Livestock-associated methicillin-resistant Staphylococcus aureus (LA-MRSA) is a novel pathogen associated with cattle, veal calves, horses, pigs, and poultry (11–13, 15, 16, 19, 22–24, 26). To date, multilocus sequence type 398 (ST398) has been most often associated with LA-MRSA. The spa type most commonly associated with ST398 in North America is t034, although up to 24 other associated spa types have been identified in North America and Europe (21).

ST398 nasal carriage has been identified in people with occupational exposure to swine (4, 6, 12, 17, 19, 26). In the U.S., ST398 colonization has been reported in two publications (2, 19), but environmental reservoirs were not examined in those studies. Locker room and athletic facilities are known reservoirs for human MRSA strains (14, 20).

Shower-in, shower-out facilities are common in modern pork production systems. Previous research has suggested that pork production shower facilities do not harbor MRSA (1); however, the presence of MRSA in pigs on those farms was not examined. We sought to determine if MRSA can be cultured from showers within production systems known to harbor pigs that yielded MRSA-positive nasal swabs.

Two conventional swine production systems were selected for this study in Iowa and Illinois. We sampled two wean-to-finish sites with 6,500 pigs each in production system A (PSA). In production system B (PSB), we sampled one 5,200-sow site, two nursery sites consisting of approximately 15,000 pigs at two sites, and one 8,000-animal finisher site.

Swine nasal swabs. In PSA, prior to shower sampling, pigs at both wean-to-finish sites were sampled (n = 50). In PSB, swine nasal swabs had been previously collected (n = 209) (19). Sampling, bacterial isolation, and molecular typing were conducted as previously described (19). At PSA, no MRSA was detected in swine nasal swab samples from the first site, and 7/25 (28%) of samples were positive for MRSA from the second site. Overall, the prevalence of MRSA in swine at PSA was 7/50 (14%). In PSB, 147/209 (70%) of swine nasal swab samples were positive for MRSA (19). From PSA, two swine nasal samples were chosen for additional molecular testing. Both were negative for the Panton-Valentine leukocidin gene (pvl, a potential virulence gene) (18) and were spa type t1746. Multilocus sequence typing (MLST) did not identify an established sequence type. From PSB, swine nasal swab samples had been previously confirmed as ST398 by MLST (19).

Shower swabs. In 10 showers, we collected 10 samples each using sterile swabs (BD BBL culture swabs with Stuart liquid media; Becton Dickinson and Company) moistened with sterile phosphate-buffered saline. We focused on areas in the showers and changing room that workers contact frequently, because so-called “hand-touch” sites are frequently contaminated with pathogens in hospitals (5). In PSA, we found one positive sample from three showers, for an overall prevalence of 1/30 (3%). The positive sample was taken from clothing hooks on the “dirty” side of the shower changing area, where employees enter the shower area before accessing the rooms holding pigs. The isolate was pvl negative and spa type t034. Previously, spa type t034 has been associated with ST398 in the Ridom SpaServer database (www.ridom.de).

In PSB, we found 18 positive samples from seven showers, for an overall prevalence of 18/70 (26%). MRSA-positive samples were collected from the following sites: shower floor (n = 5), shower drain (n = 3), clean side floor (n = 2), locker handle (n = 2), shower curtain, shower wall, dirty-side floor, light switch, chair, and soap bottle (one each). All isolates were pvl negative. Identified spa types were t034, t1746, t189, and t753. One sample (spa type t189) was identified as ST188. Novel sequence types were identified for four samples (spa types t1746 and 753) (Table 1).
Eight samples were selected for antimicrobial susceptibility testing. Five of eight (63%) isolates were resistant to oxacillin, seven (88%) were resistant to tetracycline, and two (25%) were resistant to clindamycin (Table 1). Samples that were susceptible to oxacillin by the broth microdilution test were recultured on MRSA selective plates and were retested with the MRSA latex agglutination test and mecA PCR (3) to ensure that samples were correctly identified as MRSA. Oxacillin-susceptible, mecA-positive MRSA has been previously reported (10, 25).

Type t1746 was identified in swine nasal swab samples from PSA and from a locker room chair in PSB. Upon further testing, a novel sequence type associated with spa type 1746 was found. spa type t189 was isolated from a shower floor at the sow site in PSB. This spa type has previously been associated with ST188 (7). Our sample was also identified as ST188 by MLST. spa type t753 was isolated from a shower drain at the PSB sow site. A novel ST was identified for this isolate.

At site 5, a finishing location in PSB, we observed that 50% of swine nasal swab samples from a washing machine were contaminated with MRSA, no shower samples were positive. Interestingly, this was an isolated event, as the swine barn was separated from the swine barn, indicating that physical separation of animals or dust may be important. This arrangement may also limit airborne spread, which has been previously documented for S. aureus in and around swine barns (8, 9).

This study had several limitations, including a small sample size. We did not test human workers at the farm. Therefore, we cannot be sure of the relative contributions of MRSA of human versus livestock origin in our positive shower samples. Both production systems tested utilize antimicrobials for prophylactic and therapeutic reasons. We did not test production systems that abstain from antimicrobial use and therefore cannot speculate on antimicrobial use and the finding of MRSA in showers. Further studies are needed to determine whether environmental MRSA reservoirs are associated with an increased risk of colonization and/or infection in pork production workers and to determine the most effective methods of MRSA control in the shower environment.

This research was supported (in part) by a pilot project research training grant from the Heartland Center for Occupational Health and Safety at the University of Iowa. The Heartland Center, an Education and Research Center, is supported by Training Grant No. T42OH008491 from the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health.

### REFERENCES


