HACCP-based Programs for Use on the Dairy Farm

Bhushan Jayarao

Extension Veterinarian

Dept. of Veterinary Science

The Pennsylvania State University

University Park

What's HACCP ?

- Hazard Analysis
  - A threat to food safety categorized from 3 areas: biological, chemical or physical

- Critical Control Points
  - CCP- (Critical Control Point) a point, step or procedure where a control can be used and a food hazard can be prevented, eliminated or reduced to acceptable levels.

HACCP

- To protect the food supply and assure food safety, the FDA has adopted HACCP as the food safety system
- First developed nearly 30 years ago for astronauts
- Systematic approach to be used in food production as a means to assure food safety
- Endorsed by many national and international scientific groups, corporations, government, agencies and academic organizations

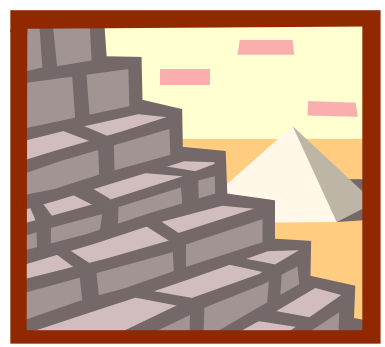
HACCP

- HACCP focuses on preventing hazards in the food industry, not on catching them when it's too late

- *Think of it as a pro-active solution instead of after-the-fact-fix*

HACCP Plan and System

- Five preliminary steps and seven principles
  - Preliminary Steps -
    - Assemble the HACCP team.
    - Describe the food and the method of its distribution.
    - Identify the intended use and consumers of the food.
    - Develop a flow diagram which describes the process.
    - Verify the flow diagram.



HACCP: Principles

- Principles
  - **Principle No. 1.** Conduct a hazard analysis. Prepare a list of steps in the process where significant hazards occur and describe the preventive measures.
  - **Principle No. 2.** Identify the critical control points (CCPs) in the process.
  - **Principle No. 3.** Establish critical limits for preventive measures associated with each identified CCP.

HACCP: Principles

- **Principle No. 4.** Establish CCP monitoring requirements.
- **Principle No. 5**. Establish corrective action to be taken when monitoring indicates that there is a deviation from an established critical limit.
- **Principle No. 6.** Establish effective record-keeping procedures that document the HACCP system.
- **Principle No. 7.** Establish procedures for verification that the HACCP system is working correctly.

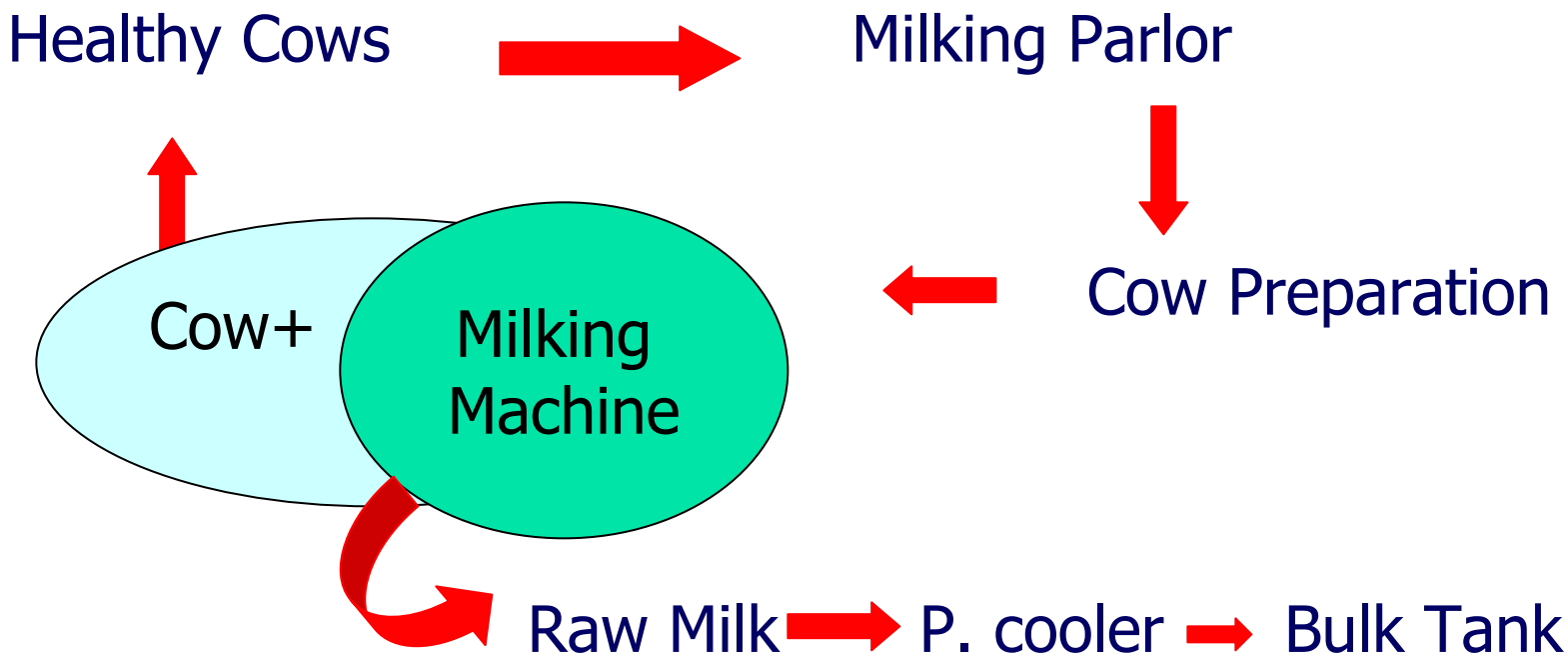
HACCP: steps 1-3

- Assemble the HACCP team.
- Describe the food and the method of its distribution.
- Identify the intended use and consumers of the food

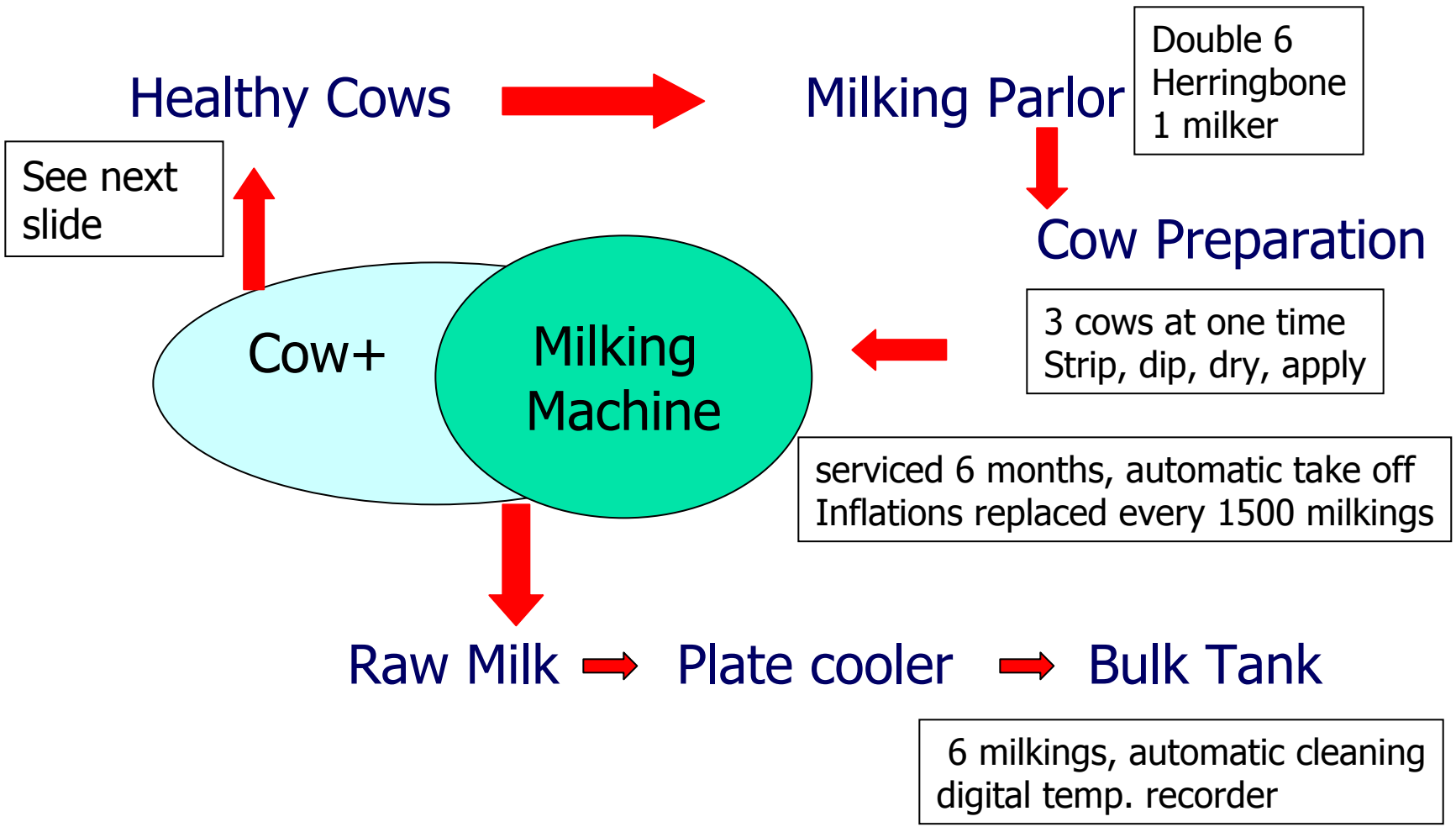
- RAW FLUID MILK
  - BTSCC ~ 250,000 CELLS/ML
  - Lac = 4.8, Pro = 3.3, Fat = 3.8
  - Temp ~ 40 F
  - SPC = ~ 5000 cfu/ml
  - Coliforms – NIL
  - PIC = < 3 x 4 SPC
- MILK COOPERATIVE
- Human consumption following pasteurization

HACCP: steps 4

- Develop a flow diagram which describes the process



HACCP: step 5


Healthy Cows
Milking Parlor
Double 6
Herringbone
1 milker
See next
slide
Cow Preparation
3 cows at one time
Strip, dip, dry, apply
Cow+
Milking
Machine
serviced 6 months, automatic take off
Inflations replaced every 1500 milkings
Raw Milk
Plate cooler
Bulk Tank
6 milkings, automatic cleaning
digital temp. recorder

HACCP: principles

- **Principle No. 1.** Conduct a hazard analysis. Prepare a list of steps in the process where significant hazards occur and describe the preventive measures.
  - Cows (mastitis,SCC, udder condition)
  - Parlor (hazardous const. Stray voltage)
  - Milker (training and supervision)
  - Cow Preparation (written protocols in practice)
  - Milking System (service and maintenance protocols)
  - Bulk Tank (bulk tank temp, and recording device)

HACCP: principles

- **Principle No. 2.** Identify the critical control points
  - **Cows**

Criteria	Ideal udder health targets
Bulk Milk Somatic Cell Count	**< 250,000 cells/ml**
Herd average (actual)	**< 200,000 SCC**
Herd average (DHI Linear Score)	**< 3.0 LS SCC**
100% of first calvers (DHI)	**< 100,000 SCC**
> 85% of herd	**< 200,000 SCC**
> 95% of herd	**< 500,000 SCC**
Incidence of Clinical Mastitis	**< 25 cows /100 cows / year**
# of culls due to udder health	**< 5 cows/ 100 cows/ year**

HACCP: principles

- **Principle No. 2.** Identify the critical control points

- **Parlor**
  - Floor - Cleaned and sanitized after every milking
  - Drop hoses - Periodically sanitized and replaced
  - Stray voltage - Checked periodically every 6 months
  - Light - 150 lux units
  - Ventilation -150 cubic feet/ min of air exchange
  - Milking pit - Cleaned, sanitized after every milking

HACCP: principles

- **Principle No. 2.** Identify the critical control points
  - **Milker**
    - **Cow handling**
    - **Detecting mastitic cows, identifying and reporting**
    - **Recognizing the importance of cows treated with antibiotics**
    - **Proper milking procedures**
      - Cow preparation
      - Milking process
    - **Milking system**
      - Daily checks on system function
      - Basic understanding on the working of milking machine

HACCP: principles

- **Principle No. 2.** Identify the critical control points
  - **Cow Preparation**
    - **Udder, teat and teat end condition**
      - Cleanliness (manure, feed, bedding)
      - Dry (Wet, chapped)
      - Teat teat end condition (warts, injury)
    - **Milking process**
      - Strip
      - Dip (prep-dip, dip cup)
      - Dry (through cleaning, including teat ends)
      - Apply (apply post-dip)
      - Other factors: Consistency and repeatability on each cow
      - Milking time on each cow

HACCP: principles

- **Principle No. 2.** Identify the critical control points

  - Milking System
    - **Checked daily**
    - **Inspected every 6 months**
    - **Serviced every year**
    - **Inflations replaced after 1500 milkings**
    - **Sanitizer and acid rinse containers inspected and periodically replaced**
    - **Gaskets and liners inspected periodically and replaced**
    - **Water temp. recorded periodically**

HACCP: principles

- **Principle No. 2.** Identify the critical control points
  - **Bulk Tank**
    - Bulk tank temperature, monitored daily
    - Temperature must reach 40 F within 2 h of milking and hold
    - Milk agitator

Estimates of percent infected quarters and losses in milk production due to elevated BTSCC

BTSCC/ml	Percent Quarters Infected	Percent Production Loss
200,000	6	0
500,000	16	6
1,000,000	32	18
1,500,000	48	29

HACCP- principles

Principle No. 3 Establish critical limits for preventive measures associated with each identified CCP

Criteria: COWS	**Critical Limit**	**Preventive Measure**
Cows treated with antibiotics	ZERO LIMIT	Label cows and milk them separately not in the parlor
Cows with chronic mastitis milked along with healthy cows	UNDEFINED Contagious mastitis pathogens in bulk tank milk ?	Cows will be identified and milked last Sanitize teat cups between milking

HACCP- principles

Criteria:Cows	**Critical Limit**	**Preventive Measure**
Dirty & Soiled Cows	UNDEFINED HIGH SPC and PIC counts	Flame udders Improve farm hygiene and sanitation
Cows high SCC	< 5 % of all cows in the herd should be ~ 500,000 cells/ml	Identify cows with high SCC, and determine their importance in the herd All fresh cows will be examined by CMT on the 6th milking All cows before drying off will be CMT 7 days before drying off

HACCP- principles

Criteria:Parlor	**Critical Limit**	**Preventive Measure**
Hygiene (Teat claws falling on the floor of the parlor)	Milk SPC > 5000 cfu/ml	Through cleaning and sanitization
Criteria:Milker	**Critical Limit**	**Preventive Measure**
Handling and Milking cows	UNDEFINED	Wear gloves

HACCP- principles

Criteria:Cow Preparation	**Critical Limit**	**Preventive Measure**
Cleaning of teat ends	SPC > 5000 cfu/ml PIC > 3 to 4 x SPC SSLO > 100 cfu/ml CNS > 1000 cfu/ml Coliforms > 100 cfu/ml	Thorough cleaning of teat & teat ends using an approved pre-dip Fore-strip cows before pre-dipping

HACCP- principles

Criteria:Milking System	**Critical Limit**	**Preventive Measure**
Function	DEFINED	Call service agent
Hygiene	DEFINED SPC > 5000 cfu/ml PIC > 3 to 4 x SPC Coliforms > 100 cfu/ml	Call sanitarian/ service agent
Criteria:Bulk Tank	**Critical Limit**	**Preventive Measure**
Temperature	SPC > 5000 cfu/ml PIC > 3 to 4 x SPC	Monitor bulk tank milk temperature

HACCP-principles

Principle No. 4. Establish CCP monitoring requirements

Criteria: bulk tank milk	**Limit**
BTSCC	< 250,000
SPC	< 10,000 cfu/ml
PIC	< 4 to 4 x SPC
LPC	< 100 cfu/ml
Coliforms	< 50 cfu/ml
Staph aureus	ZERO
Strep. ag	ZERO
Mycoplasma	ZERO
SSLO	~ 1000 CFU/ML
CNS	~ 1000 CFU/ML

HACCP-principles

- **Principle No. 5**. Establish corrective action to be taken when monitoring indicates that there is a deviation from an established critical limit.

Bulk Tank Milk Analysis:

A tool for improving milk quality and troubleshooting mastitis in a dairy herd

PENNSTATE

1855

Somatic Cells

SCC	Count
ideal	200,000
4/16	141,000
5/2	225,000
5/19	173,000
6/5	325,000

Somatic Cells

- Corrective action
  - Identify cows with high SCC
    - Early and late lactation
    - Cows with subclinical mastitis
      - CMT all suspect cows
  - CMT all fresh cows by 6th milking
  - CMT all cows 7 days before drying off
  - Make a decision to keep cows in the herd with high SCC

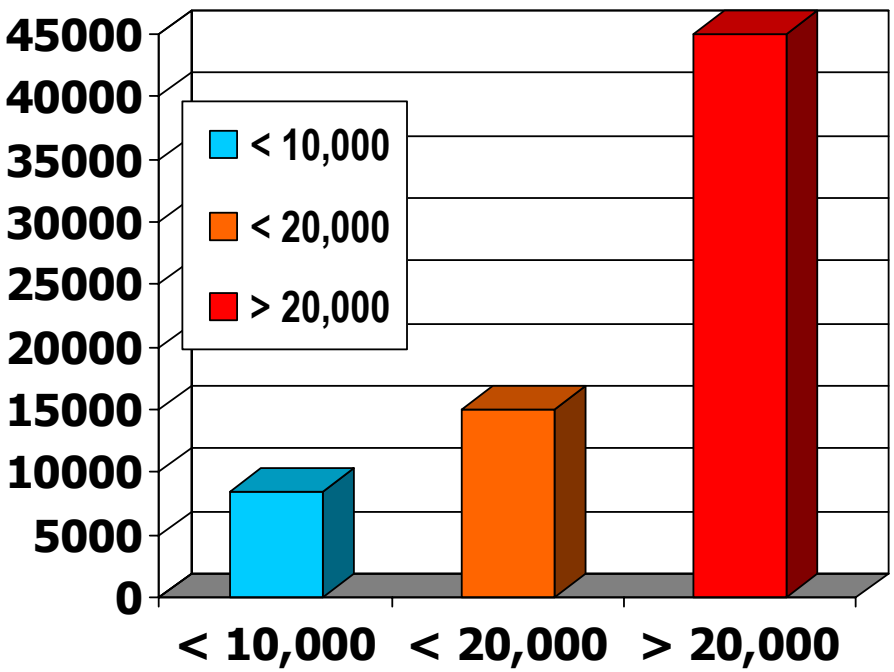
Standard Plate Count

SPC	Count
ideal	10,000
4/16	1,320
5/2	1,040
5/19	1,360
6/5	1,040

Standard Plate Count

Rating based on cfu/ml

Good	Acceptable	Concern
(low)	(medium)	(high)
< 10,000	< 20,000	> 20,000



BTM SPC of < 1000 cfu /ml is an indication that milk is from clean and healthy cows

SPC counts of less than 5000 cfu/ml can be achieved

SPC of < 10,000 can be achieved by most farms

Most probable reasons for high SPC

Improper cleaning

***Strep. agalactiae* mastitis**

Purchased animals without testing for mastitis

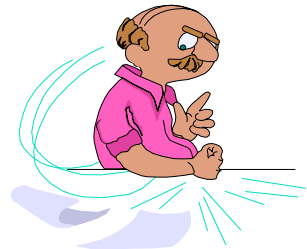
Cows with soiled udders and teats, dirty equipment new milkers ?

Inability to cool milk rapidly to less than 4.4 C (40^{o}F)

Preliminary Incubation Count

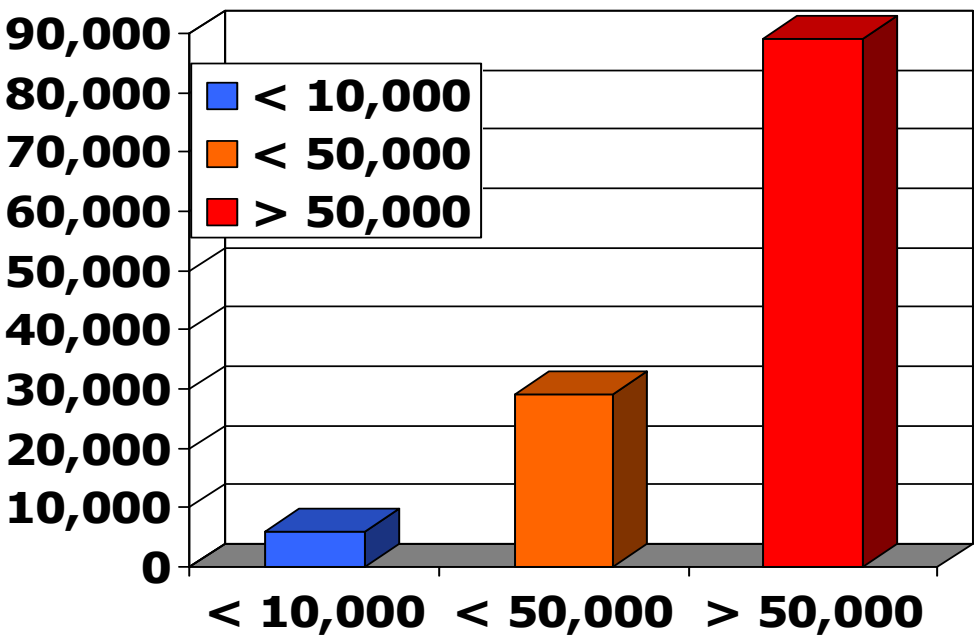
PIC	Count
ideal	10,000
4/16	1,600
5/2	4,800
5/19	14,000
6/5	2,000

PI Counts



Rating based on cfu/ml

Good	Acceptable	Concern
(low)	(medium)	(high)
10,000	< 50,000	> 50,000
	or	or
	< 3-4 x SPC	> 3-4 x SPC



Doc ?

Why are my PI counts high ?

1. Cleaning and sanitation of the milking system
2. Poor udder preparation before milking
3. Failure to cool milk rapidly
4. Prolonged storage times

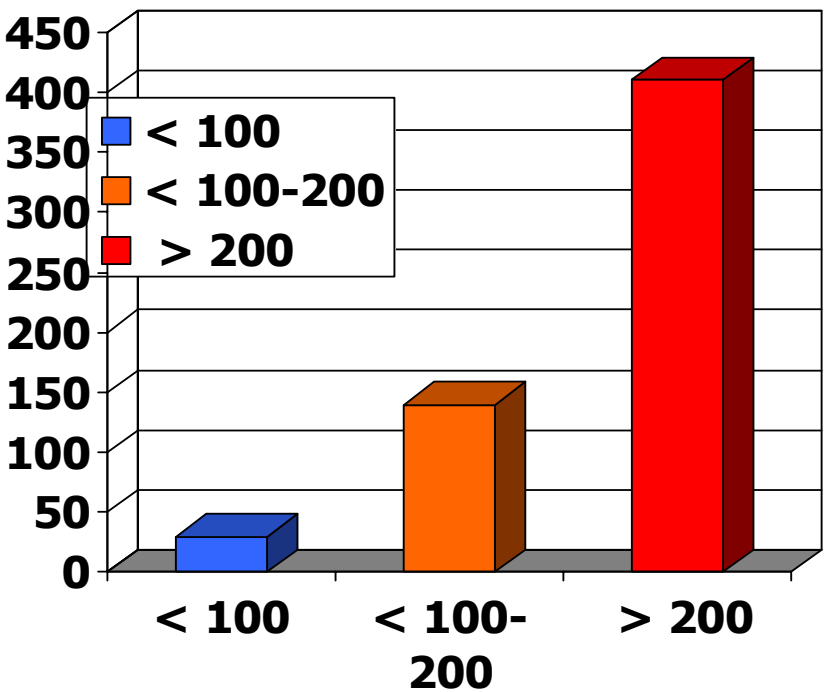
Laboratory Pasteurization Count

LPC	Count
ideal	100
4/16	20
5/2	20
5/19	0
6/5	0

LP Count

Rating based on cfu/ml

Good	Acceptable	Concern
(low)	(medium)	(high)
<100	<100- 200	> 200



Unclean milking equipment

Faulty milking machine or worn out parts

Extremely dirty cows

What causes mastitis ?

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

Contagious Mastitis Pathogens

	Staph. aureus	**Strep. Ag.**	**Mycoplasma**
ideal	0	0	0
4/16	40	Not detected	Not detected
5/2	20	Not detected	Not detected
5/19	20	Not detected	Not detected
6/5	0	Not detected	Not detected

Staphylococcus aureus

Type of herd: **closed herd**, suggests the presence of chronic infection; **open herd**, suggests the likelihood of newly purchased animals as one of the possible source of *Staph.aureus*.

BTSCC in a herd with high *Staph. aureus* infection, generally ranges from 350,000 - 1000,000 cells/ ml (most occasions 500,000- 600,000 cells/ml).

Management practices that allow spread of *Staph. aureus* in the herd:

1. Milking cows without gloves
2. Cloth towels reused without proper cleaning
3. Milking infected cows along with uninfected cows
4. Poor fly control during summer
5. During winter, milking cows with chapped teats
6. Milking cows with teat and teat end injuries

Streptococcus agalactiae

Type of herd: **closed herd**, suggests presence of chronic infection; **open herd**, suggests both the likelihood of newly purchased animals bringing in the infection.

BTSCC in a herd with high *Strep. agalactiae* infection, BTSCC count generally ranges from 500,000- 600,000 cells/ml, with high SPC (50,000 to > 100,000 cfu/ml).

Management practices that allow spread of *Strep. agalactiae* in the herd:

1. Milking cows without gloves
2. Cloth towels reused without proper cleaning
3. Milking infected cows along with uninfected cows
4. No or inadequate teat-dipping practices

Mycoplasma

Type of herd: **closed herd**, suggests the presence of chronic infections in the herd that would include animals of all ages; **open herd**, suggests the likelihood of newly purchased animals as one of the possible source of Mycoplasma

BTSCC is generally > 500,000 cells/ ml when there are more than 5 to 10% of the cows with Mycoplasma infection.

Management practices:

1. poor herd health management practices with a history of Mycoplasma pneumonia in the herd including calves
2. hygroma in adult cattle; cows treated for clinical mastitis do not respond to treatment;
3. Cloth towels and cannulas are reused without proper cleaning and disinfection.

Environmental Mastitis Pathogens

	CNS	SSLO	Coliforms	Non-coliforms
Ideal	1,000	1,000	50	1,000
4/16	620	620	20	0
5/2	960	240	0	0
5/19	900	520	20	180
6/5	480	1,000	0	20

Environmental Mastitis Pathogens

BTSCC:

Streptococci and Strep-like organisms: 250,000- 450,000 cells/ml.
CNS: 350,000 - 500,000 cells/ml
Coliforms: < 300,000 cells/ml
Non-coliforms: No data

Milking Procedures:

No established milking protocol(varies from milker to milker)
Poor udder surface (clipping or flaming not done)
Teat and teat ends not thoroughly cleaned
Milking done on wet teats
Cloth towels reused without cleaning

Farm Hygiene

Poor bedding management
Manure removal not done regularly

HACCP- principles

- **Principle No. 6.** Establish effective record-keeping procedures that document the HACCP system.

- Daily Check lists and records
  - Example: bulk tank milk temperature
- Monthly Check lists and records
  - Example: BTSCC and individual cow SCC
- Six Monthly Check lists and records
  - Example: Milking system inspection

HACCP- principles

- **Principle No. 7.** Establish procedures for verification that the HACCP system is working correctly.
  - Monthly bulk tank milk reports

DAIRY QUALITY ASSURANCE PROGRAM

Lawrence Hutchinson

Extension Veterinarian

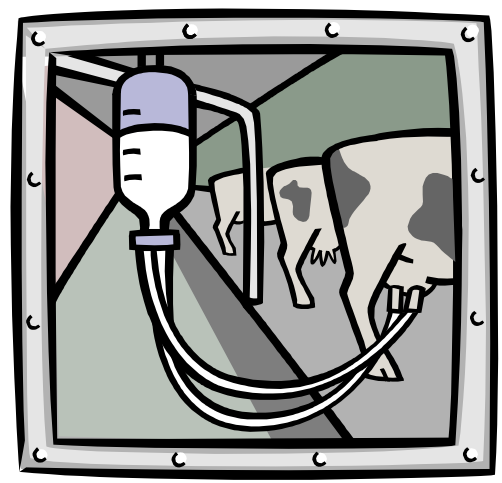
Department of Veterinary Science

The Pennsylvania State University

University Park

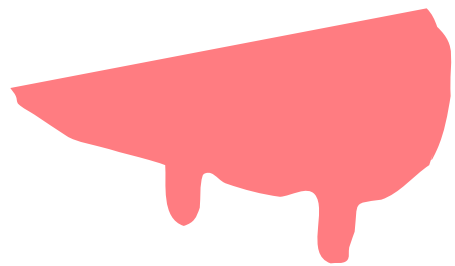
NON-MILKING TIME EVALUATION

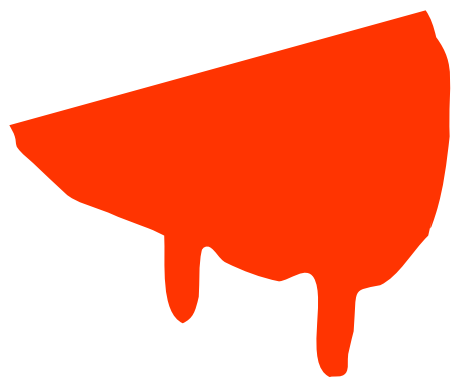
- Equipment cleaning procedures
- Equipment evaluation
  - Pump
  - Pulsators
  - Regulators
  - Inflations
- Parlor sanitation
- Employee training



CLINICAL MASTITIS

- Organism ?
- Severity ?
- Stage of Lactation
- Parity
- Treatment Response





RISK ASSESSMENT

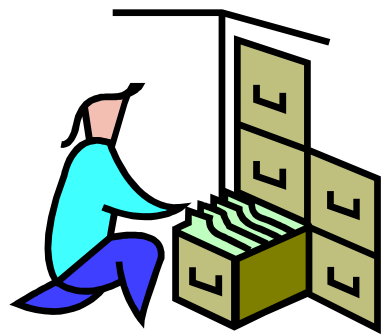
- Systematic evaluation of farm
  - By groups
  - By area of concern
- Identification and quanitation of potential problem, or risk areas

STEPS TO SOLVE MILK QUALITY AND MASTITIS PROBLEMS

- Records
- Milking-time evaluation
- Non-milking time evaluation
- Clinical mastitis
- Risk assessment

RECORDS

- Individual Cow
  - Production level
  - SCC
  - Culture
- Bulk Tank
  - SCC
  - Culture
  - Bacteria types and concentration
- Treatment Protocols
- Treatment Records
- Standard Operating Procedures



MILKING TIME EVALUATION

- Sanitation
- Cow-handling
- Teat preparation
- Unit-on time
- Post-milking:teat dip