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# Interlaboratory diagnostic test evaluation using Bayesian latent class models

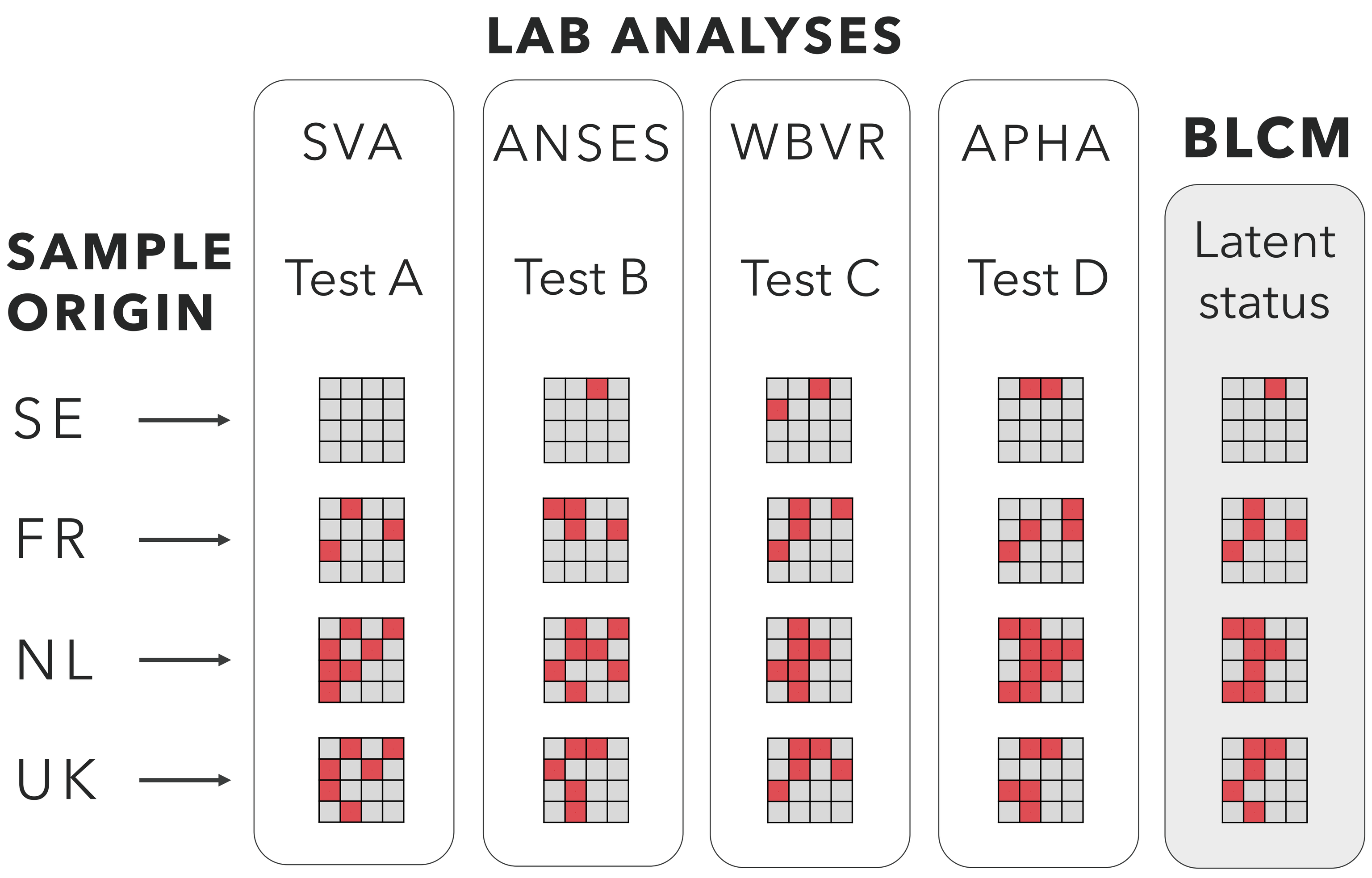
Knowing diagnostic test accuracy is essential when using test results to infer the presence, prevalence, or absence of a disease in a population

## AIM

Proof of concept for cost-effective diagnostic test evaluation

## CHALLENGES → SOLUTIONS

- Lack of gold standard test → Bayesian latent class models
- Lack of positive samples → Samples from multiple countries
- Budget constraints → Inter-laboratory evaluation




The Bayesian latent class model (BLCM) combines the test results in each population and infers the most likely *true* value for each sample, i.e. the *latent status*.

## CASE STUDIES

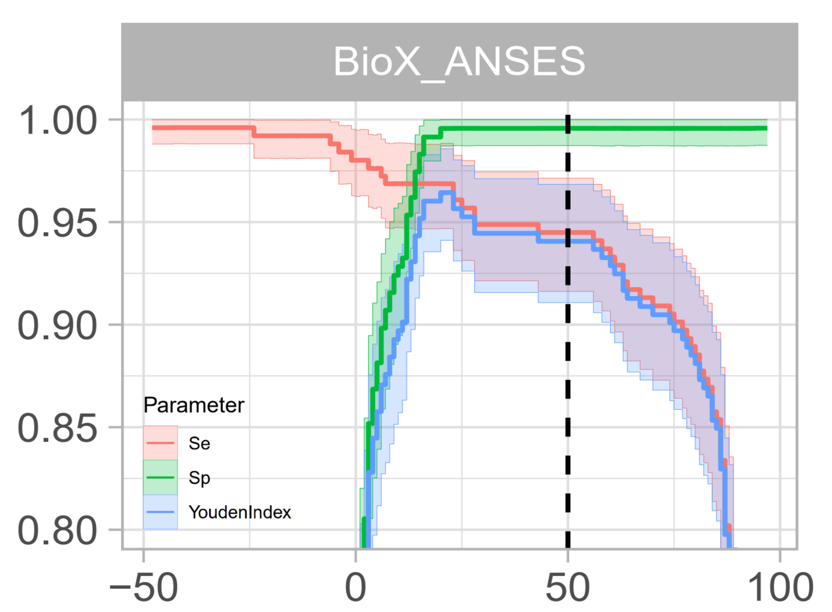
Serological detection of **BVD** & **IBR**

- **2** diseases
- **4** countries
- **4** laboratories
- **6** epidemiologists
- **6** laboratory experts
- **7** serological tests for IBR
- **8** serological tests for BVD
- **1000** samples analysed in total

## STUDY DESIGN

- Sample sharing between labs
- Each lab applied their own routine diagnostic test(s)
- Joint data analysis using BLCM

Example of ROC curve




Example of population-specific estimates (Svanovir_SVA)

| Population | Median specificity | Credible interval |
|---|---|---|
| SE | 0.995 | [0.977 - 1.000] |
| NL | 0.345 | [0.198 - 0.509] |
| UK | 0.916 | [0.780 - 0.997] |
| FR | 0.988 | [0.948 - 1.000] |
| Combined | 0.903 | [0.863 - 0.938] |

## OUTCOMES

- Diagnostic sensitivity and specificity of ELISA tests for detection of Bovine Viral Diarrhoea (BVD) and Infectious Bovine Rhinotracheitis (IBR)
- Population-specific accuracy and ROC curves for cut-off optimization
- R code for inter-laboratory diagnostic test evaluation using BLCM:
  - → algorithm for **optimal sample allocation** among populations
  - → methods for **assessing the empirical fit** of Hui-Walter models
  - → **post hoc accuracy estimates** for tests that were excluded from the model

## CONCLUSIONS

- Cost-effective approach to diagnostic test evaluation
  → especially valuable for routine diagnostics
- Useful insights for the labs and tools for test optimization
- Applying several tests entails:
  - 👎 correlations that increase model complexity
  - 👍 possibility to remove tests and get post hoc estimates
- Requires deep understanding of tests, populations and underlying latent status

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