MOTIVATING ISN'T JUST ABOUT THE MONEY

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People working in the dairy industry are continuously trying to improve the quality of milk to meet the increasing quality demands of consumers. One aspect of improving milk quality is the reduction of mastitis. Mastitis is a production disease and is described as the most expensive disease on dairy farms worldwide. However, farmers do not always perceive mastitis as being expensive. Due to the chronic nature of mastitis, economic damage is spread out over the year. Moreover, the most important cost factors, such as milk production decreases and risk of culling, are not directly visible. Therefore, the costs of mastitis may be underestimated. By calculating the costs of mastitis, farmers awareness of the economic losses can be increased, which may lead to an increase in their motivation to improve the mastitis situation on their farms. By doing this, it is expected that the farmer will make more profit and the quality of milk will improve, giving advantages to the dairy industry as a whole.

However, experiences from practice learn that motivating farmers is not that easy. In this paper, some of the backgrounds of economics of mastitis and motivation of dairy farmers are described.

Mastitis from an Economic Perspective

A recent review on the costs of mastitis by Halasa et al. (2007) revealed that the last scientific study on costs of clinical mastitis was published in 1993 (Miller et al., 1993). Since the review of Halasa et al. (2007), four new studies on costs of clinical mastitis have been published (Table 1). Outcomes of calculations were \$ 105 and \$ 115 per cow on the farm per year for Dutch circumstances (Halasa et al., 2009; Huijps et al., 2007) for all mastitis, subclinical as well as clinical. Cost calculations for clinical mastitis were \$ 131 per cow per year for the Swedish situation (Hagnestam-Nielen and Østergaard 2009) and \$ 71 per cow per year for the US situation (Bar et al., 2008) (Table 1). The Swedish study used a herd simulation model with a maximum level of avoidable losses (\$ 131 per cow per year) at the risk of mastitis being 0.1 of the default risk of mastitis. Thus, the total costs of mastitis in that study would be even higher. In the Netherlands, a dynamic bio-economic simulation model was developed (Halasa et al. 2010), aiming at modeling transmission of pathogens between cows in a herd. In that study, losses due to lower milk production were calculated by taking the marginal costs for having additional heifers that have to be milked to compensate lower milk yields. Consequently, the milk production losses in that study were low. In a study of Bar et al. (2008) a dynamic programming model to optimize culling in relation to mastitis for the US dairy situation was developed. This potentially is a valuable approach, because culling is an important cost factor, which is very difficult to model because large differences exist between farmers in their approach of culling. Total losses for clinical mastitis for the US situation were estimated to be \$ 71 per cow per year.

Table 1. Overview of cost calculations ($US) for mastitis calculated in peer-reviewed publications since the review of Halasa et al. (2007). Two studies calculated costs for all mastitis (subclinical as well as clinical), two studies calculated costs for clinical mastitis only.

	Huijps 2008[1]	Bar 2008[1,2]	Hagnestam-Nielsen 2009[1,3]	Halasa 2010[1]
Category	All mastitis	Clinical mastitis	Clinical mastitis	All mastitis
Milk production losses	49	46	105	15
Labour	5	-[4]	-	15
Treatment	20[5]	20	-	19
Culling	30	5	-	62
Death	0	-	-	0
Veterinarian	1	-	-	3
Milk quality	0	-	-	0
Materials	0	-	-	0
Diagnostics	0	-	-	0
Total	105[7]	71	131	114

[1]Original calculations in €, used exchange rate: $US 1 = € 0.74
[2]Costs were calculated under optimized culling
[3]Costs were calculated as the difference between the default risk and the lowest possible risk, being 0.1 of default risk
[4] Unknown or not calculated
[5]Including costs for discarded milk
[6]In the original paper, the total costs of mastitis were $ 189 per cow per year. The figure given here ($ 105 per cow/year) is derived by using recent Dutch calculations of milk production losses due to increased somatic cell count (Halasa et al., 2009).

Finally, a recent study of Huijps et al. (2008) describes a tool to calculate farm specific costs of mastitis by farmers and their advisors. For average Dutch circumstances, the costs of a clinical mastitis case were estimated to be $ 283, varying from $ 317 for clinical mastitis in the first month post partum to $ 221 for clinical mastitis in the last part of lactation. The costs of subclinical mastitis were dependent on the number of cows with an increased somatic cell count and were caused by milk production losses. For a farm with an average production of 8,500 kg per 305 days and a bulk milk somatic cell count (BMSCC) of 200,000 cells/ml, these costs were $ 27 per average cow on the farm per year. Using an average incidence for clinical mastitis (30 cases per 100 cows per year) the total costs of mastitis for a Dutch dairy farm with 65 cows were calculated at $ 105 per average cow on the farm per year. Costs for production losses are the largest part of these costs, as is presented in Table 1. For the new version of the NMC Handbook Current Concepts of Bovine Mastitis, the same model has been adapted for the US (non-quota) situation, in which the total costs of mastitis were estimated to be $ 101 per cow per year.

Table 2. Costs of mastitis calculated for the average Dutch situation (default) from data collected on 64 Dutch dairy farms. The mean, minimum and maximum values are given. Original data were in €; an exchange rate of $US 1 = € 0.74 has been used.

		Farmers data		
	Default	Minimum	Mean	Maximum
Input				
Farm size (nr cows)	65	28	83	160
Farm size (kg quota)	650,000	195,000	702,621	1,500,000
Yearly mastitis incidence (%)	30	6	29	100
Bulk milk somatic cell count (cells/ml)	200,000	60,000	178,484	300,000
Costs milk production losses ($/cwt)	7.27	0	4.54	7.27
Costs visit of veterinarian ($/visit)	27	0	32	135
Costs of drugs ($/treatment)	27	5	45	148
Value of farmers labour ($/hour)	24	0	25	270
Costs of culling ($/culled cow)	648	0	516	1013
Total costs for mastitis ($/cow present)	105	23	105	267

Motivating Farmers

The Need for Farm Specific Calculations

The incidence and severity of animal diseases may differ between farms. Additionally, with equal incidence and severity, the economic consequences may also differ between farms. Farmer reported data on mastitis and farmers' estimation of cost factors from 64 dairy farms are summarized in Table 2. The incidence of clinical mastitis differed largely between farms, as did BMSCC and the number of cows with an increased somatic cell count (SCC). From an economic point of view, the variation in costs of, for instance, milk production losses, labor and culling is much more interesting than the average costs. The costs associated with a decreased milk production due to disease, as estimated by the farmers, differed from $ 0 to 7.27 per cwt (Huijps et al., 2007). Estimation of these costs under the Dutch quota circumstances is difficult. Based on marginal costs and benefits of having additional cows to fill a milk quota, the authors estimated a default value of $ 7.27 per cwt. This means either that the author's estimation was too high, or that farmers underestimated the costs associated with milk production losses. Also a large variation could be seen in costs of culling. Finally, the costs for additional labor differed greatly between farms ($0 - 270 per hour). In these costs for labor, not only opportunity costs for labor were taken into account. Some farmers used the willingness to pay to prevent the labor associated with clinical mastitis. The costs per cow present on a farm for mastitis, using farmers perception of mastitis incidence, severity and economic consequences varied between $ 23 and $ 267 (Table 2). In the same study, before calculating the farm specific costs of mastitis, farmers were asked to estimate the total costs of mastitis for their farm. Of the 64 dairy farmers, 18 (28 %) made a good estimate or a slight overestimation of the costs of mastitis on their farm. However, 46 (72 %) farmers underestimated the costs of mastitis on their farm. The maximum difference between calculated and expected costs was € 122 per cow per year. These results emphasize the need for farm-specific calculations of the costs of mastitis.

Using Economics to Motivate Farmers to Reduce Cow SCC

Because of the high costs for subclinical mastitis and the fact that the economic effects of subclinical mastitis are hidden to farmers, a follow up study was carried out (Van Asseldonk et al., 2010). It was tested whether farmers were aware of the potential gains by reducing the number of cows with an increased SCC and whether providing farmers additional information on projected economic losses on a regular basis, may motivate them to implement enhanced control practices. A tool was developed for this research. The tool comprised three spreadsheet folders. The first sheet was the standard cover sheet of the milk production recording list comprising the key rolling herd statistics as well as the absolute level of BMSCC. Projected production losses (kg per farm per year) and its economic impact (€ per farm per year), that might support farmers in their decision making to control BMSCC, were appended. In the second sheet the impact of hypothetical reduction in BMSCC on production losses and its economic impact were graphically displayed with a bandwidth of 50,000 cells/ml and 400,000 cells/ml. The third sheet focused on elevated cases in the current lactation including economic information (losses per cow per year). In-depth interviews revealed that the majority of the dairy farmers perceived cow-specific and herd-specific projected losses, due to elevated SCC levels, as not very relevant to them. Farmers posed that SCC was already monitored regularly at cow-level and provided them adequate information to support decision making. Actions (or the lack of actions) were rationalized in a specific context comprising the intertwined notions of intentions and efficacy believes.

Other Motivators

A study of Valeeva et al. (2007) explored different motivating factors and quantified their importance in farmers' decisions on improving mastitis management. Using adaptive conjoint analysis, which is a computer-interactive questionnaire method developed to collect utilities for "products" with various "attributes", data on farmers' motivational factors to improve mastitis management were collected. Motivation to improve mastitis management was the "product" studied. Eight different attributes were distinguished:

1. job satisfaction
2. overall situation on the farm
3. economic losses (due to the mastitis itself)
4. animal health and welfare consciousness
5. ease in meeting regulatory requirements
6. extra financial incentives based on BMSCC (bonus or penalty)
7. dairy product quality and image
8. recognition for a job well done.

The most important factors motivating farmers were job satisfaction and overall situation on the farm (Table 3). These are factors that are internal to farm performance and the farmer himself. Those two factors explain one third of the motivation of the farmers. Whereas external factors that imply esteem and awareness of the whole dairy sector performance (dairy product quality and image and recognition for a job well done) explained in total a little less than 15 % of the total motivation. The non-monetary factors relating to internal esteem were equally motivating as factors affecting farm economic performance (economic losses and extra financial incentives). It is unclear whether the factor animal health and welfare consciousness has to be related to economics (consciousness is then related to the knowledge of economic losses associated with mastitis) or to pleasure in work.

The 100 participants of the study were randomly divided in two groups. The question with regard to extra financial incentives was asked in terms of a bonus (premium) or a penalty. There was a difference in the farmers' perception of the importance "extra financial incentive based on bulk milk SCC (BMSCC)". When the extra financial incentive was based on a penalty, this factor motivated farmers more than when the extra financial incentive was based on a premium. In fact, the extra financial incentive in terms of a penalty was the highest motivator for farmers to change mastitis management (Table 3). Although both types of methods have shown to be effect, it is expected that quality penalties will be more effective in motivating farmers than quality premiums. Further statistical analysis of individual motivators resulted in 3 distinct clusters according to farmers' motivation: "premium/penalty-oriented" motivation, motivation to have an "efficient (well-organized) farm that easily complies with regulatory requirements" and "basic economic" motivation. These results do emphasize the fact that there is more to motivation of dairy farmers than only economics. It must be noted however, that this study was done in the Netherlands, under a milk quota situation with relative good milk prices and a stable economic environment for the dairy farmers. When farm incomes would be lower, the importance of motivators might be different.

Table 3. Mean relative importance (rankings in parentheses) of factors influencing farmers' decision to improve mastitis management (%).

	Premium scenario (n = 40)		Penalty scenario (n = 43)	
Job satisfaction	17.41[a]	(1)	14.90[agij]	(2)
Overall situation on the farm	15.81[abc]	(2)	14.89[bfhj]	(3)
Economic losses	14.23[bdgj]	(3)	14.39[abcehi]	(4)
Animal health and welfare consciousness	13.95[cfgh]	(4)	14.51[ck]	(5)
Ease in meeting regulatory requirements	12.45[def]	(5)	9.59[d]	(6)
Extra financial incentive based on BMSCC	11.35[ehij]	(6)	16.43[efgk]	(1)
Dairy product quality and image	8.63[i]	(7)	8.66[d]	(7)
Recognition for a job well done	6.13	(8)	6.63	(8)
Total	100.00		100.00	
Predictive accuracy, mean of the model fit (R^2)	0.762		0.779	
	W[1] = 0.287, P<0.001		W = 0.275, P<0.001	

[a,b,c,d,e,f,g,h,i,j,k]Means within a column with different superscripts are significantly different ($P \leq 0.05$).

[1]W represents the Kendall's coefficient of concordance (P = Monte Carlo P).

Motivation in a Broader Theoretical Context

During a national survey among 378 randomly selected Dutch dairy farmers, farmers were asked about the most annoying aspect of mastitis. In this study, the uncertainty of a cows' recovery (31%) and the extra labor (24%) were more often mentioned than the financial consequences (20%). In the same study these motivational factors as well as farmers' knowledge and attitudes were highly associated with farmers' real clinical and subclinical mastitis incidence (Jansen et al., 2009). As a result, it can be assumed that economic considerations are just one part of farmers' motivation to work, or not to work on mastitis prevention. When trying to explain why farmers do what they do regarding mastitis prevention, a model from human medicine can be applied: the health belief model (Janz and Becker, 1984). In this model the required preventive behavior depends on two main issues (Figure 1): 1) the belief in a threat, including the perceived severity of the disease and perceived chance that it can happen, and 2) the belief in effective solutions, including the perceived economic and non-economic benefits and barriers.

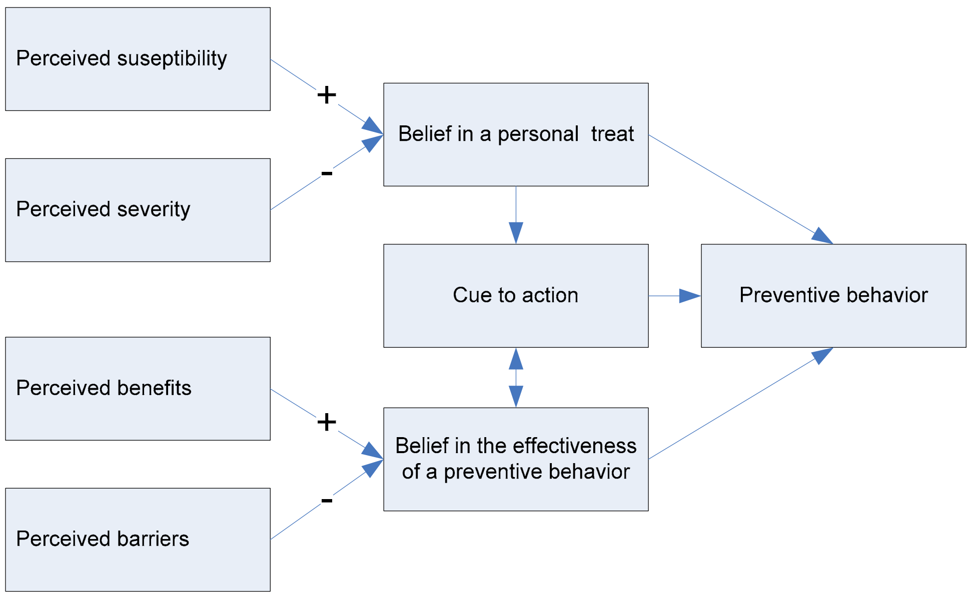

Figure 1. Determining factors with regard to behavior towards udder health. Adjusted from the health belief model (Janz and Becker, 1984).

Results of the aforementioned national survey showed, that in general farmers perceive mastitis as an annoying problem. All farmers say to have the intention to have as less mastitis as possible. This raises the question why farmers who do perceive mastitis problems and who do perceive a "threat" are not motivated to change their farm management. Such intention-behavior discrepancies have rarely been studied in the field of veterinary medicine. From a study in which qualitative interviews were held with dairy farmers (Jansen et al., 2010) it can be concluded that farmers have a strong demand for simple, short-term, effective solutions, even though they know that mastitis is a multifactorial and complex disease and that a simple panacea does not exist. It should be taken into account that farmers opinion about the lack of effective solutions depends on the perceived benefits and barriers when using the proposed management measure. These benefits and barriers are context related and for every farmer different. Social pressure from others, past experiences, education level and farmers' belief in their own competences are just some aspects that influence farmers' perceptions (Lam et al., 2007; Leeuwis, 2004). However, as the interviews showed, all these perceptions seem to reinforce farmers' beliefs that the current preventive measures to control mastitis are neither effective nor practical, and it seems to be one of the main reasons why recommended measures are not adopted (Garforth et al., 2006).

It can be hypothesized that farmers who perceive a lack of effective measures then automatically also perceive the problem as less important, in order to reduce their inconsistency. They will probably accept that they cannot solve the mastitis problem and will therefore remain passive. As a result, when the problem is perceived as less important, the supplied information on, e.g. economic consequences, will not be considered relevant by the farmer and therefore will not reach the farmer.

Concluding Remarks

Dairy farms are businesses and one of the goals of the farmer is to make money. In the case of family farms, the income of the farm should be sufficient to meet the monetary needs of the family. Farmers make many decisions, also on udder health and milk quality. In order to make good decisions, it is necessary to provide the dairy farmer with the economic effects of the different decision alternatives. It is up to the farmer to weigh these economic consequences of decisions against other goals, such as ease of working. Research in the Netherlands showed that there are more factors than only economics that motivate dairy farmers to take certain decisions.

When decision makers at an aggregate level (for instance at the processing industry or governments) want a change in farmers behavior, for instance to improve the overall milk quality to further improve the image of milk as being a health product from healthy animals, it is not sufficient to illustrate the economic benefits for the individual farmer. Although the benefits of changed farmers' behavior might outweigh costs, it remains questionable whether farmers will change behavior only based on economic calculations.

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