Trends in herd-level susceptibility of udder pathogens in bulk milk from Dutch dairy herds

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Why?

Mastitis is the disease condition for which the majority of antimicrobial agents are used in the dairy industry. Justified antimicrobial treatment needs bacteriological culture and antimicrobial susceptibility (AS) tests. In daily practice, however, only a minority of Dutch farmers regularly submit quarter milk samples (Griffioen et al., 2016). Since 2016 a more convenient and practical method for herd-level AS monitoring is available in the Netherlands, which encourages farmers to submit bulk tank samples for bacteriological examination: the dairy antibiogram.

Aim

Assess trends in herd-level susceptibility of udder pathogens in bulk milk samples collected from Dutch dairy herds from 2016 to 2018.

Materials and methods

From 1 January 2016 to 5 December 2018, bulk milk samples were routinely collected for 6 or 10 times per year from dairy farms in the Netherlands that participated in Mastitis Bulktank Optimal or Mastitis Bulktank Basic (Figure 1). Herds must have participated in the dairy antibiogram program (twice yearly, January and July) for at least 2 years and have been positive for at least one (group of) mastitis causing bacteria 3 times to be included for analysis.
After inclusion, a total of 61,222 bulk milk samples from 2,249 herds remained for statistical analysis. Samples were subjected to bacteriological culture and mastitis causing isolates to AS testing using a broth microdilution method, resulting in minimal inhibitory concentrations (MIC) of several antimicrobial agents.

Susceptibility for 16 antimicrobial agents was analyzed for five bacterial groups or species and susceptibility is either reported by the labels susceptible, intermediary resistant and resistant, or by the MIC of the bacteria-antibiotic combination. Labelled data was categorised in two outcomes (susceptible vs. (intermediary) resistant) and analysed with logistic regression to study trends in susceptibility of bacteria for antibiotics over time. Susceptibility of the bacteria (0: no, 1: yes) was the dependent variable and measurement moment (1 to 6), season (winter, spring, summer, autumn) and year (2016, 2017, 2018) were independent variables.
The difference between the MIC from the first and last tested sample of a herd was determined for each bacteria-antibiotic combination per season. For example, the MIC in winter from the first year is compared to the MIC in winter from the last year. The comparison is made this way because season appears to have an effect on bacteria presence and susceptibility, according to literature (Riekerink et al., 2007).

Results

Lots of dynamics was seen in the descriptive analysis of data. Mixed-effects logistic regression on SR-data, with unique, with unique herd number as random effect, suggested that no significant differences in susceptibility over time for the combinations of *S. aureus* with clindamycin, erythromycin, penicillin and streptomycin were present. In most bacteria/antimicrobial-combinations a herd-effect was responsible for unexplained variance.

No significant differences between years and seasons were present for the majority of combinations. Coliforms and *Klebsiella* only showed some trends in sensitivity dynamics during summer. A significant difference in sensitivity was present in 2018 (OR=5.37, 95%CI= 1.57-18.34, p=0.008) compared to 2016 for coliforms - ampicillin. A significant increase (OR=2.75, 95%CI= 1.30-5.80, p=0.008) in sensitivity was also present in 2018 compared to 2017 for this combination. No other combinations of coliforms and an antibiotic showed a significant difference.

Conclusions

- AS testing of bacterial isolates from bulk milk samples every six months is a valid tool for herd-level AS monitoring of the most prevalent udder pathogens, supporting the development of herd-level mastitis treatment plans;
- More research is desired, specifically with respect to the relationship with udder health related antimicrobial use and and total antimicrobial use;
- The use of AS testing on bulk milk samples is associated with multiple trends from which the direction differs per bacterial species or group of species;

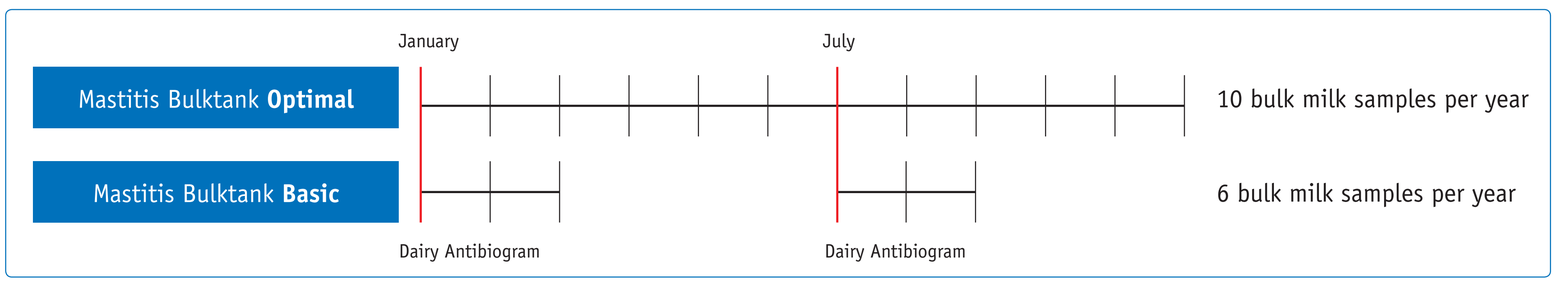

Figure 1. Schematic overview of two options for the Mastitis Bulktank Program with Dairy Antibiogram

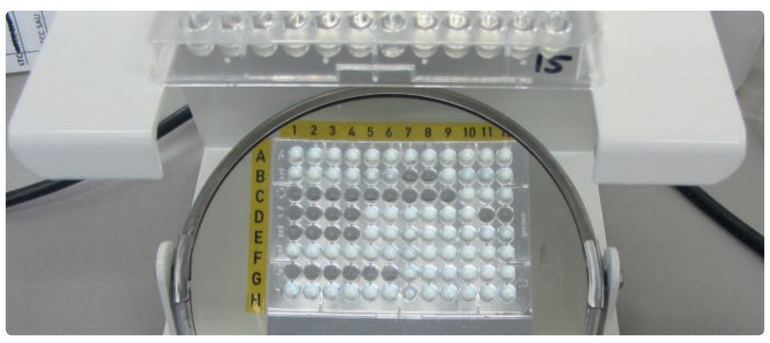

Figure 2. Minimum inhibitory concentration testing

Figure 3. Bulk Tank Milk sampling

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