

## Simultaneously modeling of antigen and antibody information

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Epidemiological field data often contains information on the presence (a) of the parasite (e.g. determined by Polymerase Chain Reaction (PCR)) and (b) of antibodies (e.g. determined by Immuno Fluorescence Antibody Test (IFAT)). In this talk<sup>1</sup>, a mathematical modeling approach is presented which describes the transmission dynamics of tick-borne diseases in horses by simultaneously using antigen and antibody information. The models introduced are compartment-based, accounting for animals with maternal antibodies, susceptible animals, infected animals and animals which have eliminated the parasite. An extension of the model allows for age-dependent infection rates. All models provide a biologically meaningful relationship to the underlying transmission process with parameters which can directly be interpreted. Thus parameter estimates can be compared to results from experimental studies to evaluate their reliability and validity. These comparisons will show that the models provide relevant insights into the epidemiological processes of tick-borne diseases.

For statistical comparison of the models, the maximum likelihood estimation (MLE) method is applied. The empirical distribution function of the test statistics is computed by means of Monte-Carlo simulations. The usefulness of the procedure for comparing models when standard MLE assumptions are violated is demonstrated.

The models are fitted to serological data of domestic horses from a study in Mongolia (Ruegg *et al.* 2007<sup>2</sup>) and consists of PCR and IFAT measurements for the protozoa *Babesia caballi* and *Theileria equi* which cause Equine piroplasmoses and which are transmitted by ticks. Clinical signs of infection may vary from asymptomatic to acute fever, anaemia and dyspnoea, and even lead to death of the horse. For *Babesia caballi*, combining the antigen and antibody information significantly improves the fit whereas for *Theileria equi*, this is not the case. Differences will be pointed by focusing on the likelihood surface.

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<sup>1</sup> *This talk is based on the paper:* S.R. Ruegg\*, D. Heinzmann\*, A.D. Barbour and P. R. Torgerson. Estimating the Transmission Dynamics of *Theileria equi* and *Babesia caballi* in horses, *Parasitology*, to appear

<sup>2</sup> S. R. Ruegg, P. R. Torgerson, P. Deplazes and A. Mathis. (2007). Age-dependent dynamics of *Theileria equi* and *Babesia caballi* infections in southwest Mongolia based on IFAT and/or PCR prevalence data from domestic horses and ticks, *Parasitology*, **134**, 929-947