

# Evaluation of two herd-level diagnostic tests for *Streptococcus agalactiae* using a latent class approach



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## Background

- *Streptococcus agalactiae* (*S. agalactiae*) continues to pose a significant economic threat to the dairy industry.
- The Danish annual surveillance programme for this pathogen initially based only on bacteriological culture of bulk tank milk (BTM) samples has recently incorporated the use of a real-time PathoProof Mastitis PCR assay with the goal of improving detection of infected herds.
- In the absence of reasonable reference standards, latent class analysis offers an invaluable option for the estimation of sensitivity ( $Se$ ) and specificity ( $Sp$ ) of tests.
- Availability of herd-level covariate data allows computation of stratum-specific estimates of  $Se$  and  $Sp$  in non-homogeneous populations.

## Objective

- To estimate the herd  $Se$  and  $Sp$  of BTM bacteriological culture and the real-time PathoProof PCR (at cycle threshold cut-off values 31, 33, 35, 37 and 40) using latent class models in a Bayesian analysis while evaluating the effect of herd-level covariates on the  $Se$  and  $Sp$  of the tests.

## Methods



- For each stratifier, the resulting 8 populations giving 24 df were sufficient to estimate stratum-specific estimates of  $Se$  and  $Sp$  of each test and 8 prevalences.
- Bayesian models with and without the effects of the stratifiers were implemented in OpenBUGS software and subsequently compared using the Deviance Information Criterion (DIC). Model giving the smallest DIC was preferred.

## Results

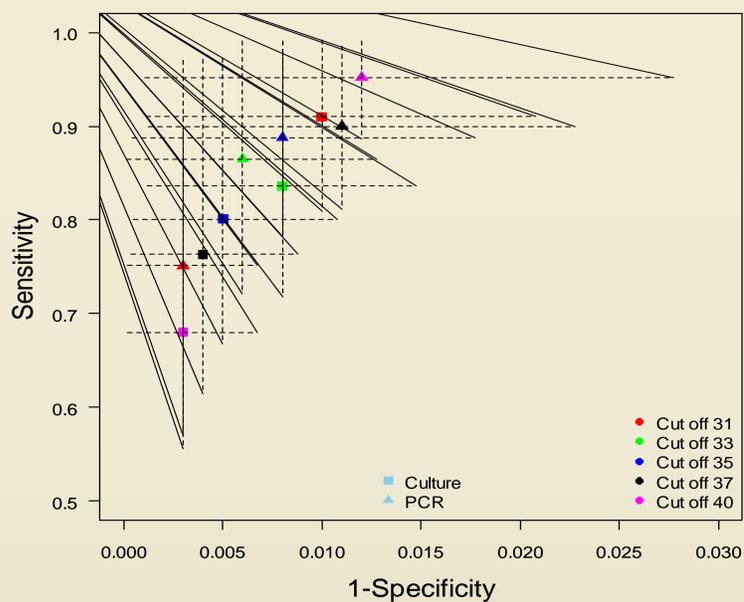


Fig. 1. A plot of the sensitivity and specificity of BTM bacteriological culture and PCR at cycle threshold cut-off value of 40.

- Highest  $Se$  of PCR was realized at a cycle threshold value ( $Ct$ ) of 40
- At this cut-off:

•  $Se_{CUL}$  68.0 (95% PCI 55.1; 90.0);  $Sp_{CUL}$  99.7; (95% PCI 99.3; 100.0)  
 •  $Se_{PCR}$  95.2 (95% PCI 88.2; 99.8);  $Sp_{PCR}$  98.8 (95% PCI 97.2; 99.9)

- No significant differences between stratum-specific test estimates i.e. accuracy of the tests was unaffected by the herd-level covariates.

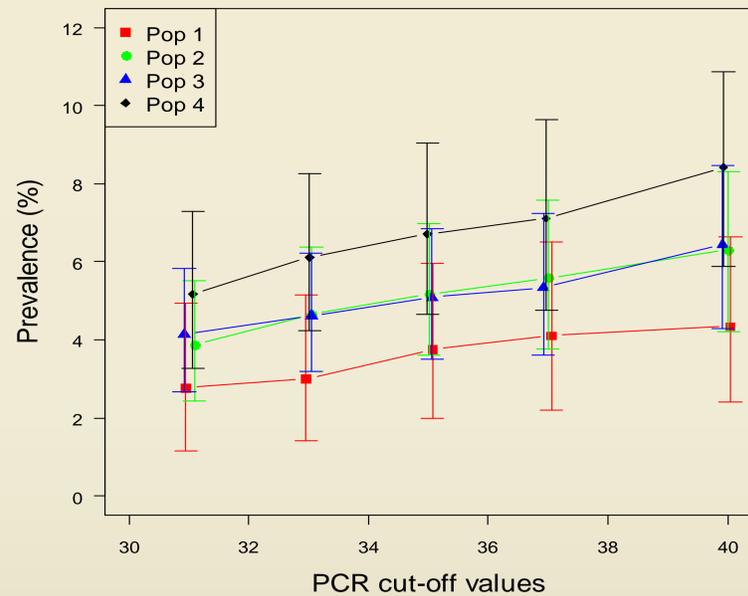


Fig. 2. A plot of the posterior mean prevalence estimates for the four populations at different PCR cut-off values.

- For each population, the prevalence increased with increasing  $Ct$  values reflecting an increasing number of herds with low concentrations of bacteria in BTM

## Conclusions

- We propose that screenings of BTM samples for *S. agalactiae* be based on the PCR assay with  $Ct$  readings of  $<40$  considered as positive.
- However, for higher  $Ct$  values, confirmation of PCR test positive herds by bacteriological culture is advisable especially when the between-herd prevalence of *S. agalactiae* is low.