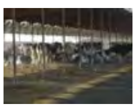
ODV MEETING
2009

MILK QUALITY

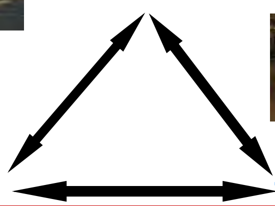
Basic Milking System Evaluation

Patrick J. Gorden, DVM
Diplomate – ABVP – Dairy Practice

Mastitis Triangle



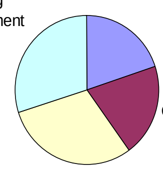
The Cow & Her Environment



Man

Equipment

Contribution to Mastitis



Mastitis – Where does it come from?

2. The Milking Equipment

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Protocol for Evaluation Milking Systems

- Visual Checks
- Dynamic Testing
- Dry Testing

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Visual Checks

- Condition of Rubber Goods
- Hose Length
- Liner alignment
- Abnormal conditions

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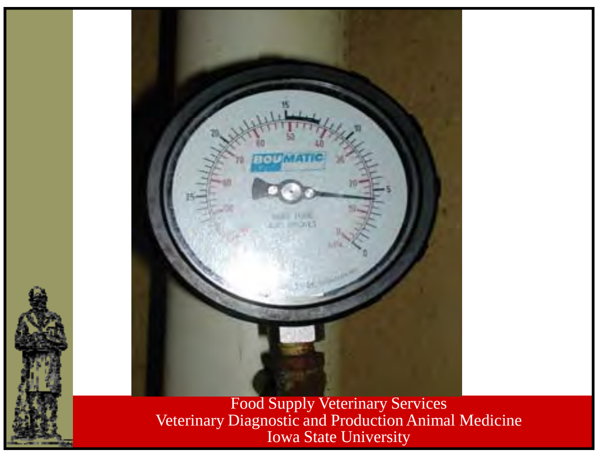
BOUMATIC
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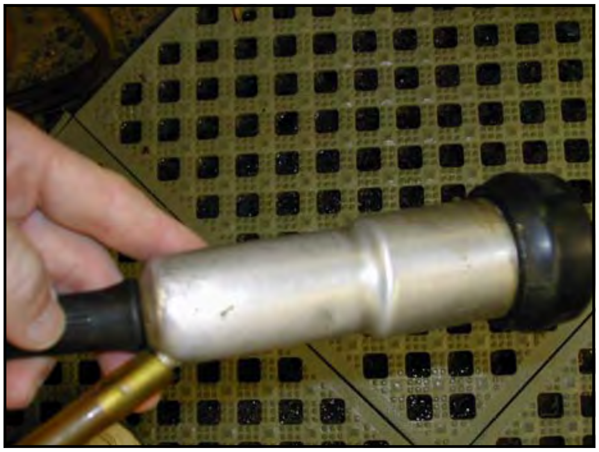
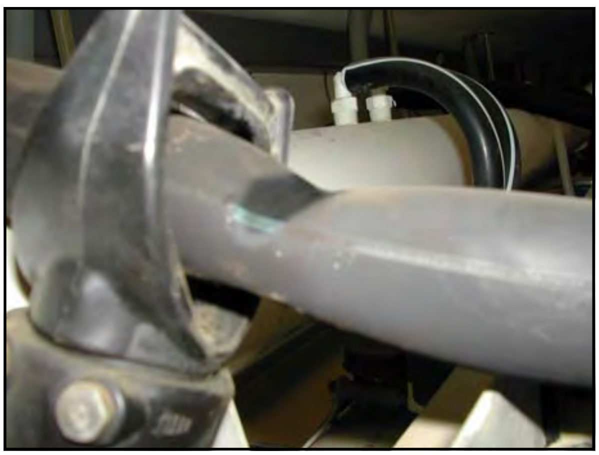
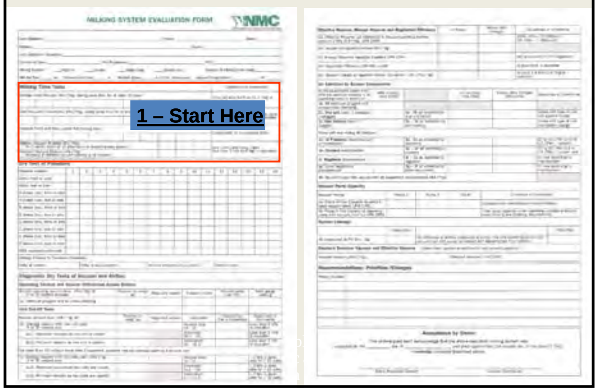




Protocol for Evaluation Milking Systems



Protocol for Evaluation Milking Systems

Milking Time Tests	Guidelines or comments
Average Claw Vacuum, kPa (°Hg), during peak flow, for at least 10 cows	36 to 42 kPa (10.5 to 12.5 "Hg) is desirable
Claw Vacuum Fluctuations, kPa (°Hg), during peak flow, for at least 10 cows	(max – min) during one pulsation cycle less than 10 kPa (3 "Hg) is desirable
Pulsator Ratio and Rate, under full milking load	Comparable to dry pulsator tests
Milkline Vacuum Stability kPa (°Hg) For 3 parlor turns or 15 minutes in a round-the-barn system	(ave – min) and (max – ave) less than 2 kPa (0.6"Hg) is desirable
Receiver Vacuum Stability kPa (°Hg) Measure if milkline vacuum stability is of concern	

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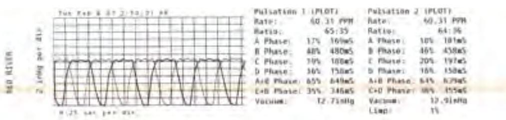
Protocol for Evaluation Milking Systems

Dry Test of Pulsators																
Pulsator number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ratio, front or side																
Ratio, rear or side																
A phase (ms), front or side																
A phase (ms), rear or side																
B phase (ms), front or side																
B phase (ms), rear or side																
C phase (ms), front or side																
C phase (ms), rear or side																
D phase (ms), front or side																
D phase (ms), rear or side																
Rate (pulsations/minute)																
Voltage Checks for Electronic Pulsators																
Volts at control:	Volts at last pulsator:					Volts at intermediate pulsator:					Volts at other:					

Pulsation Graphs



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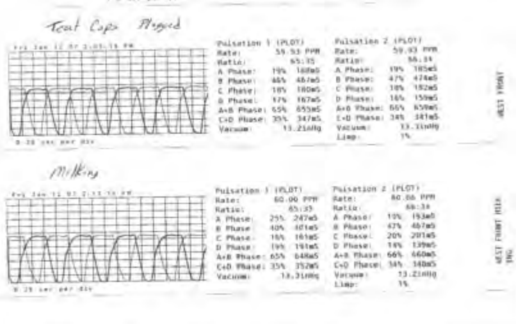
Pulsation Graphs



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Equipment problems that cause mastitis 1. Liner slips

- Liner slips occur when the mouthpiece of the liner slips down on the teat allowing air to be sucked into the milking unit.
- Liner slips result from low claw vacuum, heavy milking units that are not supported, poor unit alignment, and kicking by cows.
- Liner slips are responsible for a large number of new mastitis cases due to reverse flow of milk.

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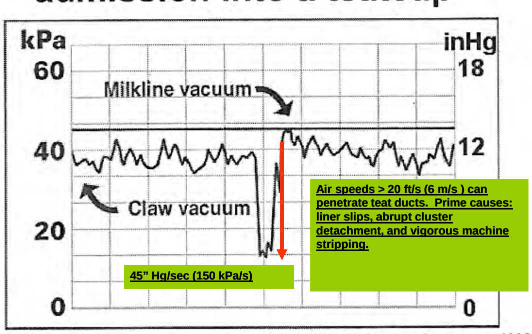
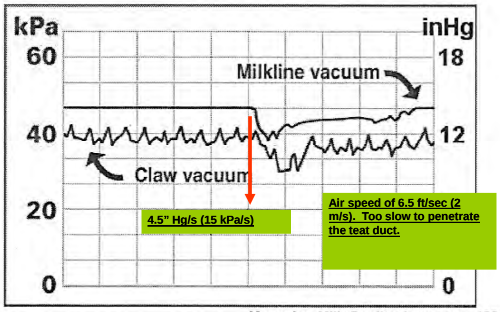
Effect of sudden air admission into a teatcup



Managing Milk Quality, Levesque, 1998

Vacuum changes in milkline affect claw vacuum but rate of vacuum change is slow



Managing Milk Quality, Levesque, 1998

Impacts and Penetration

- Teat duct penetrated by 6 m/s jet speed (20 ft/s) but 2 m/s (6.5 ft/s) is too slow (Thiel et al. 1969).
- Liners move much too slowly to generate high air speeds (Spencer, 2003).
- Sudden air admission into a teatcup can generate air speeds > 6 m/s (Woolford et al. 1980).
- Prime causes: liner slips, abrupt cluster detachment, vigorous machine stripping.

Mein et al, Storm in a Teatcup, NMC 2004

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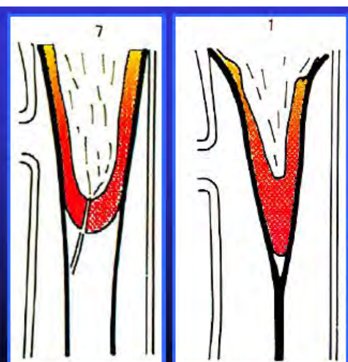
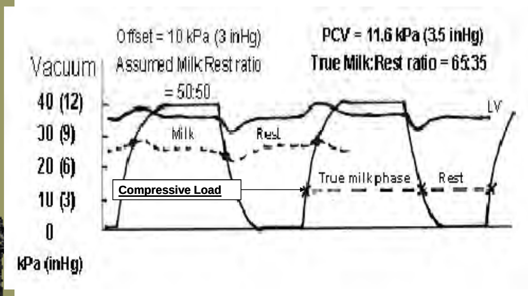
Liner Closure



Ardran *et al*
(1958)

Milk:Rest Ratio



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Compressive Load

- CL is the vacuum level within the pulsation chamber at which milk flow just begins to flow.
- AKA as Overpressure.
- Factors affecting overpressure include:
  - Liner (claw) vacuum.
  - Liner tension.
  - Length of C-phase.
  - Depth of teat penetration.
  - Liner thickness, liner hardness, or resistance to collapse.

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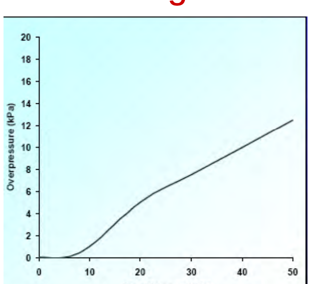
CL on the Same Liner With Increasing Claw Vacuum.



Mein, et al, Teat End Hyperkeratosis: Mechanical Factors Applied to the Teat, 2003 NMC

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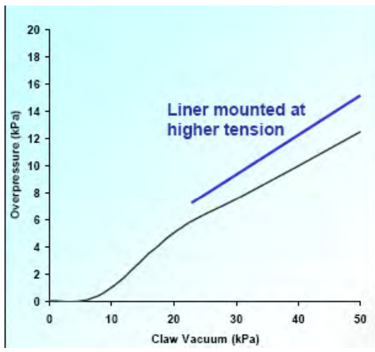

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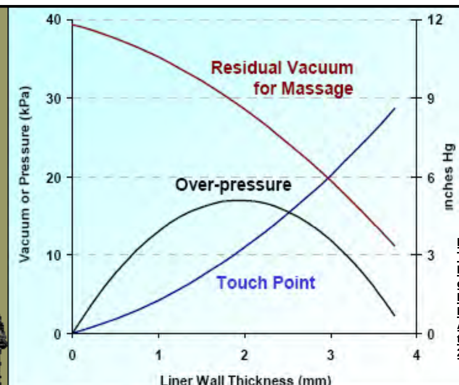

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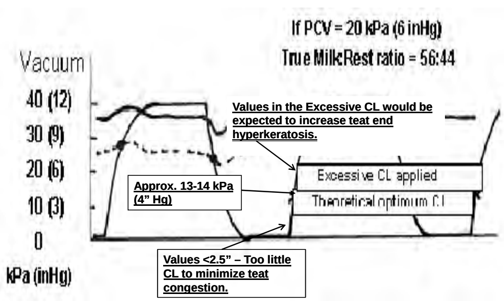
Compressive Load



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Factors Resulting in Hyperkeratosis

- Closure of the liner around the teat with excessive values of CL result in micro-fissures developing around the teat ofice.
- The stratum corneum responds to the micro-fissures by increasing keratin production.
- Weather and other factors that affect skin condition affect keratin production.

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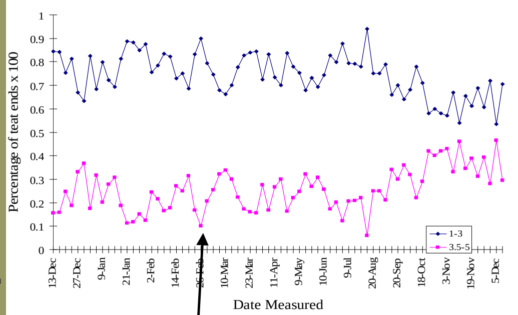
Teat End Condition



Lesson 3: Teat end cracking can occur and cure very rapidly (2-3 days) (usually assoc. w/ temp. changes).

Liner Effects: Reducing the Risk of New IMM Infections

- Minimize impacts:
  - Good liners, good unit adjustment = Minimal liner slips.
  - Quiet cows=Minimize kick offs.
  - Avoid abrupt cluster removal.
- Maintain healthy teats through effective massage with pulsation.

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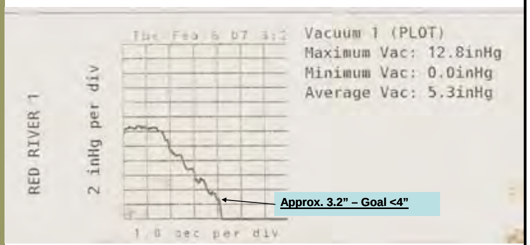
Unit Removal



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Liner Effects: Reducing the Risk of New IMM Infections

- Minimize machine related effects.
  - Maintain proper equipment settings to minimize over-milking.
    - Liner wall pressure increases during low milk flow (highest claw vacuum).
    - Increased teat thickness at end of milking causes liner to have to bend around farther teat end.
  - Reduce unit on-time. Remove unit when milk flow <2#'s/min (beginning and end).
  - Increase pulsator ratio and maintain rate.

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Effects of Liners on Milking Speed

- More dependent on milker activities than liner differences unless there are significant negative effects on teat condition.

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Dry Tests

Diagnostic Dry Tests of Vacuum and Airflow					
Operating Vacuum and Vacuum Differences Across System					
Record operating vacuum level, kPa ("Hg) at: (5 to 20 second average)	Receiver or weigh jar	Regulator sensor	Pulsator airline	Vacuum pump inlet (PV)	Farm gauge reading
1a. Teatcups plugged and all units operating					
Unit Fall Off Tests					
Record vacuum level kPa ("Hg) at:	Receiver or weigh jar	Regulator sensor	Calculation	Vacuum Drop Over or Undershoot	Guidelines or Comments
1b. Average vacuum with one unit open 5 to 20 second ave			Vacuum drop 1a – 1b		Less than 2 kPa is desirable
1b.1. Maximum vacuum as one unit is closed			Overshoot 1b.1 – 1a		Less than 2 kPa is desirable
1b.2. Minimum vacuum as one unit is opened			Undershoot 1b – 1b.2		Less than 2 kPa is desirable
For more than 32 units or more than 2 operators, systems may be checked opening a second unit.					
1c. Average vacuum with two units open, kPa ("Hg) 5 to 20 second ave			Vacuum drop 1a – 1c		< 2 kPa is desirable for > 32 units
1c.1. Maximum vacuum as two units are closed			Overshoot 1c.1 – 1a		< 2 kPa is desirable for > 32 units
1c.2. Minimum vacuum as two units are opened			Undershoot 1c – 1c.2		< 2 kPa is desirable for > 32 units

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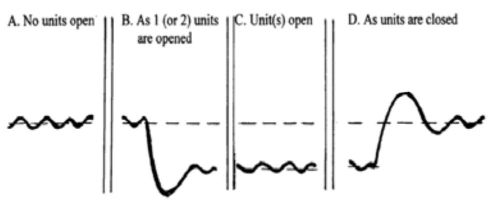
Unit Fall Off Test



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Dry Tests

Effective Reserve, Manual Reserve and Regulation Efficiency	As Found	Retest after changes	Guidelines or comments
2a. Effective Reserve: air admission to reduce operating receiver vacuum 2 kPa (0.6 "Hg), LPM (CFM)			1000 LPM + 30 LPM/unit (35 CFM + 1 CFM/unit)
2b. Vacuum at regulator sensor kPa ("Hg)			
2c. Manual Reserve: regulator disabled LPM (CFM)			Not applicable for VFD regulators
2d. Regulation Efficiency (ER/MR) x 100			At least 90% is desirable
2e. Vacuum change at regulator sensor (1a sensor - 2b), kPa ("Hg)			At least 1.3 kPa (0.4 "Hg) is desirable

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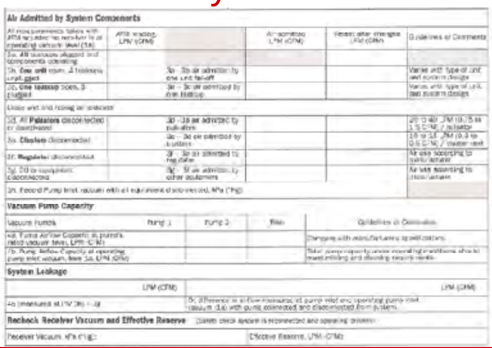
Dry Tests


Air Admitted by System Components

Vacuum Pump Capacity

System Leakage

Recheck Receiver Vacuum and Effective Reserve

Setting Up Milking Systems

- Adjust system vacuum so that there is 10.5 – 12.5" Hg in the claw during peak flow.
  - Typically measured between the 1st and 2nd minute after the unit is attached.
  - Measure at least 10 high producing cows for 15-20 seconds.
- Vacuum within the claw should not fluctuate <3" during measurement.
  - If >3", evaluate milk line vacuum.

Setting Up Milking Systems

If higher vacuums are used, there are two important points to control:

1. Good Milking Routine – No overmilking at the beginning.

2. Proper Take-off Settings.

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Setting Up Milking Systems

- Pulsator settings:
  - B phase (milking phase) – at least 500 msec.
  - D phase (massage phase) – at least 150 msec. (prefer 200 msec).
  - Measure with unit on cow or with teat cups plugged and vacuum on.

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Setting Up Milking Systems

- Set detachers to remove units when milk flow drops below 2 lbs/min.
  - Adjust detacher delay to 1 sec.
- Do strip yields after the unit is removed to evaluate teat condition and measure the remaining milk in the udder.
  - Less than 250-400 mls.

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Strip Yields

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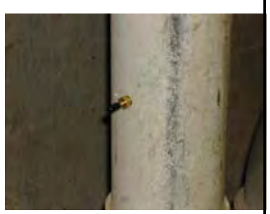
System Evaluation

- It is impossible to properly test a milking system without test ports to check vacuum levels.
- System evaluation should be done on a regular basis.
- Daily checks need to be completed.



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Other Observations:

- evaluating the operators and their udder prep procedures
- evaluating operator handling of cows and cow behavior
- evaluating timing of procedures
- observing how quickly continuous milk flow begins
- assessing alignment of units and frequency of liner slips
- observing correction of slipping units
- evaluating quality of pre and post milking teat dipping
- scoring cow cleanliness
- scoring teat condition of at least 20% of the cows
- evaluating completeness of milkout

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A global organization for mastitis control and milk quality

www.nmconline.org

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Dairy Farm Bulk Tank Differential Bacteria Counts – Farm Issues

Patrick J. Gorden, DVM
D-ABVP – Dairy Practice

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ISU VDL

- Milk Quality Testing
  - Individual samples
    - *Staph aureus, Strep ag.,* CNS, E. Streps, coliforms & others.
    - Option for aerobic only, Mycoplasma only, or combination.
- Milk Quality Testing
  - Bulk Tank Culture
    - With or without Mycoplasma
    - SPC, PI, LPC, & coliform counts.
- Introduction of Molecular Techniques.

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Topics to be Covered

- Review of current quality tests.
- Discuss bacteria responsible for elevated quality results and associated risk factors.
- Review procedures for troubleshooting bacteria count problems.
- Questions.

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Quality Milk

- Goals of Quality Milk Programs:
  - Lower bacteria counts and SCC
    - Superior Product
    - Longer shelf-life
  - Maintain & Improve Consumer Acceptance!!

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Quality – Who's Involved?

- Dairy
- Milk Hauler
- Processor/Manufacturer
- Retailer
- Consumer

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Quality – Who's Involved?

- Dairy
  1. Clean environment for the cows.
  2. Maintaining a low somatic cell count.
  3. Proper milking procedures.
  4. Maintaining the milking, milk transport, and milk storage equipment.
  5. Proper nutrition.

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Measures of Quality Milk

Standard Plate Count (SPC)

All (viable) bacteria in milk

- **Preliminary Incubation Count (PI)** – **"Psychrotrophs"**
- **Coli Count** – Coliform bacteria
- **Lab Pasteurized Count (LPC)** – "Thermodurics"

Lab Procedures

- **SPC** – 32˚ C 48 hours – Perform proper dilutions & plate pour plates with Standard Methods Agar (SMA) or Petrifilm – Aerobic Count Plates.
  - Dilutions 10^{-1}, 10^{-2} & 10^{-3}.
- **PI** – Incubate milk @ 12˚ C for 18 hours & perform SPC procedure.

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Lab Procedures

- **Coli counts** – Perform proper dilutions & incubate on pour plates with VRB agar or Petrifilm Coliform Count Plates – 32˚ C for 24 hours.
  - Dilutions 10^{0}, 10^{-1}, & 10^{-2}.
- **LPC** – Pasteurize milk sample @ 62.8˚ C for 30 minutes and plate with SMA after dilution.
  - Do not use Petrifilm.
  - Dilutions 10^{-1}.

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Bacteria Count Goals for Quality Milk

- SPC = Legal <100,000 cfu's/ml.
  - Ideally <5000 - 10,000 cfu's/ml.
  - Bactoscan values different from SPC.
  - Aerobic counts – *Mycoplasma sp*.
- PI – <2-3x SPC
  - Ideal <10,000 - 20,000 cfu's/ml.
- Coli - <50 – 100 cfu's/ml.
- LPC - <50-100 cfu's/ml.

Standard Plate Count (SPC) Normal Microbiology

Bacteria	%
Micrococcus sp. / Staphylococcus sp	30 - 99
Streptococcus sp	0 – 50
Spore forming Gr+ Rods	<10
Gr- Rods (including coliforms)	<10
Bacillus spores	<10

Dairy Microbiology Handbook, Robinson, 2002.

Elevated SPC Microbiology

- As SPC increases, *Micrococcus sp* & *Staph. spp* decrease as *Strep spp* & Gr- rods increase. (Dairy Microbiology Handbook, Robinson, 2002)
- Causes:
  - Poor milking equipment cleaning/sanitation.
  - Slow/Improper cooling of milk.
  - Unclean udders at milking.
  - Poor teat & teat end sanitation.

Risk Factors Associated with Elevated SPC

1. % of cows with manure on teats @ unit attachment.

- Normal teat skin (clean) –
  - Mostly *Staph aureus* & coagulase negative Staphs (10^4).
  - Minimal Streps
  - Minimal Gram- rods ($<10^2$) – Udder hair.
- Bedding Material with fecal contamination = $10^8 – 10^{10}$ (Not *St. uberis*).

Dairy Microbiology Handbook, Robinson, 2002.

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Risk Factors Associated with Elevated SPC

1. % of cows with manure on teats @ unit attachment.
2. Pre-spraying or no pre-milking sanitation.
   - Proper pre-milking teat sanitation reduces environmental Streps in milk.
3. Washing teats with water.

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Risk Factors Associated with Elevated SPC

4. Poor milking & dry cow hygiene.
5. Increased wash alkalinity (Keefe, et al 2008).
6. Mastitis pathogens – Rare!
   - *Strep uberis or dysgalactiae* (**10^{9***}**).
     - Environmental vs. contagious.
   - *Strep ag* *(correlations between # infected and SPC)*
   - *Mycoplasma spp* – Bactoscan.
   - Coliforms (10^8) – Clinical cases
     - Water contamination.

Hayes, et al, JDS, 2001.

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Preliminary Incubation Count (PI) Normal Microbiology

- Psychrotrophs can account for 50% of SPC.
- Psychrotrophs can produce heat stabile lipases & caseinolytic enzymes that can survive pasteurization & cause off flavors.
  - Biofilms & short generation times.
- Gr- rods – Both coliform & non-coliform.
  - *Pseudomonas sp* ~50% of PI.
- *Enterococcus sp* & *Streptococcus sp*.

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Risk Factors Associated with Elevated PI Counts

1. Improper cleaning of milking equipment or bulk tanks.
2. Slow or insufficient cooling of milk.
   - 40 vs. 45˚ F.
3. Longer duration between milk pickups.
4. SPC factors.

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Risk Factors Associated with Elevated PI Counts

5. Mastitis pathogens are <u>not typically</u> associated with elevated PI.

   -High SPC with similar PI=mastitis pathogens.

   - Common mastitis pathogens except *Strep uberis* do not grow <10˚C.

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Lab Pasteurized Count (LPC) Normal Microbiology

- *Microbacterium sp*
- *Micrococcus sp*
- Bacillus spores
- Clostridium spores
- *Alcaligenas sp*

<u>Dairy Microbiology Handbook</u>, Robinson, 2002.

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Elevated Lab Pasteurized Count (LPC) Microbiology

- *Micrococcus sp*
- Bacillus spores
- Clostridium spores
- *Enterococcus faecalis*
- Lactobaccilli
- *Corynebacterium sp*
- Coagulase Negative Staphs
- Environmental Streps

<u>Dairy Microbiology Handbook</u>, Robinson, 2002.

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Risk Factors Associated with Elevated LPC's

1. Poor equipment cleaning/sanitation that is chronic or persistant.
2. Milk stone deposits.
3. Plate coolers. (Keefe, 2008)
4. Old pipeline gaskets.
5. Old inflations or other rubber parts.
6. Bacterial contamination of water.
7. Significant contamination from soiled cows.

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Coliform Count

- *E. coli* (then *Klebsiella)* are the most common bacteria.
- **Not a measure of quality of udder prep!!!**
  - Coli count & bulk tank culture.
- Utilization of the environmental Strep count on BTC is a better measure.

Coliform Count

- Mild elevation – 100 - 500 or 1000
  - Cow contamination
  - Water
  - Dropping milking unit into manure.
- Large elevation – >1000
  - Dirty milking equipment.

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Risk Factors Associated with Elevated Coli Counts

1. Improper cleaning of milking system.
2. Contamination of water supply.
3. Manual bulk tank cleaning.
4. Larger herd size.
5. Season – summer highest risk.
6. Failure to remove udder hair.

Keefe, 2008

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Diagnosing an On-Farm Bacteria Count Problem

1. Complete a thorough investigation of milking system and bulk tank cleaning.
   1. Water temperature – beginning & end.
   2. Chemical concentrations.
   3. Slug analysis.
   4. Check all elbows, tees, swing pipes, butterfly valves, etc.
   5. Check quality of rubber & plastic goods – meters, flow sensors, gaskets, hoses, pump seals, etc.
   6. Inspect air pipes – traps, distribution tanks, & air supply lines.

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Observe

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Correct and legal way to store plugs

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Replace Rubber Components

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Bulk Tank Valves

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Diagnosing a Bacteria Count Problem

2. Evaluate milk cooling, including temps upon arrival at the milk plant.
   – How are the samples handled?
3. Evaluate milking procedures, cow & stall cleanliness (including dry cows), milker & external unit cleanliness.

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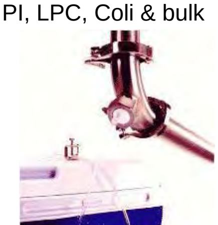
Diagnosing a Bacteria Count Problem

4. Perform sequential string samples taking samples at strategic places.
   – Perform string SPC, PI, LPC, Coli & bulk tank culture.
   – Receivers.
   – Holding vats.
   – Pre plate cooler.
   – Storage tank.
   – Plant sample.



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Diagnosing a Bacteria Count Problem

- Look at trends over time.
- Look at trends by location, i.e. before & after plate cooler.
- What bacteria types are prevailing?
  – Do the streps have sufficient opportunity to grow?
  – Do the prevailing bacteria types appear to be from the same strain within bacteria groups.

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Diagnosing a Bacteria Count Problem

5. Strategically sample sets of cows that appear to represent a problem, i.e. fresh cow pens, high groups.
   - Dilute samples sufficiently to allow the bacteria to grow to potential.
     - Look for cows >5-10 x 10^5 cfu's/ml.
   - Streps & coliforms(?) – 10^7 - 10^9.
   - Determine contribution by multiplying by milk production.
   - Determine mode of spread-cont vs. envir.

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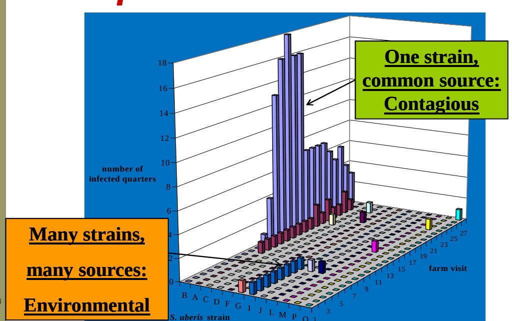
Strep uberis Outbreak



Zadoks et al., Epidemiology and Infection 2003

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"The Ghost" Temperature Failures

- "The more things change, the more they stay the same."
- Wash water temperatures are still the single biggest reason we have bacteria count issues.

-Greg Siegenthaler, Grande Cheese.

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References:

1. Keefe, G., A. Elmoslemany, & I. Dohoo, Bulk Tank Raw Milk Quality: On-farm Assessment of Risk Factors. 2008 AABP Annual Meeting, Charlotte, NC.
2. Chambers, J.V., The Microbiology of Raw Milk in Dairy Microbiology Handbook – The Microbiology of Milk and Milk Products, Richard K. Robinson, ed., 3rd edition, Wiley-Interscience, 2002.
3. Hayes, MC, RD Ralyea, SC Murphy, NR Carey, JM Scarlett, & KJ Boor, Identification and Characterization of Elevated Microbial Counts in Bulk Tank Raw Milk. J Dairy Sci, 2001, 84: 292-298.
4. Zadoks, RN, BE Gillespie, HW Barkema, OC Sampimon, SP Oliver, & YH Schukken, Clinical, epidemiological and molecular characteristics of *Streptoccus uberis* infections in dairy herds. Epidemiol. Infect. 2003, 130: 335-349.

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"Yes … I believe there's a question there in the back."

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Analysis of the Milking System

Introduction
Milk quality on the dairy farm is influenced by the cow environment, the milkers, and the milking machine. A total milk quality program must therefore not overlook the milking system. The milking system can influence milk quality, bulk tank somatic cell counts and clinical mastitis rates in many ways.

Goals of a Properly Functioning Milking System
1. Stable and adequate vacuum at the teat end
2. Efficiently remove milk from all quarters
3. Pulsation that allows adequate teat end massage

Milk Quality Influences of an Improperly Functioning Milking System
1. Poor teat end condition from improper teat end vacuum or pulsation
2. Inefficient milkout due to poor teat end vacuum
3. Liner slips due to unstable vacuum
4. Overmilking leading to poor teat end health and congestion of teats

Milking System Analysis Overview
1. Some of the steps can be performed on a static system (not milking) however most steps should be performed dynamic (under load, milking or simulated milking).
2. One of the primary advantages of being able to perform a milking system analysis is that it enables the tester to also observe the milkers. This step should never be overlooked. I have found that if I just stand in the parlor and watch milkers, they know they are being watched and often their behavior is altered by the presence of an observer. However, if the milkers think you are testing the system……anything can happen!
3. Equipment needed includes
    a. Digital vacuum guage
    b. Air flow meter – allows a measured amount of air into the milking system
    c. Pulsator analyzer (Triscan, Digimet)
    d. Inflation plugs, tubing, timers, strip yield cups, test ports

General Evaluation of System
1. Visually inspect all parts of the milking system.
2. Check slope of milk line. Are there any non-sloped areas?
3. Check cleanliness of system. Are pulsators or regulator filters dirty?
4. Check inflations and inflation changing schedule. Inflations should be changed every 1000 milkings or 90 washings.

Static Testing of a Milking System
1. Measure system vacuum at the receiver jar, pulsator line, regulator, and the vacuum pump. At no point should vacuum vary by more than 0.6 in, Hg
2. Compare to vacuum guage.

3. Perform a UNIT FALL OFF test.
    a. Turn on system and measure system vacuum in milk line, inflation cup or receiver jar
    b. Open one unit to full air admission (for systems less than 32 units) or two units (if more than 32 units). Record vacuum drop and time to drop
    c. Close unit(s). Record time it takes to return to system vacuum as well as amount of over-ride.
    d. The vacuum should not drop by more than 0.6 in Hg, should return in 1-2 seconds, and override by less than 0.2 in Hg.
    e. If the system fails this test it is an indication of unstable vacuum and a full system test is required.
4. Measure EFFECTIVE RESERVE. Effective reserve is defined as the maximal amount of air that can be let into a system and still maintain stable vacuum.
    a. Place air flow meter near or on receiver jar.
    b. Turn on to system vacuum and record
    c. Open air flow meter to allow enough air to lower system vacuum by 0.6 in Hg. Record amount of air in cfm that was admitted.
    d. Goal for effective reserve is 1 ½ cfm per unit + 35 cfm. Example = 10 units would need 50 cfm of effective reserve.
5. Measure MANUAL RESERVE. Manual reserve it the amount of air that can be admitted and maintain stable vacuum with the vacuum controller (regulator) disabled. This measurement is for non-variable speed systems only.
    a. Remove or disable regulator
    b. Place air flow meter on receiver jar. CAUTION – make sure enough holes are open to accommodate pump capacity or you can collapse the receiver jar.
    c. Close the openings on the air flow meter until the vacuum measurement is 0.6 in Hg below system vacuum. Record amount of air in cfm
6. Regulator Efficiency is the ratio between the effective reserve and the manual reserve. Example – if effective reserve is 50 cfm and manual reserve is 100 cfm then regulator efficiency is 50%. Goal is to have regulator efficiency over 90%.
7. Measure vacuum pump capacity. All vacuum pumps are rated at 15 in Hg.
    a. Disconnect vacuum pump line from the milking system or close gate valve.
    b. Open holes on air flow meter and turn on system to vacuum
    c. Close holes until vacuum reaches 15 in Hg.
    d. Record amount of air in cfm.
    e. Goal for pump capacity is 10 cfm per HP so a 10 HP pump should have 100 cfm capacity.

Dynamic Testing

1. Teat end vacuum
    a. Measure vacuum in the inflation short milk hose during peak milk flow
    b. Peak milk flow usually occurs at 30-45 seconds after unit attachment
    c. Goal is 10.5 to 12.5 in Hg with less than 1 in of fluctuation in a low line and less than 2 in fluctuation in a high line

   d. My observation is that fluctuation is highly variable between different types of milking systems
2. Evaluate system for proper unit removal
   a. If manually removed vacuum should be shut off before removal
   b. No machine stripping!
   c. Evaluate strip yields immediately after removal. Strip yield goal of over 100 mL per quarter or 400-500 mL per cow. It is difficult to have too high of strip yields!
   d. Evaluate teat ends after unit removal. Teats should not be discolored or have a ring of compression/banding.
3. Evaluate all pulsators. Check to see if pulsators are side to side or front/back.
   a. A + B phase = milking phase. Should be 50-65% of cycle
   b. B Phase = time in milk, should be >400 msec
   c. C + D phase = rest phase. Should be 35-50% of cycle
   d. D phase = time in rest. Should be >200 msec
   e. Rate = number of cycles per minute. Goal = 60
   f. All pulsators should match between and within by 5%.
4. Lactocorder graphing.
   a. Evaluates milk letdown. Minimal to no cows with bimodal milk flow indicative of cisternal milk letdown and improper lag time or stimulation.
   b. Evaluates milk flow rates. Goal is over 5 lbs per minute peak milk flow but on many dairies 10 lbs per minute peak milk flow is attainable.
   c. Goal for milk flow rate is 25 lbs in the first 4-5 minutes and one minute for each additional 10 lbs of milk. This means a 70 lb cow on 2X milking would milk out in 5-6 minutes.
   d. Evaluates end of milk flow rates. Goal is zero no flow time. Especially useful for evaluating herds without ATO or for adjusting ATO on herds that have them installed.

Milker Routine Evaluation

1. Is there a milking routine? Is it written? Are employees trained and evaluated?
2. Is the routine consistent between employees and between cows?
3. What is teat and udder hygiene as cows enter the parlor?
4. Do milkers wear gloves?
5. Is predip applied to adequately cover all teats?
6. Is predip removed in a manner to thoroughly clean teat ends and provide stimulation?
7. Are cows properly forestripped in each quarter – 1-2 good squirts of milk?
8. Is lag time appropriate and similar for all cows? Lag time should be 90-180 seconds. Teats should be plump with milk when units attached.
9. Are units attached in a way to minimize air admission?
10. Do cows stand nicely for milking and preparation?
11. Are units removed properly and strip yields appropriate (see above)?
12. Is post milking teat dip applied to thoroughly cover teat ends?

Equipment List for Milking System Evaluations

1. Digimet 3000
    a. Can serve as vacuum gauge and pulsator grapher.
    b. Costs $795
    c. I don't use the printer. I download results to laptop to print.
    d. Available from Western Dairy Research at www.sentinalproducts.com
2. Digital vacuum gauge
    a. Many versions available
    b. Surge has a nice brand that works well.
    c. Costs $200-300
    d. Don't need this if you have a Digimet unless you want a backup.
3. Air Flow Meter
    a. Allows a measured amount of air to be let in the system to calculate effective and manual reserve
    b. Surge dealer can order.
    c. Cost $300-500
4. Miscellaneous
    a. Test ports, aquarium hoses
    b. Teat inflation plugs
    c. Spare pieces of PVC pipe
    d. Spare regulator/vacuum controller
    e. Drill, port tap, plumbing tape
    f. Tape measure

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Teat End Vacuum Tests						**Lag Times**	
Test #	**Min**	**Max**	**Avg**		**Test #**	**Time (sec)**	***Goal = 90-180 seconds***
1					1		
2					2		
3					3		
4					4		
5					5		
6					6		
7					7		
8					8		
9					9		
10					10		
Avg					11		
					12		
Averages		***Goals***			13		
Avg Teat End Vac		11.5-12.5			14		
Avg Min TEV		10.5			***Average***		
Avg Max TEV		12.5			***Min***		
Min TEV					***Max***		
Max TEV							
						Strip Yields	
					Test #	**Amt (mL)**	***Goal >100 mL***
Milking Vacuums					1		
System Vac					2		
Vac @ Regulator					3		
Vac @ pulsator line					4		
					5		
					6		
					7		
					8		
					9		
					10		
Air Flow Measurements		**Goals**					
Effective Reserve						**Pump Capacity**	
Manual Reserve					**HP**		
Regulator Efficiency		***>90%***			**Result**		

The Basics of Setting Up Milk Culture labs – In-clinic or On-farm.

Patrick J. Gorden, DVM DABVP

Leo L. Timms, PhD

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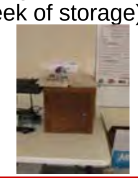
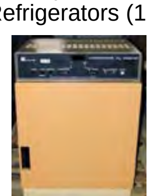
Establishing the Lab

- Who is going to do the culturing in-house?
  - 7 days a week.
- Space needs – How many cultures will you be doing/week? Incubators, Table, Refrigerators (1 week of storage).





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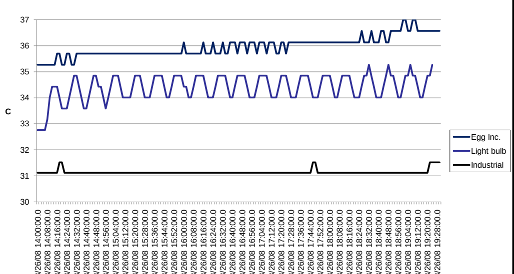
Incubator Temps



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Establishing the Lab

- Who is going to do the culturing in-house?
  - 7 days a week.
- Space needs – How many cultures will you be doing/week? Incubators, Table, Refrigerators (1 week of storage).
- Plate Disposal – Local Regulations
- Purchasing Supplies
  - Winter shipping.

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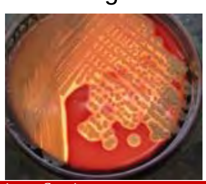
Economics of Establishing a Lab

- Initial setup – Equipment and facilities.
- Labor
- Supplies – Pricing better for larger clients.
- Competition.



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Establishing the Lab

- Quality Control – Unknowns
- Reporting Results
- Lab Safety – Protective clothing.
- Workstations – Separate work area from other activities, i.e. – Lunch.
- Separate storage area for supplies/milk samples.

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Establishing the Lab

- What kind of services to offer:
  - Aerobic culture
  - Antimicrobial Sensitivities
  - Mycoplasma culture
  - Bulk Tank Cultures
  - Milk Quality Cultures – SPC, PI, LPC, Coliform counts
  - Quantitative culturing – i.e. Bedding Cultures

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Establishing the Lab

- Aerobic culture

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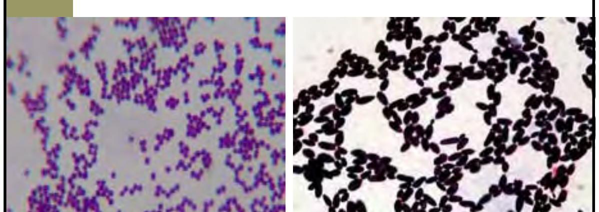
Gram Stain or KOH Test



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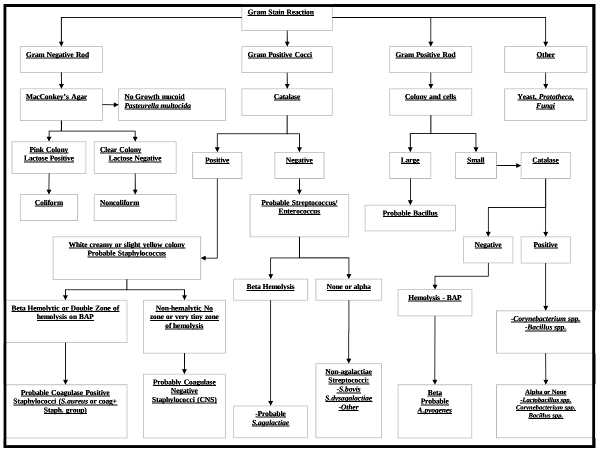

Biochemical Tests

Tube Biochemicals

API Strips

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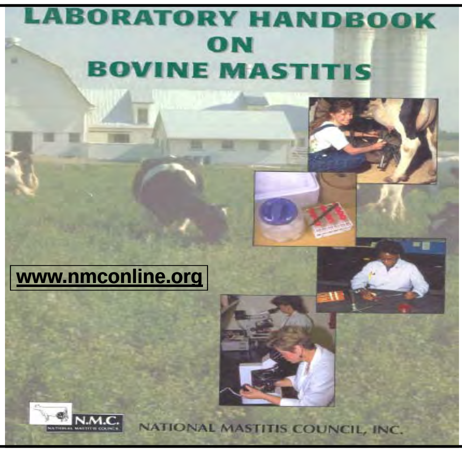

Sample Collection and Handling

- Who will collect the samples? Aseptic technique is critical!
  - The same organisms that are common contaminants can also cause disease.
  - Milk is a great culture medium for contaminants to grow.
- Written protocols for sterile collection.

Quality of Sample

↓

Quality of Results

↓

Quality Diagnosis

Courtesy of J. Hallberg, Pfizer Animal Health

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Sample Collection and Handling

- What will the samples be collected in?
  - Sterile vials.
  - Will you provide the supplies?
- How will the samples be stored?
  - Freezing – Increases *Staph aureus*, Decreases *E.coli*, Do not freeze samples for milk quality analysis (SPC, PI, LPC).
- How will the samples be transported to the lab?
- How often will they be taken to the lab?
- Large numbers of samples.

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Mastitis Diagnostics

What Is The Expected Outcome?

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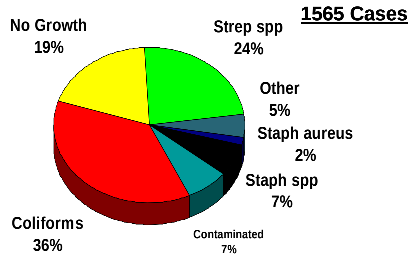
Demographics: Bacteriological Status of Clinical Cases of Mastitis in 1990



Gonzalez, et al., 1990. JDS 73:648

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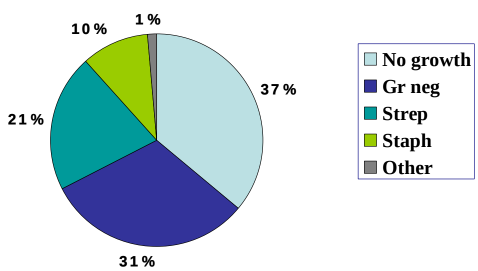
Demographics: Mild Clinical Mastitis



Erskine, et al.Michigan, 2002

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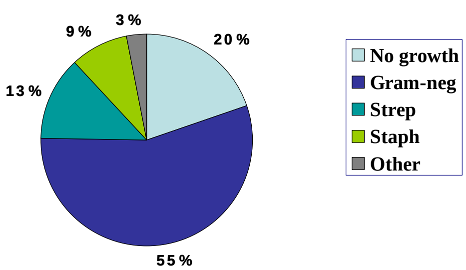
Demographics: Severe Clinical Mastitis



Erskine, et al. MI - 2002

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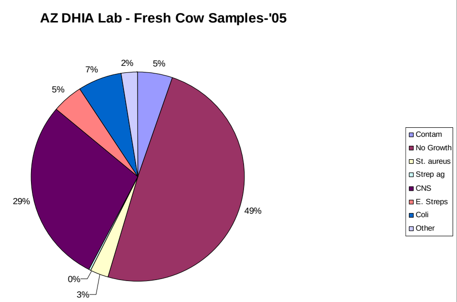

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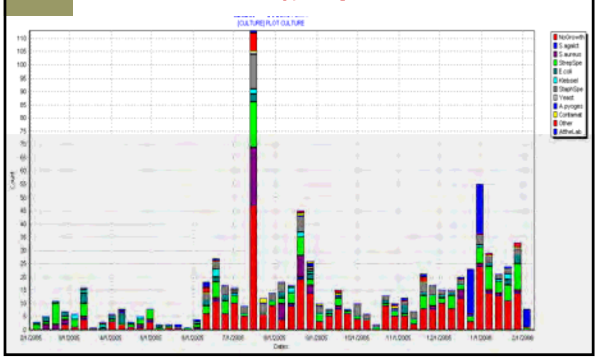
What are the results on your farms?



Status	Sensitivity	Specificity	PPV	NPV
No Growth	93%	59%	93%	61%
Staph aureus	71%	100%	80%	100%
CNS	61%	98%	69%	97%
E coli	45%	99%	59%	98%
Strep uberis	32%	98%	29%	98%

•***Mycoplamsa spp - ?***

Dingwell, et al, 2007

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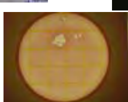
Petrifilm



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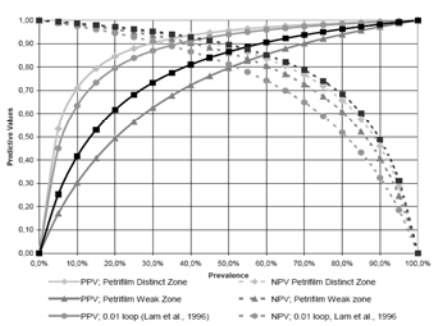
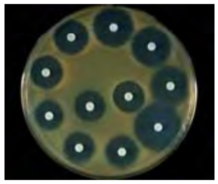
Predictive Values for Agar Plate vs. Petrifilm



Establishing the Lab

- Antimicrobial Sensitivities
  - Kirby-Bauer vs. MIC
  - Mueller Hinton Agar
- Quality Control
  - 0.5 McFarland Standard.
  - Expiration of disks.
- Break Points
  - Human vs. Bovine
  - Mastitis vs other disease.
- In vitro vs. In vivo
  - Pharmacokinetics.



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Establishing the Lab

- Mycoplasma culture
  - 5% CO_2
  - Candle Jar or Separate Incubator with CO_2

roscope
) 4 & 7 days.
positives.
vis.
nfirm positives.

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Establishing the Lab

- Bulk Tank Cultures
  - No established industry standard for performing BTC.
  - At ISU VDL we use 3 sets of Blood & MacConkey Agars.
    - Dilutions of 1:10, 1:100, & 1:1000.
    - Read plates at 24 & 48 hours.
    - Composite samples of multiple days.
    - Mycoplasma agar with no dilutions.

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Interpreting BTC

	Low	Moderate	High	Very High
Staph. aureus	<50	50-150	150-250	>250
Staph. spp.	<300	300-500	500-750	>750
Strep. ag.	0-50	100-200	200-400	>400
Strep. non-ag	500-700	700-1200	1200-2000	>2000
Coliforms	<100	100-400	400-700	>700
Misc.				
Mycoplasma	Negative			

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Bulk Tank Testing Sensitivity

Organism	Single Sample	Three Day Sample
Strep. Ag	70.6%	97.3%
Staph. aureus	59.1%	93.1%
Mycoplasma	33%	70%

Gonzalez, 2002, NMC Proceedings

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Establishing the Lab

- Milk Quality Cultures – SPC, PI, LPC, Coliform counts
  - Quantitative counts used by milk processors to assess milk quality.
    - Use dilutions of 10^{-1} - 10^{-3} depending on expected outcome (Goal-Plates between 25 – 250 cfu/plate).
  - Pour plates or Petrilm – Pipette aliquot of milk onto empty agar plate and pour in liquid agar.
  - Incubate at 32º C for 48 hours.

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Establishing the Lab

- Quantitative culturing – Bedding Cultures, Towel cultures, etc.
  - No established technique for performing procedure.
  - Little research about interpreting results.

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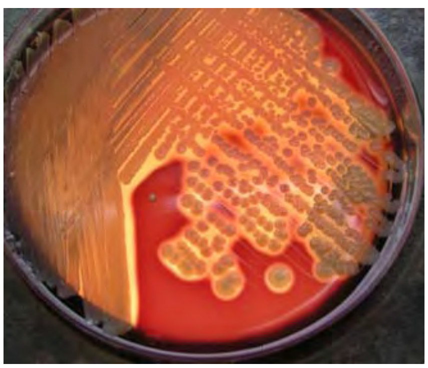

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Lab Safety

- Lab Coats
- Gloves
- Utilize lab mats
- Hand Sanitizer before leaving for breaks and lunch!!

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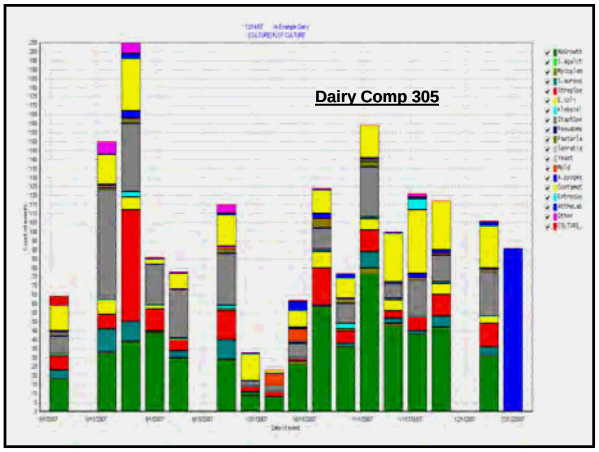
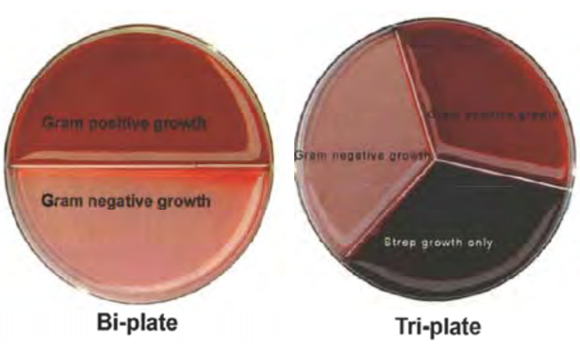
Reporting Results

- Database of all results.
- Reports need to be sent to the dairy as results become available:
  - Fax
  - Mail
  - Phone
  - Email
  - Direct transfer to record keeping software.
- Little utilization of results.



On-Farm Culture Systems



"Yes … I believe there's a question there in the back."

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Maximizing Parlor Throughput

Patrick J. Gorden, DVM
Diplomate – ABVP – Dairy Practice

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Goals of Milking Procedures

- Provide proper stimulation for oxytocin release (milk letdown).
- Maintain consistent procedures for all persons milking the cows.
- Reduce and/or maintain low SCC and clinical mastitis rate.
- Maximize parlor throughput.
- Maximize milk production.

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Maximizing Parlor Throughput

- Parlor throughput is a combination of:
  1. Cow movement.
  2. Milk letdown and speed of milking.
  3. Equipment effects.
  4. People effects.

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1. Cow Movement

- Holding Pen Design
  - Long & narrow.
  - 2-4% slope.
  - Increasing brighter lights as the cows progress towards the parlor.
  - Clear view of the parlor activities.
  - All cows crowded and facing forward.
  - Delay <10 sec desirable.

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1. Cow Movement

- Stalls should be designed for easy cow movement.
- Cows move at 3'/sec (1-2 sec/stall-parallel or 1.5-3 sec/stall-herringbone).
- Cows should exit in <30 sec.

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Maximizing Parlor Throughput

- Parlor throughput is a combination of:
  1. Cow movement.
  2. **Milk letdown and speed of milking.**
  3. **Equipment effects.**
  4. People effects.

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Goals of Milking Machine

- "to remove the available milk from each cow's udder quickly and completely, without slipping or falling, with minimum discomfort to the cow and minimum damage to her teats."

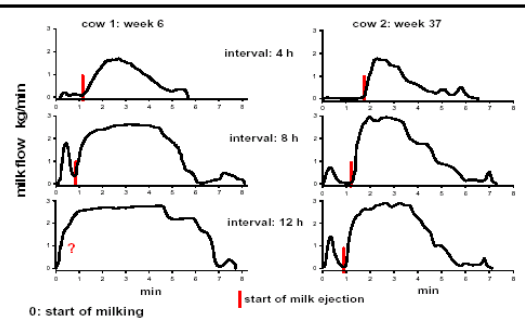
Mein, et al, Proceedings of NMC Annual Mtg, 2007

Goals of Milking

- Maximizing milking speed often results in less complete and/or less gentle milking.
- Maximizing completeness of milking generally results in slower and less gentle milking.
- Maximizing gentleness results in slower milking and may result in less complete milking.

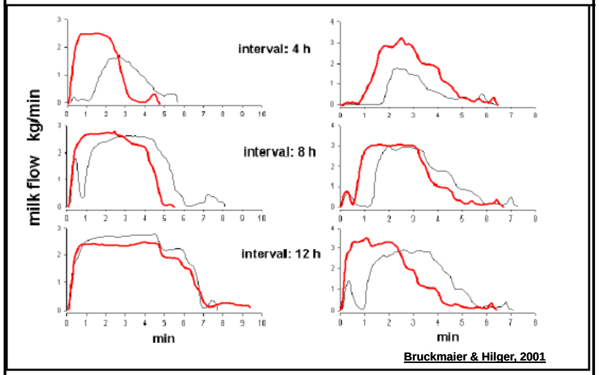
Mein, et al, Proceedings of NMC Annual Mtg, 2007

Evaluating Milk Letdown



Bruckmaier & Hilger, 2001

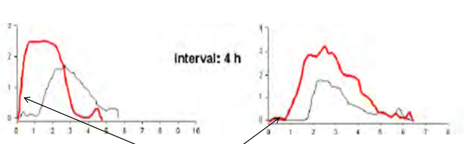
Evaluating Milk Letdown



Cow Stimulation Requirements

1. Cows that have minimal requirements for milk letdown.
2. Cows that have large changes in milk flow and unit on-time with stimulation.
3. Cows that show no change in peak milk flow rate – i.e. Cows with small teat ends.

Period of Increasing Milk Flow

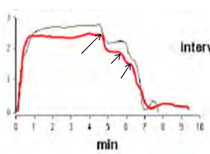


The rate at which milk flow increases is dependent upon the ability of the teat canal to expand and has little to do with vacuum or pulsation effects.

Peak Milk Flow

- Claw vacuum level and pulsation rate & ratio have the most profound effect on milking speed during this period.
- The length of peak milk flow period is longer for cows with more udder fill, i.e. higher milk production or cows with longer intervals between milking.

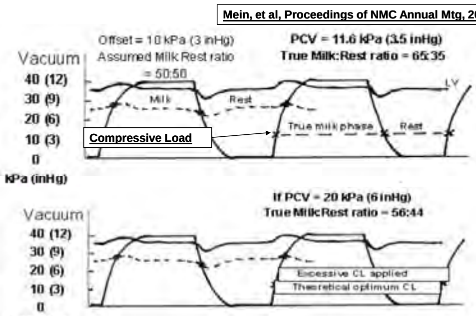
Period of Low Flow at End of Milking



- Begins when milk flow pathway becomes restricted by liner mouthpiece.
- Deficiencies in udder prep have a significant effect on slope.
- Liner design and cluster characteristics have the greatest effects.

Effect of CL on Milk:Rest Ratio

Mein, et al, Proceedings of NMC Annual Mtg, 2007



At 60 bpm, 90 msec more/cycle, ~14% slower milking speed.

ACR Settings

- Increasing flow rates for initiating ACR function and decreasing delay time has decreased unit on-time by up to 1 min.
- Other studies have demonstrated that maximum on-times have increased throughput.
- Minimal impacts on SCC and clinical or sub-clinical mastitis incidence.

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Summary of Machine Effects

- Machine related effects are usually not the rate limiting problem for parlor throughput.
- Unit on-time usually only represents approximately 30-40% of the total time in the parlor.
- Throughput is dictated by the last cow to detach. It is not additive for each cow in the parlor.

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4. People Effects

Pre & Post-Milking Procedures

- Standard Operating Procedures
  - Develop a list of procedures that must be completed in order before and after milking.
  - Post the SOP's in the milk room so that all milkers complete the procedures before and after milking.

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Milking Procedures

1. Pre-milking Observations
2. Forestripping/Check for mastitis.
3. Pre-dipping and clean the teats.
4. Attachment
5. Adjust Unit
6. Determine End of Milking
7. Unit Removal
8. Post-dipping

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Milking Sequence

- Each dairy needs to develop a milking routine for each animal as well as the sequence in which each of these steps will be performed.
- One Step vs. Two Step
- Territorial vs. Sequential

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Milking Sequence

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Timing of Operator Procedures

- Udder prep – ~15-30 sec/cow.
  - Pre-dipping - 4-10 sec.
  - Forestripping - 5-10 sec.
  - Wiping - 5-12 sec.
- Attaching & aligning unit – 7-12 sec.
- Post-dipping – 5-12 sec.
  - May not affect parlor throughput if extra labor is present.

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How do milkers cause mastitis? 1. Poor Teat Sanitation

- Attaching the milking unit to this teat increases the chance of mastitis.
- The milking machine flushes this manure and bacteria into the milk.

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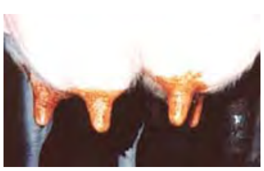
How do milkers cause mastitis? 1. Poor Teat Sanitation



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Monitoring the Milking Process

- Unit On-time
- Parlor Throughput
- Sequence Timing
- Graph Claw Vacuum
- Automated Measuring Systems
  - DC 305 - PARLOR\P

1. Average Milk Flow
2. Peak Milk Flow
3. % of Milk in the First 2 Minutes

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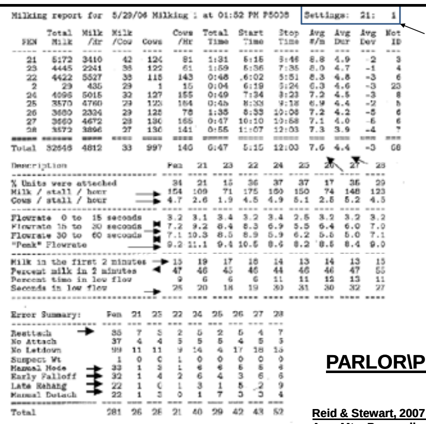


Milking report for 5/29/06 Milking 1 at 01:52 PM P5035 Settings: 21: 1

PEN	Total Milk	Milk /Hr	Milk /Cow	Cows	Cows /Hr	Total Time	Start Time	Stop Time	Avg #/m	Avg Dur	Avg Dev	Not ID
21	5172	3410	42	124	81	1:31	5:15	3:46	8.8	4.9	-2	3
23	4445	2241	36	122	61	1:59	5:36	7:35	8.0	4.7	-1	4
22	4422	5527	38	115	143	0:48	.6:02	5:51	8.3	4.8	-3	6
2	29	435	29	1	15	0:04	6:19	5:24	6.3	4.6	-3	23
24	4096	5015	32	127	155	0:49	7:34	8:23	7.2	4.5	-3	8
25	3570	4760	29	123	164	0:45	8:33	9:18	6.9	4.4	-2	5
26	3680	2324	29	128	78	1:35	8:33	10:08	7.2	4.2	-5	6
27	3660	4672	28	130	165	0:47	10:10	10:58	7.1	4.0	-6	6
28	3572	3896	27	130	141	0:55	11:07	12:03	7.3	3.9	-4	7
Total	32646	4812	33	997	140	6:47	5:15	12:03	7.6	4.4	-3	68

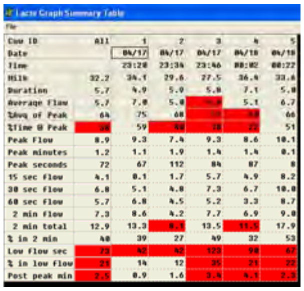
Description	Pen 21	23	22	24	25	26	27	28
% Units were attached	34	21	15	36	37	37	17	35	29
Milk / stall / hour	154	109	71	175	160	150	74	148	123
Cows / stall / hour	4.7	2.6	1.9	4.5	4.9	5.1	2.5	5.2	4.5
Flowrate 0 to 15 seconds	3.2	3.1	3.4	3.2	3.4	2.5	3.2	3.2	3.2
Flowrate 15 to 30 seconds	7.2	9.2	8.4	8.3	6.9	5.5	6.4	6.0	7.0
Flowrate 30 to 60 seconds	7.1	10.3	8.5	8.9	5.9	6.2	5.5	5.0	7.1
"Peak" Flowrate	9.2	11.1	9.4	10.5	8.6	8.2	8.5	8.4	9.0
Milk in the first 2 minutes	15	19	17	18	14	13	14	13	15
Percent milk in 2 minutes	47	46	45	46	44	46	46	47	55
Percent time in low flow	9	6	6	6	11	11	12	13	11
Seconds in low flow	25	20	18	19	30	31	30	32	27

Error Summary:	Pen	21	23	22	24	25	26	27	28
Reattach	35	7	3	2	5	2	5	4	7
No Attach	37	4	4	5	5	5	4	5	5
No Letdown	99	11	11	9	14	4	17	18	15
Suspect Wt	1	0	0	1	0	0	0	0	0
Manual Mode	33	1	3	1	6	6	5	5	6
Early Falloff	32	1	4	2	6	4	3	6	6
Late Rehang	22	1	0	1	3	1	5	2	9
Manual Detach	22	1	3	0	1	7	3	3	4
Total	281	26	25	21	40	29	42	43	52

PARLOR\P

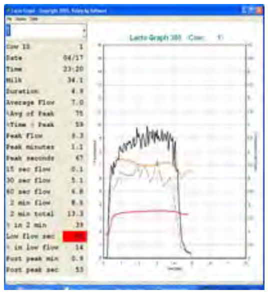
Reid & Stewart, 2007 NMC Ann. Mtg. Proceedings

Lacto Graph 305



Lacto Graph Summary Table

Cow ID	All	1	2	3	4	5
Date		04/17	04/17	04/17	04/18	04/18
Time		23:20	23:34	23:46	00:02	00:22
Milk	32.2	34.1	29.6	27.5	36.4	33.6
Duration	5.7	4.9	5.0	5.8	7.1	5.8
Average Flow	5.7	7.0	5.0	[illegible]	5.1	6.7
%Avg of Peak	64	75	68	[illegible]	[illegible]	66
%Time @ Peak	[illegible]	59	[illegible]	[illegible]	[illegible]	51
Peak Flow	8.9	9.3	7.4	9.3	8.6	10.1
Peak minutes	1.2	1.1	1.9	1.4	1.4	0.1
Peak seconds	72	67	112	84	87	8
15 sec flow	4.1	0.1	1.7	5.7	4.9	8.2
30 sec flow	6.8	5.1	4.8	7.3	6.7	10.0
60 sec flow	5.7	6.8	4.5	5.2	3.3	8.7
2 min flow	7.3	8.6	4.2	7.7	6.9	9.0
2 min total	12.9	13.3	8.1	13.5	11.5	17.9
% in 2 min	40	39	27	49	32	53
Low flow sec	73	42	42	123	98	67
% in low flow	21	14	12	35	21	22
Post peak min	2.5	0.9	1.6	3.4	4.1	2.3



Goals

- Turns/Hour:
  - 2x = 4.3 – 4.5
  - 3x = 4.8 – 4.9
- Milk/Stall/Hour
  - 2x = 150 lbs (67 kg)
  - 3x = 120 lbs (53 kg)
- Milk in the first 2 minutes
  - 2x = 16-18 (7.1-8 kg)
  - 3x = 14.5 lbs (6.4 kg)

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- Peak Milk Flow
  - 2x = 10 lbs/min (4.4 kg)
  - 3x = 8.5 lbs/min (3.7 kg)
- Average Flow Rate
  - 2x = 8.5 lbs (3.9 kg)
  - 3x = 6.5 lbs (3 kg)
- Average Duration
  - 25 lbs (11.1 kg) in the first 4 minutes.
  - Every additional 10 lbs (4.4 kg) in <0.5 min.
- Time in Low Flow
  - <10% or 30 sec

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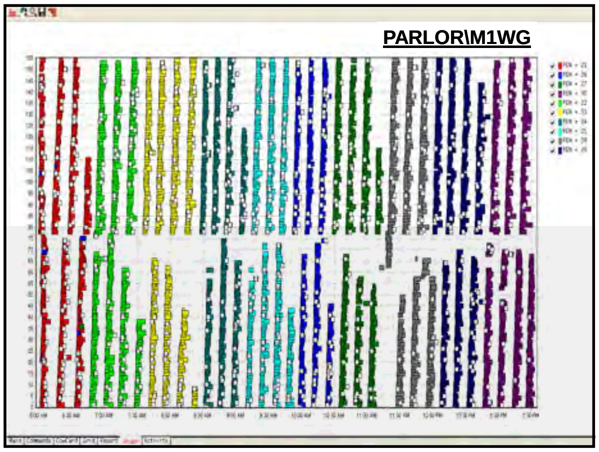
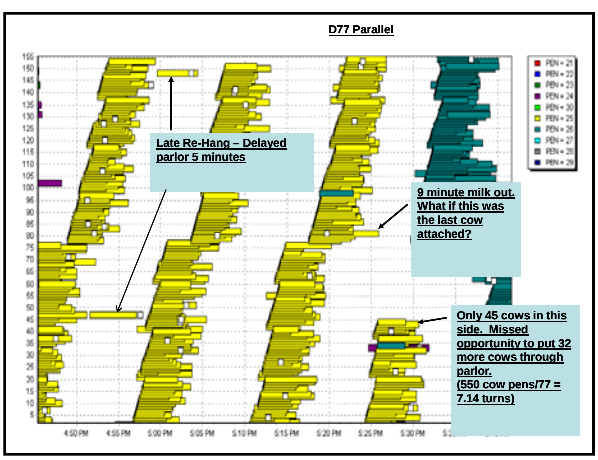


Milking report for 7/ 9/07 Milking 1 at 07:07 AM SIOPJ 77 20 1

PEN	Total Milk	Milk /Hr	Milk /Cow	Cows	Cows /Hr	Total Time	Start Time	Stop Time	Avg #/M	Avg Dur	Avg Dev	Not ID
21	10779	13473	23	464	580	0:48	5:59	6:48	5.3	4.3	-1	-12
26	8186	1825	19	420	93	4:29	6:00	10:30	4.6	4.1	-4	17
30	16521	2377	34	493	70	6:57	6:35	13:33	6.9	4.9	-4	42
27	13907	2567	31	445	82	5:25	6:37	12:02	6.8	4.6	-3	53
22	14140	9025	30	476	303	1:34	6:46	8:21	6.3	4.7	-4	32
23	13220	15864	28	478	573	0:50	7:35	8:25	6.2	4.3	-1	70
24	11099	15135	24	467	636	0:44	8:27	9:11	5.4	4.3	-3	38
25	12243	16324	26	471	628	0:45	9:09	9:54	5.9	4.4	-4	36
28	13771	8697	33	415	262	1:35	11:11	12:47	6.8	5.0	-2	115
29	16064	17524	33	494	538	0:55	11:59	12:55	6.9	4.8	-4	33
Total	120930	17209	28	4623	612	7:33	5:59	13:33	6.1	4.6	-3	426

Description	Pen	21	26	30	27	22	23	24	25	28	29
% Units were attached	30	26	4	3	4	15	27	29	29	13	27
Milk / stall / hour	111	85	11	15	16	58	102	97	105	56	111
Cows / stall / hour	3.9	3.7	0.6	0.4	0.5	1.9	3.7	4.1	4.0	1.6	3.4
Flowrate 0 to 15 seconds	2.7	3.4	2.3	2.5	3.2	2.8	2.8	2.5	2.9	2.4	2.8
Flowrate 15 to 30 seconds	5.8	5.3	4.8	6.1	6.5	5.7	6.1	5.4	5.9	6.1	6.2
Flowrate 30 to 60 seconds	4.2	3.9	3.0	4.8	4.9	4.2	4.3	3.5	4.0	4.5	4.8
"Peak" Flowrate	5.8	5.3	3.6	7.1	6.7	6.0	5.9	4.8	5.2	6.7	6.7
Milk in the first 2 minutes	10	9	7	12	12	10	10	8	9	11	11
Percent milk in 2 minutes	36	39	37	35	37	35	37	36	36	33	35
Percent time in low flow	15	20	23	12	13	15	14	18	16	12	13
Seconds in low flow	43	52	57	37	38	42	39	47	44	37	37

Error Summary:	Pen	21	26	30	27	22	23	24	25	28	29
Reattach	256	27	37	14	24	22	28	33	34	16	21
Entered Twice	7	0	0	0	2	0	1	0	0	4	0
No Attach	1	0	0	0	0	0	1	0	0	0	0
No Letdown	997	64	78	103	106	103	123	107	120	79	114
Suspect Wt	10	3	0	0	2	0	1	2	0	1	1
Manual Mode	64	5	2	19	9	2	5	6	6	4	6
Early Falloff	88	3	9	8	11	10	11	9	9	8	10
Late Rehang	354	72	34	22	26	42	33	35	31	25	34
Total	1777	174	160	166	180	179	203	192	200	137	186



Examples:

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Ohio Dairy Veterinarians Annual Meeting
Milk Culturing Wet Lab

Date: Thursday January 8, 2009
Place: Marysville Ambulatory Clinic, Marysville, Ohio
Time: 1 pm to 5 pm
Instructor: Patrick Gorden, DVM, ABVP, Iowa State University
Cost: $50.00

The wet lab will cover various topics:

1. How to set up an in house milk culture lab
2. Review of mastitis pathogen identification
3. Stations with several mastitis pathogen cultures for identification
4. Is intended to be for both veterinarians and staff who desire further training for their in house milk culturing lab as well as on farm culturing systems

AGENDA

1:00 pm Intro Materials

1:05 to 2:15 pm Setting up a milk quality lab, personnel and equipment

- *What types of services are you going to offer?*
- *Training and quality control*
- *Lab identification protocols*
- *Sample collection and processing*
- *On farm labs*

2:15 to 3:45 pm Identification of unknowns

- *Break out into groups for rotation through stations to identify pathogens on plated samples*

3:45 to 4:30 pm Working through the unknowns as a group

- *Pitfalls of short cuts in identification*

4:30 to 5:00 pm Reporting results

- *Electronic methods to reduce error and save time*

Wrap up for questions and answers

Please use the registration form enclosed for sign up and payment; please copy the registration form or use an additional sheet if signing up more than one participant's information. Thank you very much.

2009 Ohio Dairy Veterinarians Meeting

Milk Quality Case Study #1

You are called on 12/1/07 by a client who recently acquired a dairy facility from a neighbor including the existing livestock. The farm is a dry lot facility with shades and older style cooling (adequate but not state of the art). All cows are fed in fence line feed bunks that have stanchion lock-ups.

The owner has access to all of the data from the previous owner's computer and the data from milk plant. There are currently 935 milking cows distributed among 9 milking pens. There is also a hospital pen containing treated and fresh cows that currently has 31 cows in it. All hospital cows are milked through the main parlor. Additionally, there are 128 dry cows that are all housed in pen 10(no close up ration). All heifers are raised off-site and are moved to the dairy the day they calf.

By PEN	%COW	#COW	Av MILK	Av DCC
1	13	137	83	45
2	9	93	70	86
3	13	137	83	63
4	11	115	59	143
5	8	85	59	171
6	10	111	80	211
7	10	102	57	143
8	4	46	38	171
9	7	78	63	80
10	12	128	38	252
13	3	31	66	176
=========	====	======	=======	=======
Total	100	1063	66	175

The new owner thinks the bulk tank SCC is ok but wants an opinion about the other tank data that is available. There is no individual culture or DHIA component data available.

The milking parlor is a double 14 herringbone, retro-fitted with automatic detachers shortly after the current owner purchased the facility.

EVENTS\50 for 12/03/06 - 12/03/07

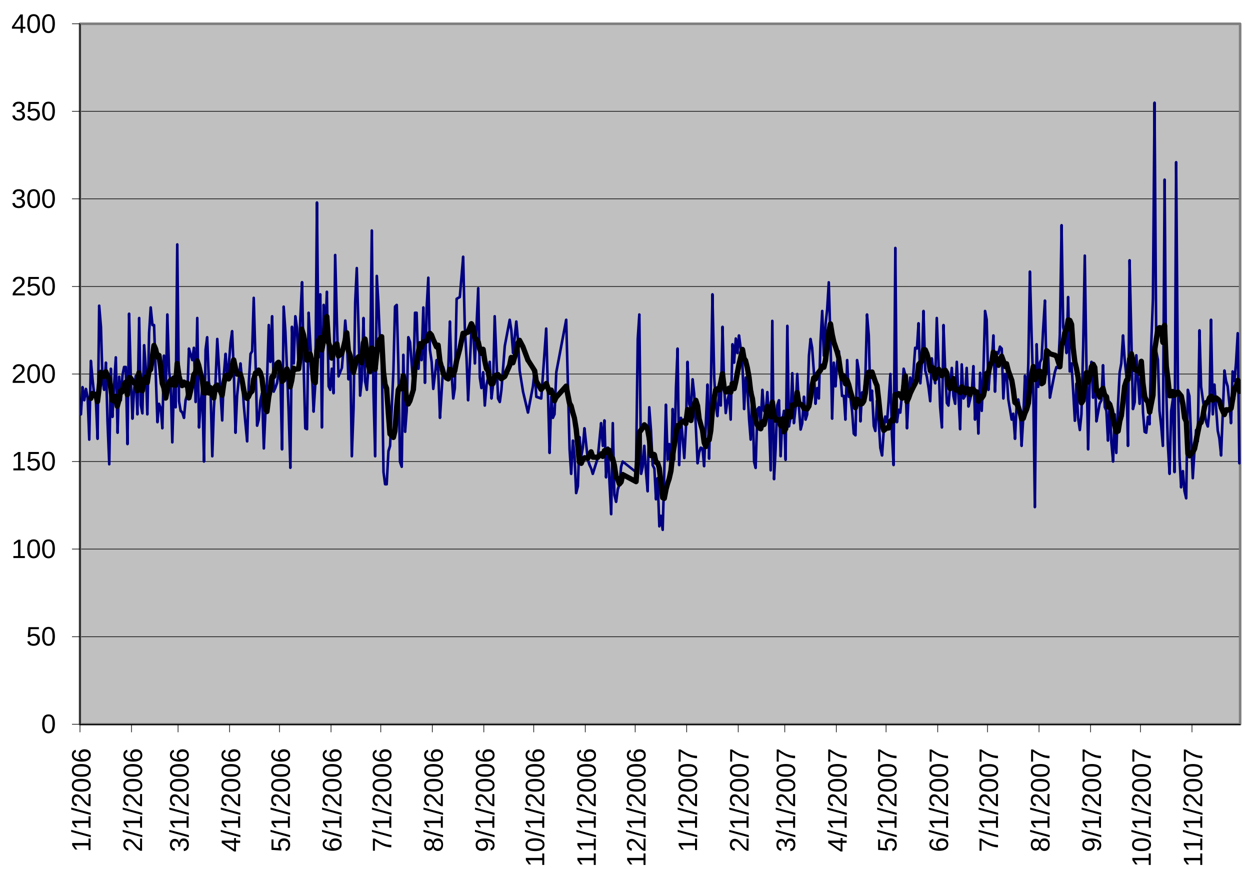
Event	Total	Dec06	Jan07	Feb07	Mar07	Apr07	May07	Jun07	Jul07	Aug07	Sep07	Oct07	Nov07	Dec07
FRESH	917	83	119	91	79	29	28	51	93	79	105	82	76	2
SOLD	328	6	37	36	38	12	37	23	34	28	35	20	22	0
DIED	79	6	9	7	4	5	5	6	5	13	8	3	8	0

DA	1	1	0	0	0	0	0	0	0	0	0	0	0	0
LAME	220	18	16	36	35	18	11	10	14	15	18	17	12	0
MAST	294	32	63	38	20	14	17	12	17	32	15	12	20	2
MF	26	4	3	8	4	2	1	0	0	0	2	1	1	0
ILLMISC	237	15	21	32	20	8	7	14	27	15	42	17	17	2
RP	67	2	5	1	1	1	0	10	11	9	12	9	6	0
REPRO	1022	78	84	101	98	44	19	30	101	101	128	147	85	6
CN	399	0	0	0	0	0	87	24	82	64	62	30	50	0
LUT3	341	0	0	0	0	0	77	27	45	51	55	44	42	0
DIARRHE	26	1	8	1	5	1	1	0	3	1	0	1	4	0
PNEU	17	3	1	1	2	0	0	1	1	1	4	1	2	0

EVENTS\7I011415 ... FOR LACT>0 DIM<61 FDAT>12.31.06 for 01/01/07 - 11/30/07

Event	Total	Jan07	Feb07	Mar07	Apr07	May07	Jun07	Jul07	Aug07	Sep07	Oct07	Nov07	Dec07
FRESH	832	119	91	79	29	28	51	93	79	105	82	76	0
SOLD	27	4	5	2	1	3	1	2	2	4	3	0	0
DIED	32	3	5	3	0	1	4	4	7	2	2	1	0
TOTALS	891	126	101	84	30	32	56	99	88	111	87	77	0
Cows and 1	21 Eve nts sk ipped becaus e the events occur prior to ar rival												

Case Study 1 Bulk Tank SCC



Case Study 1 – Quality Counts for last year

Date	STD	PI	LPC	Coli
12/4/2006	3,000	3,800	600	
1/3/2007	2,500	3,200	600	
2/4/2007	2,000	2,600	320	3600
3/5/2007	3100	4300	180	480
4/3/2007	1700	3000	80	40
5/2/2007	13600	14900	110	60
6/5/2007	2400	3800	160	600
7/4/2007	14600	16400	1200	8600
8/1/2007	4800	6600	800	360
9/3/2007	1600	3000	440	10
10/1/2007	2200	4000	100	400
11/6/2007	1600	3600	320	10

Case Study 1 Bulk Tank Cultures – 2007

Date	Staph aur	Staph spp	Strep ag	Strep non-ag	GNR	Misc.	Myco
2/1/2007	500	600	0	600	37,000	100	Neg
3/5/2007	0	1100	0	1200	2400	0	Neg
4/3/2007	100	300	0	1000	500	0	Neg
5/2/2007	200	200	0	3200	3200	700	Neg
6/5/2007	0	600	0	2400	3200	0	Neg
7/4/2007	300	0	0	34000	14000	0	Neg
8/1/2007	800	600	0	2400	3600	0	Neg
9/3/2007	300	600	0	1200	1000	2000	Neg
10/1/2007	100	600	0	200	1600	0	Neg
11/6/2007	900	300	0	1600	300	0	Neg

Bulk Tank Culture Interpretation

	Low	Moderate	High	Very High
Staph. aureus	<50	50-150	150-250	>250
Staph. spp.	<300	300-500	500-750	>750
Strep. ag.	0-50	100-200	200-400	>400
Strep. non-ag	500-700	700-1200	1200-2000	>2000
Coliforms	<100	100-400	400-700	>700
Misc.				
Mycoplasma	Negative			

1. After you initial evaluation of the data and the herds DC305 records, what are your initial impressions about strengths of the herd?

2. What are your concerns about the herd?

3. What is your game plan for this herd in the future?

Section 2

Upon completion of your review of the data, you tell the owner that you have a free afternoon this week and would like to stop by and observe milking and perform some milking time tests. The owner informs you that they start milking at 1 pm but have been having problems getting cows milked and wash up performed during the normal 8 hour shift and therefore he would prefer that you do no additional testing/procedures that are going to slow down the milking process.

You arrive around 2 pm to evaluate the parlor. Upon arrival, you speak with one of the local milking equipment company technicians who has just completed re-building and re-testing all of the pulsators.

When you enter the parlor, you briefly speak with the owner and he tells you that there are usually two milkers and a cow pusher on each shift. While you are there, you install your Lactocorder to measure milk flow rates and utilize your vacuum recorder to measure average claw vacuum and vacuum stability. The results of these analyses are presented below.

While performing your checks, you notice that the two milkers are prepping cows utilizing the follow the leader technique but are not doing any pre-milking sanitation with the exception of wiping teats. Prep lag was approximately 20 seconds or less. You also notice that there are two types of milking claws in the parlor, all claws are vented and all liners are vented. In addition, all milking hoses are long enough that they drop below the milk pipeline and in some cases they touch the floor. The milkers were using cloth towels but the towels have large amounts of dried manure debris mixed the towels even though they were properly washed and dried.

Lactocorder Results for 6 cows.

Cow ID	All	1	2	3	4	5	6
Time		15:47	15:58	16:14	16:28	16:39	16:54
Milk	25.2	6.3	9.2	34.7	34.4	29.5	37
Duration	6.9	4.1	6.9	6.7	6.5	11.7	5.5
Average Flow	3.65	1.54	1.33	5.18	5.29	2.52	6.73
%Avg of Peak	47	32	36	39	54	59	60
%Time @ Peak	22	9	14	27	24	20	37
Peak Flow	7.1	4.7	3.6	11.4	9.1	4.3	9.6
Peak minutes	1	0.2	1.8	0.2	1.1	1.6	1
Peak seconds	60	14	109	14	67	98	59
15 sec flow	1.6	2	0.4	3.4	2.9	0	0.7
30 sec flow	5.1	4.8	1.6	9.7	7	1.3	6.3
60 sec flow	4.9	3.3	0.8	9.3	6.4	2.1	7.2
2 min flow	5.9	1.3	1.5	11.2	8.7	3.7	9.1
2 min total	10	4.7	2.4	19.1	14.4	5	14.5
% in 2 min	42	75	27	55	42	17	39
Low flow sec	159	199	235	134	98	255	34
% in low flow	39	82	57	29	23	36	9
Post peak min	4.7	3.5	4.1	5.5	4.2	7.7	3
Post peak sec	280	207	246	328	252	462	182

Below are the results of the vacuum recorder analysis. Peak claw vacuum was measured for 15 cows.

MILKING SYSTEM EVALUATION FORM

NMC
A global organization for mastitis control and milk quality

Dairy Operator: 494 - Case Study 1 Phone: ____ Date: 12/2007

Address: ____ Dealer: ____

Dairy Operator's Concerns: # of Staph aureus cows in herd

Number of Cows: 950 milking Milk Production: ____ SCC: 200-250

Milking System: ___ Highline x Lowline ___ Single Loop x Double Loop Number of Milking Units Used: 28

Milkline Size: 3 in. Pulsator Line Size: 3 in. Milkline Slope: ____ in./10 ft. continuous Vacuum Pump Model: ____ HP: 15

Milking Time Tests

Average Claw Vacuum, kPa ("Hg), during peak flow, for at least 10 cows											Guidelines or comments
11.5	11.3	11.3	11.5	12	11.9	11.7	11.7	11.8	11.4	11.0	35 to 42 kPa (10.5 to 12.5 "Hg) is desirable
Claw Vacuum Fluctuations, kPa ("Hg), during peak flow, for at least 10 cows											
2.8	2.8	2.8	2.9	2.6	2.8	2.6	3	3	3.5	2.3	(max – min) during one pulsation cycle less than 10 kPa (3 "Hg) is desirable

Average Claw Vacuum, kPa ("Hg), during peak flow, for at least 10 cows											
11.7	11.6	11.7	11.8	11.7							35 to 42 kPa (10.5 to 12.5 "Hg) is desirable
Claw Vacuum Fluctuations, kPa ("Hg), during peak flow, for at least 10 cows											
3.1	2.6	3.1	2.7	2.6							(max – min) during one pulsation cycle less than 10 kPa (3 "Hg) is desirable

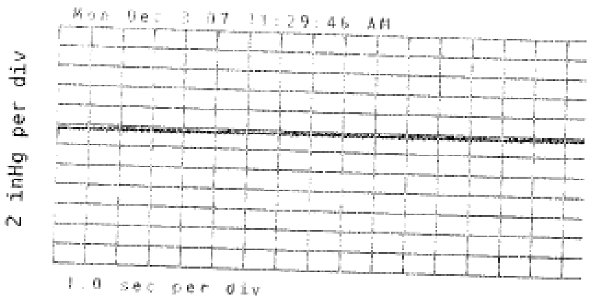
Milkline Vacuum Stability kPa ("Hg) For 3 parlor turns or 15 minutes in a round-the-barn system	0.7	0.6	0.8	(ave – min) and (max – ave) less than 2 kPa (0.6"Hg) is desirable
Receiver Vacuum Stability kPa ("Hg) Measure if milkline vacuum stability is of concern				

Dry Test of Pulsators

Pulsator number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ratio, front or side	64:36	64:36														
Ratio, rear or side	65:35	65:35														
A phase (ms), front or side	94	92														
A phase (ms), rear or side	90	90														
B phase (ms), front or side	528	564														
B phase (ms), rear or side	540	570														
C phase (ms), front or side	104	104														
C phase (ms), rear or side	105	116														
D phase (ms), front or side	247	258														
D phase (ms), rear or side	239	244														
Rate (pulsations/minute)	61.67	58.95														

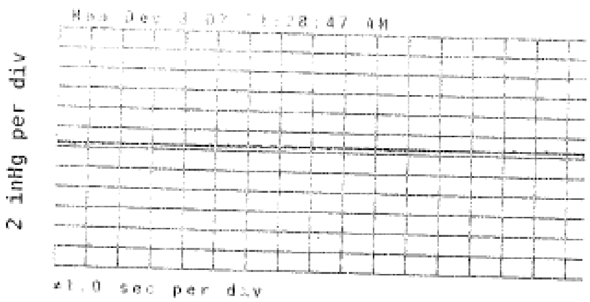
Voltage Checks for Electronic Pulsators

Volts at control: ____ Volts at last pulsator: ____ Volts at intermediate pulsator: ____ Volts at other: ____



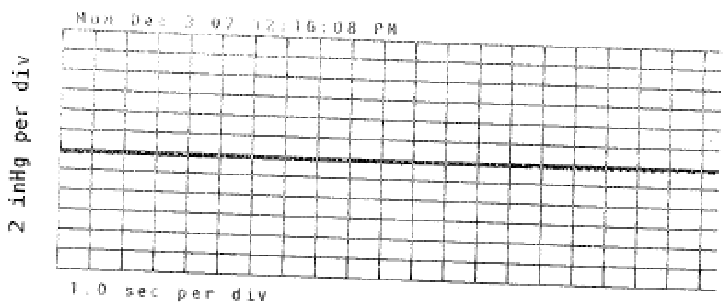
Vacuum 1 (PLOT)
Maximum Vac: 13.9inHg
Minimum Vac: 13.5inHg
Average Vac: 13.8inHg

PUMP VAC



Vacuum 1 (PLOT)
Maximum Vac: 12.7inHg
Minimum Vac: 12.4inHg
Average Vac: 12.6inHg

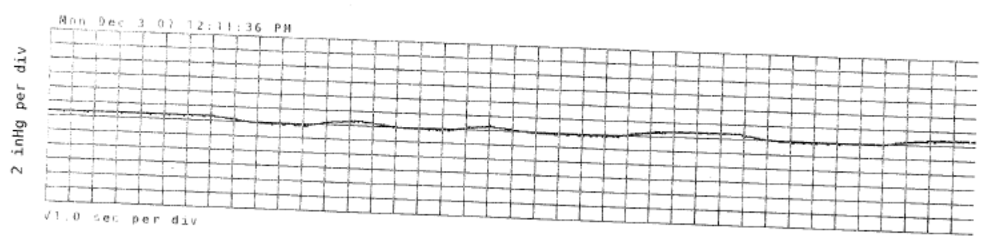
RE VAC



Vacuum 1 (PLOT)
Maximum Vac: 12.0inHg
Minimum Vac: 11.7inHg
Average Vac: 11.8inHg

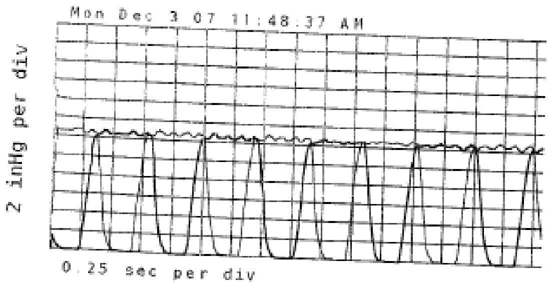
REG VAC

2 unit fall off test



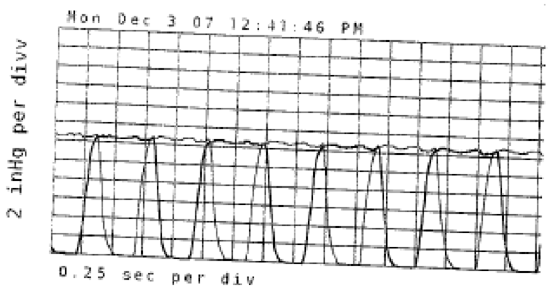
Vacuum 1 (PLOT)
Maximum Vac: 12.8inHg
Minimum Vac: 11.8inHg
Average Vac: 12.3inHg

Avg Rec vac = 12.6 - Min vac = 11.8 =



Pulsation 1 (PLOT)
Rate: 61.67 PPM
Ratio: 64:36
A Phase: 10% 94mS
B Phase: 54% 528mS
C Phase: 11% 104mS
D Phase: 25% 247mS
A+B Phase: 64% 622mS
C+D Phase: 36% 351mS
Vacuum: 12.9inHg

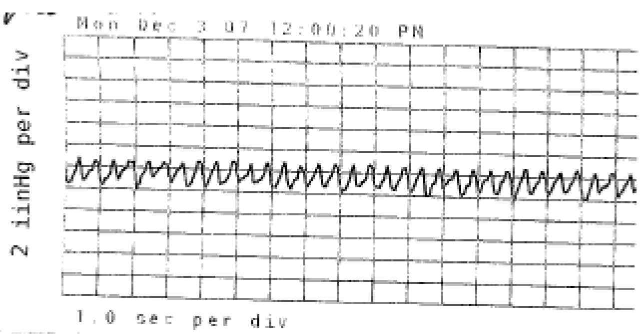
Pulsation 2 (PLOT)
Rate: 61.67 PPM
Ratio: 65:35
A Phase: 9% 90mS
B Phase: 56% 540mS
C Phase: 11% 105mS
D Phase: 24% 239mS
A+B Phase: 65% 630mS
C+D Phase: 35% 344mS
Vacuum: 13.0inHg
Limp: 1%



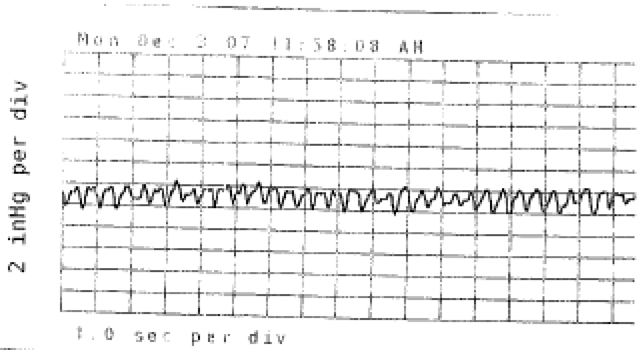
Pulsation 1 (PLOT)
Rate: 58.95 PPM
Ratio: 64:36
A Phase: 9% 92mS
B Phase: 55% 564mS
C Phase: 10% 104mS
D Phase: 26% 258mS
A+B Phase: 64% 656mS
C+D Phase: 36% 362mS
Vacuum: 12.8inHg

Pulsation 2 (PLOT)
Rate: 58.89 PPM
Ratio: 65:35
A Phase: 9% 90mS
B Phase: 56% 570mS
C Phase: 11% 116mS
D Phase: 24% 244mS
A+B Phase: 65% 660mS
C+D Phase: 35% 360mS
Vacuum: 12.9inHg
Limp: 1%

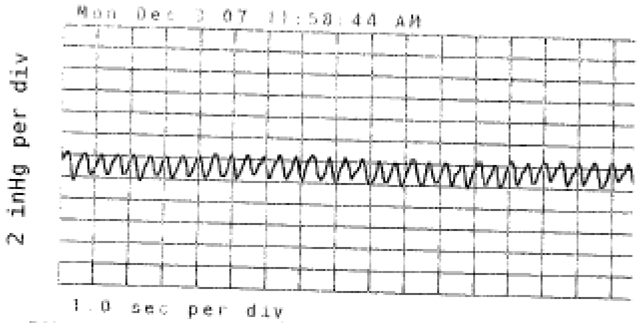
Claw vacuum measured during peak flow.



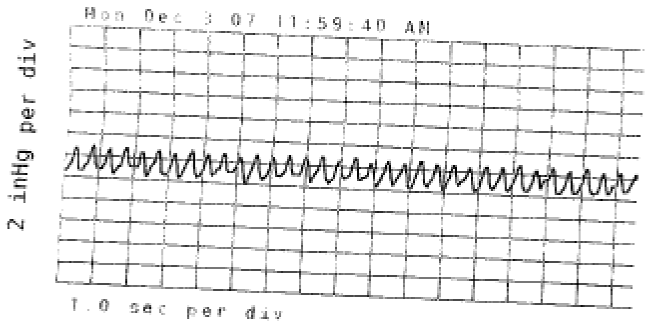
Vacuum 1 (PLOT)
Maximum Vac: 12.8inHg
Minimum Vac: 10.0inHg
Average Vac: 11.5inHg



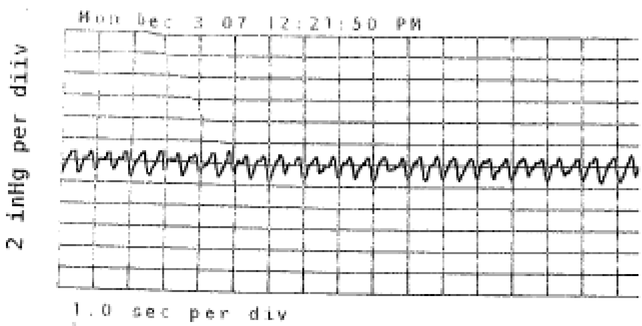
Vacuum 1 (PLOT)
Maximum Vac: 12.5inHg
Minimum Vac: 9.7inHg
Average Vac: 11.3inHg



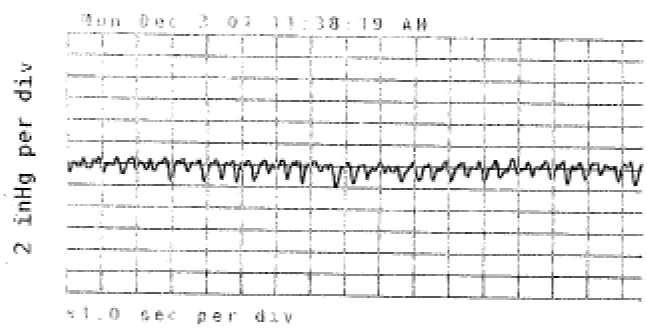
Vacuum 1 (PLOT)
Maximum Vac: 12.6inHg
Minimum Vac: 9.8inHg
Average Vac: 11.3inHg



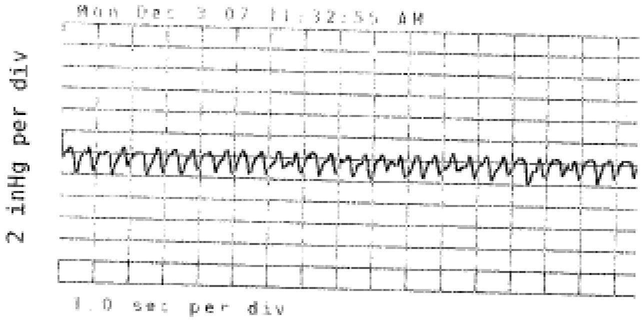
Vacuum 1 (PLOT)
Maximum Vac: 13.0inHg
Minimum Vac: 10.1inHg
Average Vac: 11.5inHg



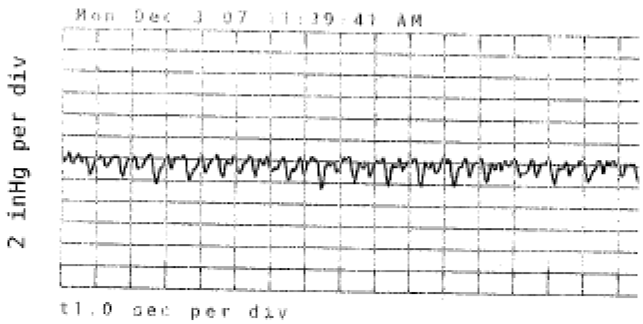
Vacuum 1 (PLOT)
Maximum Vac: 13.2inHg
Minimum Vac: 10.6inHg
Average Vac: 12.0inHg



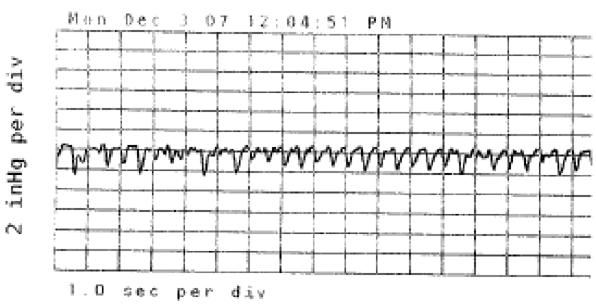
Vacuum 1 (PLOT)
Maximum Vac: 12.9inHg
Minimum Vac: 10.1inHg
Average Vac: 11.9inHg



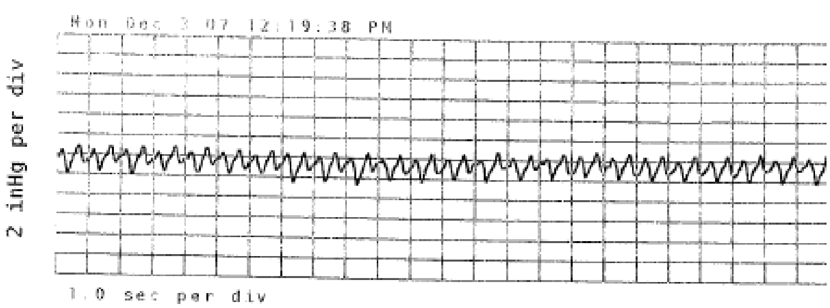
Vacuum 1 (PLOT)
Maximum Vac: 12.7inHg
Minimum Vac: 10.1inHg
Average Vac: 11.7inHg



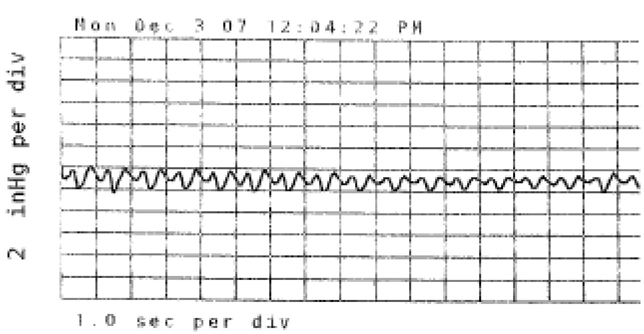
Vacuum 1 (PLOT)
Maximum Vac: 12.5inHg
Minimum Vac: 9.5inHg
Average Vac: 11.7inHg



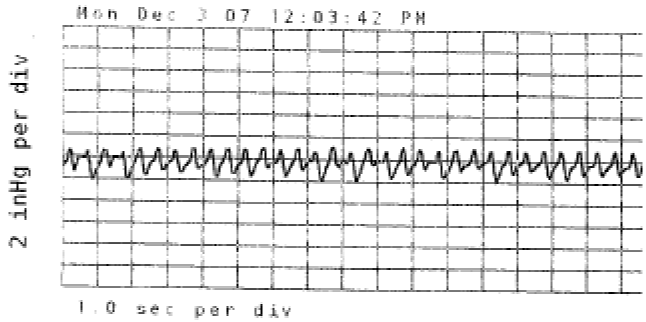
Vacuum 1 (PLOT)
Maximum Vac: 12.6inHg
Minimum Vac: 9.6inHg
Average Vac: 11.8inHg



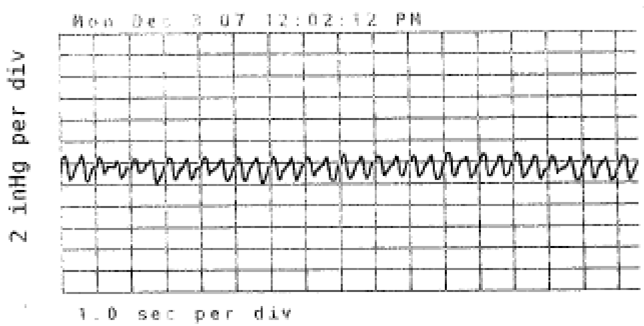
Vacuum 1 (PLOT)
Maximum Vac: 12.9inHg
Minimum Vac: 9.4inHg
Average Vac: 11.4inHg



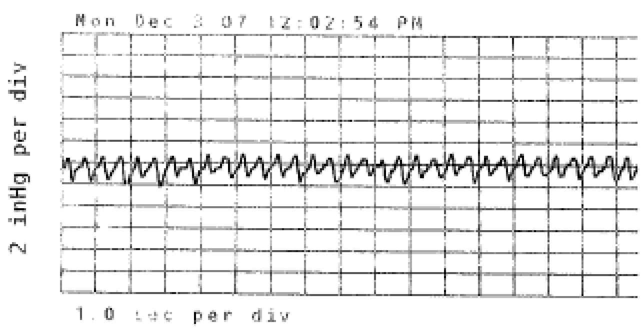
Vacuum 1 (PLOT)
Maximum Vac: 12.1inHg
Minimum Vac: 9.8inHg
Average Vac: 11.0inHg



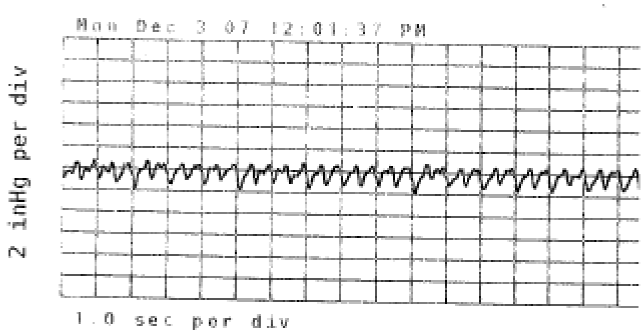
Vacuum 1 (PLOT)
Maximum Vac: 13.1inHg
Minimum Vac: 10.0inHg
Average Vac: 11.7inHg



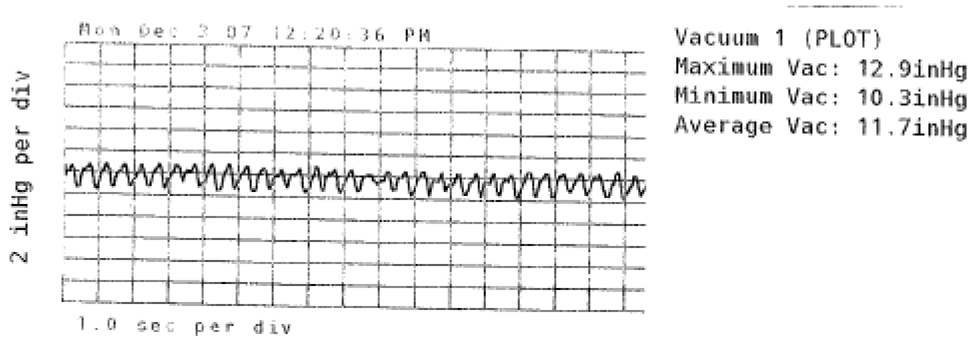
Vacuum 1 (PLOT)
Maximum Vac: 12.8inHg
Minimum Vac: 10.2inHg
Average Vac: 11.6inHg



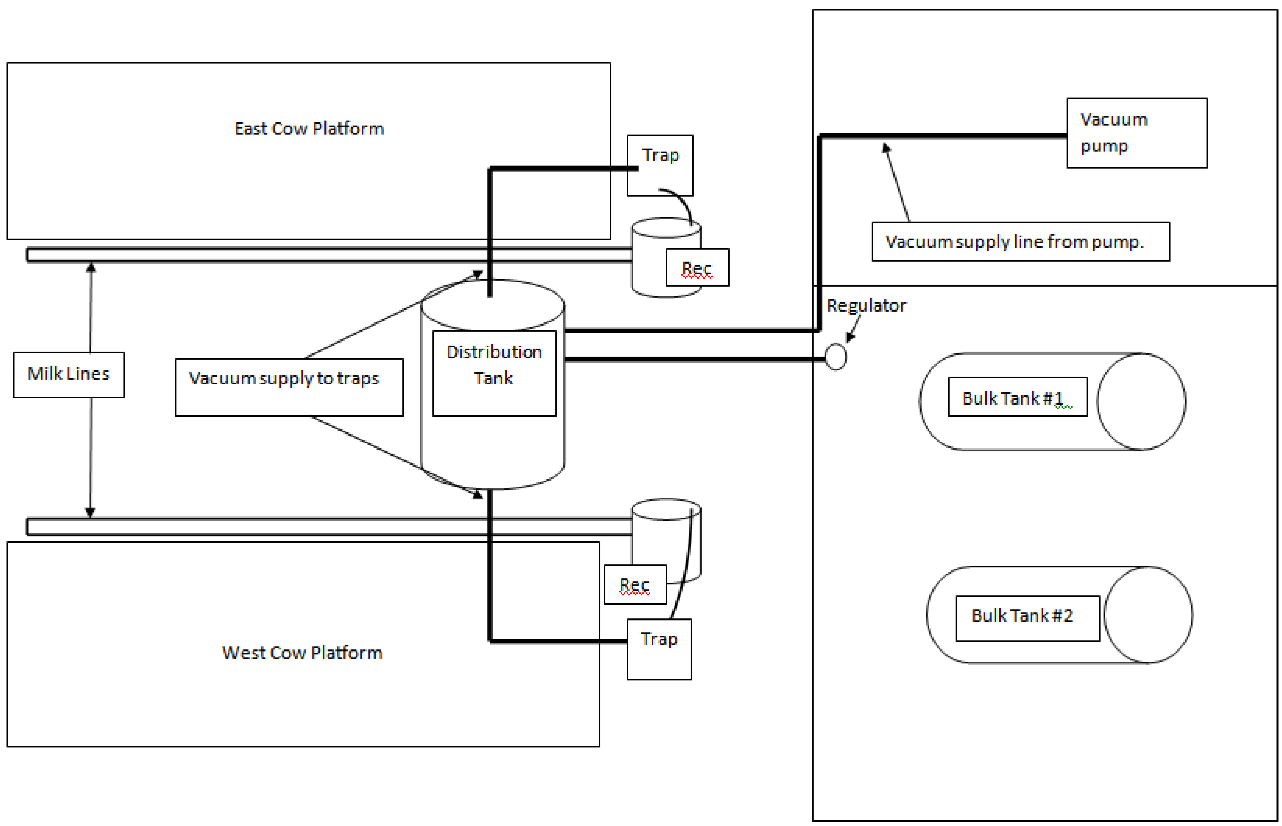
Vacuum 1 (PLOT)
Maximum Vac: 13.0inHg
Minimum Vac: 9.9inHg
Average Vac: 11.7inHg



Vacuum 1 (PLOT)
Maximum Vac: 12.8inHg
Minimum Vac: 10.1inHg
Average Vac: 11.8inHg



Parlor layout.



Barn Layout for Case Study #1

1. Based on your evaluation of the milking procedures and the data that is available, what are your concerns/areas that need attention?

2. Based on the data you collected, how many cows per hour are going through the parlor? From this, how many hours does it currently take to milk the herd?

3. What recommendations do you make for employee procedures?

4. What other testing would you like to have done at the dairy? How would you go about implementing the testing?

Section 3

After discussing your findings with the dairy owner, you convince him to allow you to do a more thorough evaluation of the milking equipment. The evaluation form is below.

Diagnostic Dry Tests of Vacuum and Airflow					
Operating Vacuum and Vacuum Differences Across System					
Record operating vacuum level, kPa ("Hg) at: (5 to 20 second average)	Receiver or weigh jar	Regulator sensor	Pulsator airline	Vacuum pump inlet (PIV)	Farm gauge reading
1a. Teatcups plugged and all units operating	12.9"	12.1"	12.7"	13.1"	11.0"
Unit Fall-Off Tests					
Record vacuum level, kPa ("Hg) at:	Receiver or weigh jar	Regulator sensor	Calculation	Vacuum Drop Over or Undershoot	Guidelines or Comments
1b. Average vacuum with one unit open 5 to 20 second ave.			Vacuum drop 1a - 1b		Less than 2 kPa is desirable
1b.1. Maximum vacuum as one unit is closed			Overshoot 1b.1 – 1a		Less than 2 kPa is desirable
1b.2. Minimum vacuum as one unit is opened			Undershoot 1b – 1b.2		Less than 2 kPa is desirable
For more than 32 units or more than 2 operators, systems may be checked opening a second unit					
1c. Average vacuum with two units open, kPa ("Hg) 5 to 20 second ave.	11.8"	1.1"	Vacuum drop 1a - 1c		< 2 kPa is desirable for > 32 units
1c.1. Maximum vacuum as two units are closed	12.8"		Overshoot 1c.1 – 1a		< 2 kPa is desirable for > 32 units
1c.2. Minimum vacuum as two units are opened	11.8"		Undershoot 1c – 1c.2		< 2 kPa is desirable for > 32 units

Effective Reserve, Manual Reserve and Regulation Efficiency	As Found	Retest after changes	Guidelines or comments
2a. Effective Reserve: air admission to reduce operating receiver vacuum 2 kPa (0.6 "Hg), LPM (CFM)	40		1000 LPM + 30 LPM/unit (35 CFM + 1 CFM/unit)
2b. Vacuum at regulator sensor kPa ("Hg)	11.85"		
2c. Manual Reserve: regulator disabled LPM (CFM)	215		Not applicable for VFD regulators
2d. Regulation Efficiency (ER/MR) x 100	18.6%		At least 90% is desirable
2e. Vacuum change at regulator sensor (1a sensor - 2b), kPa ("Hg)	0.25"		At least 1.3 kPa (0.4 "Hg) is desirable

1. What deficiencies/problems did you identify?

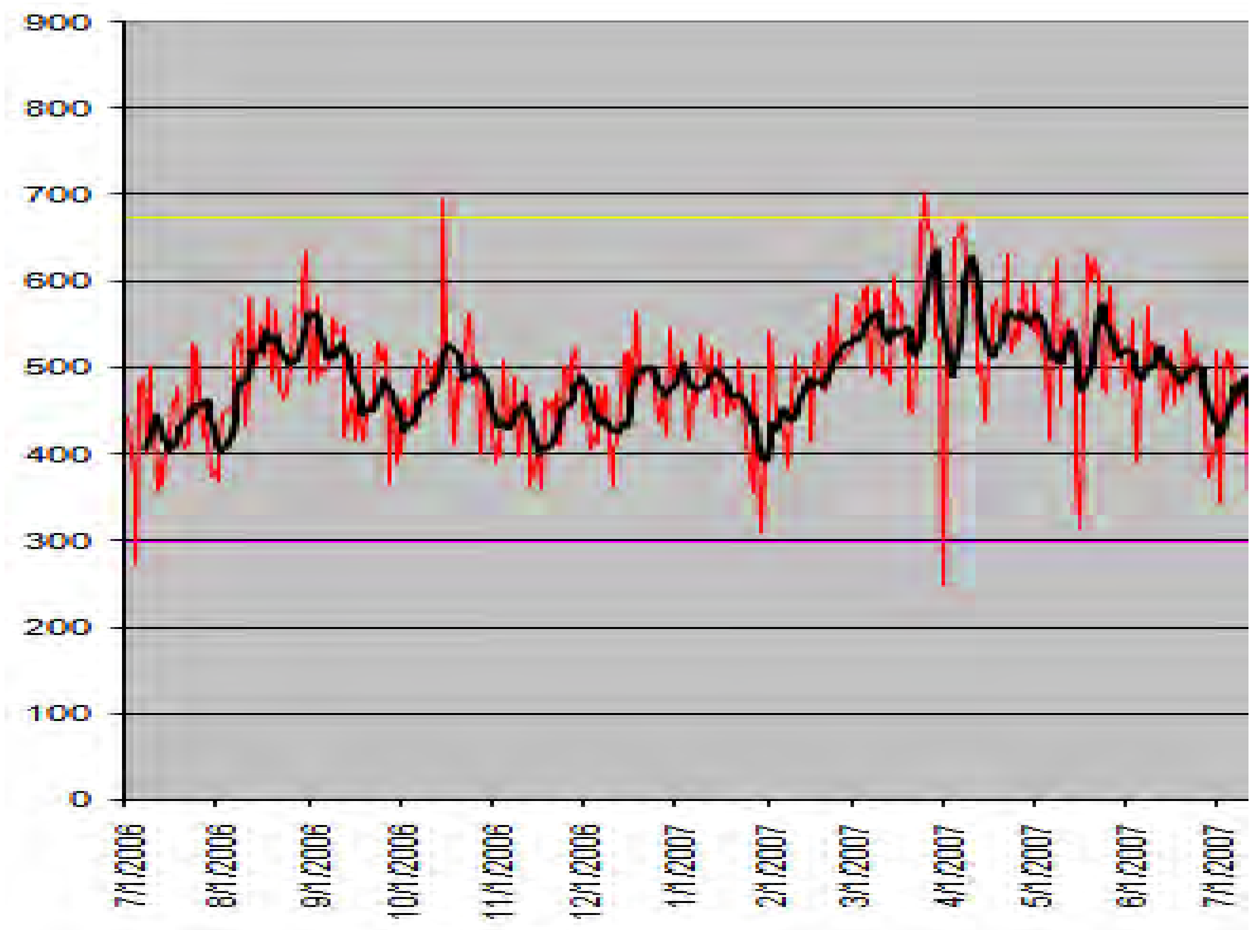
2. What additional recommendations do you have based on this testing?

2009 Ohio Dairy Veterinarians Meeting

Milk Quality Case Study #2

You are called to investigate a long term SCC problem that appears to be getting worse at a 1500 cow investor dairy that has been in business for nine years. Upon arriving at the dairy, you are met by the managing partner of the investor group who is now also functioning as the day to day manager. Approximately 3 months earlier, the previous manager left and the investor group felt there were a lot of problems that were not properly addressed during his tenure. They therefore decided to not hire a new manager until they have a better handle on the operation. Upon asking him a variety of questions about the current state of the dairy, it is obvious that he does not have a lot of experience managing a dairy. The dairy uses a well known nutritionist who has been their major source of advice along with their accountant, and to a lesser extent the local veterinarian. The veterinarian is from the town nearby and this operation is his only dairy client although he is a well respected feedlot veterinarian. The nutritionist convinced the owners to have a consultant come in and look at the equipment as he felt it was the reason for their long term SCC problem.

Figure 1-Bulk tank SCC for the previous year.



As you walk into the office, he informs you that production has been ok but not great lately and they are concerned about the number of dead cows they are having. He also tells you the dairy has never received quality in the history of its operation. The dairy would receive a quality bonus of $0.35/cwt if their bulk tank SCC averages <350,000 for an entire month. If the dairy has an average SCC of >550,000 for the month, they receive a $0.40/cwt deduction. Figure 1 and Table 1 contain bulk tank SCC data and bulk tank culture data respectively. Figure 2 below summarizes daily bulk tank milk production.

Table 1-Bulk Tank Culture Results from three consecutive days.

Date	Staph aur	Staph spp	Strep ag	Strep non-ag	Coliforms	Misc.	Myco
6/25/2007 Tank 1	50	300	0	325	450	0	ND
6/25/2007 Tank 2	65	400	0	245	935	0	ND
6/26/2007 Tank 1	50	550	0	270	11,200	0	ND
6/26/2007 Tank 2	60	340	0	410	410	0	ND
6/27/2007 Tank 1	55	210	0	290	95	0	ND
6/25/2007 Tank 2	70	535	0	310	65	0	ND

Bulk Tank Culture Interpretation				
	Low	Moderate	High	Very High
Staph. aureus	<50	50-150	150-250	>250
Staph. spp.	<300	300-500	500-750	>750
Strep. ag.	0-50	100-200	200-400	>400
Strep. non-ag	500-700	700-1200	1200-2000	>2000
Coliforms	<100	100-400	400-700	>700
Misc.				
Mycoplasma	Negative			

While in the office, you pick up a copy of their Dairy Comp 305 program. Noticing that you have expertise with DC 305, the manager asks you if you could evaluate the production records also. During the conversation, he also tells you that their hospital is always full, mostly with mastitis cows. When the local veterinarian submitted the bulk tank cultures, he also submitted samples from several cows with mastitis. Figure 3 summarizes these results.

Figure 2-Average daily milk production from bulk tank.

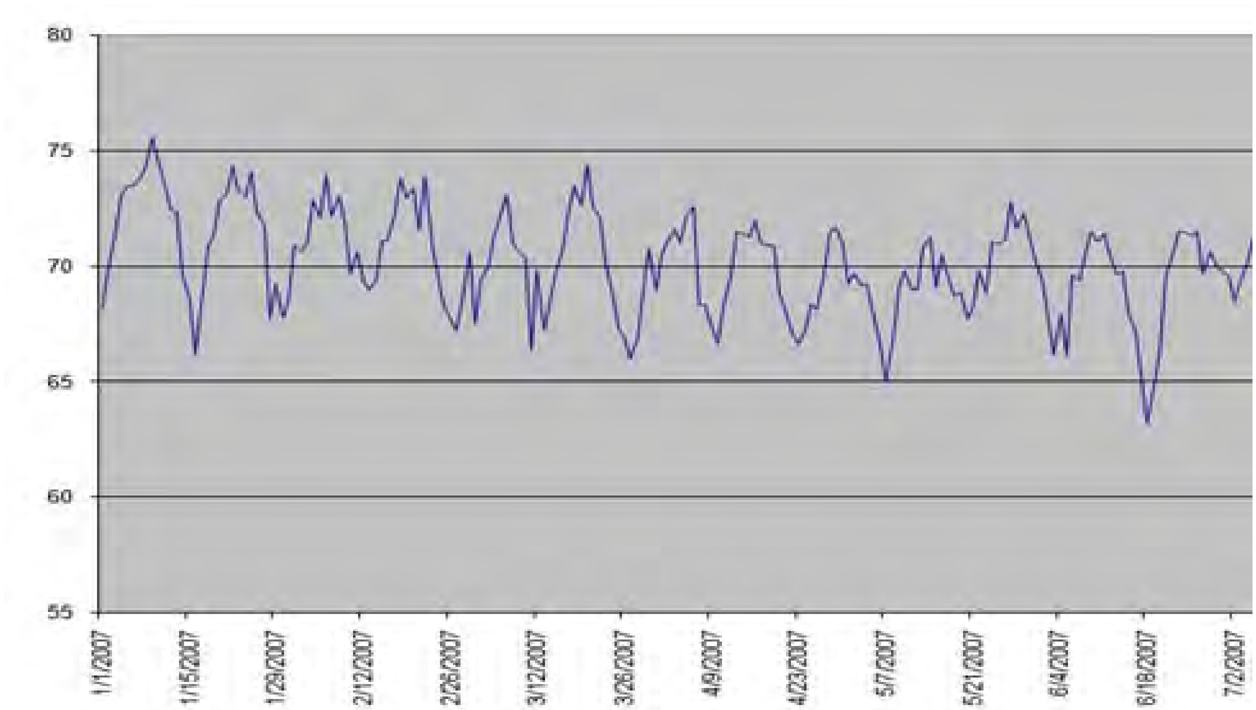
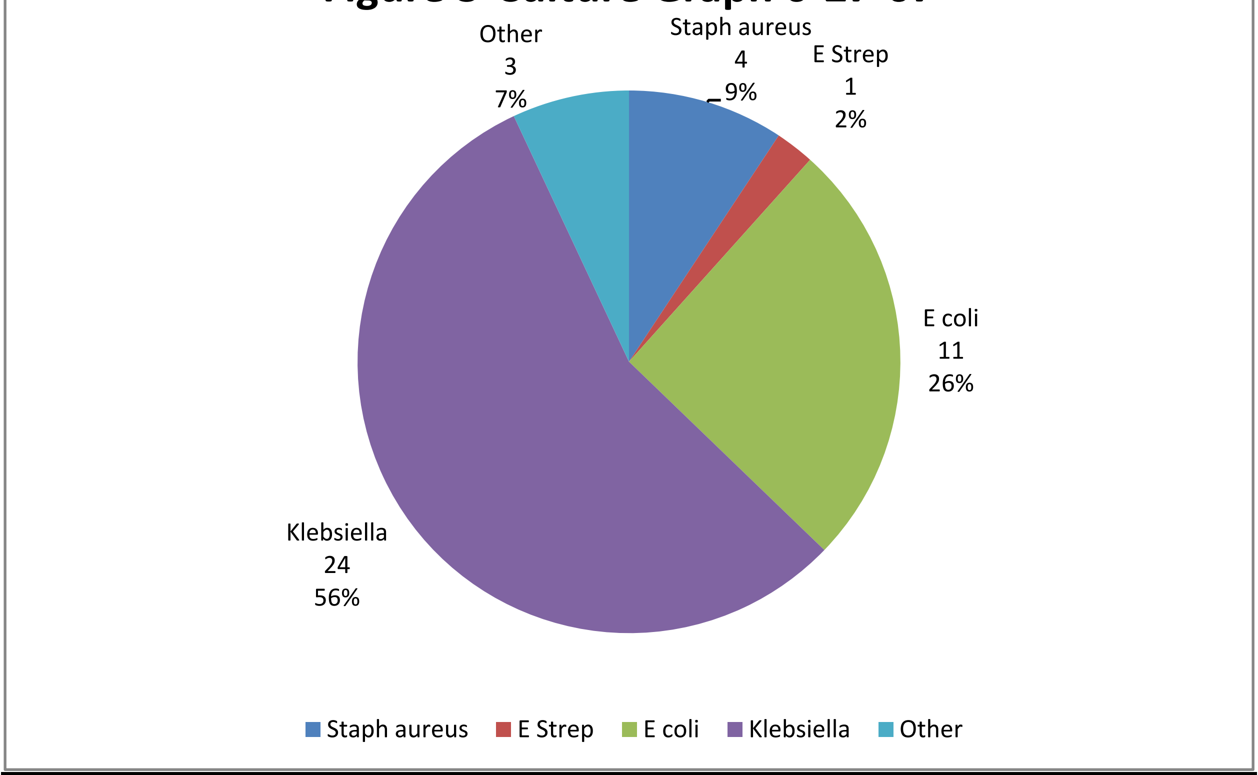


Figure 3-Culture Graph 6-27-07



Upon entering the parlor, you note that it is a double 28 Delaval system with automatic detachers and milk meters. The parlor has a basement where all of the pulsators and milk meters are located. The vacuum pump is being regulated with a variable frequency device. The cows appear to be relatively clean and you note that they must be bedded on wood shavings due to the presence of shavings on the udders.

While looking over the parlor, the local veterinarian arrives. In questioning him, it is obvious that the previous manager did not have much use for vets with the exception of providing pharmaceuticals. The previous manager did all of the herd health including treatment protocols, preg checking and repro programs, and on-farm culturing with no input from outside veterinary services. There are no records of what the culture results were. Since the previous manager left, the local vet has now taken over all of those roles but admittedly is not yet up to speed and would appreciate any help that you could provide. His major concern is the number of acute mastitis cases that are dying. From the first set of cultures that were submitted, he feels that all the cows that are dying are *Klebsiella sp.* He also is concerned that most of these acute mastitis cases are not responding well to treatment if they do not die. He states that the entire herd was recently boostered with J5 vaccine and that they currently were on a 3 dose/lactation program around the dry and early post-partum period.

There are three milkers in the parlor at all times with one man who is responsible for moving cows to and from the holding pen. As they begin milking, you note they are doing a complete milking routine and appear to be doing a very good job of udder prep. They are prepping four cows at a time with a prep lag time of ~45 seconds. Upon unit attachment, several cows have a bimodal milk letdown. As units are detached, you notice that the milkers appear to be re-attaching units to several cows. When you inquire as to why they are doing this, the show you several teats that have an edematous ring near the base of the teat similar to Figure 4 below. When this occurs, cows do not seem to milk out correctly. Strip yields on several cows like these confirm their observations. Cows that do not develop these types of teat problems appear to be completely milked out based on strip yields. Overall, teat end condition is very good with approximately 5-10% of cows appearing to have rough teat ends.

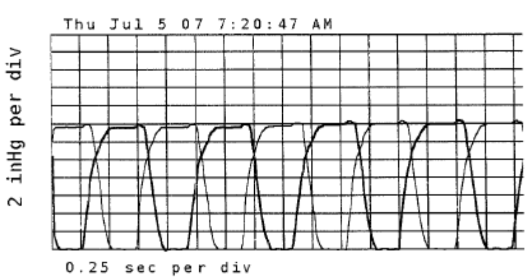
As milking continues, testing of the milking equipment begins. The system vacuum is measured and found to be 14.2” Hg. Receiver vacuum is 13.8” Hg. The dairyman has been told by the field man for the milk co-op that the vacuum is too high but he hasn’t had a chance to turn it down yet. The field man did not do any system testing and is basing his recommendation on the system vacuum reading on the farm gauge.

Figure 4-Example of teat problems.

Dynamic testing during milking determines that average claw vacuum during peak flow on 12 high producing cows is 12.2” Hg. There is less than 2” Hg of vacuum fluctuation in all the claws during claw vacuum measurements. As time allows throughout the rest of the visit, you evaluate pulsator function on all of the pulsators and find 4 that are not functioning correctly (Figure5 below). The only other equipment related problem that you note is that all of the long milk tubes are too long resulting in milk having to be raised inside the hose to enter the milk inlet leading to the meters in the basement (see Figure 6 below).

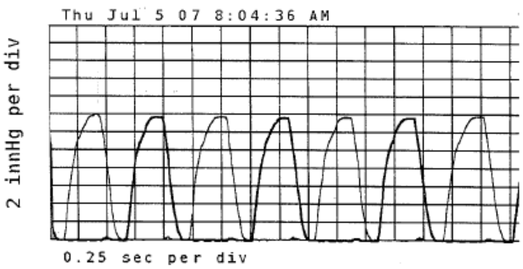
Figure 5 – Examples of pulsator graphs from herd visit.

Normal graph



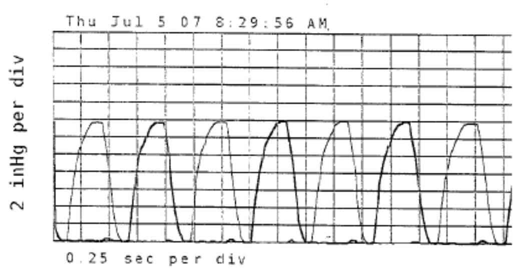
Pulsation 1 (PLOT)			Pulsation 2 (PLOT)		
Rate:		60.25 PPM	Rate:		60.37 PPM
Ratio:		60:40	Ratio:		59:41
A Phase:	23%	228mS	A Phase:	20%	198mS
B Phase:	37%	365mS	B Phase:	39%	390mS
C Phase:	14%	135mS	C Phase:	13%	131mS
D Phase:	26%	268mS	D Phase:	28%	275mS
A+B Phase:	60%	593mS	A+B Phase:	59%	588mS
C+D Phase:	40%	403mS	C+D Phase:	41%	406mS
Vacuum:		14.4inHg	Vacuum:		14.3inHg
			Limp:		1%

Abnormal graphs



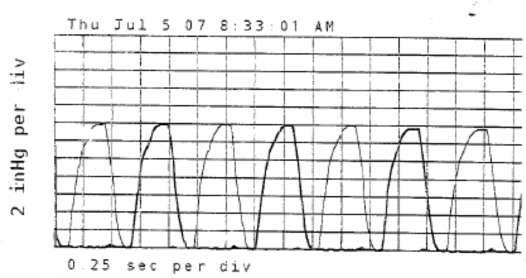
Pulsation 1 (PLOT)			Pulsation 2 (PLOT)		
Rate:	50.30 PPM		Rate:	50.21 PPM	
Ratio:	29:71		Ratio:	30:70	
A Phase:	15%	178mS	A Phase:	16%	190mS
B Phase:	14%	172mS	B Phase:	14%	165mS
C Phase:	10%	125mS	C Phase:	11%	127mS
D Phase:	61%	718mS	D Phase:	59%	714mS
A+B Phase:	29%	350mS	A+B Phase:	30%	355mS
C+D Phase:	71%	843mS	C+D Phase:	70%	841mS
Vacuum:	13.7inHg		Vacuum:	13.9inHg	
			Limp:	1%	

11



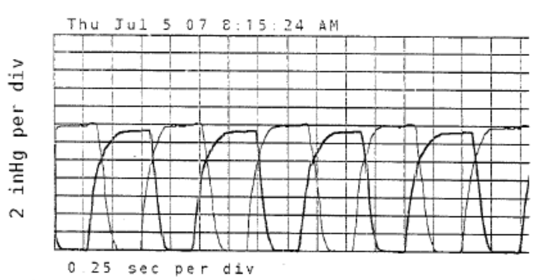
Pulsation 1 (PLOT)			Pulsation 2 (PLOT)		
Rate:	50.26 PPM		Rate:	50.21 PPM	
Ratio:	29:71		Ratio:	30:70	
A Phase:	16%	189mS	A Phase:	15%	183mS
B Phase:	13%	163mS	B Phase:	15%	173mS
C Phase:	11%	133mS	C Phase:	11%	127mS
D Phase:	60%	709mS	D Phase:	59%	711mS
A+B Phase:	29%	352mS	A+B Phase:	30%	356mS
C+D Phase:	71%	842mS	C+D Phase:	70%	838mS
Vacuum:	13.9inHg		Vacuum:	13.9inHg	
			Limp:	1%	

21



Pulsation 1 (PLOT)			Pulsation 2 (PLOT)		
Rate:	50.26 PPM		Rate:	50.26 PPM	
Ratio:	30:70		Ratio:	30:70	
A Phase:	15%	184mS	A Phase:	15%	182mS
B Phase:	15%	170mS	B Phase:	15%	171mS
C Phase:	11%	126mS	C Phase:	11%	126mS
D Phase:	59%	714mS	D Phase:	59%	715mS
A+B Phase:	30%	354mS	A+B Phase:	30%	353mS
C+D Phase:	70%	840mS	C+D Phase:	70%	841mS
Vacuum:	14.0inHg		Vacuum:	13.9inHg	
			Limp:	0%	

25

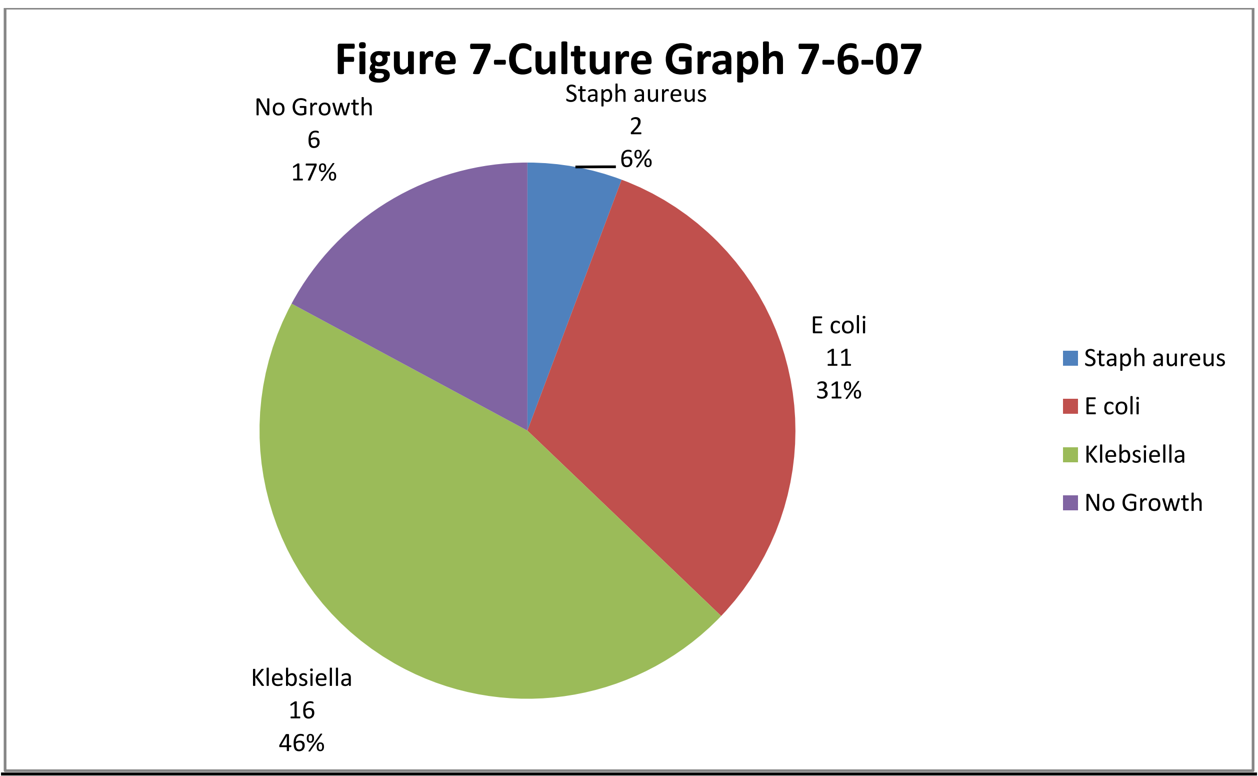


Pulsation 1 (PLOT)			Pulsation 2 (PLOT)		
Rate:	60.37 PPM		Rate:	60.37 PPM	
Ratio:	60:40		Ratio:	60:40	
A Phase:	22%	223mS	A Phase:	19%	189mS
B Phase:	38%	370mS	B Phase:	41%	403mS
C Phase:	12%	116mS	C Phase:	14%	135mS
D Phase:	28%	285mS	D Phase:	26%	267mS
A+B Phase:	60%	593mS	A+B Phase:	60%	592mS
C+D Phase:	40%	401mS	C+D Phase:	40%	402mS
Vacuum:	13.4inHg		Vacuum:	14.2inHg	
			Limp:	0%	

51

Figure 6-Depiction of milk hose length (Note: this is not the actual parlor evaluated in this case report).

When you complete the evaluation, you discuss your findings with management and the local veterinarian. They send several more milk samples along with you for culture (see Figure 5).



1. Based on the parlor evaluation and your conversations with the management, the milkers, and the local veterinarian, what are your recommendations before you leave the farm?

2. What other information would you like to have to help evaluate the situation?

Section 2: Summary of Selected Records Evaluation.

Summary of cow numbers by repro code and lactation group.

By RPRO	%COW	#COW	LGRP=1	LGRP=2	LGRP=3
NO BRED	2	32	15	5	12
FRESH	17	279	116	60	103
OK/OPEN	4	64	16	17	31
BRED	18	292	122	72	98
PREG	44	705	235	187	283
DRY	14	232	74	69	89
=========	====	======	=======	=======	=======
Total	100	1604	578	410	616

Pen inventory summary for milking pens. Pens 60 & 61 are hospital pens including fresh cows until their milk is tested free of antibiotics. See Appendix A for dairy layout.

By PEN	%COW	#COW	Av DIM	Mn DIM	Mx DIM	Av LACT
1	4	56	65	3	486	2.8
2	10	139	185	95	613	2.8
3	12	166	34	12	117	2.2
4	11	150	153	59	529	2.1
5	12	166	154	71	559	2.2
6	10	137	394	115	900	2.5
7	12	168	219	143	769	2.4
8	12	164	264	168	839	2.6
9	12	169	355	232	1041	2.3
60	4	52	115	1	491	2.5
61	0	2	178	15	341	3.0
=========	====	======	=======	=======	=======	=======
Total	100	1369	207	1	1041	2.4

Dry cow pen inventory including springing heifers.

By PEN	%COW	#COW	Av DCC
98	60	164	243
99	40	110	273
=========	====	======	=======
Total	100	274	255

Events summary for determination of cull and death loss rate and other disease incidence.

EVENTS\50 for 07/05/06 - 07/05/07

Event	Total	Jul06	Aug06	Sep06	Oct06	Nov06	Dec06	Jan07	Feb07	Mar07	Apr07	May07	Jun07	Jul07
FRESH	1736	174	141	153	149	149	178	187	117	96	127	94	148	23

SOLD	416	27	48	30	31	38	28	33	27	34	28	27	38	27
DIED	257	23	20	21	21	30	22	20	17	24	14	12	27	6

Cull Rate=42%

Death Loss Rate=16%

DA	16	2	2	1	0	3	0	4	4	0	0	0	0	0
DIARHEA	5	2	0	0	3	0	0	0	0	0	0	0	0	0
LAME	14	0	1	0	0	3	0	10	0	0	0	0	0	0
MAST	42	1	15	17	2	0	0	2	4	1	0	0	0	0
MF	2	0	0	0	0	0	0	2	0	0	0	0	0	0
RP	32	13	2	3	0	3	0	4	3	4	0	0	0	0
RETREAT	17451	1339	1455	1432	1439	1393	1377	1614	1392	1182	1558	1388	1617	265

Cows 2177 / Events 17451

47	RETREAT	117	11/13/06	LFSPEC1
47	RETREAT	118	11/14/06	LFSPEC2
47	RETREAT	119	11/15/06	LFSPEC3
47	RETREAT	120	11/16/06	LFASPEC4
47	RETREAT	121	11/17/06	LFSPEC5
47	RETREAT	122	11/18/06	LFSPEC6
47	RETREAT	122	11/18/06	LFSPEC7
47	RETREAT	124	11/20/06	LFSPEC8
47	RETREAT	125	11/21/06	LFOXY1
47	RETREAT	126	11/22/06	LFOXY2
47	RETREAT	127	11/23/06	LFOXY

Cows culled by 60 DIM.

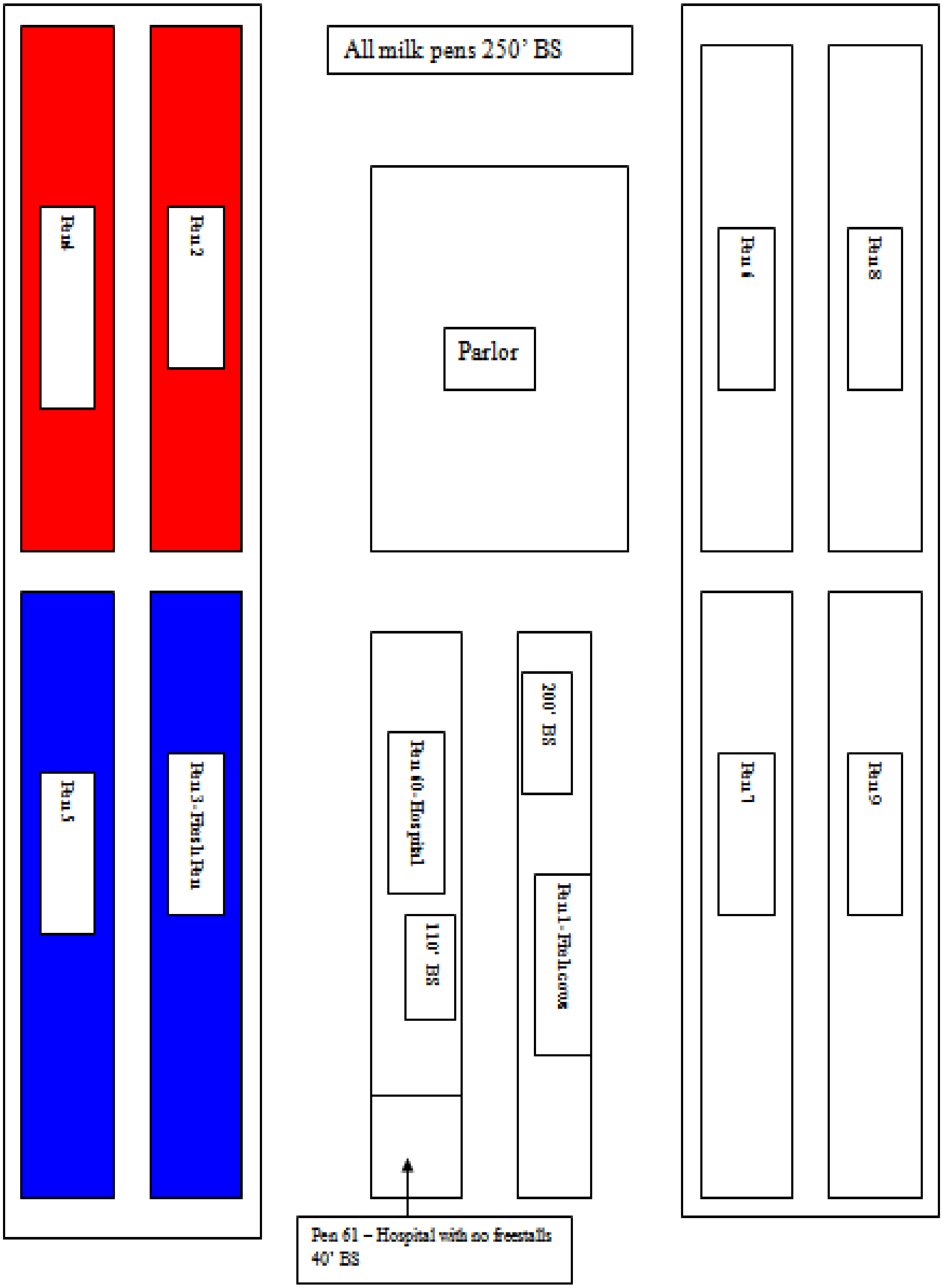
EVENTS\7I011415 ... FOR DIM<61 LACT>0 FDAT>7.31.06 for 08/01/06 - 06/30/07

Event	Total	Aug06	Sep06	Oct06	Nov06	Dec06	Jan07	Feb07	Mar07	Apr07	May07	Jun07	Jul07
FRESH	1539	141	153	149	149	178	187	117	96	127	94	148	0
SOLD	103	14	17	8	8	6	15	5	7	11	8	4	0
DIED	99	7	10	7	14	15	10	12	7	5	7	5	0
TOTALS	1741	162	180	164	171	199	212	134	110	143	109	157	0

Percent Culled by 60 DIM by Month Fresh

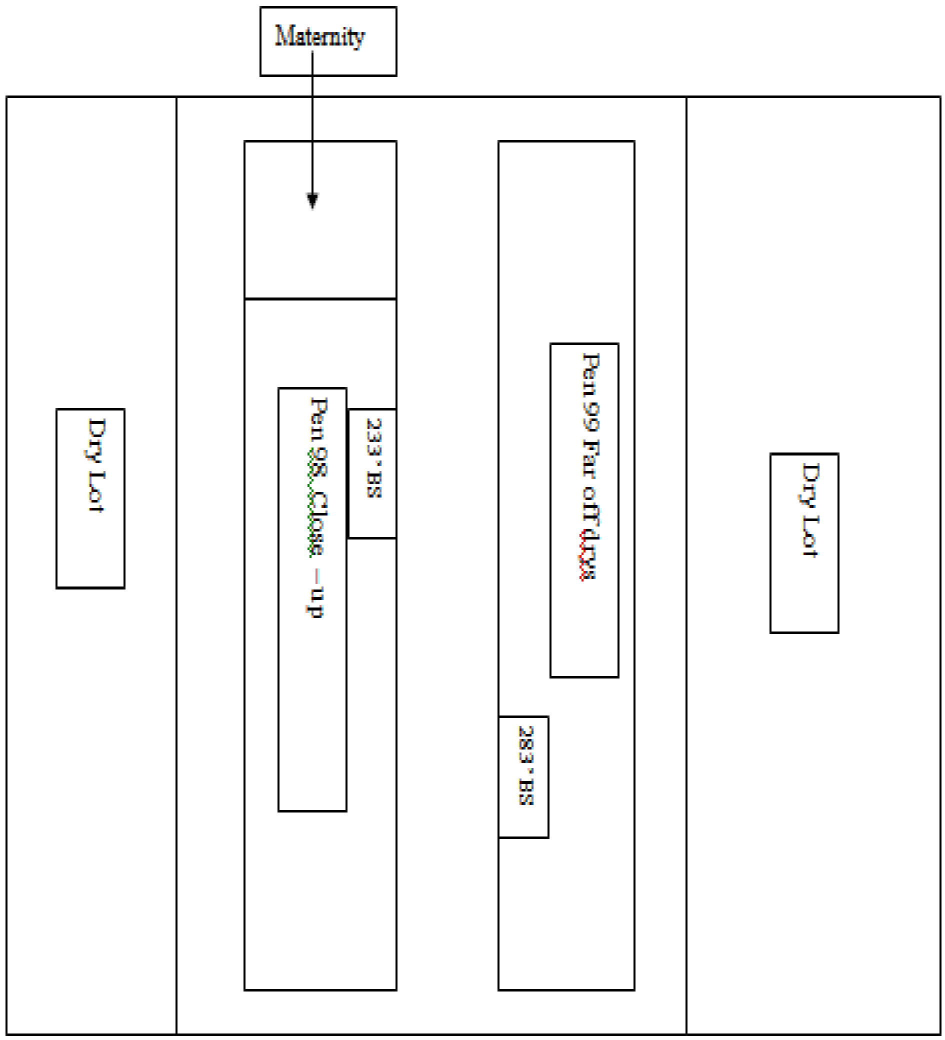
Month Fresh	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Total
	14.89%	17.65%	10.07%	14.77%	11.80%	13.37%	14.53%	14.58%	12.60%	15.96%	13.72%

Appendix A: Diagram of farm layout.



All milk pens have 170 freestalls. There are 120 in Pen 1 and 45 in pen 60 (hospital).

Dry Cow Barn



1. What is your assessment of the herd at this point?

2. What are your recommendations at your next visit to the farm the following week?

Pharmacology of Mastitis Therapy

Patrick J. Gorden, DVM
Diplomate – ABVP – Dairy Practice

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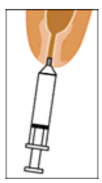
Milk Quality & Mastitis Treatments

Think Like the Military!



<u>It's More Than Shoving a Tube in the Affected Quarter!!</u>

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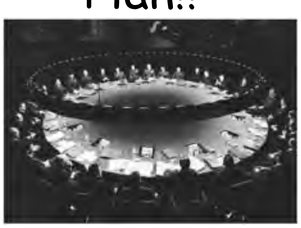
Plan!!



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Plan!!

Minimize Bad Media Coverage!

Is Treatment the Best Option for this Animal?

Government Alleges Dairy Sold Cows with Antibiotics in Meat

Des Moines Register

August 10, 2007

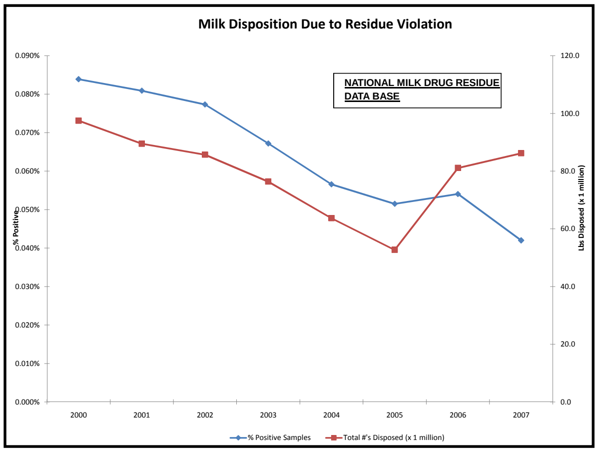
Reader Comment — Posted by: legato on Fri Aug 10, 2007 4:38 pm

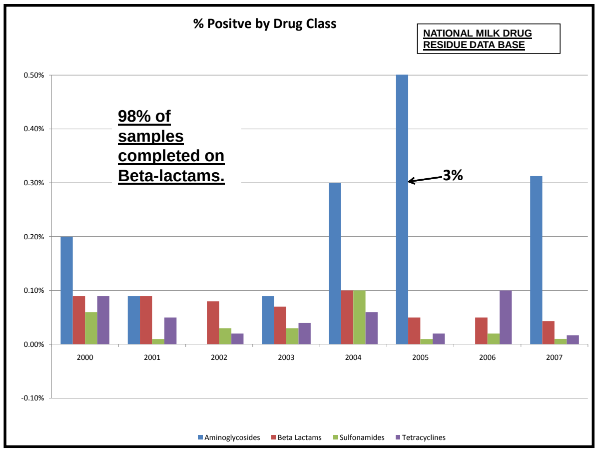
Things like this happen all the time. Even the Koreans refuse to eat our meat.

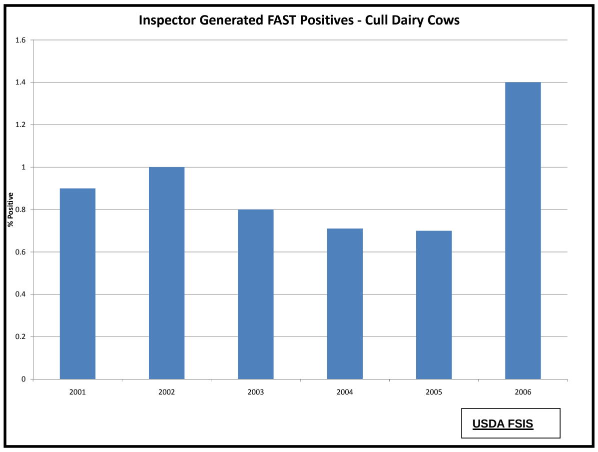
Reader Comment — Posted by: thor on Fri Aug 10, 2007 2:50 pm

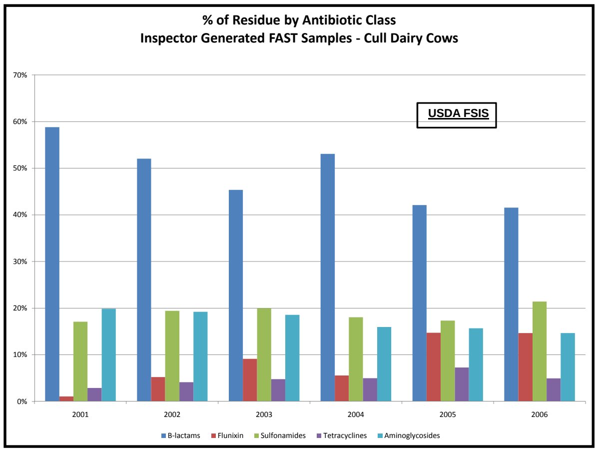
The farmer claims that this incidence happen because a breakdown in protocol. What a bold faced lie. The investigations went from 1992 to 2006!, thats 14 years of "broken protocol".

Anyways why do these cows need so many antibiotics? Could it be that they are kept in conditions so atrocious that if they weren't pumped full of antibiotics they would die? YUM that sounds like some good milk.


Milk Disposition Due to Residue Violation
NATIONAL MILK DRUG RESIDUE DATA BASE
% Positive
Lbs Disposed (x 1 million)
0.090%
0.080%
0.070%
0.060%
0.050%
0.040%
0.030%
0.020%
0.010%
0.000%
120.0
100.0
80.0
60.0
40.0
20.0
0.0
2000
2001
2002
2003
2004
2005
2006
2007
% Positive Samples
Total #'s Disposed (x 1 million)


% Positve by Drug Class
NATIONAL MILK DRUG RESIDUE DATA BASE
98% of samples completed on Beta-lactams.
3%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
-0.10%
2000
2001
2002
2003
2004
2005
2006
2007
Aminoglycosides
Beta Lactams
Sulfonamides
Tetracyclines


Inspector Generated FAST Positives - Cull Dairy Cows
% Positive
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2001
2002
2003
2004
2005
2006
USDA FSIS



Mastitis Treatments

Rules!!

The Military Has Rules & Discipline?

AMDUCA

- Animal Medicinal Drug Use Clarification Act.
- Legalized extra-label use of approved drugs by licensed veterinarians.
- 1996

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Mastitis Treatments

Know

Your

Enemy!!!

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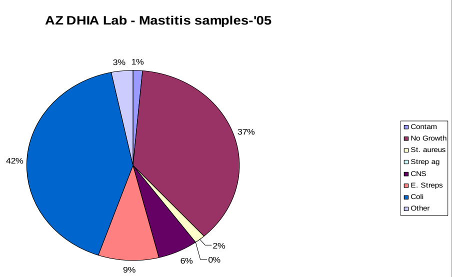

Status	Sensitivity	Specificity	PPV	NPV
No Growth	93%	59%	93%	61%
Staph aureus	71%	100%	80%	100%
CNS	61%	98%	69%	97%
E coli	45%	99%	59%	98%
Strep uberis	32%	98%	29%	98%

•***Mycoplamsa spp - ?***

Dingwell, et al, 2007

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Mastitis Treatments

Strategically Place Your Troops in the Area for the Greatest Chance of Success

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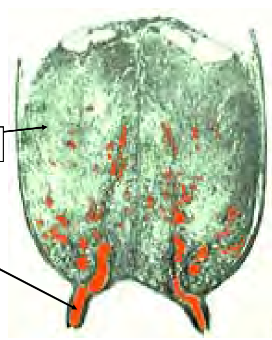
3 Compartment Model



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3 Compartment Model

3. The Cow

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3 Compartment Model

Summary of three-compartment model to target mastitis pathogens

	Pharmacologic compartment		
Mastitis pathogens	Milk and ducts	Parenchyma	Cow
Streptococcus agalactiae	+++	—	—
Streptococcal sp	+++	+	—
Staphylococcus aureus	+	+++	—
Staphylococcal sp	+++	—	—
Coliforms[a]	+	—	+++
Mycoplasma, other gram-negatives[a]	—	—	+++

[a] Severe clinical mastitis, supportive care, and prevention of secondary bacteremia are primary concerns.
+++, primary target; +, some benefit; —, of little value.

Erskine, et al, VCNA-FA, 2003

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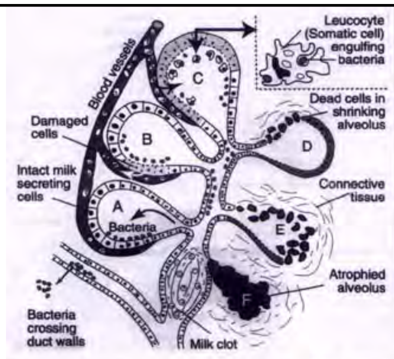

Principal changes in Mammary Tissue affected by Mastitis

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3 Compartment Model

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Mastitis pathogens	Milk and ducts	Parenchyma	Cow
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Streptococcal sp	+++	+	—
Staphylococcus aureus	+	+++	—
Staphylococcal sp	+++	—	—
Coliforms[a]	+	—	+++
Mycoplasma, other gram-negatives[a]			+++

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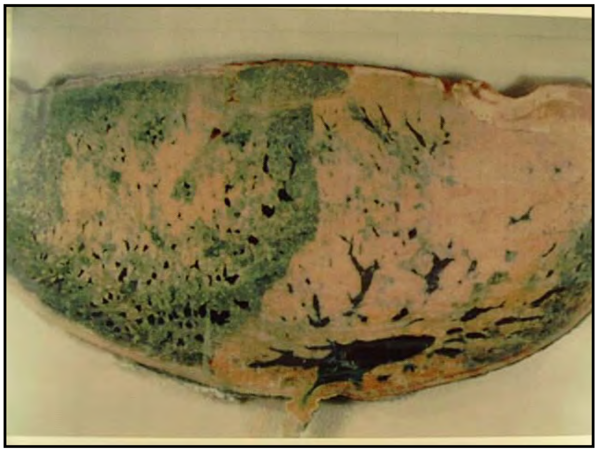

3 Compartment Model

Summary of three-compartment model to target mastitis pathogens

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Streptococcus agalactiae	+++	—	—
Streptococcal sp	+++	+	—
Staphylococcus aureus	+	+++	—
Staphylococcal sp	+++	—	—
Coliforms[a]	+	—	+++
Mycoplasma, other gram-negatives[a]	—	—	+++

[a] Severe clinical mastitis, supportive care, and prevention of secondary bacteremia are primary concerns.

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Erskine, et al, VCNA-FA, 2003

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Immune Function

- Functional Immune System Required.
  - Antibiotics by themselves cannot control infections.
- Ketosis slows the response of PMN's.
- Calcium homeostasis important not only for muscle function but also on immune function.
- Peri-parturient cows normally undergo profound immune suppression.
  - Mastectomized cows.

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Mastitis Treatments

Which Troops Do You Send?

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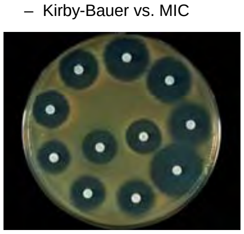
Determining Which Antibiotic to Select

- Antimicrobial Sensitivities
  - Kirby-Bauer vs. MIC



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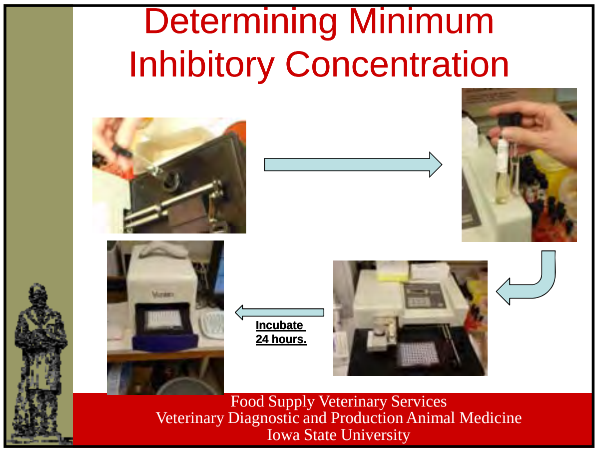
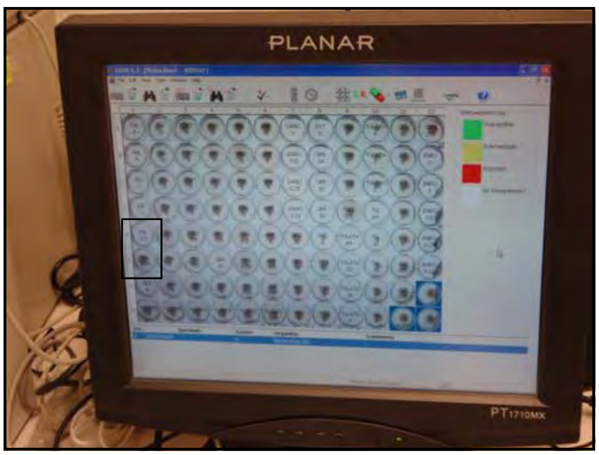
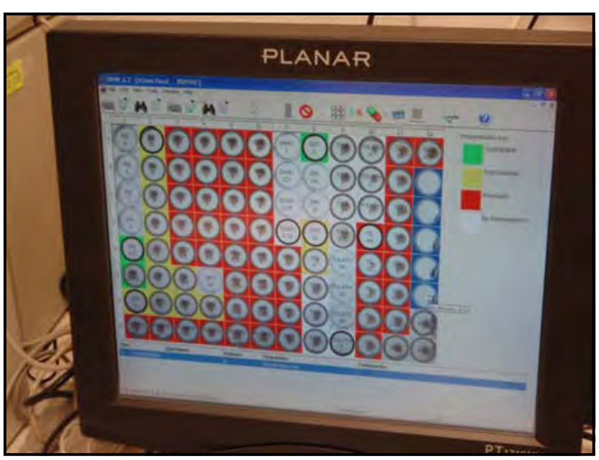

Determining Minimum Inhibitory Concentration
Incubate 24 hours.
Food Supply Veterinary Services
Veterinary Diagnostic and Production Animal Medicine
Iowa State University


PLANAR
PT1710MX


PLANAR

Therapy: Ceftiofur CLSI Interpretive Criteria for Mastitis Pathogens*

Zone Diameter (mm) Disk Content 30 µg	MIC (µg/mL)	Interpretation
≥21	≤2.0	**Susceptible**–pathogen is likely to be inhibited by achievable blood levels of drug
18 - 20	4.0	**Intermediate**–pathogen may be treated successfully if in a body site where drug concentrates; isolate should probably be retested
≤17	≥8.0	**Resistant**–achievable drug concentrations are unlikely to inhibit the pathogen; alternative therapy should be selected

*These interpretive standards apply only to label pathogens.

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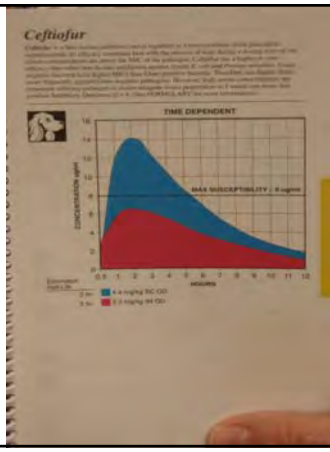

Activity in the Udder

- Time Dependent Killers – Success is dependent on time above the MIC.
  - Most products.
- Peak Dependent Killer – Success is dependent on the peak concentration achieved in the target tissue.
  - Aminoglycosides & fluroquinolones.

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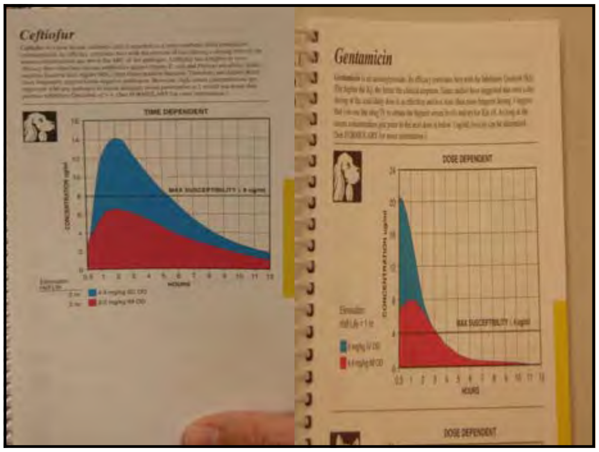

Determining Which Antibiotic to Select

- Break Points
  - Human vs. Bovine
  - Mastitis vs other disease.
- In vitro vs. In vivo
  - Pharmacokinetics.
  - Microabscesses
  - β - lactamases

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Interpretive Criteria: Data Requirements

- ***Epidemiological*** - The breakpoint should fit within the limits of clusters of susceptible bacterial populations
- ***Pharmacological*** - The upper MIC limit for establishing susceptibility should be lower than physiologically achieved levels; when appropriate.
- ***Clinical*** - The population defined as susceptible should be documented as responding clinically and reasonably correlated to *in vivo* results.

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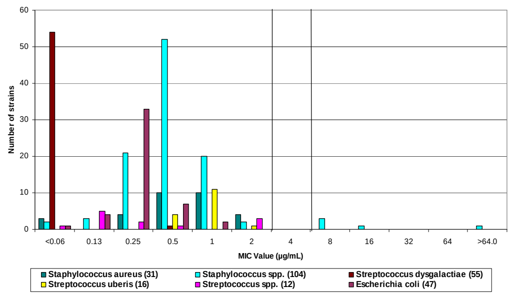
Interpretative Criteria: Distribution of Ceftiofur MIC Values Against Bovine Mastitis Label Pathogens



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Therapy: Pirlimycin MIC Values

Summary of Minimal Inhibitory Concentrations (µg/mL) for Ampicillin, Pirlimycin, and Cephalothin Against Bovine Mastitis Pathogens Isolated in the United States in 2001-2005

Pathogen	Year	No. Tested	Ampicillin MIC_{90}	Pirlimycin MIC_{90}	Cephalothin MIC_{90}
Streptococcus dysgalactiae	2001	32	≤0.06	≤0.06	0.12
	2002	139	≤0.06	2.0	0.12
	2003	122	≤0.06	1.0	0.12
	2004	125	≤0.06	4.0	0.12
	2005	125	≤0.06	4.0	0.12
Staphylococcus aureus	2001	68	0.5	0.25	0.25
	2002	190	1.0	0.25	0.5
	2003	187	1.0	0.25	0.25
	2004	132	1.0	0.5	0.25
	2005	168	0.5	1.0	0.25
Streptococcus uberis	2001	17	0.12	8.0	0.5
	2002	129	0.25	32.0	1.0
	2003	111	0.25	8.0	1.0
	2004	104	0.5	8.0	1.0
	2005	106	0.25	8.0	1.0
Streptococcus agalactiae	2001	20	≤0.06	0.12	0.12
	2002	51	0.12	0.12	0.25
	2003	48	0.12	0.12	0.25
	2004	32	0.12	>64.0	0.25
	2005	54	0.12	>64.0	0.25

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Therapy: Ceftiofur MIC Values

Summary of Minimal Inhibitory Concentrations (µg/mL) for Ampicillin, Cephalothin, Penicillin/Novobiocin, and Ceftiofur Against Bovine Mastitis Pathogens Isolated in the United States in 2001-2005

Pathogen	Year	No. Tested	Ampicillin MIC_{90}	Pen/Novo MIC_{90}	Cephalothin MIC_{90}	Ceftiofur MIC_{90}
Staphylococcus species	2001	88	1.0	≤0.06/0.12	0.25	1.0
	2002	162	1.0	0.12/0.25	0.5	1.0
	2003	132	2.0	0.12/0.25	0.25	1.0
	2004	119	1.0	≤0.06/0.12	0.25	1.0
	2005	136	1.0	0.12/0.25	0.5	1.0
Streptococcus dysgalactiae	2001	32	≤0.06	≤0.06/0.12	0.12	≤0.06
	2002	139	≤0.06	≤0.06/0.12	0.12	≤0.06
	2003	122	≤0.06	≤0.06/0.12	0.12	≤0.06
	2004	125	≤0.06	≤0.06/0.12	0.12	≤0.06
	2005	125	≤0.06	≤0.06/0.12	0.12	≤0.06
Escherichia coli	2001	63	>64.0	32.0/64.0	16.0	0.5
	2002	184	>64.0	32.0/64.0	16.0	0.5
	2003	162	>64.0	32.0/64.0	32.0	0.5
	2004	147	8.0	32.0/64.0	16.0	0.5
	2005	163	8.0	32.0/64.0	16.0	0.5

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Ampicillin Dosing for *E. coli* *(8 micrograms/ml)* *in the 3rd compartment.*

- 32 mg/kg q 6 hours x 500 kg (1100#) cow.
- 16 g q 6 hrs.
- Polyflex – 25 g/bottle
- Normal dose – 5.5 gram q 24 hrs.
- β – lactams generally only concentrate in milk at approximately 25% of that of serum.

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Selecting The Antibiotic

- Depends on the route of administration:
- Intra-mammary – Best place of β – lactams.
- Elimination related to milking frequency.
- 2x vs. 3x (or more)/day.
- Pirsue and Spectramast LC – OK for 3x, more than 3x – Need to dose 2x/day.
- Sprectramast LC only drug with Gram neg activitiy.

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Selecting The Antibiotic

- Poor penetration of micro-abscesses *(Staph aureus).* Combination therapy of IMM and systemic administration is the most appropriate in these cases.
- Re-absorption into the blood reduces duration of activity.

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Activity in the Udder
Gentocin

- Gentocin – Significant absorption in cases of mastitis (Very little in normal milk).
- Erskine et al, JAVMA 1992
- Gentocin – 500 mg IMM q 12 hours
- Did not (vs. untreated controls):
  - lower peak bacterial concentration
  - duration of infection
  - decrease SCC
  - lower rectal temperature

Activity in the Udder
Gentocin

- Readily diffused into blood.
- Urine levels detectable for 14 days after last infusion.
- Renal tissue positive for 6 months.
- 30 – 45 day half life.
- Recommended slaughter withdrawal of 30 months!!

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Selecting The Antibiotic
Systemic Therapy

- Drugs that are weakly basic (more highly un-ionized), are not highly bound and are lipid soluble are best used for systemic administration.
- Macrolides, trimethoprim, tetracyclines and fluoroquinolones.
- Sulfonamides, penicillins, aminoglycosides, ceftiofur and early cephalosporins are poorly absorbed from the blood.

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Selecting The Antibiotic

- Combination IMM & systemic therapy.
  - Owens et al – Amoxicillin vs Amoxicillin & Penicillin IM (9,000,000 IU/day).
  - Quarter: 25% vs. 51.4%.
  - Cow: 30.4% vs. 48%.
  - Newbould 305 Strain.

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Mastitis Treatments

Picking Your Battles

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Mild Mastitis

- 30+% of the cases = No Growth.
- 30+% of cases = Coliform
  - Coliform does not always result in severe mastitis.
- Extended therapy vs. gram+.
- Non-treatments?
- Role of relapsing cases.

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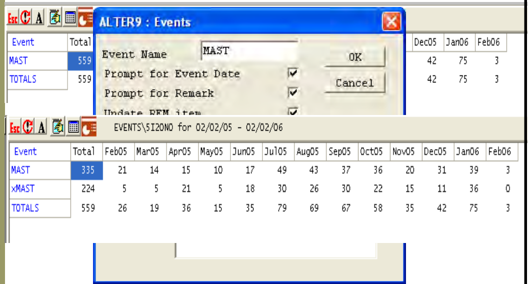
Relapsing Mastitis Cases



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Severe Clinical Mastitis

Summary of three-compartment model to target mastitis pathogens

	Pharmacologic compartment		
Mastitis pathogens	Milk and ducts	Parenchyma	Cow
Streptococcus agalactiae	+++	—	—
Streptococcal sp	+++	+	—
Staphylococcus aureus	+	+++	—
Staphylococcal sp	+++	—	—
Coliforms[a]	+	—	+++
Mycoplasma, other gram-negatives[a]	—	—	+++

[a] Severe clinical mastitis, supportive care, and prevention of secondary bacteremia are primary concerns.
+++, primary target; +, some benefit; —, of little value.

- 30+% of moderate & severe clinical mastitis cows result in bacteremia.
- Not all severe clinical mastitis cases are the result of coliforms!

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Sub-clinical Mastitis

- Theory – Reduce incidence of chronic sub-clinical infections should result in improved SCC & milk production.
- Strep ag. – Blitz therapy.
- Not as cost productive for other organisms in terms of milk production but may be in terms of reducing the potential of causing new infections.
- Best achieved with dry cow therapy.

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Sub-clinical Mastitis

- Extended therapies for sub-clinical mastitis?
- *Staph aureus* infections in heifers and cows with short term infections?
  - 8 day IMM therapy – Pirsue or Spectramast LC.

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Dry Cow Therapy

- Effective in clearing infections during the first 10-14 days.
  - Most products have little or no gram negative activity.
- Sub-clinical & chronic infections.
- Combination of systemic & intra-mammary therapy with antibiotics that concentrate in the udder.
- Milk & Slaughter withdrawals.

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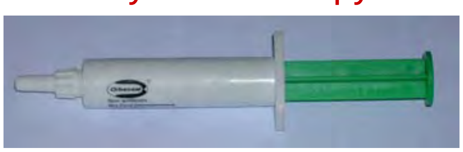
Dry Cow Therapy



- Every quarter on every cow!

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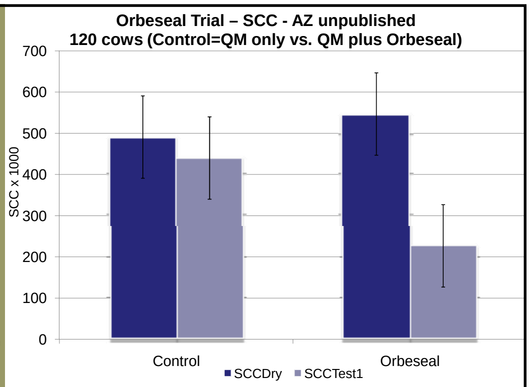

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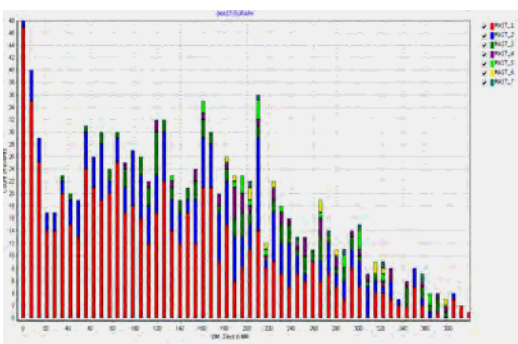

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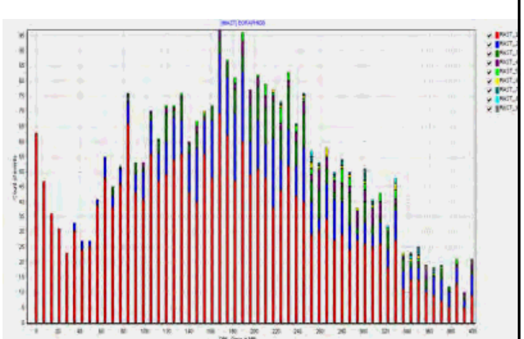

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Pre-Partum Treatment of Heifers

- Infection rates in pre-partum heifers reported to be from 15-50+ % of heifers.
- High level of spontaneous cures.
- Lact 1 animals typically have the highest average SCC count at 1st test.

Pre-Partum Treatment of Heifers

- Early work (Tennessee) proved that infusion of quarters 7-14 days prior to calving resulted in fewer IMI's at calving and 1000 lbs more milk/treated cow over the subsequent lactation (~$200) with a average LS 0.6 less than untreated controls.
- Subsequent trials have largely failed to confirm this.
- Herd by herd basis.
- Antibiotic residues!
- Safety
- Opening teat end - +/- Orbeseal

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Evaluation & Economics of Mastitis Therapy

1. How many mastitis relapses do you have?

EVENTS\5I20NO for 02/02/05 - 02/02/06

Event	Total	Feb05	Mar05	Apr05	May05	Jun05	Jul05	Aug05	Sep05	Oct05	Nov05	Dec05	Jan06	Feb06
MAST	335	21	14	15	10	17	49	43	37	36	20	31	39	3
xMAST	224	5	5	21	5	18	30	26	30	22	15	11	36	0
TOTALS	559	26	19	36	15	35	79	69	67	58	35	42	75	3

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Evaluation & Economics of Mastitis Therapy

2. Do you have established protocols, are they being followed, and how effective are your current mastitis protocols?
   - DC305 & PCDart both have protocols available.
   - It is impossible to investigate why mastitis therapy doesn't work if cows are not treated uniformly based on physical exams.

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Evaluation & Economics of Mastitis Therapy

3. How much milk do you dump every month due to mastitis?

4. What does a 1% increase/month in mastitis incidence cost a dairy?

5. What are the economics of a strategic treatment plan based on culturing?

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