



SCC DIAGNOSTICS TOOL BOX

QCF-14: *Staphylococcus aureus* Mastitis Control in Dairy Herds

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Introduction

Staphylococcus aureus is one of the most common causes of mastitis in US dairy herds. It is a major source of expense and lost revenues on many dairies. Therefore, the mastitis control program on every dairy must include measures designed to limit the degree and spread of Staph aureus infections. As herds grow larger, it becomes even more critical that these control programs are designed carefully and implemented properly. This paper will present background material on Staph aureus control and will discuss some practical implications to consider when designing herd specific control programs.

Staph aureus udder infections (along with those infections caused by *Streptococcus agalactiae*) have commonly been considered as “contagious”. “Contagious” means the primary mode of transmission is from an infected cow to an uninfected cow, usually as part of the milking process. However, Staph aureus is not strictly an obligate intramammary pathogen like Strep ag, since Staph aureus can also live outside the udder in other locations such as teat skin, udder skin, and tonsils.

Most commonly, Staph aureus mastitis exists as a very chronic, subclinical infection, but it is also a leading cause of clinical mastitis. Staph aureus udder infections are notable for the difficulty in achieving full bacteriological cures even with intensive antimicrobial treatment. Given the chronic nature and the relatively low success rate of treatment of Staph aureus infections, any herd mastitis control program (whether for Staph aureus or other organisms) must have as its major focus the prevention of new infections rather than treatment of existing infections.

Goals of a Staph aureus Control Program

There are two general goals of a Staph aureus control program:

- Reduce the number of new cows becoming infected.
- Decrease number of cows with existing infections (in turn aiding the first goal).

Commonly recommended steps to achieve these goals are listed below. Not all are equally useful or applicable on all dairies. The practical application of each recommendation and specific circumstances where each would be most useful will be discussed later in the paper.

Steps to limit the spread of Staph aureus to uninfected cows:

- Proper post milking teat dipping
- Universal dry cow antibiotic treatment
- Proper premilking hygiene
- Proper milking equipment function
- Milking infected cows after uninfected cows
- Milking infected cows with a separate machine
- Sanitation of milking units between cows
- Vaccination
- Limiting suckling in calves
- Control of flies
- Steps to eliminate existing infections
- Dry cow antibiotic treatment
- Lactating cow antibiotic treatment
- Normal culling
- Stringent culturing and identification of positive cows
- More intensive culling based on Staph aureus infection status

In most cases acceptable control can be maintained using proper post-milking teat dipping, universal dry cow therapy, adequately functioning machines, and good calf rearing methods. This approach is very economically sound and will have good results in most herds when properly applied. However, failures can occur. These failures are usually the result of incomplete implementation or breakdown of the control measures.

Steps to limit the spread of Staph aureus to uninfected cows:

a. Proper Post-Milking Teat Dipping

In our experience, the most common failure is not adequately covering the teats with a good germicidal teat dip immediately after milking. Since the role of teat dipping is the prevention of colonization of the teat skin as well as the teat canal, it is critical to consistently and properly cover the entire area of the teat that had contact with the milking unit.

While it is commonly recommended to cover the teat end and bottom one-third of the teat barrel, we feel this is inadequate. The teat should be as completely covered as possible with a good germicidal teat dip. We also do not recommend applying teat dip by sprayer, as in most cases the teat coverage will not be adequate and usually uses more teat dip than proper dipping. In any event, teat dip coverage should be monitored on a regular basis by observation of procedures within the parlor. As an additional external monitor, a high level of Staph species (other than aureus) on a bulk tank culture would suggest inadequate dip coverage.

b. Universal Dry Cow Therapy

Another common cause of failure of Staph aureus control is selective treatment of dry cows. We strongly recommend using dry cow antibiotic therapy on every cow, using proper infusion techniques (i.e., thorough sanitation of teat ends before antibiotic infusion, etc). We recommend using only FDA approved dry cow products with an efficacy claim for Staph aureus on its label. Universal dry cow treatment serves two purposes:

- Elimination of existing infections
- Prevention of new infections at start of the dry period (likely most beneficial)

c. Proper Pre-Milking Hygiene

Premilking hygiene may also be involved in the degree of spread of Staph aureus. While this step may not be as important as proper post-dipping or universal dry cow treatment, it is very important for control of other organisms. Therefore, an excellent premilking procedure should also be in place on every dairy. We recommend a procedure that results in complete coverage with a germicidal predip. Use of nitrile gloves is also recommended since the Staph aureus organism can survive and live on the hands. Gloves also help protect the milker's skin from drying due to prolonged contact with the teat dip. Direct contact with bare teat skin after loosening/removal of any organic material for an adequate time period (at least 20 seconds) is critical, as is complete drying of the teat, particularly the teat ends.

d. Proper Milking Machine Function

Proper machine function helps in controlling mastitis spread through a herd. While there can be some mastitis infections caused directly by machine faults, properly functioning machines aid mastitis control indirectly by making the milking process more pleasant for the operator and the cow through complete and rapid milk-out of the animals.

e. Milking Infected Cows Last/Segregation into Separate "Staph" Group

Milking infected cows at the end of the milking shift may be useful in some cases. However, it is more difficult than it may appear at first glance. As will be discussed in a later section, excellent and complete identification of infected cows must be done on an on-going basis and strict segregation practiced. This requires a great deal of organization and discipline to maintain over any length of time. Additionally, in many herds, grouping of cows into "Staph" strings is either not possible or of lesser importance than other management reasons such as production or reproduction. If a herd is housed in a stanchion or tie stall barn, it may be possible to place the cows identified as infected at one end of the barn and milk them last.

f. **Use of a Designated Milking Unit for Staph aureus Cows**

The use of a designated “Staph” milking unit is possible on some dairies, especially those with round-the-barn pipeline systems. While this approach can help eliminate the milking machine as a fomite, there are many other ways of transmitting Staph aureus from infected to clean cows, including the hands of the milkers’ hands as well as other equipment and materials used for cow preparation.

g. **Sanitation of Units between Cows**

Sanitation of milking units between cows is another often attempted practice. It may seem logical, but is not usually very effective. The major difficulty is that the claw bowl, the milk hose, and all four teat cups and liners need to be sanitized completely. Simply dipping the cups or rinsing with water will not sanitize the entire unit. In our experience, most attempts at milking unit sanitation are at best wasted efforts and harmful at worst.

However, mechanical back flushing units can achieve effective sanitation of the whole unit. Back flush studies have indicated about an additional 20% reduction over and above proper teat dipping, suggesting even the best case scenario for sanitation of units might be a 20% reduction in new infection rates. Less strenuous attempts at sanitation would be therefore likely be less effective. The cost effectiveness of even well functioning mechanical back flushes remains open to question.

h. **Vaccines, Bacterins, and Toxoids**

Various vaccines, bacterins, and toxoids for Staph aureus have been available for over 40 years. While some degree of prevention has been shown in certain controlled studies, controlled studies have never proven any of these products to be uniformly effective in all herds. This may be due to strain and type differences as well as unique immunological characteristics of the mammary gland. The best vaccine data suggests that a considerably better “self cure” rate was seen in animals vaccinated repeatedly, but the cost-effectiveness of vaccination is questionable. We do not presently recommend routine use of these products as part of a control program. However, due to the current research efforts in this area, it will be important to watch for the introduction of more effective vaccines.

i. **Baby Calf Cross-Suckling**

Feeding of raw milk containing high levels of Staph aureus to baby calves can lead to oral cavity infections. If the calves are raised in situations where cross-suckling may occur, Staph aureus udder infections may result. Prevention would include pasteurization of raw milk (or perhaps better, feeding of milk replacer) and taking steps to eliminate suckling by other calves.

j. **Fly Control**

Lack of fly control has been implicated in some cases of Staph aureus mastitis, especially in southern climates. Adequate fly control in the adult herd as well as the replacement herd should be practiced.

Steps to eliminate existing Staph aureus infections:

a. **Lactating Cow Antibiotic Therapy**

Cure rates following antibiotic treatment of Staph aureus infections (whether clinical or subclinical) during lactation usually are disappointing. Traditionally, cure rates during lactation have been considered to be around 20% while cure rates with dry cow therapy have been about 40%. Recently, extended therapy trials have shown up to a 50-60% cure rate in some circumstances. Results are typically poorer in cows with somatic cell counts greater than one million. While prolonged or repeated treatments may increase cure rates, the cost of discarded milk usually outweighs the potential benefits. Note that these treatments may be extra-label and therefore can legally (ADUCA regulations) only be done under veterinary supervision. Under AMUCA, these regimes may require extended withdrawal periods.

Even if prolonged or repeated treatments increase cure rates, the cost of discarded milk may outweigh the potential benefits. While in certain circumstances lactational treatment may have some value, we are not currently recommending aggressive attempts to resolve Staph aureus infections

with antibiotic treatment during the lactation. Again, as new products or approaches are introduced into the market, our recommendation may need to be re-evaluated.

b. **Normal Culling**

Cows with Staph aureus mastitis infections often have decreased production as well as abnormal milk on occasion. This situation means that these cows are at greater risk to be culled than other cows, even if they have not been specifically identified as Staph aureus cows.

c. **Intensive Culling after Identification through Culture**

While culling of all infected cows immediately may make sense biologically, it seldom makes good sense economically. Frequently, some of Staph aureus cows are among the highest producers in a herd. We feel that if the other control measures already discussed are fully implemented (and maintained), immediate culling is seldom necessary.

Special Considerations in Heavily Infected Herds

If a herd already has a very high level of infection (5% or more infected cows) or where new infection rates are high, spread can become more rapid. In these cases, more aggressive control measures may need to be implemented until the level has been reduced. Complete and on-going identification of infected cows and stringent segregation and/or culling may be needed in addition to the control measures discussed above.

Additionally, the identification of the Staph aureus cows is not a one-time effort. A system of ongoing monitoring for newly infected cows needs to be in place to determine if the methods used to prevent spread are being effective. Culturing of cows with newly high DHIA cell counts and clinical cases can be a quite effective means to determine if the new infections are Staph aureus that has spread.

Bacteriological Cultures

Bacteriological culture of all cows in the herd is the most accurate method of determining the number of Staph aureus infected cows. However, it is absolutely imperative that the culturing be done by a high quality laboratory.

Besides technical expertise in culturing Staph aureus, one must be careful to select the proper method to select cows and to obtain high quality samples. Currently, the only reliable method for collecting milk samples is to squirt a sample directly into a sterile sample vial from a sanitized teat end. Vigorous scrubbing of the teat end with an alcohol pad is necessary to minimize the possibility of contamination when the sample is collected. The samples should also be quickly frozen and delivered to the laboratory as rapidly as possible.

While the cost and labor of obtaining individual cow samples may tempt one to take shortcuts, most of these shortcuts have serious limitations and will lead to control program failure. For example, obtaining samples from milk meters would greatly reduce the labor of sample collection. However, our studies have shown there is sufficient carry-over of organisms within the meter that milking an infected cow will cause at least the next cow to have a falsely positive culture result, even if she is not truly infected.

Another common shortcut is to routinely culture only from clinical mastitis cases. While this might indicate the degree of the clinical problem due to Staph aureus, it will not accurately determine the effect on bulk somatic cell count nor will it give an accurate estimate of the reservoir of infection. This is because many infected cows will not become clinical. Cultures from fresh cows can be also be used, but there is an obvious delay in this approach.

Individual cow SCCs from DHIA or other sources can also be used to decrease the number of animals sampled. This will find the majority of the infected cows if an SCC cutoff of 200,000 (linear score 4) is used. This method will probably also find those cows creating the most serious exposure but may miss some infected cows. It has also been shown that there can be considerable variation in the number of organisms shed at any given time. Therefore, multiple day samples or repeating sampling at a later date will also decrease the number of infected cows that one misses.

Finally, a decision needs to be made whether to culture the quarters individually or to culture a composite of all four quarters. Culturing all four quarters individually obviously increases the culture cost by 4 times. Sampling only CMT positive quarters can offset some of the extra costs when sampling individual quarters.

Research studies have shown one key factor in identifying the positive cows is the amount of milk plated. If 0.01 ml is used the compost is only about 60% as accurate as individual quarter culture. However, if 0.05 ml. or more is plated, the sensitivity is 90% or more as compared to quarter samples. In general, plating these larger volumes increases sensitivity and should be used routinely.

Differential bulk tank cultures are also sometimes used to determine the level of Staph aureus. While there usually is a good correlation between the bulk tank Staph aureus count and the percentage of the herd infected, in certain situations the correlation may be poorer due to variations in shedding of Staph aureus. Thus, looking at any one-day sample may give a false impression. If multiple day (e.g., four-day) samples are taken repeatedly at approximately 24 week intervals, bulk tank culture counts will generally reflect whether the Staph aureus level is changing. The use of in-line samplers for infected cows in a given pen may also be an option, but needs more study.

Summary

Control of Staph aureus mastitis is essential for the success of today's dairy operation. The best approach is rigorously practicing standard mastitis control practices. Proper post-milking teat dipping and universal dry cow therapy (coupled with properly functioning milking equipment and limiting spread among replacement animals) are the cornerstones of any control program. In problem situations or in cases of aggressive management, other control measures may be adopted. These measures usually involve identification of infected animals via bacteriological cultures, followed by culling and/or strict segregation of all infected animals. Additionally, any control program needs to have some form of continuous monitoring incorporated into it. Bulk tank cultures (if performed properly and the information carefully analyzed) can be an excellent tool for monitoring.

