Environment and udder health

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Goal of lecture

- Understand the connection between cow housing and udder health
- Importance of dry cow housing
- Evaluation of stalls
- Collection of bedding samples
- Interpretation of culture results
Udder health goals

Prevention is overall goal -> reduce the incidence of mastitis

• What are the main organisms causing mastitis in the herd?
• Where is the greatest opportunity area?

-> Targeted Risk Assessment
Cow Environment is always part of this process!
Environment and udder health

Reducing bacterial load in the cow’s environment is one of the basic strategies in environmental mastitis control.

Patel et al. 2019
Infection dynamics

‘Contagious mastitis’
Major source: Cow

‘Environmental mastitis’
Major source: Environment
Housing facilities
Walkways
Holding area
etc.

Dominant strain = cow to cow transmission?

Klaas and Zadoks 2018
Dominant strains

‘Contagious mastitis’

‘Environmental mastitis’

- Contagious versus Environmental spread

- Identification of a dominant strain does not exclude an environmental point source

Klaas and Zadoks 2017
Reservoir of most major mastitis pathogens

- *E. coli*
- *Klebsiella spp.*
- *Streptococcus spp. (uberis, dysgalactia)*
- *Lactococcus*
- Non-aureus *Staphylococcus species*
- Other pathogens in certain situations

„Linear somatic cell scores increased as udder hygiene score increased.“

„There was a significant association between the prevalence of intramammary contagious pathogens and udder hygiene score.“
Udder Hygiene

Manure from stalls

Splashing in alley ways or walkways
Cow positioning

Ideal: cows cannot contaminate beds

Not Ideal: Cows too far in the front of beds; manure in back of beds
Alley ways
Targeted Risk Assessment

• When is the initial mastitis happening?
  • **During the dry period**
  • During lactation
  • Specific pen
Dry period infections

Infection in the dry period

- E. coli (55%)
- Staph. spp (11%)
- Strep. spp (18%)
- Other (16%)

Clinical mastitis in early lactation

- Infection in dry period
- No Infection in dry period

-> Acquired in environment!

Green et al. 2002
Susceptible points in the dry period

- Right after dry-off: high udder pressure -> leakage
- Right before calving: rising udder pressure, negative energy balance, immune dysfunction
- Clean environment during this time is crucial!
Challenges of dry cow housing
Evaluating milking cow facilities

- Stall cleanliness
- Cow positioning
- Bedding level
- Alley and walkway cleanliness
- Bedding samples

-> Goal: find opportunities to improve udder hygiene and reduce infections
Stall cleanliness

- Evaluate all functional stalls.
- Evaluate stall cleanliness as 1 or 2.
- 1 = mostly/completely clean no evidence of manure/urine, e.g. just looks used
- 2 = dirty piles of manure, urine pooling

**Guideline: 20% or fewer stalls with score 2**
Bedding quantity

- Evaluate the bedding quantity for deep beds.
  - 1 = adequate bedding: minimal curb exposure
  - 2 = inadequate bedding: visible curbs, holes where cows lay down

- Evaluate the bedding quantity for mattresses.
  - 1 = adequate bedding: none or only one small bare spot (<32 in), mattress not visible
  - 2 = inadequate bedding: no bedding, mattress visible in multiple spots
Bedding sampling strategy

• What is the bacterial load of fresh bedding?
• What is the bacterial load cows experience at the end of a bedding cycle -> ‘worst case scenario’
• Is bedding stored on the farm before spreading in stalls -> ‘pile’
Bedding sampling material

- Disposable gloves
- Sealable bags (1 gallon, e.g. zip lock)
- Cooler with ice for transportation
- Permanent marker
Selecting stalls

- DO NOT Walk behind the vehicle delivering new bedding.
- Have vehicle dump extra bedding in 5 stalls throughout pen.
- Collect from the top of this pile
- Avoid any used bedding.
Sampling stalls

- Sample 3 to 5 representative stalls into one clean bag.
- Only sample bedding from the 2’ x 2’ section where the udder would touch the stall.
- Scrape 1 inch off the top of the bedding material.
Getting ‘the worst-case scenario’ stalls

• Answers the question: what is the bacterial load in clean stalls at the end of a bedding cycle.
• Sample right before new bedding is spread
• Select stalls that are used but DO NOT show any manure or urine accumulation
Label the bags with this information:
- Farm
- Date
- New or used bedding
- Type of bedding (e.g. sand, manure solids)

Place the samples in a cooler with ice for travel.
Freeze, if they are not processed the same day.
## Bedding culture results

What does it mean????
Cut off values?
Recommendations?

<table>
<thead>
<tr>
<th>Sample ID:</th>
<th>NEW Bedding Material</th>
<th>USED Bedding Material</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Streptococcus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streptococcus spp</td>
<td>833,333</td>
<td>21,149,425</td>
</tr>
<tr>
<td><strong>Staphylococcus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus spp</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td><strong>Coliform Bacteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. coli</td>
<td>not detected</td>
<td>1,839</td>
</tr>
<tr>
<td>Klebsiella spp</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td>Other coliforms</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td><strong>Other Bacteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram negative bacillus</td>
<td>not detected</td>
<td>11,494</td>
</tr>
<tr>
<td>Gram positive bacillus</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td>Corynebacterium spp</td>
<td>27,333,333</td>
<td>193,103,448</td>
</tr>
<tr>
<td>T. pyogenes</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td>Pseudomonas spp</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td><strong>Other Organisms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prototheca spp</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td>Yeast</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td>Mold</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td>Other Fungus</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td><strong>Total (CFU)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streptococcus spp</td>
<td>833,333</td>
<td>21,149,425</td>
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<tr>
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<td>193,103,448</td>
</tr>
<tr>
<td>Other Organisms</td>
<td>not detected</td>
<td>not detected</td>
</tr>
<tr>
<td><strong>Total Number (CFU)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>28,166,666</td>
<td>214,266,207</td>
</tr>
</tbody>
</table>

Streptococcus agalactiae
Staphylococcus aureus

[Quality Milk Production Services](http://www.prodairy.cals.cornell.edu)
Bedding culture guidelines

• Data from 168 herds in 17 states across the country
• 4 common bedding types:
  • New sand
  • Recycled sand
  • Recycled manure solids
  • Organic bedding
• Udder health outcomes:
  • Test day average SCC
  • New infections

Patel et al. 2019, Rowe et al. 2019
Bedding bacteria load and udder health

• Unused and used bedding bacteria counts are associated with udder health
• Minimal differences between bedding types
• Benchmarks to monitor bedding hygiene -> orientation not cut off values!!

Patel et al. 2019, Rowe et al. 2019
## CFU benchmarks

- Achievable benchmarks for bacterial counts associated with improved udder health

<table>
<thead>
<tr>
<th>Pathogen group</th>
<th>Unused bedding</th>
<th>Used bedding</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Klebsiella</em></td>
<td>0 cfu/cm³</td>
<td>0 cfu/cm³</td>
</tr>
<tr>
<td>Coliforms</td>
<td>≤ 500 cfu/cm³</td>
<td>≤ 10,000 cfu/cm³</td>
</tr>
<tr>
<td><em>Streptococcus</em>-like organisms</td>
<td>0 cfu/cm³</td>
<td>≤ 500,000 cfu/cm³</td>
</tr>
<tr>
<td></td>
<td>≤ 1,000 cfu/cm³*</td>
<td></td>
</tr>
<tr>
<td><em>Staphylococcus</em> species</td>
<td>0 cfu/cm³</td>
<td>0 cfu/cm³</td>
</tr>
</tbody>
</table>

* Recycled manure solids

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Patel et al. 2019, Rowe et al. 2019
Summary

• Bacterial load in the environment affects:
  • Intramammary infection
  • Bulk tank cell counts
  • Bulk tank bacteria counts

• Dominant mastitis strains can spread from point sources in the environment

• Targeted risk assessment of environment by lactation stage
  • Milking cows
  • Dry cows -> higher susceptibility during early dry-off and close to calving
Summary

• Evaluation of cow housing
  • Risk assessment tool
  • Stall cleanliness
  • Cow positioning
  • Bedding amount
  • Bedding culture

• Bacteria counts in bedding are associated with udder health.
• Benchmarks for bedding bacteria counts give guidelines.