Mastitis: How to Control Clinical Mastitis

A practical and easy to use guide: 2

By Peter Edmondson
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About the author

Peter Edmondson is a dairy veterinarian who has been specialising in mastitis and milk quality work for the past 35 years. He qualified from Trinity College Dublin in Ireland in 1980. After five years in practice in Ireland, Peter joined Almarai working with large dairy herds in Saudi Arabia and China. From there he was a partner in a large specialist dairy practice in the South West of England.

Peter formed UdderWise in 2015, a company which provides mastitis solutions. UdderWise specialises in providing mastitis technical expertise, milk quality programmes, tailor made training, troubleshooting mastitis, residue and milk quality problems, residue avoidance advice and providing legal expert witness work in all cattle and milk quality related matters.

Peter works for dairy farmers, vets, pharmaceutical, agricultural and dairy processing businesses throughout the world. He has excellent communication skills and is in demand to speak at international conferences.

He is a popular trainer of vets, farmers, technical and sales staff and is renowned for his practical and down to earth approach. He has been running intensive practical hands-on mastitis seminars for dairy vets and others from the dairy industry for over 20 years. Peter carries out referral visits throughout the world using his practical problem solving skills.

Peter is a Fellow of the Royal College of Veterinary Surgeons and a Registered Specialist in Cattle Health and Production.

He is a Diplomat of the European College of Bovine Herd Medicine.

Peter is involved in transferring skills and technology to help the dairy industry in the developing world. He spends time carrying out voluntary work in Africa.

Peter lives in Somerset in the South West of England with his family and a range of animals including dogs, cats, sheep, chickens and horses.

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Introduction
How to control clinical mastitis

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How to control clinical mastitis

Introduction

Clinical mastitis is the most common disease of dairy cows throughout the world. It has great welfare and economic significance and can be the cause of great stress to farmers.

Mastitis means inflammation of the mammary gland. Clinical mastitis causes visible changes to the milk such as clots, discolouration or a watery secretion. The infected quarter might be swollen and in severe cases, the cow will be ill. The majority of cases of clinical mastitis are mild.

**FACTS**
- Clinical mastitis is the most common disease in dairy cows
- Has great welfare and economic significance
- The majority of cases are mild
- Mastitis bacteria enter through the teat canal
- The bacteria do not pass from one quarter to another

Mastitis is caused by bacteria which enter through the teat canal. The teat canal is between 6 and 10mm long. This is the only way that infection enters the udder. Mastitis infections do not pass from quarter to quarter. They are all totally separate and walled off from each other and have their own independent blood supply. Mastitis does come from animals drinking contaminated water or from the air. All bacteria have to physically enter the udder through the teat end and make their way into the udder.

There are three key bacteria which cause clinical mastitis:
- *E. coli*
- *Strep uberis*
- *Staph aureus*

This cow has clinical mastitis in the back right quarter. You can see that it is much more swollen than the left back quarter.

The milker visually detects clinical mastitis from abnormal milk such as clots as shown above.

All mastitis infections enter through the teat canal.
Economics of clinical mastitis
Calculating the costs

Mastitis is one of the few diseases where costs can easily be calculated. These include:

- Discarded milk during treatment
- Medicines
- Labour
- Veterinary fees
- Reduction in yield for the rest of lactation
- Deaths
- Culling and loss of genetic potential

**Discarded milk**

The milk discarded is easy to work out. You add the treatment time to the withdrawal period and multiply by the average yield of the cow. For example, a cow giving 40 litres per day is treated with antibiotics for three days followed by a milk withdrawal period of four days.

The milk discarded for this case will be:

\[
\text{Discarded milk} = 40 \text{ litres/day} \times 7 \text{ days} = 280 \text{ litres}
\]

(3 days treatment and 4 days milk withdrawal)

**Medicines**

This will include intramammary tubes together with any injectable antibiotics and other medicines. More herds are now using the hormone oxytocin to help ensure that mastitis cows are milked out fully. The use of non-steroidal anti-inflammatories (NSAID’s) for pain relief and to speed up healing is more commonly used. Add on the costs of any other medicines used by you or your vet.

**FACTS**

- The costs of mastitis are frequently underestimated
- The cost of medicines is low in comparison to the total cost of mastitis
- Clinical mastitis takes time to treat and manage

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Record Keeping
Introduction

Mastitis is one of the few diseases where a detailed analysis of the data is extremely valuable. It can quantify the level of mastitis and to help identify the cause and source of infection. Records allow herds to compare mastitis levels against target figures and other herds. Records are an important part of monitoring the incidence of any disease.

Many farmers keep mastitis records but these are often not analysed and so the incidence of clinical mastitis is often underestimated. It is important to make good use of records otherwise there is little benefit to be gained from keeping the data.

Mastitis records will enable the farmer to do the following:

- Monitor the herd mastitis performance
- Compare incidence with other herds
- Identify the cause of clinical mastitis
- Identify cows whose milk needs to be withheld from the bulk supply
- Identify problem cows that should be considered for culling

**KEY POINTS**

- Records allow herds to compare mastitis incidence
- Records can help to establish the cause of mastitis
- Most farmers underestimate clinical mastitis

**TOP TIP**

When recording cases of mastitis, keep records of the following:

- Cow number
- Date
- Quarter/s infected
- Severity of mastitis
- Treatments administered
- Bacteriology results
- Outcome

**FACTS**

- A case of mastitis is one quarter affected once
- Simple mastitis records can be very effective in monitoring the disease

One case of mastitis is defined as one quarter infected once. A cow that calves down with mastitis in all four quarters counts as four cases of mastitis.

Mastitis cases can be recorded in a variety of ways. With manual records, subsequent cases of mastitis should be recorded adjacent to the first so that problem cows are easily identified.

Using the system above, it is clear that cow 32 has had six cases of mastitis and four of these were in the back left (BL) quarter. Although exactly the same information is recorded on the following table (on page 22), it’s not so clear that cow 32 is such a problem.
Introduction
Types of mastitis bacteria

It is important to know which bacteria are responsible for causing mastitis in your herd. This will help you fine tune your control measures and ensure that treatment success will be maximised. All mastitis bacteria are different.

The majority of clinical mastitis is due to environmental organisms such as *E. coli* and *Strep uberis*. With environmental organisms, the reservoir of infection is the environment itself. Environmental bacteria are transferred onto the teats between milkings whenever cows lie down in dirty conditions or from splashing of manure onto the teats. Infection can enter through the teat canal during milking, between milkings and during the dry period.

Infections can enter during milking if the teats have not been properly cleaned and dried before the unit is attached. Infections can occur between milkings if cows lie down immediately after milking or lie down on very dirty beds between milkings. Dry period infections can occur because not all teats fully seal throughout the dry period (see the ‘Dry period infections’ section).

*Staph aureus* is another cause of clinical mastitis. This is a contagious mastitis bacteria. Contagious bacteria live in the udder and on the teats and are spread from cow to cow at milking time only. Infections establish on the teat and teat canal and then can penetrate the mammary gland.

Comparison of contagious and environmental infections

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<th>Environmental</th>
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<td><strong>Bacteria</strong></td>
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<td><em>Strep uberis</em></td>
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<td><em>Strep agalactiae</em></td>
<td><em>Klebsiella</em></td>
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<td>CNS (Coagulase negative Staphylococci)</td>
<td><em>Pseudomonas</em></td>
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<td><em>Corynebacterium bovis</em> (C. bovis)</td>
<td><em>Strep dysgalactiae</em></td>
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<td><strong>Source of infection</strong></td>
<td>Udder</td>
<td>Environment</td>
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<td><strong>When spread</strong></td>
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<td>Between milkings</td>
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<td>During milking</td>
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<td>During the dry period</td>
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<td><strong>Type of mastitis seen</strong></td>
<td>Predominantly subclinical</td>
<td>Mainly clinical</td>
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<td>Clinical cases from <em>Staph aureus</em> and <em>Strep uberis</em></td>
<td>Subclinical for <em>Strep uberis</em></td>
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<tr>
<td><strong>Effect on herd cell count</strong></td>
<td>Raised</td>
<td>None unless <em>Strep uberis</em> problems</td>
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</table>
Collecting a sterile milk sample
How to collect a sterile milk sample

10. **Sending samples to the laboratory.** Samples need to be sent so that they will arrive under 4°C, ideally the following day. Samples should be packed in a polystyrene container (a) with ice packs on top of the samples (b). If there is any dead space in the box this will allow the temperature to rise. Fill all dead space to maintain a low temperature (c).

   ![Images](a)(b)(c)

   **TOP TIP**

   • Make sure your fridge is working correctly to keep samples cool.

   It is very important that the lid fits correctly (d) and that it is securely taped (e) so that the inner contents are sealed to avoid any temperature loss.

   ![Images](d)(e)

   Ideally samples will be dispatched guaranteed next day delivery. If samples get delayed or are posted just before the weekend they will get warm and it is possible that the results will be contaminated.
Environmental bacteria
Minimising the risk

The environment is very important from a mastitis point of view as this is the source of the majority of clinical mastitis infections. The aim has to be to keep the udders and teats as clean as possible. If this can be achieved then the risk of clinical mastitis from environmental bacteria will be reduced. There are many herds which have excellent housing and well managed beds which have very low levels of clinical mastitis.

A good environment reduces stress levels and promotes happy and healthy cows which will maximise immunity and help fight off any infections that might be encountered. Adequate housing and comfortable beds will allow maximum lying times and reduce lameness which also helps to reduce mastitis.

Cubicles
Maximising cow lying times

Cubicles are often called freestalls and are the most common form of cow accommodation used. Care and consideration needs to be given to today’s dairy cows which are much bigger than their predecessors. Cubicles should be designed so that they are comfortable to maximise lying times. A cow will lie down and rest for up to 14 hours per day if she has a comfortable bed. If cows are lying on concrete or are standing in the cubicles this suggests that they are not comfortable.

Spotless cows on a deep sand cubicle with very low levels of mastitis

Every cow lying on this row of cubicles tells us that these are very comfortable beds

Lots of cows standing in these cubicles. They want to lie down but they are reluctant to do so because there is a solid wall in front making getting up difficult

Several cows in this herd were lying on the concrete yards as the cubicles were not comfortable

The backs of these cubicles are very dirty indicating a problem with the design or management
Heat stress
Steps to minimise heat stress

There is too much perspex sheeting in this shed and it gets very hot in the summer.

These cows are sheltering from the blazing midday sun.

These cows like the water sprinklers which are situated at the entrance to the collecting yard of the parlour and used on very hot days.

A large volume water trough with plenty of clean water for cows to drink as they come out of the parlour.

HEAT STRESS CHECKLIST

- Ensure that you have plenty of water trough space, clean water and good water flow rates so the troughs never run dry. You should have a minimum of 10 cms of trough space per cow.
- Check for excessive amounts of Perspex sheeting on shed roofs and paint over some if you are getting a greenhouse effect.
- Check ventilation levels. You need to make sure that hot air can readily escape from the buildings. Best to use a building ventilation expert for this.
- Minimise overcrowding as this will build up heat levels at cow level.
- Minimise time in holding pens where there will be poor ventilation.
- Consider using sprinklers or water misters. These can prove very effective especially around the feed area. They can provide a very fine mist of water onto the backs of the cows at set times. Evaporation takes places and helps keep cows cool and maintain feed intakes. Using fans along with misters will increase the amount of cooling even more.
- Is there adequate shade available? Cows like to stay out of direct sunlight on hot days.
- Fans in cattle houses can assist with air movement.
Milking routine

Introduction

The aim of a good milking routine is to milk cows as swiftly as possible with minimal impact on mastitis. Milk must be extracted in a clean and efficient manner. This means that the milking cluster is attached to a clean dry teat which has been well stimulated to take advantage of the milk let down reflex.

The machine must be well maintained and working efficiently. The cluster should be removed after the cow has been milked out to minimise any teat damage. The cow is then post dipped to help kill any bacteria which have been transferred to the teat during the milking process.

The milking parlour is a food factory. The quality of the milk produced cannot be enhanced or improved. A poor milking routine can result in an increase in clinical mastitis, higher cell counts and Bactoscan or TBC (Total bacteria Count) and result in poor quality milk for which the farmer is paid a lower milk price.

Milker training

A key part of mastitis control

Milkers should be trained so they understand the milking routine and this should be ongoing and updated as necessary. The significance of the milking routine on mastitis and cell counts should be explained so they understand the impact of what they do on mastitis and milk quality.

A written SOP (standard operating procedure) is essential in herds with multiple milkers to ensure that there is consistency in the routine. Herds which have a consistent milking routine can get up to 5% more milk out of the cows than herds which have variable routines. This can occur where there is no agreed way to milk cows and where each milker works to his or her own preference.

Good milker training is a key part of mastitis control. The milkers can make or break mastitis and milk quality and so training should be ongoing.

FACT:
- Milker training is a key part of mastitis control

GOALS:
- Cows should be milked as swiftly as possible with minimal impact on mastitis
- Milk must be extracted in a clean and efficient manner
Dry Period Infections
How to control clinical mastitis
Dry period infections

Are teats always sealed throughout the dry period?

For many years people thought that when cows were dried off the teat canal was sealed throughout the dry period. We now know that this is not the case. There is lots of trial work that shows that many teats remain open throughout the dry period.

The graph above shows that 50% of teats in New Zealand dairy cows were open 10 days after dry off. 20% of teats were still open 50 days after dry off. This study found that 97% of clinical mastitis cases that occurred in dry period were in quarters that had open teats.

US trial work shows that almost 70% of cows dried off giving more than 21 litres per day had open teats 7 days after dry off. 48% or almost half of these teats were still open at 6 weeks after dry off!

Higher yielding cows have faster milk flow rates and will have a higher risk of having open teats during the dry period. New Zealand cows are not the the highest yielders so this is why the US study showed more open teats.

**FACTS**

- At least 50% of teats are still open 10 days after dry off.
- Half of teats from high yielding cows are open six weeks after dry off.
- Bacteria can enter the udder during the dry period.
- Always ensure the udders and teats of your dry and calving cows are clean to minimise dry period infections.
Other associated factors
How to control clinical mastitis
Nutrition
Factors which affect the immune system

Nutrition can affect mastitis in two key ways. Firstly if there is inadequate nutrition then this can affect the cows immune system and secondly, if the faecal consistency changes.

There are a number of nutritional factors which can influence mastitis. These include hypocalcaemia (commonly called milk fever), ketosis, Vitamin E or Selenium deficiency etc.

Hypocalcaemia
Hypocalcaemia or milk fever is where the blood level of calcium is low. This most commonly occurs after calving. Jersey and Guernsey animals are very prone to this condition. The animals are unable to get up and remain recumbent. The risk of mastitis will rise further if these cows end up lying in dirty conditions. Cows that are treated with calcium around calving have a 23 fold increased likelihood of developing \textit{E. coli} mastitis. Cows which had an assisted calving will have an eleven fold likelihood of developing \textit{E. coli} mastitis.

\begin{itemize}
  \item A cow with milk fever has a 23x greater risk of \textit{E. coli} mastitis
  \item Cows that had an assisted calving will have a 11x greater risk of \textit{E. coli} mastitis
\end{itemize}

A cow with milk fever
Top tips
How to reduce clinical mastitis
Top tips to minimise clinical mastitis

The successful approach to tackling clinical mastitis includes:

1. **Teats and udders should be clean.** Keep cows on clean and dry beds. If udders and teats are dirty, the beds are not clean enough. Remember to observe the cleanliness of your cows throughout the year.

2. **Always use plenty of clean dry bedding.** Dry bedding absorbs moisture to keep beds dry. Make sure that passageways are scraped every time that cows go for milking.

3. **Calving pens.** These must be kept as clean as possible as freshly calved cows are most prone to toxic mastitis. Make sure that they are cleaned out frequently.

4. **Cubicles.** Ideally you should have 5-10% more cubicles than cows. Cows like choice where they lie. A heifer will not lie beside the dominant cow in the herd.

5. **Straw yards.** Allow adequate lying and loafing space according to the breed and size of cow. Bed up daily with plenty of clean dry straw and clean out every 2-3 weeks.
Appendix
How to control clinical mastitis

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### Liner change charts

#### Three times a day milking

Liner life in days according to average number of cows milked and parlour size and assuming a liner life of 2,500 milkings

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Glossary

How to control clinical mastitis

**Abscess** – A collection of pus which is surrounded by scar tissue. Antibiotics are unable to penetrate an abscess.

**ACR** – Automatic cluster remover to prevent overmilking.

**Acute mastitis** - Sudden onset of mastitis with swelling, pain, abnormal milk and reduced milk yield.

**Anaerobic** - Organisms which will not grow in the presence of oxygen.

**Antibiotic** – A substance which kills or inhibits bacterial growth.

**Antibody** – Proteins made by the immune system that help to remove infections such as bacteria and viruses.

**Bacillus** - An environmental bacteria.

**Back flushing** – An automated system for disinfecting liners between cows.

**Bacteria** – Single celled organisms that can cause infectious diseases.

**Bactoscan** – A rapid automated test to measure bacteria in milk. It counts dead and live bacteria.

**Blanket dry cow therapy** – Antibiotic dry cow therapy that is administered to all animals at the end of lactation irrespective of their mastitis infection status.

**Blitz therapy** – An antibiotic intramammary treatment for subclinical *S. agalactiae* infection during lactation.

**Casein** – A protein in milk that is used for cheese making.

**Chronic mastitis** – Udder infection that has been present for a long period of time. This can create damage within the udder, form scar tissue and reduce milk production.

**Clinical** – Inflammation of the udder which is shown by visible abnormalities of the milk or the udder itself.

**Closed herd** – A herd where no animals are purchased. All replacements are homebred.

**Cluster** – The milking unit which is made up of a claw piece, liners, shells and short milk and air tubes.

**Cluster dipping** – Clusters are dipped in a disinfectant solution during milking with the intention to reduce the risk of spreading infection from cow to cow.

**CMT** – Abbreviation of the California mastitis test. A cow side test to give an indication of the level of subclinical mastitis.

**CNS** – Coagulase negative Staphylococci.

**Coliform Count** - The number of coliforms in a milliliter of milk.

**Coliforms** - A group of Gram negative bacteria which include *E. coli, Klebsiella, Seratia* and *Enterobacter*.

**Contagious** – Bacteria which live in the udder and on the teats and are spread from cow to cow during milking.

**Dry cow therapy** – Antibiotics administered into the udder at the end of lactation to help eliminate subclinical mastitis.

**Dry period infection** - An infection that enters the udder when cows are not lactating. These often cause mastitis in the following lactation.

**Dry wipe** – Where teats are prepared before milking by wiping teats with a piece of paper towel.

**Dynamic milking machine test** – A test carried out on the milking machine as cows are being milked.

**Environmental** – Bacteria which live in the environment and spread onto the udder and teats between milking. Can enter the udder during milking and when the cow is dry.

**Epithelial cell** – Cells within the udder which make up the milk producing tissue.

**Forestrip** – Examination of the first few squirts of milk before milking. This is used to detect mastitis and stimulate let-down.

**Gangrenous mastitis** – Mastitis where the blood supply to the affected quarter or part of the udder stops leading to death of parts or the whole quarter.

**Hyperkeratosis** – Teat end damage where the teat canal is pulled out through the teat end or office. Mainly a milking machine induced problem.

**Hypocalcaemia** – A metabolic condition when the blood level of calcium is low.
Immune system – The body’s defence system against disease
Infection – The presence of infectious organisms in the body
Inflammation – A natural response of white blood cells to try and eliminate infection
Internal teat sealant – A non-antibiotic viscous substance infused into the teat at dry off to prevent bacterial infection entering during the dry period
Intramammary – Within the udder and most commonly refers to treatments which have been administered through the teat canal
Keratin – A waxy material produced by the cells lining the teat canal. This helps to reduce bacteria entering the teat canal
Ketosis - A metabolic condition when cows are in a negative energy balance
Klebsiella - An environmental bacteria which is commonly associated with wood products used for bedding
Lactation period infection – An infection that enters the udder when the cow is lactating
Lactose – a sugar present in milk
Lactoferrin – An enzyme that binds with iron that stops bacterial growth in the udder
Let down reflex – The hormone responsible for milk let-down
Lipase – An enzyme that breaks down fat in milk
Lipid – A substance used to provide protection against a disease
Liposome – A range of environmental organisms
Mastitis – Inflammation of the udder caused by bacterial infections
Mastitis detector - A mesh filter situated in the long milk tube close to the cluster to help pick up clots to aid mastitis detection
Mastitis rate - A measure of the incidence of mastitis. Cases per 100 cows per year
Medicated towels - Towels that have been impregnated with a disinfectant solution to help kill bacteria on the teat before milking
Milk filter or milk sock - A filter to remove any traces of debris such as straw, sand etc.
Mycoplasma - An anaerobic contagious mastitis bacteria
Neutrophil – One form of white blood cell that engulfs bacteria
Oxytocin – The hormone responsible for milk let-down
Partial blitz therapy – Blitz therapy which is carried out on selected cows during lactation
Pasteurisation – Heat treatment of milk to kill bacteria which can spoil milk and also affect humans. Tuberculosis bacteria are killed through pasteurisation
Plasmin – An enzyme that breaks down milk protein and can carry on acting after pasteurisation
Predipping or premilking teat disinfection – A solution applied to teats before milking to help kill bacteria that have been transferred onto the teat during the milking process and to optimise teat skin condition
Predipping or premilking teat disinfection – A solution applied to teats before milking to help kill bacteria present on the teat before it is brought into the parlour. This solution is always wiped off the teat before unit attachment.
Protease - An algae associated with contaminated water supplies
Protex – An environmental organism
Proteus – An environmental bacteria causing mastitis that is commonly associated with contaminated water sources
Pulsation – The opening and closing of liners during milking which results in milk flowing from the udder and the teat filling up with milk
Recurrence rate - The percent of quarters that have more than one case of mastitis
RMS - Recycled manure solids, a form of bedding
Scar tissue – Fibrous tissue that is created after infection which permanently replaces tissue. In the udder this can stop intramammary antibiotics distributing evenly throughout the udder
SCC – Abbreviation for somatic cell count
Selective dry cow therapy – Antibiotic dry cow therapy that is only administered to selected cows
Somatic cell – A body cell that enters the udder in response to inflammation. The majority will be white blood cells combined with a small percentage of epithelial cells from the milk producing tissues
Somatic cell count – The number of somatic cells in milk. This is measured per millilitre of milk and results of 200,000 are often referred to as 200
Staphylococci – One form of contagious mastitis that grow in grape like clusters. Staphylococci are divided into Staph aureus and CNS which are all the staphylococci apart from Staph aureus
Streptococci – One form of contagious mastitis that grow in chains. The most common are Strep agalactiae, dysgalactiae and uberis. Strep uberis also has some environmental properties
Subclinical – Infection which can only be detected by testing. The most common form of mastitis and can result in significant economic losses
TBC – Total bacteria count to measure bacteria in milk. Bacteria are grown on culture media and it takes three days to get a result.
Teat canal – The passageway from the teat end into the udder which is normally 6 to 10mm long. There is a sphincter muscle which helps to ensure that the teat canal remains closed between milkings and during the dry period
Teat cup shell – The metal or plastic shell that surrounds the liner
Teat seal or internal teat seal - A paste infused at dry off to form a physical barrier at the base of the teat to help prevent dry period infections. It does not contain any antibiotic.
Toxaemia – A condition caused by toxins or poisons from an acute mastitis, such as E. coli, that enter the bloodstream and causes illness
Toxic mastitis - Severe mastitis where the cow is very ill and may be recumbent. It often has a sudden onset with pain, swelling of the udder, abnormal milk and milk production often stops.
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