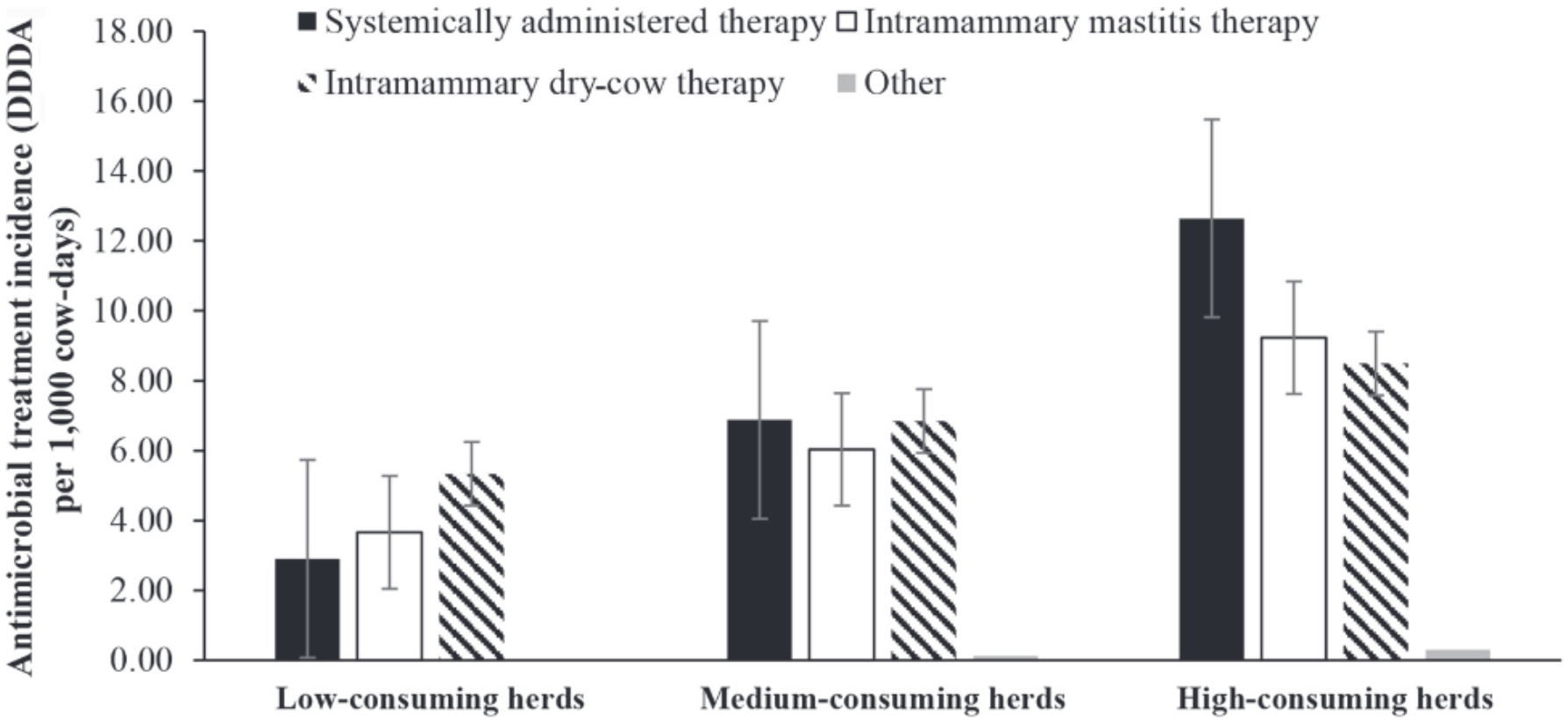
ON-FARM (CULTURE) STRATEGIES FOR SELECTIVE DRY COW THERAPY

Prof. dr. Sofie Piepers
M-team[UGent] & MEX™

Background

- Why selective dry cow therapy?

Background



Stevens et al., 2016

Background

Veterinary Microbiology 134 (2009) 55–64

Contents lists available at ScienceDirect

Veterinary Microbiology

journal homepage: www.elsevier.com/locate/vetmic

Antimicrobial resistance and genotypic characterization of coagulase-negative staphylococci over the dry period

P.J. Rajala-Schultz *, A.H. Torres [1], F.J. DeGraves, W.A. Gebreyes, P. Patchanee

Department of Veterinary Preventive Medicine, College of Veterinary Medicine, The Ohio State University, Columbus, OH, USA

Background

Table 4
Percentage of all CNS isolates (collected at dry-off and calving, $n = 460$) that were categorized as non-susceptible against different antimicrobials and percentages of non-susceptible isolates that were collected at calving from cows that either were treated ($n = 172$) or were not treated ($n = 88$) with antimicrobial dry cow therapy at the end of lactation

Antimicrobial	All isolates	Isolates from calving	
		Untreated	Treated
Ampicillin	14.6	15.5	14.9
Penicillin	22.1	17.9	25.4
Penicillin–novobiocin	17.8	11.5	26.2
Cephalothin	11.1	5.8	13.6
Ceftiofur	4.5	3.5	4.8
Oxacillin	14.0	8.1	18.1
Erythromycin	19.6	15.7	21.3
Pirlimycin	10.7	14.6	11.0
Sulfadimethoxine	29.6	17.7	34.7
Tetracycline	18.0	20.5	14.8
Pansusceptible	36.1	44.3	33.1

Rajala-Schultz et al., 2009

Background

Table 5
Results (odds ratios (OR) and their 95% confidence intervals (CI)) from the univariate screening using data on isolates from dry-off and calving and on isolates from calving only

Antimicrobial	OR[a] (and their 95% confidence intervals)					
	Isolates from dry-off and calving combined			Isolates from calving only		
	Status at dry-off[b]		Parity[c]	Status at dry-off[b]		Parity[c]
	High risk, treated	Low risk, treated	Multiparous	High risk, treated	Low risk, treated	Multiparous
Ampicillin	1.02 (0.53, 1.96)	0.61 (0.22, 1.68)	**2.01 (1.02, 4.30)**	0.96 (0.43, 2.15)	0.87 (0.25, 3.00)	1.49 (0.67, 3.32)
Ceftiofur	1.20 (0.57, 2.53)	1.45 (0.59, 3.57)	0.85 (0.44, 1.65)	1.67 (0.62, 4.51)	2.36 (0.70, 7.95)	0.63 (0.28, 3.87)
Cephalothin	1.99 (0.94, 4.25)	0.94 (0.35, 2.50)	**2.29 (1.08, 4.89)**	3.03 (0.99, 9.28)	0.64 (0.40, 6.75)	1.92 (0.76, 4.84)
Erythromycin	1.06 (0.64, 1.76)	0.55 (0.20, 1.51)	1.44 (0.86, 2.43)	1.64 (0.78, 3.44)	1.00 (0.37, 2.72)	1.64 (0.80, 3.38)
Oxacillin	**2.30 (1.20, 4.41)**	1.21 (0.46, 3.18)	**2.14 (1.52, 3.95)**	**3.09 (1.22, 7.84)**	1.79 (0.46, 6.91)	1.90 (0.90, 4.00)
Penicillin	1.02 (0.59, 1.79)	0.79 (0.37, 1.67)	**2.45 (1.39, 4.30)**	1.61 (0.77, 3.37)	1.43 (0.58, 3.55)	1.79 (0.94, 3.42)
Penic–novobiocin	**2.79 (1.29, 5.91)**	1.54 (0.36, 4.27)	1.33 (0.72, 2.45)	**3.15 (1.31, 7.55)**	1.20 (0.28, 5.21)	1.89 (0.89, 4.01)
Pirlimycin	**0.46 (0.23, 0.96)**	0.55 (0.20, 1.51)	0.67 (0.35, 1.28)	0.76 (0.33, 1.75)	0.65 (0.15, 2.72)	0.43 (0.19, 0.95)
Sulfadimethoxine	**2.44 (1.39, 4.28)**	1.32 (0.64, 2.74)	1.36 (0.84, 2.21)	**2.93 (1.42, 6.05)**	1.42 (0.50, 3.98)	1.62 (0.84, 3.09)
Tetracycline	**0.42 (0.23, 0.70)**	0.79 (0.37, 1.71)	0.80 (0.48, 1.35)	0.62 (0.29, 1.33)	0.78 (0.25, 2.45)	0.83 (0.40, 1.73)
Pansusceptible	1.03 (0.61, 1.74)	1.02 (0.56, 1.86)	0.74 (0.46, 1.18)	0.62 (0.33, 1.17)	0.57 (0.24, 3.64)	0.74 (0.41, 1.35)

Rajala-Schultz et al., 2009

Background

J Dairy Sci. 2019 Dec;102(12):11449-11452. doi: 10.3168/jds.2019-16659. Epub 2019 Oct 16.

Short communication: Selection of extended-spectrum β-lactamase-producing Escherichia coli in dairy calves associated with antibiotic dry cow therapy-A cohort study.

Tetens JL[1], Billerbeck S[2], Schwenker JA[2], Hölzel CS[2].

Author information

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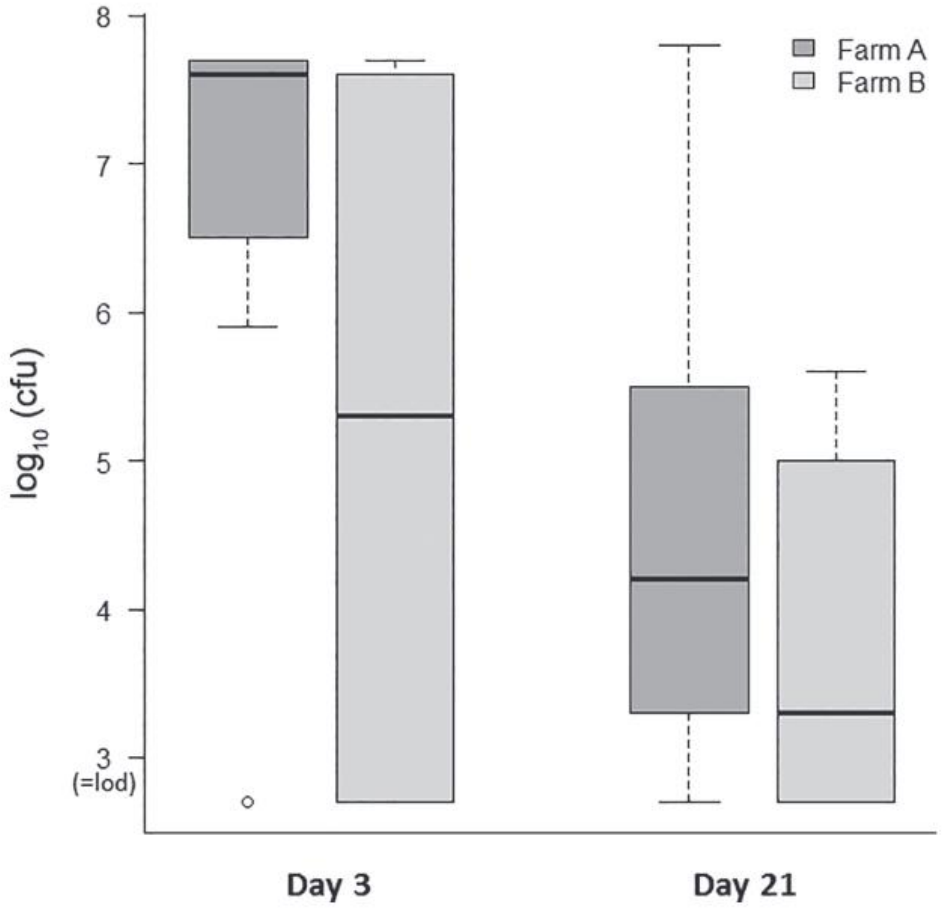
2 Institute of Animal Breeding and Husbandry, Christian-Albrecht University Kiel, Olshausenstraße 40, 24098 Kiel, Germany.

Background

Table 1. Comparison of the 2 farms included in the current study

Item	Farm A	Farm B
No. of cows	273	280
Average milk yield per year (L)	10,521	10,238
Average SCS	165,000	190,000
No. of analyzed calves	25	25
Management of dry cow therapy	Blanket	Selective
No. of analyzed calves of antibiotically dried off cows	19	9
No. of analyzed calves of nonantibiotically dried off cows	6	16
Average dry-off period of cows (d)	46.8	42.8
Agents used for antibiotic dry off	Dihydrostreptomycin, nafcillin, penicillin-G procain	Framecytin with penicillin or cloxacillin

Background



Tetens et al., 2019

Possibilities

- On-farm culture-dependent
  - Plate-based methods
    - Bacteriological culturing
    - Petrifilm
  - Non-plate based methods
- On-farm culture-independent
  - Real-time PCR
  - Cell count
    - Total somatic cell count
    - Differential somatic cell count

On-farm culture dependent

Plate based diagnosis

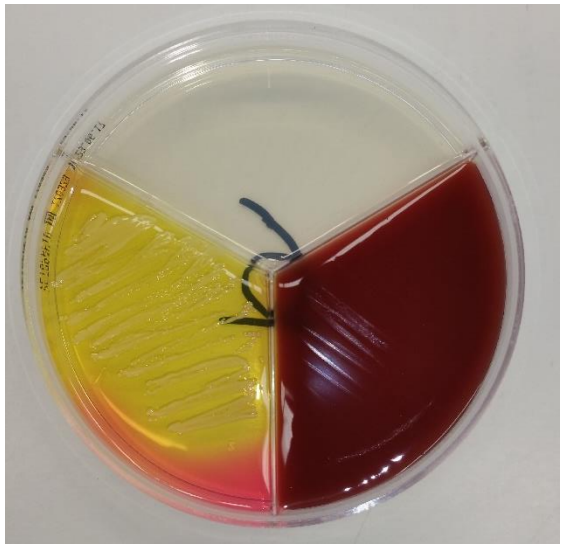
- VetoRapid
- VetoSlide
- Accumast
- Minnesota
- Micromast
- Petrifilm
- Check-up

Non-plate based diagnosis

- Mastatest – Mastaplex
- MastDecide
- Point Of Cow
- Speed Mam Color

On-farm culture dependent

VETORAPID



Triplate with 3 selective media. For Gram-negative bacteria, for Staphylococci and for Streptococci growth

(Viora et al., 2014)

VETOSLIDE

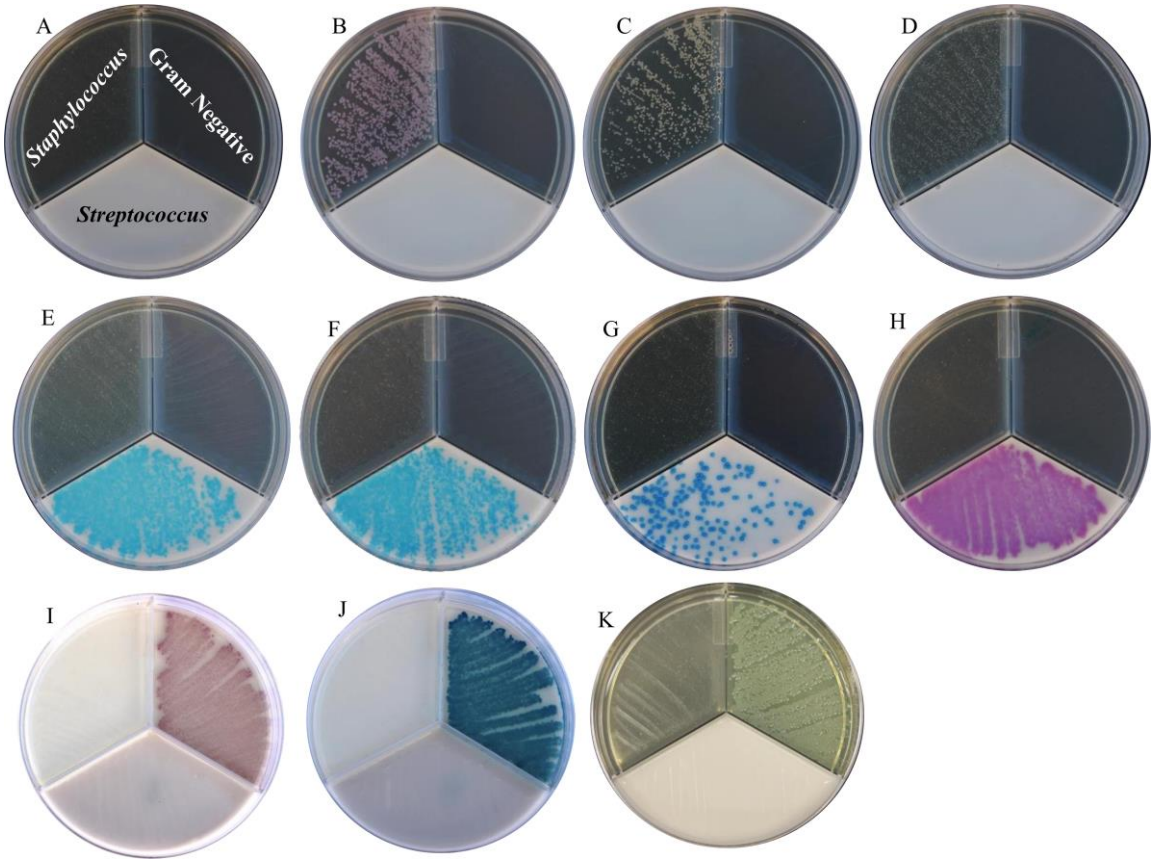
Biplate with 2 selective media. For Gram-positive and Gram-negative growth

(Malcata et al., in preparation)

On-farm culture dependent

ACCUMAST

Triplate with 3 selective media. For Gram-negative bacteria, for Staphylococci and for Streptococci growth



(Ganda et al., 2016)

On-farm culture dependent

Minnesota Easy Culture System

Biplate with 2 selective media. For Gram-positive and Gram-negative growth. Triplate with 3 selective media. For Gram-negative, for Gram-positive and for Streptococci growth.

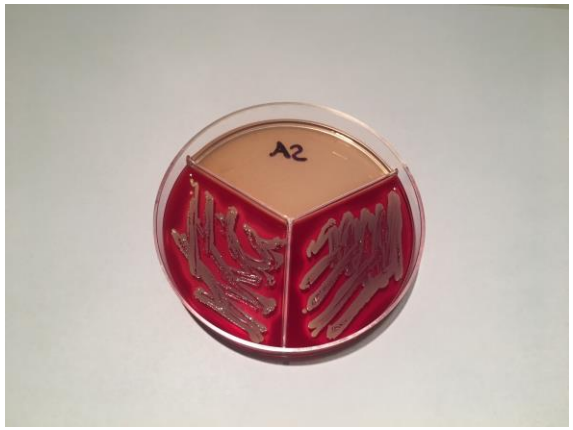
(Lago et al., 2011a, 2011b)

On-farm culture dependent

MICROMAST

MicroMast

Triplate with 3 selective media. For Gram-negative bacteria, for streptococci and a blood sheep agar not selective.



(Lago et al., 2011a, 2011b)

On-farm culture dependent

Check Up

4 quadrants: a 5% blood agar, a Gram-positive selective medium, a Gram-negative selective medium, and a yeast/fungi selective medium

(McDougall et al., 2018)

On-farm culture dependent

PETRIFILM™

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

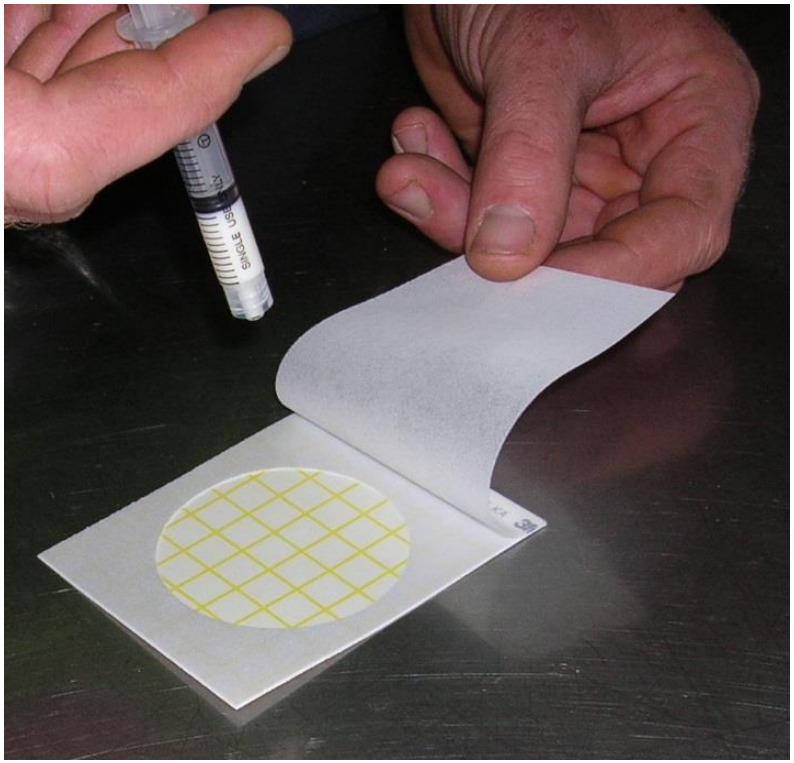
journal homepage: www.elsevier.com/locate/prevetmed

Short Communication

A field study evaluation of Petrifilm™ plates as a 24-h rapid diagnostic test for clinical mastitis on a dairy farm

Elisabeth Maria Mansion-de Vries[a,b], Nicole Knorr[a], Jan-Hendrik Paduch[a], Claudia Zinke[a], Martina Hoedemaker[b], Volker Krömker[a,*]

[a] University of Applied Sciences and Arts, Faculty II, Microbiology, Heisterbergallee 12, 30453 Hannover, Germany
[b] Clinic for Cattle, Hanover University of Veterinary Medicine, Foundation, Bischofsholer Damm 15, 30173 Hannover, Germany



AerobicCount (AC)-Petrifilm™
ColiformCount (CC)-Petrifilm™
Differentiation between Gram-positive and Gram-negative bacteria

(Mansion-de Vries et al., 2014)

On-farm culture dependent

MastaPlex

https://www.mastaplex.com/mastatest

Test based in a specific observation of a colour change in a test kit after incubation in automated reader incubator.

On-farm culture dependent

MastDecide

(Leimbach and Krömker, 2018)

Culture based diagnosis that consists of 2 test tubes containing a pink test medium that can differentiate between Gram-positive cocci, coliform bacteria and no growth

On-farm culture dependent

Speed Mam Color

Multiple wells gallery tool to identify the causative pathogen and the antimicrobial sensitivity profile of 14 different antibiotics for the pathogens present in the sample

https://bvt.virbac.com/en/home/diagnostic-solutions/pour-le-veterinaire-praticien/produit-1/main/produits/speed-mam-color-1.html

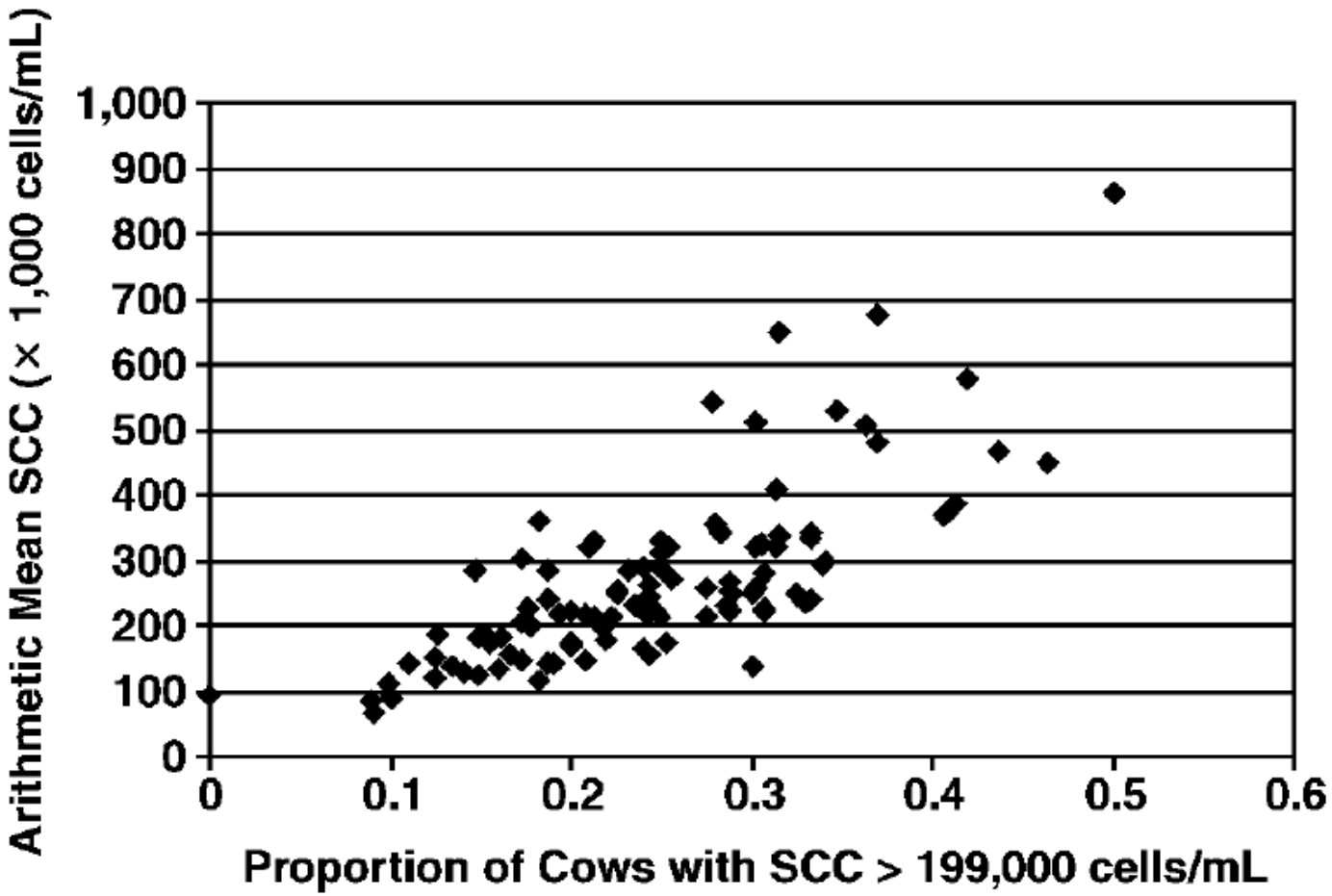
Possibilities

- On-farm culture-dependent
  - Plate-based methods
    - Bacteriological culturing
    - Petrifilm
  - Non-plate based methods
- On-farm culture-independent
  - Real-time PCR
  - Cell count
    - Total somatic cell count
    - Differential somatic cell count

…considerations

- Herd milk somatic cell count
- Cow milk somatic cell count
- Internal/external teat sealant if no antimicrobials are used

...considerations



Green et al., 2008

...considerations

Reduction total AB use: 85%

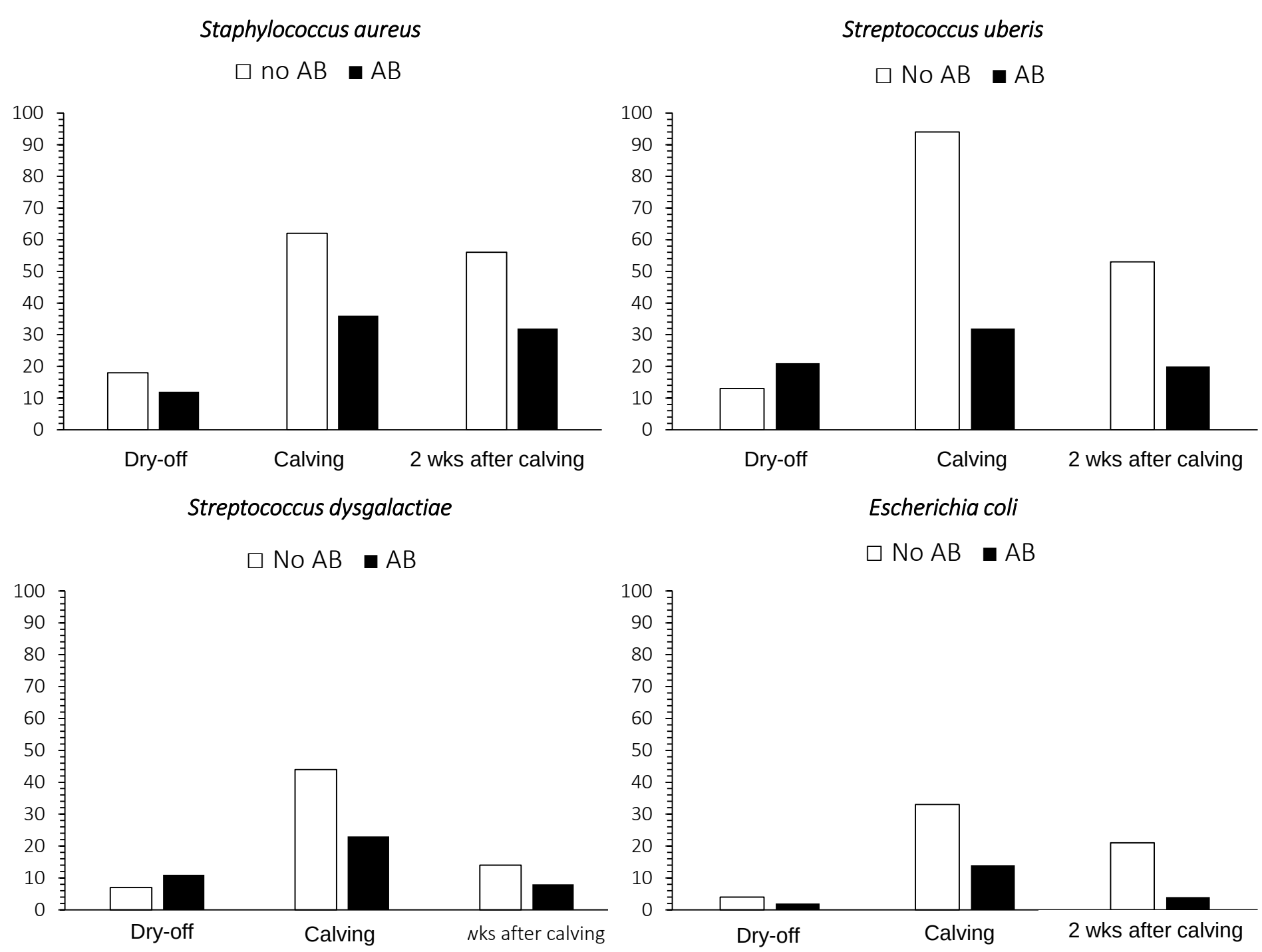
J. Dairy Sci. 97:3606–3614
http://dx.doi.org/10.3168/jds.2013-7655

Evaluation of the use of dry cow antibiotics in low somatic cell count cows

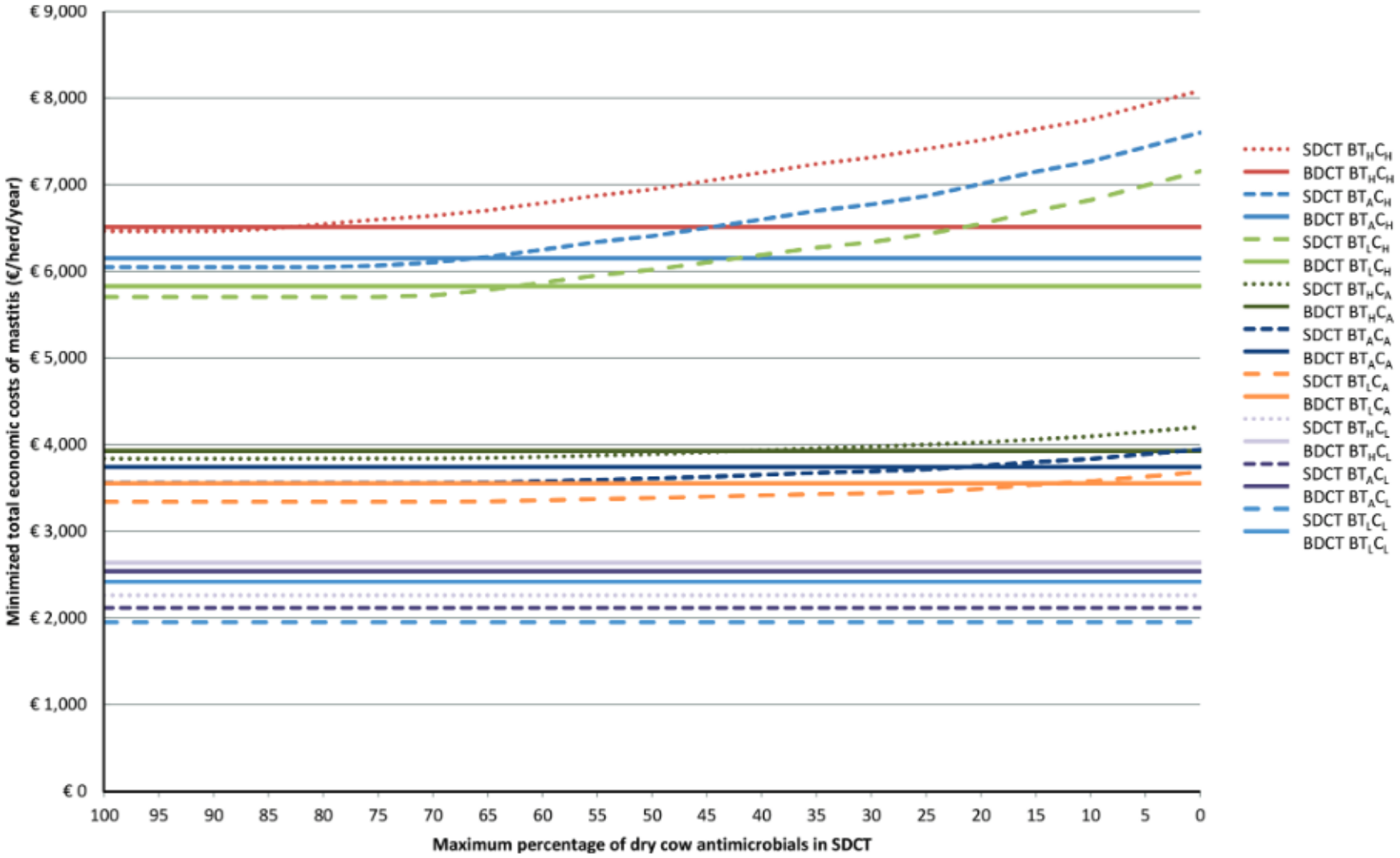
C. G. M. Scherpenzeel,*[1] I. E. M. den Uijl,* G. van Schaik,* R. G. M. Olde Riekerink,* J. M. Keurentjes,* and T. J. G. M. Lam*†
*GD Animal Health, PO Box 9, 7400 AA Deventer, the Netherlands
†Department Farm Animal Health, Utrecht University, PO Box 80151, 3508 TD Utrecht, the Netherlands

Item	CM, OR[2] (95% CI)	QSCC200 (d 14), OR (95% CI)
QSCC200 (DRY)	1.3 (0.96; 1.8)	1.5 (1.2; 1.8)
Culture positive for major mastitis pathogen (DRY)	1.8 (0.89; 3.7)	1.6 (0.95; 2.6)
Untreated	2.0 (1.5; 2.5)	2.0 (1.7; 2.3)

[1]Model adjusted for multiple cows per herd and multiple quarters per cow.
[2]OR = odds ratio.


Staphylococcus aureus
□ no AB ■ AB
100
90
80
70
60
50
40
30
20
10
0
Dry-off
Calving
2 wks after calving
Streptococcus uberis
□ No AB ■ AB
100
90
80
70
60
50
40
30
20
10
0
Dry-off
Calving
2 wks after calving
Streptococcus dysgalactiae
□ No AB ■ AB
100
90
80
70
60
50
40
30
20
10
0
Dry-off
Calving
wks after calving
Escherichia coli
□ No AB ■ AB
100
90
80
70
60
50
40
30
20
10
0
Dry-off
Calving
2 wks after calving

...considerations



Scherpenzeel et al., 2018

Petri-film

J. Dairy Sci. 97:270–284
http://dx.doi.org/10.3168/jds.2013-7060

Evaluation of selective dry cow treatment following on-farm culture: Risk of postcalving intramammary infection and clinical mastitis in the subsequent lactation

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†Faculté de médecine vétérinaire, Université de Montréal, Saint-Hyacinthe, Québec, Canada J2S 7C6

Petri-film

- Inclusion criteria
  - Herd-level: < 250,000 cells/ml last 12 months
  - Cow-level: < 200,000 cells/ml last 3 test-days
- Randomly assigned to BDCT or SDCT
- SDCT group
  - ≥ 5 CFU: antibiotic therapy + internal teat sealant
  - < 5 CFU: internal teat sealant

Petri-film

- New intramammary infection

Item	BDCT (n = 1,157)	SDCT		
		Overall (n = 1,130)	ITS only (n = 530)	DCT + ITS (n = 600)
Pathogen [no. (%)]				
Staphylococcus aureus	16 (1.4)	17 (1.5)	11 (2.1)	6 (1.0)
Streptococcus uberis	1 (0.1)	1 (0.1)	0 (0)	1 (0.2)
Streptococcus dysgalactiae	3 (0.3)	1 (0.1)	0 (0)	1 (0.2)
Nondifferentiated streptococci[1]	24 (2.1)	24 (2.2)	11 (2.1)	13 (2.2)
Total environmental streptococci	28 (2.4)	26 (2.3)	11 (2.1)	15 (2.5)
Escherichia coli	2 (0.2)	4 (0.4)	1 (0.2)	3 (0.5)
Nondifferentiated gram-negative bacteria	5 (0.4)	2 (0.2)	0 (0)	2 (0.3)
Total gram-negative pathogens	7 (0.6)	6 (0.5)	1 (0.2)	5 (0.8)
Fungi and yeast	10 (0.9)*	2 (0.2)*	1 (0.2)	1 (0.2)
CNS	100 (9.6)	114 (11.6)	51 (9.9)	63 (13.5)
Corynebacterium spp.	11 (1.0)	10 (0.9)	2 (0.4)	8 (1.3)
Total pathogen count	172	175	77	98
Quarter level[2] [no. (%)]	160 (13.8)	164 (14.5)	72 (13.6)	92 (15.3)

Cameron et al., 2014

Petri-film

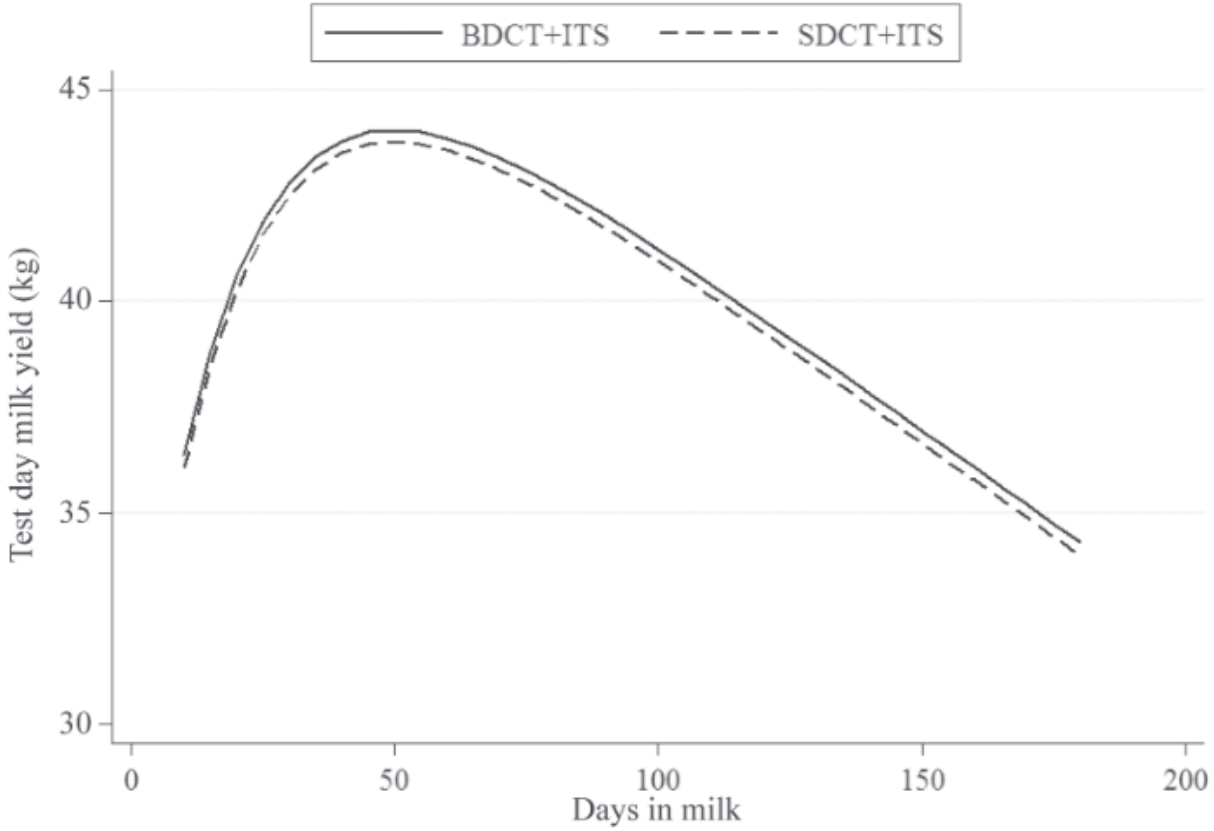
J. Dairy Sci. 98:2427–2436
http://dx.doi.org/10.3168/jds.2014-8876

Evaluation of selective dry cow treatment following on-farm culture: Milk yield and somatic cell count in the subsequent lactation

M. Cameron,*[1] G. P. Keefe,* J.-P. Roy,† H. Stryhn,* I. R. Dohoo,* and S. L. McKenna*
*Department of Health Management, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada C1A 4P3
†Faculté de médecine vétérinaire, Université de Montréal, Saint-Hyacinthe, Québec, Canada J2S 7C6

Petri-film

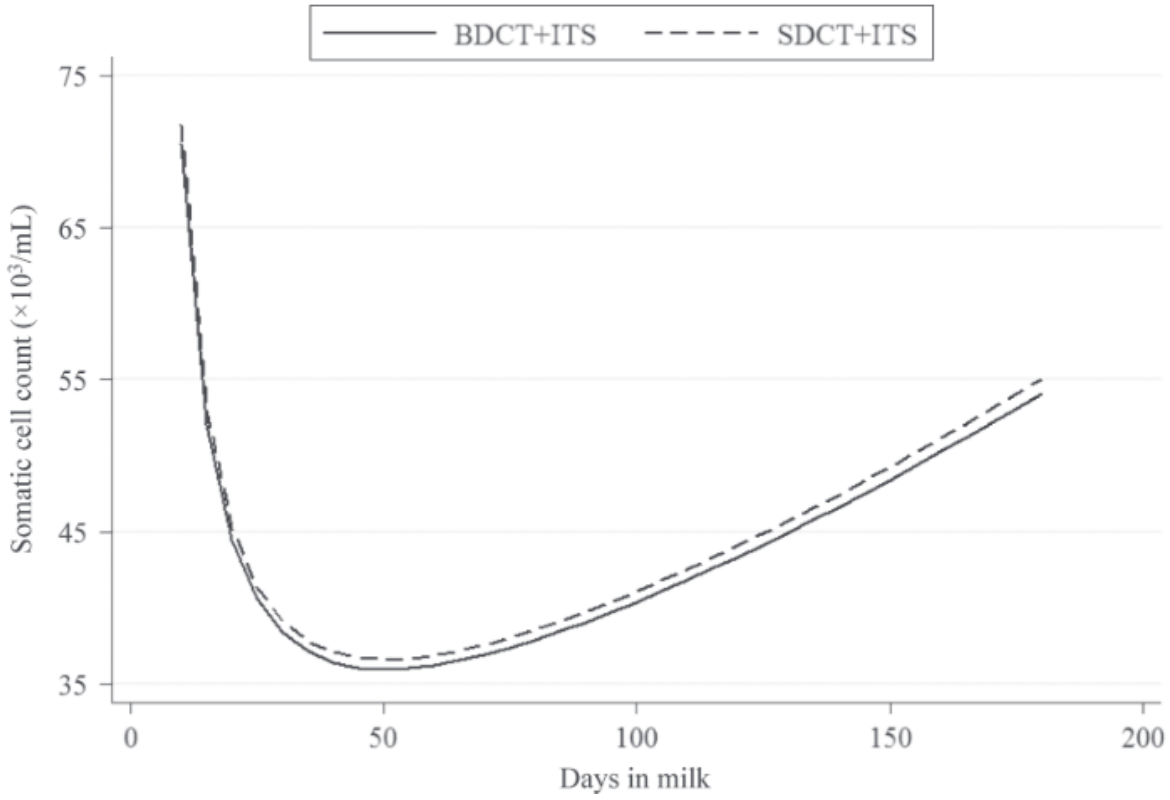
- Daily milk yield



Cameron et al., 2015

Petri-film

- Somatic cell count



Cameron et al., 2015

Somatic cell count

J. Dairy Sci. 99:3753–3764
http://dx.doi.org/10.3168/jds.2015-9963

Effect of different scenarios for selective dry-cow therapy on udder health, antimicrobial usage, and economics

C. G. M. Scherpenzeel,*[1] I. E. M. den Uijl,* G. van Schaik,*† R. G. M. Olde Riekerink,* H. Hogeveen,†‡ and T. J. G. M. Lam*†

Table 2. Eight scenarios with SCC thresholds to select cows for treatment with antimicrobials at drying off, based on cow-level SCC at the last milk recording before drying off, for first and later dry periods

	SCC ($\times 10^3$ cells/mL)	
Scenario	At end of first lactation	At end of later lactations
1	>0	>0
2	>50	>50
3	>100	>100
4	>150	>150
5	>150	>50
6	>150	>100
7	>150	>200
8	>150	>250

Risk IMI

Costs

Antibiotics

Little side step: test characteristics

		Reference (gold standard)		
		Pos.	Neg.	
Test	Pos.	TP	FP	**Pos. Pred. Value [(TP)/(TP+FP)]**
	Neg.	FN	TN	**Neg. Pred. Value [(TN)/(TN+FN)]**
		Sensitivity [(TP)/(TP + FN)]	**Specificity [(TN)/ (FP+TN)]**	

Somatic cell count

Journal of Dairy Research (2008) **75** 240–247. © *Proprietors of Journal of Dairy Research 2008*
doi:10.1017/S0022029908003257 *Printed in the United Kingdom*

Using dairy herd improvement records and clinical mastitis history to identify subclinical mastitis infections at dry-off

Audrey H Torres[1]*, Päivi J Rajala-Schultz[1]†, Fred J DeGraves[1] and Kent H Hoblet[2]

Somatic cell count

Table 3. Sensitivity, specificity, positive (PPV) and negative predictive values (NPV) for selection of uninfected cows at dry-off based on somatic cell counts (SCC) during the last three months of lactation and clinical mastitis (CM) history. Isolation of the same pathogen from paired samples (≥100 cfu/ml) was used as the gold standard (n=647)

	SC1† SCC <100 000 No CM	SC2 SCC <200 000 No CM	SC3 SCC <200 000 CM <90 DIM‡	SC4 SCC <300 000 No CM
Sensitivity	85·1 (79·5–89·6)§	71·2 (64·5–77·2)	69·7 (62·9–75·9)	62·5 (65·5–69·1)
Specificity	34·6 (30·2–39·3)	50·1 (45·3–54·9)	62·4 (57·7–66·9)	54·4 (49·7–59·2)
PPV	38·2 (33·7–42·7)	40·3 (35·3–45·5)	46·8 (41·1–52·5)	39·4 (34·1–44·9)
NPV	83·1 (76·8–88·2)	78·6 (73·3–83·2)	81·3 (76·7–85·3)	75·4 (70·3–80·0)

Table 4. Positive (PPV) and negative predictive values (NPV) using the optimal selection criterion (SC3†) for identifying infected and uninfected cows at dry-off with different prevalence of intramammary infections in the herd†, ‡

Prevalence	15%	25%	35%	45%
PPV	23·3 (11·8–38·6)§	35·6 (21·9–51·2)	47·9 (33·3–62·8)	58·0 (43·2–71·8)
NPV	91·2 (80·7–97·1)	83·6 (71·2–92·2)	76·9 (63·2–87·5)	68·0 (53·3–80·5)

Torres et al., 2008

Somatic cell count

J. Dairy Sci. 102:4309–4321
https://doi.org/10.3168/jds.2018-15642

Evaluation of test-day milk somatic cell count information to predict intramammary infection with major pathogens in dairy cattle at drying off

Z. Lipkens, S. Piepers, A. De Visscher, and S. De Vliegher*
M-team & Mastitis and Milk Quality Research Unit, Department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, 9820 Merelbeke, Belgium

Somatic cell count

J. Dairy Sci. 101:5345–5361
https://doi.org/10.3168/jds.2017-13807

Use of a culture-independent on-farm algorithm to guide the use of selective dry-cow antibiotic therapy

A. K. Vasquez,* D. V. Nydam,*[1] C. Foditsch,* M. Wieland,* R. Lynch,† S. Eicker,‡ and P. D. Virkler*
*Department of Population Medicine and Diagnostic Sciences, College of Veterinary Medicine, and
†Pro-Dairy, Department of Animal Science, Cornell University, Ithaca, NY 14853
‡Valley Agricultural Software, King Ferry, NY 13081

Somatic cell count

- 1 commercial dairy farm with > 1,500 cows.
- Bulk milk somatic cell count: 201,000 cellsml
- % clinical mastitis per month: 2%

Vasquez et al., 2018

Somatic cell count

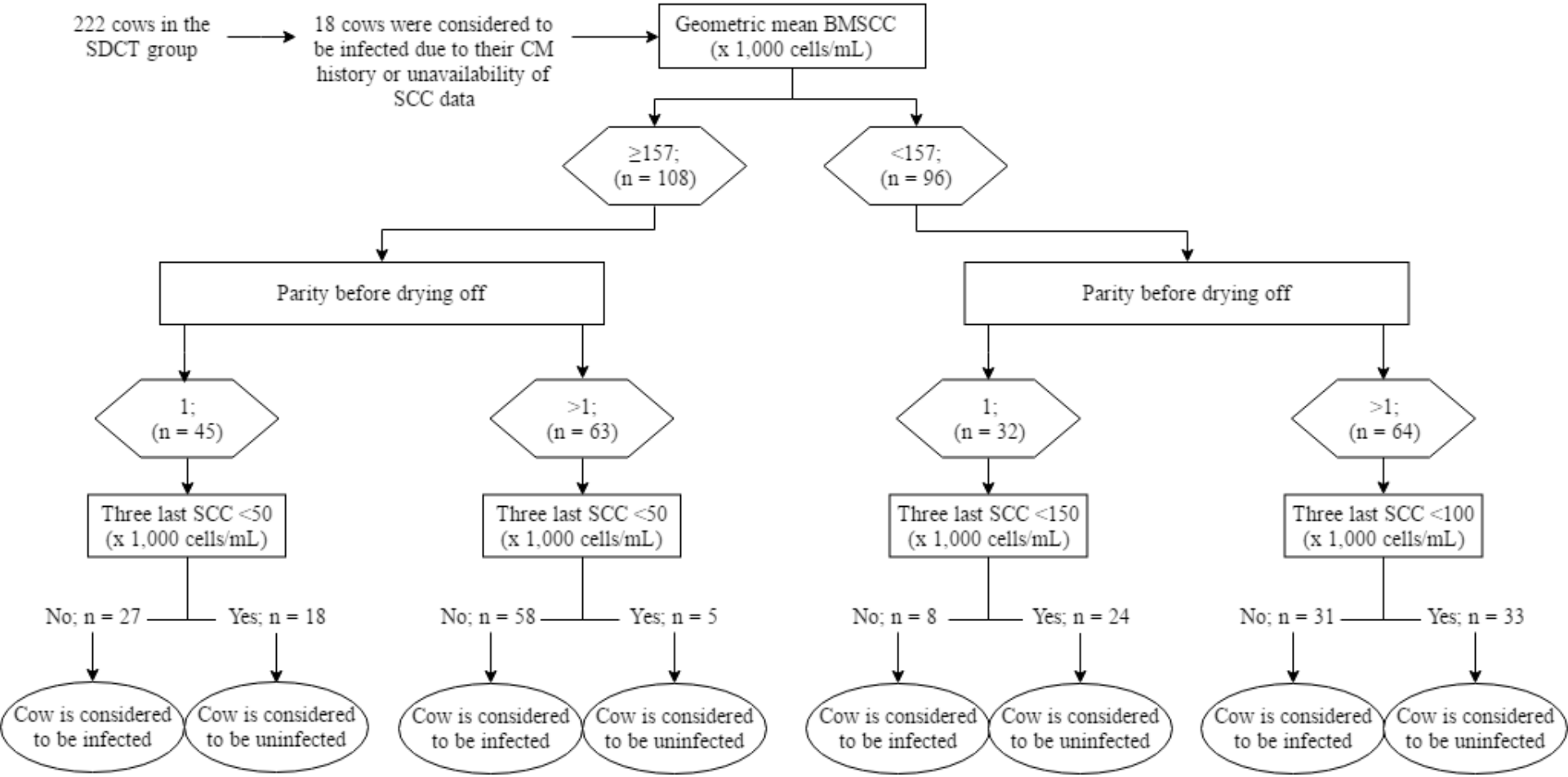
- Low risk cows:
  - Average SCC last 3 test-days < 200,000 cells/ml
  - Last test-day SCC: 200,000 cells/ml
  - Max. 1 clinical mastitis case in current lactation
- High risk cows: AB + external teat sealant
- Low risk cows:
  - External teat sealant
  - AB + external teat sealant

Vasquez et al., 2018

Somatic cell count

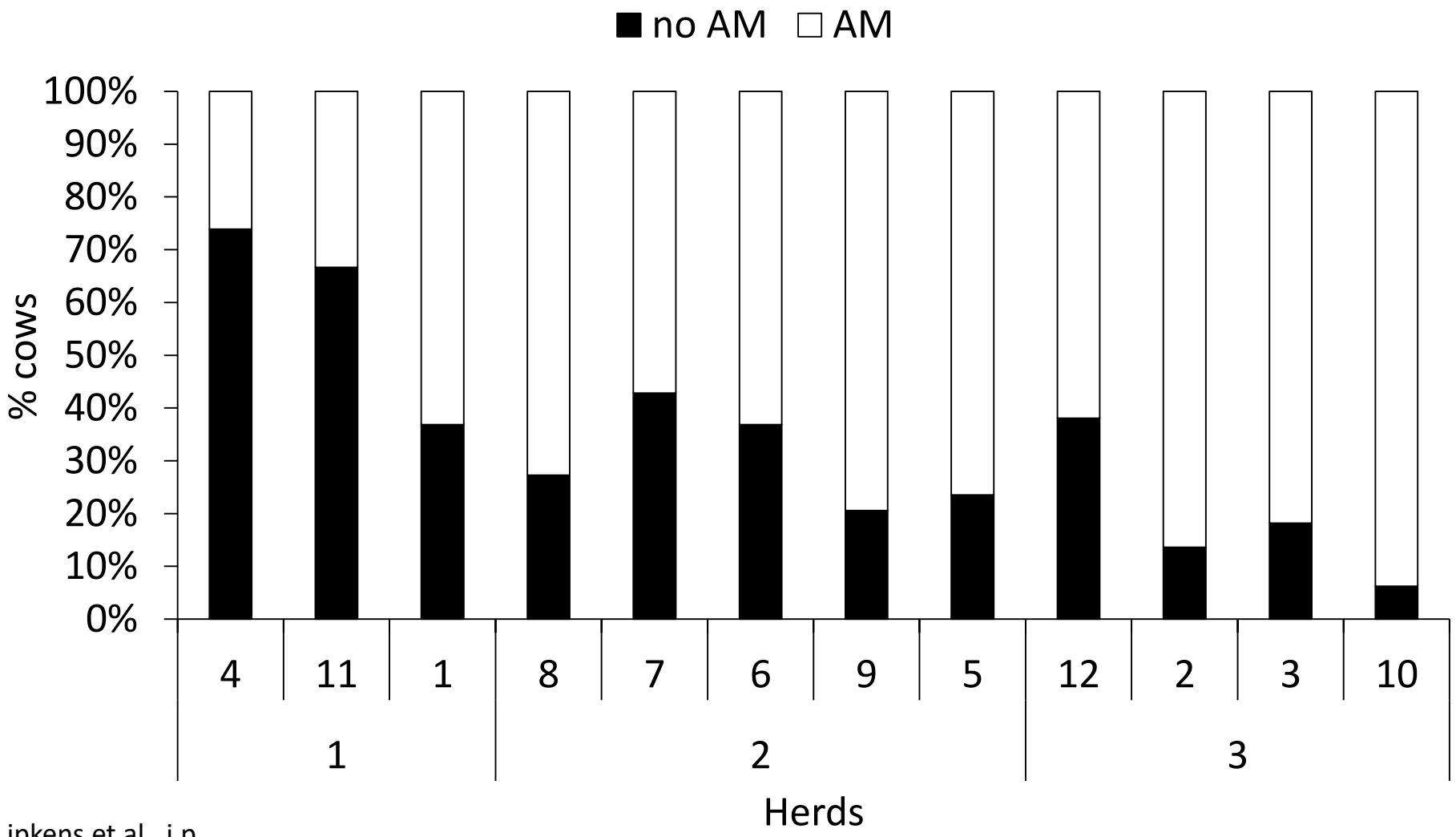
	AB	AB + ETS
New infections	5.5%	7.3%
Cured infections	93%	88%
Milk yield	40.5 kg	41.2 kg
Somatic cell count	282,843 cells/ml	324,901 cells/ml
Clinical mastitis	9	5
Culling events	18	15

Vasquez et al., 2018



Lipkens et al., i.p.

AB usage



Lipkens et al., i.p.

Key performance parameters

	BDCT		SDCT		
	Average	Number	%	Number	No AB
CM < 100 DIM	18.5%	40/244	16.4%	41/222	11/41
Culling < 100 DIM	5.3%	13/244	8.6%	19/222	1/19
% New IMI	10.8%	14/130	10.2%	11/108	3/11
% Cured IMI	75.0%	18/24	77.3%	17/22	5/6
SCC first 100 DIM	28,789 cells/ml		46,996 cells/ml		
MY first 100 DIM	38.1 kg		40.0 kg		

Lipkens et al., i.p.

Differential cell count

Preventive Veterinary Medicine 172 (2019) 104803

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Investigation of differential somatic cell count as a potential new supplementary indicator to somatic cell count for identification of intramammary infection in dairy cows at the end of the lactation period

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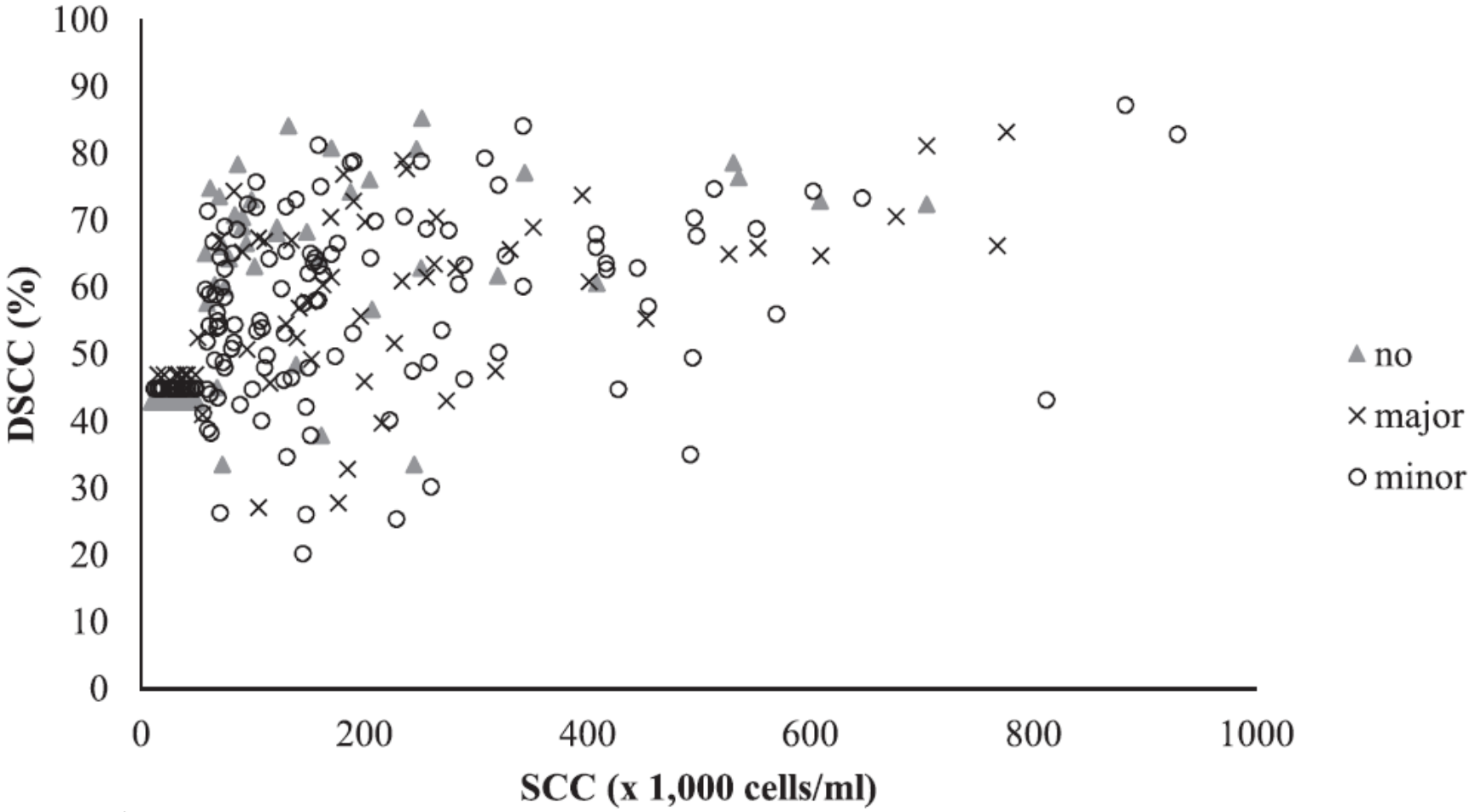
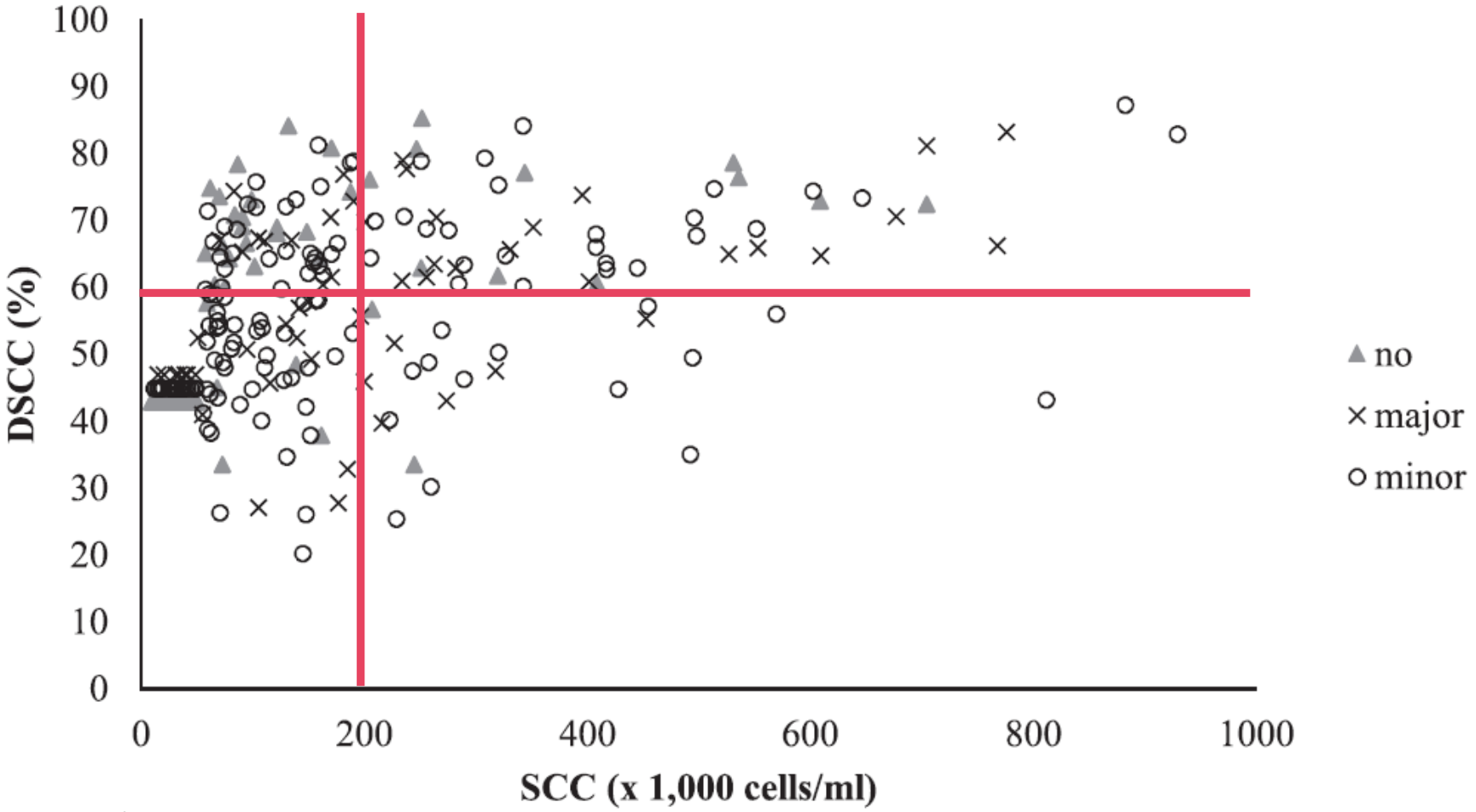
Differential cell count



Schwarz et al., 2019

Differential cell count



Schwarz et al., 2019

Differential cell count

	Cell count	Cell count and/or DSCC
	200,000 cells/ml	*200,000 cells/ml and/or 60%*
Sensitivity	44%	66%
Specificity	74%	54%
PPV	32%	27%
NPV	84%	86%

Schwarz et al., 2019

Cow or quarter level?

Cow or quarter level?

Journal of Dairy Research (2006) **73** 345–352. © *Proprietors of Journal of Dairy Research 2006*
doi:10.1017/S0022029906001981 *Printed in the United Kingdom*

Interdependence of udder quarters for new intramammary infection during the dry period in cows submitted to selective antibiotic therapy

Aurélie Robert[1,2], Nathalie Bareille[1]*, Philippe Roussel[3], Bernard Poutrel[4], Vincent Heuchel[5] and Henri Seegers[1]

Cow or quarter level?

J. Dairy Sci. 86:3912–3919

Prophylactic Effects of Two Selective Dry Cow Strategies Accounting for Interdependence of Quarter

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Table 4. Variance estimates from Glimmix models.

Trial	Variation Source	Estimate
Antibiotic	Cows	5.7497
	Quarters	0.1673
	Residual	0.2317
Teat seal	Cows	4.0016
	Quarters	0
	Residual	0.2789

Conclusions

- Strategy seems to be less important than selection of herds (low versus high prevalence herds).
- There is no perfect strategy.
- Added value of bacteriological culturing seems to be limited (at least on low SCC herds) to select cows.
- Cow-level is preferred over quarter level because of interdependence.

Questions?