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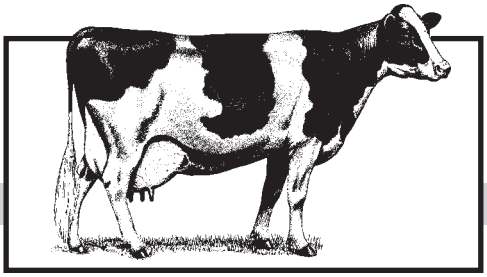

Dairy Science

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Guidelines for Using the DHI Somatic Cell Count Program

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Summary

Somatic cell counts (SCC) from a day's milk is the best indicator of the extent to which the gland is involved in fighting a mastitis infection. The DHI program provides a monthly SCC which identifies those cows with subclinical mastitis. The DHI SCC is highly correlated to losses in milk yield. The DHI SCC program assists dairy farmers in monitoring herd subclinical mastitis status, progress in mastitis control programs such as milking practices or equipment, cow environment and dry cow therapy, and can be used in making decisions regarding cow segregation and culling.

Mastitis is usually found in two forms. The first is obvious since clinical mastitis is easily recognized. Milk is abnormal, from appearance of flakes or clots to garget and quarters may be swollen or sensitive. However, most mastitis is subclinical. The milk appears to be normal. Bacteria usually, but not always, can be isolated in milk. Milk yield is depressed, and composition may be altered. Subclinical mastitis may become clinical. There are 15 to 40 cases of subclinical mastitis for every clinical case.

Herds with bulk tank SCC above 200,000 will have varying degrees of subclinical mastitis present. In Table 1, data from the National Mastitis Council (1987) show that 6% of the quarters in a herd could be expected to be infected in a herd with a bulk tank SCC of 200,000. At 500,000 SCC, 16% of the quarters may be infected with a 6% reduction in milk production compared to a SCC of 200,000. In addition to being illegal, a herd whose bulk tank SCC is one million has considerable mastitis infection and 18% reduction in milk yield.

Good udder health is essential for quality milk production and SCC is the most widely accepted criterion for indicating the udder health status of a dairy herd. The DHI SCC program is a monthly estimate of those cows with subclinical mastitis, but it does not identify the presence or absence of specific pathogens. The DHI SCC identifies cows with potential subclinical infections as well as providing the farm with a monitor on the success (or failure) of the herd's mastitis control program. The results of many studies suggest that cows with SCC of less than 200,000 are not likely to be infected with major mastitis pathogens, but cows with SCC above 300,000 are probably infected (Smith, 1996). An increase in SCC above 100,000 has been associated with a progressive decrease in milk yield and an adverse impact on dairy product quality (Jones, 1986). A 300,000 SCC threshold of infection would be comparable to a DHI SCC score of 5 and above.

Table 1. Estimated infection prevalence and losses in milk production associated with elevated bulk tank somatic cell counts.

Bulk tank SCC (1,000's/ml)	Percent infected quarters in herd	Percent production loss*
200	6	0
500	16	6
1,000	32	18
1,500	48	29

**Production loss calculated as a percent of production expected at 200,000 cells/ml. National Mastitis Council, 1987.*

Monthly Herd Average SCC

Dairy farmers should pay attention to the herd's monthly average SSC score or weighted average and any changes from month to month. A goal for herd average SCC score would be 3.0 and below. A decreasing trend suggests that improvement has occurred. On the other hand, an increase in herd average SCC score from one month to the next would indicate that a major breakdown has occurred in the herd's mastitis control program. The SCC information can be found on page 2 of the DHI-202 Herd Summary. Under Yearly Production and Mastitis Summary, the monthly herd average is shown for both Avg. SCC Score and Wt. Avg. Actual SCC.

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In the herd example below, over an 11-month period, the average SCC score varied from 4.6 to 5.2, while the Wt. Avg. actual SCC varied from 661,000 to 1,030,000. (Data were omitted for 6 mos. to save space. These data were similar to that shown.) With a goal of an average SCC score of 3.0 or less, this herd would appear to have a very severe mastitis problem that has been going on for more than a year. Over 50% of the herd is affected (5 score and higher).

Listed below are some of the areas that should be examined in herds with either increasing or high herd average SCC:

1. When was the milking system last serviced or checked? Is there a milking equipment problem, such as a loose belt on the vacuum pump, or a problem with a vacuum regulator or pulsator? Have the number of liner slips (squawking teatcups) increased?

2. Has there been a change in milking, either technique or people? Are cows clean? Are teats dried thoroughly? Are individual towels used? Is teat dip used correctly?

3. Are free stalls clean and dry? Do cows use them? Has there been a sudden change in the weather to cause muddy lots or frozen teats?

4. Could there be a problem with dry cow management (environment or calving area, dry cow therapy)?

When the herd average SCC increases, is the problem caused by several cows or a greater number of cows with increased SCC? Look at SCC for individual cows. Did very many cows have elevated SCC for the first time, which indicates a lot of new cases of mastitis? Especially pay attention to first lactation which is the future of the herd.

Effect of Age or Stage of Lactation

Cows in first lactation should have low SCC (SCC scores of 3 or below). Under the Production by Lactation Summary, 82% of first lactation animals should have SCC score of 0 to 3 and 92% should be 4 or less. The Stage of Lactation Profile will help determine when most infections develop. If the average for first lactation cows in milk less than 40 days is above 3.0, possible reasons include unsanitary heifer maternity areas, calf sucking problems, biting flies, etc. (See VCE Publication 404-281, *Mastitis Control in Heifers and First Lactation*). In general, as cows become older, a greater percentage have higher SCC. Studies conducted at Pennsylvania State University showed that higher SCC scores in older cows were not caused by age but by increased rate of udder infections (Eberhart et al., 1979). Uninfected cows, regardless of age, generally have low SCC. Higher SCC scores usually are caused by infection. In uninfected cows, the SCC should remain below 200,000 (DHI score of 4) throughout the lactation. Infection rates increase with advancing stage of lactation, especially after 200 to 250 days. Cows in milk 300 days, with DHI score 5, are probably infected; this does not appear to be an effect created by the dilution effect of lower milk yield in late lactation. Shown on page 3 are average SCC scores by lactation number and stage of lactation for 13 Virginia herds whose rolling herd average for milk exceeded 24,000 lb. in the fall, 1997. First lactation cows averaged about 2.5 for most of the lactation until they exceeded 305 days in milk. Average SCC scores for cows in second and later lactation started to increase at 101-200 days in milk, suggesting that the number of mastitis infections was increasing. Lactation SCC scores averaged 2.6, 3.0, and 3.6 for first, second, and third and older lactations. These data stress that cows are more prone to new mastitis infections as the lactation progresses, especially after first lactation. Scores of 5 and higher were found in 34% of cows in third lactation and more.

Beauty- Her monthly SCC score and milk yield appear on page 3. During her first lactation, she produced 18,702 lb milk in 347 days but she was open 131 days. Although her SCC rose to a score of 4 during the 6th month (June), it dropped to 3 for the last two months of the lactation. However, her first SCC score in 2nd lactation was a 5 and two months later it was 7. It appears that she had a subclinical mastitis infection in early 2nd lactation. A milk sample should have been cultured to determine if she was infected and by what organism. Either she was infected when she went dry and the dry cow treatment did not eliminate the infection or she developed a new infection during the dry period or early 2nd lactation. Look what happened to her milk production after she peaked at 98 lb/day. If other cows in the herd have similar elevated SCC after second or later calving, the dry cow management needs evaluation, especially dry cow treatment.

Somatic cell count summary

Date of Test	% cows SCC score 0, 1, 2, 3 <142	4 142-283	5 284-565	6 566-1,130	7,8,9 Over 1,130	Avg. SCC Score	Wt. Avg. Actual SCC
Jan	20	13	16	20	31	5.2	888
Feb	33	14	11	18	24	4.6	793
Mar	29	14	14	21	22	4.7	930
June	24	15	18	19	24	4.9	705
Nov	29	14	17	19	21	4.6	661

Average SCC scores by lactation and stage of lactation in 13 high producing Holstein herds

	Days in Milk				
Lactation number	1-40	41-100	101-200	201-305	305+
1	2.63	2.45	2.51	2.52	3.17
2+	2.75	2.32	3.11	3.71	4.19

The following examples are from two cows in two herds:

Beauty	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**
Monthly SCC score	2	0	0	2	3	4	3	3	D	D	5	3	7	4	7	8	5
Milk/day	61	67	61	56	54	42	20	41			91	98	65	81	75	80	60

Barb	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**
Monthly SCCS	2	2	0	3	0	6	5	5	2	1	1	1	D	D	D	1	9	8	7
Milk/day	58	74	74	71	68	62	49	36	54	52	51	47				101	77	89	66

Barb- She had an acceptable SCC score in her first lactation until the 6th month (June). At that time, a milk sample should be cultured. Her infection lasted for at least three months (through August). She produced 20,475 lb in 355 days (154 days open) but then was dry 81 days which is too long. She gave 101 lb in 1st month of second lactation. SCC score increased dramatically in 2nd month (May) and stayed high. Milk yield plummeted. When the SCC score jumped to 9, a milk sample should have been cultured. Was this a new infection in 2nd lactation or did her infection in 1st lactation continue as subclinical mastitis through the dry period?

298	**J**	**F**	**M**	**A**	**M**
Monthly actual SCC	1600	100	400	200	6860
Milk/day	66	76	88	96	67
300					
Monthly actual SCC			38	746	6860
Milk/day			88	72	49

298- In her first lactation, she had an elevated SCC shortly after calving which decreased. Her milk production continued to increase until May when production dropped dramatically and SCC shot up. She should be cultured and possibly treated depending on culture results. If the infection is allowed to continue until drying off, a *S. aureus* infection could wall itself off and become chronic.

300- In this, her 5th lactation, SCC increased progressively from 2nd test after calving and milk yield was severely impacted. Her previous lactations should be examined to determine if this is a first time infection. She should be cultured.

Uses of DHI SCC in Herd Decisions

Identifying Cows with High SCC. The DHI program is useful for identifying those animals with increased SCC (5 score or 300,000 and higher). DHI offers a SCC profile/report, under special options, which lists the percentage contribution to the bulk tank SCC made by each cow. In the second example, cow #298 contributed 12% of SCC found in bulk tank SCC and cow #300 contributed 9%. The SCC profile/report can be used to decide which cows should be: (1) sampled aseptically and cultured, (2) held out of the bulk tank, (3) considered for culling, (4) dried off early, and (5) segregated from low SCC, especially at milking. When collecting samples for culturing, be sure to sample cows from different lactations, including those in first lactation who have had elevated SCC, as well as cows in other stages. Include cows who have had clinical mastitis. In fact, samples from clinical cows should be collected before any treatment and frozen for later testing. One use of the California Mastitis Test (CMT) is to sample all quarters of cows with high DHI SCC and culture those with high CMT quarters.

Culling Cows for High SCC. One reasonable use of individual DHI SCC is determining which cows should be culled from the herd. Chronically infected cows have high SCC month after month, although some may vary considerably from one month to the next. Cows with persistent high SCC (5 or greater) that carry over from one lactation to another are prime considerations for culling. Usually the infection will never be cured and, thus, these cows shouldn't be bred. Use the CMT on these cows. Cows infected in three or more quarters have little chance that infection can be eradicated. Also, cows whose milk has been withheld from the bulk tank for 28-30 days or more, or who have been treated three times or more for mastitis should be culled. This stresses the importance of keeping up-to-date treatment records.

Early Drying Off. Drying cows off early allows one to use dry cow therapy sooner, which may increase the chance of eliminating the infection from that cow. The dry period can be extended by 30 to 60 days. Any Holstein cow producing less than 20 lb per day should be dried off; the chance of

infection increases as production level declines. Examine the individual cow SCC at first test after calving. A low SCC suggests that either the dry cow treatment effectively reduced any infection or prevented new infections during the dry period. An elevated SCC indicates that a new infection has developed. If this trend continues among other cows, reexamine the entire dry cow management program, including treatment and procedures, housing, and environment. If the SCC remains high from the last SCC in lactation through the first test in the next lactation, either the dry cow treatment was ineffective or the infection has walled itself off with scar tissue and became resistant to the treatment, which may occur with *S. aureus* infections.

Segregating Infected Cows From Other Cows at Milking. Some infections are spread from cow to cow at milking time, either on teatcup liners or milkers' hands, assuming that common towels, etc., are not used during washing and drying. *S. aureus* infected cows should be milked by one of the following alternatives:

- Isolate into a separate mastitis group and milk last.
- Sort into a milking group at the beginning of milking and hold until last before milking this group.
- Manually sanitize each teatcup by rinsing with hoses or dipping units into sanitizing solution.
- Install automatic teatcup sanitizers or backflush units on each milking unit.

Withholding Milk of High SCC Cows From the Bulk Tank. If the herd is experiencing problems with high SCC and is in danger of losing its Grade A permit, withholding milk from cows with high SCC will reduce the bulk tank SCC. One cow in a mid size herd can contribute 5 to 50% of the cells in the bulk tank. Withholding a few high SCC cows from the bulk tank can, in the short term, help a borderline SCC herd retain its Grade A permit.

Identifying Cows in Milk for Treatment. Antibiotic treatment of cows, based only upon high SCC, is not recommended (Seymour et al., 1989), nor is the treatment of cows whose milk shows symptoms of clinical mastitis (e.g., flakes or clots). More herd information is needed, such as culture results, previous history of clinical mastitis, lactation number, and stage of lactation, before appropriate treatment can be decided. Herds with SCC less than 150,000/ml had more clinical mastitis than high SCC herds (Guterbock et al., 1993). In low herds, almost all clinical mastitis was caused by environmental pathogens (mainly coliforms (21 to 43%) and environmental streptococci)— and minor pathogens. In herds for which clinical mastitis is caused by contagious bacteria, antibiotic therapy is often justified to reduce shedding of organisms in the milk of infected cows and the risk of spreading infection to other cows. Hallberg et al. (1994) found that intramammary antibiotic therapy to cows with clinical mastitis increased cure rates of all infections except coliforms, cured cows of clinical symptoms sooner, returned cows to normal milk sooner, and lowered SCC sooner than no treatment.

Successful treatment during lactation is greater if detected and treated early. Response is lower when treatment is administered to chronic infections. Cows whose DHI SCC increases to a score of 5 or actual SCC above 300,000 should be checked with the CMT to determine which quarters may be infected. Milk samples from positive quarters should be cultured. Use a strip cup or similar device for detecting abnormal milk. New clinical infections should be treated promptly and appropriately, especially in first lactation cows. Tissue damage can be minimized if treated during early stages of infection. Use the DHI SCC or CMT to monitor whether treated cows remain low or if infection recurs and becomes chronic.

Streptococcus agalactiae- After consultation with your herd veterinarian, consider intramammary treatment of culture positive quarters with an antibiotic. Chances of successful eradication are high if infection is located in one or two quarters.

Staphylococcus aureus- Treatment will not control this disease but it may shorten the duration of the infection. Intramammary antibiotic treatment cure rates were 70% when infections were new (less than two weeks duration) but only 35% when duration exceeded four weeks (Owens et al., 1995). Cures were only 34% when 89 cows in 10 Dutch herds were treated for subclinical *S. aureus* mastitis (Sol et al., 1997). Their results showed that probability of cure would be low in older cows with high SCC, infected in hind quarters during early and midlactation. If new *S. aureus* infections go untreated, it is likely that abscesses will form followed by scar tissue, making it difficult for drugs to penetrate and causing low cure rates (Belschner et al., 1996). Initial *S. aureus* infections probably should be treated, especially in first or second lactation. Treatment effectiveness decreases as cows become older. It seems pointless to treat recurrent *S. aureus* infections because of low cure rates. The cure rate was only 50% when Pirlimycin was administered at label dose over an extended time. Pirlimycin is one of the most effective antibiotics which can penetrate mammary tissue extremely well. Trials at Louisiana State University and Iowa State University with chronically infected cows found cure rates of 12% or less. Treatment of clinical mastitis cured 32% of *S. aureus* infections compared to 3% spontaneous recovery without antibiotic (Hallberg et al., 1994). *S. aureus* infections were found in 35% of clinical mastitis cases in Finish herds (Pyorala and Pyorala, 1997). Of these, only 39% responded to treatment. A SCC < one million was 85% accurate in predicting bacteriological cures which indicates that DHI SCC could be used to monitor treatment success or development of recurrent or chronic infections. In one study, treatment costs for discarded milk and drug expenses exceeded $100 per episode and these costs were not recovered in improved milk yields.

Environmental pathogens- These infections usually are of short duration, often lasting less than 8 days and few become chronic (Hogan and Smith, 1997). These cows may not have elevated SCC on DHI test day. On 274 dairy farms in the Netherlands with SCC averaging below 400,000, over

40% of clinical mastitis was caused by environmental streptococci or *E. coli* which usually don't recur and are not chronic; 23% were due to *S. aureus* (Lam et al., 1997). Dry cow therapy effectively reduces new environmental streptococci infections that develop during the early dry period. Studies conducted on several large California herds found that frequent milkout with oxytocin injections was as effective as intramammary infusion of antibiotics without discarding milk and becoming concerned about drug residues in milk (Guterbock et al., 1993). However, there were greater relapses. Cows were milked every 2-3 hours with an 8 hour pause at night. Coliform infections can cause mastitis of severity ranging from subclinical to peracute. In cases of severe, acute mastitis in which the cow becomes depressed and goes off feed, treatment should emphasize frequent milkout, use of anti-inflammatory drugs, and supportive care under the guidance of a veterinarian (Guterbock, 1994). Treatment of cows with clinical mastitis caused by coliforms did not eliminate the infection (Hallberg et al., 1994). Cure rates of infections other than coliform were 48% with treatment compared to 10% in untreated cows. In Finland, 49% of clinical mastitis was due to environmental streptococci and coliform (Pyorala and Pyorala, 1997). Cures following treatment were 80% for streptococci and 88% for coliforms. A SCC of one million (DHI score 6) was only 67 and 56% accurate in predicting bacteriological cure because inflammation resulting form these infections is reduced slowly.

Conclusions

An effective mastitis control program minimizes the opportunity to transmit infections from cow to cow, reduces stress upon the cow, teat and teat canal, and encourages maximal milk production. Attention should be given to:

1. Routine monitoring of milking procedures.
2. Milking sanitation and hygiene.
3. Environment and housing and teat contamination between milkings.
4. Milking system design and maintenance.
5. Dry cow management and therapy.
6. Monitoring somatic cell counts and rate and type of herd infection.
7. Herd segregation, backflushing teatcup liners, and culling.

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