Giving Dry Cow Mastitis the Boot

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Dry Cow Mastitis: Why the Concern?

- Despite decades of research and steady progress, mastitis remains the most costly infectious disease affecting dairy herds.
- Estimated loss of $200/cow/year for average upper Midwest dairy.
- Source of Losses:
  - 12%: Direct losses from clinical mastitis
  - 17%: Lost milk due to elevated SCC
  - 35%: Excess culling and death
  - 36%: Price reduction with elevated SCC

(Fetrow et al., 2000)
Results of the “Quality Counts” Program
Aug., 2003 (MN Dept. of Ag.)

SCC Trends by Year

Three Ways Cows Get Mastitis
Farnsworth 2003

- Contagious organisms spreading through the herd
- Environmental organisms infecting milking cows
- Environmental organisms infecting cows during the dry period
• Mastitis control strategies have successfully reduced the prevalence of contagious mastitis pathogens.

• Environmental pathogens have increased in relative importance.

Environmental Streptococci (e.g. *Streptococcus uberis*)

Coliforms (e.g. *Escherichia coli*)

<table>
<thead>
<tr>
<th>Herd Name:</th>
<th>4</th>
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<tbody>
<tr>
<td>Date: 2-3-69</td>
<td>3-11-72</td>
</tr>
<tr>
<td>No. Cows:</td>
<td>1,972</td>
</tr>
<tr>
<td>% of Milk:</td>
<td>87.5%</td>
</tr>
</tbody>
</table>

**Somestic Cell Count Analysis**

- **35% state avg. 20% achievable**
- **> 10-12%**: herd level increases
- **10-12%**: herd level stays same
- **4 – 5%**: herd level decreases

<table>
<thead>
<tr>
<th>Dry Period</th>
<th>35% state avg. 20% achievable</th>
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<tbody>
<tr>
<td>% Over 200,000 first test (all cows)</td>
<td>35%</td>
</tr>
<tr>
<td>% New</td>
<td>No. Cows</td>
</tr>
<tr>
<td>% Chronic</td>
<td>74</td>
</tr>
<tr>
<td>% Cows</td>
<td>1.01</td>
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<tr>
<td>Total Cows + Chronic</td>
<td>175</td>
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**Patterns**

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<tr>
<th>3 - 1/2</th>
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<th>-6</th>
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<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>This Month</th>
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<td>3 - 1/2</td>
<td>2.6</td>
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DHI Summary (QC worksheet QCW–6)
www.extension.umn.edu/dairy

Herd John Doe  # Cows 50  Avg. Milk lbs/day 87  SCC 228,000

- % SCC Contribution
  - 8% from 4 cows

- Milking Cow infection status
  - 21% over 200,000, 35% State avg, 20% or less Goal
  - 8% New infections, 10-12% Status quo
    >10-12% Herd SCC increases
    4-5% Herd SCC decreases

- Dry Period Mastitis
  - 32% Over 200,000 1st test, 35% State avg, 15-20% Goal

- Dry-off infection status compared to freshening (older cows)
  - 22% New infections 15% Achievable <10 Goal
  - 9% Chronics
  - 8% Cures

- Patterns
  ✓ In and out
  ___Continuous

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<td>-7</td>
<td>-6</td>
<td>-5</td>
<td>-4</td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>This Month</td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>2.6</td>
<td>1.3</td>
<td>2.6</td>
<td>2.7</td>
<td>2.6</td>
<td>2.7</td>
<td>2.8</td>
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<td>2.7</td>
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The Significance of Dry Period Infections

- 50 - 60% of all new infections caused by environmental pathogens occur during the dry period. (Bradley and Green, 2000)

Two Periods of High Risk for New Infections During the Dry Period

- Involution
  - No flushing action
  - Delayed keratin plug formation
  - Lactoferrin diluted
  - Inhibited leukocyte function

- Colostrogenesis (transition)
  - Protective factors diluted
  - Immune suppression
  - Keratin plug may break down
  - Antibiotic dry cow therapy (DCT) levels below the minimum inhibitory concentration (MIC)

Incidence of new intramammary infections during the dry period (Smith et al., 1985)
The Significance of Dry Period Infections

- Over 50% of clinical coliform mastitis events in the first 100 days in milk originated during the dry period. (Bradley and Green, 2002)

How Common Are New Infections During the Dry Period?

- Proportion of quarters developing a new infection during the dry period:
  - 8-12% of quarters (Eberhart, 1986)
  - 17% of quarters (Dingwell et al., 2001)
  - 25% of quarters (Godden et al., 2003)
  - 6-26% of quarters (Cook et al., 2004)

- Large variation among herds
- An opportunity area for a majority of dairy herds.
Risk factors for New Infections During the Dry Period

• Herd:
  – Bulk tank somatic cell count (SCC)
  – Prevalence of infection
  – Herd management practices

• Cow:
  – Lactation number: older cows at risk
  – High milk yield at dry off
  – Method of drying cows off

• Quarter:
  – Teat end exposure to bacteria
  – Teat end condition
  – Timely formation of keratin plug

Teat End Condition

• Hyperkeratosis predisposes teats to bacterial colonization.
  (Fox, 1997; Timms, 1998)

• Cracked teats are at 1.8 times higher risk for acquiring new infections during dry period.
  (Dingwell et al., 2004)
Timely Formation of a Keratin Plug in the Teat Streak Canal Affects Susceptibility

- Dingwell, 2003
  7 days after dry off: 50% open
  42 days after dry off: 23% open
  - Delays in keratin plug formation if high milk yield
  - Increased risk of infection if incomplete closure

Proportion of Quarters Failing to Produce an Adequate Keratin Plug During the Dry Period

- Williamson, 1995
  10 days: 50% open
  50 days: 10% open

- Dingwell, 2003
  7 days: 50% open
  42 days: 23% open
  - Delays if high milk yield
  - Increased risk of infection if incomplete closure
Two main principles to prevent new infections during the dry and transition periods

- Maximize and supplement the cow’s defences
- Minimize bacterial challenge from the environment

Specific strategies to prevent new intramammary infections…

Intramammary infusion with antibiotic dry cow therapy (DCT) at dry-off

- Very successful:
  - Eliminates existing infections caused by susceptible bacteria
  - Prevents new infections caused by susceptible bacteria during the early dry period

- Limitations:
  - Will not prevent infections caused by resistant bacteria
  - Will not prevent infections in late dry period

(Browning, 1990; Bradley and Green, 2001; Bradley and Green, 2004)
Dry Cow Teat Sealants

- Internal teat sealants
  OrbeSeal™ or TeatSeal™ (Pfizer Animal Health)

- External teat sealants
  (persistent barrier dips)
  Stronghold®/DryFlex™ (WestAgro, DeLaval)

External Sealants
(Persistent Barrier Dips)

- Rapid drying plastic polymer
- Forms a physical barrier to entry by bacteria

Examples
Stronghold®/DryFlex™
(WestAgro, DeLaval)
Reduction in new infections from Environmental Streptococci and CNS at calving
Timms, 2001

<table>
<thead>
<tr>
<th></th>
<th>Rate of dry cow mastitis (%)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Control Heifers n = 66 264 quarters</td>
</tr>
<tr>
<td></td>
<td>28.0% -18.9%</td>
</tr>
</tbody>
</table>

(Dry cow antibiotic used on all quarters of all 190 cows in study.)

External Sealants (Persistent Barrier Dips)

Advantages:
- Easy to apply
- Rapid drying
- Non-irritating / non-toxic

Disadvantage:
- Shed off teat in 3-7 days
- For full benefit must apply at dry off, and then reapply at 10 days pre-calving, then repeat as needed until calving.
Internal Sealants

- **OrbeSeal™** (Pfizer Animal Health)
  - Bismuth subnitrate in a paraffin base: 65% w/w (2.6 g in 4g)
  - Infused into quarter after last milking at dry-off
  - Insoluble in milk – excellent persistence

At Calving

- OrbeSeal™ is easily hand-stripped out of the quarter after calving.
- Safely ingested by calf.
- No antimicrobial properties or residue issues.
Studies Using TeatSeal™ in Uninfected Cows

• Studies in New Zealand and the U.K. showed that, when used alone in uninfected cows: (somatic cell count < 200,000 cells/ml at dry off)
  – TeatSeal™ prevented significantly more new infections than no treatment.
    (Berry and Hillerton, 2002)
  – TeatSeal™ was at least equal, if not better, in preventing new infections compared to antibiotic dry cow therapy (DCT)
    (Huxley et al., 2001)

Minnesota & Wisconsin OrbeSeal™ Studies

Assuming the dairy industry will continue with blanket dry cow antibiotic therapy…

Describe the effectiveness of OrbeSeal™ in the prevention of new infections during the dry period when used with an intramammary antibiotic
Wisconsin OrbeSeal™ Study
(Cook et al., 2004)

527 cows (3 herds) treated with:
- Antibiotic
- Antibiotic + OrbeSeal

<table>
<thead>
<tr>
<th></th>
<th>Herd A</th>
<th>Herd B</th>
<th>Herd C</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td># Quarters</td>
<td>295</td>
<td>942</td>
<td>743</td>
<td>1980</td>
</tr>
<tr>
<td>New IMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orbeseal</td>
<td>8.2</td>
<td>3.6</td>
<td>5.7</td>
<td>5.9</td>
</tr>
<tr>
<td>Control</td>
<td>25.8</td>
<td>5.6</td>
<td>15.5</td>
<td>13.4</td>
</tr>
<tr>
<td>% decrease IMI</td>
<td>68.2%</td>
<td>35.7%</td>
<td>63.2%</td>
<td>56.0%</td>
</tr>
<tr>
<td>P Value</td>
<td>0.004</td>
<td>0.148</td>
<td>&lt;0.001</td>
<td>0.088</td>
</tr>
</tbody>
</table>

Wisconsin Study: 100 Day Survival Curve For Mastitis Treatment (All Herds)

20% reduction in risk for clinical mastitis in first 100 days in milk
Minnesota OrbeSeal Study
Godden et al., 2003
*J. Dairy Sci.* 86:3899-3911

- 2 commercial free stall dairy herds

- 437 cows (1748 quarters)

- Random split udder design:
  - Antibiotic (control)
  - Antibiotic + OrbeSeal™ (treatment)

Godden et al., 2003
Treatment and Sampling Schedule

<table>
<thead>
<tr>
<th>Dry Period</th>
<th>1-3 DIM</th>
<th>6-8 DIM</th>
<th>60 DIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry off</td>
<td>Calving &amp; strip Orbeseal</td>
<td>SCC + Treatment</td>
<td>Culture SCC</td>
</tr>
</tbody>
</table>

Record all clinical mastitis events from dry off to 60 DIM
Godden et al., 2003

Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Antibiotic</th>
<th>Antibiotic + OrbeSeal™</th>
<th>Reduction in Risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New infection rate during dry period (%)</td>
<td>25.4%</td>
<td>20.2%</td>
<td>- 30%</td>
</tr>
<tr>
<td>Clinical mastitis rate during first 60 days in milk (%)</td>
<td>8.0%</td>
<td>5.9%</td>
<td>- 33%</td>
</tr>
<tr>
<td>Linear Score at 6-8 days in milk</td>
<td>3.2</td>
<td>2.9</td>
<td></td>
</tr>
</tbody>
</table>

a, b: P value < 0.05

Survival Curve for Clinical Mastitis Events in Quarters Between Dry Off and 60 Days In Milk

Days at Risk for Clinical Mastitis (day 0 = dry off date)

- DCT
- DCT + OrbeSeal

Survival Distribution Function for Quarters with Clinical Mastitis
Summary of North American OrbeSeal™ Study Findings

• OrbeSeal™ plus antibiotic DCT resulted in a significant reduction in new infections compared to using antibiotic DCT alone:
  • 30 – 68% decrease in new infection risk during dry period
  • 20 – 30% decrease in clinical mastitis risk in early lactation
  • Decreased somatic cell count after calving

• Cost effectiveness of using antibiotic and teat seal in combination may vary by herd.

• Must use clean infusion techniques.

Minimize Pathogen Exposure to the Teat End

• Requirements for bacteria to survive:
  – Moisture
  – Organic material: manure, soil, organic bedding

• Keep it clean and dry
  – Bedding selection & maintenance
  – Manure management
  – Ventilation
Maximizing the Cow’s Immune Defenses Through Vaccination

- Gram negative core antigens (e.g. J-5, Pfizer Animal Health)

- Successful vaccination during the dry period allows the immune system to more rapidly and effectively respond to natural infections:
  - Does not prevent coliform infections
  - Reduces duration and severity of coliform mastitis
  - Reduces death loss
  (Cullor, 1991; Hogan, 1992, 1999)

- Routine vaccination beneficial and cost-effective in almost all herds
  (DeGraves and Fetrow, 1991)

- Will not overcome poor management

Maximizing the Cow’s Immune Defenses

- Nutritional management during dry and transition periods:
  - Dietary protein and energy
  - Vitamins: A, D and E
  - Minerals: Selenium, Copper, Zinc, etc..
  - Don’t restrict feed and water intake: palatable and available

- Prevent metabolic diseases: milk fever, displaced abomasum, ketosis

- Minimize stressors:
  - Good cow comfort
  - Excellent ventilation
  - Prevent overcrowding
  - Provide heat abatement
    (shade, fans, sprinklers)
How Do We Dry-Off Cows?

- Limited studies available
- Generally ignored in most dairy extension publications

(from Dingwell, 2004)

Is there a best method for drying cows off?

- High milk yield at dry off is associated with delayed teat closure and higher risk for new infections during the dry period (Huxley et al., 2002)

- We can reduce milk yield at dry-off and reduce infection risk by:
  - Intermittent milking (once per day) for last 2 weeks of lactation (versus abrupt cessation of milking) (Oliver, J. et al., 1956)
  - Decrease energy ration density and limit water intake (Oliver, S. et al., 1990)

- Limited research in today’s high producing cows.

- Ability to implement these procedures will vary among farms.

- Each herd should carefully decide on a strategy to reduce production and cease milking. (Dingwell, 2004)
Summary

• The dry period is a high risk period for new environmental mastitis infections.

• Principles to prevent new infections during the dry period must include:
  – Maximize and supplement the cow’s defences
  – Minimizing bacterial challenge from the environment

• Specific strategies to prevent new infections will include:
  – Strategic use of antibiotic DCT and/or Teat Sealants
  – Vaccination programs
  – Nutritional management
  – Dry-off strategies
  – Attention to housing, hygiene, and cow comfort

Thank you!