

Prolonged Outbreak of Methicillin-Resistant *Staphylococcus aureus* in a Neonate Intensive Care Unit Caused by the Staff

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Abstract

Outbreaks of methicillin resistant *Staphylococcus aureus* (MRSA) in neonatal intensive care units (NICU) have been described frequently. In this study we describe a prolonged outbreak in an NICU for almost two years involving 29 children, 8 relatives and 6 staff members. For a long time it was believed that transmission of MRSA was between children and relatives and occasionally involved the staff. Later it was realized that the staff had social contact and the transmission of MRSA primary was between staff members and occasionally was transmitted to children.

The occurrence of new staff members with MRSA at every screening for MRSA should have warned the investigators for a transmission of MRSA between staff which might have shortened the outbreak considerably.

Keywords: Methicillin-Resistant *Staphylococcus aureus* (MRSA); Neonate Intensive Care Unit (NICU)

Introduction

Outbreaks of methicillin resistant *Staphylococcus aureus* (MRSA) in neonate intensive care units (NICU) have been described frequently from many parts of the world [1-5]. The majority of children has been colonized with MRSA without having infections, but some children develop lower respiratory infection or septicemia with an increased mortality [6-8]. The risk of transmitting MRSA in a neonate department is greater than in many other departments because of the intensive close contact between the children and the parents or the staff [9]. The role of health care workers in MRSA transmission is, however, still not settled [5,10-14]. The sources of outbreaks are usually not identified, but some outbreaks have been traced to community-associated MRSA [10-12,15,16].

During a period of 10 years there have been six outbreaks of MRSA in the NICU at the tertiary hospital, Copenhagen University Hospital (Rigshospitalet). The typical picture of these outbreaks has been that MRSA was transmitted to 3-6 children before it was realized that there was MRSA in the department. When infection control precautions including isolation of patients was initiated the outbreak was stopped immediately and no new cases of MRSA was observed [9,17]. During outbreaks a health care worker and one or two relatives are usually also found to be colonized with MRSA [9,17]. During the second outbreak in the neonatal unit several children were admitted to other hospitals without knowing that the children had MRSA, which caused outbreaks in the other hospitals [18]. The intensive infection precaution including isolation, use of protection gowns and gloves, hand hygiene and surveillance screening of patients and staff who have been in contact with the patient, have been the standard in Denmark for more than 25 years [19]. This policy has made Denmark a low prevalence country with regard to MRSA and MRSA is only found occasionally in the NICU. Several studies have shown that it is cost beneficial to make surveillance screening and isolation for MRSA [20,21].

In this study a long-lasting outbreak in the neonate intensive care unit was described. The importance of surveillance screening and transmission through Health care workers was evaluated.

Materials and Methods

The neonatal ward and persons: The neonate ward was divided in three units with different specialties depending on patient's diseases and with their own staff. Each unit had 5 patient rooms with 4 patients in each. In total there were about 20 children in each unit. Each unit included a staff of about xx persons.

Screening for MRSA: In non-outbreak periods there was no routine screening for MRSA. In outbreaks the first MRSA was usually found in clinical samples from the patient taken because of symptoms. When MRSA was found in a child, all other children who have been in the same room was surveillance screened for MRSA. If MRSA was found in other children, all children and all staff in the unit was surveillance screened for MRSA. Children were surveillance screened for MRSA with swabs from the nose-, throat- and perineum. Staffs were screened by nose- and throat swap.

Infection control precautions: When MRSA was found in a child, it was isolated in a single room. Children that have been in the same room as the MRSA child were cohort isolated and surveillance screened. The staff used protecting gowns and gloves when nursing the child with MRSA. The relatives were offered the same protecting means. If more than one child had MRSA they were cohort isolated. Children were usually untreated and kept isolated throughout the stay in the department. Staffs which had MRSA were treated with chlorhexidine soap daily and mupirocin nose gel three times daily. If more than one child had MRSA of the same *spa* type, all children and all staffs in the unit were screened for MRSA.

Environmental samples: About 300 samples were taken with trypsin soya agar (TSA) imprint plates (20 cm²) from risk areas such as furniture’s, incubators, beds, floor, electronic equipment, sinks and water supplies etc. The plates were incubated aerobic at 37°C for 3 days.

Typing of MRSA: Strains of *S. aureus* that were *mecA* positive were send to a reference laboratorium for *spa* and MLST typing.

Results

In June 2011 four children was found to have MRSA. All four strains were *spa* type t304, a type that was relatively rare in Denmark. By surveillance screening of relatives, three had MRSA *spa* type t304 (Figure 1). A child that was admitted to another hospital was here found to have MRSA *spa* type t304 11 days after admission. The child was not surveillance screened for MRSA before admission. At this time the outbreak would normally have been closed down but in this case a new child was found to have MRSA *spa* type t304 in August 2011. At this time all children and staffs in the unit were surveillance screened for MRSA. The child’s mother and a staff member were found to carry MRSA *spa* type t304.

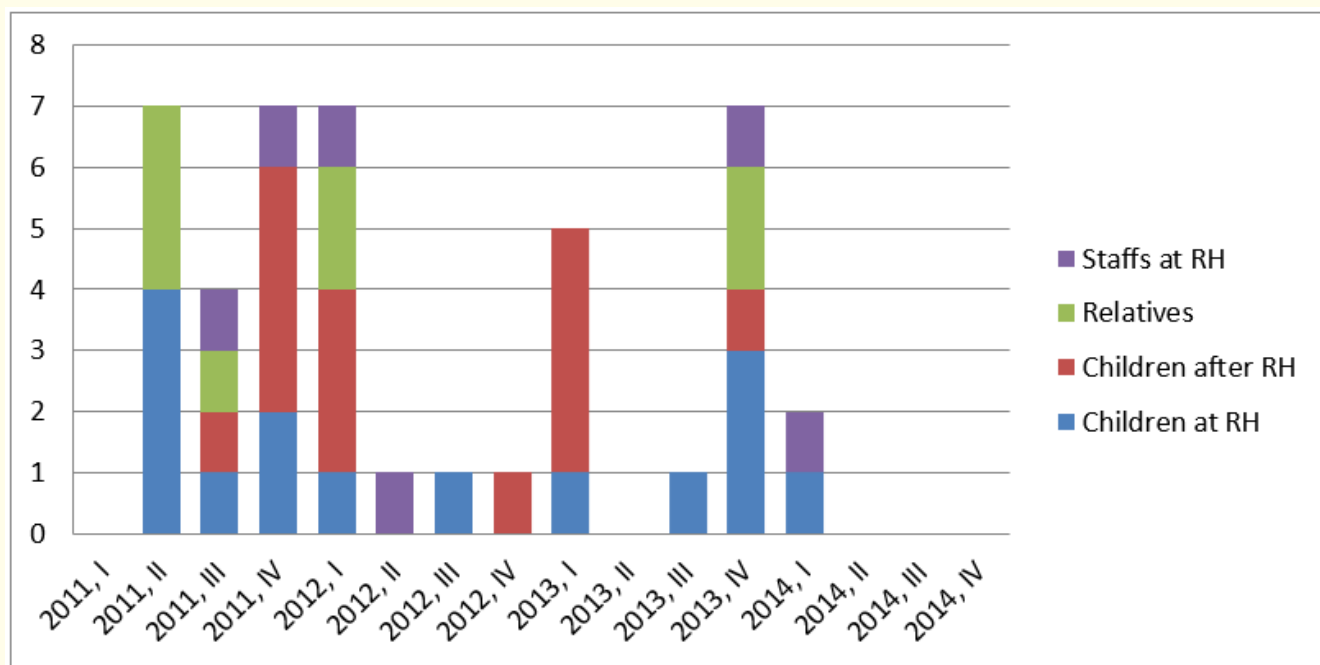


Figure 1: Number of children, relatives and staffs with MRSA t304 related to the neonatal department in 2011 to 2014.

Legend to figure 1: In the beginning of the outbreak only children and relatives were involved which is the common pattern of an outbreak. It is not unusually that a single nurse is involved or a child occasionally is transferred to another hospital. It is however unusually that several children with undiagnosed MRSA is transferred to several different hospitals. The most unusual thing was that new staff with MRSA was found at every new screening and should have been the alert for transmission between the staff members.

In October/November 2011 and again in February/March 2012 three new children with MRSA t304 occurred and both times all children and staffs in the unit were surveillance screened for MRSA and again one staff member was found with MRSA *spa* type t304 by each surveillance screening. One staff member was not screened until April 2012 and had MRSA *spa* type t304 (Figure 1). During this 6 month period 7 asymptomatic children without surveillance screening for MRSA were admitted to other hospitals and were here found to have MRSA *spa* type t304 between < 1 and 34 days after admission.

In the second half of 2012 and first half of 2013 only two children were found to have MRSA *spa* type t304 (Figure 1). During this year 5 asymptomatic children without surveillance screening for MRSA were admitted to other hospitals and were here found to have MRSA *spa* type t304 between < 1 and 67 days after admission. In this period it was not realized that the outbreak continued and no surveillance screening of children and staff was done.

From August to November 2013 four children and two relatives were found to have MRSA *spa* type t304 (Figure 1). In December 2013 all children and staffs in the unit were surveillance screened for MRSA. One new staff member was found to carry MRSA *spa* type t304. At this time it was suspected that the transmission of MRSA might have been between the staff and not the children or the environment as

previously supposed. In January 2014 a new child had MRSA *spa* type t304 (Figure 1). It was decided to surveillance screen all children and staffs in the unit once again for MRSA in February 2014. One new staff member was found to carry MRSA *spa* type t304. As the focus now was on the staff, all staff members who have had MRSA *spa* type t304 was treated with daily chlorhexidine wash, mupirocin in the nose three times daily and antibiotics (clindamycin and fusidic acid or linezolid) to eradicate MRSA. No new cases of MRSA *spa* type t304 have been found since February 2014 through July 2018.

MRSA was not found in any of the environmental samples. Potential pathogens as MSSA was found in four samples (closet twice, table over baby bed, guideway). Enterobacteriaceae (*Klebsiella pneumoniae* and *Enterobacter cloacae*) were found in 7 samples. *Pseudomonas aeruginosa* and *Acinetobacter* spp. were found in 5 samples mainly sinks and water supply. Germ counts higher than 5 CFU/cm² were found in 25% of the samples.

Discussion

This outbreak with MRSA t304 in the neonatal department started as previous outbreaks that have been in the department by identifying several children with MRSA within a few weeks. It is not unusually that a staff member is colonized with MRSA and a child with an unknown MRSA is admitted to another hospital during an outbreak with MRSA. This outbreak continued for more than two years with new children with MRSA, several children admitted to other hospitals without being screened for MRSA and new staff members with MRSA at each screening of staffs for MRSA. From the second quarter of 2012 to the fourth quarter of 2013 only single sporadic cases of MRSA t304 occurred. Thus, in this one and a half year the occurrence of MRSA was realized as coincidental from children or the environment. However, MRSA was not found in any of the environmental samples despite intensive search which contrasts with other studies [22]. This indicates that the general infection control precautions and the special precautions in relation to isolation of the patients are effective as MRSA are not spread from sporadic cases.

However, we have never observed a spread of MRSA or any other microorganism between staff in any department and it took very long time before it was realized that this could be the cause of the persistent outbreak even though it has previously been described [23]. As staff was not expected to have MRSA no special infection control precautions were taken. In these cases, the general infection control precautions were not sufficient to prevent sporadic cases of MRSA transmission to children. Therefore, several children admitted to other hospitals were found to have MRSA after admission. It has been debated whether it was in advantage to screen the children when they leave the NICU or when they are admitted to a new department. The question could be raised whether it is too early to screen when children is leaving NICU or it should be done at the departments where the children are admitted to or both.

A lesson learned from this outbreak was when one or two sporadic cases of the same MRSA *spa* type occur after an outbreak transmission between staff should be suspected and staff should be screened. If it has been done that early the outbreak could probably have been closed down a year earlier than was the case.

Conclusion

When outbreak with a rare type of MRSA is observed twice with weeks apart a reservoir in the staff should be suspected and all staff members should be screened for MRSA. If it is a common MRSA type a staff reservoir should be suspected at least at the third time it occurs and staff should be screened for MRSA.

Conflicts of Interests

The authors declare no conflicts of interests.

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