Consequences of Recorded and Unrecorded Transition Disease

Michael Overton, DVM, MPVM
Elanco Knowledge Solutions – Dairy
moverton@elanco.com

Elanco

USDBUNON01903

Dairy Profitability *Simplified:*
(Milk Price – Cost of Production)*Volume of Milk

- Increase price/*value* of milk:
  - Lower somatic cell count (SCC)/improve quality
  - Increase %fat
  - Increase %protein
- Lower *cost* of production:
  - Improve labor efficiency
  - Reduce risk & impact of disease (transition issues)
  - Minimize assets per productive unit (more cows)

Related

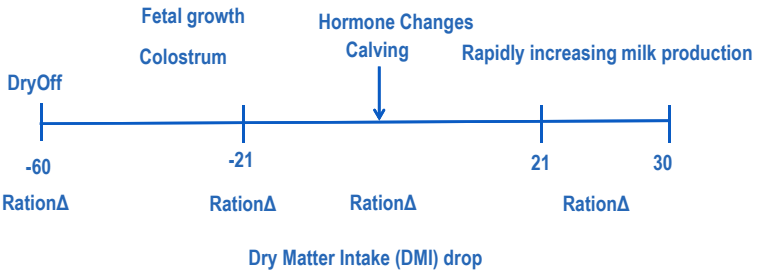
- *Volume* of milk:
  - Improve feed delivery & intake
  - Production enhancing technology
  - 3x vs. 2x milking
  - Reduce disease (transition issues)
  - Improve repro – lower Days in Milk (DIM)

Elanco | Knowledge Solutions

USDBUNON01903

THE VITAL 90™ DAYS

Transition Cow



A 90 day collection of transition periods that have interrelated events influencing either productive or non-productive outcomes in the lactation

Elanco | Knowledge Solutions

USDBUNON01903

Every Dairy Depends on Healthy and Productive Cows

- There's a critical need to help each cow reach her full potential for productivity during the lactation cycle
- Dairy producers devote a considerable amount of time and effort to prevent and treat disease during The Vital 90™ Days

Elanco | Knowledge Solutions

USDBUNON01670

Management in the Vital 90™ Days is Critical: *RISK* and *COSTS*

- *RISK*
  - The metabolic adaptation required for a successful new lactation is extraordinary
  - The preponderance of adult dairy cow diseases are related to this challenge
  - 45-60% of cows experience one or more of these diseases[1]
  - Energy balance and immune dysfunction are at the root of these diseases

[1]Santos et al, Proc. 2013 Dairy Cattle Reproduction Council Conference, Indianapolis, IN, p 32-48 .

Elanco | Knowledge Solutions

USDBUNON01903

Management Implications

- **ALL** Transition Dairy Cows Experience **Negative Nutrient Balance** and **Immune Dysfunction**
- The key issues are:
  - The degree of each (how much) and
  - The success of adaptation (how long)
- The ability to maintain DMI and energy intake prepartum and to increase each one rapidly (in a safe manner) postpartum helps:
  - Limit immune suppression
  - Improve liver health
  - Achieve optimal performance, thus reducing the consequence cost

Elanco | Knowledge Solutions

USDBUNON01903

Management in The Vital 90 Days is Critical:

RISK and *COSTS*

Two Major Types of Costs During The Vital 90 Days

Investment Costs

- Dairy producers often invest heavily to mitigate the *RISK* associated with calving
- Many products and procedures are justifiably used to reduce disease and optimize performance

Consequence Costs

- Direct and indirect costs of disease are a major source of economic loss and frustration for dairy producers
- Lowering consequence costs through reducing disease and refining treatment decisions is a great opportunity to improve profitability

Elanco | Knowledge Solutions

USDBUNON01903

Despite the Many Investments in Preventives, There are Still Many Consequences

Investments

Consequences

Transition Disorder	Incidence Range[1]
Milk Fever	0.03% - 22.3%
Ketosis	1.3% - 18.3%
Displaced Abomasum	0.3% - 6.3%
Ovarian Dysfunction	1.0% - 16.1%
Metritis	2.2% - 37.3%
Retained Placenta	1.3% - 39.2%
Mastitis	1.7% - 54.6%

[1]Kelton DF et al. 1998. JDS 81:2502-2509

Elanco | Knowledge Solutions

USDBUNON01903

Two of the Most Costly Diseases that Impact Dairy Cattle are Metritis and Mastitis

- Mastitis appears to be more consistently recorded across herds
- Metritis – much less so
  - Issues include:
    - Less consistent definition
    - Less objective approach to diagnosis
    - Cows are not necessarily being "examined" every day
- Both result in large-scale antimicrobial use
- Both issues have been associated with reduced milk production, increased culling risk, and impaired reproduction*

*Deluyker, et al., (1991). J Dairy Sci 74(2):436-445; Overton and Fetrow. (2008). Proc. of the DCRC, Omaha, Nebraska; Lee et al, (1989). J Dairy Sci 72(4):1020-1026; Wilson et al. (2004) *J Dairy Sci. 87(7):2073-2084;* Hortet & Seegers. (1998) *Prev Vet Med. 37(1-4):1-20.* Seegers et. al. (2003) Vet Res 34:475; Milian-Suazo et.al. (1988) Prev. Vet. Med 6:243; Grohn et.al. (1998) JDS 81:966; Beaudea et.al. (1995) JDS 78:103.

Elanco | Knowledge Solutions

USDBUNON01903

The Subsequent Data are from U.S. Dairy Herds that are Enrolled in Elanco's Dairy Data Access System

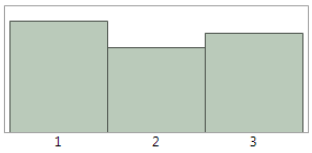
- All herds use DC305 and reported milk production data
- Initial data set had 396,000 lactation records over a 3-year period of calvings
  - Filtered to a 12-month period of calvings (8/1/13-8/1/14)
    - Allows for *at least* a 12 month follow up period after calving
  - Eliminated herds that had unreasonably low recorded incidences of mastitis and metritis (many of the removed herds failed to record one or the other)
  - Filtered to include only Holstein
  - Result: 55,643 lactation records from 20 herds
- REMEMBER: This is observational analyses of farm reported information

Elanco | Knowledge Solutions

USDBUNON01903

Descriptive Statistics for the Included Herds

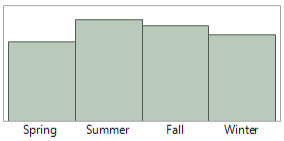
LactGrp



Frequencies		
Level	Count	Prob
1	20974	0.37694
2	16009	0.28771
3	18660	0.33535
Total	55643	1.00000

N Missing 340150
3 Levels

SeasonFsh

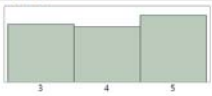


Frequencies		
Level	Count	Prob
Spring	186063	0.21921
Summer	237817	0.28018
Fall	223106	0.26285
Winter	201817	0.23777
Total	848803	1.00000

N Missing 340150
4 Levels

Distributions SeasonFsh=Spring

MonthFsh

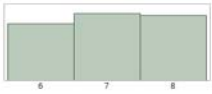


Frequencies		
Level	Count	Prob
3	3912	0.32131
4	3742	0.30735
5	4521	0.37133
Total	12175	1.00000

N Missing 72034
3 Levels

Distributions SeasonFsh=Summer

MonthFsh

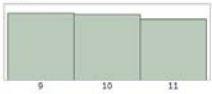


Frequencies		
Level	Count	Prob
6	4671	0.29921
7	5560	0.35616
8	5380	0.34463
Total	15611	1.00000

N Missing 93551
3 Levels

Distributions SeasonFsh=Fall

MonthFsh

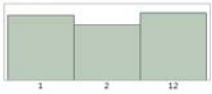


Frequencies		
Level	Count	Prob
9	5017	0.34559
10	4917	0.33871
11	4583	0.31570
Total	14517	1.00000

N Missing 94777
3 Levels

Distributions SeasonFsh=Winter

MonthFsh



Frequencies		
Level	Count	Prob
1	4645	0.34820
2	3926	0.29430
12	4769	0.35750
Total	13340	1.00000

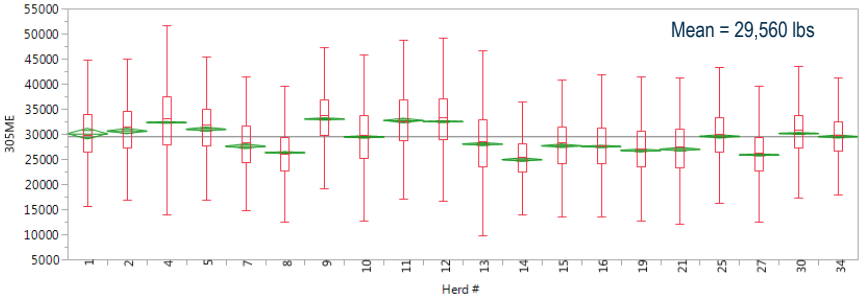
N Missing 79788
3 Levels

Elanco | Knowledge Solutions

USDBUNON01903

305ME Milk Production by Herd in Data Set

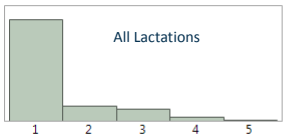
Oneway Analysis of 305ME By Herd #



Elanco | Knowledge Solutions

USDBUNON01903

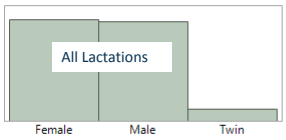
CalvEase



Frequencies

Level	Count	Prob
1	35718	0.78449
2	4861	0.10676
3	3784	0.08311
4	1008	0.02214
5	159	0.00349
Total	45530	1.00000

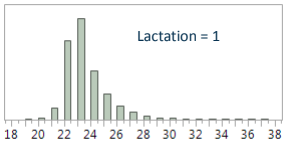
Calf Outcome M/F/Tw



Frequencies

Level	Count	Prob
Female	26673	0.47936
Male	26043	0.46804
Twin	2927	0.05260
Total	55643	1.00000

AgeAtCalving



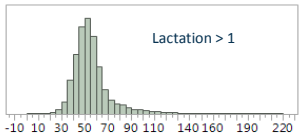
Quantiles

100.0%	maximum	37
99.5%		29
97.5%		27
90.0%		25
75.0%	quartile	24
50.0%	median	23
25.0%	quartile	22
10.0%		22
2.5%		21
0.5%		20
0.0%	minimum	19

Summary Statistics

Mean	23.341109
Std Dev	1.5815647
Std Err Mean	0.0109232
Upper 95% Mean	23.362519
Lower 95% Mean	23.319698
N	20964

DaysDry



Quantiles

100.0%	maximum	217
99.5%		128.965
97.5%		98
90.0%		72
75.0%	quartile	60
50.0%	median	52
25.0%	quartile	45
10.0%		39
2.5%		33
0.5%		24
0.0%	minimum	1

Summary Statistics

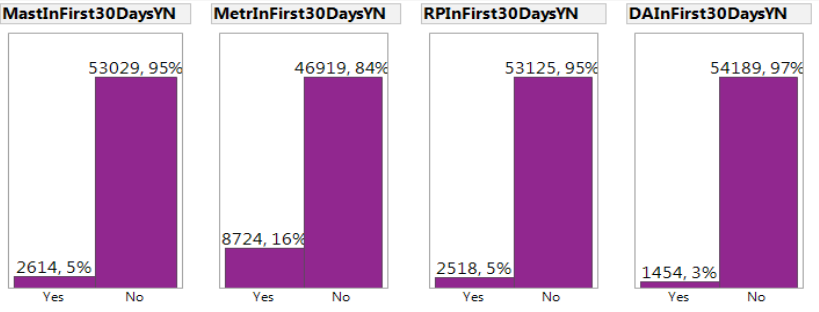
Mean	54.686384
Std Dev	16.225055
Std Err Mean	0.0872189
Upper 95% Mean	54.857336
Lower 95% Mean	54.515432
N	34606

Elanco | Knowledge Solutions

USDBUNON01903

Average Disease Incidence Across Herds (All Parities Included)

Diseases in The Vital 90 Days



Disease incidence in high producing Holstein herds that intensively detected and recorded disease[1]:

Clinical Mastitis	Clinical Metritis	Retained Placenta	Displaced Abomasum
5.5 – 26.1%	18.5 – 27.6%	2.9 – 15%	1.0 – 6%

[1]Santos et al., 2015. proceedings of the Dairy Cattle Reproduction Council, p 3-9, Buffalo, NY.

Elanco | Knowledge Solutions

USDBUNON01903

Milk Production Impact for Mastitis and Metritis

- Goal: derive estimates for milk loss for major postparturient issues using commercial data
- Approach:
  - Multivariate modeling for milk production as the outcome:
    - 2nd test 305me, Milk120, 305me
  - Factors in the model (separate models for lactation =1 and lactation >1):
    - Lact=1: Herd, Season fresh, Mastitis, Metritis, RP, and DA
    - Lact>1: Herd, Season fresh, Mastitis, Metritis, RP, DA, LactGrp and PrevLact305me

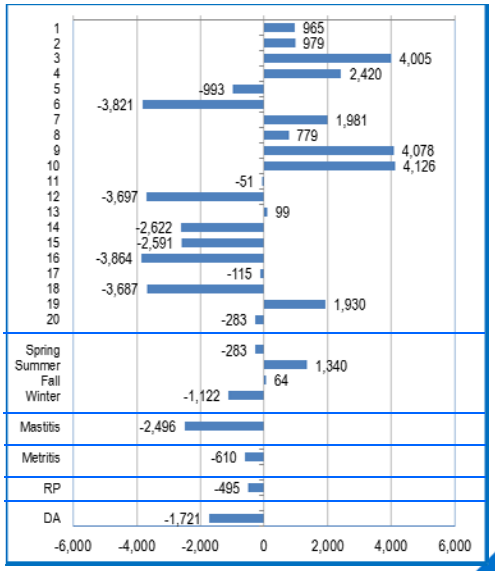
Elanco | Knowledge Solutions

USDBUNON01903

Lactation = 1 Milk Model Results (305ME)

- Final model:
  - = Intercept (29,778)
  - + Herd
  - + Season fresh
  - + Mastitis (yes/no)
  - + Metritis (yes/no)
  - + RP (yes/no)
  - + DA (yes/no)

Mastitis = -2,496 lbs
Metritis = -610 lbs
RP = -495 lbs
DA = -1,721 lbs



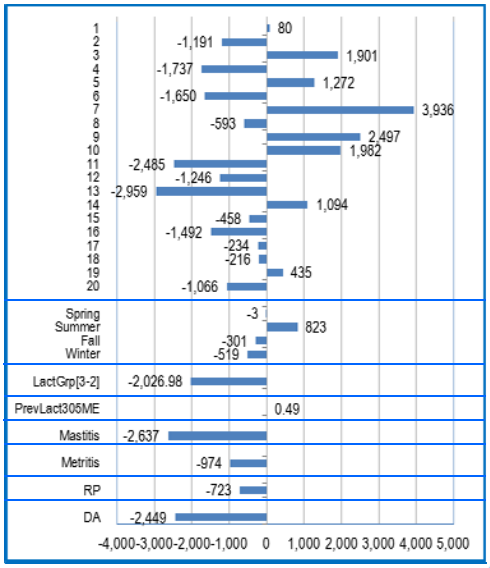
Elanco | Knowledge Solutions

USDBUNON01903

Lactation > 1 Milk Model Results (305ME)

- Final model:
  - = Intercept (14,726)
  - + Herd
  - + Season fresh
  - + LactGrp (2,3)
  - + PrevLact305me
  - + Mastitis (yes/no)
  - + Metritis (yes/no)
  - + RP (yes/no)
  - + DA (yes/no)

Mastitis = -2,637 lbs
Metritis = -974 lbs
RP = -723 lbs
DA = -2,449 lbs



Elanco | Knowledge Solutions

USDBUNON01903

To Examine the Association Between Disease and Culling, Used Multivariate Approach with Separate Models (Primiparous and Multiparous)

- Primiparous model
  - Herd
  - Season fresh
  - Age at Calving
  - 305me
  - Metritis
  - Mastitis
  - RP
  - DA
- Multiparous model
  - Herd
  - Season fresh
  - LactGrp
  - 305me
  - Metritis
  - Mastitis
  - RP
  - DA

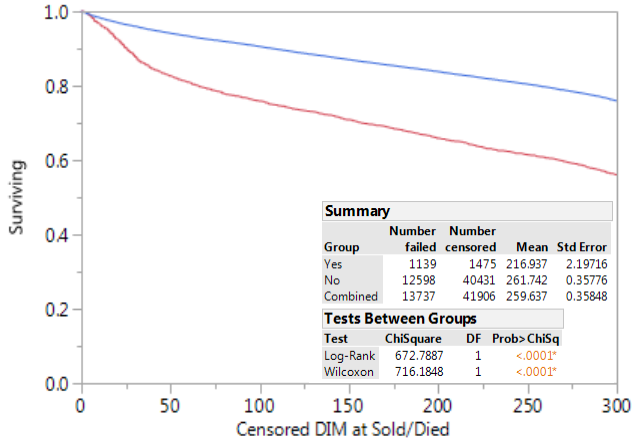
Elanco | Knowledge Solutions

USDBUNON01903

Time to Removal (Sold or Died)
Univariate Survival Plot for Mastitis (within 1st 30 DIM) Yes/No

Product-Limit Survival Fit

Survival Plot



Summary

Group	Number failed	Number censored	Mean	Std Error
Yes	1139	1475	216.937	2.19716
No	12598	40431	261.742	0.35776
Combined	13737	41906	259.637	0.35848

Tests Between Groups

Test	ChiSquare	DF	Prob>ChiSq
Log-Rank	672.7887	1	<.0001*
Wilcoxon	716.1848	1	<.0001*

Elanco | Knowledge Solutions

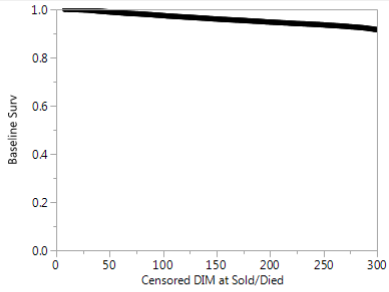
USDBUNON01903

Mastitis and Metritis Impact on Primiparous Culling (Sold & Died)

Proportional Hazards Fit

Censored By: Censor Variable for DIM at Sold/Died

Baseline Survival at mean



Effect Wald Tests

Source	Nparm	DF	Wald ChiSquare	Prob>ChiSq
SeasonFsh	3	3	26.179873	<.0001*
MastInFirst30DaysYN	1	1	6.97844158	0.0082*
MetrInFirst30DaysYN	1	1	7.11130456	0.0077*
DAInFirst30DaysYN	1	1	18.865637	<.0001*
AgeAtCalving	1	1	8.28859222	0.0040*
305ME	1	1	3520.99621	<.0001*

Risk Ratios

Unit Risk Ratios

Per unit change in regressor

Term	Risk Ratio	Lower 95%	Upper 95%	Reciprocal
AgeAtCalving	1.032573	1.010285	1.055353	0.9684545
305ME	0.999812	0.999806	0.999818	1.0001881

Risk Ratios for SeasonFsh

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
Summer	Spring	1.1941719	0.0017*	1.069145	1.3341113
Fall	Spring	1.2060312	0.0006*	1.0834695	1.3430592
Fall	Summer	1.009931	0.8524	0.9101631	1.1208921
Winter	Spring	0.9730387	0.6264	0.8717521	1.0863647
Winter	Summer	0.814823	0.0002*	0.7318428	0.907239
Winter	Fall	0.8068105	<.0001*	0.727115	0.8950638
Spring	Summer	0.8374004	0.0017*	0.7495626	0.9353268
Spring	Fall	0.8291659	0.0006*	0.7445688	0.9229609
Summer	Fall	0.9901666	0.8524	0.8921466	1.0987042
Spring	Winter	1.0277083	0.6264	0.9205011	1.1471151
Summer	Winter	1.2272604	0.0002*	1.1022454	1.3664136
Fall	Winter	1.2394484	<.0001*	1.1172388	1.3752982

Risk Ratios for MastInFirst30DaysYN

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
No	Yes	0.8113516	0.0103*	0.697081	0.9508
Yes	No	1.2325113	0.0103*	1.0517459	1.4345535

Risk Ratios for MetrInFirst30DaysYN

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
No	Yes	0.8892104	0.0082*	0.8161477	0.9699326
Yes	No	1.1245932	0.0082*	1.0309995	1.2252685

Risk Ratios for DAInFirst30DaysYN

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
No	Yes	0.5283084	<.0001*	0.4010188	0.7141856
Yes	No	1.8928337	<.0001*	1.4001963	2.4936489

Elanco | Knowledge Solutions

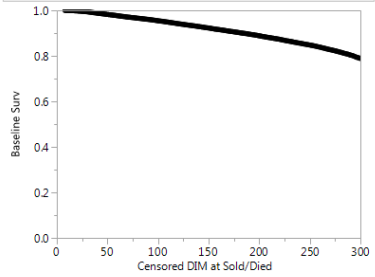
USDBUNON01903

Disease Associations with Multiparous Culling Risk

Proportional Hazards Fit

Censored By: Censor Variable for DIM at Sold/Died

Baseline Survival at mean



Effect Wald Tests

Source	Nparm	DF	Wald ChiSquare	Prob>ChiSq
LactGrp	1	1	192.456658	<.0001*
SeasonFsh	3	3	97.707455	<.0001*
305ME	1	1	7975.54879	<.0001*
MastInFirst30Days	1	1	7.91039993	0.0049*
MetrInFirst30Days	1	1	5.29110724	0.0214*

Risk Ratios

Unit Risk Ratios

Per unit change in regressor

Term	Risk Ratio	Lower 95%	Upper 95%	Reciprocal
305ME	0.999835	0.999831	0.999838	1.0001653

Risk Ratios for LactGrp

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
3	2	1.3646458	<.0001*	1.3061155	1.4260488
2	3	0.7327909	<.0001*	0.7012383	0.7656291

Risk Ratios for SeasonFsh

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
Summer	Spring	1.2164428	<.0001*	1.1454941	1.2920751
Fall	Spring	0.9487332	0.0960	0.8918539	1.0093968
Fall	Summer	0.7799243	<.0001*	0.7372747	0.8249844
Winter	Spring	0.9662811	0.2808	0.9079823	1.0284647
Winter	Summer	0.7943498	<.0001*	0.7505604	0.8406216
Winter	Fall	1.0184961	0.5384	0.9607196	1.0797281
Spring	Summer	0.8220691	<.0001*	0.7739488	0.8729857
Spring	Fall	1.0540371	0.0960	0.9906907	1.1212599
Summer	Fall	1.2821758	<.0001*	1.2121441	1.3563466
Spring	Winter	1.0348955	0.2808	0.9723231	1.1013431
Summer	Winter	1.2588912	<.0001*	1.1895959	1.3323379
Fall	Winter	0.9818398	0.5384	0.9261591	1.0408864

Risk Ratios for MastInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	1.1183186	0.0056*	1.0336309	1.207989
0	1	0.8941996	0.0056*	0.8278221	0.9674633

Risk Ratios for MetrInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	1.0744061	0.0226*	1.0102124	1.1416496
0	1	0.9307468	0.0226*	0.8759255	0.9898909

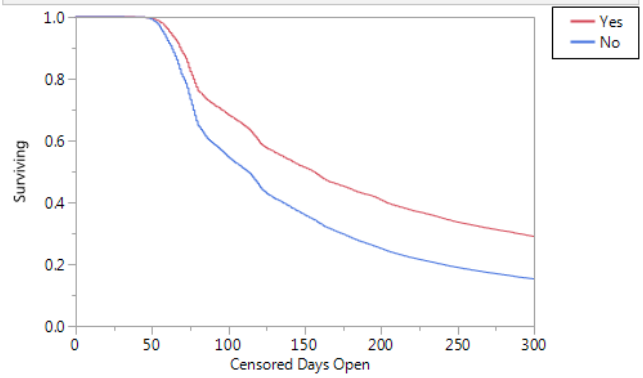
Elanco | Knowledge Solutions

USDBUNON01903

Time-to-Pregnancy
Univariate Survival Plot for Metritis (within 1st 30 DIM) Yes/No

Product-Limit Survival Fit

Survival Plot



Time to event: Censored Days Open
Censored by Censor Variable for Days Open
Censor Code 1
Grouped by MetrInFirst30DaysYN

Elanco | Knowledge Solutions

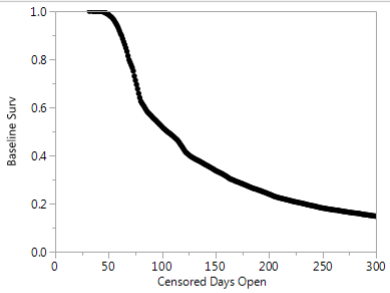
USDBUNON01903

Disease Associations with **Primiparous** Reproductive Performance

Proportional Hazards Fit

Censored By: Censor Variable for Days Open

Baseline Survival at mean



Effect Wald Tests

Source	Nparm	DF	Wald ChiSquare	Prob>ChiSq
SeasonFsh	3	3	67.3648366	<.0001*
AgeAtCalving	1	1	50.1498739	<.0001*
MastInFirst30Days	1	1	1.96833884	0.1606
MetrInFirst30Days	1	1	399.166461	<.0001*
RPInFirst30Days	1	1	66.5521105	<.0001*
DAInFirst30Days	1	1	19.4237897	<.0001*

305me was NOT significant

Risk Ratios

Unit Risk Ratios

Per unit change in regressor

Term	Risk Ratio	Lower 95%	Upper 95%	Reciprocal
AgeAtCalving	0.963899	0.95414	0.973758	1.037453

Risk Ratios for SeasonFsh

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
Summer	Spring	1.1386552	<.0001*	1.0902097	1.1893227
Fall	Spring	1.0936209	<.0001*	1.0463686	1.1430559
Fall	Summer	0.9604496	0.0593	0.9209922	1.0015819
Winter	Spring	0.9698636	0.1910	0.9263731	1.0153818
Winter	Summer	0.8517624	<.0001*	0.8151412	0.8899645
Winter	Fall	0.8868371	<.0001*	0.8481953	0.9271869
Spring	Summer	0.878229	<.0001*	0.8408147	0.9172548
Spring	Fall	0.9143936	<.0001*	0.8748478	0.9556862
Summer	Fall	1.041179	0.0593	0.9984206	1.0857856
Spring	Winter	1.0310728	0.1910	0.9848512	1.0794786
Summer	Winter	1.1740364	<.0001*	1.1236404	1.2267814
Fall	Winter	1.1276028	<.0001*	1.0785312	1.1789737

Risk Ratios for MastInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	0.9384734	0.1565	0.8577436	1.0242997
0	1	1.0655603	0.1565	0.9762768	1.1658495

Risk Ratios for MetrInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	0.660143	<.0001*	0.6336819	0.6874794
0	1	1.5148234	<.0001*	1.454589	1.5780788

Risk Ratios for RPInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	0.6497435	<.0001*	0.5849044	0.7195942
0	1	1.5390689	<.0001*	1.3896722	1.7096812

Risk Ratios for DAInFirst30Days

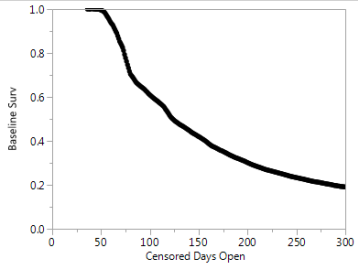
Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	0.6612305	<.0001*	0.5470143	0.7905516
0	1	1.5123319	<.0001*	1.2649396	1.8281057

Disease Associations with **Multiparous** Reproductive Performance

Proportional Hazards Fit

Censored By: Censor Variable for Days Open

Baseline Survival at mean



Effect Wald Tests

Source	Nparm	DF	Wald ChiSquare	Prob>ChiSq
LactGrp	1	1	203.773251	<.0001*
SeasonFsh	3	3	19.7152636	0.0002*
305ME	1	1	62.9989019	<.0001*
MastInFirst30Days	1	1	22.5439609	<.0001*
MetrInFirst30Days	1	1	270.502358	<.0001*
RPInFirst30Days	1	1	33.4866913	<.0001*
DAInFirst30Days	1	1	17.1187272	<.0001*

Risk Ratios

Unit Risk Ratios

Per unit change in regressor

Term	Risk Ratio	Lower 95%	Upper 95%	Reciprocal
305ME	1.000008	1.000006	1.000011	0.9999915

Risk Ratios for LactGrp

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
3	2	0.8274716	<.0001*	0.8062301	0.8492675
2	3	1.2085008	<.0001*	1.1774853	1.2403407

Risk Ratios for SeasonFsh

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
Summer	Spring	1.0446834	0.0196*	1.007028	1.0838155
Fall	Spring	1.0879727	<.0001*	1.048104	1.1294117
Fall	Summer	1.0414378	0.0220*	1.0058669	1.0782492
Winter	Spring	1.0412251	0.0377*	1.0023017	1.0816903
Winter	Summer	0.9966897	0.8557	0.9616711	1.0329475
Winter	Fall	0.9570324	0.0172*	0.9230475	0.992249
Spring	Summer	0.9572278	0.0196*	0.9226663	0.993021
Spring	Fall	0.9191407	<.0001*	0.8854167	0.9541038
Summer	Fall	0.960211	0.0220*	0.9274294	0.9941673
Spring	Winter	0.9604071	0.0377*	0.924479	0.9977036
Summer	Winter	1.0033213	0.8557	0.9681035	1.0398566
Fall	Winter	1.0448967	0.0172*	1.0078116	1.0833679

Risk Ratios for MastInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	0.850972	<.0001*	0.7955957	0.9089923
0	1	1.1751268	<.0001*	1.1001193	1.2569199

Risk Ratios for MetrInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	0.6668628	<.0001*	0.6352538	0.6996608
0	1	1.4995588	<.0001*	1.429264	1.574174

Risk Ratios for RPInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	0.8147584	<.0001*	0.7597148	0.8728207
0	1	1.2273578	<.0001*	1.1457106	1.3162834

Risk Ratios for DAInFirst30Days

Level1	/Level2	Risk Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	0.8473551	<.0001*	0.7826558	0.91566
0	1	1.1801428	<.0001*	1.0921084	1.2777008

Lots of Data….What Does it All Mean?

- Cows with mastitis were predicted to:
  - Lose ~2,500 lbs of 305ME
  - ~1.12-1.23 X higher odds to be culled by 300 DIM
  - ~0.85-0.94 X lower odds to become pregnant by 300 DIM
- Cows with metritis were predicted to lose:
  - ~600-975 lbs of 305ME
  - 1.07-1.12 X higher odds to be culled by 300 DIM
  - ~0.66 X lower odds to become pregnant by 300 DIM
- Due to inadequate/ inconsistent disease definitions, as well as detection and recording issues, the true impact in the dairy industry is likely greater than this review shows

Estimating Cost of Disease: Issues that Need to be Considered

- **Direct disease costs**:
  - Diagnostics – is there any kind of special screening or lab test that is performed?
  - Therapeutics – what are the various antimicrobials, supportives, anti-inflammatories, etc that are used in treatment?
  - Discarded milk – how much milk is being discarded and for how long? What is the true value of this milk? Is it used to feed calves or discarded?
  - Veterinary service – is the vet involved with either diagnosis or treatment of this issue?
  - Labor – how much of my on-farm labor's time is used to diagnose or treat this issue?
  - Death – how many cows die as a consequence of this disease and what is the true economic impact to the dairy?

Estimating Cost of Disease: Issues that Need to be Considered

- **Indirect disease costs**:
  - Milk production loss – how much marginal milk is NOT produced throughout lactation as a result of this disease issue and what is that worth?
  - Culling loss – how many cows leave the herd prematurely as a consequence of this issue and what is the economic impact to the dairy?
  - Reproductive loss – how much is my reproductive performance negatively impacted by this issue and what could that be costing the herd?
  - Losses due to other attributable disease issues – are there any other disease issues that are impacted by the occurrence of this issue?

Elanco | Knowledge Solutions

USDBUNON01903

The Economic Assessment Tool

Goal: To estimate the total cost incurred by cows during The Vital 90 Days, *excluding basic ration and housing costs*.

Questions:

- How much does your dairy spend on prevention and treatment?
- What are your herd's transition disease costs?
- **What is the cost to get a cow in your herd through The Vital 90 Days?**
- What if the transition disease incidence were different?

Data Inputs:

- General herd parameters
- Preventive protocols
- Treatment protocols
- Disease incidence

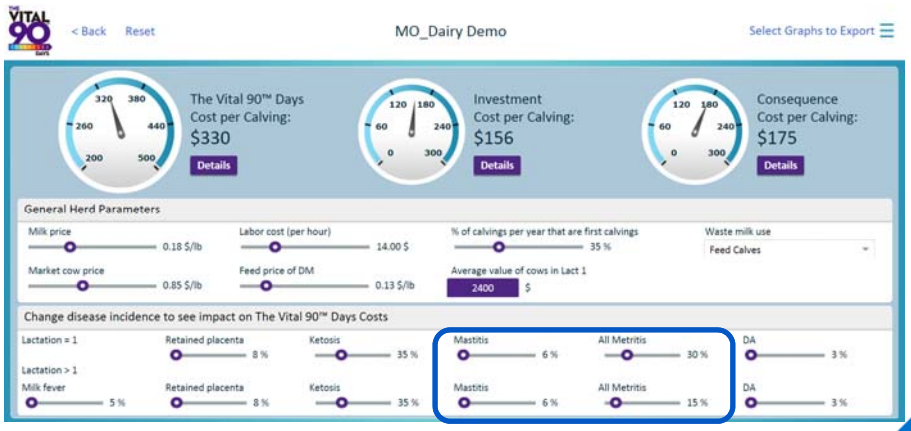
Modeling:

- Cost analysis and "what if" scenarios

Elanco | Knowledge Solutions

USDBUNON01903

Outputs of the Economic Assessment Tool



Elanco | Knowledge Solutions

USDBUNON01903

Results of the Elanco Mastitis Cost Calculator:

Assumptions Throughout All Scenarios:

% Mild Mastitis	50%	Milk Price	$20
% Moderate Mastitis	40%	Market cows ($/lb)	$ 0.75
% Severe Mastitis	10%	Replacement heifers	$ 1,900
Recurrence risk (% with 2nd case)	32%	Feed cost/ lb DM	$ 0.13
Recurrence risk (% with 3rd case)	13%	Labor/ hr	$15

Elanco | Knowledge Solutions

USDBUNON01670

Results of the Elanco Metritis Cost Calculator:

	All Cows	Lact = 1	Lact > 1
Mild Metritis	15%	25%	10%
Severe Metritis	5%	5%	5%
Total Metritis Incidence (All Metritis)	**20%**	**30%**	**15%**

Elanco | Knowledge Solutions

USDBUNON01670

Even the Best Economic Models are Severely Limited in Utility if the Input Data is Inconsistent or Inaccurate

- Disease records are extremely variable. Inconsistencies may preclude us from making faster advances in
  - understanding the impact of disease on cow performance
  - understanding the relationship between diseases
  - rate of genetic progress
- What if the disease definition used was different?
- What if the detection approach used was different?
- What if the herd inconsistently recorded it?
- It is CRITICAL that we work towards more consistent disease definitions, detection and recording
  - Disease treatment protocols with standardized recording can really help this effort

Elanco | Knowledge Solutions

USDBUNON01903

Steps to Making Impactful Decisions with Disease Records

- Define and describe disease issues
  - Consistent definitions are key to training and consistency
- Monitor and detect disease issues
  - Strategic and consistent approach to monitoring cows and detection of disease is critical
- Record and treat using protocols
  - Standardized protocols simplify treatment decisions, data recording & entry into record system
- Analyze results and modify management as needed
  - Routine, consistent approaches to records review can lead to more timely and accurate decision making and greater profitability

Elanco | Knowledge Solutions

USDBUNON01670

(Define and Describe)

Common Disease Issues that Should be Properly Defined On-Farm

- Milk Fever
- Retained Placenta
- Ketosis
  - Hyperketonemia: ≥ 1200 µmol/L (serum) or ≥ 100 umol/L (milk)
    - Clinical ketosis
- Metritis – mild and severe
- Clinical Mastitis – mild, moderate, and severe
- Displaced Abomasum
- Ovarian Dysfunction (+/-)
- Lameness - Foot and leg problems
- Pneumonia

Elanco | Knowledge Solutions

USDBUNON01670

(Define and Describe)

Disease Definitions - Example

Clinical Mastitis (MAST)

- Description: Mastitis is an inflammation of the mammary gland. Clinical mastitis is characterized by visibly abnormal milk (e.g., clots or flakes and may be watery or discolored).
- Definition: MAST is recognized by visually abnormal milk from a quarter. Clinical mastitis is further classified as mild, moderate, or severe
  - Mild: Abnormal milk only
  - Moderate: Abnormal milk + inflammed udder
  - Severe: Abnormal milk + inflammed udder + sick cow

Adapted from Kelton, 1998. J Dairy Sci 81:81:2502–2509.

Elanco | Knowledge Solutions

USDBUNON01903

(Record and Treat)

Together with the Standardized Definition, There Should be a Standardized Recording Approach

##	Protocol	Event	REMark	Pen	Milk	Meat	Days
1	PIRSUE.IMM	MAST	PIR2QQ.S	99	2	9	2
2	HETACIN-K.IMM	MAST	HET3QQ.S	99	3	10	3

REMark setup/ details (DC305 example): There are 8 characters per remark and are represented as 12345678.

123 A unique 3 letter pattern for the protocol used :
(HET = Hetacin-K, TOD = Today, MOX = Amoximast, SLC=Spectramast LC, PIR=Pirsue)

4 The labeled number of days the cow is on the protocol (typically 2-8)

56 Remark of the affected quarter: in the protocol set up, the placeholders are identified as QQ but in the actual REM, they are recorded as RF, RH, LF, LH or MQ for multiple quarters.

7 Use a period (.) Aids in later data retrieval – VERY important

8 A severity rating
1 - Mild - abnormal milk only
2 - Moderate - abnormal milk and swollen quarter
3 - Severe - abnormal milk, swollen quarter, sick cow

Example: **HET3LF.1** = Hetacin-K IMM for 3 days in left front quarter. Severity rating of 1 (mild mastitis)

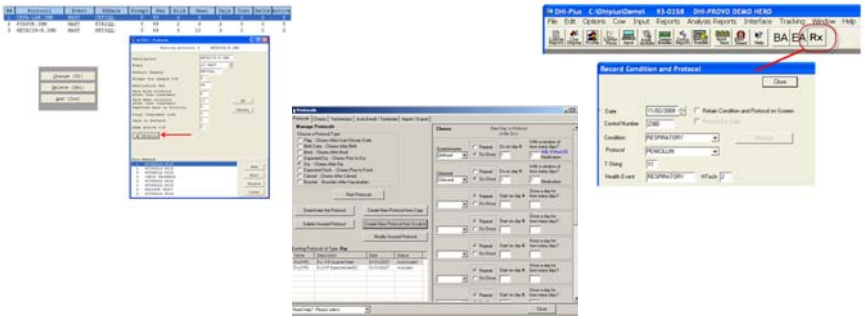
Elanco | Knowledge Solutions

USDBUNON01903

(Record and Treat)

Implementation

- On-Farm software programs can facilitate implementation of the treatment protocol strategy



Elanco | Knowledge Solutions

How Much Does the Failure to Record Disease Affect the Measurable Impact of Disease?

- Introduces bias into the system
- Types of bias/recording issues:
  - Failure to record any disease
  - Failure to correctly distinguish mild from severe
  - Failure to record mild disease
  - Misclassification of a normal cow as “diseased”

Elanco | Knowledge Solutions

Metritis Severity Score *Misclassification* Under Predicts Consequence Cost Of Disease*

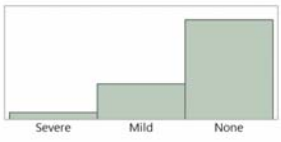
- Convenience sample of DC305 data from 1 Mid-Western Holstein herd
  - 1 year of calvings (n = 3,485)
- Herd chosen because it does an excellent job of recording metritis incidence & severity
  - No metritis recorded (**NR**)
  - Mild metritis
  - Severe metritis

*McCarthy and Overton, Abstract 16288 presented at 2016 ADSA, Salt Lake City

True Disease Severity (TS)

Normal herd recorded data

1. No metritis recorded
2. Mild metritis
3. Severe metritis



Frequencies

Level	Count	Prob
Severe	155	0.04448
Mild	858	0.24620
None	2472	0.70933
Total	3485	1.00000

Elanco | Knowledge Solutions
USDBUNON01903

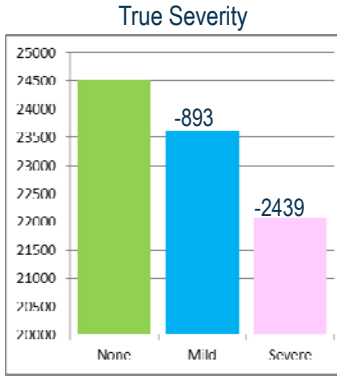
Statistical analysis

- TS, IR, and PR datasets analyzed separately in JMP 12.1.0
- ANOVA conducted for second test 305 day mature equivalent (**2nd305ME**)
- Lactation group (1, 2, 3+), month fresh, early lactation mastitis (+/-), and DA (+/-) were included in all models

Elanco | Knowledge Solutions

USDBUNON01903

Predicted 2nd 305ME and Associated Losses



Total milk loss attributable to metritis:

-1,114,083 lb **-751,618 lb** **-338,347 lb**

Non-identified losses attributable to metritis:

-392,465 lb **-805,736 lb**

Elanco | Knowledge Solutions

USDBUNON01903

Implications

- Misclassification of metritis results in greater bias and underestimates the true association between metritis and milk production, reproductive performance and culling risk
  - Misclassification leads to an underestimate of the consequence costs of diseases like metritis
- Improved definition and recording of metritis herds can lead to better interpretation of the true impact of metritis (and other diseases) on individual herds

To Summarize...

- Research has shown the negative impact and cost of common disease issues occurring during The Vital 90 Days
- Observational data from commercial US Holstein herds reflects the research findings
  - Mastitis, metritis, and other disease issues are costly
  - Significant losses in milk production
  - Significant negative impacts of mastitis and metritis on culling risk
  - Significant negative impacts of transition disease on reproductive performance
- Due to inadequate/ inconsistent disease definitions, as well as detection and recording issues, the true impact in the dairy industry is likely greater than this review shows

Thanks For Your Attention!

Michael Overton, DVM, MPVM
(706) 248-4664
moverton@elanco.com

Knowledge Solutions

USDBUNON01903