Effect of mastitis on milk production and profitability

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Outline

120 minutes

Impact of mastitis
Performance and profitability
Primary and secondary

Mastitis, reproduction, and other diseases
Fertility and pregnancy loss

Decision tree
An example for data processing and analysis

Economic value of a dairy cow
Basic principles
Impact of mastitis
A summary

Penalties for ↑ SCC

Milk loss

Clinical

Subclinical

Transmission

Infection continued

Milk discarded

Reproduction

Culling

Early culling

Mortality

Lost udder

Recurrency

Milk discarded

Modified from Pinzón-Sánchez et al. (2011)
## Impact of mastitis

Loss for an average case, an example

<table>
<thead>
<tr>
<th>Source of loss</th>
<th>$/cow per yr</th>
<th>% total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced milk</td>
<td>121.00</td>
<td>66.0</td>
</tr>
<tr>
<td>Discarded milk</td>
<td>10.45</td>
<td>5.7</td>
</tr>
<tr>
<td>Early replacement</td>
<td>41.73</td>
<td>22.6</td>
</tr>
<tr>
<td>Extra labor</td>
<td>1.14</td>
<td>0.1</td>
</tr>
<tr>
<td>Drugs</td>
<td>7.36</td>
<td>4.1</td>
</tr>
<tr>
<td>Veterinary Services</td>
<td>2.72</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>184.4</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Ahmadzadeh and Dalton (2010)
Milk loss

Clinical mastitis

Milk loss (kg/d)

-4 < -2 0 2 4 6>

Adjusted because losses occurred in high producing cows

Seegers et al. (2003)
Milk loss

Clinical mastitis

375 kg (5%) loss
Average case for Holstein 2\textsuperscript{nd} month

Highly variable
10 cases:
• 5 cases: 375 kg (average)
• 4 cases: Little loss
• 1 case: 1,000 kg (high)

Seegers et al. (2003)
Milk loss

Clinical mastitis: First lactation

![Diagram showing milk loss and relative days to onset for different pathogens.]

- Streptococcus spp.
- Staphylococcus aureus
- Staphylococcus spp.
- Escherichia coli
- Klebsiella spp.
- No patógeno
- A. pyogenes
- Otros

Effect (kg/d)

Relative days to onset

Gröhn et al. (2004)
Milk loss
Clinical mastitis: 2\textsuperscript{nd} and later lactations

Gröhn et al. (2004)
Milk loss

Clinical mastitis: 30 to 305 d

Value milk loss (@ $0.33/kg)

- Streptococcus spp.
- Staphylococcus aureus
- Staphylococcus spp.
- Escherichia coli
- Klebsiella spp.
- No patógeno

Pinzón-Sánchez et al. (2011)
Milk loss
Subclinical mastitis (in addition to clinical)

\[
y = 0.8656 \ln(x) - 9.3658
\]

\[
y = 0.5771 \ln(x) - 6.2439
\]

≥ 2\textsuperscript{nd} lactation

\textbf{0.6 kg/d}

(Each double SCC > 50,000)

1\textsuperscript{st} lactation

\textbf{0.4 kg/d}

(Each double SCC > 50,000)

Modified from Seegers et al. (2003)
Milk loss

Subclinical for SCC=800K cell/mL

- **1st lactation**
- **≥ 2nd lactation**

**Milk loss (kg)**

- **Gram positives**: 30-305 d, Pinzón-Sánchez et al., 2011
- **Gram negatives**: 30-90 d (de Hass et al., 2004)
- **No pathogen**
Milk loss

Relationship SCC & DIM (vs. 50K cell/mL)

Hortet et al. (1999)
Milk price lost

Penalty or price premium losses

Very specific
Region
Market
Economic context
Negotiations

Thresholds
Combined effect of clinical and subclinical mastitis

Bulk tank
Herd weighted average
Dilution effect
Milk price lost
Price premium or penalty (Wisconsin)

Premium or penalty ($/kg milk)

SCC Bulk tank (K cell/mL)

Umbral 350K
Transmission cost

*Staphylococcus aureus*

Infected cow

- S. aureus

- Cured

- Non-cured

New infections

- 0.33 to 5.3
  
  Swinkels et al. (2005)

Other contagious pathogens

- *Strep. agalactiae*
- *Streptococcus dysgalactiae*
- *Corynebacterium bovis*
- *Mycoplasma bovis*

Pinzón-Sánchez et al. (2011): 0.25

Harmon (1996)
Recurrence cost
Increased risk of additional cases

Risk factors
Lactation
Pathogen
Cure

Possible levels
13% 1st lactation
23% 2nd+ lactation

Pinzón-Sánchez et al. (2011)

+20%

Hoe and Ruegg (2005)

Cure
According to etiology
Lost udder cost
Increased risk because of mastitis

Risk factor
Recurrence

Possible levels
10% recurrent cases

Milk loss
15% additional milk loss

Pinzón-Sánchez et al. (2011)
Early culling risk

Culling risk is increased

**Higher risk**
- Early in lactation
- Dry period
- Udder damaged
- Clinical case

Seegers et al. (2003)

**Higher risk**
- 1.5 to 5% more risk after a clinical case
# Early culling risk

Culling risk is increased

<table>
<thead>
<tr>
<th>Higher early culling risk, %</th>
<th>Affection</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 - 4.0</td>
<td>Clinical mastitis</td>
<td>Beaudeau et al. (1994; 1995)</td>
</tr>
<tr>
<td>1.9 - 3.0</td>
<td>Clinical mastitis</td>
<td>Gröhn et al. (1998)</td>
</tr>
<tr>
<td>1.4 - 2.6</td>
<td>Clinical mastitis</td>
<td>Rajala-Schultz et al. (1999)</td>
</tr>
<tr>
<td>1.2 - 2.7</td>
<td>Elevated SCC</td>
<td>Beaudeau et al. (1995)</td>
</tr>
</tbody>
</table>
Early culling cost

Complex calculation

Economic value of affected cow
Compared with a replacement

State of the cow
Lactation
Days in milk
Days in pregnancy

Important factors
Cow productivity
Genetics of replacement

Other factors
Herd characteristics
Market/economic conditions
Early culling cost

Tool: The economic value of a dairy cow

Example:
Cost of culling this 2nd lactation, 1 MIM, open cow is $897

Cabrera (2012)
Mortality risk

Mortality risk is increased in Holsteins
0.22% (W France)
0.19% (N Ireland)

Seegers et al. (2003)

Risk according to pathogens
Gram negatives = +3 times

Bradley & Green (2001)

$E. \text{coli} = +74\%$

$Klebsiella \ sp. = +8\%$

$S. \text{aureus} = +8\%$

Hazlett et al. (1984)
Mortality cost
Calculating the cost of mortality

Mortality cost
Value of cow before dying +
Value of meat

Example:
Mortality cost of a 3\textsuperscript{rd} lactation, 5 MIM, 1 MIP
is $627 + $494 = $1,121
Mastitis and reproduction
Reproductive physiology

Prolonged service time
Energy balance
Fever
Blockage GnRH-LH

Reduced conception risk
Poorer quality oocytes
Fever
Toxins
Pregnancy losses

Chebel (2007)
Mastitis and reproduction

Reduced conception rate

- Control
- Mastitis before 1st TAI
- Mastitis between 1st TAI and pregnancy diagnosis
- Mastitis after pregnancy confirmation

Adapted from Santos et al. (2004) by Chebel (2007)
Mastitis and reproduction

Impacts (mastitis after 1\textsuperscript{st} service)

\textbf{Decreased}
Conception rate to 1\textsuperscript{st} service
28.7 vs. 10.2%

\textbf{Increased}
Services per conception
2.59 vs. 3.05

\textbf{Prolonged}
Interval from calving to conception
139.7 vs. 189.4

\textbf{Higher likelihood}
Abortion
5.8 vs. 11.6%

Santos et al. (2004)
Mastitis and reproduction

Survival curve

Mastitis incidence (9,000 lactations) = 35%

Mastitis median to pregnancy = 154 d

No mastitis median to pregnancy = 128 d

Hazard ratio for non mastitis cows = 1.25 (25% higher)

Mendonca and Chebel (2011)
Mastitis and reproduction

Survival curve

Days to conception
+49d for LnSCC ≥ 4.5

LnSCC ≥ 4.5

LnSCC < 4.5
# Mastitis and reproduction

**Logistic regression**

<table>
<thead>
<tr>
<th></th>
<th>Conception at 1(^{st}) service</th>
<th>Abortion risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>LnSCC&lt;4.5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>LnSCC(\geq)4.5</td>
<td>0.83</td>
<td>1.22</td>
</tr>
</tbody>
</table>

**Subclinical mastitis**

Significant impact on reproductive performance by increased calving to first service, calving to conception, and services per conception

Pinedo et al. (2009)
Decreased fertility cost

Tool: The economic value of a dairy cow

Decreased net return

Response to decreased 21-d pregnancy rate

Example

Decreased 21-d PR from 18 to 14% = $1,969 - $1,924 = $45/cow per year lost

Cabrera (2012)
Mastitis and reproduction

Pregnancy losses

Mastitis causes pregnancy losses
Cows diagnosed with mastitis before pregnancy diagnoses have a higher risk of pregnancy loss later in gestation

Chebel (2011)
Pregnancy loss cost
Tool: The economic value of a dairy cow

Abortion cost
Decreased cow value of cow when pregnant vs. when open

Example
Cow value of $900 when pregnant - cow value of $400 when open = $500

Cabrera (2012)
# Diseases and mastitis

## Mastitis alone and other diseases

<table>
<thead>
<tr>
<th></th>
<th>Clinical Mastitis + Other(^1)</th>
<th>Clinical Mastitis</th>
<th>Other(^1)</th>
<th>Healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>54</td>
<td>154</td>
<td>187</td>
<td>572</td>
</tr>
<tr>
<td>Days to first breeding</td>
<td>73</td>
<td>66</td>
<td>65</td>
<td>67</td>
</tr>
<tr>
<td>Services per conception</td>
<td>2.8(^a)</td>
<td>2.1(^{ab})</td>
<td>1.9(^{abc})</td>
<td>1.6(^c)</td>
</tr>
<tr>
<td>Days open</td>
<td>155(^a)</td>
<td>140(^a)</td>
<td>97(^b)</td>
<td>88(^b)</td>
</tr>
</tbody>
</table>

\(^1\)Other = ovarian cyst, retained placenta, left displaced abomasum, ketosis, milk fever, metritis, pyometra.
Diseases and fertility
Mastitis alone and other diseases

\[\text{Clinical Mastitis} + \text{other}^1\]

\[\text{Clinical Mastitis} \]

\[\text{Other}^1\]

\[\text{Healthy}\]

\[^1\text{Other}=\text{ovarian cyst, retained placenta, left displaced abomasum, ketosis, milk fever, metritis, pyometra.}\]
Mastitis decision tree

Example of data processing and analysis
# Mastitis decision tree

## Optimal culture and treatment (all in US$)

<table>
<thead>
<tr>
<th>Culture</th>
<th>Treatment</th>
<th>Primiparous</th>
<th>Multiparous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>↑Contagious</td>
<td>↑Coliforms</td>
</tr>
<tr>
<td>On-farm culture, wait 24-hr</td>
<td>Gram+</td>
<td>2 d</td>
<td>-363</td>
</tr>
<tr>
<td></td>
<td>Gram-</td>
<td>None</td>
<td>-379</td>
</tr>
<tr>
<td></td>
<td>No growth</td>
<td>None</td>
<td>-383</td>
</tr>
<tr>
<td>On-farm culture, treat</td>
<td>Gram+</td>
<td>1 d more</td>
<td>-354</td>
</tr>
<tr>
<td></td>
<td>Gram-</td>
<td>Stop</td>
<td>-385</td>
</tr>
<tr>
<td></td>
<td>No growth</td>
<td>Stop</td>
<td>-390</td>
</tr>
<tr>
<td>No on-farm culture</td>
<td>None</td>
<td></td>
<td>-314</td>
</tr>
<tr>
<td></td>
<td>2 d</td>
<td></td>
<td>-361</td>
</tr>
</tbody>
</table>
Web-based decision support tools
The UW-Dairy Management Website

Menu

DairyMGT.info

Tools

Social media
Web-based decision support tools

The UW-Dairy Management Website

DairyMGT.info: Tools
Thanks