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Absence of Livestock-Associated Methicillin-Resistant *Staphylococcus aureus* Clonal Complex CC398 as a Nasal Colonizer of Pigs Raised in an Alternative System

Christiane Cuny,[a] Alexander W. Friedrich,[b] and Wolfgang Witte[a]

Robert Koch Institute, Wernigerode Branch, Wernigerode, Germany,[a] and Department for Medical Microbiology and Infection Control, University Hospital Groningen, Groningen, The Netherlands[b]

Livestock-associated methicillin-resistant *Staphylococcus aureus* (LA-MRSA) ST398 isolated from pigs raised in conventional farms was previously reported. Here we report a study on 25 farms adhering to an alternative system. LA-MRSA ST398 was not detected in nasal swabs from 178 pigs or from 89 humans working and living on these farms.

Methicillin-resistant *Staphylococcus aureus* (MRSA) has been known since the early 1960s, and, with a few exceptions, health care-associated MRSA (HA-MRSA) had become a frequently detected nosocomial pathogen worldwide by the 1990s (9). This was followed by the emergence of community-associated (CA-MRSA) infections without any epidemiological association with health care settings during the past 19 years (10). MRSA particularly associated with livestock (LA-MRSA) nearly exclusively belong to clonal complex 398 (CC398) as determined by multilocus sequence typing. They first became known as colonizers of pigs in The Netherlands in 2004 and were meanwhile reported as nasal colonizers of pigs in many other European countries and in North America and, furthermore, of other livestock such as veal calves and chicken (for a summary, see reference 2). Although spread of LA-MRSA CC398 as a colonizer of humans is mainly associated with direct exposure to livestock and is obviously rare beyond farms (4, 11), infections in humans that correspond in their clinical presentation to deep-seated infections of skin and soft tissue caused by CA-MRSA have been previously observed (3, 6).

Most studies of LA-MRSA at the farm level were performed in facilities where pigs, veal calves, and chicken are raised in a setting of industrial livestock production. As known from studies of HA-MRSA, the use of antibacterial drugs is a risk factor for emergence and spread (for a recent meta-analysis, see reference 8). It is very likely that this also applies to animals and MRSA CC398. In systems of industrial livestock production, antibiotic treatment is not necessarily reserved for animals that are sick. Preventive treatment is often exerted. Furthermore, in cases of infection, healthy animals that are kept together with diseased animals get antibiotic-supplemented feed at the same time. This is supported by observations by van Duijkeren et al. (13), who found that the number of MRSA-colonized pigs was lower in farms that did not implement that approach.

LA-MRSA strains pose an unpredictable future risk to humans. Therefore, the issue of whether they also appear in alternative production systems and in small, individual pig production systems is of particular interest. Here we report a study on nasal colonization of pigs raised in alternative farm systems.

In contrast to farms with conventional fattening methods, alternative farms such as those of the "Neuland" association in Germany are usually smaller (fewer than 600 pigs versus at an average of 3,000 pigs in conventional farms), and pigs are kept on floors with straw bedding, with sufficient room for running of the animals. There is no administration of antibiotics to pigs with body mass > 25 kg. The systems are closed with respect to imports from conventional systems, where particular farms are often restricted to reproduction and others to fattening. Trading of piglets is very likely the route of interfarm dissemination of MRSA (1, 13). Farms visited in the study reported here were located in German Federal countries Lower Saxony, Saxony Anhalt, and Mecklenburg-Western Pomerania, where intensive farming is practiced. Nasal swabs were taken from at least 5 pigs at each of the farms and in parallel from humans working and living on these farms. For detection of MRSA, swabs were processed as reported previously (4).

Results from alternative farms of the "Neuland" association: nasal swabs from 178 pigs raised at 25 farms were negative for MRSA and also for *S. aureus*. Among nasal swabs obtained from 89 humans, 31 (34.8%) were positive for methicillin-susceptible *S. aureus*. When subjected to typing as described previously (4), nearly all of these isolates exhibited the following *spa* types typical of *S. aureus* isolates from nasal colonization of humans that had not been observed among isolates belonging to clonal complex CC398 thus far (12): 1× t127 (CC1), 1× t688 (CC5), 1× t211 (CC8), 1× t793 (CC15), 2× t7078 (CC25), 2× t012, 3 × t021, 1× t253, 1× t275, 1× t318, 1× t2387 (CC30), 2× t884 (CC34), 2× t073, 1× t1419, 1× t5529 (CC45), 2× 3397 (CC59), 5× t159 (CC121), and 1× t1645 (ST426). *spa* types t3446 and t526 are attributed to clonal lineages ST9 and ST97, respectively. ST9 occurs mainly in pigs and also occasionally in humans, and ST97 has been reported to occur in cattle worldwide (5).

Only one person tested positive for MRSA CC398 (*spa* type t034). This person worked at one of the "Neuland" farms and was previously employed on a conventional farm.

Results from 16 individual small farms with pigs raised for the consumption of the farm inhabitants in villages in a rural area

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Address correspondence to Christiane Cuny, cunych@rki.de.

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showed that nasal swabs from 43 pigs kept in backyards were negative, as were swabs from 16 human owners.

In comparison, data from conventional farms determined in a study performed previously (4) showed that nasal swabs from pigs (total, 235) were positive for MRSA in 47 of 57 (47%) farms visited. Of 113 humans exposed to pigs in these farms, 97 (86%) were positive for MRSA. Details with respect to typing and antibiotic resistance phenotypes have been reported previously (4).

Studies performed before the introduction of industrial fattening revealed that *S. aureus* was only a rare nasal colonizer of domesticated pigs (6, 7). We were not able to detect *S. aureus* or MRSA in nasal swabs taken from 120 wild boars immediately after shooting them in three different geographical areas of Germany. Thus, the rarity of *S. aureus* as a rare nasal colonizer seems to apply to free-living pigs in general as well.

Further studies are needed to address the reasons for the absence of LA-MRSA CC398 in alternative pig production, such as the role of antibiotic treatment and of intimate environmental conditions.

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