Control of Cell Count

An essential handbook for the control of cell count and milk quality
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Causes of a raised cell count

The milking cow is frequently challenged with mastitis causing bacteria and some of these become established infections within the udder. All cows that carry a mastitis infection develop a raised somatic cell count: some of these cows show abnormalities in the milk or the udder that can be detected by the stockman.

In other words, all clinical mastitis cases have raised cell counts. Yet not all subclinically infected high cell count cows will show clinical signs of disease. It’s worth remembering this since often problems with clinical mastitis in the herd can be tackled by managing subclinically infected cows.

The origins of a high bulk cell count

In all herds, there is always a proportion of cows that are infected in one or more of their quarters. Cows that are non-infected are at risk and a proportion of them will become infected with time. Over the same time a proportion of infected cows will either leave the herd, be dried off or be cured. Cows may either self-cure or respond to treatments.

The level of infection in any herd, at any time, depends on the balance between the number of cows getting infected and the number getting better. If cows stopped getting infected then the normal cull rate of the dairy herd and addition of predominantly clean heifers, will eventually mean that no cows will be infected in the herd.

Recent research into UK cell count data has revealed that around 17% of heifers are infected at their first ever milk recording. It is

Clover Cell Check

Any recorded herd can have their data processed via the Clover Cell Check software. This will categorise cows in the herd and allow specific advice to be given on managing herd cell counts. Reports are generated every month with simple action plans for a few cows.

Seasonal trends can be identified allowing producers to take proactive steps to minimise the impact of troublesome periods of the year. Problems with the milking equipment, or with dry period and calving management, can be highlighted and corrected.

Farm comparisons are made possible by using a series of benchmark and league tables. This allows farmers to evaluate their strengths and weaknesses against other dairy farmers in the same area. Regular on farm Cell Check Club meetings ensure that useful ‘best practice’ tips can be shared between participating farmers.

Clover Cell Check – total cell count control

Half of all cows recorded in the UK have a cell count below 85,000 cells per ml.
thought that these animals may have acquired infection before they joined the milking herd but at present it is not known if the infection was acquired months earlier or just in the few days surrounding calving. The same research showed that half of all cows in milk had a cell count below 85,000 cells per ml. Only one in ten cows had a cell count above 460,000 cells per ml, while typically one in four cows have a cell count above 200,000.

The basis of controlling mastitis using cell count analysis is to use monthly recording information to decide if a cow is infected or not. Because milk recording involves sampling a ‘composite’ cow sample taken from a mixture of all four quarters’ milk, the California Mastitis Test (CMT) is recommended as a cheap and simple way to determine infection status at the quarter level. The CMT tends to go positive when a quarter has a cell count in excess of around 400,000 cells per ml. It is now well accepted that a composite cell count (from a mixed sample of milk from all four quarters) of more than 200,000 cells per ml is a very good indication that the cow is infected in one or more quarters. Cows with a cell count below this threshold are often referred to as being ‘low’ and those above as being ‘high’.

Around half of cows with a composite cell count above 200,000 at any recording will be below 200,000 by the next recording. Others will often show a steady rise in cell count as the infection becomes more firmly established in the udder. This phenomenon can be referred to as the ‘infection escalator.’
The 200,000 ‘threshold’

It is important to understand that using a threshold of 200,000 cells per ml of milk, based on one monthly recording sample, is a very ‘blunt’ approach. It is known that some infected quarters shed very few cells at some milkings and that cows in very early or late lactation can be above 200,000 and be non-infected. This is also occasionally seen if recording is carried out after a short inter-milking interval when milk is more concentrated. Despite these limitations the ‘broad-brush’ approach to cell count management using the system described in the following pages has proved extremely successful in reducing infection prevalence in many herds.

In an average herd and across the country, around one in every four cows have a cell count above

200,000 at any monthly recording. It is possible to classify these cows into four distinct groups using cell count analysis software such as Clover Cell Check or NMR’s Herd Companion website.

Individual infected cows in a herd all contribute cells to the bulk tank. It can be quite difficult to work out which cows need what kind of management. There can often be a temptation to be drawn to the few cows contributing the greatest number of cells. Meanwhile there may be a larger number of more recently infected cows that together present a bigger problem. Clover Cell Check classifies the infected cows in the herd into one of four categories:

- Firsts
- News
- Repeats
- Chronics

**Firsts**

Cows that are above 200,000 at their first recording of any lactation are referred to as ‘firsts’. These cows may have acquired an infection in their first month of lactation but the majority of these cows are likely to have been infected around calving, during the dry period or prior to drying off. This means that some of these cows may well have been infected for several months.

Cows will generally have a raised cell count if they are sampled in the first few days after calving. However the CMT will show that no single quarter has a higher cell count than the others and it is likely that after ten days or so, the CMT will be negative on all four quarters if the cow is non-infected. We aim to see fewer than fifteen per cent or one in seven cows high at their first recording of each lactation.
News
Cows that have been below 200,000 for all previous recordings in the current lactation but are now above this threshold, or ‘high’, are referred to as ‘news’. It is assumed that these are recently infected cows. If the cow has had three or more low recordings prior to their first high recording of their lactation then it is almost certain that the high recording represents a genuine new infection. If the high is the second recording of the lactation then it is possible that the cow was not shedding cells at her first recording despite being infected on that day. The aim is to see fewer than four per cent (or one in twenty five) of the number of cows in milk in any month appearing as a new infection.

Repeats
Cows that were low at the previous recording but have been high for a second or subsequent time in their current lactation are referred to as ‘repeats’. For this group the issue relating to intermittent shedding of cells is very important. If the cow has had three or more low recordings prior to the current high then the infection is almost certainly another ‘new’ type infection. This subset is sometimes referred to as cows that are ‘true’ repeats. The cow having been completely non-infected in the intervening months. However, if the cow temporarily dropped below the 200,000 cells threshold for just one or two recordings then it could mean that a previous infection was persisting with variable shedding of somatic cells; in other words, a chronically
infected cow. We aim to see fewer than one in twenty cows in milk in the repeat category each month.

**Chronics**
Cows that have been above 200,000 for two months or more are referred to as ‘chronics’. Some of these cows will have only just joined the list of chronics having appeared on the new, first or repeat list in the previous month. Others will be making a regular appearance and may have been infected for most of their lactation to date. We would hope to see fewer than fifteen per cent (or one in seven) of cows in milk in this category of infected animals.

Work has shown that cows that have been infected for longer tend to be more difficult to treat successfully. Older cows are generally harder to successfully treat and cows infected in more than one quarter can be tricky. Clover Cell Check helps vets advise what approach to take with each cow.

**Options for action**
If the recorded bulk cell count is less than 150,000 cells per ml it is unlikely to be cost effective to select any cows for antibiotic treatment. All milk sold will attract payment at full price. However, it is still worth keeping an eye on the dynamics of infection in the herd and it could well be worth using the CMT to check which quarters are infected in cows listed with cell counts over 200,000. This level of action is certainly advised if more than one in four cows in the herd are listed as being above 200,000 cells per ml. In this case a low bulk cell count could merely mean that infections are not yet long established and there will be an inevitable rise in bulk cell count if action is not taken.

If the recorded bulk cell count is above 200,000 or if there are more than one in four cows with an individual cell count above 200,000 then some early action will always be a good investment and may help prevent a potential problem with high bulk milk cell count levels.

**The ‘infection escalator’**
Recent work looking at the cell count profiles of over half a million cows, in over 5,000 UK herds, focussed on 56,000 cows that had been infected for two or more months – the so called ‘chronics’.

One in five of these chronically infected cows had been infected continuously since their first recording in that lactation. The remainder were infected during their lactation and the researchers found that seven out of ten of these infected cows had started with a cell count of less than 500,000 cells per ml.

While three out of five of these cows then remained below 500,000 cells per ml the other cows showed a steady rise in cell count as their infection became longer established. One in six of the cows infected during lactation reached cell counts of over one million.

**Factors affecting the chance of treatment success**
Not all infections respond in the same way to treatment. There are several important factors to consider before a cow is targeted for treatment. The following aspects may all be involved:

- days in milk
- duration of infection
- age
It is well known that treatment of cows during lactation is much less successful than antibiotic dry cow therapy. Typically we can kill all bacteria in an infected udder in 25% to 50% of infections treated with antibiotics during lactation, whereas we would hope to cure 80% of cows treated at dry-off.

Cows are generally dried off according to their

**Tylan & Micotil – The technical story**

Tylan 200 is an injectable antibiotic preparation containing 200 mg of tylosin per ml. Although it has been around for many years there are some specific characteristics of Tylan 200 that make it a very useful product in mastitis and high cell count management.

Due to the relative acidity of an infected udder compared with the Tylan 200 formulation, the antibiotic has a tendency to concentrate in the udder. This phenomenon is sometimes referred to as ‘the pH trap’ and means that within an hour there is more than twice the concentration of tylosin in milk than in the blood stream. Levels of antibiotic continue to concentrate within the udder for six to eight hours before starting to decline.

The second interesting, and useful, feature of Tylan is that it can penetrate the interior of the inflammatory cells present within an infected udder. A cell type called the macrophage can be a place of hiding for bacteria such as *Staphylococcus aureus* whereas *Streptococcus uberis* can use mammary epithelial cells to evade normal udder defences.

Tylan 200 is able to concentrate within these cells and studies have shown that concentrations of Tylan 200 within the cell can be twenty one times higher than in the fluid around the cells.

Field studies using Tylan 200 to attempt to enhance cure rates have illustrated that this injection can improve cure rates when cows are dried off and when the product is used at the same time as tubes during lactation. This antibiotic is a very useful part of the treatment armoury on farm.

Some veterinary surgeons have advocated Micotil (tilmicosin) at dry-off as it is thought to be very effective in cows with *Staphylococcus aureus* infections. This product has some restrictions on it’s availability and it’s use should be discussed with the vet.

- number of quarters infected
- front or back quarter
- the bacteria involved

**Days in milk**

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next expected calving date but for cows with persistently high cell counts in late lactation it may be worth drying them off earlier than this. This is less relevant for recently infected cows on the new or repeat list but very relevant for cows on the list of chronically infected animals or those on the repeat list that have had a majority of their recordings over 200,000 cells per ml.

It is well known that treatment of cows during lactation is much less successful than antibiotic dry cow therapy

Any cow above 400 days in milk might be considered for early dry-off. It is always worth checking her daily yield and any farm records of clinical cases of mastitis. Many advisors now suggest that cows with no history of clinical mastitis cases – and with a history of low cell counts – can be milked on until around five weeks prior to calving. If cows are dried off early, special attention must given to feeding, as they may have a tendency to get over fat prior to calving.

If a cow has shown a cell count of above 200,000 for six months or more then it may be cost effective to consider using an ‘enhanced dry therapy’ approach. These cows will frequently be harder to cure successfully with conventional antibiotic dry therapy than a cow infected more recently. This is especially true if the cow is older and has previous high cell count lactations or a history of frequent clinical mastitis cases.
Additional antibiotic such as a whole bottle of Tylan 200 (Tylosin) at dry off has been shown to enhance bacteriological cure rates by 10% or so. Micotil (Tilmicosin) is also frequently prescribed for this purpose but needs to be administered by a veterinary surgeon.

**Antibiotic injections at dry cow tubing – enhanced dry therapy**

If an additional injection of antibiotic is to be used in the dry period then opinions vary about whether to treat cows at dry off or at some later point during the dry period. It is thought that some infections shed bacteria intermittently from deep abscesses within the udder. Some advisors, therefore, believe that administering the injection a few days or weeks after the udder has been tubed with antibiotic may improve the chances of a high concentration of antibiotic coinciding with release of bacteria. It is thought that this effect could enhance cure rates.

Other, perhaps more pragmatic, advisors believe that if cows aren’t injected at dry-off they may arrive at calving without ever receiving their injection despite good intentions! Injection at dry-off ensures that the injection actually gets done.

For cows in late lactation, it is occasionally possible to continue to milk an infected cow on just three quarters and to cease milking the problem quarter. In this case the CMT positive quarter may be tubed with lactating cow tubes or just ignored until all four quarters receive dry therapy. Obviously if a lactating cow is tubed in one quarter then the appropriate milk withhold period should be observed or the composite
sample submitted for antibiotic residue testing prior to inclusion of the cow’s milk in the bulk tank.

**Number of consecutive high recordings: the duration of an infection**

Cows listed on the chronics list may have recently joined the list or have appeared there for several months. Some of the cows that are appearing for the first time probably represent the most cost effective group for treatment during lactation. Cows that were new infections in the previous month but have failed to go below 200,000 again are very unlikely to do so without help. All these cows are good candidates for therapy in lactation.

‘True Repeats’ are those cows that have been infected previously but have been low for the last three or more recordings. These animals are also good candidates for treatment if they fail to self cure after a month or so. Finally there are cows that appeared on the ‘firsts’ list last month and which were not infected at the end of their previous lactation. These infections have been acquired recently and should be fairly susceptible to treatment.

Cows that have been high for six months or more are ones to avoid treating since therapy in lactation is unlikely to be successful. A similar group are those cows appearing on the repeat list that have only briefly, for one or two recordings, been below 200,000. If treatment is advised during lactation then one of the more aggressive approaches should be selected for this group. These are described later in this handbook.

**Age**

It is well recognised that younger cows respond better to therapy because older cows have had a greater chance of suffering a persistent
infection. When selecting cows to tube it is worth considering this fact.

**Number of quarters infected**

Cows with more than one quarter infected are less likely to be cured effectively following treatment. Of more importance perhaps is to recognise that, for these cows, systemic antibiotic injections are often more cost effective than tubes alone. A high proportion of cows that are infected on one quarter are found to have some infection on one or more other quarters. This tends to suggest that antibiotic injections should be used more commonly than simply tubing a single quarter. This should help to resolve any infection in the other quarters and rarely extends the milk withdrawal period for very long.

**Front or back quarters infected**

It is generally thought that long term and well established infections are more common in rear quarters. In addition the graph below demonstrates that:

- infections in front quarters are more easily cured than those in the rear quarters
- infections involving more than one quarter are less easily cured
- infections are more easily cured in young cows

**Testing a cow for antibiotics**

All quick antibiotic tests are intended for use on bulk milk. It is therefore recommended that an individual cow sample is diluted with bulk milk prior to testing. Most milk purchasers offer a same day antibiotic milk testing service and samples can usually be sent with the tanker driver.

![Effect of age and both number and position of quarter affected, on cure rate after dry-cow treatment.](image)
Milk withdrawal periods
It is a fact that many treatments are used in a different way to the recommendations and indications contained on the product packaging. This means that special care must be taken in the interpretation of milk withhold periods. We would always recommend that a milk sample is taken and after dilution with some bulk milk, it should be tested by your own milk processor.

Aggressive lactation treatments
Three approaches can improve the success of treating mastitis during lactation:

• treating for a longer period of time: ‘extended therapy’

• use of an antibiotic injection as well as intramammary tubes: ‘tubes plus injection’

• taking advantage of some of the natural chemical changes that take place when a cow is dried off: ‘the mini dry period’

Extended therapy
Several decades ago researchers proved that very impressive cure rates, similar to those seen with dry cow therapy, are possible if cows are treated at every milking for three weeks or so. Obviously such long periods involve discarding huge volumes of milk and the use of a massive number of tubes. A compromise approach may be used and is suitable if the CMT has shown that only one quarter is affected. This ‘off label’ approach involves tubing the cow for a minimum of a week at each milking. Her milk is tested after the recommended tube milk withdrawal period ensuring that milk is antibiotic negative prior to returning it to the tank.

Tubes plus injection
There are a couple of tube and injection combinations that have a licence for concurrent use. These have generally shown a small improvement in cure rates compared to tubes alone. It makes sense to use an injection when
more than one quarter is positive to CMT and in some cases injections alone, without tubing, can be more cost effective.

**The ‘mini dry period’**
This approach takes advantage of the chemical changes that occur in the cow’s quarter when milk ceases to be harvested. The affected quarter is tubed and then not milked for a week. Meanwhile milking continues on the other three quarters although the milk is discarded. Once milking on all four quarters resumes (after one week) milk is withheld from the tank until the composite sample from all four quarters passes an antibiotic screening test – usually not too long.

For the ‘mini dry period’ approach it is especially important to ensure that all milkers are aware of the regime and to time the treatments to avoid relief milkers (at weekends for example).

**Selecting a tube for lactation treatments**
Traditionally, vets have been very keen on testing milk samples to identify the bug involved on farm and then using that information to suggest an appropriate tube. Unfortunately this approach takes too long to be of relevance for the sampled cow and it seems normal to have around one in three samples returned with no growth or contamination. A better plan is to get into the habit of collecting a sample from all clinical cases immediately prior to first treatment of affected cows. These samples should be stored in a freezer on farm and once ten or more samples have been collected the oldest can be discarded every time a new sample is collected.

This testing system ensures that a ready supply of relevant samples is always at hand if testing is required. Another technique, to help choose the best tube on any farm, is to assess how many recent subclinical infections recover by themselves before the next month’s recording.

**Collect a sample from all clinical cases immediately prior to first treatment of affected cows**

We find that this figure varies from farm to farm and we use Clover Cell Check to compare different farms. Farms with ‘sticky’ types of bugs like *Staphylococcus aureus* may only have one in four cows recover from a cell count rise above 200,000 before their next recording. Other farms where ‘come and go’ bugs such as the coliforms are more common, may see as many as three in every four recent infections resolve without any treatment prior to the next recording date.

Finally, if no data is available, there is every reason to use the tube that works best for your clinical cases to treat the subclinical high cell count cows.

**The dry period**
It is now clear that the dry period is one of the most critical times for mastitis control. At certain times during the dry period cows are over ten times more susceptible to infection than when they are milking. The critical times for new infection are thought to be for the few days after a cow is dried off and then for the week or so prior to, and around, calving.
In every herd some cows are infected at the time they are dried off. This is the reason that almost every cow in the UK receives a tube of antibiotic dry therapy, in every quarter, at dry-off. A high proportion of these infections are cured by tubing, but it is also possible for those same cows to acquire another new infection prior to the first recording of their next lactation.

Cell count information can be very useful in advising farmers about the success, or otherwise, of their dry period management. The cell count in the last recording of one lactation and that of the first recording of the subsequent lactation are compared to measure ‘apparent cure rates’ and also to assess the level of infection pressure applied to cows that reach the end of a lactation non-infected.

Of those cows which are high (above 200,000 cells per ml) at their first recording of the lactation, a proportion are considered to have acquired their infection prior to joining the main milking herd. If their cell count was high at the last recording of the previous lactation it is possible that the same infection was present then and has failed to clear during the dry period.

It is also possible, however, that the previous infection resolved and a new infection has become established.

In order to try and understand the dynamics of infections surrounding this period, we study the outcome of the group of cows that are dried off after a low recording and the group of cows that are dried off after a high recording. These figures are reviewed for all cows dried off over the previous twelve months.

In general we aim to ensure that fewer than one in ten cows, that have been dried off after a low recording, are high at the first recording of their next lactation. This implies that all management factors are in place to limit the occurrence of new infections around the dry period and more significantly perhaps, around calving.

For those cows dried off after a high recording we would aim to see fewer than one in five cows high at the first recording of their next lactation. This implies good cure rates following antibiotic dry therapy but also infers that very few cows that are cured are then re-infected prior to their first recording.

**Internal teat sealants**

Use of internal teat sealants (such as Orbeseal) after administration of dry cow antibiotic tubes has totally revolutionised cell count and mastitis control. An internal teat sealant assists in prevention of new infections over the dry period; there is then less concern over the duration of any benefit of antibiotic tubes. Teat sealants are always recommended for use with...
‘Clean Up, Seal Up’ plan hits mastitis hard

Pfizer’s ‘Clean Up, Seal Up’ dry cow plan, using antibiotic tubes plus OrbeSeal, aims for a 30 per cent reduction in clinical mastitis cases during the first two months of lactation. Fewer infections also means lower cell counts and protects herd output. The protocol involves drying off with conventional antibiotic dry cow tubes to clean up pre-existing infection, followed immediately by OrbeSeal to prevent new ones.

Aside from the clinical data on which the protocol is based, the most compelling evidence of effectiveness of OrbeSeal is that farmers don’t stop once they’ve started it. Many farmers say they see significantly fewer clinical cases and veterinary Practice sales of milking cow tubes tend to show a reduction of about one third once this strategy is started in every cow.

Research shows that more than half of all clinical mastitis cases in the first 100 days of lactation can be caused by pathogens entering the udder during the previous dry period. There are two periods with high risk of infection, one just after drying off and the other, around calving.

The consequence of a new infection picked up during the dry period should not be underestimated. It is thought that cows that begin the dry period with a non-infected udder and end it infected, suffer a 36 per cent drop in subsequent yield. Of course, in addition to less clinical mastitis and lower cell counts, farmers find that fewer mastitis-related premature culls are also highly significant.

How OrbeSeal works and how to use it

On the outside, OrbeSeal looks like other dry cow tubes. It contains an inert paste, similar in consistency to toothpaste, with zero antibiotic content. Using it in the Clean Up, Seal Up combination with antibiotic tubes in every quarter, you first infuse the antibiotic dry cow tube followed by OrbeSeal, making sure you follow a scrupulously clean routine.

While you should massage the quarter after the antibiotic tube, you MUST NOT do so after OrbeSeal. While infusing OrbeSeal, it is now recommended that you squeeze the top of the teat, where it joins the udder, gently between finger and thumb. This traps the sealant paste within the teat canal. Here, it remains throughout the dry period and forms a physical barrier to the entry of dirt and mastitis pathogens. It should be stripped out by hand at the first milking after calving, though a suckling calf may do this for you and come to no harm.

There is a farmers’ guide and poster for more detailed, step by step instructions on the correct infusion technique for OrbeSeal. Feel free to contact us for a copy or call Pfizer.
antibiotic dry tubes since a high proportion of quarters are infected (in most herds) at dry off.

There are two high risk times in the dry period; the time around drying off and the time around calving.

**Drying off time**

At drying off researchers have shown that for every litre of milk production over ten litres there is an additional nine per cent extra risk of acquiring infection. The message is clear; lower yields at dry off are less risky. Manipulating yield in late lactation is tricky but some farmers report success through ‘stressing’ a cow with a group change. This might mean housing her on her own and managing her feed and water intake individually or could mean moving her into a different pre-dry group for a few days.

Milking a cow once daily or incompletely is definitely not advisable and leads to an increase in infections. Cows should be managed through the parlour at the normal frequency until the day they are tubed and then taken well out of sight and sound of the milking facility.

Dry tubing itself requires considerable care and attention to detail. It is recommended that cows are milked out completely at a morning milking as normal, then sorted for tubing when milking is over. Cows can be tubed through the parlour but it should have been thoroughly washed down first. Cows should preferably be milked out completely again before administration of antibiotic and internal teat sealant and then a thorough coverage of post-milking teat dip. They should then be kept standing in a clean area for twenty minutes or so until they are taken straight to the dry cow group.

**Approaching calving**

The other high risk period for new infections is in the week or so prior to calving and shortly afterwards. Group changes around this time

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Correct infusion technique for internal teat sealants

1  2  3

4  5
are thought to be incredibly stressful for cows and should be minimised. Special attention should be given to drainage, humidity and hygiene of the dry cow accommodation. Some farmers remove the cow for calving although it’s probably better to pen her off in a clean area of the close-up dry cow accommodation.

For the purposes of mastitis and cell count control, calves should be removed as soon as practicable and the cow fully milked out at the very next milking time. If there are concerns regarding a cow slipping, a well maintained portable milking facility should be used and the cow should still be milked out completely.

If milk fever is a concern, nutrition in the dry period should be addressed. Milk fever can now be completely eliminated by correct dry and transition cow feeding.

It is worth adding that milking equipment for freshly calved cows should be kept very well maintained and hygienically cleaned. Poorly maintained dump systems are often used for these highly susceptible animals and the same equipment is commonly shared with infected mastitic cows.
**Clover Cell Check**

With a producers permission advisors can access all individual cow cell count information for any herd that milk records with any of the UK recording companies. Special software allows us to categorise the cows in the herd and to offer specific advice about what steps to take to help manage cell counts in the herd. Reports are sent out every month with simple action plans for a few cows.

Seasonal trends can be identified allowing producers to take proactive steps to minimise the impact of troublesome periods of the year. Problems with milking equipment or with dry period and calving management can be highlighted and corrected.

Farm comparisons are made possible by using a series of benchmark and league tables. This allows farmers to evaluate their strengths and weaknesses against other dairy farmers in the same area. Regular on-farm Cell Check Club meetings ensure that practical ‘best practice’ tips can be shared between participating farmers.

**To find out more about Clover Cell Check and to have a free report prepared for your farm, please contact your veterinary practice.**

**Clover Cell Check – total cell count control**