Managing Mastitis in Heifers and Dry Cows

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Mastitis, or an inflammation of the mammary gland, is the most common disease on dairy farms and represents a significant economic and cow health challenge to producers[1]. While the highest probability of mastitis detection is during early lactation, the risk for a cow acquiring mastitis is highest during the early dry period[2, 3]. Because mastitis monitoring is commonly limited to cows within the lactating herd, mastitis acquired during the dry period is not diagnosed until early lactation. By emphasizing mastitis management in dry cows and heifers, cows can enter the milking herd at full potential for a successful lactation.

Risks for Mastitis in Non-lactating Cows

Understanding the mastitis risks for dry cows and heifers is a critical step to reducing mastitis incidence. At the time of dry off, cows are no longer milked. While this is a straightforward concept, it has many implications. Because she is no longer milked, the bacteria in her mammary gland and specifically in the teat canal are no longer flushed out two to three times a day, she is not given the protection from post-dip, and her udder is not observed closely for signs of infection. Changes to housing and feeding at the time of dry off also increase the stress experienced from the late stages of pregnancy. On top of this, involution of the mammary gland occurs during the first three to four weeks of the dry period, where mammary cells regress to a resting, nonproductive state. During this transition, the gland is susceptible to bacteria as inflammatory cells are actively removing milk-producing cells — in addition to bacteria — and overall milk composition at this time can promote bacterial growth[4]. The dry period is vital to give the cow and the mammary gland a rest period in between lactations, allow the calf to fully develop, and provide colostrum for calves. However, the early dry period can be a stressful adjustment, making it a time when cows are very susceptible to mastitis.

To reduce mastitis incidence, it is helpful to understand the source of what is causing it. Identifying the organism causing infection through on-farm culturing or sending samples to a milk quality lab (like the Tennessee Quality Milk Lab, tqml.utk.edu) for culturing will help to pinpoint where issues are occurring. The organisms that cause mastitis are typically categorized as either environmental, which are most commonly introduced to the mammary gland through the environment, or contagious, which are transferred through the milk.

Environmental pathogens. Environmental organisms are the most common major pathogens on dairy farms in the US, specifically environmental streptococci species, like *Strep. uberis*[5]. These pathogens are found in bedding, manure, soil, feed or water[6]. *Strep. uberis* specifically has been isolated from high traffic areas of pastures and frequently causes mastitis during the dry period[7]. *Strep. uberis* also takes advantage of the increased expression of the milk protein lactoferrin during the dry period to help invade tissue and cause infection. Because *Strep. uberis* can invade the tissue, it can be difficult to treat effectively with traditional short-duration intramammary antibiotics. This indicates prevention through pasture management is a critical control measure, as well as the use of effective dry cow therapies, discussed later in this publication. Additionally, while *E. coli* is not as prevalent during the dry period due to changes in the inflammatory response, it is an environmental pathogen that can cause severe clinical mastitis during lactation.

Contagious pathogens. In contrast to pathogens transferred through the environment, contagious pathogens, like *Staphylococcus aureus* and *Streptococcus agalactiae*, infect a new quarter through exposure to infected milk or the pathogen directly. Transmission commonly occurs during the milking procedure, but dry cows and particularly heifers are still at high risk as *Staph. aureus* is naturally found on the skin of the udder or hocks and flies can spread these pathogens to teat ends[8]. Because *Staph. aureus* causes permanent damage to milk secretory cells, it causes significant milk losses which cannot be recovered. Additionally, it can cause abscesses to form within the mammary gland that create reservoirs of the bacteria where treatment is not effective, but allows for shedding of the bacteria into the milk. Prevention is key with *Staph. aureus*, as there is only a 12 to 50 percent cure rate[9]. To control the risk of infection from contagious pathogens in non-lactating cows, ensure fly control is appropriate. Using fly parasites, topical insecticides, ear tags impregnated with insecticide, or feed additives can all be effective methods of controlling flies if used according to recommendations[10]. Because flies feed and reproduce in areas where manure and waste are present, sanitation is key for long-term effective control. This scenario can be particularly challenging when cows are on pasture and there is an increased area to maintain. Routinely dragging pastures to break up manure and decrease fly habitat can be beneficial. Focus on managing the feed area to prevent rotting silage, hay or grain; remove manure and slurry regularly from all areas of housing; and prevent undisturbed wet areas in pasture or dry lots to disrupt the areas in which flies typically breed.

Pasture. The cow's environment is the biggest driver of mastitis rates without the influence of the milking procedure. Over 70 percent of dry cows and heifers have access to pasture in the US[11], making pasture maintenance a key concern. To keep cows healthy on pasture, prevent high traffic areas from becoming muddy. This may become challenging around the feed area, if pastures are overgrazed, or if using lanes to move cattle. Adding a surface material to these areas, such as fine gravel covered with limestone screenings, can improve somatic cell count (SCC), lameness and feed intake[12]. Rotating pastures to allow for regrowth of forages to prevent pasture wear will also help to prevent increases in SCC during the dry period[13]. While managing heat stress during the dry period is important, prohibit access to streams and ponds, which can be a source of dangerous pathogens, such as *E. coli* and *Pseudomonas* species[6].

Feeding management. Feeding dry cows and heifers contributes to 20 percent of feed costs, so ensure this cost is contributing to the health and future production of these cows. The nutritional requirements in Table 1 contribute to the animal's susceptibility to mastitis through direct mechanisms like functioning of the teat sphincter, formation of the keratin plug, and reaction of the immune response. Metabolic diseases also indirectly increase the risk for mastitis[14]. Working with a nutritionist to formulate a ration for dry cows and heifers will ensure that these animals will meet expectations in the coming lactation. Double-check that the ration is meeting expectations by body condition scoring (BCS) heifers and cows approximately 45 to 60 days prior to expected calving and as they transition to the lactating herd. The BCS at both of these times should be between 3 to 3.5 on a 5-point scale[15]. To evaluate a BCS do the following:

- From the side: The line along the thurl from hooks to pins should appear U-shaped as opposed to V-shaped.
- From the side: The vertebrae should be barely visible.
- From the back: The sacral and tailhead ligaments should be visible to barely visible.

If the line along the thurl appears more V-shaped, the cow is too thin. If the vertebrae and the ligaments are not visible (i.e., no visible space around the tailhead and pins when tail is relaxed), the cow is too fat[16].

Table 1. Feeding guidelines for dairy cattle during the dry period with a body weight of 1,500 pounds. Values are given in % DM unless otherwise noted. Adapted from National Research Council's Nutrient Requirements of Dairy Cattle, 2001.

Nutritional Requirements	Early Dry Period	Close-up Period
Dry matter intake, lbs.	32	22
Energy		
Net energy- lactation (Mcal/lb.)	0.60 to 0.65	0.70
Non-fiber carbohydrates (%)	20 to 30	35
Fat (add % maximum)	0	1
Protein		
Crude protein (%)	9.9	12.4
Rumen degradable protein (%)	7.7	9.6
Rumen undegradable protein (%)	2.2	2.8
Metabolizable protein (%)	6.0	8.0
Fiber		
Acid detergent fiber (%)	30	25
Neutral detergent fiber (%)	40	35
Mineral and vitamins		
Calcium (%)	0.44	0.48*
Phosphorus (%)	0.22	0.62 *
Vitamin E (IU/day)	1,168	1,200*
Potassium (%)	0.51	0.62*

** Minerals and vitamins vary for close-up cows on a diet with anionic salts.*

Calving area management. Besides the transition into the dry period, the most critical time to manage risk of mastitis is in the week before calving. At this point, cows have started to produce milk again in preparation of calving and dry cow antibiotics are no longer effective, leaving them more susceptible to mastitis. Cows are commonly moved to a close-up or calving area around this point of the dry period. The cleanliness of this calving area can significantly impact the rate of clinical mastitis[13]. Make sure this area is clean and dry by performing the knee test. Drop onto your knees at random points throughout the pen and if your pants are clean and dry after 10 to 15 seconds of resting on the bedding, then the calving area is meeting expectations. However, if pants are dirty, wet or if it is painful to kneel, consider removing old bedding or adding fresh bedding[18]. By keeping the calving area clean, mastitis incidence can be reduced and cows can have a strong finish to the dry period.

Dry Cow Therapy — For Dry Cows and Heifers

Many of the risks associated with mastitis during the dry period can be reduced with some preparation before and at the time of dry off. This can include management changes, administration of intramammary treatments, or teat sealants.

Management changes. The ideal dry period should be 45 to 60 days long to allow the mammary gland to involute and rest before starting the next lactation. Therefore, date of drying off is based on expected calving date and can be fairly independent of how much the cow is producing. For some cows, milk production will be under the recommended 35 pounds per day at dry off, so it is a straightforward process of administering dry cow therapy and moving to the dry cow pen[19]. For high-producing cows, consider changes in management to lower production prior to dry off. By implementing changes that lower milk production, mastitis incidence can be decreased at calving and throughout the coming lactation[20], making the increased time and labor invested in these changes worth it. Gradual cessation of milking by taking the cow from two times or three times to one time for the final week of lactation can reduce milk production up

to 33 percent before drying off[21]. In addition, feed restriction for the week before drying off also reduces milk yield, but it results in metabolic stress which may lead to immunosuppression and increased susceptibility to mastitis[22]. Work with a nutritionist to identify beneficial ration changes and ensure maintenance and gestation needs are being met. Water restriction should not be used as a method for preparing cows for dry off. These changes to milking and feeding management can send the best, high-producing cows into the dry period on the right foot.

Intramammary infusion. The most important part of dry-off protocol is administering an intramammary antimicrobial infusion formulated for dry cows that has a longer period of activity. Antibiotic dry cow therapies can reduce new infections during the dry period by up to 30 percent and cure up to 90 percent of existing infections at the time of dry off[23]. Working with a veterinarian to select a dry cow intramammary antimicrobial can help ensure the most effective product is being used. Producers typically treat all cows in all quarters at the time of dry off. However, selective dry cow therapy is being used more frequently to minimize antimicrobial use on farms. For selective dry cow therapy to be effective, it is recommended only in herds with a bulk-tank somatic cell count, or BTSCC, consistently below 250,000 cells per milliliter. Cows at a high risk for mastitis during the dry period are identified by culturing milk samples or testing SCC of all cows as they are dried off. However, California Milk Testing is not sensitive enough to determine need for dry cow antimicrobials. Selective dry cow therapy can reduce antimicrobial use by 21 percent[24]. Selective therapy may not be cost effective if a number of infected quarters go untreated during the dry period. Understanding the goals and challenges of an individual farm is necessary when deciding to use blanket or selective dry cow therapy.

Internal teat sealants. Teat sealants can aid with dry cow therapy efficacy. Antibiotic therapies usually only last for the first 30 days of the dry period. After that, cows rely on the natural keratin plug to prevent bacteria from entering the teat canal. However, issues may keep these plugs from being effective. It takes a few days for the keratin plug to form completely and any milk leakage during this time can impair formation. These plugs may be weakened during the dry period and slowly dissolve as the cow gets close to calving. A solution to these issues may be internal teat sealants, which are typically a bismuth-based paste that acts as the keratin plug. Internal teat sealants can also add an extra level of protection if there are environmental challenges in dry cow housing. In herds with a low SCC (less than 200,000 cells per milliliter), teat sealants alone can be as effective as dry cow therapy with antimicrobials[24]. Whether used on their own or in conjunction with an antimicrobial, teat sealants can reduce the overall incidence of mastitis during the dry period.

Recommended procedure for intramammary treatment. Administering intramammary infusions and teat sealants can potentially introduce bacteria directly into the quarter. Aseptic techniques are absolutely required when undertaking these procedures. After the cow has been prepped and milked according to farm procedures, clean teat ends thoroughly with alcohol pads or alcohol-soaked cotton balls, using 1 pad or cotton ball per teat, and preventing contact of anything but the alcohol pad or cotton ball with teat ends. If using alcohol-soaked cotton balls, squeeze the cotton ball to prevent excess alcohol from dripping off the cotton ball. Continue cleaning with new alcohol pads until the pad is clean when it comes away from the teat. Insert only the tip of the antimicrobial tube cannula into the teat end. This method prevents bacteria introduction into the mammary gland and damage to the keratin lining within the teat canal[25].

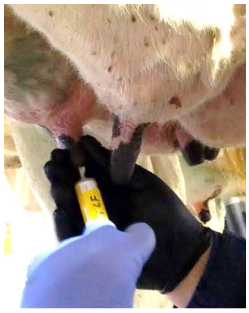

***Photo 1**. When antibiotic therapy is administered properly, only the tip of the cannula will be inserted into the teat sphincter after the teat end is cleaned and the teat is not pinched.*

***Photo 2**. To administer the teat sealant, the teat should be pinched to prevent it from entering the gland.*

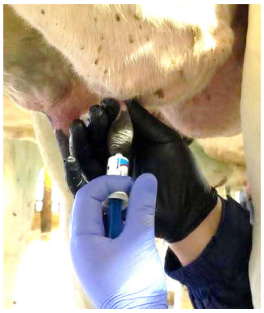

***Photo 3**. Improper administration of internal teat sealant. Inserting the entire cannula into the teat can damage the teat lining and increase risk of introducing bacteria.*

Photos 1 and 2. Proper insertion procedure for administering antibiotic therapy (Photo 1) and teat sealant (Photo 2). Photo 3. Improper insertion procedure for administering teat sealant. Photo credit: Tori Couture.

Refer to label instructions to determine whether or not treatment should be massaged into the udder. If massaging treatment into udder, avoid touching teat ends. Use only one tube per teat of both the antibiotic and teat sealant to prevent transfer of bacteria from one quarter to another. Re-clean teat ends before administering the teat sealant directly after the antimicrobial. While the technique is similar, focus on preventing the sealant from entering the mammary gland past the teat canal. Gently pinch the teat closed where it meets the udder to prevent sealant from entering the udder. If the teat sealant makes its way past the teat canal, it can be difficult to remove before the first milking and can result in build-up in milking equipment. After both the antimicrobial and/or teat sealant have been administered, cover teats with regular post-dip. The use of iodine dip throughout the dry period and the use of latex post-dip at dry off have been suggested to offer an extra level of protection during the dry period. However, these methods do not lead to a lowered infection rate at the time of calving, so using typical post-dipping procedure at the time of dry-off is sufficient[26, 27].

Dry cow therapy for heifers and heifer mastitis management. Most of the risks present for mastitis in dry cows also apply to heifers, but with the increased cost of future milk losses before lactation even starts. Key prevention strategies should include:

- Maintaining a clean and dry environment.
- Controlling for flies.
- Preventing cross-suckling between heifers.

Dedicate time each day to monitor heifers so issues can be identified quickly and changes made. Because cross-suckling is usually associated with feeding, observe heifers after feeding to identify heifers that should be separated, given a weaning ring to prevent this behavior, or determine if there are other issues that need to be addressed such as fly control or feed amount. If these practices fail and clinical mastitis is observed before calving or heifers are calving in with mastitis, dry cow therapy can be used to pre-treat clinical mastitis in heifers. One study found that treating heifers with dry cow therapy 30 to 60 days before calving

resulted in lower SCC and lower incidence of clinical mastitis throughout lactation[28]. The relationship with milk yield may be dependent on the causative pathogen and its effect on milk yield. Major pathogens like *Staph. aureus* inhibit milk production, and therefore treatment of prepartum heifers will result in higher yields during the first lactation compared to no treatment. Other pathogens like *Staph. chromogenes* are not associated with impaired milk production, and therefore treatment of mastitis caused by this organism will not affect yield[29]. However, this is an extra-label use of dry cow therapy and should be administered only in consultation with a veterinarian to determine if this is an appropriate solution to heifer mastitis.

Economic Impact of Mastitis

Subclinical mastitis is defined as an SCC greater than 200,000 cells per milliliter of milk with no visual signs of inflammation present. This condition is generally regarded as a lesser issue in comparison to clinical mastitis, when abnormal milk and udder characteristics are visible. However, for every one case of clinical mastitis, it is estimated an additional 15 to 40 cases of subclinical mastitis exist within the herd[30], giving insight into a potentially much larger mastitis issue than first meets the eye while milking.

The most straightforward impact of mastitis is the loss in milk quality and yield from increased SCC. Although not all producers receive premiums for low SCC, industry standards for milk quality are increasing and being conscious of these changes will improve a farm's marketing potential. Premiums for butterfat can be endangered from mastitis, as the effects of inflammation in the udder cause a 0.10 percent to 0.45 percent reduction in fat composition[31]. Similarly, a reduction in percent protein occurs at around a 0.05 percent decrease[32]. Loss in milk yield alone can range from a 3 percent to 25 percent loss per day, depending on severity of increase in SCC, stage of lactation, and parity, with the greatest losses observed in early and late lactation and in older cows[33].

Other potential direct factors that contribute to the costs of mastitis include diagnostics, treatment, loss of saleable milk after treatment, veterinary services, extra labor and death of the animal. These direct costs alone average $128 per case of mastitis in the first 30 days of lactation. The indirect cost averages an additional $316 per case and includes culling and replacement costs, and losses in future productivity and fertility[34]. Specifically, there is an estimated total loss of 361-558 pounds of milk in a single lactation when cows acquire a case of clinical mastitis[35]. Cows diagnosed with a clinical case of mastitis in early lactation have up to a 6 percent increase in incidence of abortions, 27 percent decrease in pregnancy rate, and 18 percent decrease in conception compared to healthy cows[36]. The total cost for a single case of clinical mastitis detected in the first 30 days of lactation is estimated at $444[34]. Because a number of these cases are likely acquired during the dry period, this significant economic burden can be reduced by implementing preventative measures during that time.

Six Things to Put on the Dry Cow To-Do List

Doing these tasks regularly will help to prevent mastitis during the dry period and bring cows into a successful lactation.

1. Prepare cows for the dry period with changes in management and administration of dry cow therapy.
2. If on pasture, rotate pastures or add surface material to high traffic areas to prevent mud.
3. Keep all housing, particularly the calving area, clean and dry and check by performing the knee test.
4. Implement fly control methods in your dry cow and heifer pens.
5. Body condition score cows that are going into and transitioning out of the dry period.
6. Monitor heifers regularly for mastitis and consult with a veterinarian if mastitis is detected.

For more information, direct requests and questions to your county Extension agent, or contact Liz Eckelkamp at 865-974-8167 or eeckelka@utk.edu.

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