The Norwegian Mastitis Control Program: Lessons to Learn

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Take Home Message

- A mastitis control program needs a data information system including somatic cell count (SCC) and clinical disease and bacteriology included in the animal recording system at an individual, herd and regional level.
- Such data can be used to estimate the mastitis dynamics at the herd level, including the prevalence, the incidence of new inflammation and the duration of inflammation.
- The mastitis dynamics at the herd level tells the farmer, advisor and veterinarian to build up a correct strategy for mastitis prevention in the particular herd. All herds are different.
- Farmers, advisors and veterinarians have to learn to use these information systems in an appropriate and economically feasible manner.
- The Norwegian breeding program since 1979 has proven to be effective in mastitis prevention.
- The mastitis bacteriology as well as the environment is in constant change, therefore the mastitis program also has to adapt to this change. Relevant research is needed to apply the correct change.
- Since 1994 the clinical mastitis incidence in Norway has dropped from 0.43 to 0.17 cases per cow-year (60%); bulk milk somatic cell count (BMSCC) fell from approximately 200,000 in 1985 to 112,000 in 2002 and then increased again to 128,000.

Introduction

The main motivation for mastitis control is economical, as stated by Morris (1975). Economic benefits from mastitis control should therefore be linked to different mastitis parameters, like SCC, losses in milk production, waste milk, clinical cases, culling, extra workload etc. (Halasa et al., 2007). As economic gain is a main goal, economic parameters must be included when mastitis control programs are evaluated. Most clinical cases are painful for the animal and work-demanding for the farmer. Hulsen (2011) stated that each diseased cow on a farm is as much work as 40 healthy cows. Mastitis causes changes in the milk content and characteristics such as shelf-life and properties for cheese processing (Barbano et al., 2006), therefore negatively impacting the dairy processors. The absence of careful mastitis control, for example, when directed only at reducing SCC, might lead to huge costs associated with extra treatment and culling at the farm level. The economic analyses should therefore absorb all the important parameters of mastitis control. Other goals are to minimize the risk of having the milk contaminated with pathogens or toxins that are a hazard to human health (*Str.agalcatiae*, *Staph.aureus*-toxines, *Listeria spp* etc), and to eliminate as much as possible specific highly pathogenic strains of bacteria or bacteria that are carriers of resistant genes. These bacteria cause a continuous need for new and sophisticated antibiotics and they might cause transfer of pathogens or resistant genes into the human food chain which again would influence consumer attitude towards milk.

■ Material and Methods

Records of Mastitis at Quarter Level

Traditional mastitis diagnostics are done by cow side tests of clinical cases by farmers and/or veterinarians. Our aim is to accumulate such information over time and to use it at the herd level to reveal which pathogen is involved in a particular herd, in clinical as well as subclinical cases. Since 2005 this information is available on the Internet for farmers, advisors and veterinarians.

Records of Clinical Mastitis

Norway introduced records of treatments in 1975, probably as the first country worldwide. Since 1978 focus has been on clinical mastitis resistance in the Norwegian Cattle Breeding Program. Since 1992 there has been more focus on mastitis than on milk yield.

Records of Subclinical Mastitis

Cow (composite) milk somatic cell count (CMSCC) has been measured every second month or every month and BMSCC four times a month since the late 1970’s or 1980. All information has been incorporated into the Norwegian Dairy Herd Recording System (NDHRS). The most important result is that the information on consecutive analyses is presented and mathematically transferred to more useful data. This presents data so they can be used directly in herd and cow analyses in a problem solving process as well as for prognostics and diagnostics at the cow level.

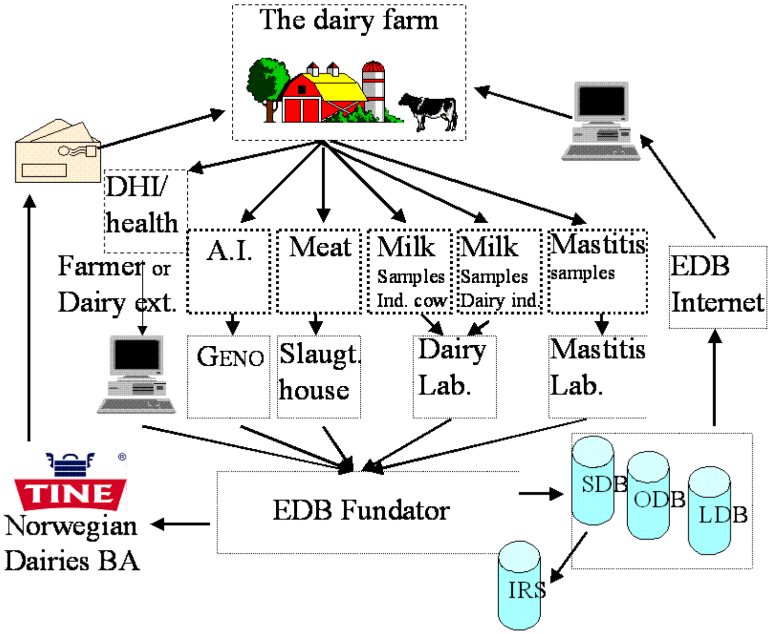

Figure 1. Data flow map illustrating the integration of all relevant information in the Norwegian Dairy Herd Recording System (NDHRS)

▪ The Usage of Information

CMSCC together with available bacteriology is the most important decision-making tool in the daily dairy herd management of mastitis. At the herd level the information can be used to analyse the economics of mastitis, and herd characteristics such as the new infection rate, incidence of clinical cases, duration, prevalence etc. This information of the mastitis dynamics can be used to put up a correct strategy for the herd prevention program. Interventions can be made as early as possible to avoid further destruction of the herd's economics. As an example, a herd with a high new inflammation rate needs to look at its risk factors in the stall environment, while a herd with long duration needs to look more into its treatment and culling strategy.

▪ The Norwegian Action Plan in Mastitis Control

Norwegian mastitis control has followed the main principles stated by Dodd (1980) and Morris (1975). Effective mastitis control should aim to reduce the new infection rate. With new computer technology the Norwegian recording system calculates both the new infection rate based on CMSCC and clinical mastitis records as well as the duration each month for each herd. The variables are described in more detail by Valde et al. (2005). The duration is simplified according to Dodd's equation; the prevalence equals the new infection rate times duration.

The Norwegian action plan in mastitis control is as follows:
If there is a high new infection rate then take a look at:

- Improving milking routines (cleaning (hygiene), good interaction between the milker and the cows (let down and welfare), proper handling and milking equipment (air inlet), good and proper preparation (let down and welfare), careful removal of clusters (air inlet and over milking).
- Improving the functioning of the milking machine (proper vacuum condition (teat handling) including proper liners (teat handling, impacts), proper pulsation (teat handling), vacuum capacity (teat handling, impacts), proper capacity and dimension of pipelines (impacts).
- Improving the environment (clean (hygiene and management) including being dry (hygiene, management and building), good stall design and function (animal welfare, hygiene), and proper bedding areas (animal welfare, hygiene)

If there is a high duration of existing infections: Improve the removal of a reservoir of udder pathogens (culling chronically infected cows (*Staph. aureus* and others)) by having a clean and dry environment (coagulase negative staph (CNS) and environmental), instituting therapy at an appropriate time and of the correct cows (dry cow period, *Staph. aureus* and *Streptococcae*) and establishing a therapy protocol adapted to the pathogens and environment at present (selective dry cow therapy (for expected responders), having appropriate therapy of clinical cases (for expected responders as well as the need for animal welfare) and appropriate detection and therapy of subclinical cases during lactation (for those with economic benefits – very few cases), and ensuring segregation (for unpromising cases until slaughtered)

The pathogens involved are different from herd to herd and the type of pathogens changes over time (Pitkala et al. 2004). This is probably caused by environmental changes and the therapy pressure. From 1994 there was a shift to free-stalls in Norway; from 2006 soft bedding was mandatory and from 2011 25% of the milk is harvested with automatic milking systems (AMS).

At Regional and National Level

In 2000, a survey was conducted in Norway (Østerås et al., 2006) that gave highly relevant information for the implementation of new mastitis prevention strategies. *Staph. aureus* is the most prevalent bacteria, however half of the *Staph. aureus* infections were associated with fairly low CMSCC and the incidence of clinical mastitis was not increased significantly in cows with this bacteria. The milk yield is higher just after calving but reduced later in lactation. The prevalence was highest at the start of the first parity and lowest in the second parity. The prevalence of *Staph. aureus* decreased during lactation while that of *Str. dysgalactiae* increased. There was also a strong seasonal effect, with higher prevalence during late indoor season and the summer compared to the autumn. The survey illustrated the importance of good surveys before implementing a control program. Surveys from Finland also illustrate that the pathogen panorama is shifting over time (Pitkala et al., 2004). The control program has to change over time and also has to be different from country to country because we are not battling the same organisms.

▪ Breeding Program for Resistance

Research has documented that it is possible to breed for a higher resistance to mastitis (Heringstad et al, 2005). The heritability is found to be 3-5% for clinical mastitis and approximately 15% for SCC. To achieve effective breeding development on traits with low heritability, it is important to have large daughter groups. As there is a negative genetic correlation between clinical mastitis and milk yield sufficient weight has to be put on mastitis to get a positive effect. The Norwegian breeding program is probably the only program that has put enough weight on clinical mastitis to get a net positive effect on mastitis in the population.

▪ Other Diseases

The control of mastitis can be even more effective if relevant diseases correlated to mastitis are included in the program (eg. Bovine Virus Diarrhoea Virus (BVDV), milk fever, reproduction, ketosis). It is documented that a herd newly infected with BVD virus had a 7% increase in the risk of clinical mastitis due to effects on the immune system during the infectious stage of the disease (Waage, 2000). When starting the BVD eradication program in Norway in 1992, the prevalence of BVD was 26% serological positive on bulk milk tank samples. BVD was finally eradicated in 2006 when the last PI animals were slaughtered.

▪ Dry Cow Therapy and Teat Dipping

Dry cow therapy was almost “banned” from the Norwegian School of Veterinary Science in the 1960’s and 1970’s. We are now implementing selective dry cow therapy. We recommend all cows with more than 100,000 in CMSCC the last three samples before drying off to be selected for bacteriological testing. Those who are positive for *Staph. aureus* and *Str. dysgalactiae* or other major pathogens should be dry cow treated. No treatment is recommended if CNS is identified. Cows with high CMSCC (above 600,000-700,000) and with major pathogens should be culled at the economic optimal time in lactation. The whole program is scientifically based on the estimated formulas of prediction of success or failure according to Østerås et al (1999a and 1999b) and Østerås & Edge (2000). At present about 0.05% of our cows are dry cow treated. According to our data, approximately 10% should be dry cow treated.

A large project including more than 200 herds evaluated the effect of teat dipping and dry cow therapy under Norwegian conditions (Whist et al., 2007). This project demonstrated that our selection process for the dry cow therapy is effective in that we have achieved a cure rate on *Staph. aureus* of approximately 80%, and reduced the incidence of clinical mastitis by an additional 15%. Teat dipping did not show any positive effect on *Staph. aureus* infections prevalence, but did so with *Str. dysgalactaie* infections.

▪ Results

The results of the Norwegian mastitis control program are illustrated in Figures 2 and 3. There has been a decrease in clinical mastitis from 1994 till 2011(Figure 2) and a decrease in BMSCC from 1980 till 2002 (Figure 3) and for. The economic losses due to mastitis in Norway have decreased from 1991 until 2011 because of reductions in clinical mastitis and production losses. The rate of clinical mastitis can be reduced further with good economic results, as long as the production and replacement loss does not increase. This will be followed closely and is an important part of the management of mastitis control in the country and regions.

The prevalence in 2003 and at the present time (in brackets) of mastitis pathogens at the quarter level isolated from milk during routine sampling in Norway is: *Staph. aureus* 11.2% (7.7%), penicillin G resistant *Staph. aureus* 1.1% (0.9%), *Str. dysgalactiae* 2.9% (3.0%), *Str. agalactiae* 0.02% (0.5%), CNS 1.7% (13.3%). Thus, the prevalence of *Staph. aureus* has decreased and the prevalence of *Strep*. and CNS has increased. Resistance to penicillin G for *Staph. aureus* seems to be under control.

For samples taken from clinical mastitis cases in 2003 and at present (in brackets), 49.8% (35.2%) of cows were infected with *Staph. aureus*, 4.1% (2.3%) with penicillin G resistant *Staph. aureus*, 17.3% (14.6%) *Str.dysgalactiae*, 6.4% (10.1%) coliforms and 7.7% (34.1%) with CNS.

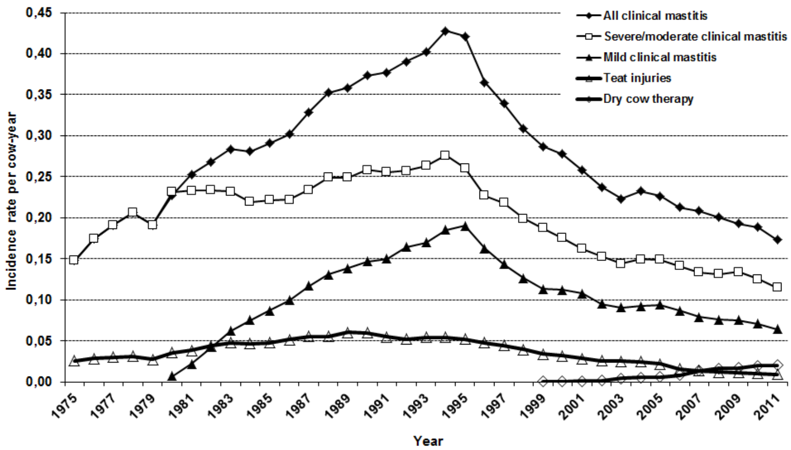

Figure 2. The incidence rate cows being treated for different diagnoses of mastitis and teat injuries per year from 1975 till 2011 (Source: Norwegian Cattle Health Service. www.storfehelse.no)

Detailed analyses on the economic benefit of the control program illustrates that of the total benefit (3 million CDN$) from 1990 to 1994, 1.4 million CDN$ was generated from better quality payment, and 4.3 million CDN$ from reduced production loss related to lower SCC, however there was an extra loss of 2 million CDN$ from increased clinical treatments (both veterinary fees and discharged milk) and finally an additional loss of 0.7 million CDN$ from increased replacements due to mastitis. From 1994 to 2011, after the change in treatment strategy, the total gain of the program was 33 million CDN$: 0.66 million CDN$ loss due to reduced milk quality payment, 8.5 million CDN$ from reduced production losses related to lower SCC, 22.3 million CDN$ from fewer clinical treatments (both veterinary fees and discharged milk) and finally 3.2 million CDN$ from reduced replacement due to mastitis. It is obvious that the treatment strategy to lower the BMSCC during the 1980’s was wrong as the extra treatment and culling costs was hardly significant in improving the economic performance in udder health, despite a large improvement in BMSCC. The new strategy from 1994 with reduced treatment costs of more than 22.3 million CDN$ without any unfavorable effect on quality or BMSCC was very successful. In fact milk quality was improving until 2003, but has since demonstrated a minor increase in BMSCC, probably due to larger herds.

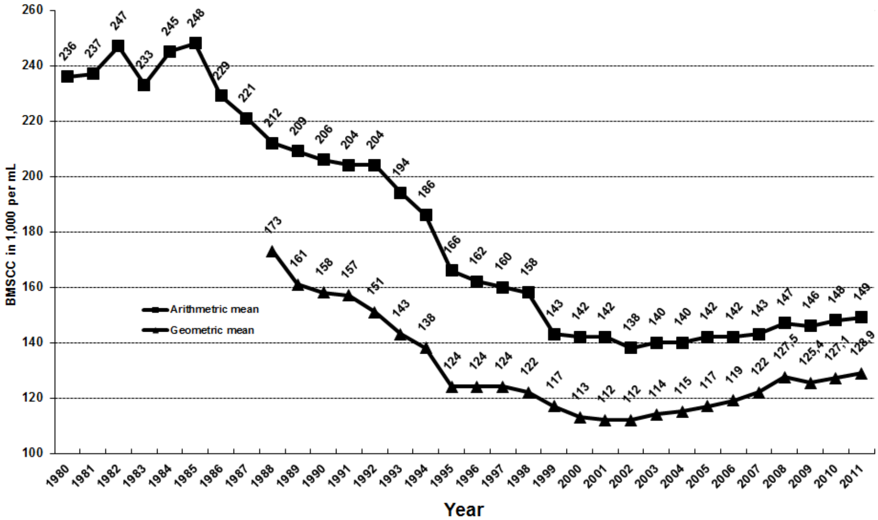

Figure 3. The bulk milk somatic cell count (BMSCC) in Norway from 1980 till 2011 expressed as both arithmetic and geometric mean. (Source Norwegian Cattle Health Service. www.storfehelse.no)

■ Conclusion

The health periodical presents for farmers and advisors the key parameters at the herd level to formulate a correct control program. The new infection rate, duration, and prevalence as well as economic estimates of total mastitis losses in CAD per liter milk delivered was presented every second month to avoid over-treating cows and also to avoid too intensive culling strategies.

We see from the paper of Herigstad et al (2005) that the genetic improvement of the Norwegian cows has been 3% unit per 10 years. This means that of the 0.15 reduction (from 0.35 to 0.20), 0.03 can be attributed to the effect of the breeding program. This is 20% of the total reduction of 35.7 million CDN$, or 7.1 million CDN$. A BVDV herd will show a 7% increase in the mastitis loss due to the introduction of BVDV according to Waage (2000) and 25% of the herds were infected in 1994 compared to zero in 2004. The BVDV contributed with 35.7 million CDN x 0.25 x 0.07, which equals 0.6 million CDN$. The rest, 28 million CDN$ (35.7 - 7.1 – 0.6), will partly be due to attitude changes, changed treatment strategies and better mastitis control due to a better information system etc.

The information technology with lots of coordinated data and modern epidemiological research is an important tool when trying to control mastitis. Experiments from the Norwegian breeding program have proven that breeding is one of the ways to go. Finally it is up to the farmer to implement a control program and this demands motivation. Attitude to handle the problem with the correct strategy is crucial. It is a question of good management practices at farm level.

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