THE COST OF MASTITIS - AN OPPORTUNITY TO GAIN MORE MONEY

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SUMMARY

The total cost of mastitis at herd level will consist of four main fractions. 1: The loss due to milk quality. 2: The loss due to less efficient milk production due to chronic subclinically infected cows. 3: The loss due to discharged milk, veterinary fee and antibiotics due to treatment and 4: The loss due to increased replacement rate or culling of cows at suboptimal time in lactation. Under Norwegian condition with low somatic cell counts the largest loss is due to treatment cost of clinical cases (48 %) and replacement costs (27 %). The distribution of these costs will vary from farm to farm and region to region according to the mastitis control strategy and environmental condition. The distributions of the costs will indicate the correct way of putting in place a mastitis control program. The total losses are not the important figure. The most important for the farmers and veterinarians are how much these costs can be reduced. The reduction in costs is the hidden benefits in a mastitis control program that will encourage the farmer to improve udder health and make a market for preventive veterinary medicine. These profits are not very obvious and it is a pedagogical difficulty to envisage the figures and thus be able to take out the increased gross margin.

(Note 1 NOK = approximately 13 £)

INTRODUCTION

The cost of mastitis is very apparent for most people working with dairy cows, however, the correct costs are not easy to calculate. Farmers will be focused on the most understandable costs that are veterinary fees, antibiotics, extra labour and discharged milk. However, veterinary fees in a high-quality practise could also be seen as investment in a certain situation. Data from Norway has shown that there is very little or marginal association between treatment rate of mastitis and the gross margin in the farm economics. Why is that? It is because the treatment cost is only parts of the total mastitis cost, where most of the cost are so called hidden costs, where therapy could be seen as an investment to decrease these hidden costs.

Cost of mastitis can be looked upon at different levels as quarter level, cow level, herd level, regional level, country level and world level. At each level an impression of the cost will be important for decision making like: Should the quarter be dried off or treated? Should the cow be treated or culled? What is the benefit or potential for preventive investment in a herd? What is the correct strategy for mastitis control at regional or national level? In this lecture I will concentrate on herd level, which is from preventive site the most interesting and difficult. Some of the calculation at herd level could also be used at cow level, as the herd very often will add up the effects of all cows in the herd.

The costs will be presented and discussed in four parts.

1. Quality cost
2. Cost in loss of production
3. Cost of therapy
4. Cost of replacement
Finally the possibilities of doing correct and wrong investments in mastitis control is discussed.

**QUALITY COST**

Milk is one of the most important and natural nutrients in the world. It is used for consumption, cheese and ingredients in other foodstuffs. In later years there has been overproduction of milk in the western part of the world in connection with a competition from other foodstuffs. When there is overproduction and competition the prices will go down. Under such circumstances it is even more important to keep the quality at a very high level. Mastitis is per definition an inflammation in the udder (1). Such inflammation will change the blood circulation and thus also influence the production of milk within the udder. These changes are well documented and can be summarised as:

- Decreased production of lactose
- Decreased production of casein
- Increased influx of blood proteins
- Increased influx of blood cells
- Increased influx of enzymes (especially proteolytic)
- Increased influx of salts
- Increased influx of immunoglobulines
- Changes in fat quality
- Decreased quality of fat membrane
- Etc, etc.

These changes starts already at a SCC at 100,000 per ml (2)

All these changes will have an effect on the quality of milk and milk products. Some of these changes are:

- Unstable and rancid taste of milk
- Less cheese yield from the same amount of milk
- Longer renneting time in cheese production
- Less stability of cheese texture and taste
- Longer whipping time for cream

In 1990 there was at least 30 references on the relation between milk quality and products quality (3).

All these changes will make a less valuable product on the market and the product will be unstable in quality after shorter time of storage. This all will have an impact on the consumers attitude to the product and thus also to the willingness to buy the products at a high price in the long run.

It is this fact that has imposed many dairies to put withdrawals and premium of milk delivered from farms to the dairy industry. Because the dairy industry have seen the extra value of a good quality products. These premium and withdrawals are mostly based on SCC because SCC reflects the inflammation process and thus the changes in milk composition. It is not the cell count by itself that is important but the association of SCC with the changes in composition. In Norway (TINE Dairy Association) these limits are at premium at below 230,000 per ml (+ 4.5 % of milk price of 3.05 NOK), first withdrawal at 300,000 BMSCC per ml (- 2.0 %), second withdrawal at 350,000 per ml (- 4.0 %) and warning and closing the delivery at 400,000 per ml. These quality limits should reflect the value of the changes in milk composition under high quality conditions. It is hard to argue for those specific limits, as the changes in milk starts at around 100,000 per ml in SCC and progress continuously upwards at a logarithmic scale (4). However, this is a decision making process and will at time reflect the goal for each dairy industry and the standard of products placed on the market.
The regulatory limit of 400,000 per ml is more relevant from the aspect of safety for human consumption as the higher the SCC the higher is the risk of the cow having mastitis or other pathogens that will have impact on human health in some or another way.

The quality loss is originally a loss that will affect the dairy processor. It most therefore be the decision of the dairy processor if this cost is distributed to the farmers that contribute most to bad quality or is distributed evenly to all farmers through the economic impact the quality will have on milk prices. It is of course, hard to argue for a specific limit and specific prices at each limit. In addition there are lots of technical problems in calculation of these figures in a faire way. This is outside the scope of this paper.

However, there is no doubt that without premium or withdrawals there is very few incentive factors from the farmers point of view to improve milk quality through mastitis control acting at subclinical infections, except for hidden costs. An effect of these limits could probably be seen in the decrease in BMSCC in Norway since 1984 and increased treatment of mild clinical cases at the same time (figure 1).

![Udder health in Norway](image)

**Figure 1.** BMSCC and incidence rate of clinical mastitis treatment in Norway 1980 till 1999.

**PRODUCTION LOSS**

It is well known and well documented that inflammation and also mastitis is connected to loss in function (functio leasa) one of the cardinal symptoms of inflammation. The loss of production in association with SCC is well documented by both Raubertas and Shook (5) and Hortet et al. (6). Both groups illustrate a difference in production loss from first calvers and older cows. The production loss is also correlated with the logarithmic scale of the cell count. Figure 2 illustrate the
association in milk production loss and SCC. Some Norwegian data also illustrate the association at herd level between BMSCC and production per cow-year.

Milk production loss is not obvious for the producer because this is milk never produced and never seen. It is therefore a hidden cost or lost opportunity income. Another problem with this cost is to put a price on it. As the milk is not produced one should probably withdraw the feed cost from the opportunity income, as milk could not be produced from any feed. Another argument (and there is some indication) is that the inflammation process also needs some energy. This extra energy should also be counted for.

![Figure 2](image_url). Production loss associated with SCC (according to Raubertas and Shook (5)) and produced milk per cow-year associated with BMSCC (data from Norway).

In Norway we have tried to calculate this loss by estimate the theoretical loss in production according to the recorded BMSCC using the results from Raubertas and Shook (5). The estimated loss is then multiplied by the gross margin for milk production (NOK 2.50). Another argument from farmers is that due to milk quota there is no need for increased production, however, there is other tools to meet the goal of the quota at correct time and level.

**LOSS DUE TO THERAPY**

The loss due to therapy is very obvious and visible. There are very few arguments against the losses, although also the argument of filled quota can be put in place. The loss due to therapy will consist of:

- Value of discharged milk
- Value of fed milk minus saved calf feed
- Veterinary fees
- Cost of antibiotics or other therapeutics
- Extra labour due to therapy

Eventually milk losses due to decreased production, decreased quality is accounted for in the two previous chapters and eventually early culling will be accounted for under replacement costs.

The discharged milk will be the daily production at the time of onset of a clinical case or therapy and usually multiplied with 8 days. The 8 days are usually four days of therapy and additionally four days of withdrawal time due to residuals. This amount of milk will be multiplied with the milk...
price given to the farmer (the opportunity income if the milk was delivered to the dairy processor). There is no withdrawal for feed costs because the milk is already produced and the effect of feed is lost. Some of this milk could in some farms be used as calf feed. If so we will withdraw the value of saved feed for calves.

The veterinary fee and antibiotic cost is fairly easy to identify and this is what the most farmers account for as the total cost of mastitis and nothing more. In one sense in fact it is an investment when the situation is put in place. The total loss due to clinical treatments according to daily milk yield is illustrated in figure 3.

![Figure 3](image_url)

**Figure 3.** The increased losses due to clinical cases of mastitis according to the daily milk yield.

Extra work is also a cost when treating clinical cases of mastitis. The problem is how to calculate the price per hour of work. In agriculture unfortunately opportunity income could be rather small at least for the few hours struggling with a mastitis case. Another argument could be willingness to pay for getting rid of all the frustration and stress associated with clinical cases of mastitis.

**REPLACEMENT COST**

The replacement cost due to mastitis is probably one of the largest costs. However, it is also a hidden cost and thus a hidden opportunity income. It is very difficult if possible to calculate in a correct way. Several ways of doing this have been presented. Some have tried to calculate every cost from birth to culling and compared with healthy cows not culled. Others have been building very complex models using linear programming to optimise the decision on replacement. However, every cost by raising a heifer is very difficult to find and is probably not even needed. A more pragmatic way is to state that the market value of an animal is at a certain time the sum of the cost of raising the cow plus the fee for doing that. In this way one could withdraw the income from a slaughtered cow (the culled cow) from the price of a pregnant replacement heifer. This difference will be the extra replacement cost arguing that the opportunity income of that heifer is the value by not needing her for replacement but putting
her out for sale on the market for live animals. Alternatively one could argue that if the farmer do not have a heifer to replace from his own herd he have to buy one also at the market of live animals. Under this concept the frame of the replacement cost will be the value of a pregnant heifer minus the value of the slaughtered dairy cow that are replaced. This difference could then be reduced according to the expected lifetime of a cow (example four years). However, we would like to correct this difference by the extra amount of milk an older cow will give (or first calving cow would give approximately 1.500 litre of less milk). Also we would correct for the value of part of an extra calf to be born when the replacement rate is increased.

Another concept is to simulate the production line of two cases (figure 4). One of a cow living for five years and another line with one replacement at different points in lactation and different lactation's as done by Østerås (7).

Figure 5 illustrate that the optimal replacement cost when replacing a mean Norwegian dairy cow with a mean Norwegian heifer vary from approximately 200 US$ till 400 US$. This optimal
replacement stage in lactation is at month 4 to 6 dependent on lactation number. Figure 5 also illustrate that culling in first lactation month will give a replacement cost of approximately 400 US$ till 800 US$. Culling at this stage in lactation will often be due to diseases like milk fever, mastitis or others. This indicates the lost opportunity income if the disease would not occur and is thus a hidden cost of disease. Probably replacement costs is one of the largest costs of dairy diseases.

**DISTRIBUTION OF DIFFERENT COSTS IN MASTITIS (NORWEIGAN CONDITIONS)**

Figure 6 and 7 illustrate the distribution of cost of mastitis under the Norwegian suppositions. Figure 6 illustrates that the total mastitis loss has decreased from 384 million NOK in 1991 till 245 million NOK in 1999 or 23.3 øre per litre milk delivered to the dairy processors in 1993 till 15.9 øre in 1999, a reduction of 32 percentage.

![Total mastitis loss in Norway](image)

**Figure 6.** Total mastitis loss in Norway from 1989 till 1999.
Figure 7 illustrates the distribution according to the different fragments of mastitis loss. As an example the mastitis loss in 1989 was 22.0 mill due to quality, 114.2 mill due to production loss, 170.7 mill due to clinical mastitis and 60.9 mill due to replacement cost. In 1999 the same figures were 3.2, 56.4, 119.8 and 65.4 respectively. This is all at the supposition set in 1989. If these suppositions are changed in 1999 to the real 1999 money values the losses would be 3.4, 32.5, 115.8 and 65.4 respectively.

**Figure 7.** Distribution of the total mastitis loss to quality, production loss, clinical mastitis and replacement during 1989 through 1999.

It is relevant to register that the farmers are very keen of keeping the quality premium because they see the benefit at each delivery and is thus very encouraged to improve BMSCC. However, the economic effect at farm level totally is very small. The effect this motivation has on production loss and milk quality is fare more. Setting up premium levels has therefore been very successful.

**EVALUATING THE COWS PLACE IN THE FARM (COW LEVEL)**

At cow level it is very important for a farmer to know if this cow in a certain situation is so valuable in the future that she can give a better future value than a heifer replacement. The calculation to do so would be mainly the same as at the herd level. As example the cost of therapy have to balance the gain in expected higher milk price (due to premium), expected higher production and less chance of culling and later clinical cases. If the future value despite therapy is less than the future value of the replacement heifer the cow should be replaced. It is complicated to do such estimation exact, however, it is now through spreadsheet and other tool possible to do so.

**THE BENEFIT OF MASTITIS CONTROL ACCORDING TO OPPORTUNITY INCOME (HERD LEVEL)**

As stated earlier in this lecture the total loss is relatively unimportant if it is not possible to decrease it by reasonable tools or changing management. An example of the total mastitis loss and possible investment strategy is illustrated in Table 1.
This herd was loosing 190,000 NOK per year in 1998 with a potential gain of approximately 50,000 NOK each year if reducing with 27 %. If the investments were 5,000 first and second year the interest rate would be above 2000 %. A tremendous large interest rate. However, we also see that the limit for investment lasting for 5 years are approximately 220,000 NOK. Close to this amount of money the approximation of reducing the loss is being critical. The closer to this limit you are the more confident one should be on the outputs of that investment. With large investments and uncertainty the output of the preventive work is a risky process. The possibility to loose money will be large.

Table 1. Estimated total mastitis loss and possible investment in a herd with 117 cow-year in 1998.

<table>
<thead>
<tr>
<th>Estimated loss</th>
<th>NOK</th>
<th>Investment</th>
<th>NOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality loss (210 BMSCC, 4 month lost premium)</td>
<td>19,411</td>
<td>Income in n year</td>
<td>5 years</td>
</tr>
<tr>
<td>Production loss (210 BMSCC)</td>
<td>43,558</td>
<td>Interest rate</td>
<td>5 %</td>
</tr>
<tr>
<td>Loss due clinical mastitis (88 cases)</td>
<td>88,510</td>
<td>Net present value</td>
<td>223,617</td>
</tr>
<tr>
<td>Replacement cost (20 replacements)</td>
<td>40,099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total mastitis loss</td>
<td>191,578</td>
<td>Proposed investment</td>
<td></td>
</tr>
<tr>
<td>Goal to reduce the cost</td>
<td></td>
<td>First year</td>
<td>5,000</td>
</tr>
<tr>
<td>Potential extra income each year</td>
<td>51,650</td>
<td>Second year</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thereafter yearly</td>
<td>500</td>
</tr>
<tr>
<td><strong>Estimated interest rate</strong></td>
<td></td>
<td></td>
<td>2023 %</td>
</tr>
</tbody>
</table>

In this herd (a real case) there was put pressure on milking routines (management changes) and selective dry cow therapy as well as teat dipping. There was a large *Staph. aureus* problem. Results the next year are illustrated in Table 2.

We see that the herd has gained approximately 68,000 NOK and there had been a large interest rate of the invested money. There is still a way to go according to the Norwegian standard. The loss per cow is still 1,040 NOK while the Norwegian mean is 850 NOK. The loss could still be reduced by 18 % to meet the Norwegian general standard. With the same investment for five years the interest rate of the money would be 342 %.

If instead of 5,000 NOK each year the investment was increased to 10,000 each year (more consultants) the interest rate will decrease to 120 %, still a incredible large interest rate. However, if the farmer and the veterinarian decided to invest approximately 90,000 NOK in the barn or milking equipment the interest rate went down to - 20 %. The farmer would loose money supposed the same gaining time and a reduction of 18 % of mastitis loss. A sensitivity analyses will show that during the same span of time the reduction must be 25 % of the total loss then the gain would be 11 %.

Table 2. Estimated total mastitis loss and possible investment in a herd with 117 cow-year in 1999.

<table>
<thead>
<tr>
<th>Estimated loss</th>
<th>NOK</th>
<th>Investment</th>
<th>NOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality loss (214 BMSCC, 4 month lost premium)</td>
<td>17,762</td>
<td>Income in n year</td>
<td>5 years</td>
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<tr>
<td>Production loss (214 BMSCC)</td>
<td>43,193</td>
<td>Interest rate</td>
<td>5 %</td>
</tr>
<tr>
<td>Loss due clinical mastitis (51 cases)</td>
<td>44,192</td>
<td>Net present value</td>
<td>95,755</td>
</tr>
<tr>
<td>Replacement cost (9 replacements)</td>
<td>17,726</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total mastitis loss</td>
<td>122,873</td>
<td>Proposed investment</td>
<td></td>
</tr>
<tr>
<td>Goal to reduce the cost</td>
<td></td>
<td>First year</td>
<td>5,000</td>
</tr>
<tr>
<td>Potential extra income each year</td>
<td>22,117</td>
<td>Second year</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thereafter yearly</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Estimated interest rate</strong></td>
<td></td>
<td></td>
<td>342 %</td>
</tr>
</tbody>
</table>
interest rate. The same result was obtained with 18% reduction in loss and a gain over 10 years. Eleven per cent is still a fairly high interest rate, however it is close to zero and there is a warning saying that you have to be careful or very convinced on the effect of the proposed investment.

In conclusion there could be stated that in preventive medicine there is not long distance from large money earned till large money lost. This, because we are working with biological processes that are influenced by lots of factors. If one or more of these factors are out of normal range the whole biological system is becoming unstable. Unstableness is typical for biological systems under diseased conditions. Therefor preventive work is a risky business where there is very close range from large money earned till large money lost. This risky process could be more safe only in one way - knowing the biological system and how it works not only from reading books but most important with experience from the field.

REFERENCES


