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**MRSA and Livestock Production**



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There is growing concern over a possible link between MRSA (methicillin resistant *Staphylococcus aureus*) and livestock production. What follows are some answers to several of the most common questions surrounding this issue.

**1. What is MRSA?** *Staphylococcus aureus* is a common bacterium present throughout nature. The organism can exist on the bodies of both humans and animals (e.g., on the skin, in the nose, etc.) without causing damage, but given the opportunity, such as entrance through a wound, it can cause very serious infections. Methicillin resistant *Staphylococcus aureus* (MRSA) is a special type of *Staphylococcus aureus* that is resistant to the antibiotic methicillin. When MRSA was first discovered, the antibiotic methicillin was a “last resort” antibiotic in the treatment of human *Staphylococcus aureus* infections, thus the strain gained quick notoriety.

**2. Are all MRSA alike?** When MRSA infections were first discovered, they were mainly found in individuals associated with hospitals or health clinics. These MRSA infections, now referred to as hospital-acquired MRSA or HA-MRSA infections, cause very serious diseases ranging from pneumonia to surgical wound infections.

In the past two decades there has been an increase in the number of MRSA infections in individuals who have had no connection to any health care setting. These infections are referred to as community-acquired MRSA or CA-MRSA infections. CA-MRSA infections are most often skin and tissue

infections. They frequently start out as a small pimple-like lesion, but can progress to affect deep tissue.

Interestingly, it appears that the strains of *Staphylococcus aureus* that cause HA-MRSA versus CA-MRSA infections may be only somewhat genetically related. HA-MRSA strains are usually resistant to not only methicillin, but to a host of other unrelated antibiotics, as well. In contrast, CA-MRSA strains are usually not resistant to multiple antibiotics. Other genetic differences may play roles both in virulence of the different strains and in the ways that they are transmitted.

**3. What makes MRSA virulent?** While methicillin resistance—along with resistance to other antibiotics—can offer MRSA a growth advantage, other virulence factors seem to help MRSA spread faster than other methicillin-susceptible strains of *Staphylococcus aureus*. While it is not clear what those virulence factors may be, several genes and their corresponding proteins have been identified as likely candidates.

**4. What is the relationship between MRSA and livestock production?** Several years ago a group from the Netherlands published a study that identified MRSA in both swine and individuals who worked with swine. In the original study, individuals who worked with pigs were more often carriers of MRSA than individuals who did not work with pigs.

Since then, other groups have confirmed that MRSA can be isolated from pigs, while others have isolated MRSA from cattle

and poultry. MRSA has also been found in companion animals and wildlife, indicating that the organism is present throughout all of nature.

### 5. Is there anything special about livestock MRSA?

The strain of MRSA that is regularly isolated from livestock is often referred to as ST398. The ST398 strain is different from MRSA strains responsible for HA-MRSA infections and MRSA strains that cause CA-MRSA infections. The ST393 strain isolated from livestock appears to be a third, distinct type of MRSA. As mentioned before, HA-MRSA strains are usually resistant to several antibiotics while CA-MRSA strains are usually susceptible to most antibiotics. The antibiotic resistance profiles of ST398 isolates seem to be less consistent—some are multi-resistant while others are not. There may be other genetic differences between the three MRSA strains, giving rise to the theory that they developed independently and not from one strain spreading into different environments or communities.

**6. Are there differences between “infection” and “carriage”?** Each of the frequently cited studies examining MRSA in livestock settings looked only at carriage rates. Put simply, carriage rates only indicate whether an individual is “carrying” the organism. “Carrying” does not imply “infection.” “Infection” means that the organism is both present AND causing harm—e.g., skin or soft-tissue damage, pneumonia, etc. To put it in perspective, 35–40 percent of the human population in the United States carries *Staphylococcus aureus* in their noses (around 1–2 percent of the U.S. population carries MRSA) with no associated infection. The organism is present, but not causing any harm. Thus far, no comprehensive studies show an association between the ST398 MRSA strain isolated from livestock and human infections. Furthermore, no connection has been made between MRSA infections and the consumption of meat or other animal products.

**7. Is methicillin used in livestock production?** No. Methicillin is not used in food animal production. Methicillin, however, belongs to a larger group of antibiotics ( $\beta$ -lactams), some of which are used in

livestock production (e.g., penicillin G, ampicillin, etc.). While resistance to methicillin usually means resistance to other penicillins, it is unclear whether the use of penicillin G (for example) is enough to promote the growth of ST398, since penicillin has been used in livestock production for approximately 60 years. More likely, other virulence factors outside of methicillin resistance are responsible for the spread of ST398 in livestock.

**8. Is MRSA treatable?** Yes, there are several antibiotics effective in treating MRSA infections.

**9. How are MRSA infections prevented?** Outside of a hospital, the vast majority of MRSA infections result from direct contact with either an infected person or a contaminated object such as a towel or a shaving instrument, etc. The best way to prevent infection is proper and consistent hygiene. As stated previously, it is unclear whether the livestock strain of MRSA (ST398) contributes to human infections.

**10. Is there a connection between pork production and MRSA infections in Camden, Indiana?** A recent *New York Times* opinion article stated that Camden, Indiana, has seen an increase in the number of MRSA infections and that these increases may be linked to hog farms located just outside the city. No scientific evidence connects MRSA infections in Camden, Indiana, to pork production.

## References

- Diep, B.A., and M. Otto. 2008. The role of virulence determinants in community-associated MRSA pathogenesis. *Trends Microbiol.* 16:361-9.
- Smith, T.C., M.J. Male, A.L. Harper, J.S. Kroeger, G.P. Tinkler, E.D. Moritz, A.W. Capuano, L.A. Herwaldt, and D.J. Diekema. 2008. Methicillin-resistant *Staphylococcus aureus* (MRSA) strain ST398 is present in Midwestern U.S. swine and swine workers. *PLoS ONE.* 4:e4258.
- Voss A, F. Loeffen, J. Bakker, C. Klaassen, and M. Wulf. 2005. Methicillin-resistant *Staphylococcus aureus* in pig farming. *Emerg Infect Dis.* 11:1965-1966.