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ORIGINAL ARTICLE

RISK FACTORS FOR COMMUNITY ACQUIRED METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS INFECTIONS IN 0-18 YEARS OLD: A RETROSPECTIVE CASE-CONTROL STUDY*

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The authors declare that the data presented are original material and has not been previously published, accepted or considered for publication elsewhere; that the manuscript has been approved by all authors, have met the requirements for authorship.

ABSTRACT

Background: Community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) infection is an emerging health problem in pediatrics. Risk factors are not well established in children.

Objectives: To determine the risk factors for the development of methicillin-resistant *Staphylococcus aureus* infections arising in the community.

Methodology: A retrospective case-control study was performed from January 2004 to December 2011. Cases included patients who were culture positive for *Staphylococcus aureus* and resistant to methicillin/oxacillin while Control included patients who were sensitive to methicillin/oxacillin. The study identified and analyzed the epidemiology, risk factors, and resistance pattern of CA-MRSA isolates.

Results: Three hundred twenty three (323) patients with *Staphylococcus aureus* infections were enrolled: 172 were CA-MRSA infections (cases); and 151 were community acquired methicillin-sensitive *Staphylococcus aureus* (CA-MSSA) infections (control). Demographic characteristics and clinical profile of cases and control were similar. The most common documented infections were skin (cellulitis, furunculosis and abscess) and pulmonary (pneumonia and empyema). The survival rate was high for both groups (>90%). The final multivariate logistic regression model showed that level of crowding and socio-economic status remained as risk factors for CA-MRSA. The odds of having CA-MRSA in crowded households is 0.35 (90%CI 0.20-0.62) less likely when compared to the odds of acquiring MRSA in less crowded households (p=0.003). Those who had low socio-economic had 2.49 times higher chance (90%CI: 1.39 – 4.47) of acquiring CA-MRSA compared to those with higher socio-economic statuses (p=0.01).

Conclusion: CA-MRSA is an emerging problem. This warrants recognition of patients with significant risk factors such as low socio-economic status and level of crowding. This may serve guide in choosing the appropriate antimicrobial therapy.

***1st Place PIDSP Research Contest 2013**

KEYWORDS:

Community-acquired (CA)-MRSA infections, methicillin resistant Staphylococcus aureus

INTRODUCTION

Community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) infection is an emerging health problem in pediatrics. It appears that new strains of MRSA have occurred *de novo* in the community and acquisition is not only due to children or their family members transmitting MRSA from the hospital through contact with the health care system[1]. Unlike hospital-acquired MRSA for which the risk factors are well-described, risk factors for CA-MRSA are not established especially in children. Outbreaks of CA-MRSA infections have been reported in group childcare centers, sports teams, correctional facilities, and military units, which suggest that close contact and suboptimal hygiene practices play a role in spread[2].

Empiric treatment of community-associated infections relied almost exclusively on β-lactamase-resistant β-lactam antibiotics, such as the semisynthetic penicillins or first-generation cephalosporins. In areas where CA-MRSA is not a concern, empiric therapy with a penicillinase-resistant penicillin or cephalosphorin should be initiated pending results of susceptibility testing. When the cause of an infection is likely to be *Staphylococcus aureus* (*S. aureus)*, the most appropriate agent to administer are based on the frequency of CA-MRSA in the particular community[3]. Since it is quite impossible to distinguish clinically between CA-MSSA and CA-MRSA infections, clinicians must be aware of the prevalence of CA-MRSA in their respective communities.

A study at Driscoll Children's Hospital on 1002 MRSA cases found that the most common risk factors were chronic disease (50.6%), recent hospitalization (46.6%), documented MRSA colonization (30.7%), recent surgery (14.8%), and previous antibiotic use (11.4%). Children with risk factors were more likely to have invasive disease than those without (26% vs 3%; p<.001)[1]. In 2008, Fritz, et al's study involving 1300 children, it was found that MRSA colonization was associated with low socioeconomic status and in people who lived in crowded homes[4]; this study is the largest community-based, pediatric MRSA nasal colonization prevalence study to date .Meanwhile, in a study conducted by Davis et al. in four teaching hospitals in the Midwestern United States from 2003 to 2005, the following characteristics were shown to be associated with CA-MRSA: men having sex with men; pulmonary disease; and health club attendance. Prior antibiotic use was common in both CA-MRSA patients (54%) and CA-MSSA patients (46%). However, patients with CA-MRSA were more likely to have received multiple classes of different antibiotics in the previous year[5]. This study aimed to evaluate the epidemiology and determine the risk factors for the development of Methicillin-resistant *Staphylococcus aureus* infections arising in the community.

METHODS

Research Design

A retrospective case-control study was conducted at the Philippine Children's Medical Center (PCMC) from January 2004 to December 2011. A list of patients, 0-to-18 years old, and with at least one sample from any site that was culture positive for *Staphylococcus aureus* using VITEK 2, was obtained from the Clinical Microbiology Section.

Case subjects were those with at least one sample from any site that was culture positive for *Staphylococcus aureus* and resistant to methicillin/oxacillin and who met the following criteria for community-acquired *Staphylococcus aureus:* (1) isolate was recovered within 48hours of hospitalization; (2) isolate was obtained from an outpatient who has no indwelling catheters,

no surgical site infections, and no history of frequent hospitalizations or frequent visits to health care facilities in the past year; (3) isolate was recovered after 48hours of hospitalization but with clinical evidence of community-acquired infection.

Control subjects were those with at least one sample from any site that was culture positive for *Staphylococcus aureus* and sensitive to methicillin/oxacillin.

A total of 525 patients were enrolled in the study. Based on the patients' medical records, those who did not meet the aforementioned criteria were excluded as well as those whose significant portions of their charts went missing. Data were encoded using a standardized data collection form (Appendix A).

Sample Size Calculation

A sample size of at least 202 is needed in order to obtain a sample size estimate with 80% power, with alpha level set at 0.05 and continuity correction factor based on the formula by Fleiss (2003)[8.] This is based on values from the study of Fritz et al. (2008) with the proportion of controls with exposure at 43.2% and odds ratio 2.51.

Statistical Analysis

Stata 12.0 was used to analyze the data. For descriptive statistics, mean and standard deviation, median and interquartile range, frequencies and proportions were presented. T-test, chi-square test and Mann-Whitney U test were used to determine if the differences between mean, median or proportions between CA-MRSA and CA-MSSA, and between outcome (death and survival), respectively, are statistically significant.

Simple and multivariate (multiple)logistic regression were performed to determine risk factors associated with CA-MRSA and obtain odds ratios.

Initially, the odds of all probable risk factors were obtained through simple logistic regression models. All variables with p-values greater than or equal to 0.25 were included in the full multivariate logistic regression model. The cut-off value ($p \leq 0.25$) was used in order to increase alpha which increases the power of the test (i.e., the probability of rejecting the null hypothesis). The backward elimination process was performed on the full model to obtain the final model. The odds ratios and 90% confidence intervals were presented to show the association of probable risk factors and CA-MRSA.

RESULTS

Out of the 323 patients enrolled in the study, 172had CA-MRSA infections (cases) and 151 had CA-MSSA infections (control). The demographic characteristics and clinical profile of these patients are summarized in Table 1.

The cases had a mean age (±SD) of 3.25±4.00 while the control had 3.92±4.97. One hundred twenty five (73.1%) of cases and one hundred twenty four (82.67%) of control shared one bedroom with more than two persons (p=0.040). The skin and soft tissue were the most common sites of infection for both groups. Ninety three (54.34%) of cases and 80 (53.33%) of control had previous antibiotic use while 22 (12.87%) cases and 19 (12.67%) control had previous hospitalization in the past year. Pneumonia is the most common co-morbid condition seen in both groups. The mean onset of illness was 10.09+/-13.91 for cases and 10.92+/-14.11 for control. Majority of patients in the cases (47.95%) and control (56.67%) had temperature of less than 37.8°C. Fifty six percent (n=96) of cases and 50% (n=75) of control had anemia. Eighty seven percent of both cases (n=148) and control

Table 1. Demographic profile of patients with CA-MSSA versus CA-MRSA infections

	MSSA (n=150)	MRSA (n=171)	p-value
Age, *mean (sd)*	3.92 (4.97)	3.25 (4.0)	0.1807[a]
Sex *n (%)*			
Male	46 (30.7)	65(38.0)	0.1607[b]
Female	104 (69.3)	106 (62.0)	
Z-score weight for age *n (%)*			0.818[b]
Z3	0 (0)	1 (0.5)	
Z2	7 (4.7)	8 (4.7)	
Z1	13 (8.7)	10 (5.8)	
Z0	34 (22.7)	41 (24.0)	
Z -1	47 (31.3)	47 (27.5)	
Z -2	24 (16.0)	34 (19.9)	
Z -3	25 (16.7)	30 (17.5)	
Sociocenomic status *n (%)*			0.252[b]
Pay	34 (22.7)	30 (17.5)	
Service	116 (77.3)	141 (82.5)	
Crowding *n, %*			
< 2 people in 1 bedroom	26 (17.3)	46 (26.9)	0.040[b]
> than 2 people in 1 bedroom	124 (82.7)	125 (73.1)	
Number of household members *median, (IQR)*	5 (2)	5 (2)	0.6787[c]

IQR – Interquartile range; a - t-test; b – chi square test; c - Mann-Whitney U test

(n=131) had leukocytosis with WBC count of more than 10 and both cases and control had neutrophilic predominance in their differential count.

Among those with previous antibiotic use, majority were prescribed penicillins followed by pencillinase-resistant penicillins for both groups. The most common initial antibiotic treatment given for both groups was Oxacillin: 58.48% (n=100) for the cases and 64.67% (n=97) for the control. Antimicrobial therapy was given to 66.67% of patients with CA-MSSA and to 18.13% of patients with CA-MRSA (n=31). The difference between the two groups were statistically significant (p<0.001). 9.94% (n=17) patients died in the CA-MRSA group as compared to 6% (n=9) of cases in the control group (p=0.197).

The skin and soft tissue were the most common sites of infection for both groups.

Table 2. Clinical profile of patients with CA-MSSA versus CA-MRSA infection

	MSSA (n=150)	MRSA (n=171)	p-value
Health factors: *n (%)*			
Previous antibiotic use	80 (53.3)	93 (54.3)	0.628[b]
Previous surgery in the past year	1 (0.7)	5 (2.2)	0.136[b]
Previous hospitalization in the past year	19 (12.7)	22 (12.9)	0.958[b]
Previous systemic infection	0	3 (1.8)	0.103[b]
Co-morbid conditions *N(%)*			
Pulmonary disease	24 (16.0)	26 (15.2)	0.845[b]
Pneumonia	7 (4.7)	8 (4.7)	0.996[b]
Asthma	6 (4.0)	5 (2.9)	0.597[b]
Tuberculosis			
Non-pulmonary	6 (4.0)	4 (2.3)	0.393[b]
Malignancy	0	4 (2.3)	0.059[b]
Congenital/acquired heart disease	6 (4.0)	13 (7.6)	0.172[b]
Neurological disease	1 (0.7)	2 (1.2)	0.640[b]
Renal disease	3 (2.0)	2 (1.2)	0.549[b]
Chronic skin disease			
Type of infection *n(%)*			0.049[b]
Furunculosis	2 (1.3)	4(2.3)	
Cellulitis	17 (11.3)	11 (6.4)	
Abscess	67 (44.7)	79 (46.2)	
Pulmonary (pneumonia, empyema)	25 (16.7)	25 (14.6)	
Bacteremia	19 (12.7)	3 (13.4)	
Osteomyelitis	1 (0.7)	6 (3.5)	
Septic arthritis	2 (1.3)	2 (1.2)	
Endocarditis	1 (0.7)	1 (0.6)	
Pericarditis	1 (0.7)	2 (1.2)	
Necrotizing fasciitis	1 (0.7)	2 (1.2)	
Otitis externa	2 (1.3)	1 (0.6)	
Cavernous sinus thrombosis	0	2 (1.2)	
Brain abscess	3 (2.0)	3 (1.7)	
Hepatic abscess	0	3 (1/7)	
Psoas abscess	0	7 (4/1)	
Ventriculitis	2 (1.3)	0	
Peritonitis	1 (0.7)	0	
Staphylococcal scalded skin syndrome	6 (4.0)	0	
Site of isolate *n, %*			
Wound	96 (64)	97 (56.7)	0.041 [b]
Blood	23 (15.3)	33 (19.3)	
Pleural fluid	16 (10.7)	20 (11.7)	
Pericardial fluid	0	2 (1.2)	
Peritoneal fluid	2 (1.3)	0	
Brain abscess	3 (2.0)	3 (1.7)	
Tracheal aspirate	6 (4.0)	3 (1.3)	
Shunt tip	2 (1.3)	0	
Ear discharge	2 (1.3)	2 (1.2)	
Liver abscess	0	4 (2.3)	
Psoas abscess	0	7 (4.1)	

Ninety-three (54.34%) of cases and 80 (53.33%) of control had previous antibiotic use while 22 (12.87%) cases and 19 (12.67%) control had previous hospitalization. Pneumonia is the most common co-morbid condition seen in both groups. The mean onset of illness was 10.09+/-13.91 for cases and 10.92+/-14.11 for control. Majority of patients in the cases (47.95%) and control (56.67%) had temperature of less than 37.8°C. Fifty-six percent (n=96) of cases and 50% (n=75) of control had anemia. Eighty-seven percent of both cases (n=148) and control (n=131) had leukocytosis with more than 10 WBC count and both cases and control had neutrophilic predominance in their differential count.

Table 3. Treatment and outcome of patients with CA-MSSA versus CA-MRSA infection

	MSSA (n=150)	MRSA (n=171)	p-value
Initial antibiotic treatment, *n (%)*			0.066 [b]
Cloxacillin	2 (1.33)	1 (0.6)	
Oxacillin	97 (64.7)	100 (58.5)	
Amoxicllin	0	0	
Co-amoxiclav	6 (4.0)	1 (0.6)	
Cefuroxime	0	4 (2.3)	
Co-trimoxazole	0	0	
Clindamycin	16 (10.7	27 (15.8)	
Vancomycin	1 (0.7)	4 (2.3)	
Others	28 (18.7)	34 (19.9)	
Adequate antimicrobial therapy, *n (%)*	100 (66.7)	31 (18.1)	<0.001 [b]
Discharge antibiotic *n (%)*			<0.001 [b]
Cloxacillin	95 (63.3)	2 (1.2)	
Co-amoxiclav	6 (4.0)	3 (1.7)	
Co-trimoxazole	3 (2.0)	18 (10.5)	
Clindamycin	26 (17.3)	110 (64.3)	
Linezolid	0	1 (0.6)	
Levofloxacin	0	1 (0.6)	
Cefuroxime	1 (0.7)	1 (0.6)	
Erythromycin	0	1 (0.6)	
Cefaclor	2 (1.3)	0	
None	17 (11.3)	34 (19.9)	
Outcome *n, %*			
Survival	141 (94)	154 (90.6)	0.197 [b]
Death	9 (6)	17 (9/9)	

Among those with previous antibiotic use, majority were prescribed penicillins followed by pencillinase-resistant penicillins for both groups.

The most common initial antibiotic treatment given for both groups was Oxacillin: 58.48% (n=100) for the cases and 64.67% (n=97) for the control. Antimicrobial therapy was given to 66.67% (n=100) of patients diagnosed with CA-MSSA and to 18.13% of patients diagnosed with CA-MRSA (n=31). The difference between the two groups were statistically significant (p<0.001). 9.94% (n=17) patients died in the CA-MRSA group as compared to 6% (n=9) of cases in the control group (p=0.197).

Antibiotic resistance

Based on the institution's laboratory data and antibiogram, *S. aureus* strains' resistance to oxacillin was 29%, 53.5%, 59%, 62%, 70%, 75%, 65% from 2004 to 2011, in successive order (Figure 1).

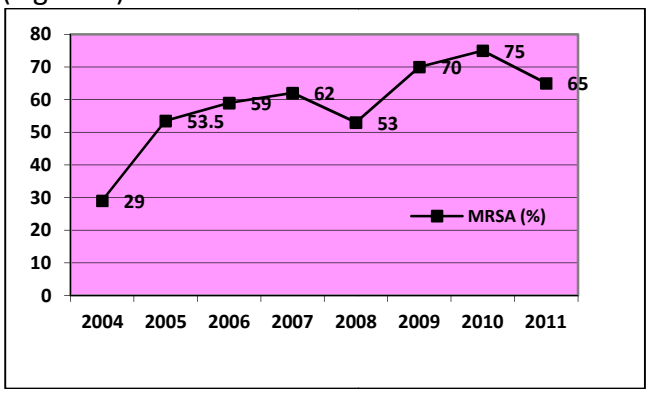

Figure 1. Percentage Resistance of CA-MRSA in the Philippine Children's Medical Center from 2004 - 2011

Among the CA-MRSA isolates (n=172), only one (0.6%) was vancomycin resistant. Three (1.75%) were resistant to clindamycin, erythromycin, cotrimoxazole and gentamicin.

All CA-MSSA isolates were resistant to penicillin and ampicillin. Five (3.31%) were resistant to erythromycin, four (2.64%) were resistant to clindamycin, three (1.98%) were resistant to

cotrimoxazole and one (0.66%) was found to be resistant to levofloxacin.

Risk factors for MRSA

Multivariate (multiple) logistic regression models were performed to determine risk factors for CA-MRSA. Simple logistic regression was done for each probable risk factor (Table 2). The cut-off value used was p≤0.25 in order to inflate alpha thereby increasing the power to reject the null hypothesis. All variables with p≤0.25 were included in the full model (Table 3). The variables that were included in the full multivariate model were age, sex, crowding, socio-economic status, neurological disease, penicillin and penicillinase resistant penicillins.

Table 4. Simple Logistic Regression of probable risk factors for CA-MRSA

Risk Factors	Unadjusted (Crude) Odds Ratio	90% Confidence Interval	p-value
Age	0.97	0.93 – 1.01	0.18*
Sex	0.72	0.49 – 1.07	0.17*
Crowding	0.57	0.36 – 0.89	0.04*
Socio-economic status	1.38	0.87 – 2.18	0.25*
Number of antimicrobial drugs prescribed	0.92	0.72 – 1.18	0.58
Previous antibiotic use	1.11	0.72 – 1.73	0.63
Pneumonia	0.90	0.54 – 1.48	0.72
Asthma	0.79	0.36 – 1.71	0.62
Tuberculosis	0.73	0.26 – 1.99	0.60
Malignancy	0.57	0.20 – 1.67	0.40
Neurological disease	1.97	0.86 – 4.55	0.18*
Renal disease	1.76	0.23 – 13.33	0.65
Chronic skin disease	0.58	0.13 – 2.63	0.55
Penicillin	0.67	0.44 – 1.02	0.11*
Penicillinase resistant penicillins	1.10	0.65 – 1.86	0.76
Cephalosphorins	1.23	0.70 – 2.20	0.54
Macrolides	1.17	0.33 – 4.18	0.836
Sulfonamides	0.52	0.15 – 1.75	0.373
*** p≤0.25 variables will be included in the multiple logistic regression analysis**			

Table 5. Multivariate Logistic Regression Full Model

Risk factors	Unadjusted OR	p-value	Adjusted OR	p-value	90% CI
Age	0.97	0.18	0.98	0.376	0.94 - 1.02
Sex	0.72	0.17	0.73	0.189	0.49 – 1.08
Crowding	0.57	0.04	0.35	0.003	0.20 – 0.64
Socio-economic status	1.38	0.25	2.52	0.011	1.38 – 4.60
Neurological disease	1.97	0.18	2.10	0.159	0.88 – 4.98
Penicillin	0.67	0.11	0.69	0.165	0.45 – 1.07
Unadjusted odds ratio (OR) derived from univariate logistic regression; Adjusted OR derived from multivariate logistic regression. CI – Confidence interval;					

For the final multivariate logistic regression model, only crowding and socio-economic status remained as risk factors for CA-MRSA. The odds of having CA-MRSA for those who share a bedroom with more than two persons is 0.35 (90%CI 0.20-0.62) less likely when compared to the odds of acquiring MRSA for those who share a bedroom with only one person (p=0.003). For socio-economic status, the odds of acquiring CA-MRSA among those with low socio-economic status (service) 2.49 (90%CI: 1.39 – 4.47) times higher as compared to the odds of acquiring CA-MRSA among those with high socioeconomic status (pay) (p=0.01).

Table 7. Outcome of Patients with CA-MSSA and CA-MRSA with Risk Factors

	MSSA			MRSA		
	Death (n=9)	Survived (n=141)	p	Death (n=17)	Survived (n=154)	p
Age, *mean (sd)*	3.36 (4.76)	3.95 (4.1)	0.73	1.87 (3.0)	3.40 (4.1)	0.14
Sex *n, %*						
Male	8 (88.9)	96 (68.1)	0.19	10 (58.8)	99 (64.3)	0.06
Female	1 (11.1)	45 (31.9)		7 (41.2)	55 (35.7)	
Socio economic status *n, %*						
Pay	0	34 (24.1)	0.09	2 (11.8)	28 (18.2)	0.51
Service	9 (100)	107 (75.9)		15 (88.2)	126 (81.8)	
Crowding *n, %*						
< 2 people in 1 bedroom	0	26 (18.4)	0.16	2 (11.8)	44 (28.6)	0.14
> 2 people in 1 bedroom	9 (100)	115 (81.6)		15 (88.2)	110 (71.4)	
Household members *median,(IQR)*	4 (3)	5 (1)	0.72	5 (2)	5 (2)	0.63

P – p value; IQR – Interquartile range; a - t-test; b – chi square test; c - Mann-Whitney U test

OUTCOME

The outcome of patients with CA-MSSA and CA-MRSA are summarized in Table 5. Among those diagnosed with CA-MSSA, the mean age of those who died was 3.36 (SD: 4.76) which was similar to the mean age of those who survived (mean: 3.95 [SD 4.10]). Among those diagnosed with CA-MRSA, the mean age of those who survived was lower (mean: 1.87 [SD:3.01]) as compared to the mean age of those who survived (mean: 3.40 [SD:4.08]), albeit the difference was not statistically significant (p=0.14).

The proportion of males who died (88.9%) was greater than the proportion of males who survived (68.1%) among those diagnosed with CA-MSSA (p=0.19). Conversely, the proportion of females who died among those diagnosed with CA-MRSA (41.2%) was higher than the proportion of females who survived (35.7%) and the differences were statistically significant (p=0.06). The proportion of service patients who died (100%) was significantly greater than
the proportion of service patients who survived (75.9%) among those diagnosed with CA-MSSA (p=0.09). Among those with CA-MRSA, the proportion of service patients who died (88.2%) was almost the same compared to the proportion of service patients who survived (81.8%), the difference of which was not statistically significant (p=0.51).

Among those diagnosed with CA-MSSA, the proportion of those sharing a bedroom with more than 2 persons who died (100%) was greater than for those who survived (81.6%). On the other hand, the proportion of patients diagnosed with CA-MRSA residing with more than 2 persons in one bedroom who died (88.2%) is greater than the proportion those residing with more than 2 persons in one bedroom who survived (71.4%). The differences are statistically significant (p=0.16) The median number of household members among those diagnosed with MSSA who died was 4 (IQR:3) while the median number of household members among those diagnosed with MSSA who survived is 5 (IQR:1) (p=0.72). Among those who were diagnosed with MRSA, the median number of household members among those who died and survived is similar (median: 5 (SD: 2); p=0.63).

DISCUSSION

This study aimed to evaluate the epidemiology and determine the risk factors for the development of Methicillin-resistant *Staphylococcus aureus* infections arising in the community. In this eight-year study period, we found that patients with CA-MSSA and CA-MRSA infections were similar in age, gender, nutritional status, and site and type of infection; this finding is similar to previous studies[1,5,9]. The most common type of infections was skin and soft tissue infections (abscess) and the most common sites of infection were the head and neck. Patients from both groups had prior antibiotic use and previous hospitalization. But, unlike other studies[5,10] were it was noted that patients with CA-MRSA infections were more likely to receive multiple classes of antimicrobial agents and the risk for CA-MRSA increased with the number of antibiotic prescribed, this study did not show any association with the class and number of antibiotic drugs used (p=0.504).

In the study done by Davis et al.[5], the most common health factors noted were chronic disease (50.6%), recent hospitalization (46.6%), documented MRSA colonization (30.7%), recent surgery (14.8%), and previous antibiotic use (11.4%)\. In this study, previous antibiotic use (54.34%) accounted for majority of the health factors associated with CA-MRSA. The same is also the case for patients with CA-MSSA (53.33%) infections.

In the Philippines, the study conducted by Soriano, et al., at the Philippine Children's Medical Center (PCMC) showed that profile, clinical presentation, co-morbid conditions, risk factors, and outcome for MRSA were the same for both CA-MRSA and HA-MRSA[6]. In a similar study done by Avendano-Coronel, et al., the result showed that the incidence of CA-MRSA was 57.5% and that CA-MRSA and CA-MSSA were similar with each other in terms of clinical profile and risk factors[7]. In these studies done in PCMC, risk factors included age, sex, co-morbid conditions and previous antibiotic use. However, no association was done for other risk factors for CA-MRSA such as crowding, low socioeconomic status, and number and class of antibiotics prescribed. Also, no assessment has been made on the adequacy of initial antibiotic used based on antimicrobial susceptibility testing.

This study showed that the mean age for CA-MRSA infections was 3.25±4.00. CA-MRSA infections had a slight male predominance and 37.4% of patients had Z-scores below -2 and -3 indicating that majority were underweight and severely underweight. Majority of the patients belonged to the group with low socioeconomic status and with household crowding.

The study done by Fritz, et al[3] was the first report in the pediatric population that MRSA colonization was associated with low socioeconomic status and household crowding. Using the multivariate logistic regression model, crowding and socio-economic status were shown to be significant risk factors for acquiring CA-MRSA in our study. The odds of acquiring MRSA for those with low socio-economic status (service) was 2.49 (90%CI: 1.39 – 4.47) times higher when compared to those MRSA patients with high socioeconomic status (pay) (p=0.01).

In contrast to the study done by Fritz, et al[3], this study showed that the odds of having MRSA for those who shared a bedroom with more than two (2) persons was 0.35 (90%CI 0.20-0.62) less likely when compared to those MRSA patients who had one or no companion in the bedroom (p=0.003).

The overall rate of CA-MRSA in Philippine Children's Medical Center showed a gradually increasing trend from 2004 to 2011 (Figure 1). In 2004, oxacillin-resistance was noted in only 29% of the isolates. From 2005 – 2011, oxacillin-resistance was noted to have emerged at 53.5%,

59%, 62%, 70%, 75%, and 65% respectively. This data is parallel to the Antimicrobial Resistance Surveillance Program report of Carlos et al., in the Philippines where the overall MRSA rate showed gradual increase from 18% in 2002 to 31%, 45%, 54% and 53% from 2008 – 2011 respectively[11-14].

Most common type of CA-MRSA infections were abscesses (46.2%) followed by pulmonary infections (14.62%) and blood stream infection (13.45%). Among those with skin and soft tissue infections, the most common site was the head and neck (42.39%) followed by upper extremities (28.26%), lower extremities (22.83%). Infections in the gluteal area accounted for only 6.52% of skin and soft tissue infections. This is in contrast to a recent study done by Pickett, et al. where they noted that the location of abscesses has remained unchanged with the exception of gluteal abscesses. In their study, gluteal abscesses have become the most common site of abscess formation and an increasing number was positive for CA-MRSA[15].

In this study, most isolates were from skin and soft tissues (56.73%), blood (19.3%) and pleural fluid (11.7%). In a study done in the Philippines by Ontengco et al[16], from 1999 – 2003, majority of the isolates were also from skin and soft tissues (34.6%) and respiratory tract (23.9%). However, unlike in this study where blood accounted for almost 20% of the isolates, only 9.7% of their isolates were obtained from the bloodstream.

Although not statistically significant, anemia, leukocytosis and neutrophilia were seen in a significant portion of cases enrolled in this study. Compared to the previous study done in 2006 by Avendano-Coronel[7] in which lymphocytosis in the CA-MRSA group was noted, the differential count of CA-MRSA infected patients in this study was mostly neutrophilic.

As regards the adequacy of antimicrobial drug used defined as receipt of an agent with in vitro activity against the isolated organism, 66.67% of those diagnosed with CA-MSSA compared to only 18.13% of patients diagnosed with MRSA received adequate antimicrobial therapy. The difference between the two groups were statistically significant ($p<0.001$). Oxacillin was the most common antibiotic prescribed for both CA-MSSA and CA-MRSA. Most commonly prescribed discharge antibiotic for CA-MSSA was cloxacillin (63.33%) and clindamycin (17.33%).

For CA-MRSA, the most commonly prescribed discharge antibiotic was clindamycin (64.33%) followed by cotrimoxazole (10.53%). In a study done by Purcell et al.[1], most commonly prescribed empirical antibiotic for CA-MRSA was clindamycin (90.8%) and vancomycin (4.65) unlike in our study where oxacillin still seem to remain as the empiric antibiotic of choice for skin and soft tissue infections.

CONCLUSION

Community acquired MRSA is indeed an emerging problem in the Philippines and throughout the world. Since it is clinically not possible to distinguish between CA-MSSA and CA-MRSA infections, knowing significant risk factors such as low socioeconomic status and household crowding may serve as a guide in choosing the appropriate empiric antimicrobial therapy.

In those areas where CA-MRSA infection is not a concern, empiric therapy with a penicillinase-resistant penicillin would suffice. However, in a setting where the incidence of CA-MRSA is high and in a setting where most of the patients belong to the low socioeconomic status, and are thus at risk, it is recommended that empiric antibiotic should be changed from oxacillin/cloxacillin to clindamycin or cotrimoxazole.

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