Mastitis in dairy cows, know your enemy

Mastitis can be classified in either contagious (Staph. aureus, Strep. agalactiae, Mycoplasma bovis) or environmental (E. coli, Klebsiella, Serratia, Strep. uberis, other Streptococcus species, CNS, Prototheca) depending on the pathogens involved in the infection process.

Mastitis has a very simple basis: the only way of transmission is by the entrance of mastitis-causing pathogens (MCP) through the teat canal.

According to the classical classification, mastitis can be either contagious or environmental. But recent studies suggest that some pathogens classically considered as environmental can act as contagious (e.g. Streptococcus uberis).

Sampling to know who is your enemy: sampling cows and sampling tank in order to know the prevalence of contagious bacteria in your milking parlour.

Send samples to the laboratory.

Segregation. When you have the results, you have to segregate cows into 2 groups: healthy group/infected group.

Sampling the bulk tank of the healthy group (before milking the infected group) and do a PCR or cultures to re-check the healthy group.

PRIORITY: keep the healthy group healthy. Repeat process: SAMPLING & SEGREGATION until the entire herd has a good health status.

Before moving a dry cow to the healthy group check if she is healthy or infected.

Factors related to mastitis

Influence of the environment

Avoid the risk of environmental bacteria, having a look to the environment:

- Stocking density.
- Cow comfort.
- Heat stress.
- Bedding maintenance programme.

Cubicle design

- The design of the cubicle is important to guarantee the comfortability of the cow and prevent that she sits in the manure.
- Check udder hygiene in the milking parlour.
**Risky periods for IM infections**
The critical period of mastitis infection: over 50% of new environmental intramammary infections originate in the dry period.

**Dry period is a critical point of mastitis infection, especially during the first three months of lactation.**


**The milking routine**

**Education**
- Practical training.
- Setting goals.
- Feedback and motivation.
- Salary linked to goals.
Teat end cleanliness is the key point!

Defining goals for milking routine

Indicators to check

- Cows per hour.
- Milk per hour.
- Average milk flow.
- Peak flow.
- Milking duration.
- % of milk in the first 2 minutes.
- Time in low flow.

KPI for milking routine

Monitoring at least 2 KPIs

- Average milk flow: >3 kg/minute.
- Peak flow: >5 kg/min.
- Milking duration: < 5 minutes.
- % of milk in the first 2 minutes: >50 %.
- Kg of milk in the first 2 minutes: >6.5 kg.

Milking machine and cow immune system

Importance of the milking machine

- Some publications from the National Mastitis Council state that 30 % of new intramammary infections (IMI) are due to a bad milking machine performance.
- Other international experts talk about 6-20 % (Graeme Mein, Douglas Reinemann).
- We use to say that new IMI due to a bad milking machine performance are somewhere between 0 and 100 %, depending on milking machine settings and maintenance of every particular farm.
Mastitis in dairy cows

**Milking machine and mastitis**
- Vacuum level-teat end vacuum.
- Vacuum stability-vacuum regulation system.
- Take off settings.
- Pulsators settings and functioning.
- Liners design.
- Maintenance.

**Teat congestion**

**Liner slips - Milk impacts**

**Cow immune system**
- A metabolic stress-negative energy balance around calving and fresh cows.
- Heat stress.
- Silage quality and water quality.
- Management.
- Vaccinations.
To treat or not to treat

Mastitis is the most costly disease in dairy farms all around the world.

80% of antibiotics are used for udder health in the US, and 40% for treating clinical mastitis (Pol, M. & Ruegg, P. L. Treatment Practices and Quantification of Antimicrobial Drug Usage in Conventional and Organic Dairy Farms in Wisconsin. J. Dairy Sci. 90, 249–261 (2007)).

- We treat much more than we should do.
- Worldwide concern about antibiotic resistance.
- Legal restrictions and consumers demands.
- Responsible use of antimicrobials.
Antibiotic resistance - Scenario 2050

Today 700,000 deaths for antibiotic resistance. 10 million people in 2050.

Distribution of sales, in mg/PCU, of the various pharmaceutical forms of veterinary antimicrobial agents for food-producing animals, aggregated by the 30 European countries for 2016

*Oral pastes, boluses and intrauterine preparations.

Source: Sales of veterinary antimicrobial agents in 30 European countries in 2016. V ESVAC report.
Aim of treatment

- Quick recovery of clinical symptoms.
- Restablish milk production.
- Avoid recurrence.
- Reduce transmisión risk to healthy animals.
- Animal welfare, reduce pain.
- Bacteriological cure.

Cow factors

% recurrence of first clinical case


The older the cow the more probability for recurrence.
Mastitis in dairy cows


Other cow factors
- The number of affected quarters.
- Days in milk.
- Duration of infection (previous SCC).
- “Uncurable cows”: more than 2 cases per lactation at quarter level, cows with previous 3 SCC test over 700,000 (Owens et al. 1999, Osteras 2006, Ziesch and Kromker 2016).

Example case
Should we treat her?

- Cow with 4 lactations.
- 235 days in milk.
- 3 previous cases in the current lactation in the same quarter.
- Last 3 SCC test > 1 million.

When a cow has this history and is considered as an “uncurable cow” there will be a lack of treatment response and therefore, use of antibiotics is not justified.
Bug factors

In mastitis cases caused by *Prototheca*, *Mycoplasma bovis*, yeast, etc. there is no need for antibiotics.

**Distribution of pathogens causing clinical mastitis from recent studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Cases</th>
<th>Strep ag1 or Staph aureus</th>
<th>CNS</th>
<th>Env.</th>
<th>Strep</th>
<th>Coliform</th>
<th>Other</th>
<th>No growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oliveira &amp; Ruegg, 2011*</td>
<td>788 cases in 51 herds</td>
<td>4%</td>
<td>7%</td>
<td>13%</td>
<td>30%</td>
<td>16%</td>
<td>31%</td>
<td></td>
</tr>
<tr>
<td>Bai <em>et al</em> 2007</td>
<td>5 herds</td>
<td>5%</td>
<td>3%</td>
<td>21%</td>
<td>40%</td>
<td>10%</td>
<td>8%</td>
<td>29%</td>
</tr>
<tr>
<td>Hoe &amp; Ruegg, 2005</td>
<td>217 cases in 4 herds</td>
<td>0%</td>
<td>14%</td>
<td>24%</td>
<td>25%</td>
<td>8%</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td>Pinzon &amp; Ruegg, 2010</td>
<td>207 cases in 4 herds</td>
<td>2%</td>
<td>3%</td>
<td>18%</td>
<td>26%</td>
<td>9%</td>
<td>42%</td>
<td></td>
</tr>
<tr>
<td>Olde Rickerink, 2007 (Canada)</td>
<td>2850 in 106 herds</td>
<td>11%</td>
<td>6%</td>
<td>16%</td>
<td>14%</td>
<td>7%</td>
<td>46%</td>
<td></td>
</tr>
<tr>
<td>Kromker and other</td>
<td>100 case in 1 herd</td>
<td>5%</td>
<td>3%</td>
<td>33%</td>
<td>18%</td>
<td>5%</td>
<td>36%</td>
<td></td>
</tr>
</tbody>
</table>

*not yet published*


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**On farms that have controlled contagious mastitis, approximately 25-40% of clinical cases are microbiologically negative before treatment.**

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Results of selected studies that describe the distribution of bacteria recovered from milk of cows with clinical mastitis in modern dairy herds located in developed countries

Widespread adoption of the 5-point plan has been demonstrated to successfully control contagious mastitis pathogens. As a result, in many developed dairy farm regions, the prevalence of mastitis caused by *Staphylococcus aureus* is minimal and *Streptococcus* agalactiae is virtually eradicated. As contagious pathogens have been controlled and herds have adopted intensive management practices, clinical mastitis is caused by an increasingly diverse group of opportunistic pathogens.
On farm culture

50 % reduction in intramammary antibiotics.
Less discarded milk.
No statistical differences in cure rate.

*Results characterized as contaminated and mixed infections were excluded; NR indicates that the study did not report that outcome.


The selective treatment of clinical mastitis based on on-farm culture results: I. Effects on antibiotic use, milk withholding time, and short-term clinical and bacteriological outcomes

A. Lago,* 1 S. M. Godden,* R. Bey,* P. L. Ruegg,† and K. Leslie‡
*Department of Veterinary Population Medicine, College of Veterinary Medicine, University of Minnesota, Saint Paul 55108
†Department of Dairy Science, College of Agriculture and Life Sciences, University of Wisconsin, Madison 53706
‡Department of Population Medicine, Ontario Veterinary College, University of Guelph, Ontario, Canada N1G 2W1

- 50 % reduction in intramammary antibiotics.
- Less discarded milk.
- No statistical differences in cure rate.
No differences in recurrence of clinical cases.
No differences in somatic cell count and milk production.
No differences in cow survival.

On-farm culture provides the following advantages
- Better treatment decisions.
- Save antibiotics-responsible use.
- Less discarded milk.
- Reduced animal traffic to the hospital.
- Maintaining udder health.
- Limitations: it is not for every farm, need to be trained and permanently reviewed by a VET.

Intramamary or systemic?

Distribution of etiologies, availability of data that demonstrates the benefit of the use of IMM antimicrobials and proposed antimicrobial treatments for 690 cases of clinical mastitis occurring on 51 Wisconsin dairy herds.
Based on the etiologies, case severity and available treatments, only about 35% of the antimicrobial usage can be justified based on the availability of scientific data that demonstrates the benefit of using an IMM antimicrobial.
Treatment success

- We need records.
- Quick recovery of clinical symptoms and milk production.
- SCC < 200 in the second SCC test after mastitis treatment.
- Repeated cases, less than 20%.

KPI for mastitis

**Key Performance Indicator: Clinical Mastitis**

Calculation of suggested key performance indicators for clinical mastitis. For ease of calculation, a case is defined as the occurrence of mastitis in 1 or more quarters of a cow.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Calculation</th>
<th>Suggested Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence Rate</td>
<td>Sum of first cases occurring in the appropriate time period divided by the average number of lactating cows in the same time period</td>
<td>&lt; 24 new cases per 100 cows per year (about 2 cases per 100 cows per month)</td>
</tr>
<tr>
<td>Proportion of cases scored 3 (severe)</td>
<td>Number of severity score 3 cases occurring divided by the total number of cases occurring</td>
<td>5-15% of total cases</td>
</tr>
<tr>
<td>Proportion of cases that die</td>
<td>Number of cows experiencing mastitis cases that resulted in death divided by the total number of cows experiencing mastitis</td>
<td>2%</td>
</tr>
<tr>
<td>Proportion of cases requiring treatment changes</td>
<td>Number of cases where the initial protocol is changed or supplemented because of non-response divided by the total number of detected cases</td>
<td>&lt;20%</td>
</tr>
<tr>
<td>Proportion of cases that are recurrent (second or greater treatment)</td>
<td>Number of cows with second or greater case of mastitis occurring &gt;14 days post treatment divided by the total number of cases of mastitis</td>
<td>&lt;20%</td>
</tr>
<tr>
<td>Proportion of cows with &gt; 1 quarter affected</td>
<td>Number of cases with &gt;2 quarters affected divided by the total number of cases</td>
<td>&lt;20%</td>
</tr>
<tr>
<td>Number of days milk discarded (per case)</td>
<td>Sum of the number of discard days for the time period divided by the total number of cases</td>
<td>4-6 days (unless many cows are receiving extended therapy because of a high prevalence of Staph aureus)</td>
</tr>
<tr>
<td>Percent of herd milking with &lt;4 quarters</td>
<td>Number of cows milking with &lt;4 quarters divided by the number of lactating cows</td>
<td>&lt;5%</td>
</tr>
</tbody>
</table>

*a numerator and denominator should include the statement “in the appropriate time period.” The appropriate time period will vary depending on herd size.a more correct denominator would exclude cows that had previously experienced a clinical case within that lactation; c cases which are detected but do not receive initial antimicrobial treatments should be included in this calculation; dherds that use quarter milkers to discard milk from selected quarters should include those cows in the numerator.

Key points

- Mastitis is a multifactorial disease:
  - Environment.
  - Milking routine.
  - Milking machine.
  - Immunity.

- Prevention is the key point.

- To know the enemy is essential to fix the problem by sampling cows.

- Many cases don’t need antibiotics.

- On farm culture is a great tool to take better therapy decisions.

- Selective treatment is an option today, but it will be mandatory very soon.

- Evaluate your treatment protocol – good records are essential.