Selection Matters: Sensitivities Of Bayesian Latent Class Model Outputs

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Bayesian latent class models (BLCMs) are commonly used to estimate the diagnostic accuracy of tests without requiring a reference standard, avoiding bias from reference standard inaccuracy (Cheung et al., 2021). However, model outputs are highly sensitive to the assumptions proposed originally by Hui and Walter (1980), particularly that i) diagnostic tests have the same performance in all populations, regardless of the prevalence of the target condition, and ii) included tests are conditionally independent on the modelled latent variable. In reality, the prevalence of the target condition may influence the spectrum of infection, and the assumption of constant test performance is unlikely to be true. Additionally, the (often implicitly defined) latent variable actually modelled is often different to the investigator's target condition, potentially affecting the interpretation of model outputs.

To highlight and investigate the impact of these issues, we performed multiple BLCMs of canine heartworm point-of-care (POC) and microfilarial tests collected from a heartworm hyperendemic population. Our goal was to assess the impact of i) prevalence and ii) latent class selection on the apparent test performance.

We found a substantial difference to model outputs based on BLCM structure. Diagnostic accuracy was overestimated when the latent variable was different to the target condition, and test performance was prevalence dependent. This highlights the importance of a deep understanding of the target condition and tests included when designing and implementing these models to ensure findings can be accurately interpreted for diagnostic decision making.

Cheung, A., Dufour, S., Jones, G., Kostoulas, P., Stevenson, M.A., Singanallur, N.B., Firestone, S.M., 2021. Bayesian latent class analysis when the reference test is imperfect. Rev Sci Tech 40, 271-286.

Hui, S.L., Walter, S.D., 1980. Estimating the Error Rates of Diagnostic Tests. Biometrics 36, 167-171.