An on-farm algorithm to guide selective dry cow therapy

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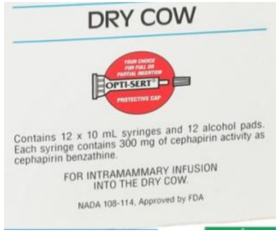
Cornell University

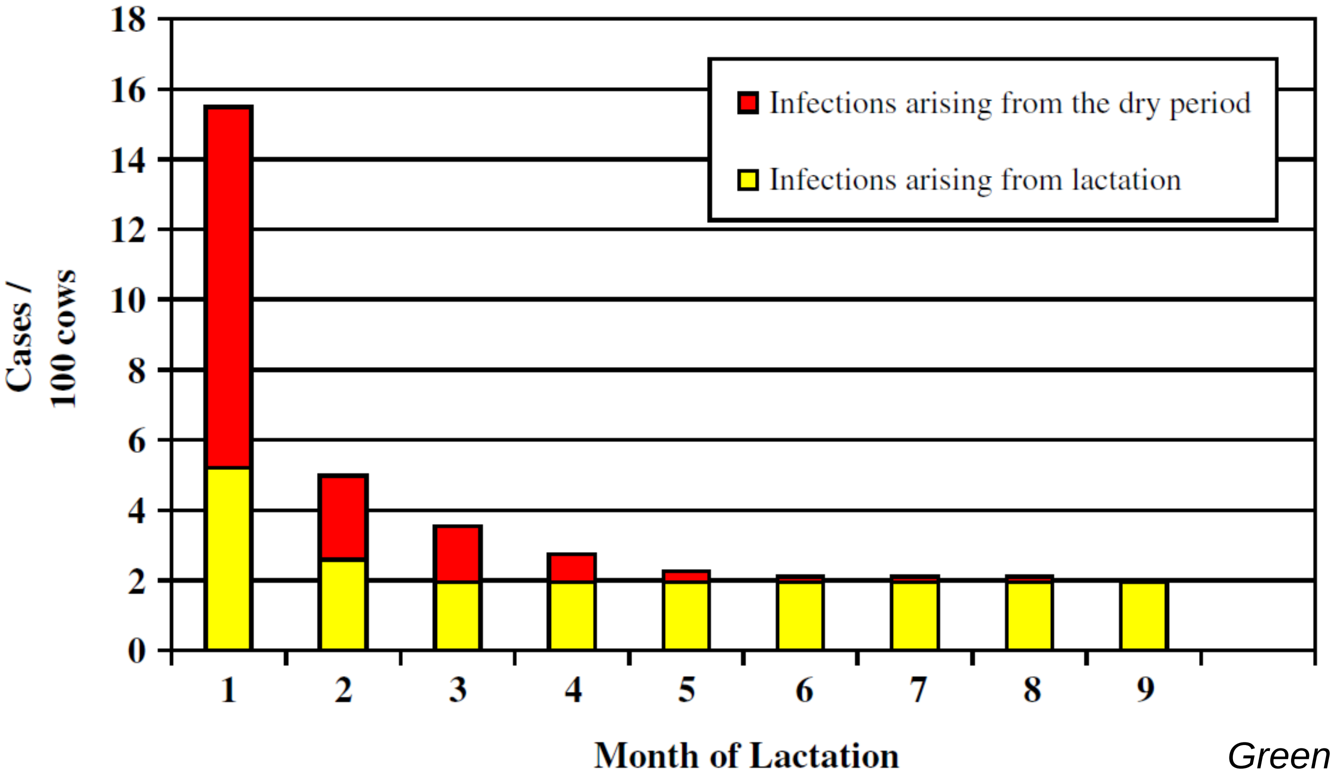
Blanket Dry Cow Therapy (BDCT)

5 Point Plan

1. Treat and record clinical mastitis cases
2. Post milking teat disinfection
3. **Dry cow therapy**
4. Cull chronic cases
5. Milking machine maintenance



The High Incidence Rate of Clinical Mastitis in the weeks following calving is due in large part to Infection during the dry period



Green et al. JDS 2002;85(10):2589–99

Blanket Dry Cow Therapy is not prudent use for all dairies

73-95% of cultures at dry off return "Negative" results (**44%** 1985)

The national average for bulk tank SCC in 2014 was **193,000 cells/mL** **(295,000 in 1997)**

11.1% of overall test days were over 400,000 cells/mL in 2016 (**27.2%** in 1995)

Huxley et al., 2002, Anderson et al., 2003, Pantoja et al., 2009, Rajala-Schultz et al., 2011, du Preez and Greeff 1985, USDA-NAHMS 2014, CDCB 2016

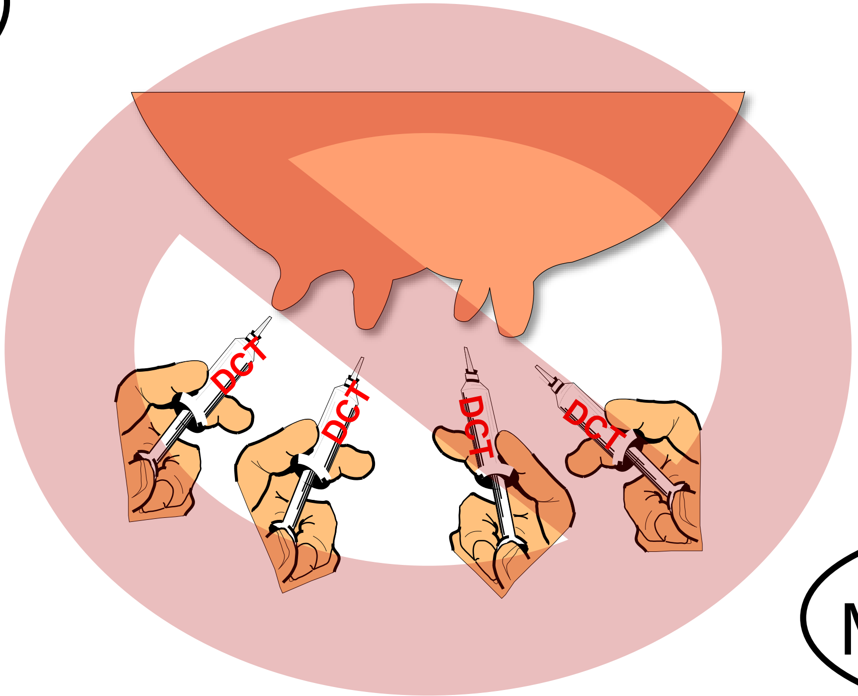
There are several ways to mitigate the high incidence rate, but most producers elect to treat with antimicrobials.

93% of cows were treated with intramammary antimicrobials at dry off

NAHMS-USDA 2014

Economics

Policy



Antimicrobial Resistance

More harm?

Residues

Selective Dry Cow Therapy (SDCT)

Identifying and treating ONLY cows/quarters that currently have or are at risk for infections

Which cows/quarters to treat?

NEEDS: accurate, quick, cheap

Currently available tools for identifying cows:

NATIONAL DHIA

vas DAIRYCOMP 305

Cowside

Culture

On-farm records

Cameron et al., 2015

n = 729; 16 farms

Last Test SCC ≥200k
- yes → Treat with Abx and sealant
- no → Mastitis in last 90 days?
  - yes → Treat with Abx and sealant
  - no → CMT ≥2
    - yes → Treat with Abx and sealant
    - no → Low Risk Group (54% cows)
      - randomize → Petrifilm growth? (SDCT)
        - yes → Abx and sealant
        - no → Sealant only
      - randomize → Treat with Abx and sealant (BDCT)

21% Abx reduction

Cameron et al. 2015, results

❖SDCT=BDCT for:

– Milk production for 200 days in milk
– Somatic cell count for 200 days in milk
– % quarters infected at freshening

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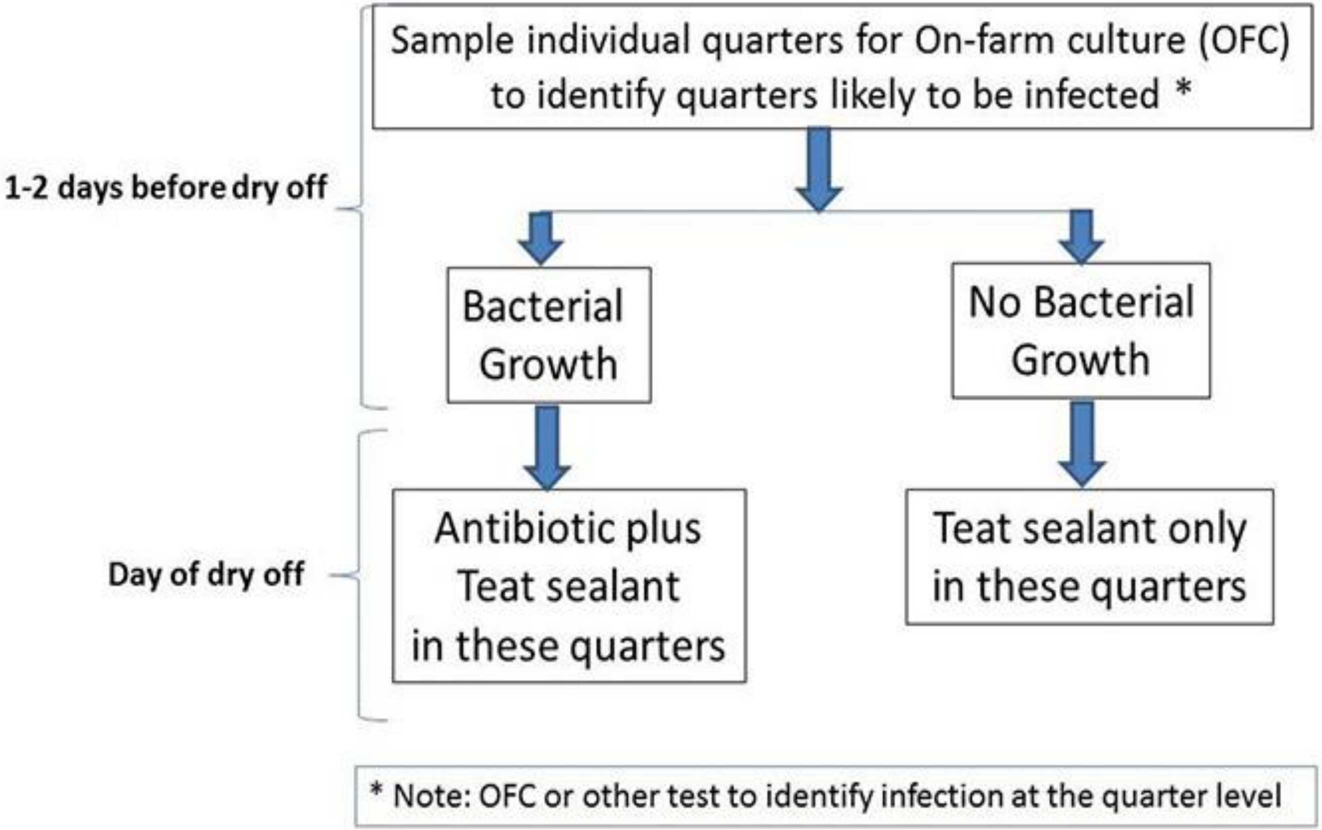
Quarter-level Culture

- ❖ Pilot study (Patel, Godden et al. 2017)
- ❖ 56 Minnesota cows
- ❖ No initial screening: Cows Randomized to Blanket (BDCT) or Selective (SDCT)

Quarter-level Culture



(Patel et al., 2018)

Quarter-level culture to drive SDCT

Results (Patel et al., 2018)

Parameter	Odds ratio of SDCT:BDCT	P-value
IMI at dry off	1.2	0.51
Cure	0.6	0.53
New IMI at calving	0.91	0.76

- Abx reduction: 48%
- Cost savings $2.62/cow

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On-farm records

Rajala-Schultz et al., 2011

<u>“Low-risk” cows:</u>

- <200,000 SCC last 3 months
- No mastitis in first 90 DIM
- If mastitis, had to have SCC<100,000 for entire lact.
- Randomized to be treated/not and compared

Rajala-Schultz et al., 2011

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=no differences in milk (kg)

=differences in SCC (↑ in SCC of 16%)

Rajala-Schultz et al., 2011

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=no differences in milk (kg)

=differences in SCC (↑ in SCC of 16%)

→1 farm the driver of increase

→¾ farms had BTSCC of >250,000

→No teat sealants

Selective Dry Cow Therapy (SDCT)

Identifying and treating ONLY cows/quarters that currently have or are at risk for infections

Which cows/quarters to treat?

NEEDS: accurate, quick, cheap

Currently available tools for identifying cows:

Cowside

Culture

NATIONAL DHIA

vas

DAIRYCOMP 305

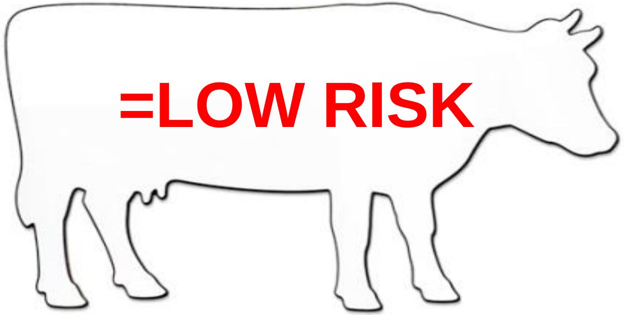
On-farm records

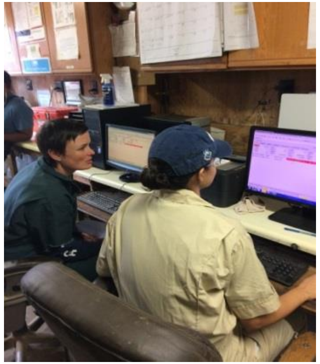
Study Question:

Does using on-farm records to identify and treat only "high risk" cows result in negative outcomes for those cows that are not treated ("low risk" cows)?

Computer Algorithm

- Last month’s SCC ≤ 200k
- Avg SCC last 3 months ≤200k
- ≤1 case of clinical mastitis
- No current symptoms of clinical mastitis
- No mastitis in the last 30 days





Study Design

Cows Due To Dry (1800/yr)

Run Algorithm

Low Risk

Randomize

Intramammary antibiotics And Sealant (ABXTS)

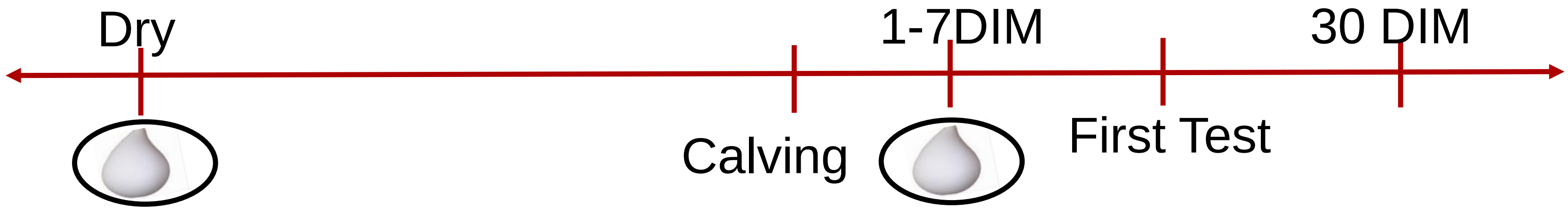
Sealant Only (TS)

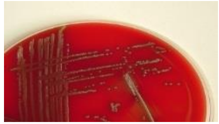
High Risk

Intramammary antibiotics And Sealant

64% cows = low risk

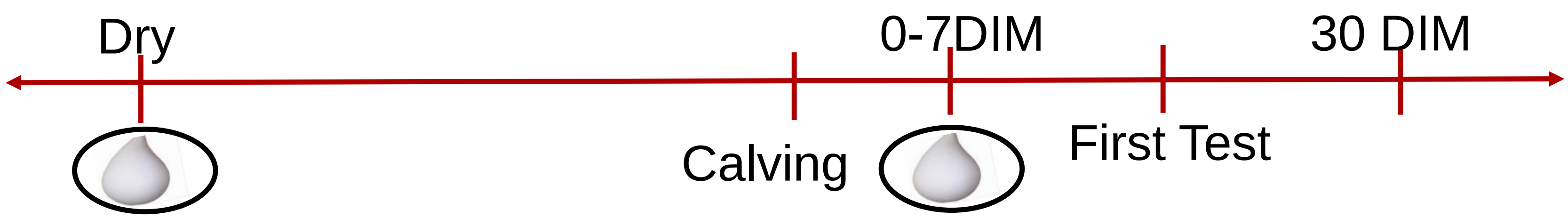
Several outcomes were assessed





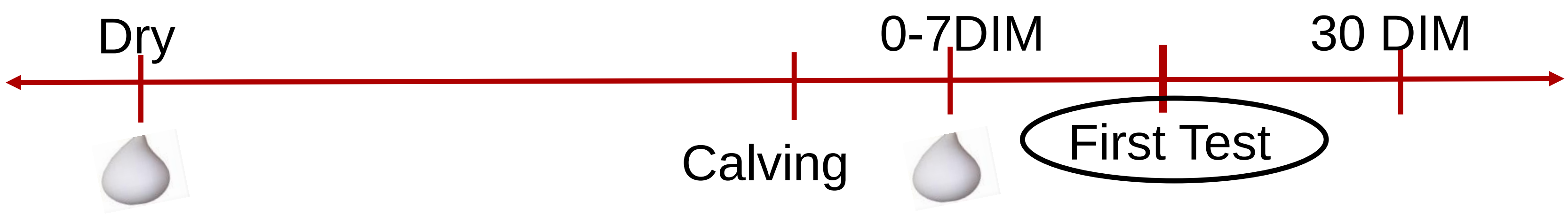
1. Bacteriological Cure

Several outcomes were assessed



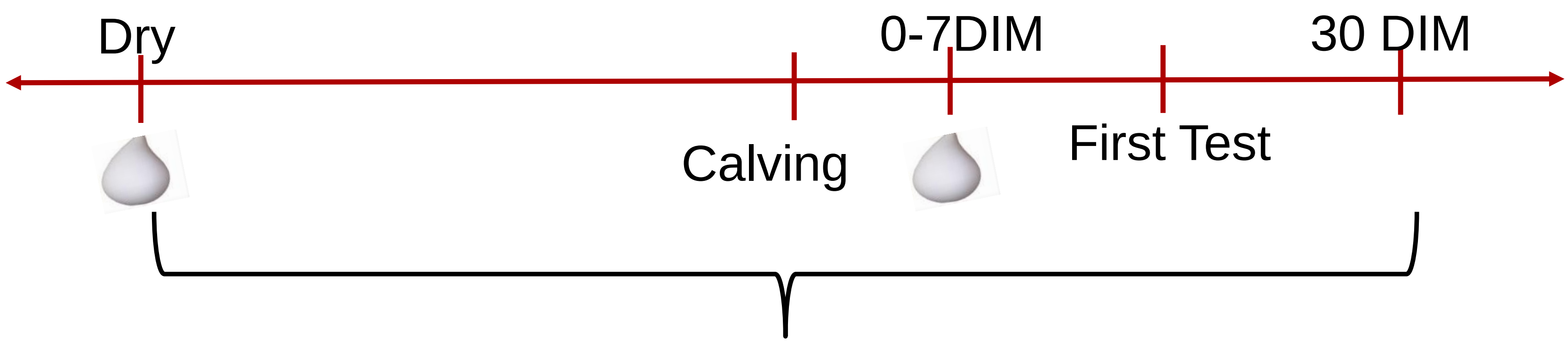
2. New Infection Risk

Several outcomes were assessed



3 & 4. First test milk production and linear score (LS)

Several outcomes were assessed



5 & 6. Risk of survival and clinical mastitis up to 30 DIM

Statistics: Models

SAS version 9.4

Covariates Explored

- Dry period length
- LS at last test
- Milk at last test
- Days in milk at data/sample retrieval
- Parity
- Previous mastitis event (yes, no)
- Organism present at fresh or dry

Bivariate Analysis

Covariates vs. Outcome

- X^2
- t-tests
- analysis of variance
- Interactions
- PROC FREQ, TTEST, ANOVA

Statistics: Models

SAS version 9.4

Regression analysis

- Continuous variables: generalized linear regression models (PROC MIXED)
- Binary outcomes:

  binomial logistic regression (PROC LOGISTIC)

Model Building

- Terms/interactions $P \leq 0.2$ in bivariate analysis offered into model
- Backwards stepwise removal of explanatory variables until all terms included have $P \leq 0.1$
- **Treatment forced**

Results

There were similar numbers of cows and quarters in each treatment group

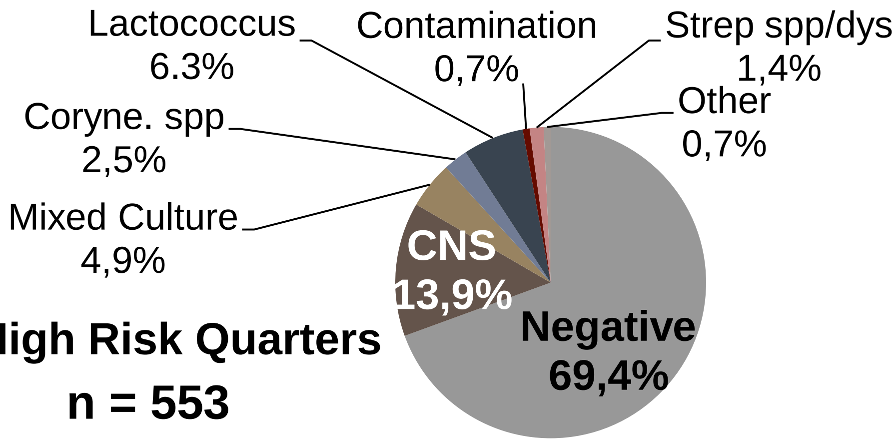
	ABXTS	TS	Total
Cows	304	307	611
Quarters	1040	1058	2098
Percentage	**50%**	**50%**	

Pre "treatment" quarter-level culture results at dry-off

	Treatment Group				
	TS (n =1204)		ABXTS (n =1183)		*P*-value
	n	%	n	%	
Negative	1086	90.2	1064	90.0	0.84
Coagulase negative *Staphylococcus* spp.	59	4.9	78	6.6	0.08
Mixed Growth	22	1.8	20	1.7	0.88
Corynebacterium spp.	24	2.0	12	1.0	0.06
Lactococcus spp.	5	0.4	4	0.3	> 99.99
Streptococcus spp.	2	0.2	1	0.1	> 99.99
Other	6	0.5	4	0.3	0.75
Total intramammary infections	114	9.5	115	9.7	0.84

Algorithm Performance:

Positive Predictive Value = 71%
Negative Predictive Value = 70%

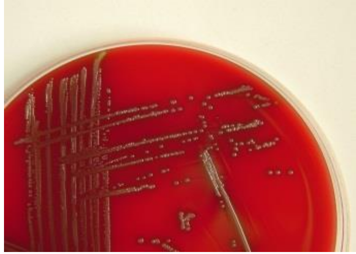


High Risk Quarters
n = 553

Models

1. Does not treating low risk quarters at dry off lead to…

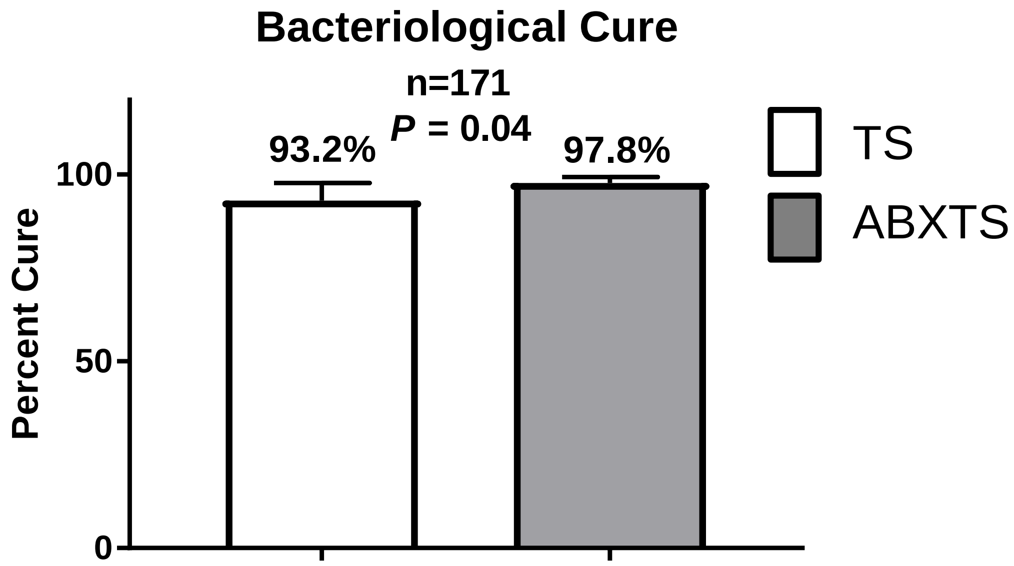
Decreased **bacteriological cure** over the dry period?



YES! Risk of cure is higher for the antimicrobial treated quarters

Logistic regression model for bacteriological cure n=171

Parameter	**Estimate**	**SE**	***P*-value**	**Odds Ratio**	**95%CI**
Intercept	6.25	1.30	<0.0001		
Treatment group			0.04		
TS	-1.12	0.55		0.32	0.11-0.96
ABXTS	Referent				
Organism cultured at dry			0.03		
CNS	-2.33	1.05		0.10	0.01-0.80
Other	Referent				
Days in milk at fresh sample	-0.52	0.16	0.002		



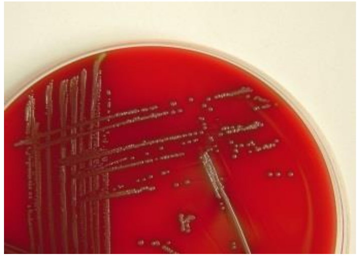
Bacteriological Cure
n=171
P = 0.04
93.2%
97.8%
Percent Cure
100
50
0
TS
ABXTS

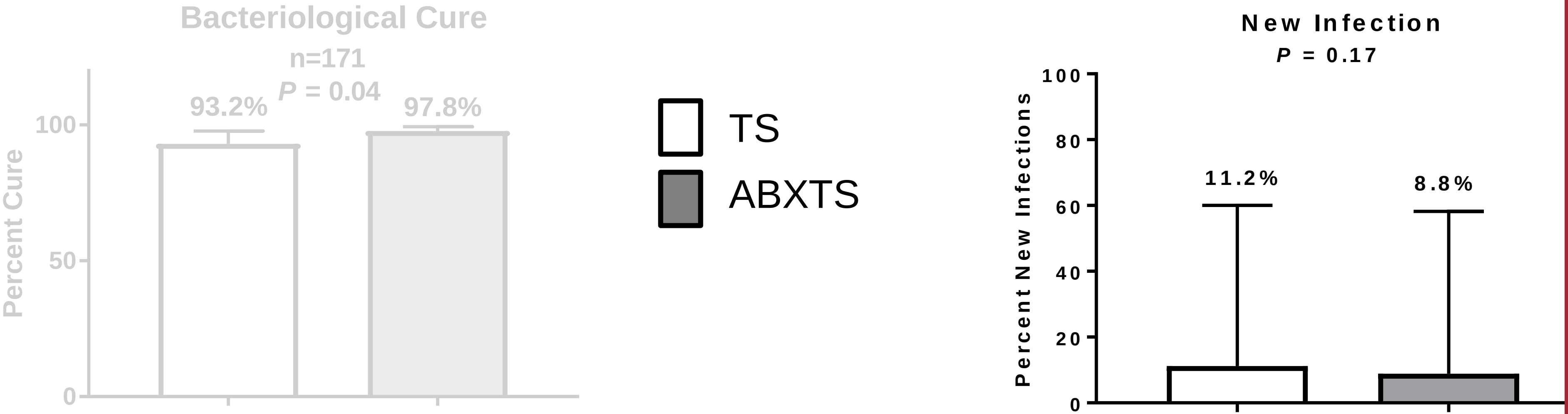
20 samples did not cure:
95% were Coagulase-negative Staph (CNS)

	Treatment		
Non-cures: Fresh Culture	**TS**	**ABXTS**	**Total**
No Growth	0	0	0
Coagulase-negative Staph (CNS)	13	6	19
Strep dysgalactiae	1	0	1
Strep uberis	0	0	0
Enterococcus	0	0	0
Lactococcus	0	0	0

2. Does not treating low risk quarters at dry off lead to…

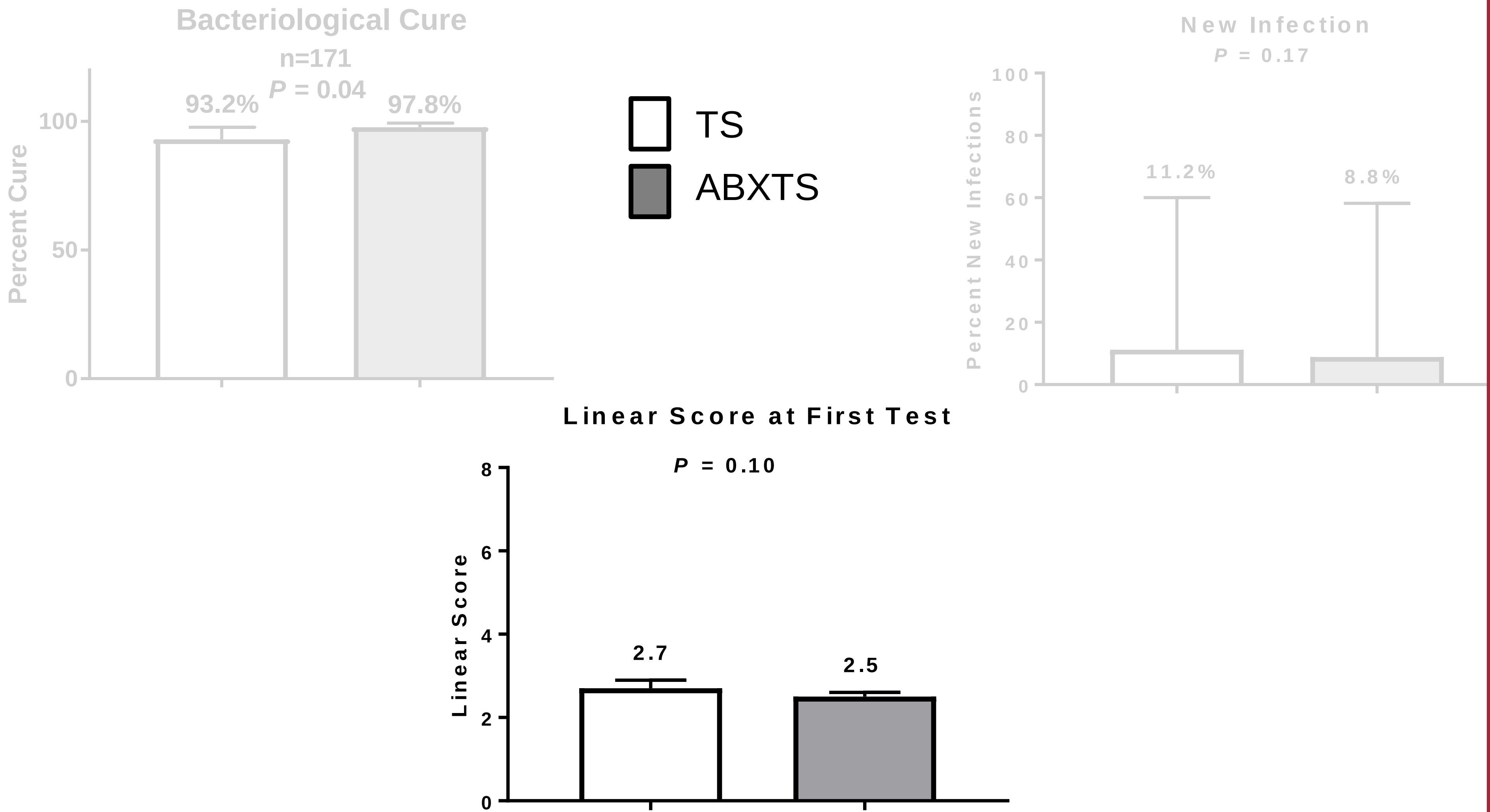
Increased **new infection** risk over the dry period?




Bacteriological Cure
n=171
P = 0.04
93.2%
97.8%
Percent Cure
100
50
0
TS
ABXTS
New Infection
P = 0.17
Percent New Infections
100
80
60
40
20
0
11.2%
8.8%

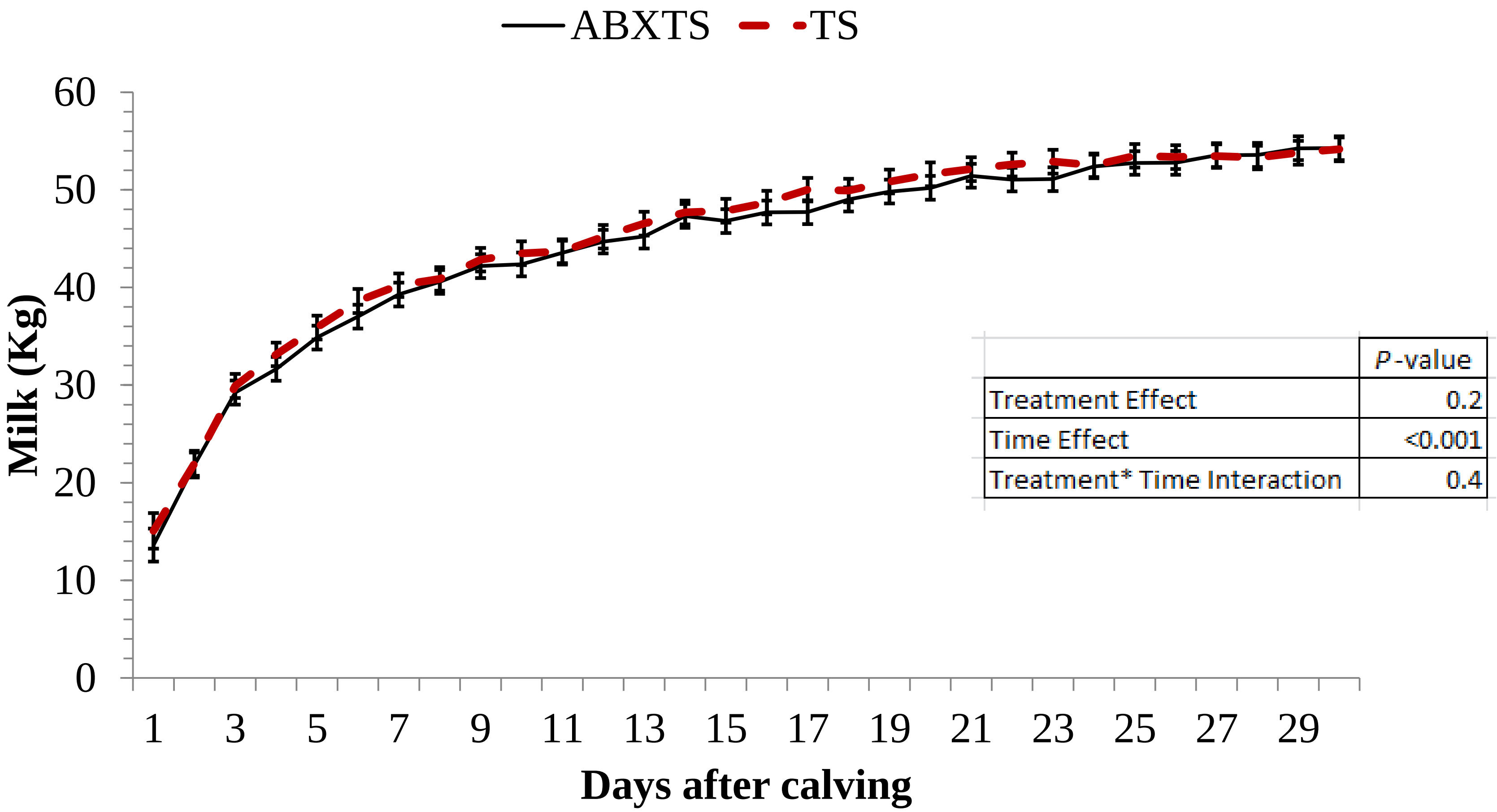
3. Does not treating low risk cows at dry off lead to…

Differences in **LS** at first test?


Bacteriological Cure
n=171
P = 0.04
Percent Cure
100
50
0
93.2%
97.8%
TS
ABXTS
New Infection
P = 0.17
Percent New Infections
100
80
60
40
20
0
11.2%
8.8%
Linear Score at First Test
P = 0.10
Linear Score
8
6
4
2
0
2.7
2.5

Milk production within the first 30 days fresh

Milk yield over the first 30 days was similar between groups



	P-value
Treatment Effect	0.2
Time Effect	<0.001
Treatment* Time Interaction	0.4

5. Does not treating low risk quarters at dry off lead to…

Increased **culling and mastitis** within the first 30 days fresh?

Culling and Mastitis

	ABXTS	TS	P-value
Died/culled <30 DIM	18	15	0.6
Mastitis <30 DIM	9	5	0.33
Total Cows with data	304	307	

~$7,000 per 1000 cows

Conclusions

- The impact of CNS needs to be further investigated
- Similar algorithms at appropriate dairies can produce economic returns and promote aspects of public health
- The proposed algorithm reduced antimicrobial use by 64% without adversely affecting production and clinical health outcomes

J. Dairy Sci. 101:1–17
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

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*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

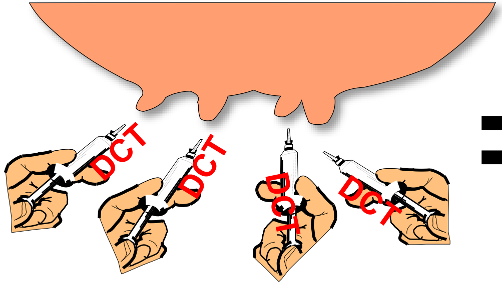
Applications:

- ❖ Additional Farms
- ❖ Alter sensitivity?
- ❖ Comparison to other SDCT programs

Current Project

Primary Objective

Null Hypothesis:



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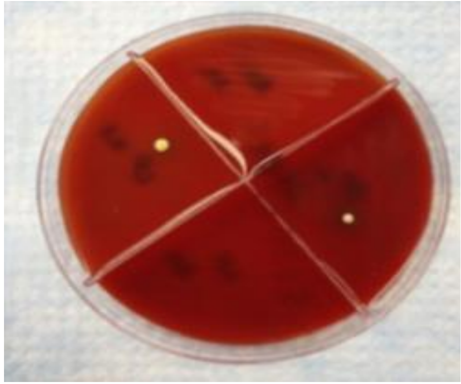

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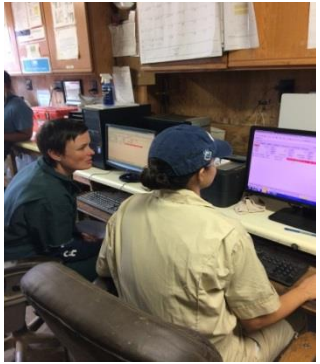
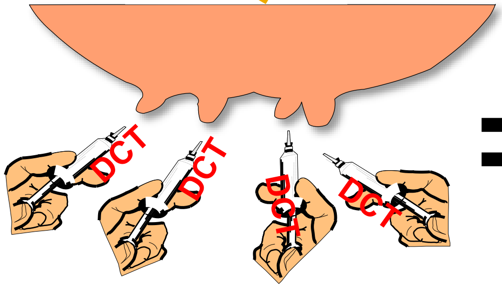


Blanket

Culture

Algorithm

2nd Objective



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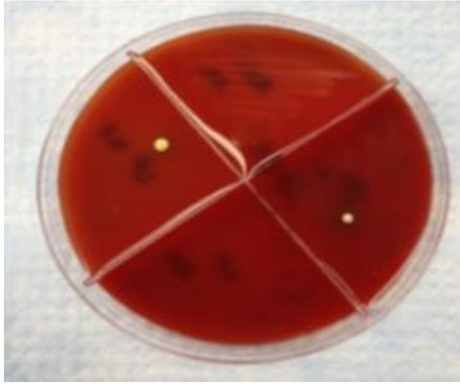

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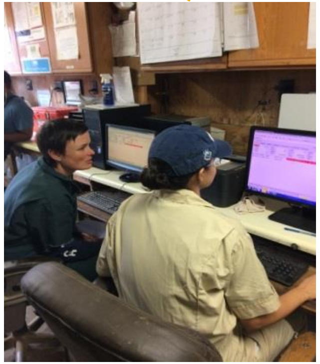
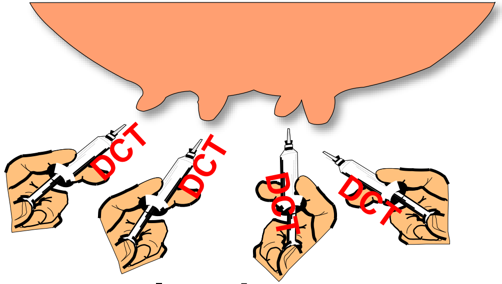


Blanket

Culture

Algorithm

3rd Objective:



Blanket

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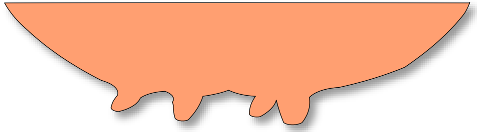
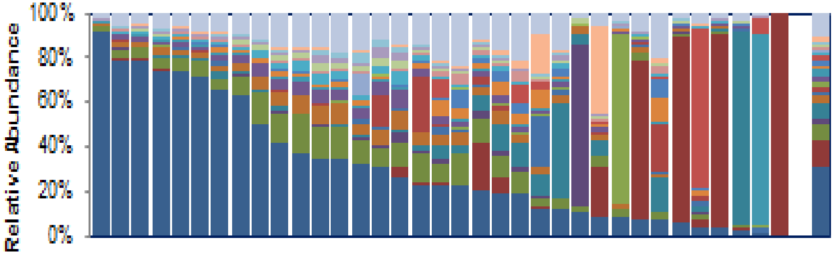
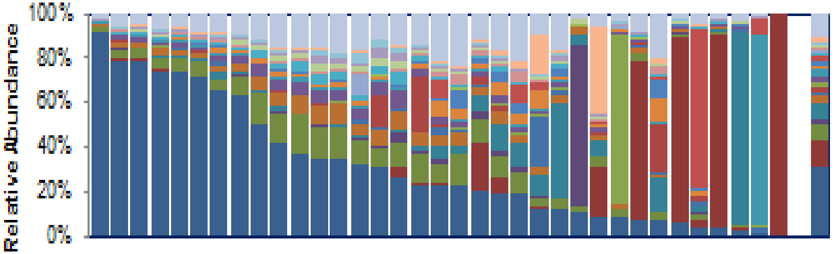


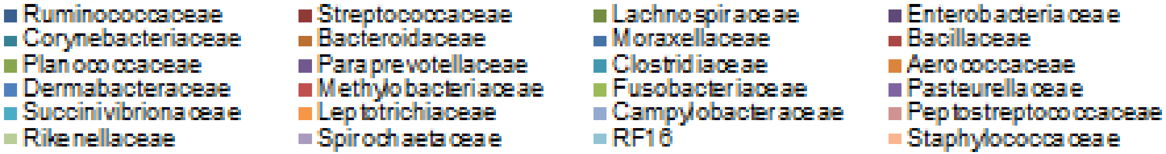
Untreated



Before Dry-off



After Freshening



4th Objective

Identifying and treating ONLY cows/quarters that currently have or are at risk for infections

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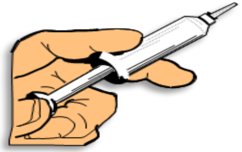
Currently available tools for identifying cows:

Cowside

Take Home Messages

- SDCT ↓  ⇦
  - Economically beneficial option vs blanket therapy in many studies (the right herds)
  - no appreciable negative outcomes
  - multiple ways of applying

- Lots more exploring to do!

Treat a dry cow as a Princess

Adapted from Lely

Acknowledgments

- Funding
  - Engaged Cornell
  - NY Farm Viability Institute
  - Academic Venture Fund
- Farm management and employees
- QMPS Staff and Veterinarians
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  - Monique Obsharski
  - Anne Hesse
  - Wolfgang Heuwieser
  - Rachel Murphy
  - Germán Granados
  - Anja Sipka
  - Valeria Alanis

Cornell University

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Economics of Algorithm

		Cost of Dry Cow Tx Per Cow												
	$6.87	$6	$7	$8	$9	$10	$11	$12	$13	$14	$15	$16	$17	$18
% Cows Treated	0%	$7.07	$8.07	$9.07	$10.07	$11.07	$12.07	$13.07	$14.07	$15.07	$16.07	$17.07	$18.07	$19.07
	10%	$6.36	$7.26	$8.16	$9.06	$9.96	$10.86	$11.76	$12.66	$13.56	$14.46	$15.36	$16.26	$17.16
	20%	$5.66	$6.46	$7.26	$8.06	$8.86	$9.66	$10.46	$11.26	$12.06	$12.86	$13.66	$14.46	$15.26
	30%	$4.95	$5.65	$6.35	$7.05	$7.75	$8.45	$9.15	$9.85	$10.55	$11.25	$11.95	$12.65	$13.35
	40%	$4.24	$4.84	$5.44	$6.04	$6.64	$7.24	$7.84	$8.44	$9.04	$9.64	$10.24	$10.84	$11.44
	50%	$3.53	$4.03	$4.53	$5.03	$5.53	$6.03	$6.53	$7.03	$7.53	$8.03	$8.53	$9.03	$9.53
	60%	$2.83	$3.23	$3.63	$4.03	$4.43	$4.83	$5.23	$5.63	$6.03	$6.43	$6.83	$7.23	$7.63
	70%	$2.12	$2.42	$2.72	$3.02	$3.32	$3.62	$3.92	$4.22	$4.52	$4.82	$5.12	$5.42	$5.72
	80%	$1.41	$1.61	$1.81	$2.01	$2.21	$2.41	$2.61	$2.81	$3.01	$3.21	$3.41	$3.61	$3.81
	90%	$0.71	$0.81	$0.91	$1.01	$1.11	$1.21	$1.31	$1.41	$1.51	$1.61	$1.71	$1.81	$1.91
	100%	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Do we want to kill Staph spp (CNS) with Abx?

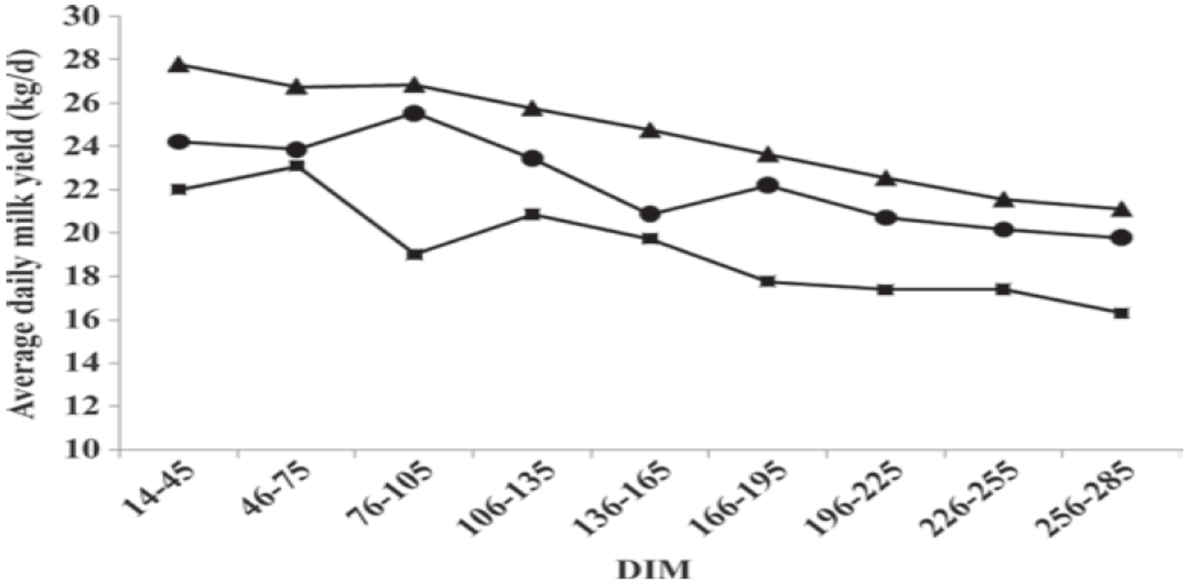

Figure 3. The actual average daily milk yield in the first 285 DIM of 85 dairy heifers that were not infected (●), infected with CNS (▲), or infected with a major pathogen (■) in early lactation.

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