Increase in a Dutch Hospital of Methicillin-Resistant *Staphylococcus aureus* Related to Animal Farming

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In The Netherlands, patients exposed to pigs or veal calves were recently shown to be at high risk of methicillin-resistant *Staphylococcus aureus* (MRSA) carriage. In Amphia Hospital (Breda, The Netherlands), 32% of patients in this risk group were shown to carry MRSA. This resulted in a 3-fold increase in the annual MRSA incidence.

Methicillin-resistant *Staphylococcus aureus* (MRSA) has become an increasingly important pathogen in hospitals and, recently, also in the community [1]. The MRSA incidence in hospitals is still low in Scandinavian countries and in The Netherlands (≤1%), whereas in other European countries, the incidence has reached as high as 50% [2]. The low rates in Scandinavia and The Netherlands are maintained by an active policy called “Search and Destroy.”

In The Netherlands, a new clone of MRSA has emerged. The first isolate was found in 2003; since then, it has been reported with increased frequency. By the end of 2006, it constituted nearly 25% of all MRSA cases in the Netherlands. This clone is characterized by being nontypable MRSA by use of PFGE with *Sma*I, which is the typing method used at the Dutch National Reference Centre (Bilthoven, The Netherlands) [3, 4]. All nontypable MRSA belong to 1 clonal complex—namely, multilocus sequence type 398 (ST398). The first observation that related nontypable MRSA to pig farming was made by Voss et al. [3], who reported a pig farmer’s child who was colonized by MRSA before cardiac surgery. Also, the father, the mother, and 1 of the pigs on the farm carried MRSA. Subsequently, a survey of pigs at slaughterhouses was performed by de Neeling et al. [5], who found that 39% of them carried nontypable MRSA. On the basis of these results, it was concluded that a reservoir of MRSA in pigs had been established that could spread to humans. An epidemiological survey found a strong relationship between nontypable MRSA and pigs, as well as to veal calves [6]. The clinical consequences are potentially severe, as was shown by Ekkelenkamp et al. [7], who described a case of endocarditis caused by nontypable MRSA. Therefore, the Dutch Working Party on Infection Prevention modified the guidelines for the control of MRSA in June 2006. People who are directly exposed to live pigs or veal calves should be screened for MRSA carriage and should be isolated on admission to hospitals [8]. The objective of our survey was to determine (1) the epidemiology of nontypable MRSA in a hospital located in an area with a relatively high density of pig farming and (2) the MRSA carriage rate in patients with exposure to pigs or calves.

**Methods.** A prospective survey was performed during 2002–2006 in Amphia Hospital, a training hospital with 1370 beds, which is located in the southwestern part of The Netherlands. The hospital serves a population of ~440,000 inhabitants, and there are ~7000 pig farms in the area. Both patients and health care workers who carried MRSA were identified by means of the files of the infection control department and from the laboratory information system. Individuals who were found to be colonized for the first time were included in the survey. Newly identified cases of MRSA carriage were classified on the basis of PFGE type and proposed source. PFGE typing results were obtained from the National Reference Centre (National Institute for Public Health and the Environment). The source was proposed on the basis of the patient’s history. Statistical significance was calculated using the 2-tailed Fisher’s exact test.

**Results.** During 2002–2006, 95 cases of MRSA carriage were found in Amphia Hospital, consisting of 73 newly identified cases and 22 secondary cases. Twenty-three (31.5%) of the newly identified cases had nontypable MRSA (figure 1). The first case of nontypable MRSA carriage was found in 2004 in a child who was adopted from China. In 2005, the second case of nontypable MRSA carriage was encountered in a pig farmer who was admitted to the emergency department with an infected thumb after being bitten by a pig. In the first half of 2006, before active screening was introduced, a pig farmer and a veterinary surgeon with frequent pig exposure were found to be colonized with nontypable MRSA. After the introduction
had not been treated in isolation. Colonized with nontypable MRSA, acquired from a patient who... Only recently, in 2007, 1 health care worker was MRSA and nontypable MRSA was statistically significant. Care workers were colonized. The difference between typable MRSA and nontypable MRSA was significantly higher in patients infected with a typable MRSA... Comparisons were made by selecting patients who were hospitalized without transmission-based precautions. Sixteen patients who carried typable MRSA stayed in the hospital without precautions, for a total of 138 days. Twenty-two of 2139 persons exposed to these 16 patients were shown to be colonized with the index strain. For nontypable MRSA, during 37 exposure days for 8 patients, 0 of the 408 exposed patients and health care workers were colonized. The difference between typable MRSA and nontypable MRSA was statistically significant (P = .037). Only recently, in 2007, 1 health care worker was colonized with nontypable MRSA, acquired from a patient who had not been treated in isolation.

In the second half of 2006, a total of 57 patients who reported exposure to pigs or veal calves were screened. Eighteen (32%) of them carried MRSA—that is, 14 (36%) of 39 of the patients who were exposed to pigs and 4 (22%) of the 18 patients who were exposed to calves (P > .05). The carriers consisted of 11 pig farmers, 1 pig farmer’s wife, 1 artificial inseminator, 1 student from an agricultural university, 3 calf farmers, and 1 calf farmer’s daughter.

Discussion. This study showed a sudden and strong increase of MRSA carriage in Amphia Hospital that was caused entirely by the emergence of nontypable MRSA. This strain was almost completely related to exposure to pigs and calves. The MRSA carriage rate in this new risk group was 32%, which is higher than in any other population that has been described to date. For example, in 2000, in The Netherlands, the MRSA carriage rate of patients on admission to the hospital was 0.03% [9]. The most important risk group for MRSA carriage in The Netherlands used to be patients who were transferred from foreign hospitals. Kaiser et al. [10] reported a carriage rate of 4.7% in this group, which is ~150 times higher than the carriage rate of the general population in The Netherlands. Patients who reported exposure to pigs and calves carry a risk that is ~1000 times higher than that of the general population in The Netherlands. Patients who reported exposure to pigs carried a higher risk than did patients who reported exposure to calves, but this was not statistically significant (risk ratio, 1.6; 95% CI, 0.7–4.3).

The incidence of patients with invasive infections and of secondary cases was lower for nontypable MRSA, which may indicate a lower virulence and a lower human transmissibility of this veterinary strain, although Witte et al. [11] reported an outbreak of ventilator-associated pneumonia with ST398 in Germany. The methodology of our study is not suitable for drawing final conclusions on these issues, so more research is required.

The conclusion is that a new reservoir of MRSA associated with an extremely high carriage rate has been established outside the hospital. After introduction of the new MRSA risk category in a hospital, which is located in a region with a relatively high density of pig farms, the number of MRSA carriers immediately increased >300%. This challenges the Search and Destroy strategy. Part of this strategy is the screening of patients at risk of MRSA and isolating them until they are proven to be free of MRSA. If MRSA is present, isolation is continued until hospital discharge. The unexpected and sudden increase of the MRSA incidence in our hospital resulted in a shortage of isolation facilities. An additional problem is the treatment of carriers, which is also part of the Search and Destroy strategy. Pig and cattle farmers colonized with MRSA return to the source of MRSA after hospital discharge; this raises questions about treatment of carriers. Our findings indicate that, currently, this strain does not spread easily among...
humans, but more research on this aspect is needed. Although the increase in absolute numbers of MRSA carriers is obvious, the true impact for hospitals will depend on the virulence and transmissibility of this new clone.

Despite many questions that remain to be answered with regard to this new clone, it is clear that people who work with pigs or calves in The Netherlands are at risk of developing a MRSA infection that should be taken into consideration by physicians treating these patients.

Acknowledgments

Potential conflicts of interest. All authors: no conflicts.

References