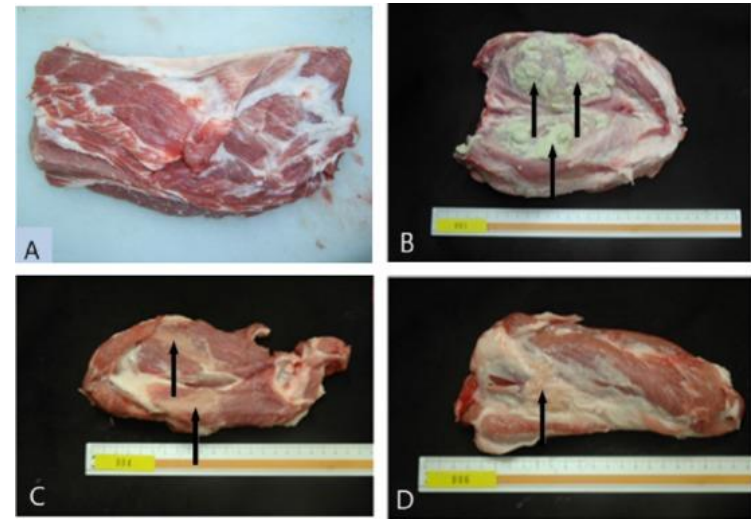
Wilna Vosloo | 18 March 2022



New approaches to vaccinate pigs

- Pigs respond poorly to the current FMD vaccines administered intramuscularly (IM)
 - Pigs do not develop sufficient antibody titres
 - Poor correlation between antibody titres and protection
- Concerns with carcass quality (abscess and granuloma on site of inoculation)

- Low antigen dose and dose volume could reduce cost of vaccine and vaccination



(Ko et al 2018)

Pilot study to compare vaccination routes

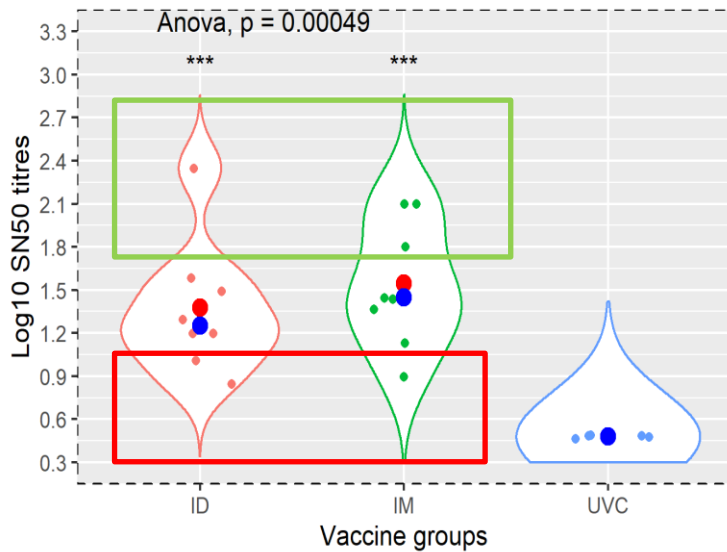
- Aim: to compare the immune response between IM and ID vaccination
 - Traditional serological readout: serology by VNT
 - Systems immunology: based on transcriptomics using RNAseq data



Antibody responses (VNT)

A Malaysia 97 titres

route  ID  IM  UVC

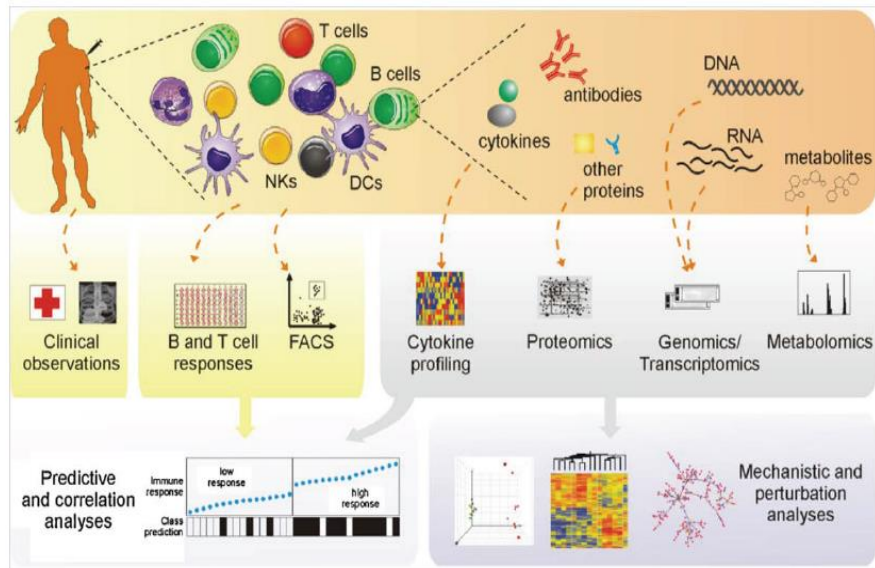


Why Systems Immunology?

“The whole is **greater than** the **sum** of its **parts**”*



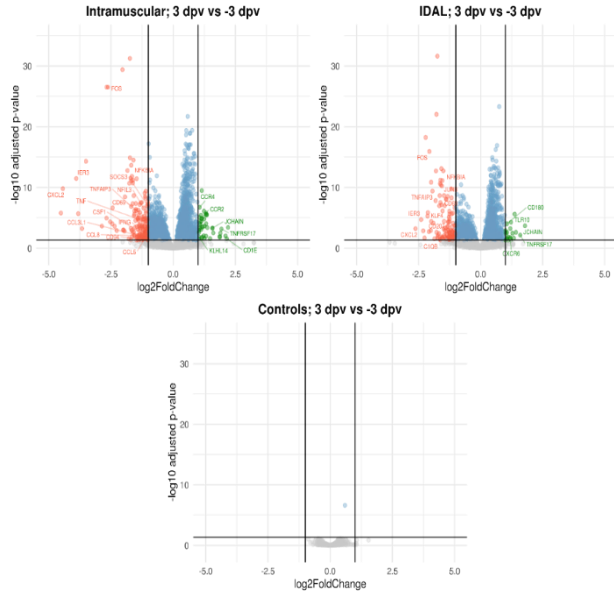
Clinical observation
Virology readouts
Serological response
CMI response



‘Multi-omics’
approaches

- Holistic approach to understand complex biological systems.
- Application of computational and mathematical modelling.

Differential gene expression analysis



Volcano plots showing differential expression of genes

- Grey circles – No change
- Blue circles – Significant ($\text{padj} \leq 0.05$) but not \log_2 Fold change
- Red circles – Significant ($\text{padj} \leq 0.05$) and $-\log_2$ Fold change
- Green circles – Significant ($\text{padj} \leq 0.05$) and $+\log_2$ Fold change



And then SARS-CoV2 emerged!

- Five projects where this capability could be applied
 - Efficacy of SARS-CoV-2 vaccine candidates in ferrets
 - Immunogenicity of Inovio SARS-CoV-2 vaccine candidates in ferrets
 - Gobata 1.0: Systems biology approach to study after-effects of COVID-10
 - sySTEMS initiative - Selection of human stem cell derived tissue models for screening approved drug molecules and repurposing for COVID-19 therapy
 - Strengthening COVID-19 animal models and regulatory science using a systems biology approach

Outcomes of Systems Immunology approach



Dissect impact of vaccine components on the immune system and thereby help to identify improved delivery systems and immunostimulants



Identify innate correlates and biomarkers of good vaccines to improve formulations and select optimal immunostimulants



Identification of pathways responsible for the heterogeneity in vaccine responses (impact of age, nutrition, stress, genetics)



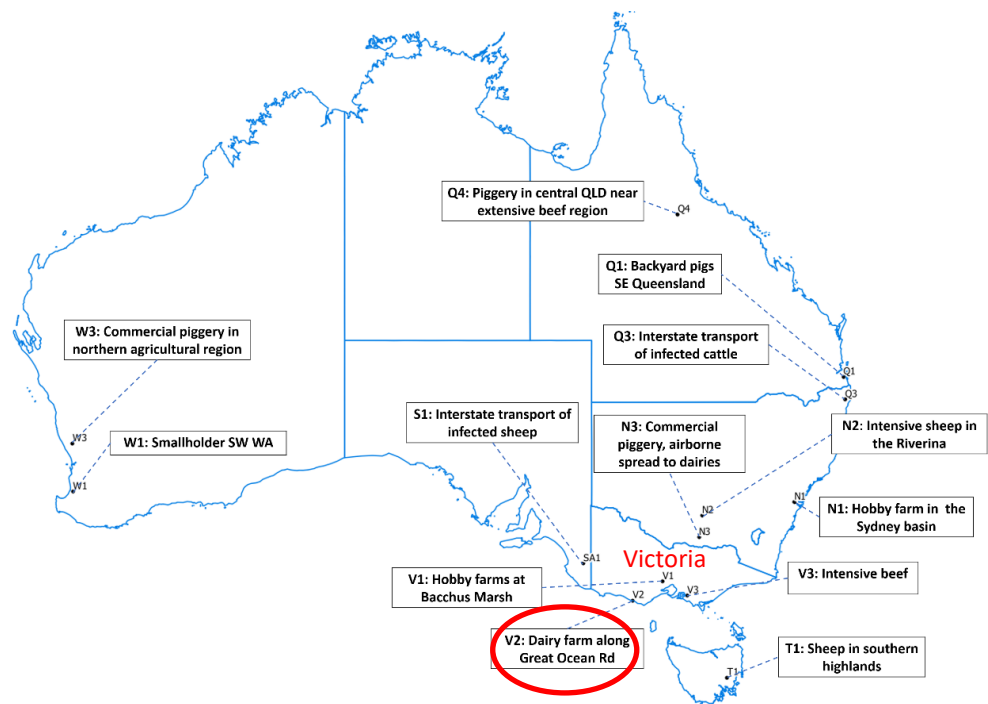
Identifying biomarkers of unwanted responses including pathogen mediated immunomodulation



Using modelling to prepare for outbreaks

Comparing surveillance approaches for regaining FMD free status

- Post outbreak surveillance is required to provide assurance infection has been eradicated
- Used a simulated outbreak (AADIS) to compare sero-surveillance with novel bulk tests
 - Bulk milk testing (BMT)
 - Saliva collection
 - Swabs
 - Rope tethers
- Control options for simulated outbreak
 - Stamping out with no vaccination
 - Stamping out with vaccination
 - Vaccinates removed
 - Vaccinates retained





Conclusion

- Alternate approaches based on non-invasive sampling methods and qRT-PCR tests - potential to enable post outbreak surveillance to be done more quickly and less expensively than traditional approaches based on serological surveys
- Increase the sensitivity and specificity of the post-outbreak surveillance
- Needs to be 'validated' with more modelled scenarios and in real outbreak situation

Garner et al doi: [10.1016/j.prevetmed.2021](https://doi.org/10.1016/j.prevetmed.2021)



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FMD READY PROJECT

PROJECT PARTNERS

