Udder Health and Milk Quality: from science to practice

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From Science to Practice

- Implementation of udder health PROFIT TEAMS
  - Continuously incorporate the most important scientific findings in on-farm udder health programs
    - Routine monitoring & surveillance programs
  - Development of practical udder health improvement protocols
Objectives

- Identifying the issues and understanding farm culture.
- Establishing goals and guidelines.
- Risk assessment.
- Plan Development.
- Motivating change.
- Monitoring and Surveillance

Scientific Progress

1. Bacterial pathogens
2. Host
3. Human Factors
4. Environmental Management
Key scientific issues:

Chronic IMI are quite prevalent and cause long term high SCC and recurrent clinical mastitis:

- We observed the occurrence of host-adapted strains across bacterial species:
  - Adopt advanced diagnostics.
  - Focus on elimination of host-adapted strains.
- Hosts are becoming more susceptible to mastitis, dry period is high risk time.
  - Develop and adopt dry cow management programs.
  - Develop breeding programs against clinical mastitis.
- Management needs to recognize that early diagnosis and intervention is important
  - Adopt aggressive treatment programs when management is appropriate.

Human Factors

- Producer motivation:
  - Premium programs
  - Economic value of programs
- Milking procedures.
- Treatment programs for both clinical and high SCC cows.
Environmental Management

- Heifer, dry cow and lactating cow hygiene.
- Milking equipment
- Nutrition: minerals/vitamins and water

Herd Health Improvement

![Diagram showing the process of herd health improvement with steps including farmer's utility function, goals, planning, analysis, check, and implementation factors.]
Identify the Concern

- High BTSCC (economics and productivity)
  - Decreased Milk value
  - Market at risk
  - Unappreciated consequences
    - Milk loss
    - Poor treatment results
    - Increased culling

Identify the Concern

- High SPC/PIC
  - Decreased Milk value
  - Market at risk
  - Unappreciated consequences
    - Cow hygiene
    - Milking procedures
    - Undetected Mastitis
Identify the Concern

- Clinical Mastitis
  - Increased culling & death
  - Treatment costs
  - Milk Lost
  - Poor treatment results

Udder health improvement protocol

1. Resolve immediate udder health and milk quality issues
2. Goal setting
3. Risk assessment and problem analysis
4. Prioritize main issues and planning
5. Execution of proposed solution
6. Evaluation and monitoring
1. Resolve short term problems

- IDENTIFY The Chronic High SCC Cows
  - Test day Linear Score Information.
    - Contribution to the bulk tank list
    - Chronic infection List (Dairy Comp, PC Dart)

- CMT
  - Must be done on a routine basis. (monthly?)
  - History of clinical mastitis?

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1. Resolve short term problems

- Manage the high cell count milk – cow or quarter level:
  - Use CMT
  - Quarter milkers / dry-off / cull

- Segregate suspect animals
  - Chronic infection group
  - High cell count group
  - Infection dynamics – reduced risk for transmission

Quarter Milker Systems
1. Resolve short term problems

- **Manage the high cell count milk – cow or quarter level:**
  - Use CMT
  - Quarter milkers / dry-off / cull

- **Segregate suspect animals**
  - Chronic infection group
  - High cell count group
  - Infection dynamics – reduced risk for transmission

2. Goal setting

- **Identify key performance indicators:**

<table>
<thead>
<tr>
<th>Key Performance Indicator (KPI)</th>
<th>Goal values</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Top</td>
<td>Ok</td>
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<tr>
<td>1. Incidence of clinical mastitis per month.</td>
<td>&lt; 1%</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>2. Bulk Milk Somatic Cell Count.</td>
<td>&lt; 150</td>
<td>&lt; 250</td>
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<tr>
<td>3. Prevalence of culls for udder health reasons.</td>
<td>&lt; 3%</td>
<td>&lt; 5%</td>
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Incidence calculated as all mastitis cases per month / cows milking. Average of all bulk milk SCC measurements in a given month. Calculated as all udder health culls / average number of lactating and dry cows in the herd.
Producer motivation

- Explain issues seen in KPI
- Discuss costs to farm
  - Ask if owner is aware of issues
- Discuss causes of problems
- Provide materials
  - Ask if owner understands
- Identify potential solutions
- Discuss costs/benefits
- Ask preferences from owner

- To do lists
- Action points

- Support implementation
- Provide follow up

- Success leads to loyalty

---

### Producer motivation

- $$, increase net income
  - Ask objectives – listen and record
  - Help increase income
  - Help reduce costs
  - Be creative to help producer increase bottom line (share ideas!)

- Make teams work on the farm
  - Teach, always
  - Motivate workers on the farm

- Help enjoy farming
  - Everyone enjoys healthy animals
  - Farmers enjoy good health data
  - Build enduring relationships with producer
  - Respect, not arrogance
  - Praise success
3. Risk assessment and problem analysis

- Four potential areas of:
  - Clinical mastitis
  - SCC
  - Culling
  - High bacteria counts (SPC, PIC)
- What are the customers concerns?
- What concerns have you identified?
- Are there other concerns or priorities?

Herd mastitis audit

- Analyse herd data
- Perform herd audit
  - Menu system (NYSCHAP risk assessment guide)
  - Herd observations
- Summarize findings
  - On farm presentation
  - Written summary

http://nyschap.vet.cornell.edu
Analyze Clinical Mastitis

Clinical Mastitis >20%

First Cases >5% of cows

Dry period origin D0-30: >5% of cows

Heifers

Mineral Status

Vaccination

Protocol

Dry Treat

Mineral Status

Dry period

Housing/ Hygiene

Pre fresh

Treatment

Ketosis

ARCS

Mineral

Status

Housing/ Hygiene

Culling

Analysis

Heifers

Cows

LACTATION

DRY-PERIOD

Analyze high SCC

Contribution of individual cows

Few Cows (<2%) responsible for high counts

More than 2% of cows are responsible

Chronic vs spikes

New infections >8%*

Chronic infections >8%*

Fresh cow infections >15%*

Analyzing New infections

Hygiene

Milk processing

Purchase cattle

Segregation

Days in milk / Dry

Seasonality

Pen/bar specific effects

SCC Patterns: Heifers vs cows

Spikes

High - low - high

Chronic high

Culture Chronic High SCC Cows

Segregate

Treat

Cull/dry

Dry off

In Lactation

DRY-PERIOD

LACTATION

* New Chronic Fresh
Top ≤5% ≤5% ≤10%
Ok ~8% ~10% ~15%
Not ok 9+% 10+% 18+%

Analyzing Chronic infections

Chronic vs spikes

Segregate

Culture

Treat

Dry

Cull

Analyzing Fresh cow infections

Hygiene dry period

Minerals

Seasonality

Heifer facilities

Transition mgmt

Dry cow treatment

Culling/Dry

In Lactation
High new infection, chronics and high fresh SCC

Evaluate:

>5% of cows culled for udder health

Analyze culling

Cows Culled Evaluate:
- due to high SCC
  - Add cases to 1. SCC analysis
  - RELV/Repro
  - Culling moment Appropriate?
- due to clinical mastitis
  - Add cases to 2. Mastitis analysis
  - RELV/Repro
  - Culling moment Appropriate?

Cows Not Culled Evaluate:
- Cows with >3 repeat cases
- Cows >5 high Linear Score (>4.5)
  - RELV vs. avSCC and repro
- Cows infected with S.ag, S.au, Myco
4. Prioritize main issues and execution of plans

- **Decision making procedures**
  - Models to aid decision making
  - How well do interventions work on a farm?

- **Motivation of owner and workers**
  - Communication for attitude change
  - Training methods

- **Standard operating procedures**
  - Written and pictorial
Motivation: ‘marketing funnel’

- Explain issues seen in KPI
- Discuss costs to farm
- Ask if owner is aware of issues
  - Discuss causes of problems
  - Provide materials
- Ask if owner understands
  - Identify potential solutions
  - Discuss costs/benefits
  - Ask preferences from owner
  - To do lists
  - Action points
- Support implementation
  - Provide follow up
- Success leads to loyalty

6. Evaluation and monitoring

- Bulk milk monitoring
- Clinical mastitis and culling monitoring
- Monitoring of chronic high SCC and repeated clinical cases
Farm Somatic Cell Count

Milk Quality Bonus is paid in the paycheck after the 20th of the following month after goal is achieved

Success of mastitis control program

- Clinical mastitis reduction of 20% was obtained when farmer compliance with advice provided was over 67% (2/3).
- Similarly, at high compliance a decrease in new infection rate of 17% was obtained.

Green et al. 2007
Key program components

- Milking machine function
- Milking technique
  - Prep, gloves, PMTD
- Milking cow hygiene
- Dry cow and heifer hygiene
- Nutrition
  - Vitamins and minerals
  - Water
- Clinical mastitis treatment and segregation
- High SCC treatment and segregation

Conclusions

- Milk quality and low bulk milk SCC are manageable.
- Clinical mastitis incidence is more difficult to manage but adequate control programs will lead to reduction in both first cases and repeated cases.
- Udder health consultancy according to standard procedures:
  - Goal setting
  - Risk evaluation
  - Planning
  - Execution
  - Evaluation and monitoring
- Producer motivation is key component
- Continuous incorporation of improved knowledge is valuable
Got Questions?
# Milk Quality and Udder Health Key Performance Indicators

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<thead>
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<th>Key Performance Indicator (KPI)</th>
<th>BEST</th>
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<th>NOT ACCEPTABLE</th>
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<td>Bulk Milk Somatic Cell Count.</td>
<td>&lt;150</td>
<td>&lt;250</td>
<td>&gt;350</td>
<td>Average of all bulk milk SCC measurements in a given month.</td>
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<tr>
<td>Standard Plate Count (SPC or PLC)</td>
<td>&lt;5,000 cfu</td>
<td>&lt;10,000 cfu</td>
<td>&gt;10,000 cfu</td>
<td>Average of all bulk milk SPC measurements in a given month.</td>
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<td>NEW Infection Rate</td>
<td>&lt;5%</td>
<td>≈6%</td>
<td>&gt;10%</td>
<td>% LS&gt;4.5 PLS&lt;4.5 for lactating animals per test period</td>
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<tr>
<td>CHRONIC Infection Rate</td>
<td>&lt;5%</td>
<td>≈10%</td>
<td>&gt;10%</td>
<td>% LS&gt;4.5 PLS&gt;4.5 for lactating animals per test period</td>
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<tr>
<td>HiFresh cow Infection Rate</td>
<td>&lt;10%</td>
<td>≈15%</td>
<td>&gt;15%</td>
<td>% LS1&gt;4.5 for calving animals per test period</td>
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<tr>
<td>% of lactating herd &lt;4.5 Linear score</td>
<td>&gt;90%</td>
<td>80%-90%</td>
<td>&lt;80%</td>
<td>% LS&gt;4.5 / all lactating animals per test period</td>
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<tr>
<td>Incidence of clinical mastitis per month.</td>
<td>&lt;1%</td>
<td>&lt;2%</td>
<td>&gt;2%</td>
<td>Incidence calculated as all mastitis cases / cows milking/ month.</td>
</tr>
<tr>
<td>Prevalence of culls for udder health reasons.</td>
<td>&lt;3%</td>
<td>&lt;5%</td>
<td>&gt;10%</td>
<td>Calculated as all mastitis culls / all culls in a given 12 month period.</td>
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# Udder Hygiene Scoring Chart

Score udder hygiene on a scale of 1 to 4 using the criteria below. Place an X in the appropriate box of the table below the pictures. Count the number of marked boxes under each picture.

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<th>SCORE 1</th>
<th>SCORE 2</th>
<th>SCORE 3</th>
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<td>Free of dirt</td>
<td>Slightly dirty 2 – 10% of surface area</td>
<td>Moderately covered with dirt 10 – 30% of surface area</td>
<td>Covered with caked on dirt &gt;30% of surface area</td>
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</tbody>
</table>

**Score 1**
- Free of dirt

**Score 2**
- Slightly dirty

**Score 3**
- Moderately covered with dirt

**Score 4**
- Covered with caked on dirt

|   | 1 | 2 | 3 | 4 | 5 |   | 1 | 2 | 3 | 4 | 5 |   | 1 | 2 | 3 | 4 | 5 |   | 1 | 2 | 3 | 4 | 5 |
|   | 6 | 7 | 8 | 9 | 10 |   | 6 | 7 | 8 | 9 | 10 |   | 6 | 7 | 8 | 9 | 10 |   | 6 | 7 | 8 | 9 | 10 |
|   | 11 | 12 | 13 | 14 | 15 |   | 11 | 12 | 13 | 14 | 15 |   | 11 | 12 | 13 | 14 | 15 |   | 11 | 12 | 13 | 14 | 15 |
|   | 16 | 17 | 18 | 19 | 20 |   | 16 | 17 | 18 | 19 | 20 |   | 16 | 17 | 18 | 19 | 20 |   | 16 | 17 | 18 | 19 | 20 |

**Total Number of udder scores:**

Number of udders scored 1: ______________________
Number of udders scored 2: ______________________
Number of udders scored 3: ______________________
Number of udders scored 4: ______________________

**Percent of Udders Scored 3 & 4:** ____________

Udders scored 3 and 4 have increased risk of mastitis as compared to scores 1 & 2.
# Teat Cleanliness Scorecard

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- **1: Clean**
  - No manure, dirt, or dip

- **2: Dip Present**
  - No manure or dirt

- **3: Small amount of dirt and manure present**

- **4: Larger amount of dirt and manure present**

---

- **Number of teats scoring 1** __________
- **Number of teats scoring 2** __________
- **Number of teats scoring 3** __________
- **Number of teats scoring 4** __________

- **Total scores** __________

- **Percent of teats scoring 3 & 4** __________

---

- Teats scoring 3 & 4 have an increased risk of mastitis as compared to scores of 1 & 2.

- Milkers tend to get scores of 1 & 2 on smoother teat ends and trend toward 3 & 4's as hyperkeratosis is more prevalent. For this reason, it is very important for milkers to make a physical pass across teat ends, making sure to pinch the end of the teat with the towel.

---

**Farm Name:** __________

**Date:** __________
Goal setting

To be able to define realistic goals for future performance for a specific dairy farm it is probably important to get an idea of current performance. There are no generally applicable udder health and milk quality goals, except to meet the minimum legal standards for milk quality. Any dairy farm will need to decide what the optimal investment is into udder health and milk quality to maximize its overall performance. This decision is likely based on the knowledge of current performance and the short term and long term plans of the management of the dairy farm.

To define performance a set of primary and secondary parameters is provided below. Primary parameters are meant to be an indicator for overall performance. They provide the general state of the farm's health status, or flag the presence or potential presence of performance flaws. Secondary parameters are especially useful when primary parameters indicate sub-optimal performance. These parameters guide the user to the cause of the underlying problems.

Udder Health

*Primary parameter:*
Bulk milk somatic cell count (bulk milk SCC or mean SCC and mean Linear Score over time). These parameters are usually provided through the milk buyer or through results from the Dairy Herd Improvement Association (Dairy One in New York).

*Secondary parameters:*
- Proportion of cows with high SCC
- Proportion of cows with new high SCC (‘new infections’)
- Proportion of cows with chronic high SCC
- Culture results of high SCC cows

The preceding parameters are only available when individual somatic cell counts are measured on a regular basis (preferably monthly) for all cows in the dairy.

*Primary parameter:*
Clinical mastitis incidence (% cows with \( \geq 1 \) case of clinical mastitis per month)
Secondary parameters:
- Mastitis incidence per lactation group
- Graph of mastitis cases by dim
- Repeat cases of mastitis
- Mastitis incidence per season
- Culture results of mastitis cases

The preceding parameters can only be calculated from records held at the dairy farm. Either hand help records or on-farm computerized records must be kept by the dairy producer.

Primary parameter:
Proportion of cows culled for udder health reason (% culled for mastitis as a percentage of all cows in the herd)

Secondary parameters:
- List of cows culled
- Cows not culled but should have been culled

The preceding parameters can only be calculated from records held at the dairy farm. Either hand help records or on-farm computerized records must be kept by the dairy producer.

Criteria that define excellent udder health status of individual cows and the herd.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Ideal udder health targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk milk somatic cell count</td>
<td>&lt; 250,000 cells/ml</td>
</tr>
<tr>
<td>Herd average (actual)</td>
<td>&lt; 200,000 SCC</td>
</tr>
<tr>
<td>Herd average (DHI Linear Score)</td>
<td>&lt; 3.0 LS SCC</td>
</tr>
<tr>
<td>100% of first calvers (DHI)</td>
<td>&lt; 100,000 SCC</td>
</tr>
<tr>
<td>&gt; 85% of herd</td>
<td>&lt; 200,000 SCC</td>
</tr>
<tr>
<td>&gt; 95% of herd</td>
<td>&lt; 500,000 SCC</td>
</tr>
<tr>
<td>Incidence of clinical mastitis</td>
<td>&lt; 25 cases / 100 cows per year</td>
</tr>
<tr>
<td>Number of culls due to mastitis or other udder health problems</td>
<td>&lt; 5 cases / 100 cows per year</td>
</tr>
</tbody>
</table>
Table 1. Secondary Parameters to be Calculated in Herds with Udder Health Problems

*Somatic Cell Counts:*

Define cut-off for infection vs no infection (e.g. SCC >250 or LS > 4.5). This is referred to as LS-cutoff in the formula’s below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>% cows infected in the herd</td>
<td>( \frac{\text{# cows above LS-cutoff}}{\text{# cows SCC tested}} )</td>
</tr>
<tr>
<td>% new Infections</td>
<td>( \frac{\text{# cows below LS-cutoff last sample and above LS-cutoff this sample}}{\text{# cows below LS-cutoff last sample date}} )</td>
</tr>
<tr>
<td>% Chronic Infections</td>
<td>( \frac{\text{# cows above LS-cutoff last sample and above LS-cutoff this sample}}{\text{# cows SCC tested at both sample dates}} )</td>
</tr>
<tr>
<td>% Cured infections</td>
<td>( \frac{\text{# cows above LS-cutoff last sample and below LS-cutoff this sample}}{\text{# cows above LS-cutoff last sample}} )</td>
</tr>
<tr>
<td>Contribution of highest SCC cows</td>
<td>( \frac{(\text{SCC} \times \text{lbs. milk}) \text{ for highest SCC cows}}{\text{Sum of (SCC} \times \text{lbs. Milk}) \text{ for all cows}} )</td>
</tr>
</tbody>
</table>

*Incidence of clinical mastitis:*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative Incidence per lactation</td>
<td>( \frac{\text{# cows with at least one case of mastitis in this lactation}}{\text{# cows that have completed a lactation}} )</td>
</tr>
<tr>
<td>Percent of mastitis cases per months</td>
<td>( \frac{\text{# cases of mastitis in a given month}}{\text{Avg # cows lactating in a given month}} )</td>
</tr>
</tbody>
</table>

*Culling due to udder health:*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of culling due to udder health</td>
<td>( \frac{\text{# cows culled for mastitis in a given year}}{\text{Avg number of cows present in a given year}} )</td>
</tr>
</tbody>
</table>
Milk Quality

Primary milk quality parameters are often reported to the producer by the milk buyer. The parameters usually include Somatic Cell Counts (SCC), Plate Loop Counts (PLC), freezing point information to check for added water, acidity or rancidity, and visible milk cleanliness. Every load of milk is also test for antibiotic residues. Goal setting for bulk milk SCC depends on the ambition of the producer and the possible penalty or additional benefits that may happen by crossing a specific SCC level. In the graph below the advised SCC performance goal is graphed as a function of penalty level. For example, to remain in almost all situations below a level of 750,000 cells, the producer should aim for a mean somatic cell count of approximately 500,000. Similarly, if benefits are paid for milk with a cell count below 300,000, then the performance goal should be approximately 200,000.

![Graph showing the advised SCC performance goal as a function of penalty level.](image-url)
Bulk milk PLC should be as low as feasible, but year round production of milk with a bacteria count below 10,000 bacteria is certainly feasible.

Possibly extra information on bacteria counts in milk comes from Preliminary incubation (PI) counts, Coliform counts, and Laboratory Pasteurized Counts (LPC). These tests are described elsewhere and are claimed to make a distinction between washing failures, pipeline contamination and manure contamination in milk.

Residue violations or Growth Inhibitors indicate the presence of antibiotic residues in milk. The average risk of a producer obtaining at least one violation per year is in New York State approximately 3%. It is feasible to put policies in place that there should be no antibiotic residue violation in the herd.
**Mastitis Module Risk Assessment Guide**

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Risk Information</th>
<th>Risk factors on this farm (level of implementation)</th>
<th>Farm Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.) Biosecurity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| ✓ Purchased herds                | ✷ The majority of herds that are sold are infected with contagious mastitis pathogens.  
                                  | ✔  Culture (aerobic and Mycoplasma) the bulk tank of the prospect herd at least once, and ideally three times (at weekly intervals) prior to purchase  
                                  | ✔  Contact with non-resident livestock creates a risk for introduction of contagious mastitis pathogens into the herd.  
                                  | ✔  Test all incoming cattle for contagious mastitis (S.agalactia, S.aureus, and Mycoplasma)  
                                  | ✔  Milk incoming cattle separate or last until culture results or at least two somatic cell counts are available  
| ✓ Purchased cattle                | ✷ Contagious mastitis infections often are transmitted at fairs and shows.  
                                  | ✔  Do not share milking equipment at fairs or shows.  
| ✓ Fairs and shows                 | ✷ Cattle infected with contagious mastitis will transmit the infection to other cattle.  
                                  | ✔  Milk known infected cattle last  
                                  | ✔  Clean or disinfect equipment after milking infected cattle  
| ✓ Infected resident cattle        | ✷ Many new infections occur during milking. Additionally, milk can become contaminated with coliforms and other harmful bacteria during the milking process.  
                                  | ✔  Wear latex gloves to reduce bacterial exposure to the teats  
                                  | ✔  Checking foremilk helps to detect clinical mastitis earlier  
| 2.) Milking procedures            | ✷ Get good coverage of teat for at least 30 seconds  
                                  | ✔  Dry with an individual towel  
                                  | ✔  Attach unit within 60 seconds of stimulation  
                                  | ✔  Vacuum fluctuation and liner squawks may be  
                                  | | | |
| Cluster removal | Prevented by precise attachment  
Timely removal of the cluster prevents over-milking and teat lesions. |
|-----------------|------------------------------------------------------------------|
| Post milking disinfection | Post milking teat disinfection is the single most important factor in preventing new infections.  
Ensure that at least the lower half of the teat is dipped.  
Flaming udders removes a bacterial reservoir. |
| General hygiene | Faulty milking equipment may cause new infections in the milking herd.  
Change teat cup liners according to manufacturer recommendations  
Check other rubber parts (e.g. short milk tubes) regularly  
Provide regularly scheduled maintenance  
Milking system should be professionally evaluated at least annually. |

### 3.) Milking equipment

#### Maintenance
- Faulty milking equipment may cause new infections in the milking herd.
  - Change teat cup liners according to manufacturer recommendations
  - Check other rubber parts (e.g. short milk tubes) regularly
  - Provide regularly scheduled maintenance
  - Milking system should be professionally evaluated at least annually.

### 4.) Treatment protocol and residue avoidance

#### Culture clinical and high SCC cows
- Culture and sensitivity results can help to discern the cause of mastitis, and aid in developing treatment protocols.
  - Develop treatment protocols based on the organism present (high SCC), or likely to be present (clinical cases), clinical signs, and farm goals
  - Evaluate treatment success on a regular basis, at least once yearly.
  - Follow manufacturer’s (OTC and Rx drugs) or veterinarian’s (ELDU) recommended withholding times.
  - Follow the 10 Point Plan.

#### Review culture results with your veterinarian

#### Avoid violative drug residues
- Mastitis vaccines are becoming available and appear to be efficacious, especially to lessen the severity of Gram negative infections.
  - Vaccination protocols should be developed and implemented in collaboration with the herd health advisor, and reviewed by the management team on an annual basis.

### 5.) Vaccination considerations

### 6) Nutrition

#### Energy
- The two main nutritional areas adversely affecting immunity are energy and trace mineral/vitamin deficits
  - Monitor DMI for dry, pre-fresh, and lactating cows.
  - Review management procedures that may increase DMI (forage quality, amount fed, times pushed up, bunk characteristics, ventilation, etc.).
7.) Environment and Housing

- Avoid overcrowding
  - Over-crowding can compromise overall herd hygiene, and lead to cows laying down in alleyways. Hygiene is improved at the following stocking rates:
    - For bedded packs, space requirements should be at least 100 sq. ft. per cow.
    - For freestall facilities, strive for 100 – 110% stocking rate.

- Keep stalls clean and comfortable
  - Comfortable stalls encourage cows to lay down
    - clean manure off stalls when cows are milked
    - bed stalls frequently with dry, clean, bedding materials. Sand is the bedding of choice.

- Keep stalls adequately bedded
  - Bedding materials can harbor mastitis pathogens (e.g. green sawdust)
    - culture bedding materials if they are suspected as a source of mastitis.

- Use the right bedding material
  - Heavily soiled walkways cause manure to be splashed onto udders, and soiled hooves bring manure into stalls.

- Keep walkways clean

8.) Data collection and record keeping

- Clinical cases
  - Strive to have fewer than 2 clinical cases of mastitis per 100 cows each month
  - and less than 5% new infections (previous month’s Is < 4.0, current Is > 4.0) each month.

- Subclinical mastitis
  - and less than 5% chronic infections (previous and this