



The prevalence of nasal carriage of *Staphylococcus* among hospitalized patients at a Tertiary Care Hospital in Iligan City, Philippines

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Abstract

Staphylococcus aureus is harboured in the nares of 20-30% of healthy people. However, it is also recognized as a pathogen in human disease and is a common cause of healthcare associated infections worldwide. The aim of this study was to determine the nasal carriage rate of both *Staphylococcus aureus* and coagulase-negative staphylococci of 112 paediatric and adult ward patients of a public tertiary hospital in Iligan City, Philippines. Clinical samples were used to isolate, characterize and identify *S. aureus* and coagulase negative staphylococci using standard microbiological protocols. The screening for nasal carriage of *S. aureus* and CoNS revealed the presence of *S. aureus* in 84% of the patient volunteers and 34% had CoNS. It was further observed that the females of the study population harboured higher numbers of *S. aureus* and CoNS than the males. This trend of staphylococcal colonization was detected in both the paediatric and adult populace. Predisposing factors to staphylococcal colonization among the paediatric patients were assessed and it was observed that there was a significant association between staphylococcal colonization and antibiotic use ($p=0.028$). However, there was no identified variable that was found to be statistically association with the colonization of staphylococcal isolates amongst the adult patients. This study is one of the very few in the Philippines and the high prevalence of *S. aureus* nasal carriage rates highlights the significant need for regular *S. aureus* screening, interventions and decolonization strategies.

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Introduction

Staphylococcus aureus is a widespread commensal organism (Young *et al.*, 2017) affecting humans with a display of its ample potential to cause infections (Boncompain *et al.*, 2017) ranging from superficial boils to life-threatening infections. The nose is the primary reservoir of *S. aureus* and nasal carriage may be transient (hours or days) or persistent (Hawkins *et al.*, 2011).

This carrier status has been identified as a risk factor for the development of nosocomial infections in general hospital populations (Wertheim *et al.*, 2005). Due to an increasing number of antibiotic resistant staphylococcal strains, therapy has become problematic. Thus, screening of nasal carriage is an important component in the control of infection in any healthcare facility, allowing appropriate management (Rongharpi *et al.*, 2013).

The purpose of this study was to detect the presence of staphylococci in the anterior nares determine the staphylococcal nasal carriage of admitted patients of Iligan City and its associated patient risk factors.

Materials and Methods

Data collection and study design

A cross-sectional study of the carriage of staphylococcal strains of patients from different wards (n = 112) was conducted at a public tertiary hospital in Iligan City, Philippines. Participants were recruited on a voluntary basis and an informed consent form was made available to each patient. Information on demographic characteristics, clinical presentation and treatments provided was also collected.

Surveillance swab specimens were taken from the anterior nares of the patients. Moistened sterile cotton swabs were applied to both nares of the patients. Clinical specimens obtained were placed in Amies transport medium tubes, kept cool in an ice bucket and were immediately transported to the laboratory where it was processed at the laboratory within two hours of sampling.

Detection and isolation of Staphylococcal isolates on mannitol salt agar

The swabs collected were inoculated on to the surface of the mannitol salt agar (MSA) plates in a zigzag pattern along all areas of the medium for primary isolation. MSA plates that were negative for *S. aureus* were still considered for growth of other staphylococci and were further incubated for an additional 24-48 hours and re-examined. Total colony counts and colony characterizations were made.

Presumptive identification of Staphylococci

Following appropriate incubation, the plates were examined for presumptive identification of *S. aureus* and as coagulase-negative staphylococci. The isolates were retested to confirm the identity of the bacterial strains through the following methods: observation of cell morphology, ability to ferment mannitol, and determination of catalase and coagulase activities.

Statistical analyses

Descriptive analysis was employed in investigating the association between known variables and patient subgroups. Distribution of relationships between variables, subpopulations, staphylococcal colonization were also evaluated. Comparison of categorical variables between groups was done by means of Fisher's Exact and Chi-Square Test (Pearson).

Results and discussion

Study population

Two subpopulations were considered from the total of 112 recruited patients: pediatric (0-19 years of age) with median age of six years and adults (20-83) with median age of 30 years. There was equal number of subjects from the two subpopulations each with 56 individuals.

The sampling was done through opportunistic method, thus the study did not reflect the actual distribution of the local hospital. The equal proportion of the subjects was somehow favourable in the sense that there was not bias of the age factor.

Hospitalization presents a significant risk for a patient to acquire nosocomial disease. Several clinical variables were considered in the study which are identified predisposing agents of subsequent nosocomial infections: presence of skin abscesses or lesions, use of nasal spray and herbal medicines, history of antibiotic use, hospitalization in the past

prior to recent hospitalization and smoking habits. Only five out of the six identified variables were observed among the pediatric subjects (Table 1). More than half (30/56) had history of hospital exposure prior to recent hospitalization and twenty five percent had history of antibiotic use.

Table 1. Sociodemographic data and colonization rates of the pediatric patients (n=56).

Variables	n (%)	Colonization Rates	
		<i>Staphylococcus aureus</i>	Coagulase-negative staphylococci
Sex			
Males	29 (52%)	9 (32%)	5 (18%)
Females	27 (48%)	14 (50%)	5 (18%)
Risk Factors			
Presence of skin lesions	7 (13%)	4 (57%)	2 (29%)
History of antibiotic use	56 (100%)	40 (72%)	16 (29%)
Previous hospitalization	30 (54%)	7 (24%)	1 (3%)
Smoker	3 (5%)	3 (100%)	0
Use of nasal sprays	7 (13%)	7 (100%)	2 (29%)
Use of herbal medicines	4 (7%)	2 (50%)	2 (50%)
Length of hospital stay			
Newly admitted	30 (53%)	24 (81%)	3 (7%)
More than 3 days	26 (47%)	9 (33%)	3 (12%)

The proportion of nasal spray users, those who had taken herbal medicines, children with evident skin lesions were relatively low at 13% (7/56), 7% (4/56), 13% (7/56) respectively.

Table 2 shows that almost three-fourths of the adult population (37/56) claimed they have been to a hospital in the past six months (whether to visit a

patient or they themselves have been institutionalized). Forty percent and 12% of the adult subjects counteract minor health conditions by the use of nasal sprays and herbal treatments while the rest either use antibiotics or just ignore minor ailments. Less than one-third of the population were smokers, had skin lesions/abscess and pregnant women at 13%, 9% and 7% respectively.

Table 2. Sociodemographic data and colonization rates of the adult patients (n=56).

Variables	n (%)	Colonization Rates	
		<i>Staphylococcus aureus</i>	Coagulase-negative staphylococci
Sex			
Males	13 (23%)	5 (36%)	5 (7%)
Females	43 (77%)	22 (50%)	11 (25%)
Risk Factors			
Presence of skin lesions	5 (9%)	2 (40%)	4 (80%)
History of antibiotic use	56 (100%)	13 (23%)	15 (27%)
Previous hospitalization	37 (66%)	8 (22%)	10 (28%)
Smoker	7 (13%)	3 (43%)	3 (43%)
Use of nasal sprays	22 (40%)	7 (32%)	0
Use of herbal medicines	7 (12%)	6 (86%)	4 (57%)
Length of hospital stay			
Newly admitted	54 (96%)	8 (14%)	5 (9%)
More than 3 days	2 (4%)	1 (50%)	1 (50%)

The identified variables for the study have been documented to be of significant association with facilitating possible contraction of diseases from nosocomial pathogens (Perera and Hay, 2005)

Nasal colonization of Staphylococcus among paediatric and adult subjects

MSA was used to confirm carriage and to define topography of *Staphylococcus* colonization. On MSA typical pathogenic staphylococci (coagulase positive staphylococci) ferment mannitol and form yellow colonies with yellow zones around the colonies while those typical non-pathogenic staphylococci do not ferment mannitol and form white or cream colonies.

Eighty four percent of the study population was colonized with *S. aureus*. The colonization rates obtained was the highest so far in all nosocomial data in the Philippines which averaged at 62% (Ontengco *et al.*, 2004). The colonization of the anterior nares is suggested to antedate bacteremic as well as non-bacteremic infection thus detection of nasal colonization may be of great clinical relevance (Kokai-Kun *et al.*, 2003). Thirty four percent of the subjects harboured coagulase-negative staphylococci (CoNS). Coagulase negative staphylococci are normal residents of the skin but may also be found in the nasal passages (Toltzis, 2012).

Gender was identified by previous studies as a major risk factor for higher bacterial colonization (Kuehnert *et al.*, 2006). The results of this study conformed to the idea that gender is a variable for obtaining higher bacterial colonization ($p=0.0062$). Forty eight percent of the total female population was colonized with *S. aureus* while only 35% of the males were carriers of this potential pathogen. The higher proportion of staphylococcal colonization among women is also true for coagulase-negative staphylococci at 21% and only 13% of the men had CoNS as part of their nasal microflora. Colonization patterns for *S. aureus* among the paediatric population were also higher among the females (50%) than the males (32%) although both genders had the same percentage of colonization for CoNS at 18%. Higher number of female individuals in the adult population was colonized with *S. aureus*

(50% females over 36% males) and CoNS (25% females over 7% males). This may also be attributed to the fact the there were more female individuals included in the study group than males.

Age is another identified significant factor in the nasal bacterial colonization and a study in 2005 showed that staphylococcal colonization is more common in adults although colonization rates in children have increased steadily in recent years (Johnson, 2005). Accordingly, in this study, the adult carriers (48%) was able to slightly outnumber the paediatric population (46%) colonized with *S. aureus*. However, the paediatric patients had a slightly higher CoNS colonization rates than the adult populace (20% vs 18%).

Association between Staphylococcal colonization and identified clinical variables among the paediatric population

Predisposing factors to staphylococcal colonization (smoking habits, pregnancy, presence of abscess, prior hospital exposure, use of herbal medicines, and nasal sprays and antibiotic use) among paediatric patients were also assessed. Forty-nine percent of the paediatric patients in the study population was colonized with *S. aureus* and the 19% were carriers of the coagulase-negative staphylococci. The predisposing factor with most number of subjects colonized with *S. aureus* and CoNS is the usage of antibiotics at 72% and 29% respectively. The association between the use of the antimicrobial agents and the type of staphylococcal colonization among patients was found to be significant ($p=0.028$).

The next prominent factor associated with high rates of staphylococcal colonization was prior exposure to hospital settings with colonization rate of 24% *S. aureus* and 3% CoNS. However, there was not associated relationship found between hospital exposure and type of colonization with *Staphylococcus* species. No association was found with the rest of the categorical variables.

Association between Staphylococcal colonization and identified clinical variables among the adult population

A significant proportion of adults associated with exposure to hospital settings before their recent admission was observed to have been colonized with *S. aureus* and CoNS. No significant relationship was found between antibiotic use of the adult patients and the type of staphylococcal colonization ($p=0.3774$). Open wound/s and/or abscess and other categorical variables (smoking, pregnancy, use of herbal medicines) were also taken into consideration to determine if such factors predispose for higher staphylococcal colonization. Based on the results, colonization of *S. aureus* and CoNS is significantly higher for those patients with skin lesions and pregnant females. However, no significant associations were found regarding the remaining variables and the type of staphylococcal species colonizing the anterior nares.

Identifying staphylococcal nasal carriage has various important implications in healthcare settings. Surveillance is the first significant step in order to create and impose infection control policies.

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