

Klebsiella Mastitis



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What management tools are in your toolbox?

Over the years, milk quality programs implemented on dairy farms have reduced herd bulk tank somatic cell counts (SCC) to historically low levels. With this improvement in SCC, there has been a decrease in the prevalence in mastitis cases associated with traditional contagious pathogens, such as *Staph aureus* and *Strep ag*, and an increase in the

prevalence of environmental mastitis with pathogens such as environmental *strep-tococci* and *E. coli*. These bacteria have an increased severity in their presentation of the clinical cases. There has also been an emergence of pathogens that have been troublesome in mastitis control programs, including one coliform by the name of *Klebsiella pneumoniae*. →



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*For cows that received both doses of vaccine before calving, the vaccine reduced the risk of *Klebsiella* by 76.9% compared to the placebo group.*

Coliform bacteria are a group of rod-shaped bacteria that are found in the intestinal tract. Their cellular makeup has three layers in their outer membrane, which include an outer layer containing lipopolysaccharide (abbreviated as LPS) and also have channels, called porins, present to allow for movement of materials in and out of the cell. The LPS molecule is built differently in each coliform bacterial species and even between pathogenic strains of bacteria such as *E. coli* and commensal *E. coli* found in the intestinal tract.

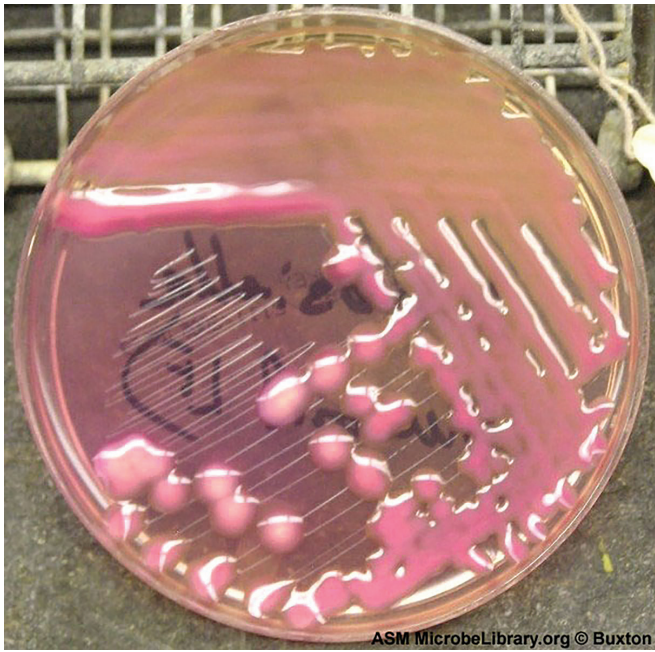
Cases of mastitis caused by coliform bacteria are the result of the cow's immune response to the LPS molecule (also known as endotoxin) and not directly to the bacteria itself. Mastitis caused by the emerging pathogen *Klebsiella pneumoniae* is often characterized by the overwhelming immune response resulting in severe clinical disease. This has resulted in a higher percentage of cows being sold from dairy herds due to low production or death from the more severe clinical disease associated with the bacterium.

To minimize losses from *Klebsiella spp.* mastitis, prevention of exposure is the key to control. Intermittent fecal shedding of *Klebsiella spp.* from healthy cows allows for the contamination of the environment. In herd and environmental surveys, these bacteria have been isolated from >80% of fecal samples collected from healthy cows. Once in the environment, *Klebsiella spp.* populate bedding material by fecal contamination regardless of bedding type. Another tool in the prevention toolbox to consider is vaccination.

At Iowa State University's Dairy Farm, the staff and veterinarians have dealt with *Klebsiella mastitis* issues for the past 10 years. The 400 lactating cows at ISU are housed in a naturally ventilated, four-row freestall barn with mattresses that are bedded with recycled manure solids generated on-site. The manure solids do not undergo further processing and are approximately 35% dry matter when added to the freestalls every two to three days. Bedding cultures of newly generated recycled solids collected in the summer from the dairy showed coliform bacteria numbers were >10,000 colony forming units per milliliter of bedding material.

Freestall mattresses were cleaned of any manure present three times per day, and alleyways were scraped on the same schedule. Prior to 2015, cows and pregnant heifers were vaccinated with a J5 bacterin at 60 days and 30 days precalving, and all lactating cows were again vaccinated at 35 and 90 days in milk. Despite this, 55% of the herd experienced cases of clinical mastitis in 2014. Of those, 14% of all mastitis cases were diagnosed as being associated with *Klebsiella spp.* The majority of *Klebsiella spp.* cases were diagnosed in the summer months.

From the cows identified with *Klebsiella spp.*, 57% were third and greater lactation cows with cases from all lactations between fairly equally distributed across the lactation. Severity scores *Klebsiella spp.* cases were 24% mild cases, 33% moderate cases, and 43% severe cases. Of these clinical cases,



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38% culled following clinical mastitis due to low milk production and 19% died on-farm. The dairy farm also experienced a higher-than-desired rate of clinical mastitis caused by *E. coli*. However, if diagnosed with *Klebsiella* spp. mastitis, cows were 5.5 times more likely to be culled and 19 times more likely to die or be euthanized on-farm than cows diagnosed with *E. coli*.

In 2015, my research team initiated a study with Epitopix, LLC (now Vaxxion, Willmar, Minn.) to complete an efficacy trial for USDA licensure of their *Klebsiella pneumoniae* SRP vaccine (Vaxxon SRP *Klebsiella*) with the results published in the Journal of Dairy Science (2018; 101:10398–10408). SRP stands for Siderophore Receptors and Porins. These are highly conserved proteins in the outer membrane of coliform bacteria and assist in essential cellular functions, such as iron acquisition. SRP vaccines are designed to elicit an

immune response to these siderophore receptors and porin proteins, which slows bacteria growth once it enters the cow's mammary gland.

During this randomly controlled clinical trial, we vaccinated 50% of the cows with the *Klebsiella* SRP vaccine and the remainder with a placebo vaccine containing all vaccine components, except the *Klebsiella* SRP proteins. Throughout the trial, the herd remained on the J5 vaccination schedule.

For cows that received both doses of vaccine before calving, the vaccine reduced the risk of *Klebsiella* by 76.9% compared to the placebo group. Interestingly, there was also a reduction of 47.5% in total coliform mastitis cases during the course of the trial. Additionally, vaccinated cows had an increased milk production of 0.31 kg/d and a somatic cell count reduction of 20.1%.

Unfortunately, the trial did not demonstrate a reduction in culling or death loss over the course of the trial.

Since completing the trial, the ISU herd has continued to utilize the *Klebsiella* SRP vaccine in a two-dose program per lactation. During this time, the herd has continued to struggle with clinical mastitis as the farm has not been able to change bedding types. However, culling due to *Klebsiella* clinical mastitis has dropped substantially. **BV**

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