Dry-off treatment of dairy-cows
Methods to guide targeted antimicrobial use

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Objectives

Development of a personalised **drying-off strategy** for **individual dairy farms**.

Minimisation of antibiotic use without negatively affecting udder health.

Development of targeted **„Decision Support Tools“** to enable implementation of cow-specific drying off strategy.

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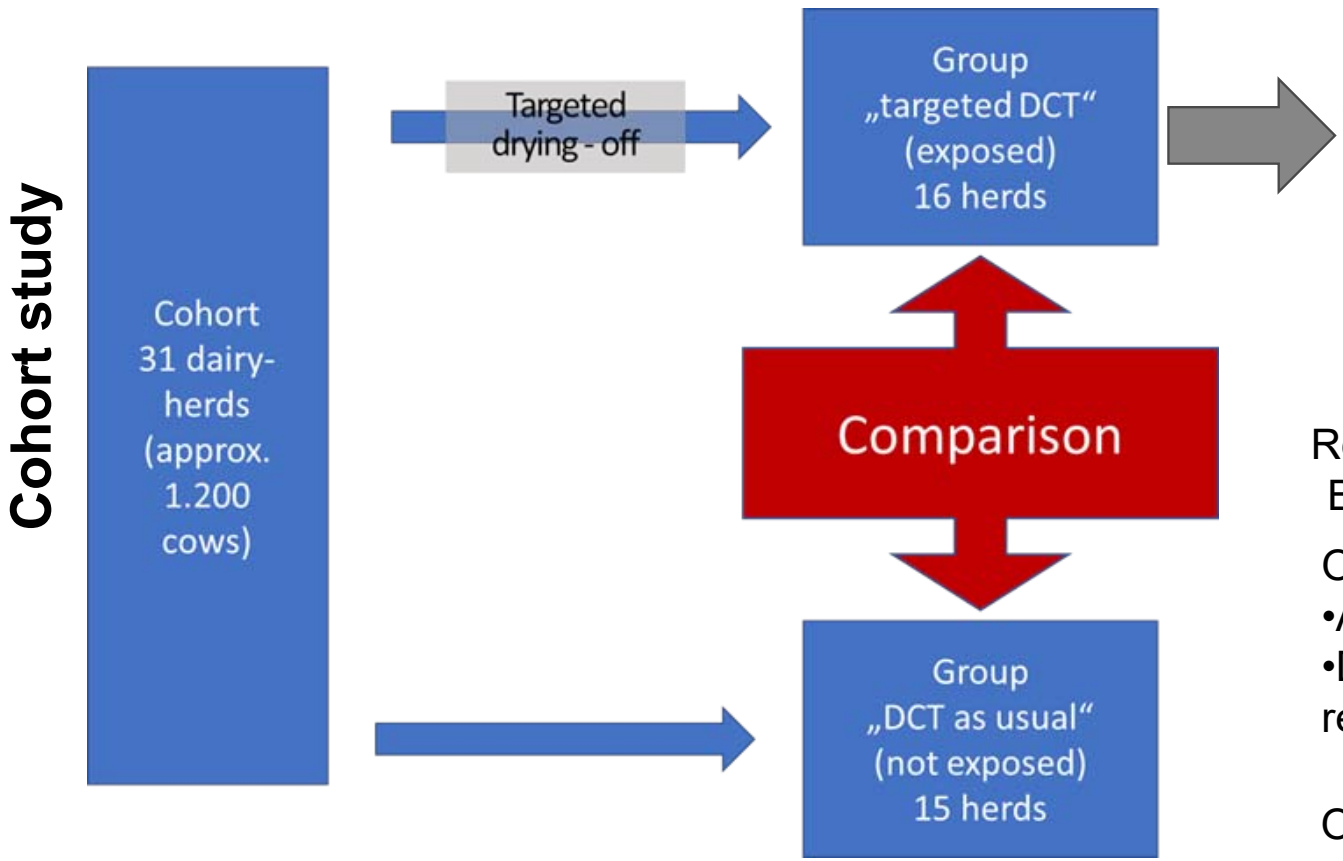

Criteria:
- Calculated weighted somatic cell count of the total herd
- Individual cow somatic cell count (ICSSC), last two milk recordings
- Primiparous, multiparous
- Mastitis events in an individual cow

Recommendation Biggs et al. 2016

Outcome:
- Antimicrobial dry cow therapy (aDCT)
- Drying off without antibiotic - teat sealant recommended

Oct. 1st 2019 – March 31st 2021

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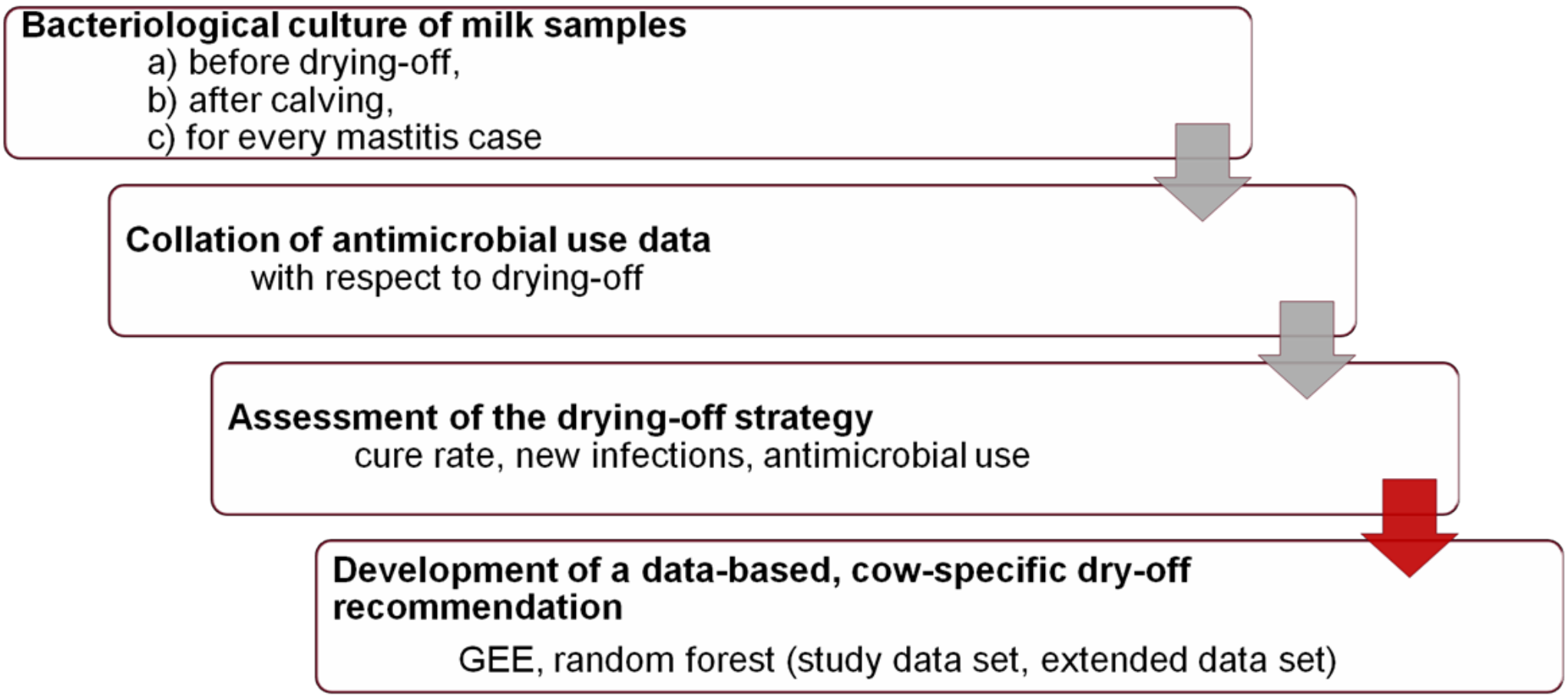

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Cohort study, CASE herds: targeted antimicrobial dry cow therapy (ADCT)

Weighted SCC of the total herd x 10^3 cells / ml	ICSCC- threshold x 10^3 cells / ml Multiparous cows	ICSCC- threshold x 10^3 cells / ml Primiparous cows
< 100	250	200
100 - 150	200	150
150 - 200	150	100
200 - 250	100	50
> 250	Targeted ADCT may not be appropriate!	

Biggs et al., 2016: Antibiotic dry cow therapy: where next? Veterinary Record **178**, 93–94.

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Cohort study – results

- Bacteriological examination of milk samples before drying-off (detection of bacteria by culture)
  - Detection of MAJOR- / MINOR-pathogens
  - Factors associated with the detection of pathogens
- Evaluation of the drying-off strategy
  - Cure rates, new infection rates
  - Antimicrobial use

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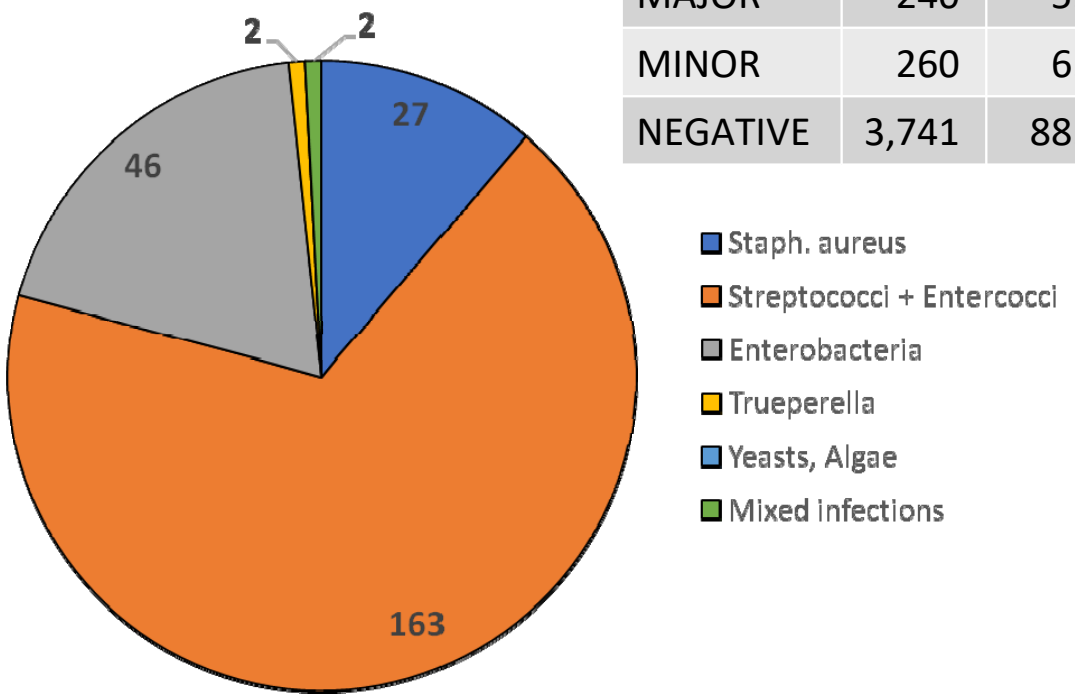
Detection of bacteria by culture before drying off (quarter milk samples)

Species	N
Staph. aureus	27
Streptococci + Enterococci	163
Enterobacteria	46
Trueperella spp.	2
Mixed infections	2
MINOR pathogens*	260
Negative, contaminated	3,741
	4,241

*Coagulase negative Staphylococci + Corynebacteria



Pathogens	N	%
MAJOR	240	5.7
MINOR	260	6.1
NEGATIVE	3,741	88.2

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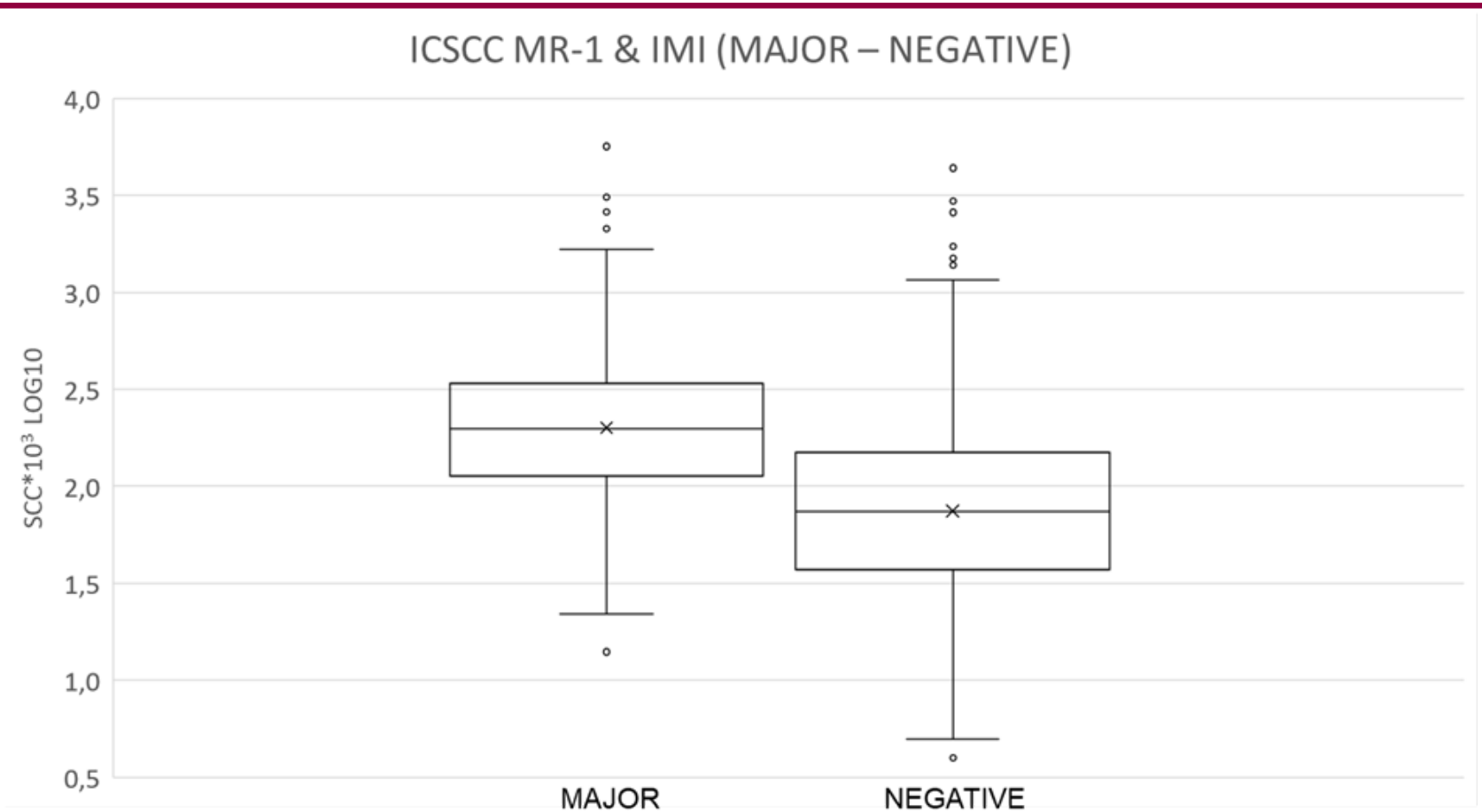

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Evaluation of the drying-off strategy: cure rates, new infection rates

			Dry cow therapy				CASE				CONTROL			
Status of infection	**Total**		**AM**		**No AM**		AM		no AM		AM		no AM	
No infection	404	58%	215	50%	189*	73%	80	47%	107	75%	135	51%	82	70%
New infection	89	13%	47	11%	42	16%	22	13%	24	17%	25	9%	18	15%
Cure	171	25%	146*	34%	25	10%	58	34%	10	7%	88	33%	15	13%
Persistently infected	30	4%	26	6%	4	2%	10	6%	2	1%	16	6%	2	2%
	694	100%	434	100%	260	100%	170	100%	143	100%	264	100%	117	100%

* significant Pearson´s Chi-squared test

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Evaluation of the drying-off strategy: antimicrobial usage (AM-DCT)

- **Formula to calculate antimicrobial usage for dry-off therapy**

$$\#\,TD_{365}DCT = \sum_{i=1}^{n} \frac{\#\,UD/udder\ (route\ intramam - DC)\ in\ period\ P}{\#\,cow \cdot days\ in\ period\ P\ (days)} \times 365 \times \frac{calving\ interval^{1}\ in\ period\ P\ (herd,\ days)}{365} \times \left(1 + \frac{\#\,cow\ LN = 1^{2} \cdot days\ in\ period\ P\ (days)}{\#\,cow \cdot days\ in\ period\ P\ (days)}\right)$$

= number of treatment days / cow / year / for aDCT = number of unit doses (UD) per udder given to any cow of a population within 1 year (1 UD = 4 DCDvet = 4 injectors of an antibiotic licensed for intramammary use in dry-cow therapy).

[1]Correction for calving interval
[2]Correction for herd replacement rate (heifers)

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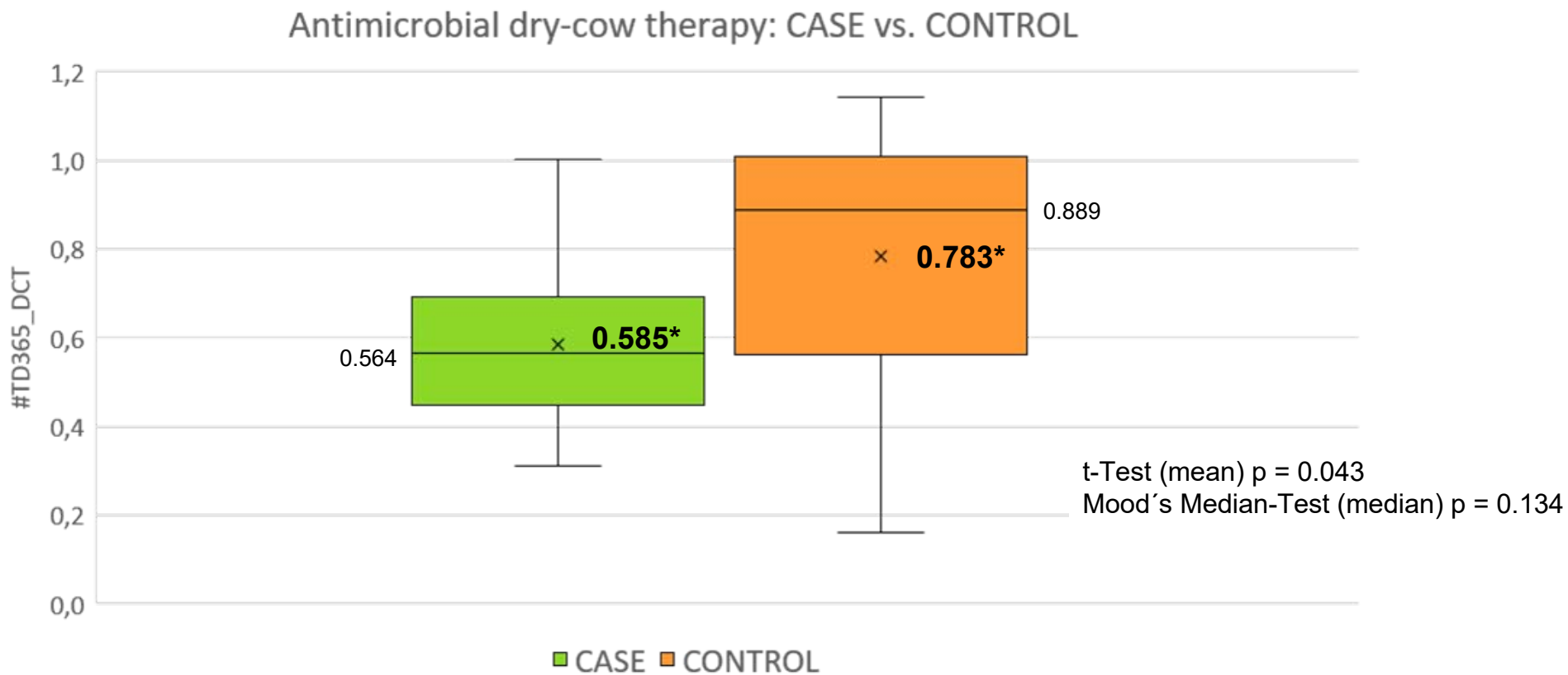
Evaluation of the drying-off strategy: antimicrobial usage (AM-DCT)



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- **Statistical modelling (data-based selection method):**

  Data collected in the cohort study was used to model the result of bacteriological milk testing at drying off (binary result (major / negative) as target variable).

  – Expert-knowledge based method (Biggs et al., 2016)
    - o ICSCC, SCC-herd, lactation (1, >1)

  – Prediction models:
    - – GEE (Generalized Estimating Equations) model
    - – Random forest model (Breiman, 2001)
      - o ICSCC, SCC-herd, lactation, mastitis diagnosis, milk performance recordings, recordings from health monitoring program

  Comparison of the two data-based approaches with the expert-knowledge based method
    - – Field study recommendations were evaluated for the same test set
    - – Performance measures: accuracy, sensitivity, specificity, and f1-Score

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Comparison of predictions for a positive result of bacteriological milk tests before drying off for the D4Dairy data set (121 observations)

	Recommended ADCT (Biggs et al. 2016)	Generalized Estimating Equations*	Random Forest
Accuracy	0.752	0.719	**0.876**
Sensitivity	0.652	**0.739**	0.565
Specificity	0.776	0.714	**0.949**
F1-Score	0.500	0.500	**0.634**

* A cut-off value of 0.19 was used to classify the GEE prediction into positive bacteriological milk cultures or negative tests. This was determined using an ROC analysis.

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Comparison of predictions for a positive result of bacteriological milk tests before drying off for the extended data set (2 838 observations)

	Recommended ADCT (Biggs et al. 2016)	Random Forest
Accuracy	0.645	**0.700**
Sensitivity	0.593	0.519
Specificity	0.681	**0.827**
F1-Score	0.579	**0.588**

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- **Summary:**
  - Evaluation of the drying-off strategy - cure rates, new infection rates
    - New infections: no significant difference between AM-DCT and no-DCT
    - Cure, new infections: no significant differences between CASE and CONTROL herds
  - A selective dry cow therapy recommendation led to a reduced mean antimicrobial usage (AM-DCT)
    - Significant (weak, p-value = 0.043) mean difference between CASE herds (assisted targeted DCT) and CONTROL herds (selective DCT – blanket AM-DCT)
  - Data based selection method
    - Prediction models demonstrate, that selection for ADCT based on cell count thresholds alone recommends the use of antibiotics more often than is necessary
    - Relationship between udder infections, milk performance test results, lactation age and herd health indicators is complex and could not be well explained with a GEE model
    - With a statistical prediction model (random forest), an even more precise selection for ADCT could be made
    - Due to the marginally lower sensitivity, a few more infections would have been missed compared to the SDCT method

Thank you for your attention!

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Company partners:

Cooperation partners:

www.d4dairy.com

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