

Bovine Mastitis

John Swain Fall 2019

References from Dr. Bhushan Jayarao- Ex. Vet. Penn State Univ.

Dr. Larry Fox, Washington State Univ.

Dr. Jim Salfer U of MN

Mastitis Management- Who on the farm needs to be involved???

- Milkers
 - Housing Maintenance personnel
 - Milk Equipment Maint. Personnel
 - Operation Supervisor
- ◆ Mastitis cannot be eliminated. It can be controlled
- ◆ People control mastitis- TEAM EFFORT

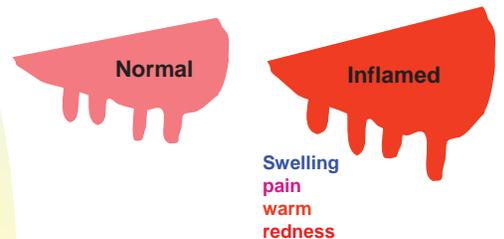
Incidence of Mastitis

- When do most new infections occur?

What's mastitis ?

- Inflammation of one or more quarters of the udder

Mammae = breast
-itis = Latin suffix for inflammation



What's the significance of bovine mastitis ?

The most costly disease affecting dairy cattle throughout the world



- Causes **significant economic losses** to the dairy industry in the US
- \$ 200/cow/year**
- \$ 2 billion/year**



Somatic Cell Count and Relationship to Milk Losses

Linear Score	Daily Yield Lost		Lactation Yield Lost	
	First Lactation	Older Cow	First Lactation	Older Cows
0-2	-----Lbs/Day-----		Lbs/Lactation	
3	0	0	0	0
4	0.6	1.3	200	400
5	1.3	2.6	400	800
6	2	3.9	600	1200
7	2.6	5.2	800	1600
8	3.3	6.6	1000	2000
9	3.9	7.9	1200	2400
	4.6	9.2		

What are the health concerns of mastitis ?

- Animal health**
 - Loss of functional quarter
 - Lowered milk production
 - Death of cow
- Human health**
 - Poor quality milk
 - antibiotic residues in milk



How severe can mastitis be ?

Subclinical Mastitis	Clinical Mastitis
<ul style="list-style-type: none"> ~ 90 -95% of all mastitis cases Udder appears normal Milk appears normal Elevated SCC (score 3-5) Lowered milk output (~ 10%) Longer duration 	<ul style="list-style-type: none"> ~ 5 - 10% of all mastitis cases Inflamed udder Clumps and clots in milk Acute type <ul style="list-style-type: none"> major type of clinical mastitis bad milk loss of appetite depression prompt attention needed Chronic type <ul style="list-style-type: none"> bad milk cow appears healthy

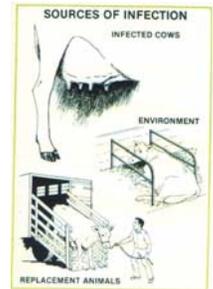
What causes mastitis ?



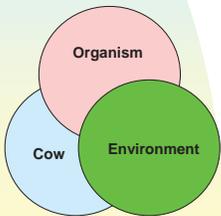
- Bacteria (~ 70%)
- Yeasts and molds (~ 2%)
- Unknown (~ 28%)
 - ◆ physical
 - trauma
 - weather extremes

Where do these organisms come from ?

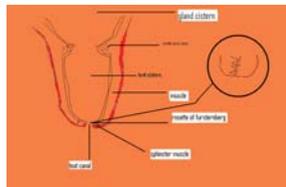
- Infected udder
- Environment
 - ◆ bedding
 - ◆ soil
 - ◆ water
 - ◆ manure
- Replacement animals



How does mastitis develop ?



- **Cow**
 - ◆ Predisposing conditions
 - Existing trauma (milking machine, heat or cold, injury)
 - Teat end injury
 - Lowered immunity (following calving, surgery)
 - Nutrition
- **Organisms**
- **Environment**



Process of infection

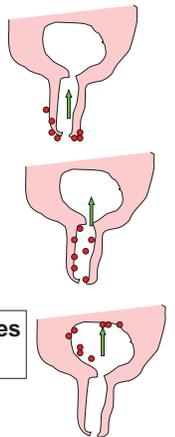
Organisms invade the udder through teat canal



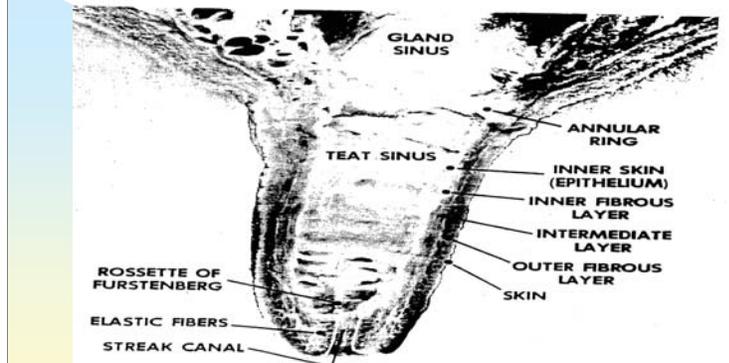
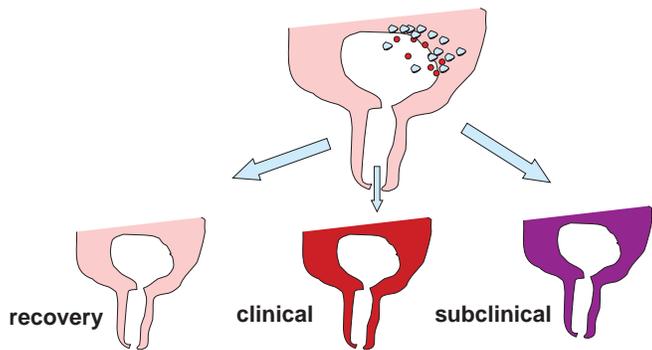
Migrate up the teat canal and colonize the secretory cells



Colonized organisms produce toxic substances harmful to the milk producing cells



The cow's immune system send white blood cells (Somatic cells) to fight the organisms



Mastitis

- Mammary Immune system
 - ◆ Skin and keratin lining 1st line of defense
 - ◆ Cellular-2nd line of defense
 - ☞ Leukocytes
 - PMNs-phagocyte-engulfment and destroy
 - Macrophages-phagocytic
 - Lymphocytes-antibody producers + cytokine (hormones of the immune system)

Mastitis

- **Environmental** bacterial pathogens
- **Contagious** bacterial pathogens
- Identification of the bacteria and where it came from is critical to mastitis treatment. Minimizing exposure is key to mastitis management

Mastitis

- Bacterial physiology
 - ◆ A. Gram + (thick cell wall membrane)
 - ◆ B. Gram – (thin cell wall membrane)

Gram stain to determine category of pathogen.

Gram Positive/ Gram Negative

- Gram Positive
 - ◆ Staphs
 - ◆ Streps
- Gram Negative
 - ◆ E. coli
 - ◆ Klebsiella

Gram Positive Mastitis

- Gram (+) become chronic if not treated with the right antibiotic
- NMC recommendations -- “treat Gram (+) lactating mastitis early”

Gram Negative Mastitis

- University research -- coliform bacteria gone by the time we see abnormal milk
- Neutrophils (white blood cells) clear infection
- Clinical signs due to endotoxins (dead bacteria)
- Antibiotic treatment only supportive

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Streptococci

Field language

“Streps”
“Environmentals”
“Environmental Strep”

- **Environmental**
 - ◆ *S. uberis*
 - ◆ *S. dysgalactiae*
 - ◆ *S. equinus*
- **Contagious**
 - ◆ *S. agalactiae*
 - ◆ Gram +
- **Clinical mastitis**
 - Cannot live outside the udder
 - Treated easily with penicillin
- **More subclinical mastitis**
- **Environment**
- **Predominant early and late lactation**

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Staphylococci

Field language

“Staph”
“Staph. Mastitis”

- **Staph. aureus**
 - ◆ Summer mastitis
 - ◆ Spread by milking equipment and milker's hands
 - ◆ Persistent, difficult to eliminate
 - ◆ If unattended leads to chronic mastitis
- **Other Staph**
 - ◆ Found normally on skin
 - ◆ Lowers milk yield
 - ◆ Elevated SCC
 - ◆ Easily responds to antibiotics
 - ◆ Relapse frequently seen

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Coliforms



J-5 vaccine

- Groups of organisms
 - *E. coli, Klebsiella, Enterobacter*
 - Gram -
- Environmental source (manure, bedding, barns, floors and cows)
- Coliforms cause acute clinical mastitis
 - ◆ high temp, and inflamed quarter
 - ◆ watery milk with clots and pus
 - ◆ toxemia

Other organisms

- *Pseudomonas aeruginosa*
 - ◆ outbreaks of clinical mastitis
- Serratia
 - ◆ outbreaks of clinical mastitis
- *Corynebacterium pyogenes*
- Fungi
- *Mycoplasma bovis* (non treatable and very contagious)

Strep. Ag. Problem

- Responds well to treatment
 - Identify infected Cows
 - Work with Veterinarian on Treatment/Culture Protocol
- Focus on teat dip coverage

S. Aureus. Problem

- Does not respond well to treatment
- ID infected Cows (ear tags, ear notches, brand)
- Segregate and milk last to prevent spread
- Infections caught early may respond to treatment
- Focus on teat dip coverage to prevent colonization

Environmental Problem

- Varied response to treatment
- Often caused by milking wet, dirty teats
- Focus on Teat Ends!!!!
- Focus on clean, dry comfortable environment

How is mastitis diagnosed ?



- **Physical examination**
 - ◆ Signs of inflammation
 - ◆ Empty udder
 - ◆ Differences in firmness
 - ◆ Unbalanced quarters
- **Cowside tests**
 - ◆ California Mastitis test
 - ◆ Electrical Conductivity



Mastitis

- Leucocytes are the cell that leave the blood and enter the milk to destroy bacteria. They are the cells that chiefly make up the milk somatic cell count (scc).
- As scc increase, so does the likelihood of bacterial infection as more cells are moving into milk to fight the infectious agent.

Mastitis

- CMT- scc>200,000 cells/ml indicate that intramammary infection is probably present.
- Score Scc (cells per ml)
 - ◆ Neg 0-200,000
 - ◆ Trace 150,000-500,000
 - ◆ 1 4,000 – 1,500,000
 - ◆ 2 800,000 -5,000,000
 - ◆ 3 >5,000,000

Mastitis

■ Scc x1000	Linear score	Milk loss
0-12.5	0	17,124 lbs.
12.5-25	1	16,724
25-50	2	16,324
50-100	3	15,924
100-200	4	15,524
200-400	5	15,124
400-800	6	14,724
800-1,600	7	14,324
1,600-3,200	8	13,924
3,200-6,400	9	13,524

U of Wisconsin 1995

Somatic Cell Count

Linear Score	LogSCC (cells/ml)
1	25,000
2	50,000
3	100,000
4	200,000
5	400,000
6	800,000
7	1,600,000

- Legal Limit in the U.S. is 750,000 cells/ml
- Legal limit in Europe is 400,000 cells/ml
- Infection level is >200,000 cells/ml
- Herd bulk tank goal: <250,000 cells/ml

Mastitis

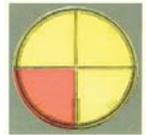
- Electrical Conductivity
 - ◆ Leakage of blood components
 - Proteins
 - Ions – chloride (salts increase conductivity)

How is mastitis diagnosed ?

- Culture analysis
 - ◆ The most reliable and accurate method
 - costly (\$ 5- 12)



Strep ID Quad w/beta-hemolytic streptococci.



Surety Quad w/Enterococcus faecalis.

How do you treat mastitis ?

- **Clinical mastitis**
 - ◆ Strip quarter every 2 hours
 - ◆ Oxytocin valuable
 - ◆ high temp, give aspirin
 - ◆ Seek veterinary assistance
 - ◆ Treatment with penicillins
- **Subclinical mastitis**
 - ◆ Questionable



Attitude adjustment !!!!!
 Don't expect SCC to go down ASAP (4-5 weeks !)
 Discard milk from treated cows (double jeopardy !)

THE 10 STEPS TO MASTITIS CONTROL

- **ONE: Prepare cows properly for milking**
 - ◆ Udder preparation is pre-dipping with a dip labeled for pre-dipping. Pre-dips lower the risk of new infections by 70% !!!!!!!!!!!!!!!
 - ◆ Pre-dips
 - Iodophors 0.0 -1.0 %
 - Chlorhexidine 0.2%
 - Quats 0.5%
 - LDBSA 0.2%
 - Hypochlorous acid
 - Bleach ?
 - ◆ Use single service paper towels, dry teats before machine-application.

■ **TWO:** Have a good milking system

- ◆ Milking equipment should be adequate in size, functioning properly, and regularly cleaned and maintained
- ◆ **Correctly use proper functioning milking machines and properly prepare udders**
 - Attach teat cups after thorough cleaning and drying of teats
 - Provide stable vacuum
 - Check for slipping of teat cup liners
 - Shut of vacuum before removing teat cups.

■ **THREE:** Apply and remove machine carefully

- ◆ Properly adjust to prevent liner slippage.
- ◆ Remove machine when cow is milked out, shut off vacuum at claw before removal.

■ **FOUR:** Dip each teat after each milking using a germicidal teat dip.

- ◆ Post-dips seal the teat ends temporarily for 6 to 8 hours
- ◆ A must for long term mastitis control program

■ **FIVE:** Monitor your mastitis score (DHI-SCC, WMT) regularly. Take action when significant increases occur.

■ **SIX:** Treat clinical cows, follow label recommendations, treat aseptically. Withhold treated cows' milk from milk supply.

■ **SEVEN:** Segregate chronic mastitis cows, milk them last, cull when necessary.

- ◆ cows with chronic mastitis serve as reservoirs of organisms and could infect susceptible cows

■ **EIGHT:** Dry treat each quarter using partial insertion techniques with an approved dry cow treatment at drying off.

- ◆ Cure rate is twice high as that during lactation
- ◆ Lowers the risk of clinical and subclinical mastitis during subsequent lactation

■ **NINE:** Keep cows clean, udders free from soil and manure.

- ◆ Fence off wet, swampy areas.
- ◆ Keep free stalls and stanchions bedded properly.
- ◆ Keep calving areas clean, properly bedded (straw preferred).

■ **TEN:** Properly feed and care for cows.

Summary



- Mastitis is primarily a management problem
- Mastitis can be controlled
- Prevention programs work best when correctly followed

Optimum Milking Procedures for quality Milk and Udder Health

- The Goal is to:
 - ◆ Milk clean dry teats
 - ◆ Optimize Parlor efficiency (cows/hr)
 - ◆ Optimize Milking time hygiene
 - Rubber gloves-individual towels
 - Clean claws- clean floor
 - Pre and post dips

Milking Procedures

1. Clean udder of debris
2. Strip 3-4 squirts of milk from each quarter
 - a. Look for mastitis
 - b. Stimulation
3. Pre-dip
4. Dry teats
5. Attach milking unit
6. Automatic take-off
7. Post-dip teats



Timing considerations of proper milking procedures

- Predip – 30 second contact time min.
- Strip
 - ◆ Milk Ejection
 - Udder to brain <1sec.
 - Release of oxytocin 1-2 sec
 - Circulation to MG 19-22 sec.
 - Contraction of Myo cells 6 sec.
 - Milk ejection 20-30 sec.
 - Total time from stimulation 1 to 1.5 min.

Milking Procedures for Quality Milk

Milking Procedures for Quality Milk

■ PREREQUISITES

- ★ Maintain clean, well ventilated bedded areas for cows
- 🕒 Segregate known infected cows. Milk them last or with designated equipment
- 🕒 CMT all fresh cows by the 6th milking
- 🕒 Milk all treated cows last
- 🕒 Change rubber inflations every 60 days or 1000 cow milkings whichever comes first

PREREQUISITES

- 🕒 Check the milking systems or units periodically for function and reliability
- 🕒 Clip or singe the udder hair
- 🕒 Examine periodically teats and teat ends
- 🕒 Mastitis treatments should be done by one or two persons and should be done after milking
- 🧼 Cloth towels should be washed after every use

Simple Steps

“Two trips to each cow will provide a routine to Maximize Milk Quality and Parlor Performance” Dr. Andy Johnson

Step One.....Strip and Predip

Step Two.....Dry and Apply

Standardized Milking Procedures

Stanchion / Tiestall

- Wear Gloves
- Wipe off excess dry manure, straw and bedding
- Strip each teat into a stripcup
- Dip teats with an approved pre-dip
- Allow the pre-dip to react for at least 30 sec.

Parlor

- Wear Gloves
- Wipe off excess dry manure, straw and bedding
- Strip each teat into a stripcup
- Dip teats with an approved pre-dip
- Dip 3-4 cows
- Allow the pre-dip to react for at least 30 sec.

Stanchion/ Tiestall

- Clean teat and teat ends using single paper towel or individual towel cloth
- The teats must be dried for at least 15 sec
- Attach milking machines immediately after teats are dried
- Dip teats with post-dip immediately after milking

Parlor

- Return to the first cow and clean teat and teat ends using a single paper towel or individual towel cloth
- The teats must be dried for at least 15 sec
- Attach milking machines immediately after teats are dried
- Dip teats with post-dip immediately after milking

EACH STEP IS A CRITICAL POINT !!!!!!!

Steps involved in employing HACCP-based concepts for establishing proper milking procedures

STEP ONE

- ◆ Educate owners and milkers about implementing a standardized milking procedure (**Benefits !!!!!!!**)
- ◆ IF a dairy farm initiates and shows sustained interest
 - Establish ground rules
 - They will have to be proactive and adopt changes
 - TEAM EFFORT !!!

STEP TWO

- ◆ Establish a team (owner, milkers, veterinarian, facilitator)
- ◆ Mission statement
- ◆ Goals and timeline
- ◆ Written Procedures
 - Protocols
 - Critical Limits (SCC > 250,000)
- ◆ Recording Keeping
 - Milking time/milking
 - Bulk Tank Temp; end of 1 hr of milking
 - Sanitation
- ◆ Schedule team meetings to review the process

■ STEP THREE

- ◆ Train milkers and owners in implementing the standardized milking procedure

■ STEP FOUR

- ◆ Monitor the application of the standardized milking procedure
 - Floor tests (each step is a critical point !)
 - Laboratory tests (SPC or BTSCC)
 - Monitor records

■ STEP FIVE

- ◆ Establish corrective actions to be implemented if milk quality critical limits have exceeded.