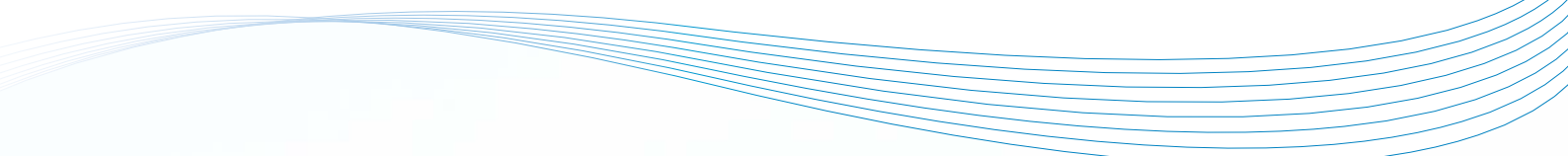


Understanding mastitis in sheep



Key messages

- Mastitis can present with physical signs such as heat or swelling in the udder, watery or bloody secretions or palpable intramammary masses (IMM)
- Flock-level incidence of clinical mastitis ranges from 0–6.6 per cent per year
- When one ewe has mastitis, the flock is at increased risk because of its contagious and transmissible nature
- More than 30 bacterial species have been isolated from sheep milk
- Underfeeding protein and energy in pregnancy and lactation increases the risk of mastitis, so make sure appropriate levels are fed
- Low body condition score (BCS) at lambing has been linked to subclinical and clinical mastitis
- Poor hygiene at lambing time will allow environmental bacteria to multiply, which increases the chance of infection
- Good udder conformation is associated with decreased risk of mastitis
- The chance of developing acute mastitis increases when ewes rear two or more lambs, regardless of ewe age
- The risk of developing mastitis increases the longer ewes and lambs stay indoors
- It is beneficial to leave ewes and lambs in the same area before, during and after lambing, so they are not challenged by unfamiliar bacteria
- Although knowledge has increased, there is still no effective control strategy to prevent mastitis
- The recommended treatment is injectable antibiotics and anti-inflammatory medicines given as soon as possible
- It is unlikely that any one vaccine will prevent mastitis. Focus on hygiene, nutrition and prevention of spread will always be critical for control



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Introduction

Mastitis is an inflammation of the mammary gland, usually caused by bacterial infection. It can present as subclinical infection or clinical disease, which can be acute (sudden, short-term) or chronic (long-term).

Mastitis can result in premature culling of affected ewes, loss of udder function, reduced milk yield and quality and occasionally death. Reduced milk production leads to lower growth rates of suckling lambs and impacts on farm profitability.

Estimates suggest that mastitis costs the UK sheep industry more than £120 million per year in direct and indirect costs. It is ranked as one of the most important diseases affecting ewes.

Mastitis



Mastitis is predominately caused by bacteria, but other causes include viral infection, eg mastitis is a symptom of Maedi Visna, which is a viral disease affecting sheep.

The first line of defence for the udder is the teat end, which has a sphincter that closes to protect the teat canal and prevents entry of bacteria. Bacteriostatic keratin-secreting cells in the canal also play a defensive role. During milking and suckling, the teat end is open and can stay dilated for up to two hours.

Damaged teats or udder injuries can increase susceptibility to bacterial invasion, for example because of damage to keratin-secreting cells or the teat end not closing properly.

The inflammatory response is the ewe's second line of defence. This includes the accumulation of somatic cells, such as white blood cells to destroy invading organisms. The size of response can vary and influences disease presentation. Some bacteria release toxins which can destroy the udder, impair function and cause pain to the ewe.

Presentations

Both acute and chronic mastitis present with physical and behavioural signs.

Symptoms of acute mastitis include:

- Heat
- Swelling
- Pain in the udder that causes the ewe to appear to be lame in the hind leg
- Cold, hard udder

Mastitis can present physical signs, such as heat, swelling in the udder, watery or bloody secretions or palpable intramammary masses (IMM).



- Black udder
- Milk becomes a watery or bloody secretion
- Clots may be seen in the milk
- A sick ewe hanging back from the flock and not eating
- A ewe will not allow lambs to suckle
- Lambs looking hungry

Symptoms of chronic mastitis include:

- Palpable intramammary masses (IMM) in the udder

Subclinical infection presents no visible signs of disease, but the mammary gland is still infected. Indirect indicators include:

- Decreased yield and quality of milk
- Poor or lower than expected lamb growth rates
- The formation of IMM or abscesses. This underlying infection can be detected by testing the somatic cell count (SCC) of the milk, which is a measurement of inflammation

Incidence

There is limited data on the incidence and prevalence of mastitis and several factors about the disease which leaves it susceptible to under-reporting. However, of the data available, the reported flock-level incidence of clinical mastitis ranges from 0–6.6 per cent per year.

Flock-level incidence of clinical mastitis ranges from 0–6.6 per cent per year.

Subclinical infections have been reported to affect up to 50 per cent of the flock. However, because of the difficulty in detecting subclinical infections, the true levels may be higher.

Chronic disease, where IMM are used as an indicator, has been detected in almost 5 per cent of ewes during pregnancy and 11 per cent during lactation. The cycle of these lumps appearing, bursting and reappearing could affect precise measures of incidence and prevalence.

When one ewe has mastitis, the flock is at increased risk due to its contagious and transmissible nature.

When one ewe has mastitis, the flock is at increased risk due to its contagious and transmissible nature. Identifying and treating individual cases could decrease the risk of mastitis spreading to others.

Detection of acute mastitis is more straightforward than chronic or subclinical cases because of the visual clinical signs. Flock-level testing, testing individuals at risk or checking individual udder health could help identify chronic or subclinical infections.

Costs

Mastitis causes great strain on farm and industry economics. This can be through direct costs, such as treatments, and indirect costs, such as reduced lamb growth rates.

Mastitis significantly impacts on farm and industry economics. This can be through direct costs, such as increased use and expenditure on treatments, and indirect costs, such as reduced lamb growth rates.

Culling

Affected ewes are often culled prematurely because of damaged udders and teats or loss of udder function. The decrease in milk yield and quality caused by damage to the udder affects the flock's production and the farm's profitability. Approximately 4–6 per cent of ewes are culled because of udder problems.



Treatment

A direct cost of mastitis is the use of treatments such as painkillers and antibiotics, as well as visits from the vet. Prompt treatment of affected ewes is necessary to treat the infection and prevent further damage to udder function. Repeat treatments may be necessary.

Mortality

In extreme cases, mastitis can lead to death of the ewe and can even be fatal to the lambs. Not only does this lead to production losses but incurs other costs, such as fallen stock removal, replacement ewes and potentially rearing lambs if the mother dies before weaning.

Reduced milk yield and quality

There is a marked difference in quality, yield, content and clotting ability of milk from infected ewes. This particularly affects production costs, end-product quality and profits in the dairy ewe and cheese-making industry. However, there is also a knock-on effect to any suckling lambs.

Lower lamb growth rates

A significant indirect cost of mastitis is the impact it has on the growth rates of suckling lambs. This is because of lower milk yield and quality. It is also possible that damaged or misshapen udders or teats make it more difficult for lambs to suckle or latch on efficiently. Additional creep feed may be required to maintain growth rates. However, weaning and sale may be delayed and lower total sale weights may be seen.

Results from the AHDB-funded Validating Sheep Key Performance Indicators Project has shown that all lambs from ewes that suffered from clinical mastitis were below 17 kg at eight weeks. The flock target was to achieve 20 kg by eight weeks.

Signs

Acute disease

Visible symptoms, which can appear quite quickly, include a red/discoloured, hot, swollen udder or udder half, which is painful to touch. It is possible that behaviour changes due to the pain, for example lameness to avoid hitting the udder against the rear leg, increased vocalisation, reduced activity or 'unwillingness' to lie down and not allowing lambs to suckle.

Unusual discharge might also be seen, such as watery milk or a pus-like secretion. Manual expression of milk may be difficult or impossible.

Other systemic signs may be present, including increased temperature, anorexia and an increase in the somatic cell (white blood cell) count.

Severe cases can turn gangrenous, sometimes referred to as blue bag or black bag, as the udder turns blue or black because of the toxins secreted by the bacteria. The udder or udder half can slough off and the ewe may appear physically well after this. However, the ewe can still die and the risk of secondary infection is high.

Subclinical infection

Ewes with subclinical mastitis appear unaffected because they do not exhibit visible signs of infection. However, when infection is present, ewes will have increased levels of somatic cells in the milk. While these cells can be detected by pen-side or laboratory tests, other indicators include underperforming lambs. This is because subclinically infected ewes may have a reduction in milk yield and quality. As a result of this, lambs can take longer to achieve their finishing weight.

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Chronic disease

With chronic disease, masses in the udder can be palpated. These lumps are of abnormal consistency when compared with the rest of the udder and are abscesses that have formed as a result of an infection. Their size does not correlate with severity. These abscesses can rupture, spreading infection around the udder, and can reform at a later date.

Progression

It is likely that chronic disease starts as acute disease or subclinical infection.

Ewes that have had acute mastitis are 12 times more likely to develop IMM than ewes that did not have acute mastitis.

Abscesses that burst could cause another case of acute mastitis.

Bacteria species involved

More than 30 bacterial species have been isolated from milk from sheep with mastitis. There does not appear to be specific bacteria relating to each mastitis presentation or location.

More than 30 bacterial species have been isolated from milk from sheep with mastitis. There does not appear to be specific bacteria relating to each mastitis presentation or location. However, one bacteria species dominates over all others during infection.

The major causative bacterial species for mastitis in sheep are *Staphylococcus aureus*, *Mannheimia haemolytica*, *Streptococcus sp.*, *Escherichia coli* and coagulase-negative staphylococci (CNS).

Staphylococcus aureus is one of the most frequently detected species responsible for acute mastitis. However, it has also been associated with subclinical infection and chronic disease, where closely related strains of this species have been found in IMM.

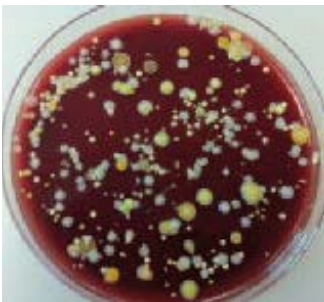
Mannheimia haemolytica has been highlighted as a significant causative species. It is thought to be the most common cause of acute mastitis in certain parts of the UK and Europe for meat sheep. Australian research has shown that it can also persist, linking it to chronic disease.

Escherichia coli infection from the environment can cause acute mastitis and is more commonly the causative agent for gangrenous (black or blue bag) mastitis.

The CNS pathogens are not thought to have as much ability to cause disease as the others, although they have been linked to both subclinical infection and acute disease.

The transmission of bacteria within the flock could be via the environment, for example in the case of *Escherichia coli*, or contagiously spread from sheep to sheep, for example *Staphylococcus aureus*. Bacteria can also be spread via milking equipment or the hands of milkers in dairy flocks, or cross-suckling lambs in flocks of meat sheep. The actual transmission patterns or pathways are still to be fully established.

The presence of these bacteria in milk does not always mean infection. It has been demonstrated that healthy individuals shed or carry bacteria such as *Staphylococcus aureus*. Intramammary microbial communities that include many species of bacteria exist. Fluctuations in these communities could initiate or predispose the ewe to mastitis.



Well-nourished ewes are better able to fight infection. Underfeeding could be a trigger factor causing bacteria normally resident in the mammary gland to become pathogenic.

Risk factors

Nutrition

Feeding a ration that meets the ewes' requirements for energy and protein during pregnancy and lactation is important so they can produce healthy lambs and sufficient milk.

Dairy cow research has shown that feeding heifers the correct balance of energy and protein is important in ensuring they have a healthy immune system and especially important at the onset of lactation. Cows in negative energy balance have depressed immune systems and increased risk of intramammary infection.

In sheep, underfeeding protein in pregnancy is associated with increased risk of acute mastitis in lactation. Protein is involved in mammary development, and if protein is insufficient in the diet, there will be inadequate milk supply for lambs. Hungry lambs can cause trauma to the teats and udder through overeager suckling, which can then lead to acute mastitis.

Underfeeding energy in pregnancy and lactation is associated with an increased risk of IMM and acute mastitis. The ewe is under increased physiological stress during these times, while experiencing increased energy demands.

Underfeeding protein and energy during pregnancy and lactation increases the risk for mastitis, so ensure appropriate levels are fed.

Increased risk of subclinical and acute mastitis has been linked to vitamin A deficiency and selenium deficiency. However, results and evidence vary on the effectiveness of the role of these vitamins and nutrients, so more investigation is needed.

See the BRP manual on **Improving ewe nutrition for Better Returns** for more details on metabolisable energy and protein requirements of ewes in late pregnancy and early lactation.

Body condition score (BCS)

Low BCS has been linked to subclinical and clinical mastitis. Ewes in poor body condition at lambing (below BCS 3 for lowland ewes), or receiving inadequate nutrition, may not produce enough milk for their lambs. Hungry lambs will butt the udder and sometimes bite teats in an attempt to draw more milk, which can cause udder damage and teat lesions.

Low body condition score at lambing has been linked to subclinical and clinical mastitis.

Hygiene

Good hygiene reduces the risk and spread of infectious diseases. Poor hygiene at lambing time, such as wet and dirty bedding and high stocking densities, will allow environmental bacteria to multiply and increase the chance of infection.

Poor hygiene at lambing time will allow environmental bacteria to multiply and increase the chance of infection.

Infections can also spread between ewes through contaminated hands or clothing. The practice of testing milk supply can also contaminate bedding if the milk is squirted freely around rather than being collected in a container.

Presence of lumps

Lumps in the udder are known as intramammary masses (IMM). They are a physically detectable mass of abnormal consistency compared to the rest of the glandular tissue. They come in all shapes and sizes.

A common practice is examination of the udder at weaning or before tupping to detect IMM. Ewes with IMM should be culled because they are a reservoir for infection and can be poor milk producers.

A recent UK study found that as the percentage of the flock with IMM in the udder in pregnancy increased, so did the risk of IMM in lactation in individual ewes. This suggests that IMM can be a source of infection to other ewes in the flock. Depending on the bacterial species present, transmission possibly occurs through the cross-suckling of lambs.

Intramammary masses are not always present at examination. This is because they are typically abscesses, which develop and rupture as part of their maturation cycle. Rupture facilitates the spread of bacteria within the mammary gland, which then may cause abscesses to reform elsewhere within that gland. On rupture, abscesses can leave behind fibrotic scars. Therefore, IMM may come and go and they may feel different, change size and location.



However, once a ewe has had IMM, it is much more likely to have them again at a later date than a ewe that has never had IMM. She is also at greater risk of acute mastitis. The presence of IMM makes teat lesions more likely, possibly because milk supply is affected.



Teat lesions

If a ewe's teats are damaged, her mastitis defence mechanism will not be as effective as it should be. These lesions create an entry point and an environment suitable for bacterial survival and multiplication.

The skin on teats can be physically damaged by the teeth of lambs during suckling, resulting in cuts and broken skin known as traumatic lesions.

First-time lambers may be more prone to these kinds of lesions as the skin on their teats has not hardened up yet. Their mammary tissue is still developing, so lambs need to feed for longer or more often to obtain sufficient milk, making teat lesions more likely.

The skin on teats can also be affected by growths or lesions, known as non-traumatic teat lesions, often caused by orf.

A ewe of any age that has teat lesions may be reluctant to allow lambs to suckle due to pain. The lamb will need to make repeated suckling attempts to feed.

Increased frequency of suckling increases the chances of bacteria entering the udder and could lead to acute or subclinical mastitis. If lambs are prevented from suckling due to teat lesions, this could lead to a build-up of milk in the udder, which can also cause mastitis. The teat lesions themselves can become infected, which may make it easier for bacteria to invade the udder.

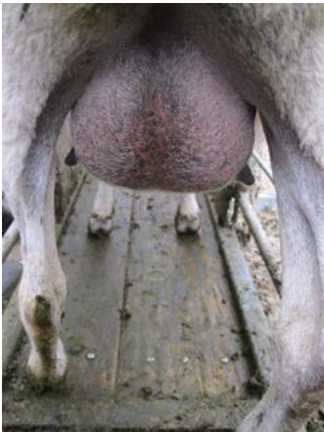
Teat position and udder conformation

Good udder conformation is associated with a decreased risk of mastitis. Teat position, teat angle and udder drop have been linked to the risk of mastitis (see Figure 1).

Good udder conformation is associated with a decreased risk of mastitis.

There are various linear scoring systems for udder traits that assess udder conformation. These measure:

- Udder drop
- Udder attachment
- Teat position
- Teat length
- Teat angle
- Degree of separation of the two halves of the udder



In some dairy sheep breeds, udder traits have been included in breeding programmes with the aim of improved machine milking ability. For this, the ideal udder conformation includes vertically aligned teats. However, a different udder shape is more suitable for suckling ewes where lambs feed to the side.

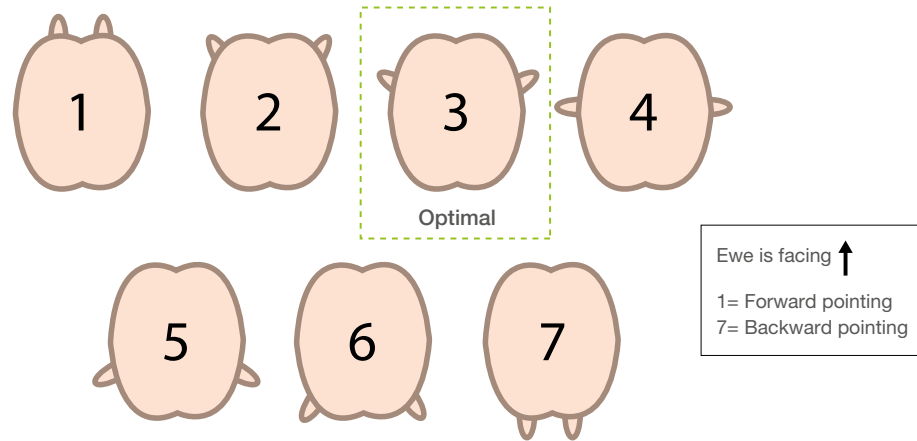
Dairy ewes with pendulous udders (high udder drop) are more prone to poor udder health. Research in suckler ewes has shown that pendulous udders are associated with a higher milk SCC. Dairy ewes with low udder drop, at or below the hock, are also more prone to intramammary infections and udder damage.

Low, pendulous udders are closer to the ground and have a larger surface area. They are more likely to come into contact with environmental bacteria when the ewe is standing and lying down, as well as being difficult to milk by machine. Pendulous udders may also be difficult for lambs to suckle effectively, resulting in repeated suckling attempts, possible milk retention in the udder and increased trauma to the teats. This could lead to an increased risk of teat lesions and intramammary infection.

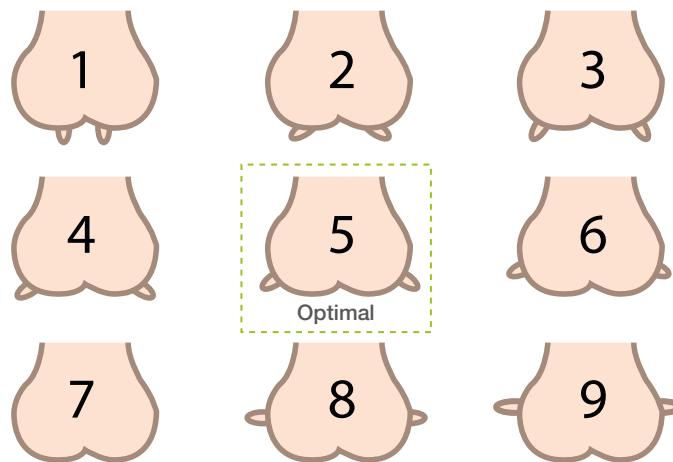
In a research study, an optimum teat angle score of 5 (a 45° angle on the udder – see Figure 1) was associated with greater weight gain in lambs. This optimum teat angle was also associated with decreased risk of traumatic teat lesions caused by lambs.

Research in suckler ewes has found that teat angles pointing downward and a forward-pointing teat position were associated with an increased risk of acute mastitis. This might be because teats at these angles and positions are less protected by the non-woolly skin in the flank and more exposed to climate and soil environments, where potential pathogens such as *Escherichia coli* live. They might also be difficult for lambs to suckle effectively. However, it is worth noting that the teat angles that are sought in dairy sheep (vertically aligned – score 1 in Figure 1) to aid machine milking are rare in suckler sheep and associated with increased risk of acute mastitis.

Teat position - The placement of the teats on the udder on a horizontal plane



Teat angle - The placement of the teats on the udder on a vertical plane



Udder drop - The distance of the ventral abdominal wall when viewed from behind

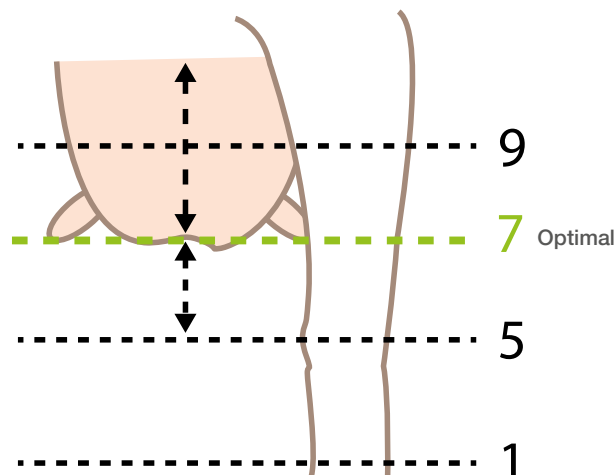


Figure 1. Linear scoring system of udder conformation traits with optimal conformation for non-dairy ewes indicated (adapted from Casu et al., 2006)



Cross-suckling

Cross-suckling is likely to occur when a lamb is not getting enough milk from their own mother because she has subclinical, chronic or acute mastitis.

When they do attempt to suckle another ewe, they may transfer some bacteria from their dam's udder and teat canal to the new ewe, spreading infection. Cross-suckling is more likely where ewes are rearing larger litters, have teat lesions, are malnourished or where ewes and lambs are housed together in small spaces.

Age of the ewe

There is an increased risk of all types of mastitis in older ewes that are more than four years old. Older ewes are also more likely to have lower BCS and poorer udder conformation.

Aged ewes may be more likely to suffer from other health issues, which may make them more susceptible to mastitis.

First-time lambers are also at risk of mastitis, possibly due to an increased risk of teat lesions from suckling lambs. The skin of the teat may not have hardened yet and it is being exposed to certain bacteria for the first time. In addition, the mammary gland will still be developing.

One study has demonstrated that first-time lambers take longer to feed their lambs than older ewes so increasing the risk of teat lesions and udder damage.

The Maedi Visna virus, which was introduced into the UK through imported sheep, can cause mastitis, presenting as lesions and hardening of the udder.

Maedi Visna

Most mastitis in ewes is caused by bacterial infection. However, the Maedi Visna virus, which was introduced into the UK through imported sheep, can cause mastitis, presented as lesions and hardening of the udder.

The virus has a long latent period, during which it propagates and spreads through the body without any clinical signs, possibly for months or years. Infection persists for life.

Respiratory disease with nasal discharge is a common symptom of Maedi Visna infection and the virus is primarily transmitted via this secretion. This means it can spread rapidly when sheep are housed. Maternal transmission may also occur from ewe to lamb via colostrum and milk.

Infection can be detected by blood testing. In the UK, there is a voluntary Maedi Visna Accreditation Scheme (MVAS). Membership means all sheep in the flock have been tested and are free of Maedi Visna.

The risk of developing mastitis increases the longer ewes and lambs stay indoors.

Indoor or outdoor lambing

The incidence of clinical mastitis increases when lambing indoors compared to outdoors. The risk of developing mastitis increases the longer ewes and lambs stay indoors.

Increased stocking densities mean ewes are much closer together, increasing bacterial load, thus infection can spread more easily. There is also greater chance of cross-suckling. Contaminated bedding or damp, warm conditions favour bacterial growth.

A lack of nutrients, competition for food and reduced checks of ewes that gave birth to more than one lamb outdoors could increase the risk of mastitis.

When lambing indoors, appropriate flooring and the provision of fresh straw every day can reduce the risk of mastitis. The flooring needs to offer good drainage and be easy to clean to prevent bacterial growth.

It is beneficial to leave ewes and lambs in the same area before, during and after lambing, so they are not challenged by unfamiliar bacteria.

While not always practical, it is beneficial to leave the ewes and lambs in the same area before, during and after lambing, so they are not challenged by unfamiliar bacteria. Moving during these times increases mastitis levels. This could be because the ewe has adapted to the bacteria in her environment. If she is moved when her teat orifices are open, she may not adapt quickly enough.



Early weaning or extended lactation

There is currently no evidence on the effect or impact of early or late weaning on mastitis. However, it is important to pay attention to ewe and lamb nutrition as part of an effective weaning strategy.

Use the ewes' BCS, lamb daily liveweight gain and feed availability to decide on a weaning date. If grass supply is restricted, then ewes and lambs end up competing with each other for feed. The lambs should be the priority for feed quality and quantity.

Udder chilling and dagging

Chilling of the udder in cold weather, or overexposure from short tail docking, excessive crutching or lack of shelter, has traditionally been thought to predispose ewes to acute mastitis. However, there is no scientific evidence to support this, although there are anecdotal reports of a higher incidence of mastitis in cold, harsh weather conditions.

It could be that in such conditions ewes are unable to graze sufficiently to produce enough milk to feed their lambs and keep themselves warm. A lamb's demand for milk increases to keep warm, putting increased physiological pressure on the ewe, making them more prone to diseases like mastitis.

Dagging, the process of shearing dirty wool from around the rear of the sheep, can be helpful during warmer weather to reduce fly numbers.

Seasonal effect

In dairy cows, summer mastitis is an issue and often referred to as 'August bag'. Mastitis levels increase during the warmer months and seem to coincide with an increase in flies, particularly the sheep head fly (*Hydrotaea irritans*). However, there is currently no proven link between flies and mastitis in sheep.

Whether they are acting as vectors, or it is just a coincidence that the flies also favour the same temperatures as the mastitis-causing bacteria, is not known. If a farm has a lot of flies, using repellent is advisable.

Most cases of mastitis occur two to four weeks post-lambing and this coincides with peak milk yield. Mastitis cases later in the summer occur when lambs are weaned or approaching weaning and therefore not as reliant on the ewe's milk.

Prevention

Managing risk factors

Mastitis is a multifactorial disease. Although knowledge of causes and possible transmission routes has improved, there is still no effective control strategy in place to prevent mastitis.

Managing risk factors is one way of reducing the possibility of ewes developing mastitis. This can be done by:

- Maintaining ewes' BCS at 3+. This may involve adapting feed rations to include more protein during pregnancy and more energy and protein during lactation
- Providing extra supplementation for thin ewes and old ewes.
- Consider culling older ewes or those with poor udder conformation
- Checking the udder for abnormal masses to make sure chronic mastitis is not overlooked
- Separating ewes with mastitis from the rest of the flock and managing as a separate group to reduce transmission between healthy and diseased animals
- Keeping ewes and lambs in the same field or shed before, during and after lambing, because they will have grown accustomed to the bacteria in that area
- Ensuring there is shelter for the flock during bad weather
- Providing extra nutrition for ewes with multiple lambs

Although knowledge has increased, there is still no effective control strategy in place to prevent mastitis.

- Testing for Maedi Visna
- Adopting good hygiene practices to prevent bacteria spreading from ewe to ewe
- Reducing plane of nutrition of freshly weaned ewes for two weeks to make sure they dry off and to reduce the risk of mastitis post-weaning

Treatment

Effective and rapid treatment of mastitis is needed to prevent damage to udder function and to minimise sources of infection for the rest of the flock. Removing infected milk from the affected gland into a container and disposing carefully might help with recovery from mastitis. This is not always possible as sometimes the gland is swollen or hard and cannot be milked.

Injectable antibiotics

The recommended treatment for mastitis in sheep is injectable antibiotics and anti-inflammatory medicines given as soon as possible. Checking ewes at least once a day following lambing is important to identify any problems early so treatment can be administered for best ewe recovery. There is no one most-effective antibiotic, so this should be discussed with your vet to understand which antibiotic to use.

The recommended treatment is injectable antibiotics and anti-inflammatory medicines given as soon as possible.

Tilmicosin is licensed for treatment of ewe mastitis, but a vet must administer this.

Other long-acting antibiotics that are used include oxytetracycline or amoxicillin. These do not need daily injections and it is not necessary for the vet to inject them.

Treating with anti-inflammatory drugs or painkillers will aid recovery and help ewes cope with the systemic effects of toxic mastitis.

Anti-inflammatories will also encourage the ewe to eat, which will stop the loss of BCS.

Antibacterial spray

There is currently no evidence for the use of sprays against mastitis.

Treatment outcomes

Ewes can die from mastitis, especially rapid-onset toxic mastitis. Giving anti-inflammatory medicines and antibiotics may prevent death, but ewes might lose function in the affected gland for the rest of the lactation and probably future lactations.

Ewes that do survive and regain milk supply to the gland may develop IMM afterwards. Remember, these ewes will be carriers and sporadically infectious and so should be culled after weaning.

Future vaccine possibilities

Vaccine availability for mastitis is still in its infancy, with little or limited options available. In the UK, there is currently no vaccine licensed for sheep, although there are some for cattle.

Vaccines of varying efficacy and older technology can defend against Staphylococcal infections, but, mostly, these only manage to reduce clinical symptoms of mastitis.

In Portugal, there is a vaccine for small ruminants against subclinical infection caused by *Staphylococcus aureus* or CNS, which lowers the severity of the symptoms of clinical mastitis.

It is unlikely that any one vaccine will prevent mastitis. Several different vaccines may need to be developed and then one or two of them selected depending on the bacteria most persistent on the farm. In any case, a focus on hygiene, nutrition and prevention of spread will always be critical for control.

It is unlikely that any one vaccine will prevent mastitis. Focus on hygiene, nutrition and prevention of spread will always be critical for control.



Breeding for resistance

Genomic selection

Genomic selection can identify genetic markers associated with increased resistance to certain diseases. Breeding disease-resistant animals can reduce the impact of diseases such as mastitis and provide a sustainable way of controlling them.

An estimate for the heritability for chronic mastitis is about 10 per cent which means it is highly heritable, so do not keep replacements from ewes which develop mastitis. Ewes that have not had mastitis, may have lower SCC scores so it is better to keep replacements from these ewes.

The Texel Sheep Society is currently involved in an Innovate-funded project with Scotland's Rural College to understand whether a genomic test for resilience to mastitis can be identified in the Texel breed.

Good udder and teat conformation

Breeding from ewes that have a symmetrical, non-pendulous udder with teats at a 45° angle could help to reduce the risk of mastitis.

Good teat and udder conformation will also help lambs suckle, reducing the risk of teat damage that could lead to mastitis.

The majority of ewes examined as part of an AHDB-funded trial with University of Warwick had good udder conformation, with more than 50 per cent achieving the optimal score for each udder and teat conformation trait. Ewes with extremely forward or downward pointing teats and udders, at or below the hock, should not be used to breed replacements.

Acknowledgements

Information compiled by Professor Laura Green, Claire Grant, Kate Bamford and Louise Whatford of the University of Warwick

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