Subclinical & Clinical Mastitis

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Mastitis
- Bacterial infection of the udder
- 99% occurs when bacterial exposure at teat end exceeds ability of immune defenses of cow

Subclinical mastitis
- Milk appears normal but contains excessive numbers of inflammatory cells
- This milk can be sold for human consumption

Clinical mastitis
- Visual abnormalities of milk
- Cannot be sold for human consumption

Mastitis Definitions
- Clinical mastitis
  - Visible abnormalities in milk or udder
    - Case definition?
    - Detection intensity?
- Subclinical mastitis
  - Presence of inflammation caused by bacterial infection
    - Detection is by indirect test
    - Case definition?
    - Detection intensity?

Somatic Cells in Milk
- Subclinical mastitis is a bacterial infection of udder but appearance of milk is NOT altered
- Cows immune system responds to bacteria by sending neutrophils to engulf and destroy the bacteria
- 90% of SCC in infected gland are neutrophils

How Somatic Cells Get into Milk

SCC of Normal Milk
- The largest influencer of SCC is mastitis
- SCC from uninfected quarters or cows is usually <200,000
  - Many cows have SCC <100,000
- SCC >200,000 is almost always caused by mastitis
**SCC and Product Quality**

- Injury to secretory cells reduces synthesis of lactose, fat & protein
- Increased permeability of cell membranes allows leakage of blood components into milk
- Reduced shelf life

**Subclinical Mastitis is Common**

- Detection of subclinical mastitis requires testing
  - Therefore it is usually undetected
- Sale of milk from cows with subclinical mastitis is allowed
  - Treatment costs money
- Some farmers have little incentive to reduce the prevalence

**Impact of Subclinical Mastitis Across Lactations**

- Quarter SCC data from 215 Holstein cows
  - Compared SCC at dry off, early lactation & first DHIA test
  - Percent of quarters with SCC >200,000 3-8 days postpartum
    - 20% of 2nd lactation
    - 59% of 3rd lactation
    - 83% of 4+ lactation
  - Milk Yield was strongly associated with SCC during first week postpartum

**Causes of Subclinical Mastitis**

- Almost any pathogen can cause mastitis
- Ability to cause subclinical mastitis often occurs because of host-adaptation of the bacteria
- Most cases are Gram positive bacteria
- Major pathogens cause greater SCC

**Causes of Subclinical Mastitis in WI Dairy Herds**

- Bacteria from Herds (40) with SCC >250,000: 5672 samples
- Bacteria from (24) quarters: 5 herds: 428 samples
Isolation of Bacteria from >77,000 Milk Samples, Wisconsin, 1994-2001

- Large decrease in the prevalence of the traditional subclinical contagious mastitis pathogens
  - \textit{S. aureus} & \textit{Strep ag}
- Ecological niche has been occupied by opportunistic environmental pathogens

Need to Identify Most Prevalent Pathogens to Define Treatment

- A high SCC is good evidence of mastitis
- If a cow has a high SCC, a single negative milk culture is not sufficient evidence that a cow is not infected
- Initially, a minimum of 25 quarter milk samples should be obtained from a herd

Negative Effects of Subclinical Mastitis

- SCC > 200,000 cells/ml indicates large probability of 1+ infected quarters
- Greater SCC = lower quality milk
  - Lower cheese yields
  - Shorter shelf life
- Subclinical mastitis reduces milk yield
- Establishment of chronic infections

Cost of Clinical Mastitis

- Clinical mastitis occurs in 6-8 cases/100 cows/month
  - Pol & Ruegg, 2007
- Wisconsin farmers estimate each case costs $91.00 USD
  - Actual cost is probably 2-3 times greater
  - Farmers perception of cost determines amount that can be spent treating each case
  - Accounts for 80% of antibiotic usage on farms

Herd Performance By BTSCC

<table>
<thead>
<tr>
<th>Herd Performance By BTSCC</th>
<th>Low (&lt;250)</th>
<th>Med. (251-400)</th>
<th>High (&gt;400)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herds (n)</td>
<td>36</td>
<td>83</td>
<td>61</td>
</tr>
<tr>
<td>Bulk Tank SCC (x1000)</td>
<td>198</td>
<td>317</td>
<td>565</td>
</tr>
<tr>
<td>Milk (lb)</td>
<td>70</td>
<td>68</td>
<td>64</td>
</tr>
<tr>
<td>Clinical Cases per 100 cows per month</td>
<td>6</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>New Infection: % of cows per month</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Total Cows Culled per year (%)</td>
<td>32</td>
<td>41</td>
<td>53</td>
</tr>
</tbody>
</table>

How Much Clinical Mastitis is Occurring?

- It can be very difficult to know the actual clinical case rate
  - Few cases are recorded
  - Records are often difficult to summarize
  - Veterinarians are usually presented with ONLY the most severe cases
Recording of Mastitis Events

- Representative Survey of WI dairy producers
  - Conducted in 2003
  - Hoe & Ruegg, JDS 2005
- Where is information about antibiotic treatments recorded?
  - 536 Responders to question

Most Mastitis is Treated Using Intramammary Antibiotic Tubes

- Pol & Ruegg, JDS Jan 2007
  - Most Mastitis is Treated Using Intramammary Antibiotic Tubes
- Most people are only aware of treatments given to severity score 3 cases

Clinical Mastitis is Caused by Many Bacteria

- Hallberg, 1994
- Nash et al., 2002
- Hoe & Ruegg, 2005
- Pantoja & Ruegg, 2008
- Holmamn et al., 2006
- Oliveira & Ruegg, 2008

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Herds</th>
<th>Cases</th>
<th>S. ag</th>
<th>S. aureus</th>
<th>CNS</th>
<th>Strep spp</th>
<th>Coliform</th>
<th>Other</th>
<th>No Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strep ag</td>
<td>10%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>S. aureus</td>
<td>25%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>21%</td>
<td>21%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>CNS</td>
<td>14%</td>
<td>32%</td>
<td>26%</td>
<td>28%</td>
<td>16%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strep spp</td>
<td>18%</td>
<td>32%</td>
<td>24%</td>
<td>28%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coliform</td>
<td>22%</td>
<td>17%</td>
<td>25%</td>
<td>29%</td>
<td>13%</td>
<td>28%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>10%</td>
<td>11%</td>
<td>8%</td>
<td>9%</td>
<td>6%</td>
<td></td>
<td>2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Growth</td>
<td>15%</td>
<td>19%</td>
<td>29%</td>
<td>24%</td>
<td>25%</td>
<td>27%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First Cases of Mastitis by Days in Milk

- 1009 cases on 2 commercial dairy farms

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>N</th>
<th>Severity</th>
<th>Lact. No.</th>
<th>DIM</th>
<th>Number of Cases</th>
<th>Milk (lbs)</th>
<th>SCC (log)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS</td>
<td>14</td>
<td>1.4</td>
<td>2.5</td>
<td>85</td>
<td>1.3</td>
<td>67</td>
<td>5.5</td>
</tr>
<tr>
<td>S. aureus</td>
<td>48</td>
<td>1.6</td>
<td>2.3</td>
<td>158</td>
<td>1.2</td>
<td>75</td>
<td>5.5</td>
</tr>
<tr>
<td>Strep spp</td>
<td>37</td>
<td>1.6</td>
<td>2.4</td>
<td>95</td>
<td>1.7</td>
<td>70</td>
<td>5.3</td>
</tr>
<tr>
<td>No Growth</td>
<td>60</td>
<td>1.6</td>
<td>2.4</td>
<td>132</td>
<td>1.8</td>
<td>78</td>
<td>5.1</td>
</tr>
<tr>
<td>E. Coli</td>
<td>50</td>
<td>1.9</td>
<td>2.3</td>
<td>137</td>
<td>1.6</td>
<td>71</td>
<td>5.0</td>
</tr>
<tr>
<td>Klesbiela</td>
<td>7</td>
<td>3.0</td>
<td>2.0</td>
<td>202</td>
<td>2.0</td>
<td>96</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Relatively Few Cases are Severe

- The cow should NOT be sick for most cases of clinical mastitis
  - 5 to 20%
- Treatment records should include:
  - Cow & Date
  - Severity score
  - Case Number
  - Quarter?
  - Treat condition
  - Diagnosis
  - Gram + or -
  - Treatment
  - Date of saleable milk

Percent of Cases by Severity Score

<table>
<thead>
<tr>
<th>Severity Score</th>
<th>CNS</th>
<th>S. aureus</th>
<th>Strep spp</th>
<th>No Growth</th>
<th>E. Coli</th>
<th>Klesbiela</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Abnormal Milk Only)</td>
<td>57%</td>
<td>75%</td>
<td>52%</td>
<td>48%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 (Ab. Milk + secretion quarter)</td>
<td>20%</td>
<td>20%</td>
<td>45%</td>
<td>31%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 (Ab. Milk + secretion quarter + sick cow)</td>
<td>23%</td>
<td>5%</td>
<td>7%</td>
<td>22%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Most cases of mastitis present symptoms that are similar regardless of pathogen

- The biggest difference is severity
- 216 cases from 8 herds with known S aureus problems
**Cow Factors Associated with Clinical Mastitis: Parity**

- Most studies demonstrate increased risk for mastitis as cows age.
- Study of 218 multiparous cows in UW herd followed over 2 lactations.
- Pantoja et al., in press.
- Cows with case of mastitis in previous lactation were 4X more likely to have a clinical case in first 120 days.

**Age is Associated with Response to Treatment**

- Deluyker et al., 1999.
- Enrolled 256 cases in a mastitis clinical trial.
  - Variety of pathogens including S aureus.
  - Compared 2 different IMM compounds.
  - Evaluated bacteriological & clinical outcomes.
  - About 3 weeks post RX.

**Age & Mastitis Susceptibility**

- Risk factors for mastitis in older cows:
  - History of previous infections.
  - Greater milk yields.
  - Teat end health is more likely to be impaired.
  - Age needs to be accounted for when assessing mastitis rates.
  - Younger herds should have less mastitis.
  - Herds that cull based on recurrence cannot be compared to herds that do not.

**Take Back to the Barn**

- There is no way to understand the amount of mastitis that is being treated without recording information.
- Mastitis is caused by a variety of bacteria throughout lactation.
- Only culturing can be used to distinguish among them.
- Severity scores are one of the most critical elements to guide treatment.

**Questions?**