An Investigation of Methicillin-resistant *Staphylococcus aureus* Infection of Infants in a Hospital in Nantou County, Taiwan

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Abstract

The nosocomial infection of methicillin-risistant *Staphylococcus aureus* (MRSA) is very common and difficult for treatment. A nosocomial infection control subcommittee in a hospital in Nantou, Taiwan, found a MRSA-suspected incidence in the Baby Room and Infant Care Center. This hospital immediately adopted necessary measures for infection control as well as requested technical support from Centers for Disease Control laboratories. Pulsed-field gel electrophoresis (PFGE) was used for *S. aureus* genotype differentiation. This incidental infection of MRSA was confirmed by comparing the bacterial DNA fingerprint-maps. This article described the epidemical course, detection, investigation, and disease control in this hospital.

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Introduction

Methicillin-risistant *Staphylococcus aureus* (MRSA) has been discovered for nearly 50 years and spread world-wide. In the recent decades, the incidence of MRSA is increasing and nosocomial and community infection is more and more critical (1). According to an investigation proceeded by the Tri-Service General Hospital in the period between 1995 ~1998, the ratio of MRSA in nosocomial bacterial infection was 82.2% (2). This investigation indicated that MRSA was the most common antibiotic-resistant nosocomial bacterial infection in recent years. The damage caused by this infection was a clinically serious issue and worthy of being closely monitoring. Moreover, the incidence of community MRSA carrier is dramatically increased in children population in Taiwan (3), which also increases the potential risk of interactive infection between hospital and community.

The nosocomial infection control subcommittee and the obstetrics, gynecologic, and neonatal nursing subcommittee in a hospital in Nantou, Taiwan, were aware of increasing MRSA cases in the middle of November, 2007. These subcommittees convened an urgent meeting for discussing the preventive expedient immediately. However, another 5 MRSA infection cases were confirmed during November 21~30, 2007. The hospital preceded the procedures of cluster infection investigation to improve the measures for infection controlling. The hospital informed the Third Branch, Taiwan Centers for Disease Control (CDC), as well and requested for laboratory support and epidemiologic

investigation. They also consulted the experts in the Central District of Disease Control for further recommendations for controlling this event. This article described the epidemical course and disease control in this hospital for further reference in similar MRSA events for colleague hospitals.

Description of this event

The infection MRSA cases (and suspected nosocomial MRSA cases) from September to December were 2 (1), 2 (1), 8 (6) and 4 (4). The first suspected case was found in mother-baby room sickbed No. 1307 (Table 1) in September 10th. The second suspected nosocomial infection case was also found in mother-baby room (sickbed No. 1301) in October 11th. The third case was confirmed in the Newborn Care Center (NBC 3) in a month later. A MRSA strain was isolated from a newborn infant in mother-baby room (sickbed No. 1310A) in November 18th. The hospital convened an urgent meeting and then issued a MRSA infection warning. Complete disinfection was administered in the mother-baby room (Figure 1). However, 6 MRSA cases were confirmed again in the mother-baby room and NBC 3. The hospital proceeded environmental cleansing and disinfection in the NBC 3 and baby room, and took hand and nasal cavity samples from care taking personnel and environmental samples from the Obstetrics, Gynecologic, and Neonatal Nursing Department. The related personnel were treated by mupiocin oint on December 13. Metal bathtubs were purchased on December 28 and were disinfected by high pressure and high temperature daily. Separate bathtub was used on each infant. The infant clothing was required to be disinfected by high pressure and high temperature before being used since December 1.

The Third Branch, Taiwan CDC, was informed of this event and was

requested for laboratory and epidemiologic investigation supporting by this hospital. Simultaneously, the directing doctor of the Central District of Disease Control was also informed.

Sample taking and Laboratory analysis

Disease control personnel were taking samples from the environment and 38 medical professionals in the related department (including Obstetrics, Gynecologic, and Neonatal Nursing Department, NBC, maternity, and regular wards). Nasal cavities and right hands of the medical professionals were sampled. 5 strains of MRSA (4 strains from nasal cavity and 1 strain from right hand) and 3 strains of MSSA (1 strain from nasal cavity and 2 strains from right hand) were isolated. The environmental sampling was centered on telephones, handlers, computer keyboards/mouse, instrument buttons, working tables, the bedside, handlers, and door of the warming cabinets in the NBC, and trolleys. 4 MRSA strains and 1 MSSA strain were isolated from 79 environmental samples. The sampling and analysis results were listed in Table 2.

In order to clarify the relation between isolated strains and this epidemiologic event, 20 isolated strains, including those listed above, 6 MRSA positive cases (5 infants and 1 mother) and 1 MRSA isolated outside the hospital, were submitted to the Central Regional Laboratory of the Center for Research and Diagnostics Center, Taiwan CDC, for subtyping and differentiating the relatedness of these isolates.

The phylogeny tree of PFGE mapping indicated that the DNA fingerprints from 11 out of 16 MRSA isolates were 100% in similarity, while 5 other MRSA and 4 MSSA isolates contained different DNA fingerprints (Figure 2). Those 11 strains with 100% similar DNA fingerprint were isolated from 5 infants, 1 mother,

4 environmental samples from NBC and nursing room, and 1 nasal cavity sample from a nursing staff in the NBC (Figure 2). Due to the same fingerprint map from strains isolated from NBC, nursing room and MRSA positive cases, this event was confirmed to be a nosocomial infection and the isolated strains could be descended from the same resource.

Epidemic situation investigation and infection speculation

The neonate and mother are situated in the same room in this hospital. The procedures of childbirth and infant caring are followed: (1) birth giving; (2) put the neonate on the operating table; (3) holding the neonate by the mother for 20 minutes; (4) put the baby in the warming chamber for observing skin color and vital signs for 2 hours; (5) baby and mother in the same room. 3 shifts of nursing and pediatrics staffs visit the baby and mother everyday. However, the staffs of NBC and baby room are nearly the same personnel. Those staffs rotate between NBC and baby room and the MRSA pathogens already exist in the environment, which may cause interactive infection.

Some of the infants infected by MRSA were stayed in NBC right after birth and some were stayed with their mother most of the time. The baby bathtubs are thoroughly scrubbed by Hibiscrub (chlorhexadine) after bath before used by another baby. It can not be ruled out the correlation between MRSA infection and mix usage of bathtubs, although no MRSA was isolated from those bathtubs.

One MRSA infected infant was placed into the warming chamber right after birth and eczema was found on the right ear. Samples were taken on November 27 and a MRSA strain was isolated. This infant was right-sided lying and contaminated baby clothing and bed sheet were speculated. Thus, the entire baby clothing and bed sheet were disinfected by high pressure and high

temperature. It was confirmed that the MRSA infection was not induced by the contaminated baby clothing and bed sheet after a month of period without new case revealed.

A sample collected from a NBC staff was isolated a MRSA strain with same PFGE map compared with the cluster infection strains. This staff was suspected as the infection source or was infected during the work shift. Nasal cavity is the natural habitat for *Staphylococcus aureus*. Pathogens may transmit to hands, especially those with wounds, and cause transmission to other people or contamination of food. The mother of the infected infant No. 4 was infected by MRSA and the MRSA strain was isolated on November 28 from this infant. Thus, this mother may also be the possible source of MRSA infection.

The infection control subcommittee found that a patient (Mrs. Ho) gave birth in the afternoon of October 28 and discharged on October 29. This infant was sent to NBC due to navel infection. A MRSA strain was isolated from the navel pustules. This mother has bad hygienic habits and usually walks around and touches everything in the nursing room, or even sleeps on the floor. This mother and infant were also suspected as the source of infection. Unfortunately the samples collected from this infant were not preserved and unable to confirm this suspicion. In the mean time, the MRSA strains isolated on September 10 (case 1), October 11 (case 2) and November 11 (case 3) were not preserved neither. Thus, the initial source of MRSA infection and the first existed case and date could not be clarified.

In conclusion, this MRSA cluster infection may be caused by pathogen carrier, either patient or medical staffs, but epidemic investigation and bacterial subtyping data were unable to clarify the initial source of infection. All MRSA cases were found in NBC, baby room, and the environment was also

contaminated, which was responsible for the increased number of MRSA cases.

The procedures for disease control

The emergence procedures for this event were followed:

1. The NBC and baby room were cleared and disinfected and infected patient were isolated. Staffs dressed sterile gowns and masks and washed hands before entering these units.
2. The entire baby clothing were disinfected by high pressure and high temperature before reuse. Separated bathtub for every infant should be prepared.
3. Delivery room and maternity wards were also cleared and disinfected. Staffs wore masks and thoroughly scrubbed the hands before entering the delivery room. Doula was temporarily forbidden. Good hygiene habits and washing hands before touching the baby were enlightened
4. All medical staffs in NBC, baby room, obstetrics and gynecology department were equipped dry cleaning lotion and washed their hands before touching the infants.
5. Low allergic gloves were purchased. Staffs with clinical signs of allergy should wear low allergic gloves to touch the babies and apply topical medicine. Taking bath for the infants should be temporarily forbidden.

Discussion and recommendation for disease control

1. Medical staffs' hands are the main point in literature searching for the reasons for cluster infection. It is worthwhile to emphasize the right manner of hand washing and medical staff education. Staffs should cut the nails and take off the hand decoration in order not to hurt the babies while taking bath for them. It is not recommended to take bath for the babies when the staff has clinical

signs of cutaneous disease (such as eczema). Furthermore, nasal cavity is the natural habitat for *Staphylococcus aureus*. Pathogenic bacteria can easily contaminate the hands and wounds. It is a key point to examine the medical staffs' nasal cavity while a nosocomial MRSA infection occurred. Simultaneously, medical staffs with wounds on the hands should not contact with any patient.

2. Lupetigo Contagiosa was found increase in the hospital during this event occurred and most of these lesions were noted on the cutaneous folds. It is suspected that the cutaneous lesion bacterial infection may be due to rubbing the skin to clean the fetal bath, especially the cutaneous folds area with more fetal fat, while taking bath by the nursing staffs. It is recommended not to clean the fetal fat purposely.
3. Ordinarily the warming chambers will be disinfected before using by another infant and the filter cotton will be changed every 3 month. It is possible that the infant is infected by MRSA strain from contaminated filter cotton. Change of the filter cotton, and thoroughly disinfecting the warming chamber after used by infant with infectious disease is recommended.
4. Serial numbers should be given to all warming chambers and the numbers should be recorded in the anamneses of infants who have ever used the warming chamber to clarify the possible source(s) of nosocomial infection.
5. The infant is staying with the mother and may contact with other family members very often. In order to protect the baby from pathogen infection, it is necessary to educate the family members washing the hands before entering the ward and to limit the visitor number. Dry cleansing lotion should be set on the bedside and the mother should wash her hands before nursing the baby.
6. In this event, disease control staffs went to every unit to take nasal and hand

samples from the medical staffs. All medical staffs were taken hand samples by disease control staffs without washing their hands. One of the medical staffs on night shift was assigned to the laboratory for taking samples. This staff claimed that he/she had washed his/her hands after work, although he/she touched the facilities before being taken samples. The MRSA strains were found in the hand samples from this staff; the nasal cavity samples were unremarkable. The MRSA strains from nasal cavity contained different gene sequence analyzed by PCR compared with MRSA strains from hand. These situations revealed that environmental cleanness was also an important part of this event. In addition, more and more community MRSA cases visited this hospital and the environment may easily be contaminated. It is highly recommended to enhance the clearness and disinfection of the environment.

Conclusion

Nosocomial MRSA infection events are usually seen in hospitals. Immediate and effective monitoring the infection, detailed epidemiologic investigation and scientific evidence of genetic subtyping of laboratory strains are efficient instruments for disease control, preventive procedure estimation and disease control improvement. In this event, laboratory analysis is a very helpful instrument for examining and searching for the traces and route of infection.

Acknowledgement

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Table 1：The sequence of MRSA infection cases

Date of sample collected	9/10	10/11	11/11	11/18	11/21	11/24	11/27	12/3	12/5	12/12	12/15
MRSA cases	1	2	3	4	5	6	7, 8	9	10	11	12
Case location	Room 1307	Room 1301	NBC 3	Room 1310A	Room 1308A	Room 1305	7. NBC10 8. Room 1308B	Room 1306	Room 1303	Room 1303	Room 1306

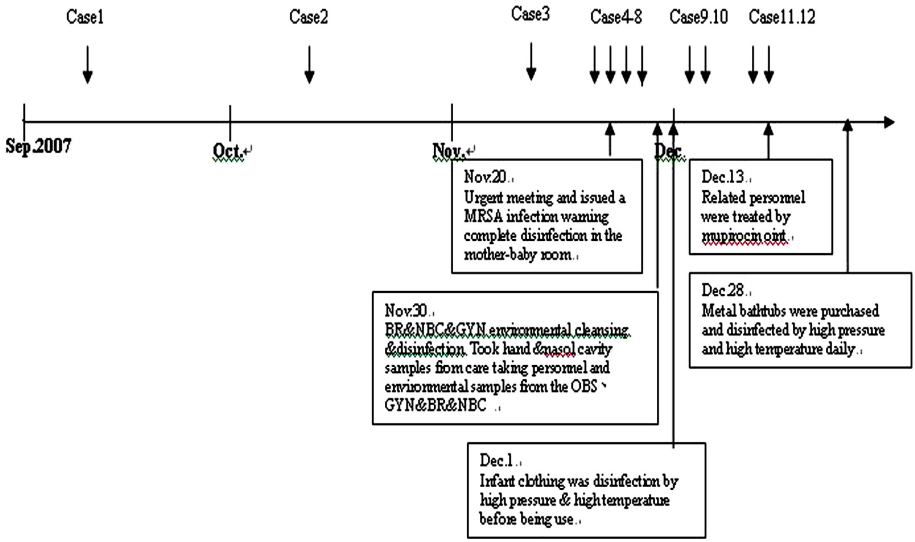
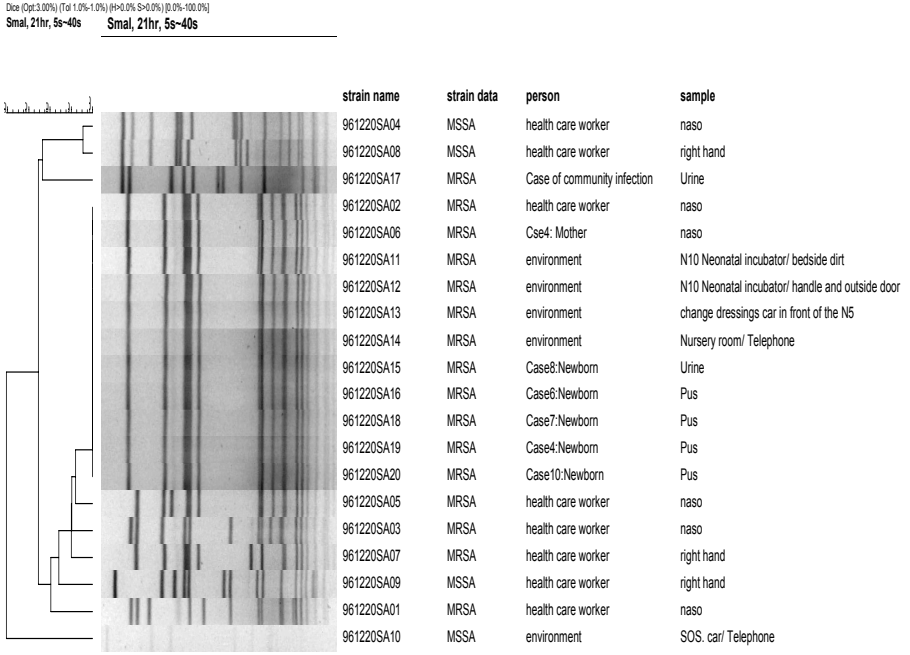


Figure 1. The time sequence of MRSA infection cases and related preventive procedure.

Table 2. Sample collecting, analysis, and strain serial number of PFGE gene type.

	Unit	No. of personnel	Positive (serial No.)	
			Number	Collected site
Staff	Doctor of obstetrics and gynecology	3	0	0
	Medical staff of obstetrics and gynecology	2	0	0
	Doctor of pediatrics	5	1 (No.5)	Nasal Cavity
	Medical staff of pediatrics	4	1 (No.3)	Nasal Cavity
	Medical staffs of 3A	11	1 (No.7) 1 (No.4)^ 1 (No.9)^	Right hand Nasal Cavity Right hand
	Medical staffs of NBC	8	1 (No.2)* 1 (No.8)^	Nasal Cavity Right hand
	Medical technicians of NBC	2	0	0
	Medical staffs of baby room	3	1 (No.1)	Nasal Cavity
Environment	NBC	26	1 (No.11)* 1 (No.10)^ 1 (No.12)* 1 (No.13)*	Dust in warming chamber N10 Telephone in the ambulance Handlers and door of warming chamber N10 Table of medical cart N5
	Nursing room	12	1 (No.14)*	Telephone in the nursing room
	Delivery room	32	0	
	3A ward	9	0	
Strains from cases	Infant-mother room	Case 4	1 (No.19)*	Pustules
	Infant-mother room	Case 6	1 (No.16)*	Pustules
	NBC	Case 7	1 (No.18)*	Pustules
	Infant-mother room	Case 8	1 (No.15)*	Urine
	Infant-mother room	Case 10	1 (No.20)*	Pustules
	Infant-mother room	Case 4 mother	1 (No.6)*	Nasal cavity
	Non-nosocomial infection		1 (No.17)	Pustules

* Strains with same PFGE fingerprint map.
^ MRSA strains



strain name	strain data	person	sample
961220SA04	MSSA	health care worker	naso
961220SA08	MSSA	health care worker	right hand
961220SA17	MRSA	Case of community infection	Urine
961220SA02	MRSA	health care worker	naso
961220SA06	MRSA	Cse4: Mother	naso
961220SA11	MRSA	environment	N10 Neonatal incubator/ bedside dirt
961220SA12	MRSA	environment	N10 Neonatal incubator/ handle and outside door
961220SA13	MRSA	environment	change dressings car in front of the N5
961220SA14	MRSA	environment	Nursery room/ Telephone
961220SA15	MRSA	Case8:Newborn	Urine
961220SA16	MRSA	Case6:Newborn	Pus
961220SA18	MRSA	Case7:Newborn	Pus
961220SA19	MRSA	Case4:Newborn	Pus
961220SA20	MRSA	Case10:Newborn	Pus
961220SA05	MRSA	health care worker	naso
961220SA03	MRSA	health care worker	naso
961220SA07	MRSA	health care worker	right hand
961220SA09	MSSA	health care worker	right hand
961220SA01	MRSA	health care worker	naso
961220SA10	MSSA	environment	SOS. car/ Telephone

Figure 2. The phylogeny tree of PFGE map and related data.