

Reducing SCCs in Ontario

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The dairy industry's relationship with the consumer is built on trust. Cases of human disease associated with drinking raw milk, positive antibiotic tests of retail milk and other such incidents have received front page publicity in the general press over the last 10 to 15 years. The impact to date on consumption has been minimal but erosion of consumer's trust has occurred. As milk producers and sellers, we must continually strive to anticipate and respond to consumer pressure by improving raw and finished dairy product quality and safety.

The consuming public not only seeks safe, high quality products, but also increasingly demands that the animals used for food production be free of disease and raised in a clean, humane manner. The use of BST to improve dairy cow feed efficiency has sensitized and educated the media and the consuming public to milk production practises. The debate on how consumers want milk producing cows managed is open. Other commodities have already experienced the impact consumers can have on widely utilized industry production practises that until now have been acceptable. Witness the recent demands by McDonalds of their egg producers to increase the size of cages for layers on farms that want to sell eggs to their restaurants. The quality and safety of all foods, including milk, as well as the system that produces it and the wellbeing of the animals we use, are under increasingly close scrutiny.

Somatic cell counts and Canadian regulatory programs.

Somatic cells are part of an inflammatory reaction in the udder raised by the cow to fight bacterial invasion and infection. This inflammation is called mastitis. The level of somatic cells (SCCs) in cows milk and herd bulk milk can easily be counted to provide an estimate of the probability and the prevalence of infection. This inflammatory process brings not only infection fighting cells into the milk, but also enzymes and other immune factors that we can't measure as easily. As this battle between the cow and the bacterial invaders is waged in the udder, milk producing tissue is damaged and the composition of the milk is changed. Herds and cows with elevated SCCs have udder disease, lower milk production and milk of poorer quality. Raw milk from herds with SCCs above 300,000 cells/ml, used for cheese manufacturing, has been shown to produce a lower yield and quality of cheese (1). Ma and colleagues have shown that pasteurized fluid milk with a pre-pasteurization SCC of 849,000 cells/ml developed flavour defects and has a shorter shelf life than milk with lower SCCs (2).

Canadian consumers are concerned about dairy product quality and safety, and would not have confidence in an industry that failed to "keep up" to standards of the highest quality of any established elsewhere in the world. Multinational processors that buy Canadian milk do not want to purchase milk of lesser quality than they do elsewhere in the world because they know that it puts the efficiency of their business at a disadvantage. Therefore to protect cow health, maximize producer and processor efficiency, and assure consumers the milk they drink comes from healthy cows, SCC levels are closely regulated in Canada. All farms are subjected to the same quality scrutiny and must be in compliance with the regulations to be licensed to produce milk. In the Canadian system, provincial and national SCC data includes monthly values

from mandatory testing on every farm nationwide. Individual cow SCC testing programs are readily available on a voluntary basis to assist producers in disease control, and widely used. In Ontario over 70% of herds are on monthly individual cow SCC testing.

As in other jurisdictions worldwide, the approach to milk quality regulation in Canada is based on comparing herd SCCs to a national regulatory level to define acceptable milk. The Canadian regulatory limit for SCC is 500,000 cells/ml. The European Union and countries like New Zealand produce milk that complies with an SCC regulatory limit of 400,000 cells/ml, clearly indicating such levels are readily achievable.

Canadian provinces vary slightly on how they apply the regulatory limit. In Ontario, producers receive a weekly SCC count. For the monthly official SCC value the weekly values are averaged proportionately according to the volume of milk they represent. Producers whose calculated monthly SCC value exceeds 499,000 cells/ml in 3 out of 4 months are penalized. The penalty is applied in the third high month, on a volume basis, to all the milk sold that month. Subsequent high SCC months are penalized at an increasing rate to the 5th level. Producers penalized in 4 months out of the most recent 12, receive the most severe penalty - their milk is not purchased. To re-establish milk sales they must make management changes that convince the marketing board the mastitis problem is remedied. Two SCCs below 500,000 cells/ml are part of the requirements as proof. Currently, penalty levels are \$1, \$2, \$3, \$4 and \$5 per hectolitre of milk, representing from 2 to 10% of the milk price.

Like most provinces, Ontario arrived at the current regulatory limit in a stepwise fashion. When the SCC regulatory program commenced in 1989, the regulatory limit was first set at 800,000 cells/ml. Annually this level was reduced by 50,000 cells/ml until the current level of 500,000 was reached in 1995. The impact of the SCC regulatory program in Ontario is clear (Figure 1). Over the 5 years of the stepwise SCC reduction in level, from 1989 to 1995, the provincial average SCC decreased from over 350,000 cells/ml to about 250,000 (3). In the 5 years since that time, as the regulatory limit has remained constant the SCC has remained at this value with little further improvement.

Most other provinces have experienced a similar downward trend in average SCCs (Figure 2). Among provinces, Ontario ranks 5th in SCC average for 1999. The province with the lowest SCC is British Columbia where, in 1999, 792 producers had an average SCC of 172,000 cells/ml. In Canada, the national average somatic cell count is between 225 and 260,000 cells/ml annually (Figure 3).

Monitoring mastitis in Ontario: The Sentinel Project

Underlying somatic cells is the disease that elevates counts and damages cows and milk, mastitis. All mastitis elevates SCCs in about the same fashion. SCCs do not predict the types of bacteria causing the infection. The different types of bacteria causing the infections are controlled through different and specific actions. To implement the right preventive milking practises, therapy programs or cow management changes then, it is essential to identify the major families of bacteria causing a particular herd problem with elevated SCCs or mastitis cases. With this knowledge, the epidemiological characteristics known about a particular kind of mastitis can be used as the basis for assessing the herd situation and for making targeted recommendations for prevention or control.

As in any single herd, to advance improvements in the "provincial" or "national" herd there is a need to identify and track the differing mastitis pathogens and to monitor the implementation of recommended

controls. The stalling in the further reduction of the Ontario average SCC after 1995, suggested to researchers and producers that there was a need to redefine and reexamine the relative importance of the various kinds of mastitis pathogens prevalent and incident in Ontario herds. Furthermore, there was a need to look at whether the widely utilized recommendations, such as the National Mastitis Council 5 point plan, were still valid or needed revision for further SCC reduction.

A major collaborative research project, entitled "Sentinel Herds to Monitor Udder Health and Milk Quality" was undertaken to estimate mastitis in Ontario. The projects' objectives were to:

- Determine the predominant bacterial infections in the Ontario dairy herd;
- Describe the procedures, management practises and other factors associated with the different kinds of mastitis;
- Describe the changes in mastitis and health over time;
- Identify issues or problems with udder health and milk quality as they arose, and
- Develop specific solutions for Ontario farms.

The project involved 40 veterinary practitioners across the province who enrolled 63 of their dairy producer clients. Over the 18 months of the project each herd was cultured on 5 occasions approximately 3 months apart. Herd owners collected milk samples from every clinical mastitis case and cow or heifer at freshening and completed an entry and exit questionnaire. Herd and cow culture data was combined with production, animal inventory and SCC data from Ontario Dairy Herd Improvement and Dairy Farmers of Ontario.

Early results compared the prevalence of the mastitis pathogens among the herds after one herd culture to previous culture survey work of 73 herds done in Ontario in 1987. In 1987, *Streptococcus agalactiae* (*STRAG*), a major contagious cause of mastitis, was found to be present in 55% of herds. On the initial Sentinel herd culture, cows infected with *STRAG* were found in only 7% of the herds. Clearly *STRAG*, while not eradicated, has become a less significant pathogen in Ontario. In 1987 only 66% of the 73 survey herds used antibiotic to treat all cows at dry off time, 25% selected only some cows to treat and 9% used no dry cow treatment at all. By 1997, among the Sentinel herds, all used antibiotic for treatment at dry off and 87% used it to treat all cows. It seems reasonable that the reduction in SCCs in Ontario over the 5 years following the implementation of the SCC penalty program resulted from the increased usage of practises known to be reduce the prevalence of *STRAG*, especially lactational and dry cow antibiotic therapy.

Unfortunately the same success rate has not been documented over the intervening years for the other major contagious cause of mastitis, *Staphylococcus aureus* (*STAAU*). In the 1987 project, 76% of herds had at least one cow positive for *STAAU*, while in 1997 after the first round of herd cultures, 78% were found to be infected. And, after the four subsequent rounds of cultures of the Sentinel herds were completed, more herds were confirmed as having at least one cow with *STAAU*, until ultimately the pathogen was identified in 97% of the Sentinel herds. The overall prevalence of infected cows within each herd however, generally remained low. Only an average of 5 to 8% of cows were identified as infected with *STAAU* on each round of the herd cultures. Within each herd the proportion of culture positive cows ranged from 0 to 57%. Four herds experienced epizootics of *STAAU*, a sudden increase in culture positive cows from one herd culture to the next, during the course of the project.

Practises such as antibiotic therapy which appear to have been so effective in reducing the prevalence of STRAG infected herds have had almost no impact on the herd STAAU prevalence. However, it is noteworthy that while the Sentinel project suggests that most Ontario herds must deal with STAAU, practises such as post-milking teat dipping which have been shown to limit the spread of STAAU, have apparently been successful in most herds in preventing STAAU epidemics. Post-milking teat dipping or spraying, used by only 80% of herds in 1987, had been adopted by 97% of the Sentinel herds by 1997.

The downward shift in the provincial SCC, coupled with documentation of improved adoption of on-farm control practises and the change in the prevalence of STRAG, suggests that as of 1995 the emphasis on the two contagious mastitis pathogens was justified. Education targeted at control and prevention of these has been successful and has resulted in the implementation of effective controls at a greater rate than previously. The lack of success against STAAU was a less rewarding but equally important finding. Future programs must emphasize that all Ontario herds, regardless of SCCs, must be vigilant to reduce the risk of STAAU spread. Eradication, while apparently a reasonable goal for most herds for STRAG, might not be a reasonable or cost-effective objective for STAAU infection.

For further SCC reduction in Ontario, there is now a need to determine the most efficient route to reduce infection with what are now the major remaining pathogens, STAAU and the environmental mastitis bacteria. Further pressure on producers to improve, through either stiffer penalties or new bonus payments can only be effective if the appropriate on-farm controls or preventive practises can be recommended.

Previous research in the Netherlands has indicated that herds with bulk milk SCCs consistently below 150,000 cells, who have adopted the commonly recommended contagious mastitis control procedures, are still at risk of having high rates of clinical mastitis (4). In this study the low SCCs were a good indication that the predominantly subclinical contagious pathogens were at a very low prevalence. However, cows in these herds still experienced infections with environmental bacteria and STAAU, whose presence in the udder commonly caused clinical signs of mastitis to appear. Even in these low SCC herds with a traditional mastitis control plan then, all the specific preventive practises either had not been correctly identified or fully implemented.

With the overall reduction in SCCs, Ontario has shifted a greater proportion of the herds in the province into the lower SCC categories. The Dutch research suggests that these low SCC herds are at risk of mastitis caused by the environmental mastitis bacteria, predominantly those in the non-agalactiae or environmental strep and coliform families. Herd measures of SCC used so effectively to date to measure the progress of mastitis control against subclinical mastitis, will not completely measure the incidence and prevalence of the increasingly important clinical, environmental mastitis infections, even though the impact on production efficiency of the herd and overall milk quality is likely profound.

Apart from the Dutch research, there has been little multi-herd research on environmental mastitis. And it is likely the regional and farm level factors impact on the occurrence of this kind of mastitis. Identifying these is a complex task as there is a wide variety of housing, management, milking and climatic factors believed to be important. Many more factors, and perhaps some not typically those associated with mastitis, may remain to be discovered. At this time it is difficult to make universal recommendations for prevention of environmental mastitis with the same level of confidence, as are made for contagious mastitis

The Sentinel herd project data describes not only subclinical mastitis but clinical and fresh cow infections as well. In 1998 among the 61 herds there were 1080 clinical cases identified and milk sampled. This was about 1 case of mastitis for every 4 cows enrolled in the project that year. Data from 1998 also shows that more cases of clinical mastitis were recorded in the typically warmer, wetter months of July, August and September (Figure 4). This seasonal time of higher rates of clinical cases coincides with the high SCC months provincially, suggesting that even though the milk from cows with clinical mastitis is withheld from the bulk tank milk, mastitis occurring at this time does have an impact on overall milk quality.

Of the clinical cases cultured in 1998, significant bacterial pathogens were isolated from only 50% of the cases. Of the 1080 cases cultured, 6% were positive for STAAU, the only major contagious bacteria cultured from clinical cases, and 35% were positive for a major environmental pathogen (environmental Strep, *E. coli* or *Klebsiella* sp.) (Figure 5). These results emphasize the importance of environmental bacteria isolations when clinical case material is examined.

In these data, the rate of isolation of STAAU from clinical case material was somewhat higher than expected but similar to that seen by the Dutch researchers. This may suggest that the behaviour and/or detection of STAAU in low SCC herds is different than that in the chronically high SCC herds. Further examination of the dynamics of STAAU in low SCC herds is warranted.

The 50% of clinical case cultures negative for a mastitis pathogen shows that further work is required to identify the bacterial infections responsible for such a large proportion of clinical mastitis cases. Collection of milk samples at the time of clinical signs may not be an adequate detection technique. Tests other than milk culture, especially for some pathogens such as *E. coli*, need development. Improving the diagnosis of the underlying bacterial cause of clinical mastitis would greatly improve our confidence in our detection and subsequently, our identification of factors contributing to herd mastitis outbreaks. Currently, with the testing techniques available, and knowing that on average half the samples from clinical cases will likely be negative, the best plan is to sample and culture a large number of clinical cases in a particular herd situation to have a reasonable chance of identifying the predominant bacteria present in case material.

During 1998 the 61 herds recorded 4391 calvings on DHI. Owners collected samples from 2398 (55%) of these with 48 hours of calving. The range of calvings successfully sampled monthly in 1998 are shown in Figure 6. Monthly, a major bacterial pathogen (a gram negative, environmental Strep or STAAU) was isolated from the milk of 23% (range 15 to 33%) of the fresh cows cultured (Figure 7). There appeared to be no seasonal trend amongst the different pathogen categories in this dataset of all the herds combined (Figure 8). Anecdotal cases from the field suggest that in Ontario, SCCs in some herds rise in the late summer because of outbreaks of environmental mastitis. Further work continues at this time to characterize the herd patterns of environmental mastitis and to estimate the proportions of Ontario herds at risk of seasonal mastitis. Herd questionnaire information and climatic data, combined with cow and herd culture results, will be used to begin to identify some of the factors associated with this particular aspect of the epidemiology of environmental mastitis in Ontario dairy herds.

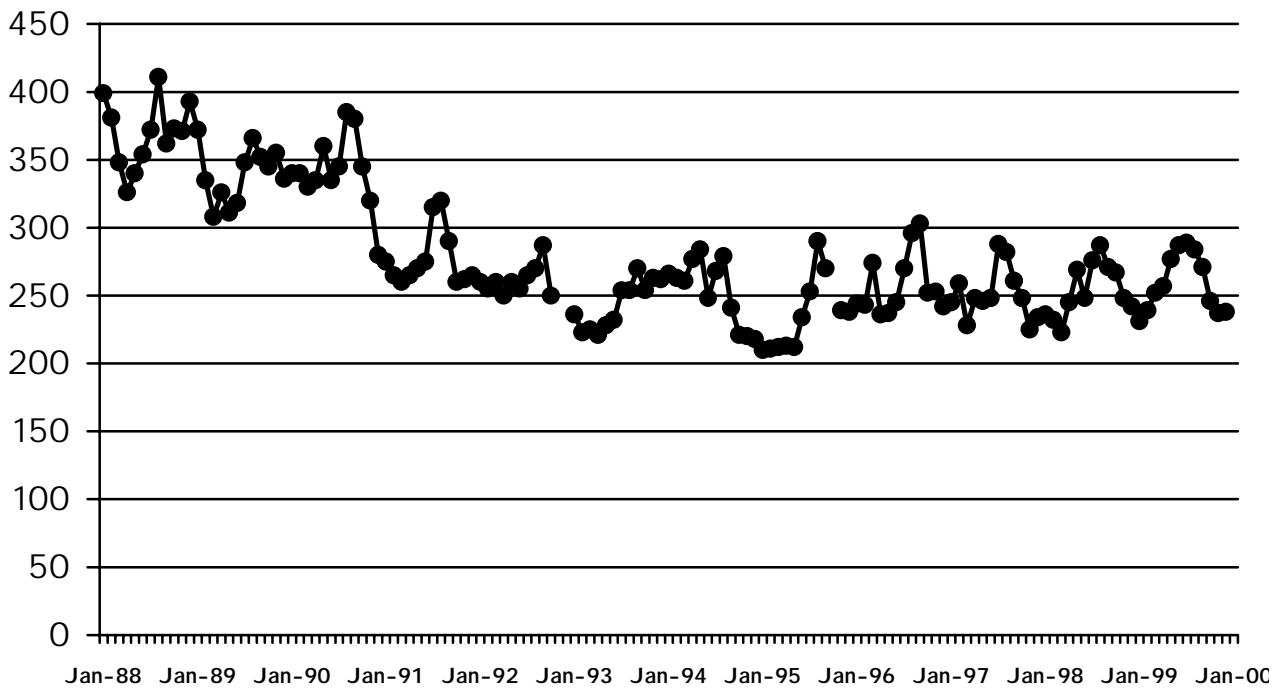
In summary, ten years into a major, industry-driven program to improve milk quality, all Canadian provinces show improvements in SCCs. Control of the major contagious pathogen STRAG in Ontario, has been achieved by implementation of traditional mastitis prevention and treatment practises. Further improvements depend on characterizing the types of mastitis this new low SCC population of herds experiences and identifying and reducing the impact of the predisposing factors. The Sentinel project results to date suggest the emphasis

will be on the development of cost-effective environmental mastitis control programs, while maintaining the implementation of the proven controls for contagious mastitis, especially STAAU.

References:

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3. Schukken YH, KE Leslie, AJ Weersink and SW Martin. Ontario bulk milk somatic cell count reduction program 1. Impact on somatic cell counts and milk quality. 1992. J Dairy Sci 75:3352-3358.
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Figure 1: Ontario Provincial Average SCC 1988 to 2000 inclusive



1988 to 2000

Figure 2:

Provincial average SCC data for the 10 Canadian provinces 1995, 1996, 1997, 1998 & 1999

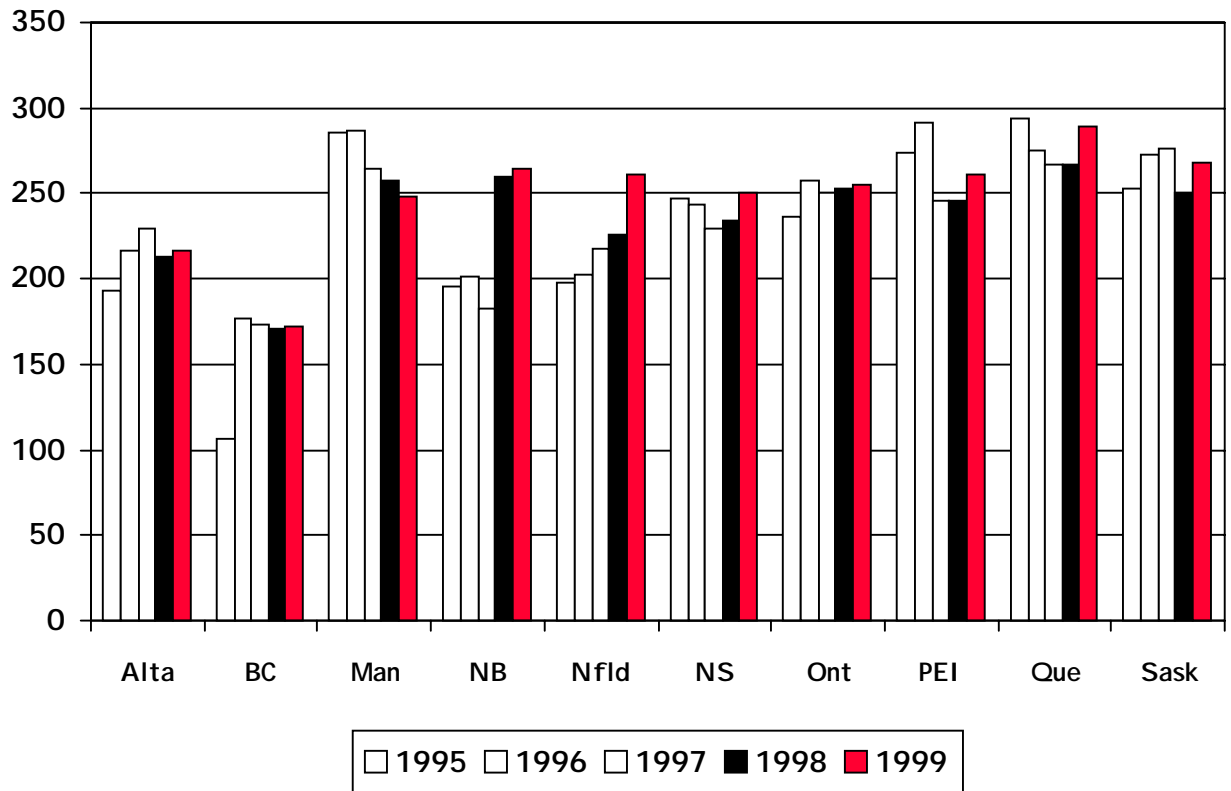


Figure 3: Canadian Bulk Milk Average SCC, 1998 and 1999

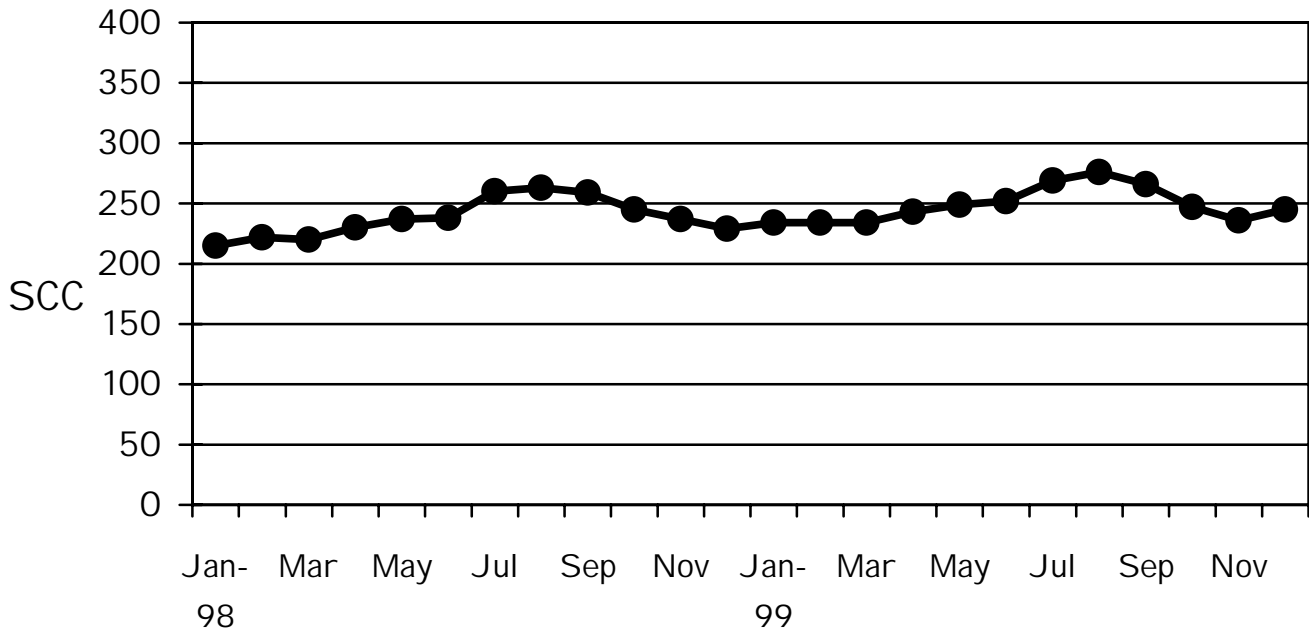


Figure 4: Number of clinical cases sampled per month in Sentinel herds, 1998

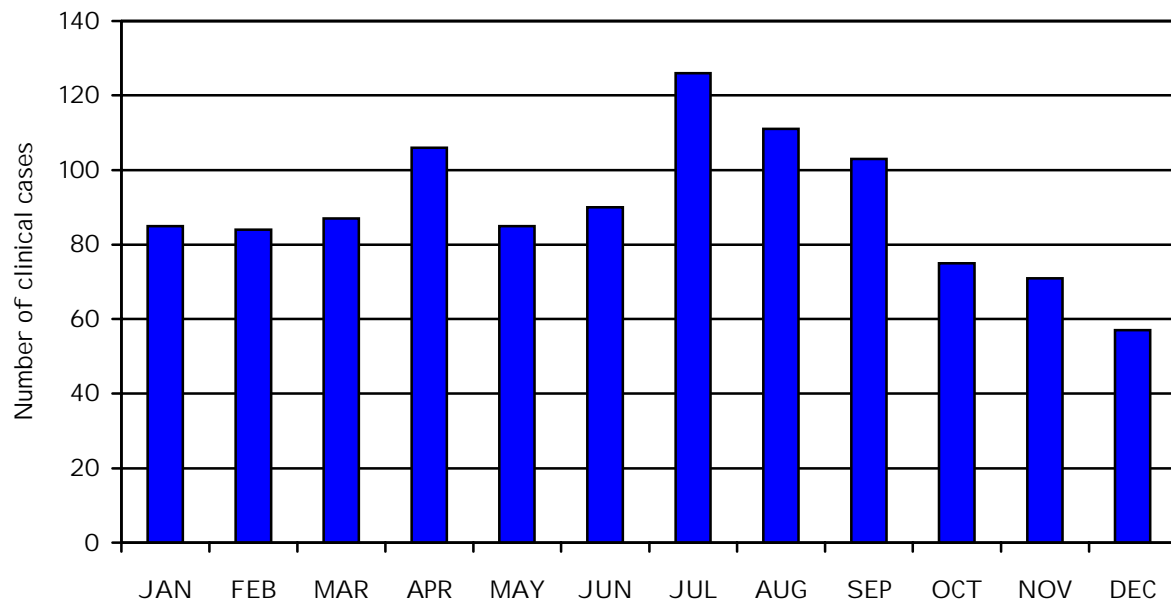
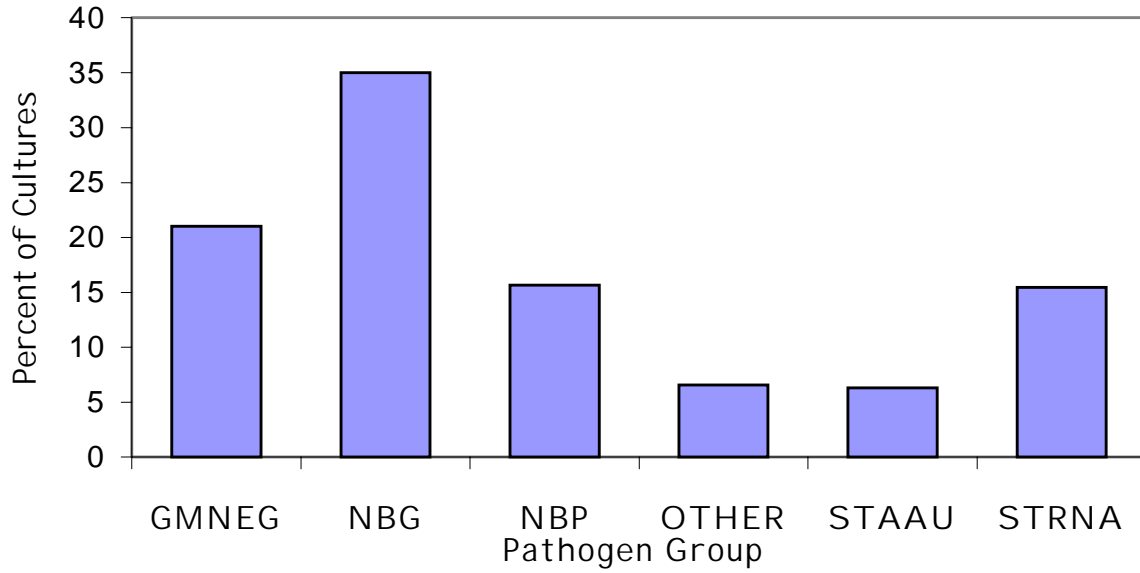


Figure 5: Sentinel herds: bacteria cultured from 1080 clinical mastitis cases in 1998



GMNEG: all gram negative bacteria
NBG: no bacterial growth
NBP: no bacterial mastitis pathogens identified
Other: all other bacteria
STAAU: *Staphylococcus aureus*
STRNG: all Streptococci other than *Streptococci agalactiae*

Figure 6: Sentinel herds: proportion of fresh cows with a milk sample collected for culture in 1998

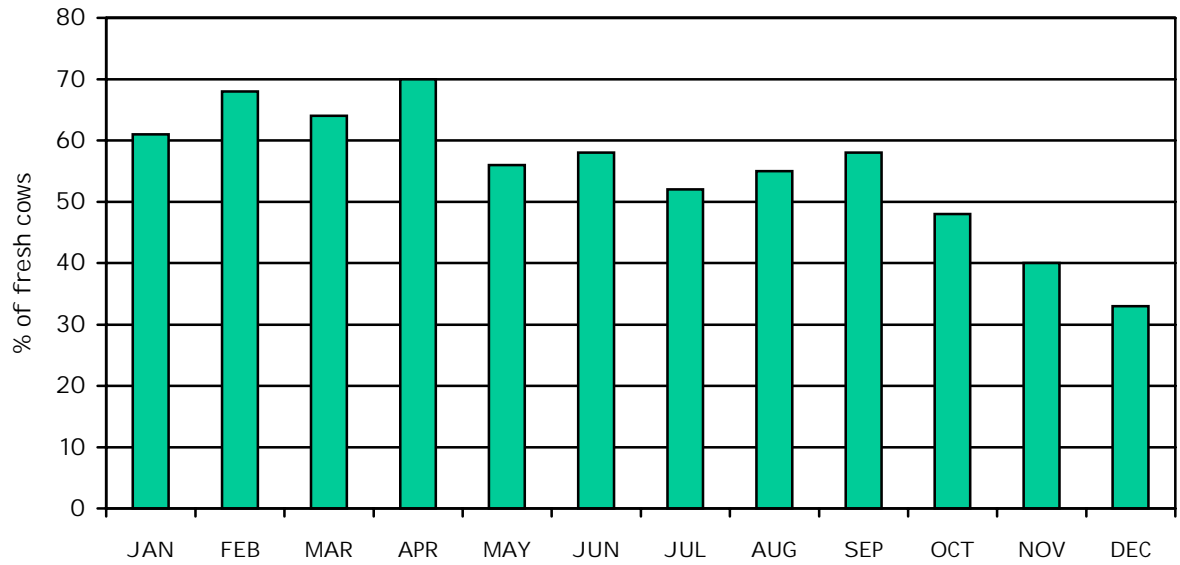


Figure 7: Sentinel herds: proportion of fresh cows cultured with *any* major bacterial pathogen isolated by month in 1998.

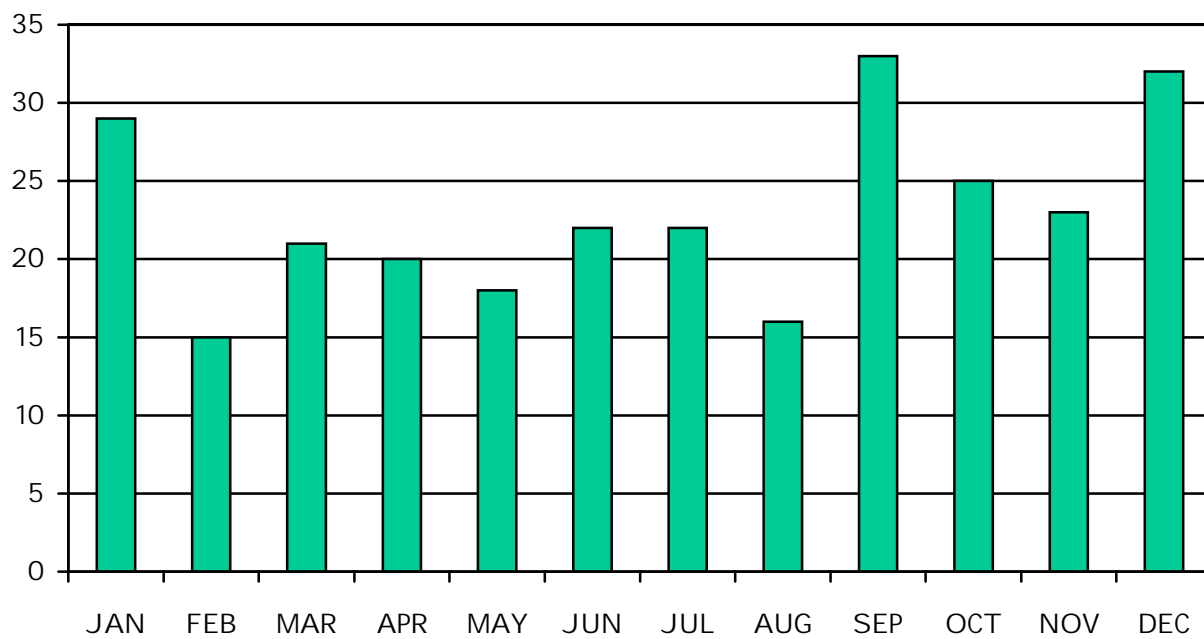


Figure 8: Sentinel herds fresh cow samples, 1998: proportion of culture positive samples within the major bacterial categories (negative cultures excluded)

