MRSA in Pork Production Shower Facilities: An Intervention to Reduce Occupational Exposure

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ABSTRACT. *Methicillin-resistant* Staphylococcus aureus *(MRSA) nasal colonization has been documented in swine and swine workers. MRSA has also been found in the shower facilities of conventional swine farms. We previously conducted a review of the literature to identify measures used to reduce MRSA prevalence in athletic facilities. In this study, we evaluated those measures for adaptability to the pork production environment. A best practices protocol was developed to reduce MRSA levels in pork production shower facilities and implemented in two conventional swine production systems.*

Keywords. *Agricultural workers' diseases, Methicillin-resistant* Staphylococcus aureus*, Occupational health, Swine.*

Livestock-associated MRSA (LA-MRSA) colonization has recently been described in people with occupational or environmental exposure to pigs, cattle, veal calves, poultry, and horses (Voss et al., 2005; Khanna et al., 2008; Smith et al., 2009; Cui et al., 2009; Juhasz-Kaszanyitzky et al., 2007; van Loo et al., 2007; Leenders et al., 2007; Mulders et al., 2010; Weese et al., 2005a; Weese et al., 2005b). LA-MRSA transmission is most likely due to direct contact with colonized animals (Vanderhaeghen et al., 2010). However, contact with inanimate environmental reservoirs may also be a mode of transmission. In human sports/athletic facilities, where community-associated MRSA (CA-MRSA) is a known problem, the bacterium has been detected in locker rooms and training facilities (Montgomery et al., 2010; Stanforth et al., 2010). Locker rooms and shower facilities are also common in large pork production operations due to biosecurity. A previous study of ten Indiana pork production facility showers was negative for MRSA (Amass et al., 2005); however, our study sampling showers in Iowa and Illinois (at farms known to harbor MRSA positive pigs) found that 3% and 26%, respectively, of shower samples were MRSA positive (Lee-

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dom Larson et al., 2011). Conditions in pork production shower facilities have many similarities to athletic locker rooms, for which MRSA preventive measures have been developed (Benjamin et al., 2007). We first summarized, and then implemented and evaluated common MRSA prevention guidelines to determine their effectiveness in pork production operations.

Materials and Methods

Combining components of a standard biosecurity plan with methods aimed at reducing MRSA in athletic facilities, we formulated recommendations to protect workers and prevent MRSA transmission in pork production facilities (table 1).

We then recruited two conventional swine production systems in Iowa and Illinois to participate in an intervention study evaluating our MRSA prevention guidelines. In both systems, swine colonization with MRSA had previously been documented (Smith et al., 2009; Leedom Larson et al., 2011). We swabbed ten locations each in five different showers (at two wean-to-finish sites and one sow farm site) using sterile swabs (BBL CultureSwabs with Stuart Liquid Medium, Becton Dickinson and Co., Sparks, Md.) moistened with sterile phosphate buffered saline. We focused on areas with which workers would commonly be in contact (i.e., shower floor, shower walls, shampoo or soap bottles, door handles, locker handles, and chairs). After the initial samples were collected, the pork producers were asked to implement the MRSA prevention guidelines shown in table 1. The producers were provided with information on hand washing and disinfectants for MRSA. A local veterinarian served as the study coordinator in each location and was responsible for ensuring that the intervention was implemented properly.

Table 1. Adapted methods to prevent MRSA infection in pork producers.

Category	Methods
Hygiene	Educate employees about good hand hygiene.
	Encourage use of alcohol-based hand sanitizers when hands not visibly dirty.
	Educate employees about general infection control.
	Educate employees about MRSA transmission.
Wounds	Report cuts or wounds to supervisor immediately.
	Clean wounds or abrasions immediately and cover with a clean, dry bandage.
	Restrict worker to a single shower stall and disinfect after each use if wound cannot be covered.
	Encourage proper treatment of non-healing wounds by a healthcare professional.
Showers	Advise workers to use warm water and soap.
	Use liquid soap dispensers instead of bar soap.
	Provide separate, clean towels for each employee.
	Discourage sharing of personal items including soap and razors.
Clothing and laundry	Provide separate boots for each worker.
	Provide separate, clean coveralls for each worker.
	Wash soiled coveralls separately from other clothing and towels.
	Wash all coveralls, clothing (including underwear and socks), and towels with hot water and soap after each use.
	Machine dry every article of clothing and towel after washing.
Environment	Develop a protocol for cleaning and disinfection of showers.
	Include removal of visible dirt, proper dilution of disinfectant, and contact time.
	Use dilute bleach (1/4 cup bleach in 1 gal water) or EPA-approved disinfectant.
	Develop a routine schedule for cleaning and disinfection of showers.
	Provide a separate kitchen space for eating.

Approximately four weeks after the initial samples were collected and the intervention was implemented, the investigators returned to repeat the shower sampling. The same investigator took both the pre- and post-intervention samples, and the same locations were used for sampling in each shower.

Laboratory procedures were identical to our previous studies (Smith et al., 2009). The catalase test, coagulase test, and *S. aureus* latex agglutination test were used to confirm samples as *S. aureus*; next, the MRSA latex agglutination test was used to confirm the samples as MRSA. All samples were tested for the presence of the *pvl* gene and for *spa* type. Selected isolates were also tested for antimicrobial susceptibility (Institute CaLS, 2006) and multi-locus sequence typing was performed as previously described (Enright et al., 2000).

Results

Of the shower room samples, 7 (14%) were positive for MRSA pre-intervention but became negative post-intervention. We also observed that 4 (8%) of samples that were negative for MRSA pre-intervention became positive post-intervention. For the remaining samples, no change in status was observed post-intervention; 14 samples (28%) remained negative and 2 (4%) samples remained positive.

Pre-intervention, *spa* types t034 and t189 were detected. Post-intervention, *spa* types t034, t374, t3446, and t571 were detected. Type t034, which has been associated with LA-MRSA, was the most commonly isolated *spa* type pre-intervention. We also identified t189, which has been previously associated with human CA-MRSA strains in Malaysia (Ghaznavi-Rad et al., 2010). Of the *spa* types found post-intervention, only t034 and t571 have been previously associated with LA-MRSA. However, t3446 was found to be ST9, another LA-MRSA type (Guardabassi et al., 2009). We observed resistance to a number of antimicrobials, including an uncommon pattern of resistance to both trimethoprim-sulfamethoxazole and levofloxacin that has been previously described in association with the human CA-MRSA form ST1 in Europe (Aspiroz et al., 2010).

Discussion

Given our preliminary results, the effectiveness of this intervention is unclear. However, many pork producers remain concerned about MRSA in the workplace. Most of the intervention components are inexpensive and could be implemented by pork producers with minimal effort. We suggest that this study be repeated with a larger sample size and more thorough oversight of the intervention by investigators.

However, there are important limitations to this study. Our sample size was small, and the investigators did not directly observe implementation of the intervention. In addition, the intervention instructions could have been worded more clearly in some cases. For example, we asked employers to “advise” employees to use warm water and soap in the shower. Using the statement “require” may have increased the likelihood of follow-through for employees. In addition, we may not have identified all possible ways to prevent MRSA transmission with this intervention.

Conclusions

MRSA colonization has been documented in swine and humans with swine contact in Europe, Asia, Canada, and the U.S. (Voss et al., 2005; Khanna et al., 2008; Smith et al., 2009; Cui et al., 2009). MRSA has also been documented in conventional swine production system shower facilities (Leedom Larson et al., 2011). It is plausible that MRSA could be transmitted among workers in pork production facilities, originating either in the community or in the barn. For that reason, pork producers should consider implementing procedures to prevent the transmission of MRSA in their facilities. We developed methods for prevention of MRSA transmission by combining recommendations from athletic teams and currently practiced swine production biosecurity measures. However, our pilot intervention study provided mixed results.

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