MASTITISCONTROL

AHDB

Control of contagious mastitis

DAIRY

Contents

The information in this booklet was compiled by AHDB and the Dairy Mastitis Control Plan Team at the University of Nottingham and Quality Milk Management Services.

Photographic credits

Introduction

Mastitis treatment and control is one of the largest costs to the dairy industry in the UK and is also a significant factor in dairy cow welfare.

Udder infections may be picked up from the environment or transmitted from cow to cow, i.e. contagious transmission. Analysis of clinical mastitis records and individual cow somatic cell counts can reveal which of these 'infection patterns' is most important in a herd at a particular time.

The Mastitis Pattern Analysis Tool (MPAT) provides a simple automated way of determining the transmission pattern. This factsheet provides information relevant for herds with a contagious 'pattern'.

Recent analysis indicates that contagious transmission is much less common than infection from the environment, as an overall herd pattern.

Contagious pathogens that cause mastitis tend to live on the cow's udder and skin of the teats and transfer from affected cow (or quarter) to unaffected cow (or quarter) during milking. They adhere easily to the skin, colonising the teat end and then 'grow' into the teat canal, where infection occurs.

This resource has been produced as part of the QuarterPRO initiative. Other resources include;

- ***Managing mastitis***
- ***The QuarterPRO approach*** factsheet
- ***Control of environmental mastitis in lactation***
- ***Control of heifer mastitis***
- ***Dry cow management***

For a more detailed mastitis/udder health investigation, consider the Dairy Mastitis Control Plan **mastitiscontrolplan.co.uk**

Derek Armstrong
Lead Veterinary Science Expert

In 2018, in the AHDB Dairy 'Sentinel Herds' group found:

- **92% of herds had mainly environmental mastitis patterns**
- **Contagious mastitis patterns were important in only 8% of herds**

Table 1. Main patterns of mastitis on dairy farms

Mastitis Pattern	When most cows get infected	Where most infection was picked up from
Dry period environmental	Dry period	Environment
Lactating period environmental	Lactation	Environment
Lactating period contagious	Lactation	Other cows

Contagious mastitis bacteria

Over 100 different bacteria can cause mastitis. Most of these are bacteria from the environment, which reach the udder from the cow's surroundings.

The main features of bacteria classified as causes of contagious mastitis (i.e. transmitted cow to cow) are:

- Persistence of infection within the udder of an infected cow (e.g. *Staphylococcus aureus*)
- And/or the ability to be shed in very large numbers from an infected quarter (e.g. *Streptococcus agalactiae*)

Staphylococcus aureus

The Gram-positive bacterium *Staphylococcus aureus* (*Staph. aureus*) is the most common cause of contagious mastitis for the majority of UK dairy herds and often results in persistent subclinical infections. However, it is still found in only a relatively small percentage of all mastitis cases (*Staph. aureus* was only found in 6% of clinical samples and 9% of subclinical mastitis samples in a survey of 6,005 samples from over 500 farms[1]).

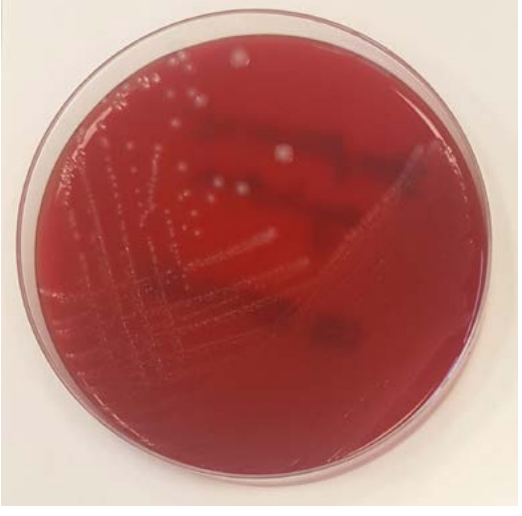


Figure 1. *Staph. aureus* in laboratory culture

Staph. aureus can survive on various parts of the cow and in the environment. However, in most herds, the main reservoirs of infection are infected quarters and bacteria living on the teat skin.

Streptococcus agalactiae

Streptococcus agalactiae (*Strep. agalactiae*) is now rare in the UK, probably due to good implementation of the Five Point Plan over many years (see page 6). With *Strep. agalactiae*, there are often large 'spikes' in Bactoscan and bulk milk SCC (BMSCC). It is occasionally cultured from herds where the basic elements of contagious mastitis control are not in place – for example, no history of using antibiotic dry cow therapy (antibiotic DCT), or 'flying' herds that buy in lactating cows with no individual cow SCC history. *Strep. agalactiae* was found in less than 0.5% of samples tested in the survey above.

Streptococcus dysgalactiae

Streptococcus dysgalactiae (*Strep. dysgalactiae*) is often important in herds with high levels of teat-end lesions and where teat skin condition is poor. This pathogen is able to live on teats and teat skin and spread between cows by indirect contact, e.g. on hands or milking cloths. A high prevalence of *Strep. dysgalactiae* is often associated with:

- Herds with poor post-milking teat disinfection routines (particularly in bad weather, for example very cold conditions where teats become chapped and sore)
- Herds that use poor-quality post-milking teat dips with little or no emollient

[1] B. Payne, J. A. Bradley, E. Coombes, E. Lusby, K. Mining, C. Hunt and A. J. Bradley (2013). The aetiology of bovine mastitis in UK dairy herds. Proceedings of the British Mastitis Conference (2013) Sixways, Worcester, p 59 – 60. **www.britishmastitisconference.org.uk/Previous%20Proceedings.html**

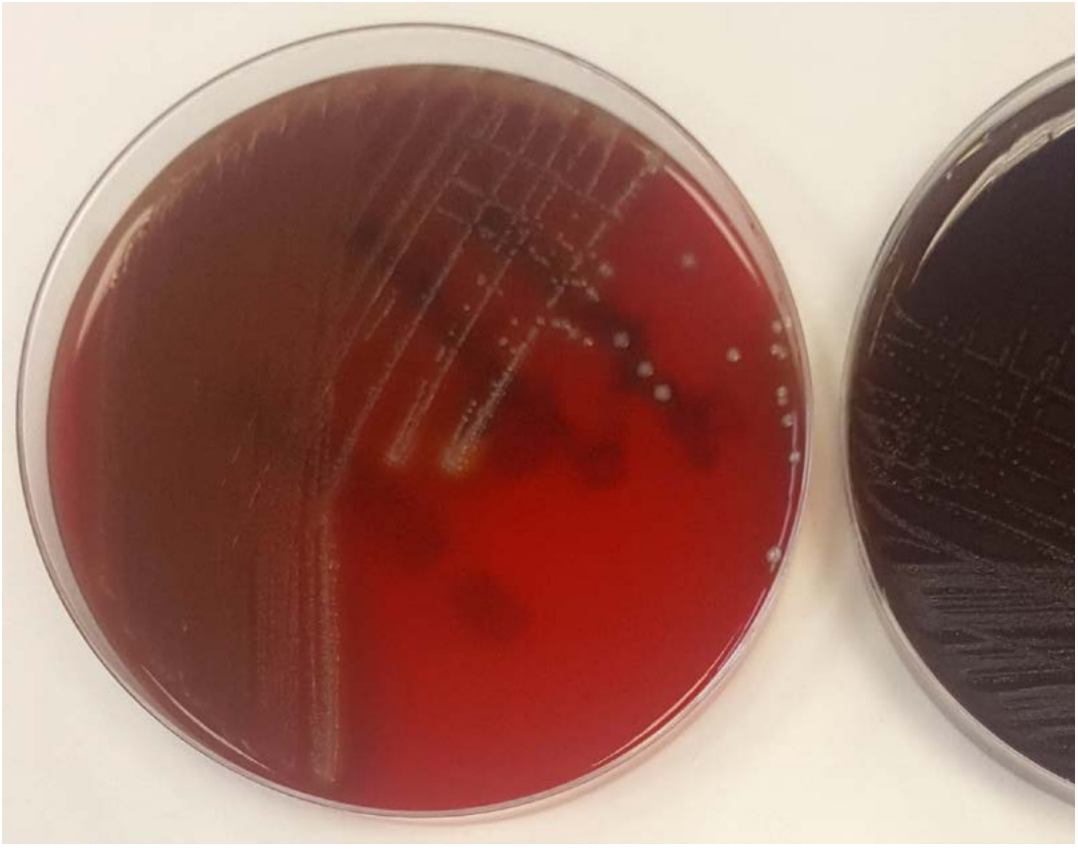


Figure 2. *Strep. dysgalactiae* in laboratory culture

Strep. dysgalactiae was present in 6% of all samples tested in the survey.

Mycoplasma

Infection caused by a group of bacteria known as *Mycoplasma* is rarely diagnosed as a cause of mastitis in GB. It may be underestimated because diagnosis is difficult. *Mycoplasma bovis* is thought to be the most common of the *Mycoplasma* causing mastitis, but other *Mycoplasma* species may also cause mastitis.

Most cases of *Mycoplasma* mastitis are subclinical and the greatest loss is as a result of subclinical disease. It can spread from cow to cow at milking time but might also be spread by shedding from the mouth, nose and other external mucosal surfaces of a clinically or subclinically infected animal.

There is often a poor response to treatment of cows with *Mycoplasma* mastitis. Cure rates using antibiotics are very low. A test-and-cull policy has been used on some farms but is not always needed. The success in controlling the disease is likely to depend on the effectiveness of isolation (to reduce spread) while self-cure occurs in infected cows.

Even when *Mycoplasma* species are present in a herd, it is rarely the sole cause of mastitis on a farm. In many cases, other contagious and environmental organisms are likely to be the major issue.

Reducing the risk

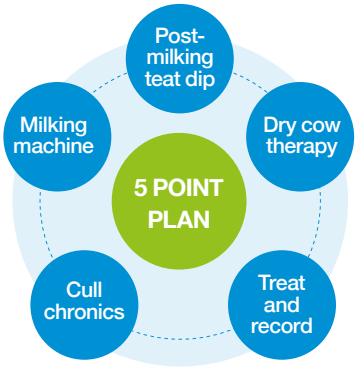
The key to the control of contagious mastitis is to take steps to reduce the risk of spread of infection from cow to cow. Two things contribute to this:

1. Reducing the prevalence of infection (meaning fewer infected cows) – by treatment and possibly culling of infected cows.
2. Preventing the spread of infection – by management to avoid transfer of bacteria directly from cow to cow.

You can cut the risk of new cases of mastitis by reducing the number of cows with mastitis in the herd. One way to do this is to increase the cure rate of infected cows.

The traditional Five Point Plan helps to reduce the number of mastitis cases and to cure infected cows, through:

- Use of antibiotic DCT for infected cows at the end of lactation
- Early and effective treatment in lactation and recording of clinical mastitis cases
- Culling chronic mastitis cases
- Post-milking teat dipping
- Milking-machine maintenance



Reducing the population of infected cows can be achieved by:

- Antibiotic DCT (page 8)
- Treatment of clinical mastitis (page 9)
- Treatment of high-cell-count cows (page 12)
- Culling persistently infected cows (page 14)

The focus in preventing the spread of infection from cow to cow is on:

- Biosecurity (page 16)
- Segregation and grouping (page 15)
- Post-milking teat disinfection (page 17)
- Milking-machine maintenance (page 19)
- Teat-cup-liner maintenance (page 23)
- Milking routines (page 25)
- Somatic cell count (SCC) (page 8)

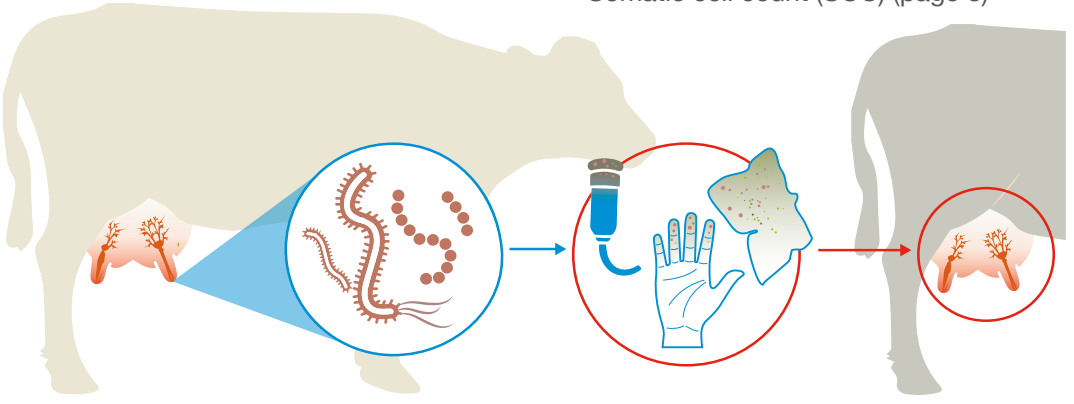


Figure 3. Cow-to-cow transfer

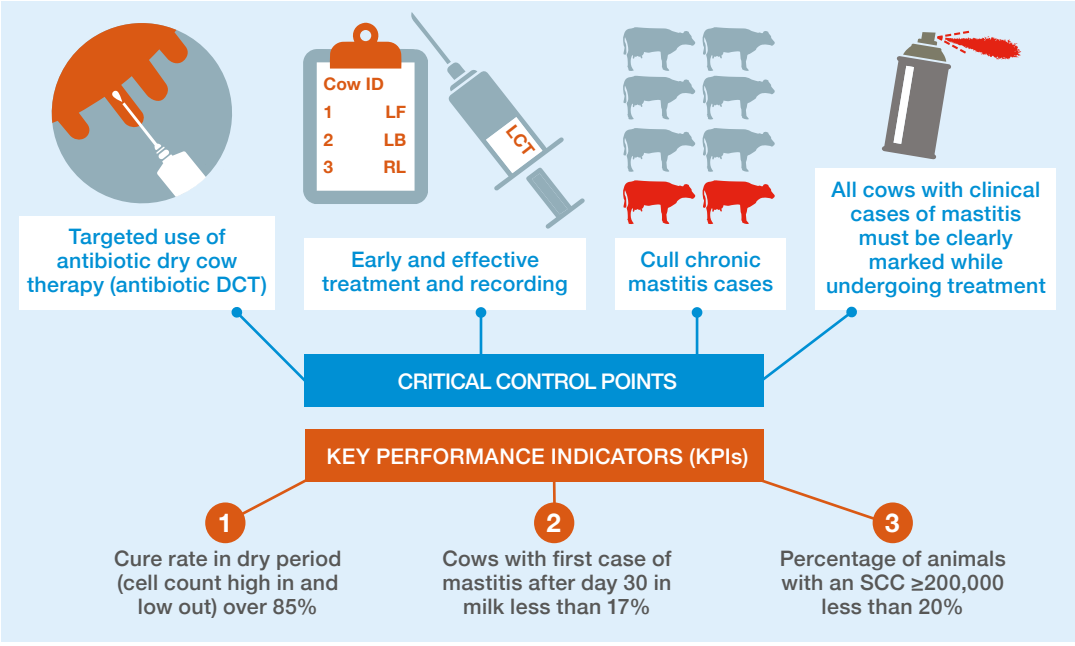


Figure 4. Critical control points and KPIs

In the control of contagious mastitis, it is important that all high-risk cows are clearly marked to make it easier to manage the risks of antibiotic bulk milk tank failures and the risk of spreading infection to other cows.

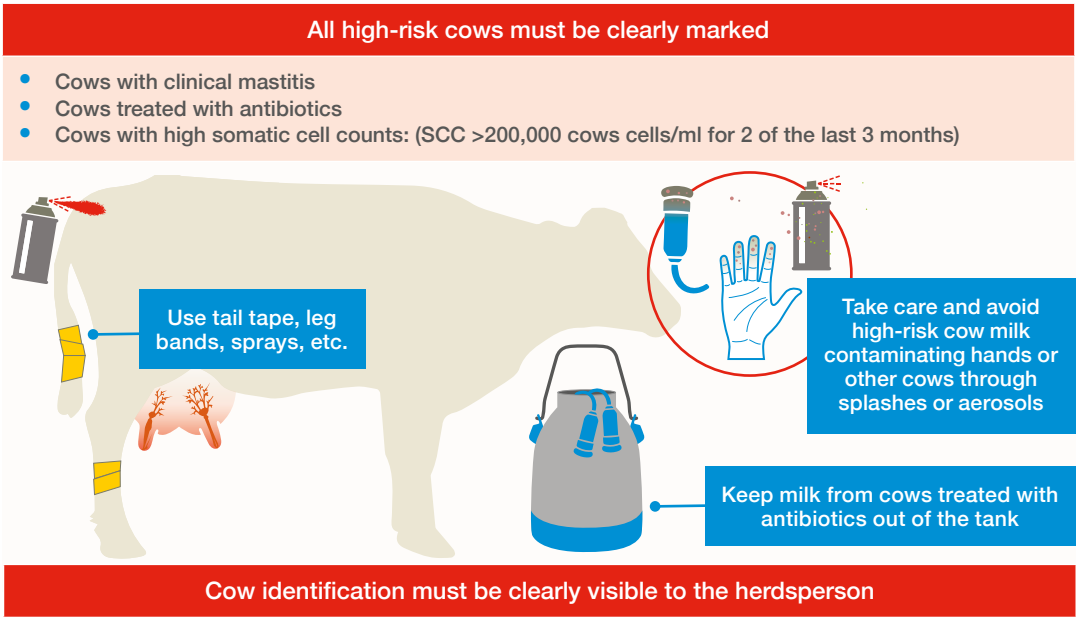


Figure 5. High risk cow consideration

Targeted antibiotic dry cow therapy

The cure rate for contagious mastitis pathogens, such as *Staph. aureus*, during lactation is often poor. Cure rates of over 90% are possible with antibiotic dry cow therapy, even against *Staph. aureus*. Narrow-spectrum, long-acting penicillin antibiotics can be very effective in achieving a bacteriological cure.

Identifying chronic mastitis helps in deciding between treatment and culling. A number of factors influence the probability of cure during the dry period. The most important factors are:

- Age of the cow and history of mastitis cases in the udder
- Number of affected quarters
- Somatic cell count (SCC)

Discuss the best way to select cows on your farm for treatment or culling with your vet.

Think about monitoring actual versus predicted cure rates across the dry period using cell counts. If poor cure rates cannot be explained by high rates of new infection, they should be investigated using culture.

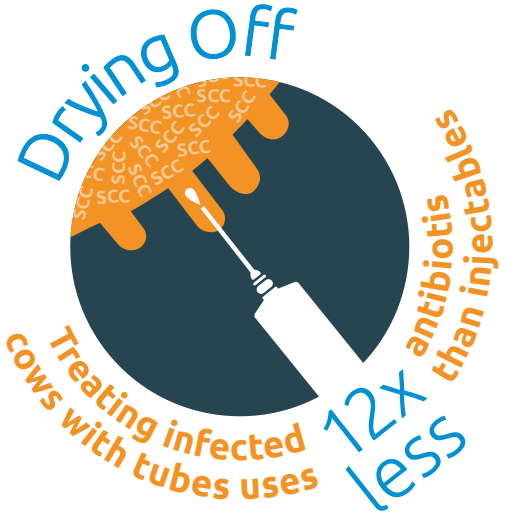
Key Performance Indicator

Cure rate in dry period 85% or higher (cell count high in and low out).

More information regarding targeted antibiotic dry cow therapy can be found in the AHDB ***Dry cow management guide*** and accompanying videos on the AHDB website.

In high-cell-count herds with a mainly contagious mastitis pattern, consider reducing the threshold for antibiotic dry cow therapy. Using a low SCC threshold and three consecutive monthly milk recordings will increase the chance of identifying infected cows in the herd.

Do not use antibiotic injections at drying off or shortly before calving. There is little research evidence to show that cure rates are any better than using antibiotic dry cow therapy alone.



No evidence that injectable antibiotics have any meaningful impact on cure rates. Decrease new cases by using the AHDB Dairy Mastitis Control Plan.

Treatment of mastitis in the milking cow

It is important to identify cases of clinical mastitis as quickly as possible in herds with a contagious mastitis pattern.

- Early treatment increases the likelihood of effective treatment
- Early identification and removal of affected cows reduces the risk of both the spread of infection and increasing bulk milk SCC (BMSCC)

Foremilk stripping is the most effective way to identify clinical cases. Be extra vigilant during periods of high risk – for example, in the first 30 days of lactation. Check that all staff know what signs of mastitis they are looking for and how to respond. They should also be looking for swollen quarters both at cups-on and cups-off.

Figure 6. In-line mastitis filter

If using in-line mastitis filters, check them regularly. Check the main filter or filter sock after milking for any clots or other irregularities that may indicate clinical signs of mastitis, and other problems, such as large amounts of soiling due to bad milking techniques or technical problems with the milking plant. A sudden increase in daily bulk milk cell counts could indicate a missed clinical case.

Prompt detection (i.e. at that milking) and immediate treatment (particularly for the first clinical case in lactation) is important, to maximise the chances of cure and minimise risk of transmission of infection.

Cows with clinical cases of mastitis must be clearly marked while undergoing treatment (See Figure 7). Record all mastitis cases accurately – by cow, quarter and date.

Figure 7. Marking clinical-mastitis-case cows

If not milked last, cows with clinical mastitis should at least be milked with a separate cluster. This cluster should not be used to milk freshly calved cows or cows with milk out of the tank, for reasons other than mastitis.

Agree a treatment plan with your vet for mastitis on your farm.

- Keep good records of clinical cases and regularly review cure rates
- It may be useful to look at antimicrobial resistance patterns for the main bacteria

Mastitis caused by *E. coli* may not need treatment with antibiotics – discuss with your vet.

Lactation treatment protocol

Good hygiene is important when administering mastitis tubes. Milk the cow out completely first. Then, wearing clean gloves, ensure the teat has been thoroughly cleaned and disinfected before inserting the intramammary tube. Poor hygiene may make things worse. Carefully insert the tip of the injector into the teat canal and gently empty the contents. Dip or spray the teat afterwards with a teat disinfectant. Accurately record the cow number and treatment for entry in the farm medicines book.

Lactation treatment protocol

1

Identify cows to be treated, for example with stockmarker spray on their legs.

2

Wash arms and hands. Wear a fresh pair of disposable gloves and keep clean and dry. Replace gloves after handling infected cow.

3

Pre-dip each teat using a fast-acting disinfectant; leave on for at least 30 seconds.

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Using a partial-insertion technique, infuse the whole antibiotic tube into the teat. **Only insert the tube end** and maintain a gentle pressure to stop the product leaking around the nozzle. **Do not let go of the teat**.

8

Without letting go, **massage** the antibiotic up the teat canal. Slide your non-tube hand down the teat after infusing and hold the teat end without touching the teat orifice, to allow you to **massage** the contents up towards the udder with your tubing hand.

4

Wipe teat to be treated with an individual paper towel per teat, paying particular attention to the teat end.

5

Keeping hold of the teat in one hand, wipe the teat and teat end with cotton wool soaked in surgical spirit. Focus on getting the teat end spotless. If there is dirt on the cotton wool after you have cleaned the teat end, repeat with a fresh piece of cotton wool. **Do not** let go of the teat.

6

Ideally, an assistant should help prepare the tube and hand it to you.

9

After each teat has the appropriate product infused, it should have **post-milking teat dip or spray** applied.

10

Check that the cow is **permanently identified** as treated. This reduces the chances of milking a dry cow with antibiotic and causing antibiotic failure.

All cows with clinical cases of mastitis must be clearly marked while undergoing treatment (see page 7).

Treatment of clinical mastitis

Treatment with intramammary tubes should start immediately for the first case in lactation. The treatment of mild and moderate repeat cases (only a few flecks in the milk and little or no swelling in the udder) in high-cell-count herds could be delayed while individual cow history and cell count is assessed (in this case, segregation of these cows is important). You may decide to use only anti-inflammatories for mild or moderate cases in cows with chronic mastitis that you plan to cull.

One of the most important treatment factors affecting cure is the length of the treatment course. Increased duration of treatment is associated with increased chance of cure. Treatment courses should be finished, even if the clinical signs appear cured, because additional time may be needed for bacteriological cure.

Extended intramammary treatment for five to eight days may improve cure rates. If doing this, in most cases it will be an off-label use of the antibiotic and withdrawal periods will need to be extended. Off-label use must be agreed with your vet on a case-by-case basis.

Injectable antibiotics should not be used routinely in the treatment of mastitis cases.

Treatment of subclinical mastitis

Cows with an SCC of over 200,000 cells/ml are likely to be carrying infections. If more than 10% of cows in the herd have an SCC of over 200,000 cells/ml, the risk of contagious mastitis spread will be higher on your farm.

In the short term, it may be reasonable to treat cows with a high SCC (more than one SCC over 250,000 cells/ml) in contagious-pattern herds to reduce mastitis cases and infection pressure. However, this is not a good medium- or long-term strategy to control mastitis.

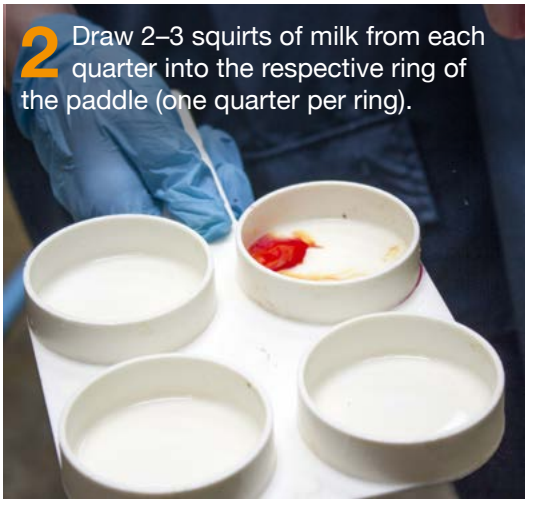
There is no evidence that injectable antibiotics will have any meaningful impact on cure rates or repeat cases.

The California Milk Test (CMT), also known as the California Mastitis Test can be used to detect which quarter(s) are likely to be affected and targeted for treatment with intramammary antibiotics. The reaction is scored on a scale of 0 (the mixture remaining unchanged) to 3 (an almost-solid gel forming), with a score of 2 or 3 being considered a positive result. This result is not a numerical result but is an indication as to whether the cell count is high or low; the CMT will only show changes in cell counts above 300,000.

Cure rates are likely to be poor when compared with antibiotic dry cow therapy during the dry period. Cure rates will be low even compared with treatment of the first clinical mastitis case in lactation.

The chance of cure for a high-SCC cow during lactation is affected by factors such as cow age, number of quarters affected and number of high cell counts, as well as duration of treatment. Treatment is unlikely to be effective in cows with chronic mastitis.

With the possible exception of penethamate, the use of injectable antibiotics is not justified in the treatment of high-SCC cows.



AHDB Dairy has produced a short film to show how to perform a CMT test along with the results that might be seen. Watch online: youtube.com/watch?v=O41cqEvmrRw

Figure 8. The California Milk Test (CMT)

Chronic mastitis and infection control

Cows with chronic mastitis, which are unlikely to recover, should be culled. Chronically infected cows are likely to be a source of bacteria for other cows. Culling infected cows removes the risk that they will spread infection.

Key Performance Indicator

Percentage of animals with an SCC equal to or over 200,000 less than 20%

Culling cows with chronic infections helps protect your healthy, young cows, which are the future of the herd. Cows to consider for culling are those unlikely to be cured.

Culling is not a way of controlling contagious mastitis unless the spread of mastitis within the herd has also been controlled. If you only cull cows with chronic mastitis, it is like removing the bucket from under a dripping tap.

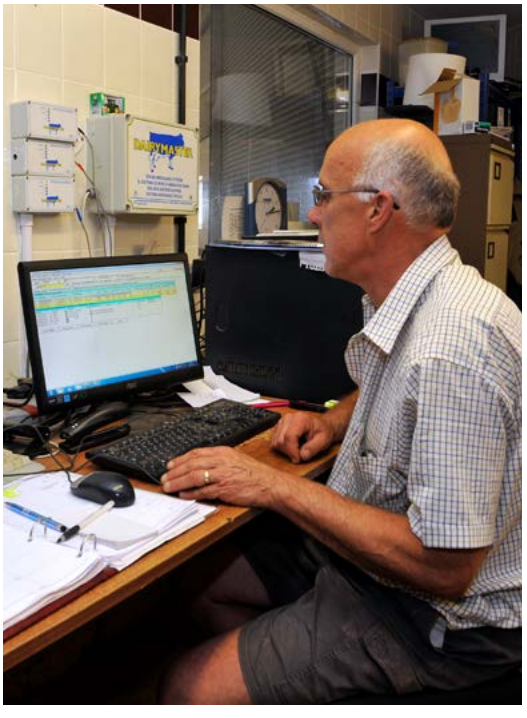


Figure 9. Data collection and recording

Unless you fix the tap, it will continue to drip. In the same way, unless you stop mastitis spreading in the herd, more cows will become chronic cases, replacing the cows that were culled.

Antibiotic DCT does not cure all existing infections. Cure rates are lower for older cows with chronic infections. Consider culling cows which have had:

- Three or more cases of clinical mastitis in a single lactation
- Persistent high SCCs in two consecutive lactations, despite treatment with antibiotic DCT in the dry period in between

Other factors to consider before deciding to cull high-cell-count cows, include:

- The type of infection involved – for example, treatment of *Streptococcus agalactiae* infection is likely to be successful; treatment of *Staphylococcus aureus* infection is unlikely to be successful in chronic cases
- The risk of mastitis spreading to other cows in the herd
- Their impact on the BMSCC and, consequently, on milk payment
- The number of cows in the category (i.e. the number of chronic cows that could be culled)
- Genetic merit
- Milk yield
- Fertility and general health status
- The source of, and the cost of, replacement cows

Before culling, always check the history of the cow. Cows that have had a very high cell count in only one lactation are candidates for antibiotic DCT.

Think about monitoring the success of mastitis treatments (with your vet), using cow SCC in the months after treatment, and consider culling chronically high-cell-count cows.

Do not use antibiotic DCT in cows due to be culled in the next couple of months. If cows have been treated, note the withholding period.

Culling chronic mastitis cases will reduce the risk of new mastitis cases in the rest of your herd.

Drying-off quarters

You can reduce the risk to the rest of the herd from infected quarters by simply deciding to stop milking a persistently infected quarter(s). If there have been three or more clinical cases in a single quarter, one option may be to dry off that quarter in this lactation or permanently.

Simply not milking a quarter for part of a lactation gives that quarter a prolonged 'dry period'. This may result in an improved chance of cure by the next lactation.

Important

Do not use a corrosive agent (e.g. povidine iodine or chlorhexidine) to destroy secretory tissue in a persistently affected quarter.

It is important to clearly identify cows and dried-off quarters so that all milkers know not to milk that quarter.

Segregation of 'infected' cows with high SCC

The segregation of infected cows (and quarters) away from other herd-mates is a cornerstone of any infectious-disease management. Although this may be difficult to implement in some herds, it is often effective. The risk of infection spreading through a herd is markedly reduced if cows with mastitis are milked last. This includes clinical cases and cows that have subclinical mastitis infection.

Figure 10. Segregation of high risk cows

Segregation can be the physical removal of infected cows out of the main milking groups and the creation of an 'infected' group that is milked last. It can also be virtual, through the use of separate clusters for infected cows.

The aim is to try to keep cows that are more likely to be infected with a major pathogen away from healthy cows. In high-prevalence herds, it may be better to segregate the uninfected cows and milk them first.

The segregation system must be practical, e.g. group size related to number of units in the parlour.

If milked last, these infected groups of cows will cause contamination of the milking plant, which could remain until the next milking. A hot wash after every milking will help prevent this risk.

Although probably rare, be aware that purchased cows could still be under withhold period for a previous treatment. Best practice is to test purchased cows' milk for antibiotic residues before adding their milk to the bulk tank.

Biosecurity – don't buy mastitis

Many people do not think about mastitis when buying cows. People usually focus on other major infectious diseases, such as TB, BVD and IBR. Bought-in cows and heifers may be infected with mastitis pathogens. Infected cows are a possible risk to other cows in the herd. This risk can never be totally avoided, but, by taking some biosecurity measures, it can at least be minimised.

Examples of pathogens that may be bought in include *Strep. agalactiae* (although this is uncommon), *Staph. aureus* and *Mycoplasma* spp.

Avoid buying in cows, if possible. If you must buy, to reduce the risk of introducing mastitis, focus on the following:

- Check the individual cow SCC records of the herd of origin before purchasing any animals from that herd – ideally, at least bimonthly records for the previous six months. For example, only buy a cow that has never had an SCC of over 100,000/ml during her life
- If buying a cow in early lactation, check whether she received antibiotic DCT and teat sealant last time she was dried off and find out the dates these were given. If antibiotic DCT was administered, find out why it was used

Milk any bought-in cows last until they have had three negative CMT tests on consecutive days.

Think!

- **Do you have a separate group of high-cell cows that are milked last every milking?**
- **Do you mark high-cell cows and then flush milking cluster?**
- **Do you at least group cows with clinical mastitis separately from the main herd?**
- **Do you keep groups of freshly calved cows separate from groups of high-SCC cows or groups of cows with clinical mastitis?**

Post-milking teat disinfection

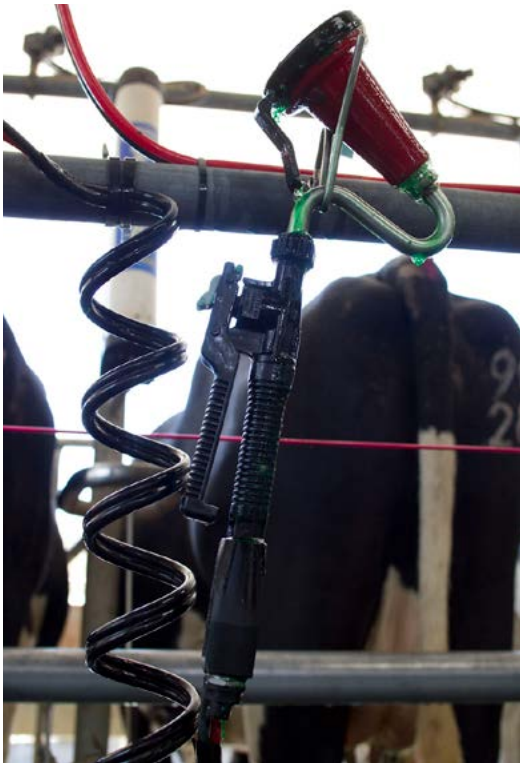


Figure 11. Examples of post-milking teat dip equipment and application

Post-milking teat disinfection is a cornerstone of contagious mastitis control and is critically important if the herd bulk SCC is over 100,000 cell/ml. The aim of post-milking teat disinfection is to remove any mastitis-causing pathogens that may be on the teat surface. Teat disinfection also controls bacteria present on any sores on the teats, promoting quicker healing.

For the best possible effect, it is important to dip or spray teats immediately after cluster unit removal – before the teat canal sphincter begins to close and before any bacteria have the opportunity to colonise and multiply.

The aim of teat disinfection is to cover the whole teat of every cow after every milking – check this regularly to see how close you are getting to achieving this aim.

For best results from teat disinfection

- Use an approved teat disinfectant – select the right product
- Make up fresh batches regularly – at least daily, unless using RTU dip
- Follow manufacturer's instructions on dilution
- Only use good-quality (drinkable) water for dilution
- Spray or dip the whole surface of all teats after every milking
- Suggested volumes are 10 ml to dip and 15 ml to spray per cow per milking

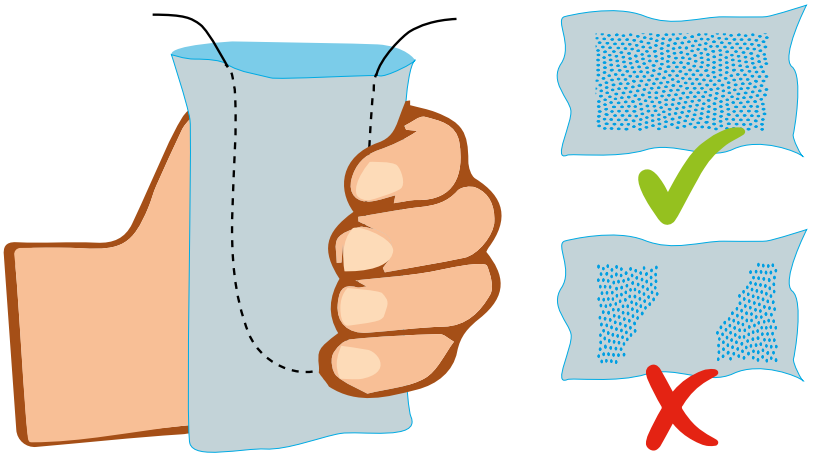


Figure 12. Checking coverage with a paper towel. Use post-milking teat disinfection – spray or dip every teat at every milking

Source: Dairy Australia Technote 7

- Check teat coverage with post-milking teat disinfectant (PMTD) – using a paper towel, wrap around the teat barrel, then carefully remove and examine the wet or stained area (see Figure 12)
- Keep an eye on the amount of PMTD being used
- Clean out teat-dip cups when empty – don't just refill
- Clean all dip cups at the end of each milking
- Store out of direct sunlight and protect from frost
- Choose an emollient/humectant content to optimise teat condition, but be aware that high levels will reduce disinfectant efficacy and low levels might not maintain good teat condition. Talk to your supplier for specific information on the product you use

Effective PMTD is a critical control point for contagious mastitis.

Post-milking teat disinfection is an essential component of a good milking routine. Further information on milking routines can be found on pages 25–27.

- **Regularly check that the majority of the teat skin of every teat is completely covered with post-milking teat disinfectant (PMTD) at the end of every milking**
- **PMTD kills bacteria deposited onto the teat during milking and also helps to improve teat skin condition and is a cornerstone of the Five Point Plan**

Key Performance Indicator

The majority of the teat skin is completely covered with post-milking teat disinfectant at the end of every milking.

Milking-machine maintenance

The milking machine is arguably the most important machine on your dairy farm. All of the milk sold off your farm will be harvested by the milking machine. It is the only part of the farm's equipment to come into contact with the cow's udder every day. It can spread bacteria from cow to cow. If your milking machine is not working properly, it can damage blood vessels and lead to hyperkeratosis at the teat end, limiting the cow's natural defences against mastitis. It is critical that the milking machine is regularly serviced and maintained.

Parlours require a minor service every 750 operating hours and a more significant service every 1,500 operating hours.

How it works

The milking machine requires a vacuum to extract milk from the teat. There are four teat cups (comprising shells and liners) attached to the claw piece. The chamber between the shell and the liner is the pulsation chamber. The alternating admission of air at atmospheric pressure and under vacuum into this chamber (pulsation) causes the liner to open and close.

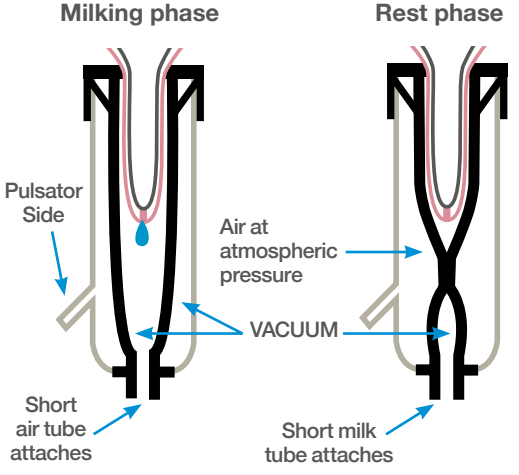


Figure 13. Teat cup vacuum and milk flow diagram

When the vacuum level between the liner and the shell is greater than the vacuum under the teat, the liner opens and milk flows. When the pulsation chamber contains air at atmospheric pressure, the vacuum under the teat causes the liner to collapse, massaging the teat and mitigating the adverse effects of vacuum.

Hyperkeratosis – a thickening of the skin at the teat end – is the result of excessive growth of the keratin that lines the teat canal. There are many possible causes of hyperkeratosis, including unsuitable vacuum level, over-milking, inadequate pulsation, excessive liner compression and teat shape. Hyperkeratosis increases the risk of new infections. Other changes in teat condition at the end of milking, such as discolouration, fluid swelling, ringing or wedging, are reliable signs there could be a problem with the milking system.

Uneven or incomplete milking are also indicators of poor milking-machine operation. Good cluster position, adequate tube support and well-controlled cows all help to ensure even milking.

Milking-machine checks

There are regular daily, weekly and monthly checks farmers can do to make sure the milking machine is working efficiently and not damaging the teats.

Daily checks

Check the vacuum level

In a low-level plant, the vacuum should be about 40–44 kPa and in a high-level plant 44–48 kPa. When the vacuum isn't at the correct level, the teat can be adversely affected. You should also be able to hear the vacuum regulator opening and closing when the cluster is attached.

Listen to the pulsators

When the milking machine is working and milking, the pulsation should be regular. Listen to the pulsators and, if they are out of sync, get the machine tested.

Check air-admission holes are clear
Air-admission holes are usually in the claw piece. If the hole is blocked, milk will be removed more slowly from the claw, leading to large fluctuations in the vacuum. Liner slips can occur and there will be milk in the liners when the cluster is being taken off. Use the proper tool designed to unblock or clear the air-admission holes.

Figure 14. Airbleed problems

Figure 15. Blocked airbleeds

Check teats as cups come off
Check cows' teats as clusters are removed. If teats are discoloured, either red or blue, congested or ringed, it can suggest problems such as high vacuum, poor pulsation, over-milking or incorrect liner selection. This should be investigated.

Check cow behaviour
Watch the cows when they are milking – unsettled cows can be an indicator of a problem with the milking machine.

Weekly checks

Check for twisted liners
All liners come with marking on the hood and on the short milk tube; ensure these markings are aligned.

Check filters on pulsator airlines
The filter on the pulsator airline needs to be kept clean; ensure the pulsation characteristics are satisfactory.

Listen to the regulator
When milking, make sure the regulator is admitting air; a hissing sound should be heard. The volume of air should reduce when clusters are attached.

Check liner condition
Liner condition is critical. Liners are the only part of the machine that come in direct contact with the cows' teats, and need to be kept in good condition. When liners are worn, they lose their shape and do not massage the teat correctly, resulting in longer milking times and reduced yields. Worn liners are also a source of bacteria, particularly thermoduric bacteria (see AHDB/NML guide to thermoduric management), as they hide in the cracks in the liner. Liners should be changed every 2,500 milkings or every six months, whichever comes first. Silicone liners have a life expectancy closer to 8,000 cow milkings.

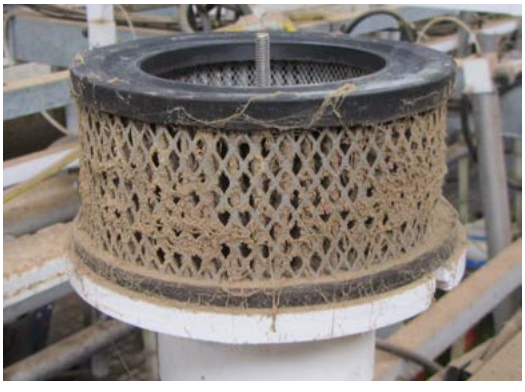


Figure 16. Example of dirty filter

Check drain valves on pulsator airlines
The drain valve on the airline should be opened when the milking machine has stopped working. Any milk/water coming from this airline post-milking would suggest a cracked liner or pulse tube.

Check vacuum-pump oil level
The oil in the vacuum pump forms a seal between the rotor and the frame of the motor, to keep the vacuum from leaking air/vacuum.

Monthly checks

Check effective reserve
Effective reserve can be checked by closing the buttons on all the claw pieces and then opening just one. If the vacuum gauge drops by more than 2 kPa, the effective reserve is not adequate. This test is applicable for plants with 16–32 units. If there are more than 32 units, open two units and check the vacuum gauge again.

Check milking times
The 'milking time' is the time it takes to milk one cow. It will depend on cow yields, but from milk let-down to finish, it will usually be 5–7 minutes.

Check liner slip
During one milking, record the number of liner slips or squawks that need to be corrected by the milker. Five or less per 100 cows is acceptable, while 10 or more per 100 cows requires investigation.

Milking-machine testing

Routine servicing and maintenance of your milking machine keeps it working effectively and reliably. It also helps reduce the risk of faults developing and inconvenient breakdowns. The correct vacuum levels, pulsation rate and ratios are essential to remove milk efficiently without damage to the teat or udder. These are checked when a static milking-machine test is performed.

This service should include:

- Static test monitoring of the system vacuum level
- Pulsation operation
- Effective vacuum reserve
- Vacuum leakage
- Vacuum-pump output

Figure 17. Badly cracked rubberwear

Figure 18. Book regular milking machine testing

The service will probably include service kits for pulsators, milk meters, and milk and vacuum pumps.

In addition, you should arrange a test if you notice any abnormalities. Looking at teat condition (teat ends, teat colour) and cow behaviour while you are milking will give you a lot of information about how the milking machine is working.

How often should the milking machine be serviced?

A milking parlour will usually need an interim service after 750 operating hours and a more significant service after 1,500 hours. A 250-cow herd milking for 7 hours a day will need a major service every 215 days.

The milking machine can have a major effect on the incidence of mastitis. It can spread bacteria from cow to cow, provides a reservoir for bacteria and creates impact forces at the teat end. It can damage cows' teats if vacuum levels are incorrect, if pulsation is not working properly or through over-milking from badly adjusted automatic cluster removers. Regular checks, maintenance and servicing are recommended to keep the milking-machine in good working condition.

A static and dynamic milking-machine test should be carried out at least twice a year. Machines should be tested by an independent, suitably qualified technician to the latest standards relevant to machine or installation date (currently ISO6690:2007)

Teat-cup liners

Liners have a limited effective life – generally quoted at 2,000 to 2,500 milkings for rubber-based liners and 8,000 for the silicone liners. However, many factors can affect the lifespan of liners and it is essential that they are checked frequently for condition; it is not unknown for defective liners to fail at a relatively early point in their quoted lifespan. If liners are being back-flushed with peracetic acid, they may need to be changed more frequently.

A liner must be designed specifically to fit the teat-cup shell for which it is intended and, more importantly, the cows' teats. Liners should be long enough to collapse fully around the teat base and allow proper blood circulation, to avoid teat congestion.

Liners are damaged by normal wear and tear and by chlorine and other chemicals used in the milking plant, which denatures and weakens the rubber-based liners in particular, leading to loss of elasticity, roughness, perishing and splitting. When the interior of the liner becomes rough, it can become more difficult to clean and disinfect and can act as a reservoir of infection, leading to increased potential of cross-contamination between cows, and can also increase Bactoscan readings.

Most liners are packaged with similar information, enabling easy calculation of their expected lifespan. Use the simple calculations in the table below to check liner-change intervals in terms of number of days.

The milking machine is the most important piece of equipment on a dairy farm. As part of its maintenance it is critical that liners are changed as per recommendations.

Why is it important to change the liners on a regular basis?

Teat-cup liners are the only part of the milking plant that actually come into contact with the cow. The condition of the liners is critical in mastitis control and for efficient milking

Table 2. Calculation to check liner-change intervals

Number of cows	**190**
Daily milkings	**2**
Number of milkings per day	190 x 2 = 380
Number of clusters	**20**
Number of milkings per day for each cluster	380 / 20 = 19
Target number of milkings per liner	2,500
Number of days of milking before liners are due to be changed	2,500/19 = 132
Date started milking with current liners	**2 Jan 2019**
Date liners are next due to be changed	14 May 2019

Note: The cells with bold text indicate an example of farm data

Cleaning and disinfection of the liner and cluster

Infected milk residues from cluster units that are not disinfected can cross-contaminate the following six to eight cows to be milked with the cluster. An appropriate disinfectant should be used to wash clusters after milking a cow with clinical mastitis or a high SCC, whether or not a separate cluster is used. If a dump bucket is not used, where possible, the plant back to the recording jar/meter should also be back-flushed with an appropriate disinfectant.

In herds that are not able to segregate infected cows and milk them last in the milking order, disinfection of the cluster and milking equipment between cows, either manually or via an automated system, may result in a reduced risk of transmission.

Automated disinfection of the liner/cluster

Automated 'back-flushing' systems are gaining in popularity. These may help to reduce labour input in the parlour and improve cow flow, while maintaining udder health. There is currently no research evidence to show a significant reduction in the rate of new infection in lactation or even a reduction in pathogen numbers on the liner.

Figure 19. Automatic cluster disinfection

Manual disinfection of the liner/cluster

The ideal way to flush the cluster unit is to dip it in a bucket of disinfectant solution. Dip two teat cups at a time, so there is no air pressure build-up in the cluster unit, to prevent the solution from entering the liners. It is important to ensure that the liners do not touch the parlour floor. Peracetic acid disinfectants tend to be recommended for this procedure as they are less likely to damage parlour rubberware. Where there is regular exposure of liners to disinfectants, more regular liner changes may be worth considering if there is evidence of liner damage.

Weekly checks

Check for twisted liners

All liners come with marking on the hood and on the short milk tube; ensure these markings are aligned.

Check liner condition

Liner condition is critical. Liners are the only part of the machine that come in direct contact with the cows' teats, and need to be kept in good condition. When liners are worn, they lose their shape and do not massage the teat correctly, resulting in longer milking times and reduced yields. Worn liners are also a source of bacteria, particularly thermoduric bacteria (see AHDB/NML guide to thermoduric management), as they hide in the cracks in the liner. Liners should be changed every 2,500 milkings or every six months, whichever comes first. Silicone liners have a life expectancy closer to 8,000 cow milkings.

Monthly checks

Check liner slip

During one milking, record the number of liner slips or squawks that need to be corrected by the milker. Five or less per 100 cows is acceptable, while 10 or more per 100 cows requires investigation.

Milking routines

The milking routine is a critical control point in the production of high-quality milk. If you get your milking routine right, cows will milk faster and give more milk, milk quality will be better and you should see less mastitis.

The aim of a good milking routine is to put the teat cups on calm cows with clean, dry, well-stimulated teats, to remove milk rapidly, and to take the teat cups off as soon as the cow has finished milking.

Pre-milking procedures

Aim for a time between first stimulating the teats to attaching the units (prep-lag time) of between 60 and 120 seconds. This will synchronise milking out the alveolar milk (high up in the udder tissue) with the cisternal milk (in the udder just above the teat), and cows will milk out cleaner and faster. This will reduce the risk of stop-start milking (bimodal or biphasic milking) and reduce new infection risks. It is also nicer for the cow!

It is not possible with long parlours to prepare all cows in the row and still achieve this. Check how many cows can be prepared with your teat-preparation system and then return to attach the units within 60 to 120 seconds. It will vary depending on the size of your parlour and the details of your cow preparation.

Two-step process

Dip and strip

1. Contact time – the length of time the pre-dip has been in contact with the teat before drying off: 30 seconds is the minimum recommended time.

Wipe and apply

2. Prep-lag time – the interval between manual stimulation and cluster attachment: this should be between 60 and 120 seconds.

Aim for 2 visits not 3 visits to each cow.

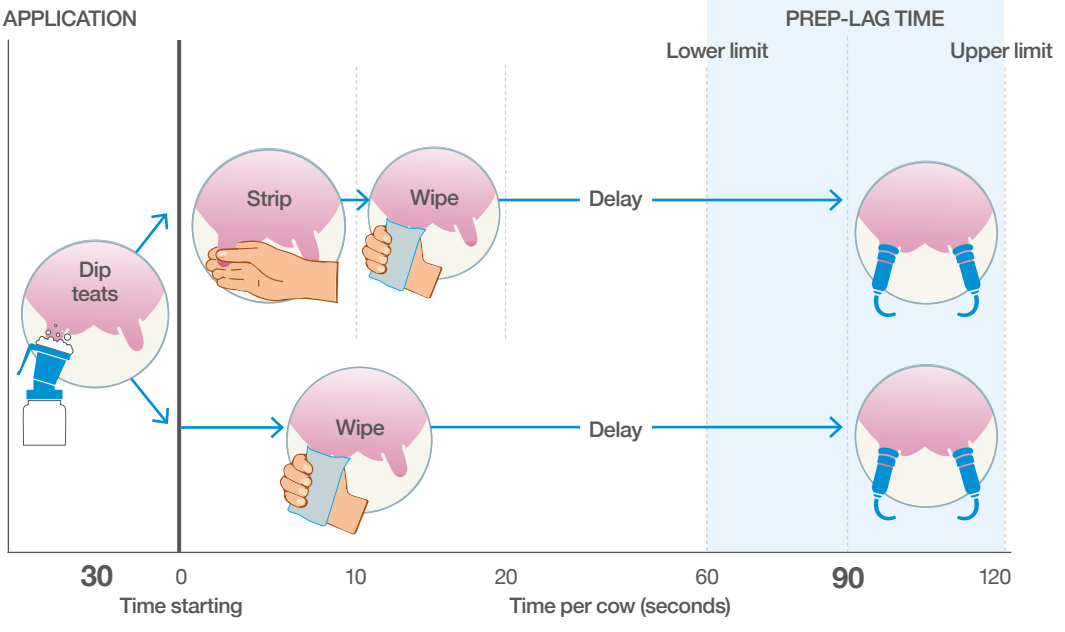


Figure 20. Pre-milking procedure

Reducing risk of spread during milking

Contagious mastitis can be spread easily by the milking equipment and even the milkers themselves. Bacteria in milk from infected quarters can spread to other quarters by splashes and aerosols of milk during stripping, by milkers' hands, by teat-cup liners and by cross-flow of milk between teat cups.

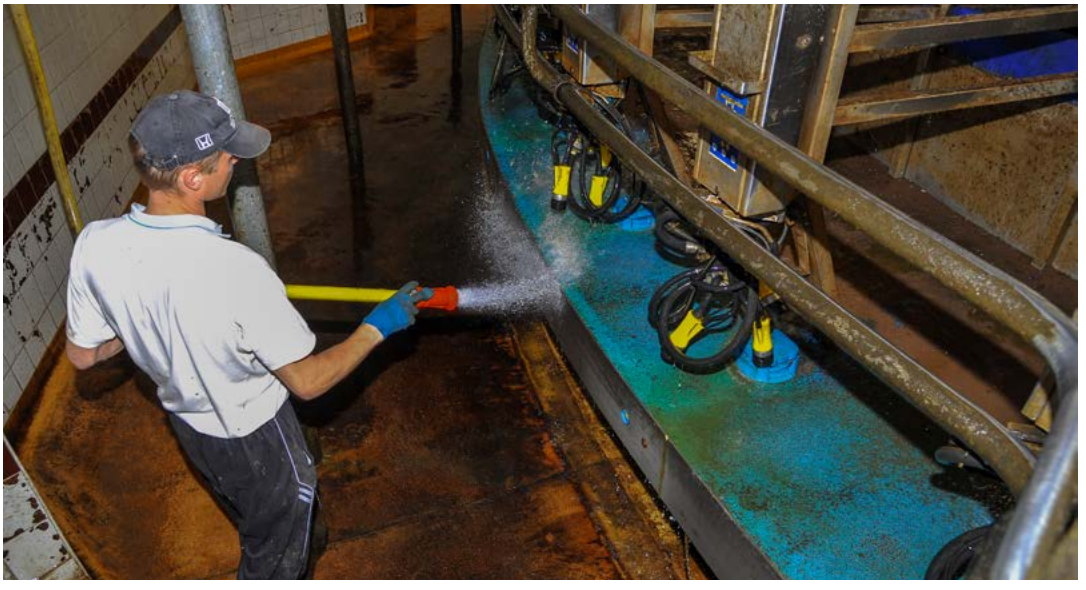
Hands and old pairs of non-disposable gloves are a risk factor for mastitis because they can carry bacteria. They can easily spread pathogens between cows during the milking preparation. Clean gloves are cleaner than clean hands. A new pair of clean disposable gloves should be worn every milking.

A consistent milking routine will help reduce the risk of spreading mastitis pathogens. Routines will vary between farms, parlour types and different systems. Once the cows are in the parlour, the aim is to put clusters on clean, dry teats: wash the teats, then wipe dry with a clean dry cloth or towel. Only use single-use towels, to avoid transfer of pathogens between cows.

Wash the parlour between rows – don't wash while cows are in the parlour unless all the units are attached to cows. Use running water and disinfectant solution to remove infected milk from gloves, liners and other equipment.

Milking routine

1. Wear disposable gloves.
2. Give pre-milking teat disinfection enough time to work – over 30 seconds.
3. Lag time of 60–120 seconds from manual stimulation to cups on.
4. Put teat cups on calm cows with clean, dry teats.
5. The majority of the teat skin of every teat should be completely covered with post-milking teat disinfectant at the end of every milking.



Summary of milking routine

- Cows should be calm and clean when they enter the milking area
- Cows with clinical mastitis, cows treated with antibiotics and high SCC cows must be clearly marked
- Consider a dry wipe to remove dry dirt (helpful if bedded on sand)
- Pre-dip the teats. Give the pre-dip enough time for the product to work. To avoid residues, only use licensed products and follow manufacturers recommendations
- Foremilk, checking for any signs of mastitis or irregularities in the milk
- Prep-lag time of 60–120 seconds from manual stimulation to attachment
- Wash grossly soiled teats, wipe off the pre-milking teat dip (PrMTD) and wipe dry with a clean dry cloth or towel. You have paid for the PrMTD so leave it on until just before attaching the units
- Attach the cluster unit, ensuring the clusters are squarely attached, aligned and balanced centrally. If you have automatic cluster removers (ACRs), pull the cord so it is not under tension. Never apply weights to clusters
- Hands and gloves should be washed and dried during milking if they become dirty or splashed with milk. If cluster units fall off and get dirty, clean in warm disinfectant solution
- If you don't have ACRs and you are removing the cluster by hand, pinch off the vacuum, wait a few seconds for the vacuum to drop. Before the cluster falls off, twist the claw to break the seal and remove the cluster
- **Never** pull off the cluster under vacuum
- **Never** break the vacuum at the mouthpiece of the liner
- Apply post-milking teat disinfectant – regularly check that the majority of the teat skin of every teat is completely covered at the end of every milking
- Wash the parlour between rows – don't wash while cows are in the parlour unless all the units are attached to cows
- Use running water and disinfectant solution to remove infected milk from gloves, liners and other equipment

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