Environmental Mastitis

Part 2 of 3

By Ruth Zadocks

The Paradox of Environmental Mastitis

Many people are familiar with the terms *Streptococcus agalactiae*, Strep. species (also called "non-agalactiae streptococci" or "environmental streptococci"), *Staphylococcus aureus*, and Staph. species. Many people are also familiar with the terms "contagious mastitis" and "environmental mastitis". And many people think they know how the bacterial names and the mastitis names go together: *S. agalactiae* and *S. aureus* are contagious, and Strep. species and Staph. species are environmental. For *S. agalactiae* and *S. aureus* it is all about the spread from cow to cow, and for Strep. species and Staph. species it is not at all about the spread from cow to cow. And that is where the "paradox of environmental mastitis" kicks in:

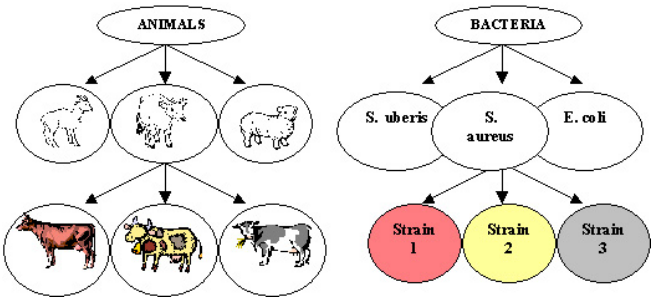
Not all "contagious mastitis" is spread from cow to cow, and not all "environmental mastitis" comes from the environment.

Some of the insight into this paradox is old and based on observations of the effect of management changes on the occurrence of mastitis. A lot of the insight into this paradox is fairly new and based on the ability to use DNA-fingerprinting or strain typing of bacteria. Among animals, we can identify animal species, such as goats, cattle and sheep. Similarly, we can identify species among bacteria, e.g. *Streptococcus uberis*, *Staphylococcus aureus*, and *Escherichia coli* (see figure). Within animal species, we can identify breeds, e.g. Holsteins, Jerseys and Ayrshires among cows. Similarly, we subdivided bacterial species into strains.

Just like animals and plant have genetic (DNA-based) and phenotypic (manifestation of the genetic information in a specific environment) traits, bacteria have genetic and phenotypic characteristics. Both types of traits can be used for identification of strains. Antibiotic resistance patterns are an example of phenotypic traits. They are very useful for farmers that want to select an appropriate antibiotic for treatment of a cow, but they have limited value for strain typing because it is a fairly coarse subdivision of the species. DNA-based fingerprinting is better suited to identify numerous different strains.

There are many ways to fingerprint bacteria. Unfortunately, most methods are currently too expensive to be useful as routine typing methods ($80 to $120 per isolate). However, some methods are cheap enough to be of use as on-farm diagnostics at an estimated cost of approximately $10 per isolate.

How does strain typing help solving environmental mastitis problems? In two ways: firstly, it may identify the source of mastitis. As mentioned before, in rare cases dogs, cats or people may be the source of bacteria in cows or in bulk tank milk. Imagine finding *Streptococcus agalactiae* in a bulk tank sample or a cow milk sample when you have maintained a closed and *S. agalactiae* free herd for years. Does that mean that you're on the brink of an *S. agalactiae* outbreak, and run the risk of losing a low cell count premium? Probably not. Humans may also carry *S. agalactiae* and they usually carry different strains than cows. The human strains are occasionally found in milk, and can sometimes infect a cow. But the human strains of *S. agalactiae* are not nearly as contagious for cows as the cow-specific strain. When a single *S. agalactiae* positive sample is found in a closed, *S. agalactiae* negative herd, strain typing can help determine whether there is a real problem looming due to some breach in biosecurity, or whether a human strain contaminated the milk sample, with little risk of mastitis outbreaks and financial losses.



Secondly, strain typing may help us determine whether a mastitis problem is contagious or environmental in nature. If a cow is infected with a certain strain of, say *S. aureus*, and she transmits that *S. aureus* to the next cow, and on to the next cow, and so on and so forth, most cows in the herd would be infected with the same strain of *S. aureus*. But what if you have done everything in your power to control the transmission of *S. aureus*, by identifying the infected animals through bi-annual herd surveys, and segregation of infected animals from the rest of the herd, and new cases of *S. aureus* keep showing up every now and then, particularly in fresh heifers. Where do these infections come from if not from contagious transmission? Well, it could be that they originate from the environment. As said before, there are many sources outside of the cow's udder that may harbor *S. aureus*. And these sources may harbor many different strains. Thus, if multiple samples were submitted for strain typing, we would expect many different strains if the infections came from the environment. We know that *S. aureus* may be spread from cow to cow (most common) or from the environment to cows (much less common). Strain typing can help identify which type of transmission takes place on your farm.

And it works the other way around too: some bacteria are thought to be environmental, for example the so-called "environmental streptococci". The two most important bacterial species in this group are *Streptococcus uberis* and *Streptococcus dysgalactiae*. Although they are indeed mostly environmental in origin, outbreaks of mastitis due to these streptococci may occur. And such outbreaks may be the result of contagious transmission. Again, strain typing can help to determine what is going on in a specific herd: if multiple cows are infected with *S. uberis*, and they are all infected with a different strain, clearly they didn't get that infection from

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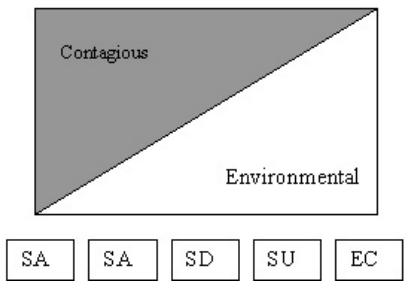
one-another. But if all cows are infected with the same strain, that strain may very well have spread from cow to cow, via the milking machine, or via contaminated bedding material. In that case, identification and segregation of infected animals, part of the control strategy for contagious mastitis, is the way to go.

In fact, all arguments that have been used to claim that *Staph. aureus* is a contagious pathogen also apply to *Strep. uberis*. Similarly, arguments that are used to claim that *Strep. uberis* is an environmental pathogen also apply to *Staph. aureus*. To which extent the arguments apply, differs between the species. In addition to differences between species, there are differences between strains within species. The concepts of "contagious mastitis" and "environmental mastitis" need to be interpreted at the level of the pathogen strain or the individual herd rather than at the level of the pathogen species and across all herds. Classifying all *Staph. aureus* as contagious and all *Strep. uberis* as environmental is an oversimplification of mastitis epidemiology. The epidemiology of mastitis pathogens is better represented by a sliding scale where the balance of contagious and environmental transmission shifts gradually, than by a species-based dichotomy (Figure 3).

Figure 3. Sliding scale from contagious to environmental epidemiology of mastitis pathogens. SAG = *Streptococcus agalactiae*. SAU = *Staphylococcus aureus*. SDY = *Streptococcus dysgalactiae*. SUB = *Streptococcus uberis*. ECO = *Escherichia coli*.



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