

Nasal- Carriage and Characterization of Methicillin- Resistant *Staphylococcus aureus* (MRSA) Among Hospital Nurses of Tuguegarao City, Cagayan: A Cross Sectional Study

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Abstract: The study aimed to determine the prevalence of MRSA infection in the selected hospitals and identify possible risk factors that contribute to its spread. 69 respondents from secondary hospitals (39 from public and 30 from private hospitals) were studied. The profile factors studied were hospital type, sex, position, length of service and working hours. Of these, only the type of hospital and the staff position are the variables that affect MRSA carriage. There was a higher rate of infection in public hospitals (66.67%) compared to private hospitals (30.00%). The calculated odds ratio for the public hospital, the private hospital and both private and public hospitals were 14, 0.29 and 2.31 respectively. Respondents were gauged on their knowledge of MRSA guidelines, policies for the admittance of MRSA-positive patients, the transportation guidelines, hand washing procedures and knowledge of hand hygiene products. Statistics show significant differences in the information release and transport of MRSA patients and the knowledge of hand hygiene products between public and private hospitals. 60.42% of respondents were not confident of their knowledge of MRSA with 84.60% feeling that they lacked information. Respondents from hospital A (68.40%), B (63.75%) and C (61.5%) were not informed of the MRSA status of patients who were admitted. 47.83% don't inform the transport service of the status of the patient being transported. Hand hygiene was maintained by constant washing with soap and water and alcohols. Differences in policies of public and private hospitals may account for the differences in the number of infected individuals.

Keywords: Methicillin-resistant *Staphylococcus aureus*, hospital nurses, nasal-carriage, cross-sectional study.

INTRODUCTION

Nosocomial infections caused by opportunistic microorganisms are now considered a major threat to public health today. They are especially common in healthcare settings where infections may be transmitted through inhalation, direct contact with lesions and contaminated hospital equipment and materials. Generally, *Staphylococcus* infections which is the most common bacterium associated with nosocomial infections are easy to treat using antibiotics but recent years have seen a rise in reports of methicillin-resistant *Staphylococcus aureus* (MRSA) [1].

MRSA carry the *mecA* gene and its regulatory regions that code for a mutated penicillin-binding protein called PBP-2' or PBP2a. This gene makes MRSA resistant to all β -lactam antibiotics, the most commonly used group of antibiotics for staphylococcal infections. Based from the National Nosocomial Infections Surveillance System Report, MRSA accounts for more than 55% of *Staphylococcus aureus*-related infections in the intensive care setting [2].

At present, MRSA is the most commonly identified antibiotic resistant pathogen causing bacteremia respiratory infections and skin infections. Its growth throughout the world has reached a prevalence of 23.3% to 73% [3]. The trend is a cause for concern as MRSA infections result in greater morbidity and cost of treatment compared to their methicillin-susceptible counterparts.

In the Philippines, the Antimicrobial Resistance Surveillance Program (ARSP) of the Research Institute for Tropical Medicine of the Department of Health showed the prevalence of MRSA to have increased from 52.6% in 2011 to 54.9% in 2012. In that year, Region 2 was the third region with the highest count of MRSA cases with 108 of the 1990 reported true MRSA cases to have come from Cagayan Valley Medical Center, one of the 21 ARSP regional sentinels [4].

Health care workers who are in close contact with patients are possible sources of such highly transmissible antibiotic-resistant pathogens. Nurses who

are in direct contact with patients over a 24 hour period are of high risk of acquiring pathogens due to the nature of their job. Nurses who harbor MRSA can transmit the pathogen from patient to patient during routine patient care. This is the very reason why nurses were chosen as the respondents of this study [5, 6].

Considering the role of MRSA as a commonly occurring nosocomial pathogen, its established association with community-acquired infections, and its reported presence as a normal flora in some individuals, the study aimed to determine the occurrence and possible factors that contribute to the acquisition and transmission of MRSA among the health care workers in secondary hospitals of Tuguegarao City. Moreover, knowledge of nurses in understanding the risk factors and knowing the pattern of occurrence of MRSA will be of great help in the establishment of preventive measures that may lead to the eradication of MRSA associated infections.

MATERIALS AND METHODS

Sampling Methods

Nasal swabs were obtained from nurses of the three hospitals. Stratified random sampling was performed and the number of respondents were determined using Slovin's formula and at a 0.01 confidence interval. Nurses were coded and respondents were identified using the lottery method.

Research Instrumentation

The study made use of questionnaire based on the research instrument drafted by Henrietta in 2012 [7]. The questionnaire focused on work practices, basic participant profiles and MRSA training and education.

Reagents

The study made use of Tryptic Soy Broth (Hi-Media) supplemented with NaCl. The media was prepared according to the package specifications and the appropriate amount of NaCl was added for a final concentration of 10% NaCl. chromID™ MRSA (Biomerieux) was used for selective culture of MRSA. Confirmation of MRSA colonies was done using the Slidex® MRSA Detection (Biomerieux) latex agglutination kit.

Collection, Transport and Storage of Specimen

Sterile swabs moistened with saline were inserted approximately 2 cm into the anterior nares and rotated against the nasal mucosa for 3 seconds. The procedure is repeated on the other nare using the same swab. The swabs are placed in tubes containing 2 mL of TSB supplemented with NaCl to a final concentration of 10% NaCl. The swabs were stored at 4°C overnight before inoculation the day after.

Inoculation and identification of presumptive MRSA colonies

Transport tubes cooled to room temperature before inoculation. The cotton swabs were streaked across the selective agar and allowed to stand for approximately 5 minutes before sealing with Parafilm® and incubating in an inverted position at 37°C. Plates were checked 24 and 48 hours after inoculation. Blue-green colonies were subcultured onto fresh chromID™ agar plates and incubated at 37°C. Cultures were checked 24 and 48 hours. Cultures which showed the characteristic blue-green colonies were regarded as presumptive MRSA colonies.

Detection of Penicillin-binding protein 2a

Confirmation of presumptive MRSA into true MRSA was done using the Slidex® MRSA Detection (Biomerieux) latex agglutination kit. The kit was used according to manufacturer's instructions. Colonies which were positive for latex agglutination were identified as true MRSA colonies.

Statistical analysis

Descriptive statistics was employed to summarize the collected data. The Chi-square Test for Independence ($\alpha=0.01$) was used to identify if the risk factors have an effect on the observed MRSA infections in the target hospitals.

RESULTS AND DISCUSSION

Profile of respondents and patterns of infection

The study population consisted of 69 subjects from three hospitals in Tuguegarao City, Cagayan (39 in Hospital A, 17 in Hospital B, and 13 in Hospital C). Swabs from the anterior nares were cultured onto MRSA selective media where MRSA colonies grow as blue to blue green colonies. Confirmation of the positive colonies was done using the Slidex® MRSA Detection (Biomerieux) latex agglutination kit. In addition to nasal swabs, questionnaires were also floated to the participants. The profile variables were sex (male or female), type of hospital where they worked (public or private), their position (Chief nurse, Staff Nurse or Volunteer Nurse), their total number of working hours (0 to 8 hours, 8 to 16 hours, 16 to 24 hours) and their length of service (6-12 months, 2-5 years, 6-10 years or 11 years or more). Table 1 shows the general profile of the respondents of the study.

In general, there were a comparable number of respondents from the public hospital (Hospital A) and from the chosen private hospitals and clinics (Hospital B and C). The number of female respondents was more than twice the number of male respondents which further demonstrated the dominance of the female sex in the healthcare setting. Most of the respondents were staff nurses and volunteer nurses. More than half of the respondents have been working at the hospitals for a short period (6-12 months).

Table-1: Profile of Respondents and Frequency of MRSA Infections

Field	Parameter	Total Frequency	Frequency		Percentage MRSA (+)
			MRSA (+)	MRSA (-)	
Hospital Type	Government	39	26	13	66.67
	Private	30	9	21	30.00
Sex	Male	16	8	8	50.00
	Female	53	27	26	59.94
Position	Chief Nurse	2	1	1	50.00
	Staff Nurse	51	24	27	47.06
	Volunteer Nurse	16	10	6	62.50
Length of Service	6-12 months	46	28	18	60.87
	2-5 years	14	4	10	28.57
	6-10 years	4	2	2	50.00
	More than 11 Years	5	1	4	20.00
Working Hours	Less than 8 Hours	23	11	12	47.83
	8-16 hours	46	24	22	52.17
	17-24 hours	0	0	0	0

Table 1 also shows the frequency of MRSA infections based on the profile variables considered. In terms of the type of hospital, there was a higher percentage of MRSA positives (66.67%) in public hospitals compared to the number of MRSA infections in private institutions (30%). In the Philippines, public services are still largely dictated by the ability to pay. The government provides direct health care through its public health institutions along with premium subsidies for poor families. These public health institutions cater to the majority while private health institutions focus on the middle- and higher-income households [8]. Public health institutions source however. In addition, the longer the hours, the more fatigue build up and the higher the chance for mistakes in the later part of their shifts. These mistakes could be a forgotten step or a missed procedure. Such can lead to the spread of the pathogen.

Of all the profile variables considered, it appears as though the type of hospital and the staff position are the main profile variables that affect the prevalence of nasal MRSA carriage. More respondents

are needed in order to make conclusions on the other variables. In addition, continuous monitoring of the hospitals would give more information on the possible source and spread of the infection.

Prevalence of MRSA infections in hospitals

The study focused on nurses from secondary hospitals within Tuguegarao City, Cagayan. Table 2 shows the frequency of MRSA infections in the different hospitals. More than half of the subjects from the public hospital were positive for MRSA while approximately a third of the subjects in the private hospital were nasal carriers of MRSA. This could be accounted by a difference in the protocols of private and public hospitals. Private hospitals invest more money on maintaining cleanliness and order in the hospital. A public hospital is paid for by the government but the funds are always inadequate to address the number of people going to them. This leads to a difference and cleanliness of the facilities and to the standard by which some of their guidelines may be followed.

Table-2: Frequency of MRSA Infections in Selected Hospitals

MRSA status	Hospitals					
	Hospital A		Hospital B		Hospital C	
	F	%	F	%	F	%
MRSA (+)	26	66.67	6	35.29	3	27.03
MRSA (-)	13	33.33	11	64.71	10	76.93
Total	39	100	17	100	13	100

The risk ratio for public hospitals, private hospitals and both private and public hospitals are shown in Tables 3, 4 and 5 respectively. The calculated odd's ratio for the public hospital is 14. This means that hospital nurses are 14 times more likely of acquiring an MRSA infection if exposed to the pathogen compared

to if they are not exposed. On the other hand, the calculated odd's ratio for private hospitals is 0.29. This means that it is 0.29 times more likely for nurses exposed to the pathogen to acquire the infection compared to nurses who are not exposed. The calculated odd's ratio for both public and private

hospitals is 2.31. This means that it is 2.31 times more likely to for nurses to acquire the infection if they are exposed to the pathogen compare to those who are not

exposed. Results show that no matter the hospital, there is still a chance to acquire the infection.

Table-3: Risk Ratio for Public Hospitals

	D (+)	D (-)
E(+)	24	6
E(-)	2	7

Table-4: Risk Ratio for Private Hospitals

	D (+)	D (-)
E(+)	5	17
E(-)	4	4

Table-5: Risk Ratio for Both Public and Private Hospitals

	D (+)	D (-)
E(+)	29	23
E(-)	6	11

CONCLUSIONS

Recent reports of MRSA infections in healthcare setting stressed the need to properly monitor and control the spread of the infection. In the Philippines, there has been continuing efforts to monitor the status of MRSA in local hospitals. However, the study is limited to the major hospitals in the locality. Little attention has been given to the smaller hospitals in the country. The objectives of the study were to determine the prevalence of MRSA carriage in nurses of Tuguegarao City, Cagayan hospitals and to determine risk factors and methods for controlling the spread of the infection.

Of the profile variables considered, only the type of hospital and the position showed a possible effect on the spread of the infection. The public hospital showed higher frequency of MRSA positives compared to the private hospitals which may be due to differences in the cleanliness, protocols and facilities of the hospitals. The staff nurses had a higher frequency of infection compared to chief nurses in part due to the duties assigned to each with staff nurses being in contact with patients longer than chief nurses.

Public and private hospitals were compared based on risk factors associated with the spread of the infection. Although there were marked differences between each in terms of the availability of specific resources and differences in their level of information dissemination, results showed that based on questionnaire data, it was only in their knowledge of hand hygiene products that there was a significant difference between the two.

Public hospitals were seen to have a higher incidence of MRSA infections compared to private hospitals due in part to differences in their general guidelines. Risk factors investigated were not able to

identify specific differences between them that could account for the observation seen. More risk factors may be taken into account to properly discern the factors that lead to a higher spread in public hospitals. A continuous study of the MRSA infection state should be performed in the hospitals to further identify profile variables and risk factors that could contribute to its spread.

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REFERENCES

1. San Juan JA, Cabugao DB. Dabbay BR, Cabrera E. Occurrence of Methicillin-Resistant Staphylococcus aureus (MRSA) Among Health Workers of Rizal Provincial Hospital and Characterization for the Presence of luks-lukf PVL gene. Philippine Journal of Science. 2011; 141(2): 157-163.
2. Micek ST, Dunne M, Kollef MH. Pleuropulmonary complications of Pantone-Valentine leukocidin-positive community-acquired methicillin-resistant Staphylococcus aureus: importance of treatment with antimicrobials inhibiting exotoxin production. Chest. 2005 Oct 1;128(4):2732-8.
3. Diekema DJ, Pfaller MA, Schmitz FJ, Smayevsky J, Bell J, Jones RN, Beach M, SENTRY Participants Group. Survey of infections due to Staphylococcus species: frequency of occurrence and antimicrobial susceptibility of isolates

- collected in the United States, Canada, Latin America, Europe, and the Western Pacific region for the SENTRY Antimicrobial Surveillance Program, 1997–1999. *Clinical Infectious Diseases*. 2001 May 15;32(Supplement_2):S114-32.
4. Kim SH, Song JH, Chung DR, Thamlikitkul V, Yang Y, Wang H, Lu M, So TM, Hsueh PR, Yasin RM, Carlos CC. Changing trend of antimicrobial resistance and serotypes in *Streptococcus pneumoniae* in Asian countries: an ANSORP study. *Antimicrobial agents and chemotherapy*. 2012 Jan 9: AAC-05658.
 5. Planta PM, Laiño AG, Alqueza M, Noreen B, Gonzales M, Liza M. Nasal Carriage of *Staphylococcus aureus* among pediatric health care workers in a Pediatric Intensive Care Unit. *Pediatric Infectious Disease Society of the Philippines Journal*. 2012 Jun 1;13(1):44-50.
 6. Mallik M, Hall C, Howard D, editors. *Nursing knowledge & practice*. Bailliere Tindall; 1998.
 7. Henrietta, B. An Analysis of a Questionnaire Survey of Healthcare Workers (HCWs) Knowledge on Methicilin-Resistant *Staphylococcus aureus* (MRSA). 2012.
 8. Picazo OF (n.d). Public governance in the Philippines: A case study on health care reforms. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjlhbbn6ePLAhUMmJQKHZIICEMQFggcMAA&URL=HTTP%3a%2F%2Fwww.wpro.who.int%2Fasia_pacific_observatory%2Fcountry_comparative_studies%2Fccs_public_hospital_6_phl.pdf&usg=AFQjCNErDn1gjobSpPseSQtQC6-GE9WIYg&sig2=J_i5MXw-S61Y3SU8ZlwEFQ&bvm=bv.117868183,d.dGo.