PREVALENCE OF NOSOCOMIAL INFECTION BY *STAPHYLOCOCCUS AUREUS* AND ITS ANTIMICROBIAL SUSCEPTIBILITY TEST IN A HEALTH CARE CENTER AT KATHMANDU

Preeti Maharjan [1], Shova Shrestha [1], Vijay Kumar Sharma [2]

[1]Department of Microbiology, Tri-Chandra Multiple Campus, Ghantaghar, Kathmandu, Nepal,
[2]Department of Pathology, Alka Hospital, Kathmandu

ABSTRACT:

Introduction: Staphylococcus aureus (*S. aureus*) is responsible for causing variety of human infections ranging from minor skin infections to life threatening infections and is major cause of nosocomial infections worldwide. This study was carried out to study the prevalence of nosocomial infection by *S. aureus* and determine the antimicrobial susceptibility pattern of isolated *S. aureus* strains.

Methodology: Samples were collected from patients who stayed for more than 48 hours in hospital and were further processed with standard microbiological methods. Samples included wound & soft tissue swab, pus, blood, sputum, urine and devices.

Result: *S. aureus* was found to be dominant organism. S. aureus was mainly obtained from wound and soft tissue swab resulting skin and soft tissue infection among the most prominent infection. Higher number of organism was isolated from higher age group.

Conclusion:

Keywords: nosocomial infection, Staphylococcus aureus, MRSA

INTRODUCTION:

Infections that occurs that forty eight hours of admission are considered nosocomial. The Center for Diseases Control and Prevention (CDC) defines nosocomial infections as infections acquired while in health care setting, with a lack of evidence that infection was present or incubating during admission (Horan, Andrus et al. 2008). According to World Health Organization (WHO) 2001, among 100 patients admitted to hospital, 7 in developed countries and 10 in developing countries will attain at least one health care infection (World Health Organization 2011). Health care infections are frequent adverse effects in hospital setting worldwide. As per CDC, about 1.7 million hospital associated infections from all types of bacteria combined cause or contribute to

99,000 deaths each year(Centers for Disease Control and Prevention 2005). *S aureus* is widespread pathogen and is frequently associated with nosocomial infections. The most remarkable characteristic of *S. aureus* is its ability to develop antibiotic resistance. Methicillin resistant *S. aureus* (MRSA) is any strain of S. aureus that has developed resistance against beta lactam antibiotics and cephalosporin (Batabyal, Kundu et al. 2012). Strains unable to resist these antibiotics are called Methicillin sensitive *S. aureus* (MSSA). The basic mechanism of resistance is the alteration in penicillin binding protein. MRSA contains mecA gene in SCCmec cassette chromosome that codes for low affinity penicillin binding proteins (PBP2A) that allows bacterium to continue synthesizing cell wall normally and multiply. MRSA was first isolated in 1961 in UK soon after the introduction of methicillin and since then MRSA emerged itself as the challenge for all health institution (David and Daum 2010). The development of resistance does not cause organism to become intrinsically more virulent but are difficult to treat with standard types of antibiotics posing therapeutic challenges (Dietrich, Auld et al. 2004). There are very few studies carried out to assess the nosocomial infections in Nepal that showed the varied range of 20 – 50 % ((Rijal, Pahari et al. 2008). The aim of this study is to determine the prevalence of nosocomial infection by *S. aureus* and determine the antibiotic susceptibility pattern of isolated *S. aureus* strains.

MATERIALS AND METHODS:

A cohort study was carried out at Alka hospital from November 2012 to April 2013. The samples collected included wound and soft tissue swab, urine, sputum, pus, blood, CSF & body fluids and invasive devices. The patient inclusion criteria included prior MRSA infection or colonization, current hospital stay exceeding forty-eight hours and known colonization of other infection whereas exclusion criteria included patients who had received oral and intranasal antibiotics for MRSA within past 14 days.

The samples collected from inclusive were processed through standard microbiological methods and antibiotic susceptibility test was done by Kirby Bauer Method. Samples collected were inoculated onto Mac Conkey Agar (MA), Chocolate Agar (CA) and Blood Agar (BA) by following standard microbiological methods. Catalase positive, coagulase positive, oxidase negative, Voges Proskaeur positive and fermentative gram positive cocci were identified as *S. aureus.* Mannitol Salt Agar (MSA) was used as selective media for identification for *S. aureus*. Cefoxitin disc was used to differentiate methicillin resistant *S. aureus* (MRSA) and methicillin sensitive *S. aureus* (MSSA).All data collected were analyzed by using IBM SPSS version 20.

RESULTS:

Out of 316 different samples, growth was seen only in 25 % (79/316). Major contributing organism was found to be *S. aureus* followed by *Escherichia coli*, *Acinetobacter spp*, *Pseudomonas spp*, *Klebsiella spp* and *Citrobacter spp* respectively (Figure 1). *S. aureus* was mainly isolated from the culture of swab, pus, urine, sputum and devices samples (Figure 2).

Issue 6, Vol. 4 (July-August 2016)
ISSN 2249 – 5738

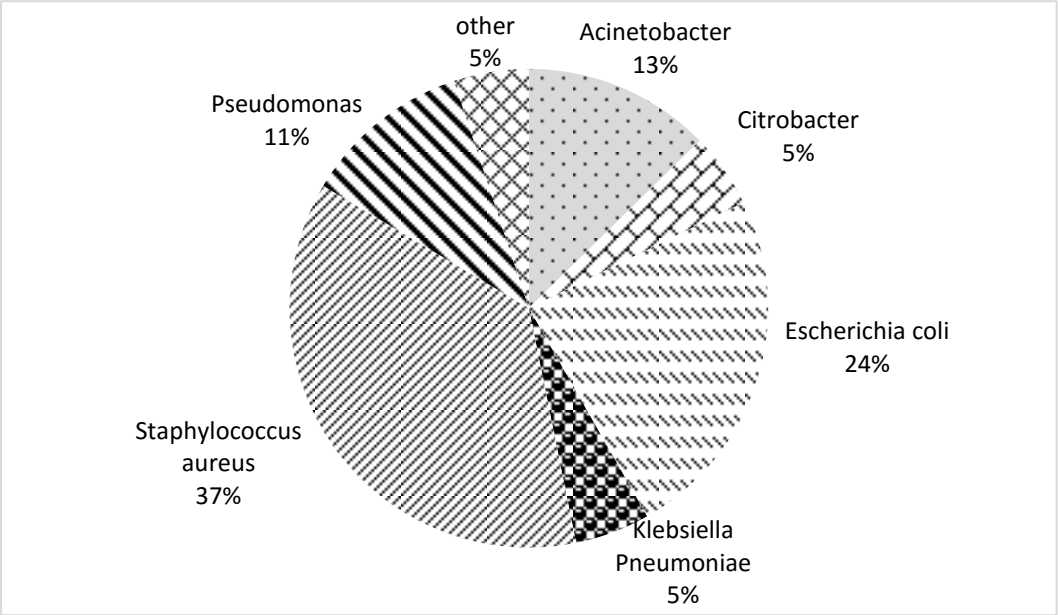

Figure 1: Distribution of pathogens

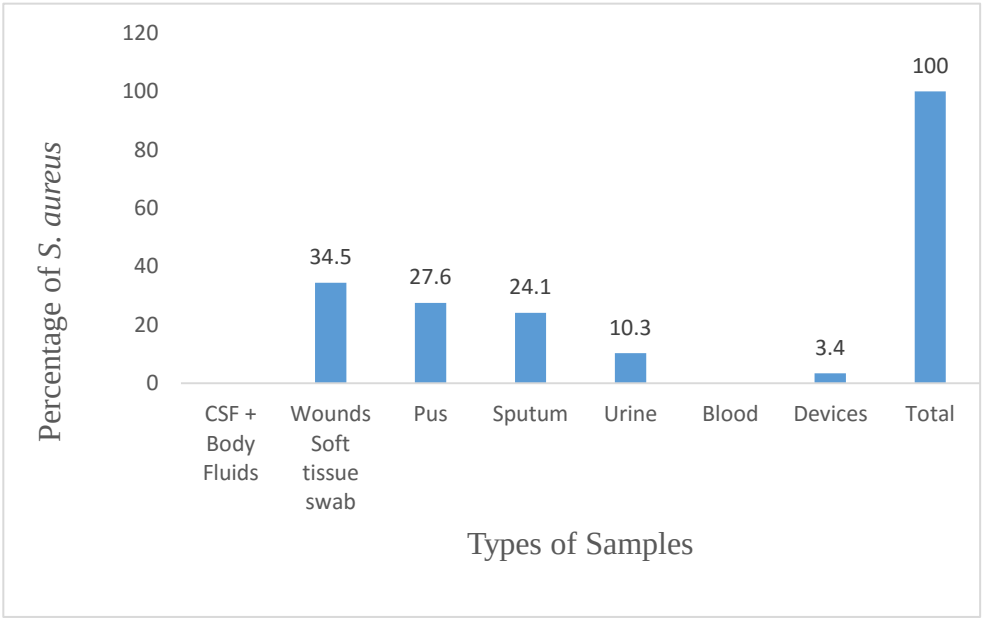

Figure 2: Isolation of *S. aureus* from different clinical specimen

However, *S. aureus* was not isolated from blood samples, CSF and body fluids. Among total *S. aureus* isolated, 27.6 %(8/29) were found to be methicillin resistant (Figure 3).

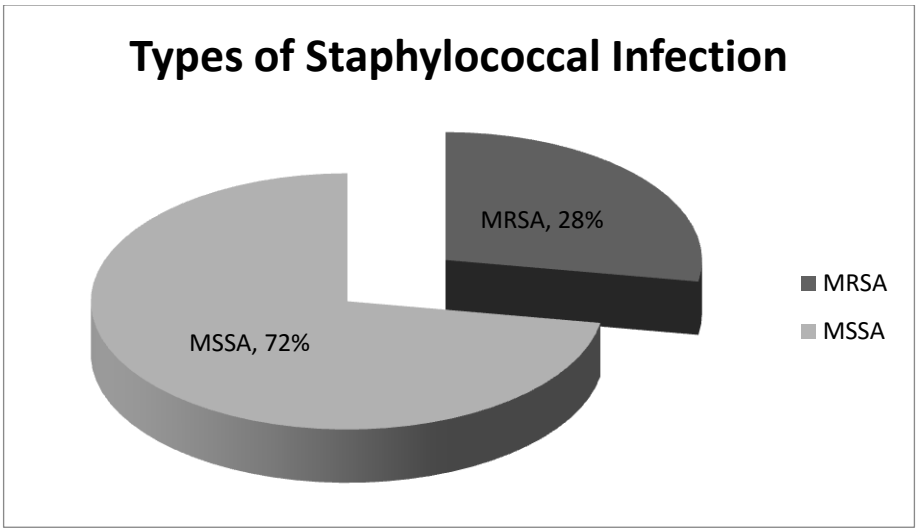

Figure 3: Distribution of MRSA and MSSA

In this study, age of patient ranged from 1 to 89, however, no clinical samples were collected from 0-10 age group. Highest number of *S. aureus* was isolated from age group 61-70 (Table 1).

Table 1: Age and gender wise distribution of MRSA and MSSA.

Age Group	Male		Female		Total	
	MSSA n (%)	MRSA n (%)	MSSA n (%)	MRSA n (%)	MSSA n (%)	MRSA n (%)
0-10	0	0	0	0	0	0
11-20	1 (4.8)	0	1 (4.8)	0	2 (9.5)	0
21-30	1 (4.8)	0	2 (9.5)	0	3 (14.3)	0
31-40	0	0	1 (4.8)	1 (12.5)	1 (4.8	1 (12.5)
41-50	1 (4.8)	1 (12.5)	0	0	1 (4.8	1(12.5)
51-60	2 (9.5)	0	2(9.5)	0	4 (19)	0
61-70	6 (28.6)	3 (37.5)	4(19)	0	10 (47.6)	3 (37.5)
>70	0	2 (25)	0	1(12.5)	0	3 (37.5)
Total	11 (52.5)	6 (75)	10 (47.6)	2 (25)	21 (100)	8 (100)

The most prevalent site for *S. aureus* infection was found to be skin and soft tissue which alone contributed to 62.1 % of total staphylococcal infection. This was followed by lower respiratory tract infection and urinary tract infection (Table 2). There was no significant association (P>0.05) of isolation of *S. aureus* strains with site of infection.

Table 2: Prevalence of MRSA and MSSA according to the infection site

Site of Infection	S. aureus	MRSA	MSSA
Skin and soft tissue infection	18 (62.1%	5 (27.8%)	13 (72.2%)
Lower Respiratory Tract	7 (24.1%)	1 (14.3%)	6 (85.7%)
Urinary Tract	4 (13.8%)	2 (50%)	2 (50%)
Others	0	0	0

The most effective antibiotic was found to be Gentamycin however, the least effective was Amoxicillin (Table 3).

Table 3: Antibiotic Sensitivity pattern of *S. aureus*

Antibiotics Discs	Total S. aureus	Sensitive	Intermediate	Resistant
Ciprofloxacillin	29	17 (58.6%)	2 (6.9%)	10 (34.5%)
Erythromycin	29	14 (48.3%)	3 (10.3%)	12 (41.4%)
Cloxacillin	29	17 (58.6%)	1 (3.4%)	11 (37.9%)
Ofloxacin	29	18 (62.1%)	2 (6.9%)	9 (31%)
Amoxycillin	29	10 (34.4%)	1 (3.4%)	18 (62.06%)
Gentamycin	29	22 (75.9%)	0	7 (24.1%)
Cefoxitin	29	21 (72.4%)	0	8 (27.6%)

DISCUSSION:

S. aureus was found to be most dominant pathogen causing nosocomial infections which alone caused 36.7% of total infections. This is in concordance with most of the similar kind of studies where S. aureus remains the most frequently encountered organisms ((Lizioli, Privitera et al. 2003, Vincent, Sakr et al. 2006, Jroundi, Khoudri et al. 2007, Razine, Azzouzi et al. 2012). Correspondingly, *S. aureus* was followed by *E. coli* in a study carried out in University of Medical Center, Morocco (Razine, Azzouzi et al. 2012).

Of total *S. aureus* isolated, skin and soft tissue infection contributed a major part comprising 62.1 % of total isolates. This is similar to different studies carried out in Nepal, Bangladesh, Pakistan and India where skin and soft tissue infection ranged from 38 to 72 % of total infections (Shrestha, Pokhrel et al. 2009, Tiwari, Das et al. 2009, Faruquzzaman 2011). The skin has a diverse ecology of organism that can cause infection. The organism on skin surface may cross the skin barrier during invasive procedures and surgeries in a hospital set up. In addition, direct inoculation from flora, personnel's hand, airborne transmission are other sources of infection. The organism may invade the lower respiratory tract infection through mechanical ventilators, tracheostomy and contaminated aerosols (Richards, Edwards et al. 1999). *S. aureus* is uncommon cause of urinary tract infection though the organism may ascend to urinary tract through use of catheters. Gender, duration of catheterization and underlying diseases play an important role in microbial colonization resulting urinary tract infection (Coll, Crabtree et al. 1994).

Age of the patient is important factor for occurrence of nosocomial infection. Highest number of *S. aureus* was obtained from age groups 61-70 and above 70. Prevalence of staphylococcal infection is higher in patients within the range of 50 – 80 years of age (Aslam, Khan et al. 2011). Contradictorily in some studies, highest number of infection occurred in age group of 1-10 however in studies carried out by Rajbhandari *et al*., 2002 and Sapkota *et al*., 2006, the highest infection was found in age group 20-29. This may be because their immune system is comparatively weak and are frequently admitted to hospitals where they are exposed to different pathogens and are prone to infection. In addition, patients with higher age have underlying diseases like diabetes, heart diseases etc. that delays wound healing and favors infection.

The history of antibiotic resistance of *S aureus* started in 1940's soon after the historic invention of penicillin drug. The most effective and least effective drugs were Gentamycin and Amoxicillin respectively. The evaluation of antibiotic susceptibility pattern of MRSA and MSSA reveals that the sensitivity of MRSA is markedly reduced in comparison to MSSA.

CONCLUSION:

S. aureus was dominant organism for nosocomial infections and was isolated mainly from skin and soft tissue infections. Of total *S. aureus* isolated, 27.6% were MRSA which highlights the need for regular surveillance for prevention of nosocomial infection. As this is a small pilot project so the retrospective study of MRSA development for identifying the root cause of MRSA development and identify its intervention possibilities.

REFERENCES:

Aslam, M., et al. (2011). "Current trend of antimicrobial susceptibility pattern of methicillin resistant staphylococcus aureus isolated from tertiary care hospital Delhi NCR Regoin India." International Journal of Research in Ayurveda and Pharmacy **2**(4): 1339-1342.

Batabyal, B., et al. (2012). "Methicillin-Resistant Staphylococcus Aureus: A Brief Review." International Research Journal of Biological Sciences **1**(7): 65-71.

Centers for Disease Control and Prevention, C. (2005). National Statistics for Health Statistics 2002 NHDS data file documentation.

Coll, P. P., et al. (1994). "Clinical risk factors for methicillin-resistant Staphylococcus aureus bacteriuria in a skilled-care nursing home." Arch Fam Med **3**(4): 357-360.

David, M. Z. and R. S. Daum (2010). "Community-associated methicillin-resistant Staphylococcus aureus: epidemiology and clinical consequences of an emerging epidemic." Clin Microbiol Rev **23**(3): 616-687.

Dietrich, D. W., et al. (2004). "Community-acquired methicillin-resistant Staphylococcus aureus in southern New England children." Pediatrics **113**(4): e347-352.

Faruquzzaman (2011). "Positive associations of nosocomial infections in surgical ward with etiological clinical factors." Bratisl Lek Listy **112**(5): 273-277.

Horan, T. C., et al. (2008). "CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting." Am J Infect Control **36**(5): 309-332.

Jroundi, I., et al. (2007). "Prevalence of hospital-acquired infection in a Moroccan university hospital." Am J Infect Control **35**(6): 412-416.

HAI is linked to the surgical category, a hospital stay of more than 10 days, and the use of intravascular and urinary devices. CONCLUSIONS: The prevalence of HAI is high at our center. This survey provided the principal information for future surveillance and prevention programs in Morocco.

Lizioli, A., et al. (2003). "Prevalence of nosocomial infections in Italy: result from the Lombardy survey in 2000." J Hosp Infect **54**(2): 141-148.

Razine, R., et al. (2012). "Prevalence of hospital-acquired infections in the university medical center of Rabat, Morocco." Int Arch Med **5**(1): 26.

Richards, M. J., et al. (1999). "Nosocomial infections in medical intensive care units in the United States. National Nosocomial Infections Surveillance System." Crit Care Med **27**(5): 887-892.

Rijal, K. R., et al. (2008). "Prevalence of methicillin resistant Staphylococcus aureus in school children of Pokhara." Nepal Med Coll J **10**(3): 192-195.

Shrestha, B., et al. (2009). "Study of nosocomial isolates of Staphylococcus aureus with special reference to methicillin resistant S. aureus in a tertiary care hospital in Nepal." Nepal Med Coll J **11**(2): 123-126.

Tiwari, H. K., et al. (2009). "Methicillin resistant Staphylococcus aureus: prevalence and antibiogram in a tertiary care hospital in western Nepal." J Infect Dev Ctries **3**(9): 681-684.

Vincent, J. L., et al. (2006). "Sepsis in European intensive care units: results of the SOAP study." Crit Care Med **34**(2): 344-353.

World Health Organization, W. (2011). Report on the burden of Endemic Health Care - Associated Infection Worldwide.