UPDATE ON EFFECTIVE MASTITIS CONTROL METHODS

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Mastitis is still our most expensive herd management problem. In herds where there is not an effective mastitis control program, approximately 50 percent of the cows are infected in an average of two quarters. In 1978 the National Mastitis Council (NMC) estimated that mastitis cost about $161 per cow per year in the average herd. If this is adjusted with a 13 percent inflation rate, it becomes about $180 per cow.

How much does mastitis cost you? Obviously the only way you can answer this question is to know how much mastitis you have in your herd. Mastitis robs you in four ways:

(1) Treatment cost - This is a direct loss for veterinary fees, drugs and medicine.

(2) Discarded milk - When milk does not go into the tank, it is a direct loss. If abnormal milk finds its way into the tank, the quality of your milk goes down. In time, this will affect you and your fellow producers at the market place.

(3) Cost of replacements - When you cull a cow because of mastitis, you have to bring in a replacement. The difference between beef price and the replacement cost is a loss.

(4) The hardest financial blow from mastitis is lost milk production--milk your cows never produced. This loss is due to subclinical mastitis that most dairymen do not detect (the quarter is infected, but the milk appears to be normal). The NMC estimates this loss at $105 per cow after the feed cost for lost milk production is removed.

How effective is your mastitis control program? Most dairymen evaluate the effectiveness of their herd mastitis control program by the number of cows requiring antibiotic therapy. However, several facts indicate that knowing the amount of clinical mastitis (visibly abnormal quarters), although important, is not adequate for evaluating the effectiveness of a control program.

(1) Most cases of mastitis in a herd are subclinical. These quarters are infected and are costing money but are not visibly abnormal. Research has demonstrated that for every case of clinical mastitis observed in the average herd, approximately 15 to 40 cases of subclinical mastitis are not detected.

(2) The percentage of subclinical cases that eventually show up as clinical and require treatment is quite variable. A few factors are: how well we detect clinical cases, what type of bacteria are involved, how much the cows are stressed, etc.

I am convinced that in most herds, a routine procedure for obtaining an accurate evaluation of the herd mastitis control program will increase profits. This is particularly true for large herds. Some reasons include:

(1) The direct supervision of the milking operation is more difficult. Weaknesses in the milking operation will affect a far greater number of cows.

(2) The purchase of milking cows from different sources introduces more strains of microorganisms into the herd (some of which are highly invasive and difficult to cure).

(3) The problem associated with providing adequate housing increases with herd size as well as the likelihood of infections with environmental microorganisms.

On the other hand, if the mastitis control program is evaluated on a routine basis and problems detected before they become problems of major proportions, special precautions can be taken at a lower cost per cow.

How should you evaluate your herd mastitis control program? Because mastitis is frequently "hidden," a number of tests have been developed for detecting mastitis. The majority of these tests approximate the number of somatic cells present in a milk sample. The term "somatic" simply means to be derived from the body. Thus somatic cell counts include both tissue cells and leucocytes (white blood cells). It is normal for these cells to be in milk, however, it is abnormal for an excessive number of them to be there. Tissue cells enter milk as a result of stress or injury to secretory tissue. Whereas leucocytes (the body's chief defensive mechanism against foreign material) accumulate at the site of an injury or infection. Their primary function is to engulf and degrade invading bacteria. There are, however, other occasions when cell concentration in milk are higher than normal. Freshening, late lactation, old age, estrus, sickness, environmental stress, etc., may elevate cell counts. Such increased counts will generally be lower than those due to infection. Thus when leucocytes are found in excessive numbers, they indicate udder irritation.

Bulk tank cell counts. Cell counts on bulk tank milk, if accurate, provide a good indication of the average mastitis status in your herd. Unfortunately, regulatory agencies in some areas only follow the abnormal milk program to the letter and the information they provide is not as useful as it might be. However, even accurate counts on herd milk do nothing to identify problem cows nor locate factors contributing to the high counts.

It should also be noted that herds with bulk tank counts over 500 thousand have serious subclinical mastitis problems even though they do not approach the 1.5 million regulatory level. Milk production has been estimated to decrease by 12 percent with bulk tank counts between 500 thousand and one million and by 20 percent or more when counts exceed one million.

Screening tests on individual quarter samples. The effectiveness of a control program can best be evaluated by conducting the California Mastitis Test (CMT) on milk from each quarter of each cow and determining the

frequency of the various reactions. However, to be of value as a management tool, the screening test must be conducted and summarized on a routine basis.

Since most dairymen find this difficult to do in their own herds, many states have provided a mastitis screening test option through DHIA.

Somatic cell counts on cow composite milk samples. In North Carolina somatic cell counts are determined on the same sample as is used for the fat test. These counts are determined at the centralized butterfat testing laboratory using a Fossomatic (an automated cell counting instrument). The results for individual cows for the current and previous month are reported on the standard monthly report (DHI-200). A scale of 1 to 99 is used with each count corresponding to 100,000 somatic cells/ml milk. The current test day results are also summarized on the herd summary page (DHI-202) as to percentage of first lactation cows and older cows in each of five cell count categories (0 - 200,000; 200 - 400,000; 400 - 800,000; and above 800,000).

Herd problems can be identified from initial tests by a high percentage of positive reactions (400 - 800,000 and above 800,000) and a low percentage of negative reactions (less than 200,000). Cell counts of greater than 400,000 are cause for concern since the vast majority of these cows have quarters with bacterial infections and thus decreased milk production. We would suggest that less than 5 percent of the cows above 800,000 cells/ml is a good goal level to be achieved without increasing cow turnover. Dairymen with 15 percent of their cows above 800,000 cells/ml should re-evaluate their herd mastitis control program.

Perhaps the best evaluation as to whether the current control program is effective in preventing new infections in your herd is the condition of the first calf heifers (provided on DHI-202). These cows are not affected as much as older cows by previous herd conditions.

STATUS OF HERDS ON
THE DHI SCREENING TEST PROGRAM

Percent >800,000 cells/ml	No. of Herds	Percentage of Herds	Rolling Average	
			% Cows Left Herd	Holstein Herds Production
0 - 5	55	22	28	15,114
6 - 10	52	21	31	14,735
11 - 20	75	30	30	14,005
21 - 30	36	15	31	13,633
31 - 40	12	5	35	13,595
Over 40	17	7	33	11,427

Table 1 presents a summary of North Carolina herds on the DHI screening test program. It appears that the herd goal level (less than 5 percent of the cows above 800,000) is achievable. It is not possible to determine from these figures how much of the differences in production between high cell count herds and low cell count herds is due to mastitis. However, it seems safe to conclude that a reduced incidence of mastitis must be achieved before substantial production progress will be made in the high cell count herds.

North Carolina dairymen have found the somatic cell count program to be a valuable tool for monitoring their herd milking management and mastitis control program. Evidence for this is the fact that the number of herds using the optional program has continued to increase, and the percentage of problem cows in these herds has decreased.

Prevention and Elimination of Infection

Long-term programs for mastitis control must be based on the prevention of new infections. However, for a program to be successful in an average herd in a relatively short period of time (one year), it must be directed at eliminating existing infections as well as preventing new ones.

The following management areas must be evaluated:

(1) Inspect and restore milking equipment to proper operating condition.

(2) Re-evaluate and correct milking procedures, including milking sanitation (especially the practice of dipping teats immediately after milking on a routine basis with a proven product).

(3) Review other management practices, such as culling source of herd replacements, condition of cow lots and free stalls, etc.

(4) Re-evaluate mastitis detection and lactation treatment program. DHIA somatic cell count monitoring programs are of particular value in making this evaluation. The presence of individual cows in the milking string with counts above 5 million (reported as 50) indicates that clinical cases are either being ignored or not detected. In large herds this is unfortunately one of the first indications that "all is not going well in the milking parlor."

(5) Re-evaluate dry cow treatment program.

Prevention of Infections

Streak Canal - Intramammary infections occur as the result of micro-organisms passing through the streak canal (teat opening). Injury to, or sores on the teat apex greatly enhance the chances of an intramammary infection.

What is a normal teat end? The streak canal is 1/4 to 1/2 an inch in length and lined with cells that form a series of very small folds. These cells secrete a lipid-like secretion that inhibits bacterial growth. Normally this canal is kept closed, except when pressure opens it, by a sphincter muscle. The tightness of this closure determines the ease of milking as well as the ease by which bacteria enter the gland.

If we dip normal teats in a culture containing large numbers of bacteria capable of causing an infection, the incidence of infection is quite low (higher than we could tolerate in a herd, but still low). On the other hand, if we place very small numbers of bacteria halfway up the streak canal

(1/8 to 1/4 of an inch), infections (at least temporary infections) will occur almost 100 percent of the time. Thus, the importance of maintaining the integrity of the teat end is obvious.

Sources of Pathogens. Mastitis may be caused by many different types of microorganisms. An extensive review of the literature indicates that approximately 90 different microorganisms may cause mastitis. However, four types, Staphylococcus aureus; Streptococcus agalactiae; Streptococcus dysgalactiae; and Streptococcus uberis account for about 95 percent of all udder infections.

It is desirable to obtain bacteriological information for evaluating a herd control program. Although it is usually not practical to sample all cows, a reliable herd profile can be obtained by sampling a representative group of cows (subclinical infections as well as clinical ones). The characteristics of the predominant microorganisms should then be considered in evaluating the control program.

Streptococcus agalactiae (Streptococcus Group B) is the only mastitis pathogen which is an obligate parasite of the mammary gland. It can be isolated from other sites within the herd; however, once it is removed from the cows, it usually cannot be brought back to the herd unless infected cows are purchased. Thus, if a herd has a high incidence of infection with this organism, it has been passed from infected to noninfected cows during the milking process. S. agalactiae is not an active tissue invader. It multiplies in the milk and on the surface of cisterns and large ducts. Antibiotic therapy during lactation or the dry period is very effective against this organism.

The primary source of Staphylococcus aureus in a herd is also infected glands. However, it can persist for long periods of time outside the udder. Thus, secondary sources of the organism: the skin of cows' teats, infected teat blemishes, etc., are important reservoirs of infection. Staphylococcus aureus differs from Streptococci in that it can penetrate into tissue producing deep seated areas of infection. Thus, severe clinical flareups are more frequent. Only a small percentage of established infections can be eliminated with antibiotic therapy during lactation. Dry period therapy is much more effective.

Streptococcus uberis and Streptococcus dysgalactiae (Strep not Group B) are widely distributed being isolated quite frequently from cow's lips, belly and udder skin. They are moderately susceptible to antibiotic therapy during lactation. A higher percentage are successfully eliminated by dry period therapy.

A second group of bacteria which have received a great deal of attention in the last few years is the coliforms. Only a small percentage of dairymen have problems with these microorganisms; however, when they do cause problems, the losses are severe. The term "coliform mastitis" has been used to identify mastitis caused by Escherichia sp., Enterobacter sp. and Klebsiella sp. Results from problem herds suggest that the primary source of all three of these microorganisms is the environment. Recommendations for preventing

coliform mastitis are based on reducing the amount of contamination from the environment as well as the ease with which they enter the mammary gland.

It can be seen from the previous discussion that methods that aid in reducing the transfer of microorganisms from infected to noninfected quarters must be incorporated in any successful mastitis preventative program.

Milking Equipment

When did you last have your milking system checked with testing equipment and deficiencies in function corrected? It has been well established that the milking machine can contribute to an increased incidence of mastitis. The milking machine can influence the likelihood of infection in three ways:

(1) The milking machine liners may transfer large numbers of organisms from one cow to others milked with that same unit.

(2) The milking machine may cause injury to the teat end, teat canal and delicate interior lining of the teat sinus. The extent of the injury is increased if the milking equipment is improperly designed, installed or used. Injury to or sores on the teat apex greatly enhance the chances of an intramammary infection.

(3) During operation organisms may be jetted on the teat end with sufficient force to place the organisms at least part way into the streak canal.

Considerable emphasis has been placed on milking time sanitation to reduce the spread of organisms from cow to cow during milking. Post-milking teat dips are effective because they eliminate organisms placed on the surface of the teats during the milking process before they can gain entrance into the mammary gland. British workers have also shown in extensive field trials that the incidence of infection was reduced by an additional 10 percent when teat cups were pasteurized between cows.

During the last few years automated back-flushing units have been developed for the sanitation of units between cows. Currently the majority of the experimental and commercial back-flushing units are being used in large herds in California. This approach may become practical and economical as these models are improved and as our milking parlors become more automated.

The mechanical aspects of milking machine function as it relates to the new infection rate is not fully understood. Research has shown that vacuum fluctuation at the teat end during milking contributes to an increased incidence of mastitis. Two types of fluctuation may occur during milking. The first type, cyclic fluctuation, is associated with liner movement, milk flow and volume change within the inflation. This type occurs with each pulsation cycle. Some of the factors that increase cyclic fluctuation include: (1) claw of insufficient size, (2) decreased or lack of air admission at the claw or in the inflation stems, (3) flooding of the inflation, (4) small diameter short milk tubes. The second type, irregular fluctuation, is not associated with the pulsation cycle but occurs at random during milking. Factors that increase irregular fluctuation include: (1) inadequate pump capacity, (2) malfunctioning vacuum regulators, (3) poorly sized milk

or vacuum lines (restricted, under-sized or excessively long), (4) milk entering the bottom half of the pipeline, (5) lifting milk to a high line, (6) careless attachment or improper removal of teat cups.

Research has shown that the incidence of mastitis is increased when cyclic and irregular vacuum fluctuation occur at the same time. The combination apparently results in a higher vacuum at the teat end than the claw or pipeline. Thus, small milk droplets containing bacteria are jetted back on the teat opening (possibly implanted in the streak canal). These studies have also shown that the majority of the machine-induced infections occur near the end of milking. There are several possible explanations: (1) the bacteria that have been jetted on the teat end are not washed away again, (2) the velocity and frequency of impacts on the teat end are greatest when there is not much milk in the cluster, (3) the air entering the first teat cup to be detached will cause jetting on the other three teats.

Milking Procedures

When did you last analyze your milking procedures or review the correct way of milking with your hired men? It is well documented that the milking procedures have a pronounced effect on milk production and mastitis control. The primary emphasis must be placed on sanitation and avoiding udder injury. The following steps should be considered:

(1) Udder washing - The purpose of this step is to clean the udder and at the same time stimulate milk let-down. In too many herds this is done with a quick spray from a hose and a "promise" with a sponge. This will not accomplish either purpose. Washing with warm running water metered with a sanitizer and an individual paper towel followed by drying will minimize the spread of mastitis-causing bacteria.

(2) Remove a few streams of milk prior to attaching the milking unit. This step is often omitted by dairymen. However, it can play an important role in early detection of mastitis and keeping abnormal milk out of the bulk tank. Further, it will aid in the milk let-down process.

(3) Attach the milking unit about one minute following stimulation. Be careful to minimize the amount of air let into the system. Timing is important since the effect of oxytocin (milk let-down hormone) occurs within one minute after stimulation and persists for five to eight minutes. Failure to milk within this interval will result in a decrease in the milk obtained and an increase in milking time.

(4) Adjust the teat cups during milking as necessary to insure that the quarters milk out properly.

(5) When milk flow ceases, remove the unit by breaking the vacuum. Machine stripping should be eliminated or at least minimized (0-1/2 minute). Avoid overmilking; most cows will milk out in four to five minutes if machines are operating properly and if cows are prepared correctly.

(6) After removing the machine, dip teats in a post-milking teat dip of proven safety and efficacy. This is the most important single procedure that a dairyman can follow for preventing new infections during lactation. Research at several institutions has shown that teat dipping reduces the rate of new infections by approximately 50 percent in most herds.

(7) Rinse teat cups between cows - Although recommended for years, this procedure is difficult to effectively carry out. However, units that have been used on clinically infected cows should be sanitized before being used on another cow.

Are you using an effective teat dip? A post-milking teat dip to be effective must: remove the film of milk which provides nutrients for bacterial growth; kill microorganisms deposited on the teat skin during the milking process; leave a film of sanitizer on the teats between milkings; and be non-irritating to the teat. Currently, proof of effectiveness is not required on products prior to going on the market. A few products have appeared on the market which, when tested, have been shown to be ineffective. Most of these products are no longer being manufactured; however, there are still products being marketed that have not been tested for effectiveness. Since the benefits of teat dipping may become apparent only after a long period of use, dairymen must demand good research evidence concerning the value of a product prior to using it.

Are you really dipping the teats immediately after each milking? Obviously to be effective, this procedure must be carried out at each milking in a way that gets good coverage of the teat; particularly the teat end. The limited research that has been done comparing teat dipping with spraying shows a marked advantage for dipping. This is most likely due to better coverage of the teat end. If you are spraying, examine the teats on the opposite side immediately after spraying. Be sure you are getting good coverage of the bottom one-half inch of the teat.

Elimination of Infections

Infections are eliminated from a herd by three means: spontaneous recovery, culling and antibiotic therapy. Spontaneous recovery is relatively common in instances of milk infection, but the frequency is extremely low in cases of well-established infection. At the present time, we do not understand this mechanism nor have a method to increase the spontaneous recovery rate.

Culling is often the most practical means of eliminating chronic infections from a herd. In most herds the clinical mastitis flare-ups actually involve a relatively small number of cows. If a cow requires therapy more than three times during lactation (using a full series of recommended intramammary treatments) her value in the herd should be re-evaluated. These cows provide potent reservoirs of bacteria which are spread during the milking process.

Therapy is by necessity the most suitable procedure for eliminating mastitis infections from a herd. A few general suggestions will be offered regarding antibiotic therapy as it relates to lowering the level of infection in a herd. However, as with any procedure involving herd health, you will want to consult with your veterinarian. The general subject of mastitis treatment is also covered in the National Mastitis Publication entitled, "Mastitis Treatment Guidelines for Dairymen."

Lactation treatment

The efficacy of treating subclinical infections, especially old well-established infections during lactation, is extremely poor. The only exception is infections caused by Streptococcus agalactiae. Thus, treatment during lactation in most herds should be limited:

(1) The first group of quarters that must be treated during lactation are clinical quarters. Since the milk must be discarded from all quarters on treated cows regardless of the number treated, other high CMT quarters should be treated at the same time. In instances of acute-clinical mastitis, normal appearing quarters should also be treated to prevent possible spread of infection. Although the treatment of clinical quarters is necessary, the effectiveness of treatment (complete elimination of bacteria) is not high.

(2) Much research is needed before we can clearly determine conditions (age, stage of lactation, type or organism, etc.) where lactation therapy is economical. Young cows in early lactation with increasing cell counts (approaching 400,000 cells/ml) would be the most likely possibliity. I would suggest that dairymen run the CMT on individual quarters of these cows as potential cows for lactation therapy. NOTE: Lactation treatment based on cell counts should be extremely limited.

(3) Dairymen in danger of losing their Grade A market because of high somatic cell counts (leucocytes) may find it necessary to treat additional high cell count cows during lactation. Bacteriological results, production, stage of lactation and age should be considered in selecting cows for treatment.

It should also be emphasized that even after a successful treatment the screening test will probably remain higher than normal for the remainder of the lactation.

Dry treatment

Treatment at drying off has several advantages; a higher percentage of infections can be eliminated; the number of new dry period infections is reduced; damaged tissue may be regenerated prior to freshening; reduces clinical mastitis at freshening; and salable milk is not lost.

What type of preparation should be used? Use a product that is labeled specifically for treatment at drying off. By using a slow release base, a

higher concentration of antibiotic can be kept in the udder for a longer period of time. Unless you have bacteriological information to tell you differently, a formulation that is highly effective against both Staphylococci and Streptococci should be chosen.

Which quarters should be dry treated? There is not complete agreement on how much we should dry treat. Certainly in most herds all quarters of all cows should be treated. Research data is not available to determine if there is a level of infection which is low enough to justify selective dry therapy rather than complete therapy.

If the dairyman chooses to use a selective dry cow treatment program, a mastitis screening test is essential. For example, if only quarters which are visibly abnormal in late lactation are treated, most of the infected quarters will be missed--about 80 percent. Therefore, the selection procedure must identify more infections for treatment. Suggested quarters would include: those treated or clinical during lactation, those running high on the screening test at any time during lactation, and all quarters on cows with problems drying off. Selective treatment based on these criteria may still fail to reach 20 to 40 percent of the infected quarters. In addition quarters not treated at drying off are more likely than treated quarters to become infected before calving.

A comparison of the cell counts for a few months before drying off with a month after calving will give some indication as to how effective the dry treatment program (selection of cows, formulation, etc.) is in your herd.

Dry treatment should be a part of our herd mastitis control program. However, it is pointless to initiate a dry treatment program unless an effective preventative program is being used to keep susceptible quarters from becoming reinfected.

Response To A Control Program

Implementation of proven procedures will reduce the incidence of mastitis in most herds. Results from an extensive field trial conducted in New York State revealed that the simple routine of dipping teats after each milking in an effective teat dip, and the treatment of quarters at drying off with a specially formulated preparation, reduced the level of infection by about 50 percent within one year and 75 percent within two to three years. This reduction in the infection level was accompanied by an increase in herd milk production of more than 1,000 pounds per cow annually when compared to control herds not on the study. The production increase in your herd will depend on the level of infection, but there is money to be made by managing the mastitis control program.