

# The importance of dairy herd health provision and data management, with a focus on mastitis control

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## Abstract

Current concerns about global food security and the sustainability of agriculture have increased the importance of efficient dairy production, and in this context the importance of herd health management is highlighted. Veterinary surgeons should play a central role, and data collection and interpretation are central to the successful implementation of dairy herd health. In this article we use the example of mastitis monitoring to illustrate some principles of herd health management, including describing parameters useful for decision-making and discussing the use of predictive tools.

## Résumé

Les préoccupations actuelles relativement à la sécurité alimentaire mondiale et à la viabilité de l'industrie agricole ont accru l'importance d'une production laitière efficiente et, dans ce contexte, l'importance de la gestion de la santé des troupeaux est mise en évidence. Les vétérinaires doivent jouer un rôle de premier plan, et la collecte et l'interprétation des données sont essentielles à la mise en œuvre d'un système efficace de gestion de la santé des troupeaux laitiers. Dans cet article, nous donnons l'exemple du suivi d'une mammite pour illustrer certains principes de gestion de la santé d'un troupeau, nous décrivons les paramètres utiles pour la prise de décision et nous discutons de l'utilisation d'outils de prévision.

## Introduction

In the last five years, concerns over the rapidly increasing global population and changes to the world's climate have meant that food security and agricultural sustainability have become hugely important global issues. For example, the UK government Foresight Report, published in 2011, assessed the likely pressures on global food supply to 2050 ([www.bis.gov.uk/assets/bispartners/foresight/docs/food-and-farming/11-546-future-of-food-](http://www.bis.gov.uk/assets/bispartners/foresight/docs/food-and-farming/11-546-future-of-food-and-farming-report.pdf)

[and-farming-report.pdf](http://www.bis.gov.uk/assets/bispartners/foresight/docs/food-and-farming-report.pdf)). The key findings were:

"The global food system will experience an unprecedented confluence of pressures over the next 40 years;

- Global population size will increase from nearly seven billion today to probably over nine billion by 2050
- Many people are likely to be wealthier, creating demand for a more varied, high-quality diet requiring additional resources to produce
- Competition for land, water and energy will intensify, while the effects of climate change will become increasingly apparent
- The need to reduce greenhouse gas emissions and adapt to a changing climate will become imperative
- Globalization will continue, exposing the food system to novel economic and political pressures."

Key challenges highlighted in the report were:

- Balancing future demand and supply sustainably
- Addressing the threat of future volatility in the food system
- Ending hunger
- Meeting the challenges of a low emissions world
- Maintaining biodiversity and ecosystem services while feeding the world.

## A Role for the Veterinarian in Sustainable Dairy Farming

There is general agreement that efficient production in agriculture, including prevention of disease and minimizing waste, has an important role to play in sustainability and food security.<sup>11</sup> For dairy farming, improved efficiency of milk production will have an impact to improve sustainability. For example, if fewer cows (and replacements) are required and there is less

discarded milk, the environmental impacts per liter of milk sold or per animal on the unit are reduced. A reduction in greenhouse gases, and use of non-renewable resources and chemicals per liter of saleable milk, is a consequence of improved health and fertility because fewer cows (at a given level of production) are required to produce the same quantity of milk.

Improving cow health and fertility to reduce the environmental impact of dairying has the added advantage that it is also beneficial for cow welfare and farm financial returns, and this is an area in which the veterinary profession can and should take a leading role. Yet, despite this, the undertaking of regular, holistic herd health and preventive medicine on dairy units remains relatively rare. Whilst many herds have routine reproductive visits and infrequent evaluation of a 'Health Plan', regular (weekly, fortnightly, or monthly) evaluation of all aspects of health and production is often the exception rather than the rule.

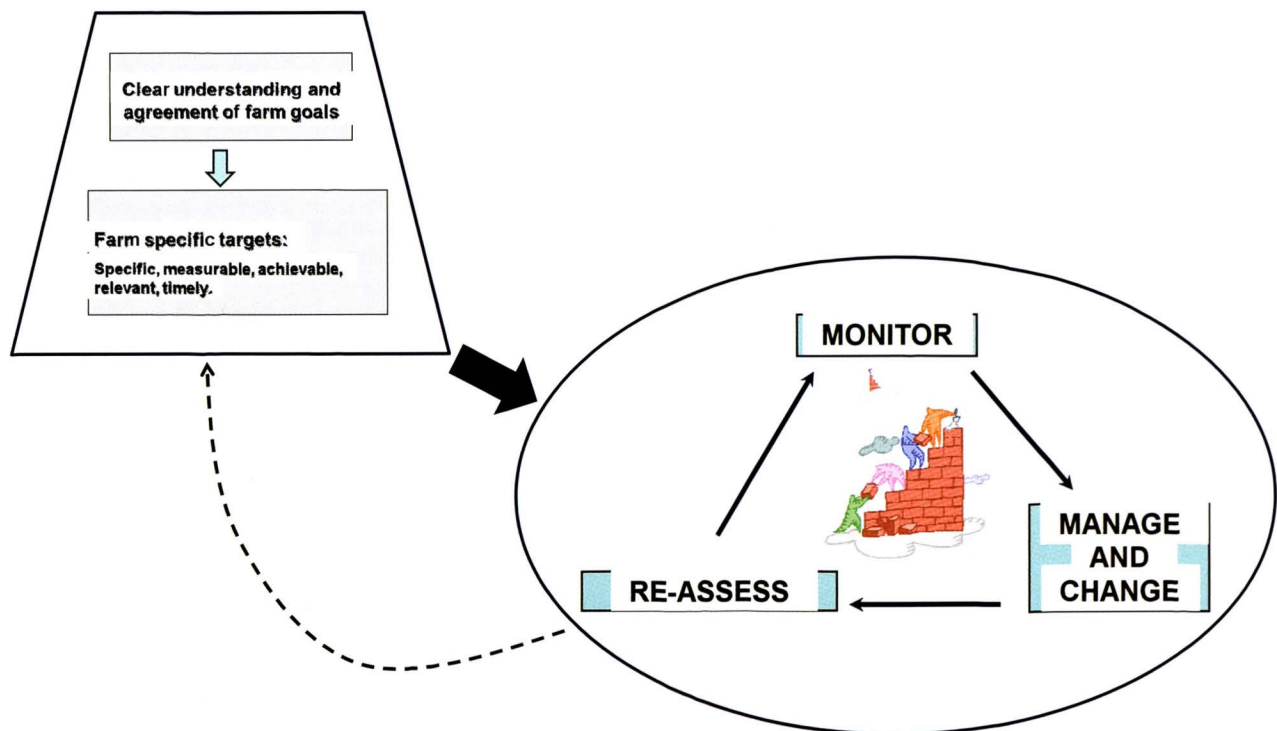
#### Herd health management

Whilst the concept of active herd health management is not new<sup>7</sup>, the current issues of global food security and agricultural sustainability again highlight its importance and perhaps invite criticism over why uptake has been relatively slow to date. In this context, we describe herd health management as *"a method to optimise health, welfare and production in a population*

*of dairy cows through the systematic analysis of relevant data and through regular objective observations of the cows and their environment, such that informed, timely decisions are made to adjust and improve herd management over time"*<sup>10</sup>. Crucially, herd health management is a continuous and regular process, not a short-term response to a herd problem, and the critical aspects are routine evaluation of herd data and frequent contact between the herd health advisor and farm staff such that a close working relationship is developed. An outline overview of the process of herd health management is illustrated in Figure 1.

#### The importance of data evaluation in herd health provision

All businesses need to monitor performance to allow assessment of management structures and enable improvements to be made. However, monitoring itself has a cost to a business (financial, time, etc) and therefore the key to monitoring is to ensure it has a real net value. Therefore, the monitoring of a parameter or performance index in dairy herd health has to go further than just measuring an overall level of the performance; it should be recorded, analysed and fed back in such a way to inform where improvements can be made. In terms of our example of mastitis on dairy farms, a monitoring system should *not* just tell us how bad the situation is, *but should guide us on what we need to do to put it right*.



**Figure 1.** Pictorial representation of overview components of herd health management

One reason that there has been a general lack of monitoring of dairy cow health (e.g. clinical mastitis, clinical lameness, LDAs etc) is often because data are not fed back in a way that is sufficiently useful, and thus the motivation to record disease events declines. In recent years improvements have been made in the monitoring of disease, and mastitis is a good example of how disease monitoring can be made truly informative for disease control. However, we stress that monitoring would involve all aspects of herd health and production, including youngstock, fertility, lameness, infectious disease, nutrition/production, culling, housing, and genetic status<sup>10</sup>.

### Monitoring Mastitis

Until relatively recently, the monitoring of mastitis in dairy herds was generally simple. Bulk-milk somatic cell counts (SCC), available on a monthly basis, were used as a rough guide to prevalence of infection. Individual cow SCC recording was used by many herds, but often to identify problem cows for treatment, culling or removal from the bulk supply. Clinical mastitis was only accurately recorded by a minority of herds, and the indices used were mostly annual incidence rates at quarter or cow level, recurrence rates at quarter or cow level, and possibly intramammary tube usage. In terms of gaining an understanding of the dynamics of intramammary infections in dairy herds, and in particular when new infections are occurring, such monitoring was of limited value, although clearly better than nothing.

Three main areas have changed and proved to be of great value in mastitis monitoring: using data to estimate when new infections occur, using clinical mastitis records to augment SCC data, and using bespoke software to allow analysis to be updated on a regular basis.

#### *Some principles of monitoring*

There has been considerable research over the last decade to indicate that the dry period is an important time when new intramammary infections occur, and that these infections can lead to clinical mastitis in the subsequent lactation<sup>4,5,12,13</sup>. The dry period is now accepted as a key period for mastitis control and widespread data analyses have identified that in some UK herds, more than 75% of clinical/subclinical mastitis arises from the dry period. Clearly, separation of dry period new infections from those that occur during lactation is of huge help in constructing a mastitis control strategy.

Maiden heifers can present particular problems with intramammary infections,<sup>9</sup> and this has important financial consequences<sup>14</sup>. Monitoring new infections in cows of different parities and also in different management groups is again straightforward, and provides key evidence for where to focus control measures. Im-

portantly, infections during the dry period or lactation, in different groups of cows can be carefully monitored over time.

A further use of mastitis data is to assess whether a herd pattern is suggestive of an environmental mastitis or contagious mastitis problem; there tends to be differences between these herd patterns. Contagious mastitis is often associated with a constant high level of chronically high SCC cows, a high rate of new infection during lactation, no great seasonal variation in new infection rates, and poor cure rates both during lactation and the dry period. Environmental patterns, by contrast, often do not show a high level of chronic infection, are often seasonal, are associated with higher cure rates during lactation and the dry period, and may be associated with dry period new infections.

#### *Monitoring mastitis data*

Somatic cell counts can be used to define cows as being infected or uninfected, with new infections being defined as cows moving from below to above a given cell count threshold. Chronically infected cows can also be defined by their (intermittent) persistence above a given threshold. A widely used threshold for detection of infection is 200,000 cells/ml, though there is a strong argument for the use of a higher threshold in early lactation. A list of currently used SCC indices with (UK) target values is given below – all of these parameters require monitoring in different parity and management groups and on a monthly basis:

**Lactation new infection rate.** A measure of the proportion of cows acquiring a new intramammary infection between consecutive recordings (below to above 200,000 cells/ml), measured on a monthly basis. Target <7% (heifers <5%).

**Proportion of the herd infected** (>200,000 cells/ml) and **chronically infected** (>200,000 cells/ml for at least two of the last three recordings). Target values <15% and <10%, respectively.

**Dry period new infection rate:** An indication of the proportion of cows acquiring a new infection during the dry period (proportion of cows moving from below to above 200,000 cells/ml between the end of one lactation and the beginning of the next, although a correction needs to be made if cows are recorded in the first seven days of lactation). Target <10% (heifers <5%).

**Dry period cure rate.** An indication of the proportion of cows curing during the dry period (see below).

**The Net Transmission Index (NTI):** This is a simple way to assess monthly SCC records to give an assessment of the transmission dynamics within a herd. It is a simple ratio of the number of cows with an SCC increasing from below to above 200,000 cells/ml, to the number of cows with SCC decreasing from above to below 200,000 cells/ml. Thus, NTI gives an approximation of



the ratio of “new infections” to “cures”, and can be used to assess both lactation and dry period performance. Target <1.

**Calculated bulk-milk somatic cell count** (from weighted individual cow SCC). This is a useful value to compare with the bulk-tank SCC measured from milk sold. The difference often relates to the number of cows being withheld from the tank.

**SCC legacy.** Using intelligent software it is possible to trace the origin of when cows with a currently raised SCC, first had an SCC >200,000. This is particularly useful to identify the proportion of cows that first had a raised SCC in a previous (rather than the current) lactation and also the proportion of cows that first had a raised SCC from a dry period infection rather than a lactation infection.

#### *Clinical mastitis monitoring*

It is now clear that in most dairy herds monitoring of individual cow SCC alone is insufficient to give a clear picture of mastitis on the unit. It is common to find that the patterns of clinical mastitis are much more helpful to provide information on prevention, although ironically clinical mastitis remains relatively poorly recorded. Clinical mastitis analysis is of particular importance in herds with predominantly environmental mastitis problems.

A central concept of monitoring clinical mastitis is to categorise clinical cases by putative origin based on when it occurs during the lactation cycle. Cases in the first 30 days of lactation are attributed to the dry period<sup>12</sup>. Once the first (index) case has been identified, subsequent cases in that cow are then ‘linked’ to the index case so that recurrences are attributed accordingly. Using this approach it is possible to define target rates and recurrences and to plot herd performance in terms of overall, lactation, and dry period rates. Again, these indices are monitored in different parity and management groups and on a monthly basis. Currently used indices for monitoring clinical mastitis are:

**Basic incidence rates.** Historically this has been calculated as a number of cow or quarter cases/100 cows/year, but it is useful to examine this as a monthly and three-monthly incidence rate. Target rate < 0.3 cow cases per cow/yr.

**Dry Period Origin Rates.** This is the proportion of cows that calve that get an index case of clinical mastitis within 30 days of calving. The target is a rate of <1 case in 12 cows.

**Lactating Period Origin Rates.** This is the proportion of cows at risk that get an index case of clinical mastitis from 30 days-in-milk until the end of lactation. The target is a rate of <2 cases in 12 cows.

**Recurrence rates.** This can be defined in a variety of ways, and here we define it at cow level. Overall,

a target figure for recurrence at a cow level is for the number of recurrent cases to be <30% of index cases, but the overriding issue when examining recurrence rate is to identify whether the recurrences occur in a few cows repeatedly (a common problem) or in many cows but with each having few cases. These different scenarios will lead to differences in mastitis management; either the focus being on reasons for a poor cure rate at first treatment, or the management of a few chronic cows.

#### *Practical methods to evaluate treatment outcomes*

Treatment of intramammary infections (IMI) in dairy cattle is required both during lactation and during the dry period, and assessment of the success of treatment strategies forms an interesting component of monitoring mastitis. Decisions can be made on whether current regimes are effective or whether changes should be made. Arguably, treatments during the dry period are most important since these provide the best opportunity for cure. Treatments during lactation are also of importance, and the assessment of cure rates provides information to some extent on the characteristics of pathogens present as well as on the effectiveness of treatments being used.

#### *A method to evaluate the treatment of clinical mastitis during lactation.*

Up to three sequential SCC are used, alongside further clinical mastitis events, to categorize cows as either ‘cured’, ‘infected’, or ‘uncertain pending the next SCC’. The uncertain category is used for cows that have a SCC between 100-200,000 cells/mL and their final categorization will depend on where the SCC moves over subsequent recordings. SCC recordings occurring ≤14d after the clinical mastitis event will be ignored to allow time for the natural reduction of SCC after infection. (A SCC reading that is missed because of a concurrent case of clinical mastitis is assumed to be a ‘high’ reading, and data treated accordingly.) Here, we define a cure as occurring when either two of the next three recordings are under 100,000 or all three are under 200,000 cells/mL (with no recurrent clinical mastitis), and in this case suitable herd target figures for cure rate are >50% for first cases of clinical mastitis or >40% for all cases.

#### *Evaluating cure of intramammary infections during the dry period.*

Many people have now reported making use of somatic cell count changes across the dry period as indicators of apparent cures and new infections<sup>2,3,8,15</sup>, and a common SCC threshold taken to indicate an intramammary infection is 200,000 cells/mL. The definition of presence of an infection prior to drying off may be taken from one single SCC in the recording before drying off or may include previous SCC and cases of clinical mas-

titis in the months (often three) before drying off. The outcome from the dry period is usually considered to be the first SCC reading in the first month of lactation, so that minimal contamination occurs from new infections during lactation. Since SCC in the first six days after calving are often raised in both infected and uninfected cows<sup>1</sup>, the threshold should be increased if an SCC recording occurs within this period. A suitable herd target figure for dry period cure rate is >80%. One important and notable feature of examining apparent cure rates during the dry period is that it should not be examined in isolation of the dry period new infection rate. During periods of high risk of new infections during the dry period, cows that do truly cure will be at increased risk of a new infection after the cure has occurred, and it will thus appear that they have not cured, when in fact a cure and new infection has occurred.

#### *Bulk-tank monitoring*

In general, monitoring of bulk milk is too blunt a tool to be of much value in mastitis monitoring, the exception to this being herds at risk of *Mycoplasma* or *Streptococcus agalactiae*. Thus, for mastitis monitoring, the role of bulk-tank analysis is usually as a tool to gain entry into less enthusiastic herds, before conducting more detailed mastitis monitoring.

#### **Use of Farm Tools and Prediction Models to Aid Decision-Making**

As an extension to disease monitoring, the use of farm-specific tools to aid decision-making can be of particular value. Disease cost calculators have been a common addition to the armory of the herd health advisor, but tools can be extended to conduct a variety of 'what if' scenarios and to assess the possible expected effects of different interventions. Stochastic (probabilistic) models can be useful to predict the probability of different outcomes, and thus to inform decision-making. An example of a stochastic mastitis model to make farm-specific predictions will be provided during the conference.

#### **Into the Future**

Mastitis monitoring has moved on greatly in the last five years with performance indicators becoming much smarter, some basic molecular techniques being commercially available (e.g. PCR and PGFE) and data being accessible in different farm software and via the web. It is likely that the next five years will see more improvements, and many of these are likely to be at a molecular level. A significant movement could arise from predictive genotypic models: the ability to predict

pathogen behavior and host susceptibility could revolutionize mastitis monitoring and management, and such technologies may not be far away.

#### **Summary**

Current concerns about global food security and the sustainability of agriculture has increased the importance of efficient dairy production and in this context the importance of herd health management is highlighted. Veterinary surgeons can play a central role and data collection and interpretation are vital to the successful implantation of dairy herd health.

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