MASTITISCONTROL

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Control of environmental mastitis in lactation

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.

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Introduction

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

Udder infections may be picked up from the environment or transmitted from cow to cow (contagious transmission), so understanding the origin can improve the effectiveness of any preventative steps.

Analysis of clinical mastitis records and individual cow somatic cell counts (SCC) can reveal which of these 'infection patterns' is most significant in a herd at a particular time, and also whether most new infections originate during lactation or the dry period.

It is important to remember that many of the mastitis cases in the first 30 days of lactation are a result of infections picked up from the environment during the dry period and around calving.

The Mastitis Pattern Analysis Tool (MPAT) provides a simple automated way of determining the transmission pattern.

In the AHDB 'Sentinel Herds' group in 2018, environmental lactation mastitis was the main pattern in 45% of herds, and of equal importance with environmental dry period mastitis in 23% of herds.

Environmental patterns are by far the most common in UK herds. This factsheet provides relevant information for herds with an environmental lactation pattern (i.e. the majority of new infections come from the environment, and the majority of new cases originate during lactation, rather than the dry period).

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Lead Veterinary Science Expert

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

- ***Managing mastitis***
- ***The QuarterPRO approach*** factsheet
- ***Control of contagious mastitis***
- ***Control of heifer mastitis***
- ***Dry cow management***

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

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

Environmental mastitis pathogens

Environmental mastitis pathogens are widespread in cows' dung, in bedding materials, at pasture, in water and on the cow's skin itself.

The most common major pathogens causing environmental mastitis are *Streptococcus uberis* (*Strep. uberis*) and *Escherichia coli* (*E. coli*). Others include *Klebsiella*, *Pseudomonas* and *Trueperella* species.

Data from 6,005 milk samples submitted from over 500 farms between 2010 and 2013 reported by Payne and others[1] showed *E. coli* to be the most prevalent major pathogen recovered from clinical cases of mastitis (19.2% of all clinical cases), closely followed by *Strep. uberis* (17% of all clinical cases). britishmastitisconference.org.uk

Figure 1. *E.Coli* in laboratory culture

Figure 3. *Klebsiella* in laboratory culture

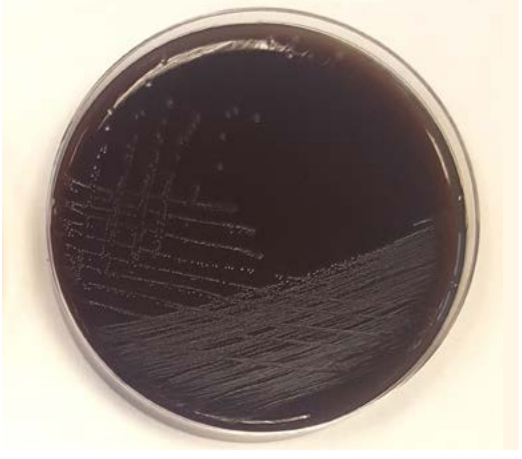


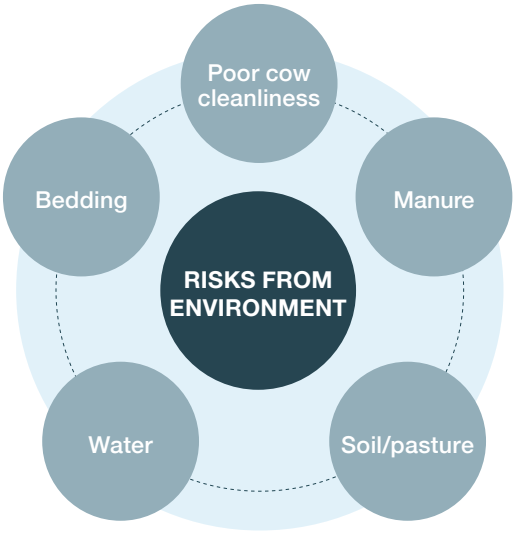
Figure 2. *Streptococcus uberisli* in laboratory culture

[1] Payne, B., Bradley, J.A., Coombes, E.M., Lusby, E., Mining, K., Hunt, C. and Bradley, A.J. (2013). The aetiology of bovine mastitis in UK dairy herds. Proceedings of the British Mastitis Conference (2013) Sixways, Worcester, 59–60.

Reducing the risk

Environmental mastitis is caused by bacteria picked up from the environment, rather than bacteria spread from other infected cows. Bacteria in the environment, which can cause mastitis, are found in manure, bedding, soil and water. Cows leaking milk can also play a role. Cows pick up these infections from:

- Lying areas or cubicle beds
- Floors and passageways
- Dirty legs and feet
- Wet, dirty areas at pasture
- Contaminated water



Herds with environmental mastitis infections in lactation typically see seasonal patterns, which may be the result of infections acquired from:

- Winter housing environments
- Pasture environments
- The impact of heat stress and environmental infections during summer months

Investigate outbreaks of environmental mastitis to identify the risk factors so that action can be taken.

The key to the control of environmental mastitis in lactation is to take steps to reduce the risk of cows picking up infection from the environment.

You can cut the risk of new cases of environmental mastitis by improving cow cleanliness and stocking rates, and management of housing, feed and water.

Control of environmental mastitis in milking cows

If cows are in damp and dirty conditions, the risk of environmental mastitis is increased. Aim to keep cows clean and dry.

A quick checklist of the key areas for the control of environmental mastitis in lactation is:

Cow cleanliness

- Are cows scored regularly for cleanliness?
- Is action taken to improve cow cleanliness?

Cow comfort and housing design

- Are cows using cubicles properly? (i.e. lying in the cubicles but not soiling beds)
- Do cows in loose yards have a clean and dry bed?

Stocking rate

- Is there any overcrowding?
- Are there at least as many cubicles as cows? (Ideally 105/100 cows)
- Is there a bedded lying area of 1.25 m^2 per 1,000 litres of milk per cow (herd annual milk yield) in straw yards?
- Do cows have a loafing space of at least 3.0 m^2?

Beds and bedding

- Is bedding generally clean and dry?
- Is new bedding applied at least once a day? (twice/day if problem persists)
- Are cubicle beds cleaned off at least twice per day?
- Are straw yards cleaned out at least once a month?

Slurry management

- Are all alleyways, loafing and feeding areas being scraped out at least twice daily?
- Does slurry never overflow the sides of the scrapers?

Ventilation

- Is the atmosphere dry and draught-free?

Feed and water

- Is there at least 0.6 m of feed space per cow? (0.7 m for Holsteins; more for transition cows?)
- Is there at least 10 cm of water trough space per cow in every group?
- Are the areas around water troughs clean and well drained?
- Are feed and water provided to encourage cows to stand for 30 minutes after milking?

Pasture

- Are paddocks grazed for no more than two weeks and then rested for four weeks before regrazing?
- Are wet and dirty areas fenced off?
- Is stocking rate less than 100 cows per acre per day in any two-week period?

Milking

- Do any cows have to wait for more than an hour to be milked?
- Are all teats dipped or sprayed with pre-milking teat disinfectant?
- Do all milkers wear gloves?
- Are all cows checked for mastitis by fore-milking?
- Are all teats dried before attaching the cluster?
- Is all water used in the parlour of drinking water quality?
- Improving cows' defences
- Are cows teat scored regularly?
- Are there less than 20% abnormalities at teat ends?
- Is negative energy balance and subclinical ketosis well controlled?
- Has vitamin and mineral supplementation been reviewed?
- Have you considered vaccination?

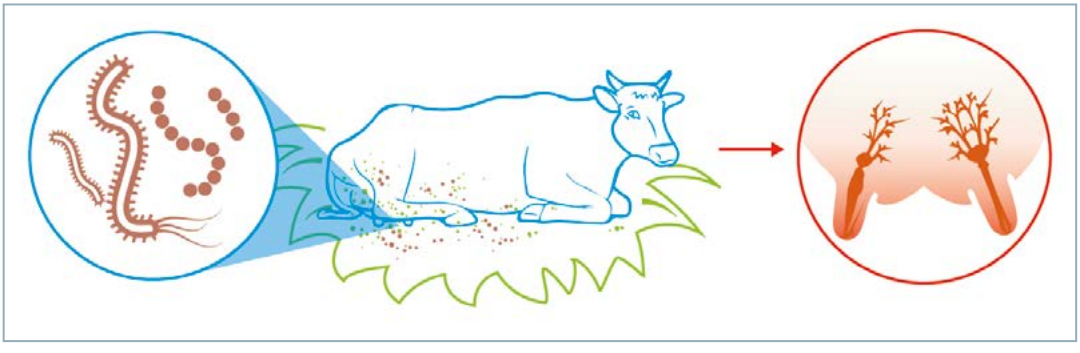


Figure 4. Bacteria in the environment, which can cause mastitis, are found in manure, bedding, soil and water

Cow cleanliness

Looking at the cows can give the first indication of environmental issues. If a cow looks clean, it means the environment is clean. The risk of infection from the environment is likely to be lower if the cow and her environment are clean. If a cow is dirty, it is likely to be at higher risk of infection from the environment.

Cleanliness scoring is used as a measure of how much muck and dirt is on different body parts. You can check how clean your cows are by using the AHDB ***Cleanliness scorecards***. Cows are scored 0, 1 or 2, based on the cleanliness of the udder, flank (including tail) and the hind legs of the cows.

The AHDB ***Cleanliness scorecards*** use photos to show how to score cows. Ideally, score the whole herd but it is important to score enough cows for your herd size (full details can be found at **ahdb.org.uk/knowledge-library/cleanliness-scorecard**. A video entitled 'Scoring cleanliness in the dairy herd' has been produced and can be found on the AHDB Dairy YouTube channel.

Bulk milk Bactoscan readings tend to be higher in herds with poorer cleanliness scores.

Using the cleanliness scores

- Investigate the causes of very dirty cows (score 2) in the cow's environment
- Make changes to help reduce the number of 'score 2' cows
- Regularly score the herd and check whether the changes are improving the cleanliness scores

Cows with dirty udders are one and a half times more likely to have a case of clinical mastitis than those with clean udders.

Dirty udders? Check:

- Hygiene of bedding
- Hygiene of passageways (scraping frequency) and yards
- Lying comfort of the cubicles
- Manure consistency
- Shaving or flaming of udders
- Health of the animals

Dirty flanks and tails? Check:

- Maintenance and the cleaning of beds
- Frequency and the spreading of the bedding
- Lying comfort of cubicles and manure consistency
- Health of the animals

Dirty legs? Check:

- Use of a manure scraper
- Removal of manure from passages where there is no manure scraper
- Manure consistency
- Cleaning of the collection and loafing areas

Cow cleanliness can give a clear picture of the risk of infection from the environment. However, clean cows can also be lying in heavily contaminated beds. You cannot see bacteria but they can be present in large numbers in what looks like 'clean' bedding. This can result in a high risk of infection that is not easily seen.

Important

Less than 5% of cows should have dirty udders.

Housing design

To control environmental mastitis, it is important to keep cows clean and dry because infection can happen at any time between and during milkings. Housing, bedding and other surfaces with which cows come into contact must be clean and dry. The best way to prevent environmental mastitis is to minimise the number of bacteria that can cause mastitis, at the teat end.

Cow comfort is a key factor in reducing environmental risks for mastitis. Housing designed with the cow in mind is important. Even in well-designed housing, providing enough clean and dry bedding with regular maintenance is essential.

Mastitis control can be maintained with a focus on bedding management and pre-milking teat disinfection. However, fundamental issues with building design, ventilation and stocking rate can often mean new infection rates remain high, particularly in higher-yielding herds.

Ventilation of lactating cow housing

In herds in which environmental infections in lactation are the main cause of mastitis, it is worth checking ventilation. Good ventilation in the milking herd's housing provides a drier atmosphere and reduces bacterial numbers on the bedding by reducing pathogen survival time. The outlet and inlet must be assessed and optimised to enable efficient natural ventilation (the 'stack effect').

This early lactation group is housed in a shed characterised by a wide, open ridge and open sides, to maximise air outlet and inlet, and allow the stack effect to function and the building to ventilate naturally. Note the absence of skylights to ensure that heat is not trapped in the building during warmer months of the year.

Mechanical ventilation should be considered where natural ventilation may be insufficient and where the impact of heat stress, particularly in summer months, has been shown to increase the rate of new mastitis infections in lactation.

Figure 5. Early lactation housed cows

Access to feed and water

Cows need enough trough space to avoid unnecessary pressure on feed or water intakes. If cows don't have enough space, this can lead to crowding and competition, both of which may increase the risk of faecal soiling and will increase stress.

Adequate feeding space

Adequate feeding space is essential to avoid competition between cows and build-up of dung in the passageways as cows are queueing to feed. It is also important to maximise cows' dry matter intake and, therefore, energy input for better immune function.

A feed space of 0.6 m is approximately half a cubicle width – this means that, where there are two cubicle rows per feed face, cows will have sufficient feed trough space. If there are three cubicle rows per feed face, cows will not have enough feed space.

Most Holstein-Friesian cows will need at least 0.7 m of feed space. Try to give more feeding space to cows in early lactation – many top-performing herds are offering feed space closer to 1 m.

Important

- **There must be at least 0.6 m of feed space per cow in total for access to forage, concentrate or complete diet portions of the cow's feed.**
- **There should be water trough space of greater than 10 cm per cow at all stages of the production cycle**
- **Areas around water trough should be clean and well-drained**

Adequate water trough space

Water troughs must not be sited close to or on bedded areas and must be surrounded by a clean, well-drained surface in the loafing or feed areas.

Clean water is essential, as bacteria will survive in water for varying lengths of time. Cows will also drink more clean water. Cows should have access to water at all times, including before and after milking.

Loafing areas

Loafing areas are non-lying, non-passageway, non-feeding areas that allow cows freedom to express normal behaviour, such as grooming and heat expression. They also allow cows to spread out, reducing faecal contamination of the housing areas and bullying stress. The total loafing area (exclusive of lying areas) must provide a space allowance of 3.0 m^2 per cow.

The importance of loafing space cannot be over-emphasised, particularly in low cell count, high-yielding herds that struggle to control opportunistic environmental infection in milking cow groups.

There should be sufficient grip and grooving of concrete in all areas to prevent the risk of slipping and injury, and well-designed yards and alleys that minimise the risk of slipping and injury.

Figure 6. Loafing areas

Slurry management

A 700 kg cow produces over 60 litres of slurry per day, most of which will end up in feed and cubicle access passages. Cows standing, walking and lying in slurry will become dirty, with softer hooves, and will be at a higher risk of disease. Keeping floors, passageways and hardstanding areas as clean as is practicably possible at all times will reduce the risk of health problems.

For more information about cow flow, housing systems, design, slurry and waste management, refer to the AHDB website.

Important

- All alleyways, loafing and feeding areas must be scraped out at least twice daily
- If using automatic scrapers, the slurry must never overflow the sides of the scrapers, and scrapers must work often enough to keep alleyways clean

Figure 7. Scraping alleyways

Bedding management

To reduce the risk from environmental sources of mastitis, it is important to keep levels of bacteria near the teats and teat ends low. Bacteria are everywhere in the environment. When cows lie down, teats and teat ends will come into close contact with the bacteria in the bedding.

Bedding types

The bedding used on farm will depend on availability and cost, as well as cow housing and slurry handling facilities. There are two main types of bedding materials used for dairy cows.

- Organic materials, including straw, sawdust, wood shavings, paper-based products and recycled manure solids
- Inorganic materials, such as sand and chalk

Organic material can be used as a source of food by bacteria, especially if some milk leakage is added. Inorganic material (sand) contains no or fewer nutrients, unless it is very contaminated with organic material, such as manure or milk. If inorganic bedding is not well managed, it soon becomes organic with faecal contamination. A comparison between different types of bedding materials is difficult, but it is generally accepted that, to prevent mastitis, clean inorganic materials are best.

Inorganic bedding materials should be used wherever possible.

Good bedding and cubicle management are critical to minimising risks and successfully using any bedding material.

Bacteria multiply faster in damp and warm conditions. It is important that all types of bedding used are as dry as possible.

Top tips for bedding

- Damp straw is a major risk factor for mastitis and should not be used to bed lactating cows
- Poor quality sawdust can contain *Klebsiella* bacteria, which can cause severe udder infections
- Sand is an inorganic material and lacks nutrients, so there is less rapid multiplication of bacteria
  - But, even in sand, bacteria can multiply, especially if contaminated
  - Although sand is present for a longer period of time in beds before being refreshed, the bacterial population is lower than with other bedding materials
  - Clean, washed sand is ideal. It should break up when you move a ball of it from hand-to-hand three or four times. If it doesn't, there is too much clay content
- Recycled Manure Solids (RMS or 'Green Bedding') have been used as a bedding material for dairy cows. However, there is only limited information on the risks of mastitis when using RMS
  - For this reason, there are regulations covering the use of RMS bedding
  - See also AHDB ***RMS research report***
  - If using RMS, keep under cover and aim for a dry matter content of at least 34%
  - Prepare on the day of use, rather than storing

Bedding storage

Ideally, the bedding material should be clean and practical before use. Keep the material dry by storing it under a roof. Covering with plastic often results in mould formation and bacterial growth due to condensation. Prevent the litter from absorbing moisture from a (damp) surface, for example by using a layer of gravel underneath.

Sand should be stored under a waterproof cover or sheet to keep it clean and dry. Straw, sawdust, paper products and RMS should be stored under a waterproof cover and kept dry at all times.

'Bedding conditioners'

'Bedding conditioners' (lime or commercial products) are often promoted for mastitis control. The effectiveness is likely to be affected by the type of bedding material, and the frequency and rate of application. Studies suggest that bedding treatments need to be applied frequently. The effect of lime appears to last for 24 or, at most, 48 hours. Twice-daily application, along with twice-daily bedding, will likely be more effective and will help keep beds clean. Little and often is easier to keep clean than less frequent application.

Less frequent use, e.g. sprinkling 100 g/cubicle per day of lime on the cubicle bed every day (spring/summer) or every two days (autumn/winter) may help slow down bacterial growth.

Important

- **Do not spray disinfectants onto the cubicle beds because the disinfectant is rapidly inactivated by organic matter. Spraying also adds moisture, which helps bacterial growth**
- **Keep bedding materials clean and dry before use**

Figure 8. Bedding materials need to be prepared and stored under cover. This is particularly important for recycled manure solids

Cubicle housing for lactating cows

Infection with bacteria from the environment can happen at any time between and during milkings. To reduce the risk from environmental sources of mastitis, it is important to keep levels of bacteria on the teats and near teat ends low. In housing, keep bedding and other surfaces with which cows come into contact clean and dry. This will help to reduce the risk of environmental infection.

Cow comfort is a key factor in reducing environmental risks for mastitis. Housing designed with the cow in mind is important. Even in well-designed housing providing enough clean and dry bedding with regular maintenance is essential.

Well-managed cubicles give a lower incidence of mastitis infections in lactation compared with loose yard systems, in general. To minimise the risk of mastitis infections, aim to:

- Minimise cows lying out in the passageways
- Reduce manure soiling of the cubicle beds
- Minimise the risk of teat and udder injury
- Pay close attention to cubicle bed management

Cubicle size and design

Cubicles must be appropriate to the size of the cows in the herd and designed so that 90% of cows will lie in them correctly at all times:

- The minimum cubicle size must be greater than 2.36 m long x 1.15 m wide (7'9" x 3'9") and should be more than 2.43 m long by 1.22 m wide (8' by 4') for Holstein-Friesian cows
- There should be a slope on the cubicles, front to back, of 1 in 20 to ensure good drainage
- There should be an adjustable brisket board (or cow pillow) in the cubicles at a distance of approximately 75% of the cubicle length, to ensure that at least 90% of the cow's dung goes into the passageway
- Neck rails should be adjustable. The diagonal distance from rear kerb to neck rail should be more than 200 cm (216 cm for Holsteins)
- Cubicle partitions should not have a bottom rail lower than 0.4 m and could have flexible partitions (Figure 9)

Figure 9. Flexible cubicles

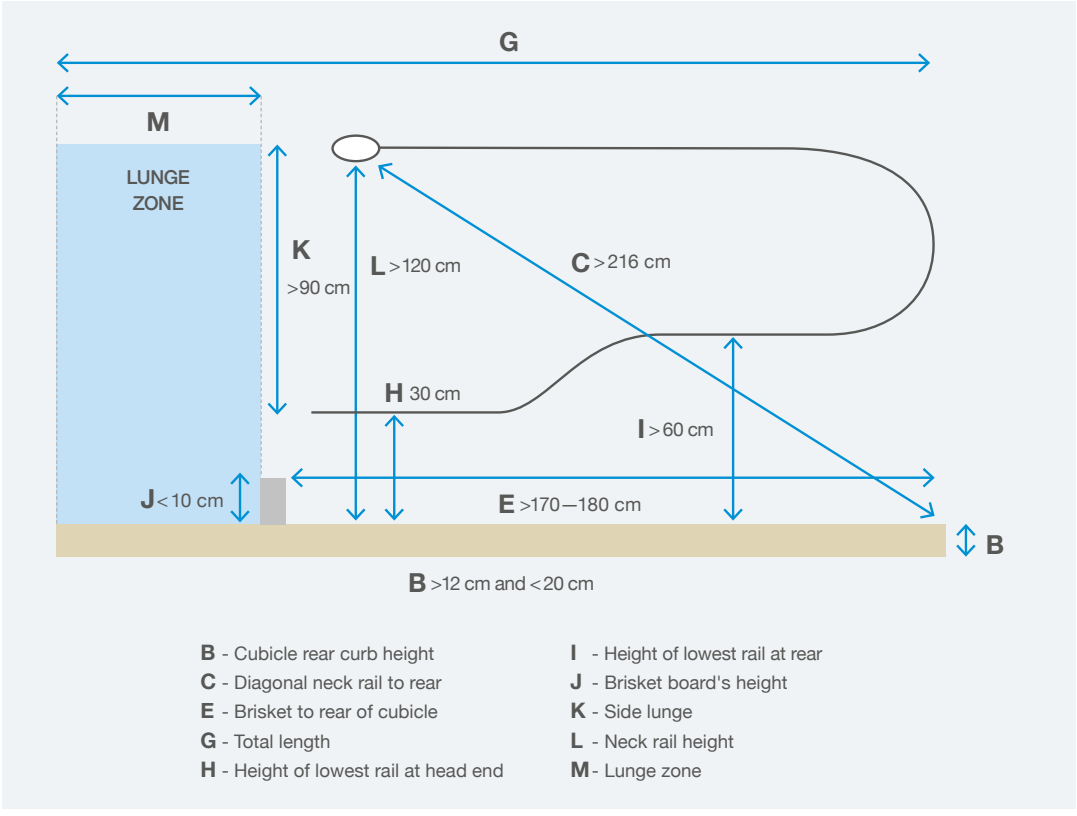


Figure 10. Recommended cubicle dimentions for Holstein - Friesian cows over 600 kg

Source: K.A Leach and H.R Whay 2009; The welfare quality lameness control programme for Dairy Cattle – Welfare quality report No. 14, p26 **http://www.welfarequality.net/media/1122/wqr14.pdf**

Figure 11. Cows lying well in cubicle rows

Stocking rate

The stocking rate for lactating cows housed in cubicles can be an underlying issue for some herds. It may be difficult to control the risk of environmental infection from high stocking rates even with gold standard milking parlour routines. High stocking rates can be a particular risk in low cell count herds where the impact of environmental infections can be dramatic. Cows are herd animals and prefer to synchronise their behaviour by lying down at the same time.

In early lactation and heifer groups, stocking rate at 80% occupancy is recommended. This occupancy level (80%) gives more choice of lying spaces as well as reducing competition for resources and bullying behaviour.

Important

- 90% of cows lie correctly in cubicles at all times
- There must be at least as many cubicles as cows (Red Tractor)
- Ideally, there should be 5% more cubicles than cows for each group (e.g. a 100-cow group should have 105 cubicles)
- New, clean bedding material must be applied at least once daily for organic bedding. Twice-daily application of new, clean bedding should be considered if problems persist
- Clean bedding material must be applied at least once every other day for inorganic bedding materials such as sand
- Dung, soiling and wet bedding must be removed at least twice daily from cubicle beds for lactating cows

Management of cubicle beds

In cubicles, using enough bedding material will keep surface conditions dry and will make the bed soft and cushioned enough for cow comfort.

A 'knee test' with clean overalls or kitchen paper can immediately make it clear whether a bed is comfortable and dry enough for the cows.

It is especially important that clean bedding is placed where the cow's udder will be when she lies down. Cows move around in their bed when lying down, much as we do. Even if there are mattresses in a cubicle, bedding is always needed to absorb the moisture (urine and milk), to reduce the risk of mastitis, to make it comfortable and to help reduce friction sores.

Milk leaking onto beds from high-yielding cows is a potential source of nutrition for bacteria already in the bedding, and may also contain additional bacterial that will cause further contamination.

Wet knee test

Involves kneeling in the stall for 10-30 seconds and if the knee is wet, the bedding is not dry enough.

Drop knee test

Involves crouching and then dropping to your knees. Any pain reaction in your knees will quickly tell you how confortable the beds are. If it hurts, it is likely the cows will be reluctant to use this area.

For more information about cow flow, housing systems, design, slurry and waste management refer to the AHDB website.

Loose yards for lactating cows

In general, the risk of mastitis infections from the environment in lactation is higher in loose yards than when cows are housed in cubicles. To control environmental sources of mastitis, it is important to maintain low levels of bacteria near the teats and teat ends. Well-managed loose yards can reduce the risk of picking up infections from the environment in lactation. To minimise the risk of mastitis infections, aim to:

- Keep the cows clean and as free from manure soiling as possible
- Minimise the risk of teat and udder injury

Straw, woodchip and sand are the main materials used for bedding in loose yard systems. The base of the loose yard should have excellent drainage, possibly with sand on top of hardcore or concrete.

Stocking rate

In general, for loose-housed systems, priority should be given to the space allowances for high-yielding cows, and bedding frequency should be increased if limited space is available.

For information on bedding management, refer back to page 11-12.

Management of straw yards

Managing milking cows in straw yard systems is difficult and, in general, mastitis rates are higher than in cows housed in cubicles. High-yielding cows consume more food and, therefore, produce greater quantities of dung and urine, leading to rapid build-up of contamination. A 700 kg cow produces over 60 litres of slurry per day, most of which will end up in the bedding and in passageways.

A knee test (see page 15 for full details) with clean overalls or kitchen paper can immediately make clear whether a bed is comfortable and dry enough for the cow.

Example

An 8,000 litre cow needs approximately 10 m^2, while a 10,000 litre cow needs 12.5 m^2. If limited space is available, priority must be given to the space allowances for high-yielding cows. This could be done, for example, by regrouping the lactating cows and/or higher stocking of lower-yielding cows in favour of transition cows and cows in early lactation.

Figure 12. Cows in straw yard

Figure 13. Access to this straw yard has been altered to allow cows onto the yard on the long side, with additional feeding and loafing space provided down the side of the yard

Management of sand yards

Managing milking cows on sand yards can be labour-intensive but, in general, mastitis rates are lower in cows kept on sand yards than on straw yards, and bedding purchase costs may be lower.

Important

- There should be a bedded lying area of 1.25 m2 per 1,000 litres of milk per cow (herd annual milk yield)
- New clean, dry straw MUST be put in yards at least once daily, and twice daily should be considered if mastitis problems persist – bedding should be spread evenly
- Aim for at least 15 kg of straw per milking cow per day to bed lactating cows
- Straw yards should be cleaned out completely at least once per month
- All alleyways, loafing and feeding areas MUST be scraped out at least twice daily
- Dung must be removed at least twice daily from lying areas
- Fresh, clean sand should be spread evenly in the lying areas at least daily
- Sand yards should be cleaned out completely at least every 6 months or earlier, if necessary

Lactating cows at pasture

Environmental mastitis has traditionally been seen as a problem that occurs during housing. However, time at pasture appears to be a considerable risk period for clinical mastitis and increased somatic cell counts for many dairy herds. This is often due to exposure to different bacterial pathogens as well as variable environmental conditions.

Where grazing is not adequately rotated, bacteria that cause mastitis can build up in the environment. The areas that can be hotspots of contamination include areas where:

- Cows tend to gather
- Cows lie during the night
- Cow traffic is high

Giving some thought to managing these areas, particularly when dividing fields into grazing paddocks, is an important means of controlling the risk of environmental mastitis. This is even more important in wetter summers and where extended grazing techniques are practised.

High-risk areas

Wet, dirty areas at pasture are high risk – around feeders and water troughs, under trees, around gateways and cow tracks. Note the areas where cows regularly like to lie. These are likely to include shaded areas on hot summer days, flatter areas in undulating fields and areas just inside gateways.

Time spent in paddocks and grazing areas

Avoid having cows on the same pasture, paddock, field or lying area for more than two continuous weeks and try to avoid returning cows to any one grazing, loafing or rest area for at least four weeks after cattle have used it – unless using short-interval rotational grazing. This is clearly dependent on grazing conditions and grass growth.

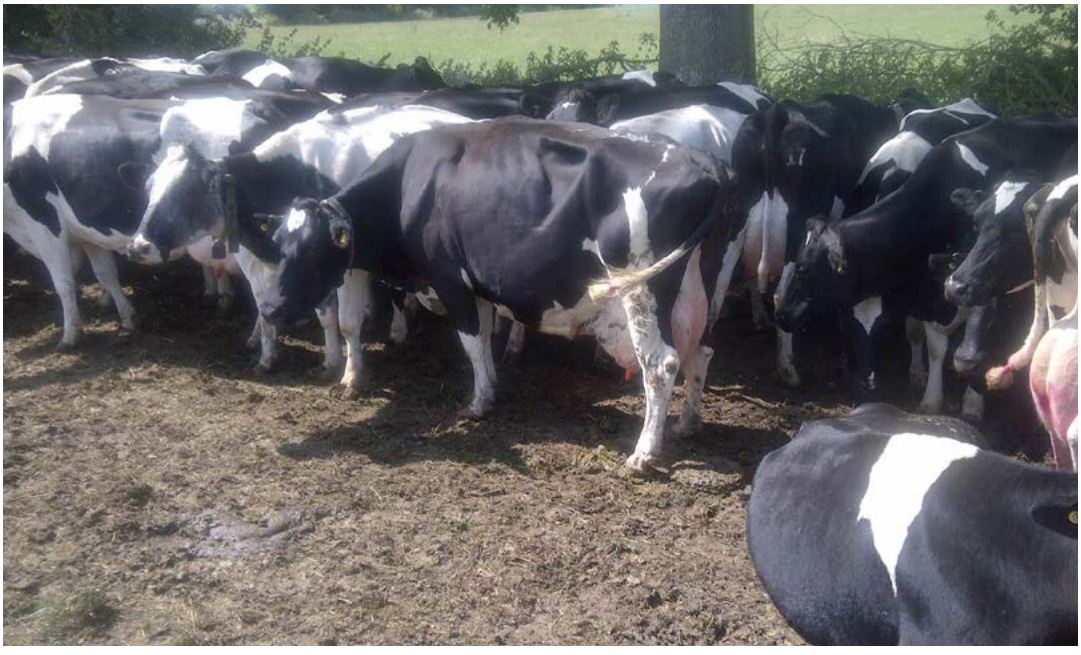


Figure 14. Cows camping in one area of a paddock

Accessing grazing paddocks and areas

Consider actively managing gateways and walkways by using bark, hardcore, or shavings to minimise the risk of poaching and/or change the use of routes and gateways, wherever possible.

Stocking density at pasture

Aim for a stocking density of no more than 100 cows per acre per day in any two-week period.

Fly control

Fly eggs and larvae thrive in warm, moist organic matter such as undisturbed muck heaps. If you can minimise these fly development sites, it should help reduce the fly populations.

At pasture, a build-up of muck around boundaries and under trees can harbour flies. Don't overstock these areas or graze for too long to reduce the risk. To control flies in stored manure, keep it dry and compacted or held in a lagoon at very low dry matter.

Flying insects should be controlled from early on in the fly season. Several products are available based on synthetic pyrethroids such as permethrin and deltamethrin. They can be used as pour-on applied to the backs of animals or as sprays applied as an emulsion via a knapsack sprayer or spray arch. In an average summer, three or four treatments are usually required. Ear tags containing cypermethrin are also available. Most products have zero milk withdrawal requirements and can be used during pregnancy and lactation.

Top Tips

- Clean and renovate areas around feed and water troughs, gateways, tracks and the entrances to the collection yards
- Move water troughs away from gateways
- Check track and gateway placement to avoid wet or poached areas that could lead to cows' udders being splashed
- Wherever possible, rotate gateway use if a field has more than one possible entry/exit point, and design farm tracks to make use of all gateway options
- Adequate drainage, proper design and regular maintenance of cow tracks will reduce problems with dirty teats and udders (the AHDB ***Cow tracks guide*** provides further information)
- High traffic areas that regularly become muddy could be resurfaced with concrete or other alternative surface material
- Consider fencing off areas that become heavily contaminated and ensure drains and culverts are regularly cleaned out. This can also help reduce the risk of liver fluke
- Where access is required to buildings for water troughs, for milking or for feeding, either rope off cubicles or manage cubicle housing in the same way as during the housing period
- If cows are buffer fed, it should be done before milking, so that cows are more likely to graze directly after milking, giving the teat sphincter time to close before they lie down

Cow flow to and from the parlour

Good stockmanship is key to moving cows quickly and quietly around the farm.

In the collection area before milking, some teat ends may not be completely closed. Splashing manure, especially if the manure is liquid, makes the udders and teats dirtier and increases the risk of infection.

Calm cows:

- Dung less frequently
- Kick the cups off less often
- Have a better milk let-down
- Can be moved more easily than stressed and anxious cows

Cows must be able to access the parlour with ease throughout milking, and the milking staff must not use aggressive methods to move slow cows into the parlour, as this will cause stress and affect milk let-down, leading to more pressure on the overall milking routine.

Stressed cows:

- Produce adrenalin that interferes with milk let-down

Avoid stressing cows through shouting, use of sticks, dogs or electrified backing gates.

Collecting yard management

Management of the collecting yard is very important for the control of environmental mastitis infections in lactation, largely because teats are more likely to be open at this time. You can reduce the risk of contaminating teat ends, by:

- Scraping the collecting yards before or after every milking
- Good drainage of the yard to prevent excessive pooling of liquid
- Keeping the time cows have to wait to be milked to less than one hour. Bringing your cows to the parlour in groups may help to achieve this
- Providing at least 1.5 m^2 space per cow in collecting yards
- Not using footbaths just before milking

Figure 15. Cleaning collecting yard

After milking

Immediately after milking, the teat canal is open and can remain open for 30 minutes. The risk of new intramammary infections after milking is high, despite the use of teat dip disinfectant. Look at how you can reduce risk as the cows leave the parlour and for the following 30 minutes, including:

- A safe and non-slip exit from the parlour with no excessive slopes or bends
- Minimise stress on the cows as they leave, with no operator pressure
- A clean yard for cows to go into after leaving the parlour
  - Scrape before and during milking, if necessary
  - Good yard drainage so there is never any pooling of liquid
  - At least 3 m^2 per cow in the post-milking yard
- Footbaths used after milking, designed so that cows use them slowly

Important

- **Provide fresh food and plenty of water trough space after each milking to encourage the cows to stand for more than 30 minutes after milking**
- **Scrape collecting yard before and after each milking**

Figure 16. This picture shows the post-milking dispersal area and view back to the high-yielding cow accommodation. Note the clean yard on exit from the parlour, water troughs available (left). However, the ramp to the cubicles should be scraped

Reducing the risk during milking

Environmental mastitis is usually the result of infections picked up outside the milking parlour. This does not mean that environmental infections cannot be spread during milking. If there are bacteria from the environment on the teat ends, milking time is an ideal opportunity to get into the udder through the teat canal. Infected cows can contaminate the cluster, and infection can spread to other cows during milking. Actions taken to prevent cow-to-cow spread during milking will not eliminate environmental mastitis, but good routines and effective action during milking will help reduce the risk.

Teat preparation and milking routine

A good milking routine is key to both the hygienic harvesting of milk and minimising the risk of infections acquired during the milking process from environmental bacteria on the teat skin. You can reduce the risk of mastitis from bacteria in the environment, by:

- Cleaning the teats to remove dirt
- Using a pre-milking teat disinfectant (PreMTD) as you cannot see bacteria
- Leaving PreMTD on the teat long enough for it to kill bacteria (at least 30 seconds)
- Drying the teat to prevent a drip full of bacteria collecting at the teat end

Preparing teats for milking – washing, pre-milking teat disinfection and drying will reduce new infections with environmental pathogens and help reduce Total Bacterial Count (TBC) and Bactoscan.

However, if cows are arriving in the parlour heavily contaminated with bacteria from the housing or the pasture, it can be very difficult to reduce the risk to manageable levels.

Why is a milking routine important?

The aim during milking is to harvest milk hygienically from the udder to produce a top-quality product and to minimise the risk of mastitis. For more details, see ***Control of Contagious Mastitis***.

Pre-milking teat disinfection (PreMTD)

If the udder and teats are very dirty, washing with clean water will remove dirt and allow more effective disinfection prior to milking – but this should not be necessary if the environment is well managed.

When properly carried out, PreMTD ('pre-dipping' or spraying) achieves a rapid reduction in the number of bacteria that are present on the skin of the teats. It greatly reduces the likelihood of intramammary infection from environmental bacteria during the milking process.

Pre-milking teat disinfection must be carried out with a product approved for use pre-milking that has a rapid 'kill', and should be applied for at least 30 seconds before teats are dried.

Dipping is more effective than spraying.

It is important that the pre-milking teat disinfectant used is fit for purpose. It must kill the bacteria but not leave any risk of contaminating the milk. The active ingredients include chlorine dioxide, lactic acid, hydrogen peroxide and sodium dichloroisocyanurate.

Teat cleaning

The aim in cleaning is to remove bacteria from the teats. Dirt usually contains a lot of bacteria. Dry dirt and sand may be more easily removed using a dry wipe first. Wash grossly soiled teats – if teats are washed, they must be dried.

Hands and old pairs of non-disposable gloves also carry bacteria and can easily spread bacteria between cows. Clean gloves are cleaner than clean hands. A new pair of clean disposable gloves should be worn every milking.

Mechanical teat scrubbers can clean teats well, but:

- Are not proven to reduce mastitis infections
- Can be expensive to install
- Water quality must be excellent
- Need to check brushes regularly for dirt and damage, and deal with any problems immediately
- Ideally, should dry teats after scrubbing

Disposable disinfectant wipes are a popular means of cleaning and disinfecting teats before milking. The teats dry quickly through evaporation, and using one per cow will limit cross-contamination from cow to cow – but the contact time between the disinfectant and the teat skin is very short. The short contact time does not allow much time for the disinfectant to work.

Wiping teats dry

Where teats are washed and disinfected, they must be dried, to avoid bacterial contamination entering the teat canal and the possibility of liner slip.

All wet areas must be dried with clean paper/laundered towel, with one clean/fresh part used per teat. Disposable paper towels can be used but a good system for handling paper waste is needed.

Figure 17. A cow's teat being dried

Should I consider machine-washable udder cloths?

Using machine-washable udder cloths avoids paper towel waste and can be an effective way to clean teats and remove disinfectant. But the cloths can become heavily contaminated and cause new infections, both with contagious pathogens and with bacteria from the environment.

Think about:

- Washing machine – service contract
- Washing towels at 90°C
- Water quality
- Adding disinfectant to the wash
- Drying cloths before use
- Storage in a clean container
- Checking the cleanliness of the cloths by sending a clean cloth to a laboratory every few months for microbiological analysis

Water quality

The water used to clean the parlour standings and clusters, and, of course, to wash the plant, must be human drinking water quality. Ideally, there should be no or very few bacteria in the water. Water quality is vitally important, to reduce the risk of new environmental infections from water and aerosols of water around milking time.

It is very common for bore hole water, harvested rainwater, or spring water to be contaminated with environmental bacteria. Header tanks and water storage are often overlooked – check that tanks are clean and covered, and check water pipelines for leaks and dirt

Think about:

- Methods of disinfecting water – e.g. UV treatment
- Storage of water – header tanks
- Avoid recycling water from the plate cooler back into storage

Important

- Use a pre-milking teat disinfectant on the teats before the clusters are attached and ensure 30 seconds contact time
- Dry all teats with a clean paper or laundered towel, using one clean/ fresh part per teat
- Foremilk/strip to find all new cases of mastitis as soon as practical – ideally all cows, but especially cows in the first 30 days after calving
- Only use water of human drinking quality in the parlour – no matter how it is used, e.g. cleaning down, washing cows, etc.
- If not using mains water, the drinking water should be tested at least once a year for freedom from pathogenic bacteria

Figure 18. Parlour cleaning

Improving cow defences

In addition to minimising the challenge of infection from the environment, improving the cow's natural defences will play a part in mastitis control. To infect the udder and cause mastitis, bacteria need to:

- Physically enter the teat
- Migrate up the teat canal into the udder
- Survive the cow's immune response (the activities involving white blood cells, which become concentrated in the udder to fight the infection)

The natural defences include:

- Anatomy of the teat
- Physiology of the teat
- Immune system

For more details, see ***Control of Contagious Mastitis***.

DID YOU KNOW?
Severe (rough) teat-end hyperkeratosis is significantly associated with increased odds of clinical mastitis.

Figure 19. Severe teat-end hyperkeratosis.

Ways of supporting these defences include:

- Anatomical support (good teat-end condition and using internal teat sealants for dry cows)
- Nutritional support (maintaining energy balance, mineral and vitamin levels)
- Immunological support (vaccination)

Teat-end defences

Maintaining normal teat-end structure and function will help prevent bacteria entering the udder. Teat ends can be damaged by infection with bacteria or viruses, trauma or excessive milking machine vacuum. All these types of damage will increase the risk of bacteria entering the teat canal, as the teats will be more difficult to clean, and the teat sphincter may not close completely.

Regular teat scoring is recommended.

Important

Less than 5% of cows with severe teat-end hyperkeratosis.

Severe (3 - Rough and 4 - Very Rough) teat-end hyperkeratosis increases the risk of clinical mastitis because it makes it easier for bacteria to get into the udder.

Teat scoring, like any scoring system, should, ideally, be done by the same individual over the whole herd and at every occurence. Results will be more consistent and any trends can be recorded over several months. It needs to be done thoroughly, and this means a good light source is required for good observation – a good head torch is recommended. Make a note of any teat abnormalities such as hyperkeratosis, cyanosis (dark colouration) and oedema (swelling).

Teat-end scoring

Teat-end condition can be scored on a scale of 0 to 4, with teats in the best condition scoring 0:

1. Defines a 'perfect' teat end. The teat sphincter may be visible (a thickened ring around the teat orifice), the ring itself will be smooth.
2. The teat orifice is slightly more open, appears rougher and has lost its circular appearance.
3. Some small roughness appears in the form of keratin fronds, protruding up to 2 mm from the raised teat orifice.
4. A very rough orifice, with keratin protruding all around the teat sphincter.
5. A rough keratin protrusion of up to 4 mm, with the sphincter giving the impression of having been turned inside out.

If more than 20% of teats show evidence of abnormalities, try to find out why this may be happening. Problem areas could include vacuum and pulsation irregularities, worn teat cup liners, overmilking (due to badly adjusted Automatic Cluster Removers (ACRs), for example), or poor milking techniques.

See ***Control of Contagious Mastitis*** for further information on the proper maintenance and operation of the milking machine that will minimise teat damage.

Nutritional support

Cows in early lactation will be in a state of negative energy balance and their immune function will be impaired. In particular, the recruitment of white blood cells into the udder and the ability of these white blood cells to 'kill' bacteria are both known to be reduced with ketosis.

Improved control of negative energy balance and subclinical ketosis reduces the risk of severe clinical mastitis events and the risk of new intramammary infection.

Milking cows should receive the lactating cow diet immediately from the onset of calving, and changes to the forage base and concentrate portion of the milking cow ration must be minimal between the transition (dry) and lactating diets. Any changes should be made slowly (over a period of 10–14 days) to allow the rumen to adapt.

The importance of mineral and vitamin supplementation grows with increasing milk yield as the demands on the cow are greater. Components of high-yielding cows' diets, including some conserved forages, and soda treated grain, have low levels of vitamin E.

Vitamin and mineral supplements for early lactation cows

Adequate supplementation with Vitamin A (75,000 iu per cow per day) and Vitamin E (550 iu per cow per day) is important to maintain white blood cell function.

Selenium is also important to supplement (0.3 mg/kg DM in the diet) as well as other minerals such as zinc and manganese.

Immunological support

Vaccination against some mastitis-causing bacteria is possible. Both commercial vaccines and herd-specific autogenous vaccines using killed bacteria cells have been used in dairy herds with variable results.

Vaccination could be considered if the herd is suffering from a high rate of severe toxic mastitis, as it has been shown to reduce the severity of cases of clinical mastitis (Bradley et al, 2015)[2].

Figure 20. Correct energy balance and mineral & vitamin supplementation improve cow defenses.

[2] References: Bradley AJ, Breen JE, Payne B, White V, Green MJ. (2015) An investigation of the efficacy of a polyvalent mastitis vaccine using different vaccination regimens under field conditions in the United Kingdom. J Dairy Sci. 98:1706-20

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