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A New Method for Estimating Transmission Rates of Mastitis-causing Pathogens

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Background

- Epidemiological **simulation models** can predict effects of **control strategies for mastitis** if they rely on decent data

- The transmission rate controls the **spread of contagious pathogens** between animals in the herd.

- Transmission rates are estimated from **expensive** and **time-consuming** field studies testing all lactating cows repeatedly, often using large sampling intervals.

- **Poisson regression** is often used to estimate the transmission rate, but may perform poorly at large sampling intervals

Methods

- We derived a **new mathematical formula** for estimating the transmission rate. This new method is suitable for systems in equilibrium using the number of susceptible and infected animals directly **without regression analysis**. The new method allows for **multiple infection and recovery events between sampling points**, unlike Poisson regression.

- We used an existing simulation model to simulate transmission of *S. aureus* in a dairy herd using different transmission rates.

- We sampled the lactating cows in the simulated herd with different sampling intervals and **estimated the transmission rate** with traditionally used **Poisson regression (P)** and a **new method (N)**.

- The results were compared to determine whether one method performed **significantly better** than the other.
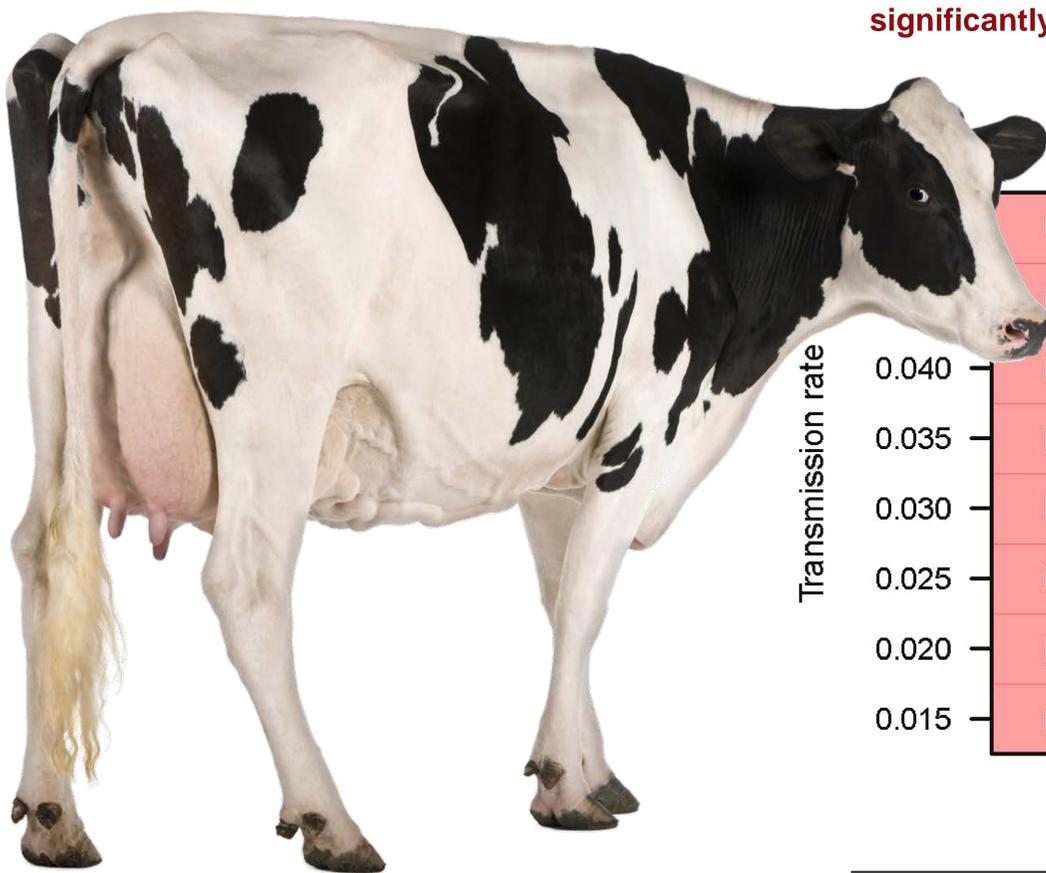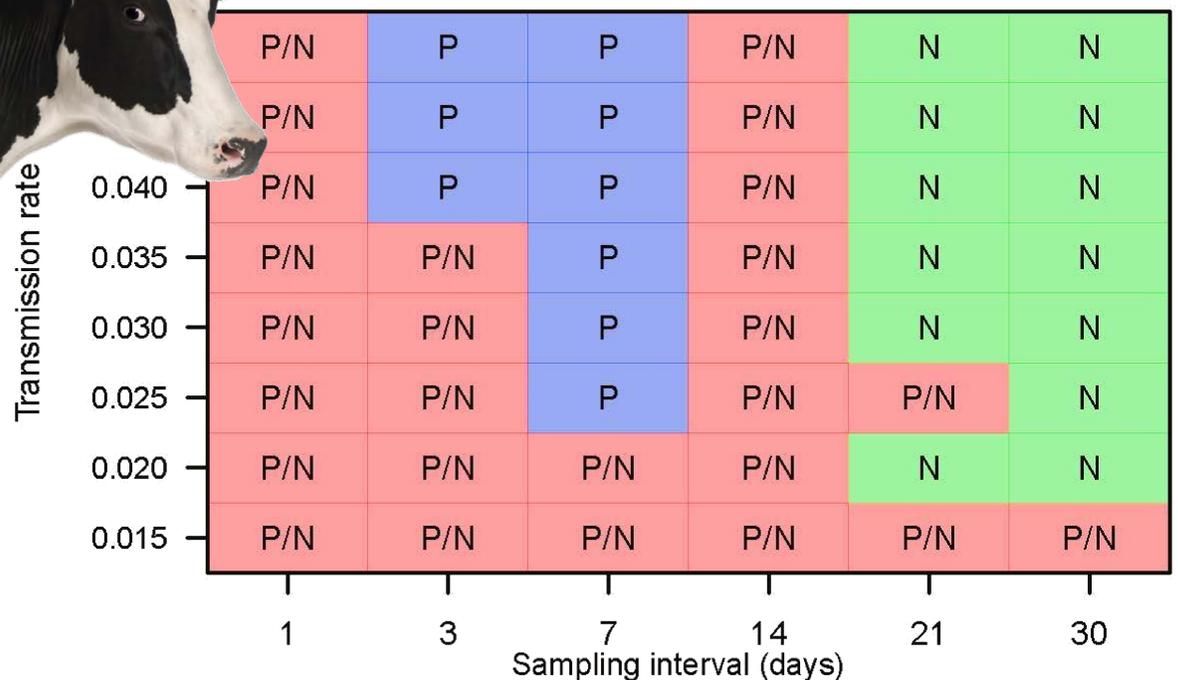
Figure 1: The optimal method for the true transmission rate and sampling interval. Letters show whether Poisson regression (P) or the New method (N) performed significantly better than or equally good as Poisson regression (P/N).

Transmission rate						
	P/N	P	P	P/N	N	N
	P/N	P	P	P/N	N	N
0.040	P/N	P	P	P/N	N	N
0.035	P/N	P/N	P	P/N	N	N
0.030	P/N	P/N	P	P/N	N	N
0.025	P/N	P/N	P	P/N	P/N	N
0.020	P/N	P/N	P/N	P/N	N	N
0.015	P/N	P/N	P/N	P/N	P/N	P/N
Sampling interval (days)	1	3	7	14	21	30

Results

- The new method performed **equally well** to Poisson regression in most of the simulated scenarios, but **both models** showed areas where they were better than the other (Fig. 1).

- The new method proved more suitable for estimating transmission rates when **sampling with large intervals**, which can often be the case in field studies (green area).

Take home message

- We developed a **new method to estimate transmission rates** from field studies of endemic contagious diseases like **mastitis**.

- The new method **performs better** than Poisson regression at **large sampling intervals**.

- **Read more** in Scientific Reports 7, 9496 (2017) doi:10.1038/s41598-017-09209-x

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