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)

- 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)
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
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


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
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.

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

<table>
<thead>
<tr>
<th>Investments</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management practices</td>
<td>Transition Disorder Incidence Range$^1$</td>
</tr>
<tr>
<td>Dietary adjustments and feed supplements</td>
<td>Milk Fever: 0.03% - 22.3%</td>
</tr>
<tr>
<td>Vaccination programs</td>
<td>Ketosis: 1.3% - 18.3%</td>
</tr>
<tr>
<td>Monitoring programs</td>
<td>Displaced Abomasum: 0.3% - 6.3%</td>
</tr>
<tr>
<td>Mastitis control and prevention practices</td>
<td>Ovarian Dysfunction: 1.0% - 16.1%</td>
</tr>
</tbody>
</table>

$^1$Kelton DF et al. 1998. JDS 81:2502-2509
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*


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
Descriptive Statistics for the Included Herds

### LactGrp Frequencies

<table>
<thead>
<tr>
<th>Level</th>
<th>Count</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20974</td>
<td>0.37984</td>
</tr>
<tr>
<td>2</td>
<td>16009</td>
<td>0.28771</td>
</tr>
<tr>
<td>3</td>
<td>16000</td>
<td>0.32020</td>
</tr>
<tr>
<td>Total</td>
<td>53643</td>
<td>1.00000</td>
</tr>
</tbody>
</table>

N Missing: 140150
3 Levels

### SeasonH

#### Spring Frequencies

<table>
<thead>
<tr>
<th>Level</th>
<th>Count</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>189063</td>
<td>0.23921</td>
</tr>
<tr>
<td>Summer</td>
<td>23787</td>
<td>0.28018</td>
</tr>
<tr>
<td>Fall</td>
<td>223306</td>
<td>0.28285</td>
</tr>
<tr>
<td>Winter</td>
<td>201837</td>
<td>0.23777</td>
</tr>
<tr>
<td>Total</td>
<td>644803</td>
<td>1.00000</td>
</tr>
</tbody>
</table>

N Missing: 140150
4 Levels

### 305ME Milk Production by Herd in Data Set

#### Oneway Analysis of 305ME By Herd #

Mean = 28,560 lbs
### Average Disease Incidence Across Herds (All Parities Included)

#### Diseases in The Vital 90 Days

<table>
<thead>
<tr>
<th>Disease</th>
<th>Masti in First 30 Days</th>
<th>Metri in First 30 Days</th>
<th>Retri in First 30 Days</th>
<th>DAl in First 30 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>53029, 95%</td>
<td>46919, 84%</td>
<td>53125, 95%</td>
<td>54189, 97%</td>
</tr>
<tr>
<td>No</td>
<td>2614, 5%</td>
<td>872, 15%</td>
<td>2518, 5%</td>
<td>1454, 3%</td>
</tr>
</tbody>
</table>

#### Disease incidence in high producing Holstein herds that intensively detected and recorded disease

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

---

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

**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
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

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

Mastitis and Metritis Impact on Primiparous Culling (Sold & Died)
Disease Associations with Primiparous Reproductive Performance

**Risk Ratios**

**Unit Risk Ratios**

**Risk Ratios for SeasonalFish**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - Summer: Spring 1.138552 <0.001 1.092067 1.183327
  - Fall: Spring 1.905629 <0.001 1.846288 1.965059
  - Winter: Spring 0.985036 0.083 0.956362 1.013612
  - Fall: Winter 0.884871 <0.001 0.865595 0.904189
  - Summer: Fall 0.931395 <0.001 0.874847 0.990862
  - Spring: Fall 1.041179 0.058 0.988620 1.096756
  - Spring: Winter 1.010728 0.130 0.948352 1.074879
  - Summer: Winter 1.174094 <0.001 1.123464 1.227064

**Risk Ratios for MasstInFirst30Days**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.830374 0.125 0.877226 1.024297
  - 0 2 1.005562 0.150 0.962788 1.038345

**Risk Ratios for MetnInFirst30Days**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.966643 <0.001 0.940482 0.994055
  - 0 2 1.161638 <0.001 1.04270 1.280278

**Risk Ratios for RPInFirst30Days**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.849423 <0.001 0.804004 0.893942
  - 0 2 1.005669 <0.001 0.934272 1.084421

**Risk Ratios for DAInFirst30Days**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.662165 <0.001 0.547543 0.805538
  - 0 2 1.122359 <0.001 1.244696 1.814607

---

Disease Associations with Multiparous Reproductive Performance

**Risk Ratios**

**Unit Risk Ratios**

**Risk Ratios for LactGrp**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.827474 <0.001 0.806201 0.849075
  - 0 2 1.208508 <0.001 1.177485 1.240487

**Risk Ratios for SeasonalFish**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - Summer: Spring 1.044834 0.018 1.070788 1.083825
  - Fall: Spring 1.07197 0.029 1.124217 1.028242
  - Winter: Spring 1.041478 0.097 1.005899 1.078248
  - Winter: Fall 0.999688 0.857 0.965701 1.032347
  - Winter: Winter 0.957032 0.172 0.920475 0.993249
  - Spring: Summer 0.973278 0.196 0.932953 0.995022
  - Spring: Fall 0.913407 <0.001 0.885457 0.943038
  - Summer: Fall 0.940211 <0.001 0.907429 0.974673
  - Winter: Winter 0.960407 0.077 0.924479 0.997706
  - Summer: Summer 1.003323 0.857 0.968212 1.03990
  - Fall: Fall 1.044897 0.077 1.007818 1.083679

**Risk Ratios for MasstInFirst30Days**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.815972 <0.001 0.790997 0.840923
  - 0 2 1.175528 <0.001 1.092557 1.269109

**Risk Ratios for MetnInFirst30Days**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.668852 <0.001 0.635238 0.699908
  - 0 2 1.007598 <0.001 0.92954 1.087347

**Risk Ratios for RPInFirst30Days**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.814784 <0.001 0.787148 0.873207
  - 0 2 1.223257 <0.001 1.218107 1.238624

**Risk Ratios for DAInFirst30Days**
- Level1 / Level2: Risk Ratio: Probo:Chig: Lower 95%: Upper 95%
  - 0 1 0.847551 <0.001 0.783958 0.913996
  - 0 2 1.180428 <0.001 1.092184 1.277708
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-inflammatory, 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?

**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
Results of the Elanco Mastitis Cost Calculator:

**Assumptions Throughout All Scenarios:**
- 50% Milk Price $20
- 40% Market cows ($/lb) $0.75
- 10% Replacement heifers $1,900
- 32% Feed cost/lb DM $0.13
- 13% Labor/hr $15

**Mild Mastitis**
- 5% Milk Price $20
- 4% Market cows ($/lb) $0.75
- 1% Replacement heifers $1,900
- 2% Feed cost/lb DM $0.13
- 2% Labor/hr $15

**Moderate Mastitis**
- 5% Milk Price $20
- 4% Market cows ($/lb) $0.75
- 1% Replacement heifers $1,900
- 2% Feed cost/lb DM $0.13
- 2% Labor/hr $15

**Severe Mastitis**
- 5% Milk Price $20
- 4% Market cows ($/lb) $0.75
- 1% Replacement heifers $1,900
- 2% Feed cost/lb DM $0.13
- 2% Labor/hr $15
### Results of the Elanco Metritis Cost Calculator:

<table>
<thead>
<tr>
<th></th>
<th>All Cows</th>
<th>Lact = 1</th>
<th>Lact &gt; 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild Metritis</td>
<td>15%</td>
<td>25%</td>
<td>10%</td>
</tr>
<tr>
<td>Severe Metritis</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Total Metritis Incidence (All Metritis)</td>
<td>20%</td>
<td>30%</td>
<td>15%</td>
</tr>
</tbody>
</table>

| Diagnostic (i.e., testing) | -79 | -72 | -87 |
| Treatment | -3 | -2 | -5 |
| Veterinary service | 0 | 0 | 0 |
| Labor | -8 | -8 | -8 |
| Death loss | -34 | -23 | -46 |

**Direct Cost of All Metritis per Case:**
- $124
- $104
- $146

**Direct Cost of All Metritis per Cow Calving:**
- $25
- $31
- $22

**Future milk production losses:**
- $89
- $89
- $89

**Future culling losses:**
- $34
- $43
- $24

**Repro losses:**
- $69
- $69
- $69

**Indirect Cost of All Metritis per Case:**
- $193
- $202
- $183

**Indirect Cost of All Metritis per Cow Calving:**
- $39
- $61
- $27

**Total Cost of Metritis per Avg Case:**
- $317
- $307
- $328

**Total Cost of Metritis per Cow Calving:**
- $64
- $92
- $49

---

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
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

(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
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

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

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Event</th>
<th>REMark</th>
<th>Pen</th>
<th>Milk</th>
<th>Meat</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIRSUE.IMM</td>
<td>MAST</td>
<td>PIR2QQ.S</td>
<td>99</td>
<td>2</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>HETACIN-K.IMM</td>
<td>MAST</td>
<td>HET3QQ.S</td>
<td>99</td>
<td>3</td>
<td>10</td>
<td>3</td>
</tr>
</tbody>
</table>

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)
Implementation

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

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”
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*
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

Predicted 2nd 305ME and Associated Losses

<table>
<thead>
<tr>
<th>True Severity</th>
<th>None</th>
<th>Mild</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-893</td>
<td>-2439</td>
<td></td>
</tr>
</tbody>
</table>

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
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