DOI: 10.7860/JCDR/2013/5160.3735

Original Article

Microbiology Section

Prevalence of Methicillin Resistant *Staphylococcus aureus* Carriage amongst Health Care Workers of Critical Care Units in Kasturba Medical College Hospital, Mangalore, India

RADHAKRISHNA M[1], MONALISA D'SOUZA[2], SUBBANNAYYA KOTIGADDE[3], VISHWAS SARALAYA K[4], SHASHIDAR KOTIAN M[5]

ABSTRACT

Background: Outbreaks and prevalence of Methicillin resistant *Staphylococcus aureus* (MRSA) Nosocomial Infection (NI) among various populations have been well reported in literature, particularly those from developed countries. There is a paucity of information on carriage of MRSA in developing nations, including the carriage by critical healthcare givers who are potential transmitters.

Aim and Objectives: Present study was aimed at establishing the carriage rate of MRSA among healthcare workers in the critical care units of Kasturba Medical College Hospital, Mangalore, India and at formulating an MRSA control policy, based on the outcomes.

Material and Methods: We screened 200 healthcare workers in the critical care units of the Kasturba Medical College Hospital, Mangalore, India, for MRSA and vancomycin susceptibility of the isolates. Swabs taken from both anterior nares were transported, inoculated onto mannitol salt agar (MSA) and incubated aerobically at 37°C for 18-24 hours. Gram positive cocci in clusters, with positive catalase, coagulase and DNAse tests, were identified as *S.aureus*. Further categorization of *S.aureus* into MRSA was done by using cefoxitin disc diffusion method. Sensitivity to vancomycin was tested by vancomycin disc diffusion and vancomycin agar screen plating.

Results: The number of strains *of S. aureus* which was isolated from our 200 participants was 35, with a rate of 17.5% of the 35 isolates of *S. aureus*, 5 (14.3%) were MRSA. None of the *S. aureus* strains were vancomycin resistant.

Conclusion: MRSA carriage among healthcare workers who were involved in the management of critically ill patients at Kasturba Medical College hospital, Mangalore, India was 2.5%, which is comfortably low. The existing infection control policy in our hospital seems to be effective and the same should be maintained.

Keywords: Methicillin resistance *Staphylococcus aureus*, Healthcare workers

INTRODUCTION

Staphylococcus aureus is one of the commonest human bacterial pathogens which is capable of causing a wide range of infections, especially through cross infection spread from patient to patient in hospitals and in other institutional settings. In contrast, healthy individuals have a small risk of contracting invasive infections caused by *S. aureus*. However, they can be carriers of the organism [1]. The incidence of community – acquired and hospital acquired *S. aureus* infections has been rising, with increasing emergence of drug resistance strains which are called methicillin resistant *S. aureus* (MRSA), which have become endemic worldwide within the past two decades [2-4]. Infections caused by MRSA are associated with worse outcomes, in addition to prolonged hospital stays, higher costs of treatment and increased mortality [5]. MRSA has become a global problem. In recent years, dissemination of MRSA has been increasingly recognized in other healthcare settings, including primary care [6]. Similarly, healthcare providers are also exposed to patients with MRSA infection and/or are colonized in the course of their work [7]. The ecological niches of *S. aureus* strains are the anterior nares and most of invasive *S. aureus* infections are assumed to arise from nasal carriages [8]. Nasal carriage rates of MRSA have been reported to be between 0.8% and 3.0% and 6% to 17.8% among adults in the community and healthcare workers in hospital settings elsewhere in the world respectively [9,10]. The necessity of mass screening of health care workers for MRSA has been extensively debated with regards to advantages, disadvantages and ethical issues [11]. Nonetheless, nosocomial transmissions of MRSA which occur from and through health care givers to hospitalized patients have been documented and they may be greater than had been previously thought [12]. Thus, the role of MRSA carriers in the transmission of this pathogen is critical and healthcare workers who are at the interface between the hospital and the community may serve as agents of cross-transmission of hospital acquired – MRSA and community acquired – MRSA [13]. Policies which have been made towards the control of spread and infection caused by this organism are therefore, mandatory and they will best be formulated when a holistic approach is given to the problem. Present study therefore, was aimed at establishing the carriage rate of MRSA among healthcare workers in the critical care units of Kasturba Medical College Hospital, Mangalore, India and at formulating an MRSA control policy for our hospital, based on the outcomes.

MATERIAL AND METHODS

This study was conducted at Kasturba Medical College Hospital, Mangalore, from 1st June 2011 to 30th of September 2011. The hospital has a tertiary health care facility with a total of 1863 beds and an annual average of 78,175 and 2,29,468 admissions in the

inpatient and outpatient sections respectively, in the past 2 years. All volunteering staff members who were working in the hospital units, who were involved in the management of critically ill patients (General Intensive Care Unit, adults), Coronary/cardiac ICU, Nephrology ICU, Neurology ICU, Paediatric ICU, Neonatal ICU, Post-operative ICU) and students (medical and nursing) who were on clinical rotation to the units, were conveniently included in the study. Approval was obtained by the research ethics committee of the institution for carrying out the study. A total of 200 consenting participants were included in the study. They were apprised with the details of the study. The age, sex, designation, MRSA carriage statuses of the individuals and treatment for the same, duration of stay in the critical care unit, the hospital wing to which they belonged to, the type of critical care unit and other relevant information about the consenting participants were obtained in a proforma which was made for this purpose. Swabs from both anterior nares of consenting participants were taken by using sterile cotton swabs which were moistened with sterile physiological saline and were transported to the microbiology laboratory unit of the hospital for bacteriological analysis. The samples were processed within 2 hours after their collection. The swabs were inoculated onto mannitol salt agar (MSA) plates and incubated at 37°C for 18-24 hours.

Any growth was identified as *S. aureus* by using standard procedures to study colony morphology, microscopic appearance on gram stained smears, catalase test, tube coagulase test and deoxyribonuclease test [14].

The isolated strains of *S. aureus* were screened for methicillin susceptibility by modified Kirby-Bauer method by using cefoxitin (30 µg) discs on Mueller-Hinton agar (MHA) by using an inoculum density which was equivalent to McFarland's 0.5 standard (1.5×10^8 CFU/ml) [15]. Isolates which showed inhibition zone sizes of diameter ≤21 mm were considered as MRSA strains [16]. All isolates of *S. aureus* were also screened for vancomycin susceptibility test by the modified Kirby-Bauer method by using vancomycin discs (30 µg) on MHA which was incubated at 37°C for 24 hours. Isolates with inhibition zone sizes of diameter ≤15 mm were considered as vancomycin resistant. This was confirmed by detection of MIC by employing the broth dilution method [17]. Strains that showed an MIC of more than 4 µg /ml were considered as Vancomycin Resistant *Staphylococcus aureus* (VRSA).

Antibiotic susceptibility testing for all isolates of *S. aureus* was also done against other antibiotics like amoxicillin/clavulanic acid (20/10 µg), ciprofloxacin (5 µg) ceftriaxone (30 µg), cotrimoxazole (23.75/1.25 µg), erythromycin (15 µg), gentamicin (10 µg), linezolid (30 µg), penicillin (10 units) and teicoplanin (30 µg) by the modified Kirby-Bauer method. All antibiotic susceptibility tests were conducted by using *S. aureus* ATCC 25923, MRSA ATCC 29213 and MSSA ATCC 33591 as controls under similar conditions as were used for test strains. All antibiotic discs were procured from HiMedia Laboratories Pvt. Limited, India. Antibiotic sensitivity testing and interpretation of results were done according to CLSI guidelines [18]. Repeat samples were collected from the participants who showed a nasal carriage of MRSA after an interval of 15 days and they were processed in the same manner as has been mentioned above, for confirmation.

STATISTICAL ANALYSIS

A convenient sample technique was used for sample selection. Results were compiled, tabulated and all data were subjected to SPSS, version17.0 software statistical package for analysis. Association was done by using Chi-square test. A p-value of < 0.05 was considered as significant.

RESULTS

A total of 200 critical unit healthcare workers, whose ages ranged from 20-55 years (mean = 28.6 ± 7.5), were screened for MRSA. Thirty eight (19%) were males and 162 (81%) were females. Number of years of work in critical care units ranged between < 1 year to >5 years (median=0.5417). Staff nurses (110) and doctors (40) constituted a majority of subjects who were screened [Table/Fig-1]. Various species of bacteria, including MRSA, which were isolated from the anterior nares of the participants, have been shown in [Table/Fig-2]. Out of 200 healthcare workers who were screened, 35(17.5%) were positive for nasal carriage of *S. aureus*. Among these, 5 (14.3%) were MRSA carriers. Coagulase Negative Staphylococci (CoNS) were the predominant isolates (73%). Overall, MRSA nasal carriage rate was 2.5% in our study. Various hospital critical care units which were encompassed in the study, the number of participants which was examined and the type of *S.aureus* which was isolated, have been provided in [Table/Fig-3]. The distribution of *S. aureus* and MRSA carriage in relation to profession/cadre has been presented in [Table/Fig-4]. MRSA were isolated only from housekeeping personnel (13.3%) and from nursing staff (2.7%). All five participants from whom MRSA was isolated, were females.

Parameter	Description
Age in years(mean=28.6300,SD=7.51368)	Frequency (%)
<25	84(42)
25-35	80(40)
35 -45	28(14)
45 -55	8 (4)
Sex distribution	
Males	38(19)
Females	162(81)
Number of years in critical care (Median=0.5417)	
<1	129 (64.5)
1 – 5	54 (27)
>5	17(8.5)
Designation	
Doctor	40(20)
Internee	4 (2)
Staff Nurse	110(55)
Hospital auxiliary	6 (3)
Student nurse	22(11)
Housekeeping	15(7.5)
Physiotherapy	3(1.5)

[Table/Fig-1]: Distribution of Participants

Organisms Isolated	Frequency (%) n = 200
Staphylococcus aureus	35 (17.5)
CONS	146 (73.0)
Others	10 (5.0)
No growth	9 (4.5)

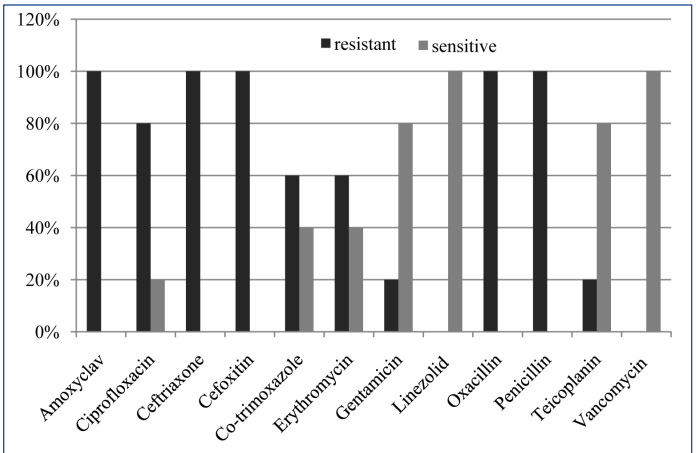
[Table/Fig-2]: Nature of organisms isolated from anterior nares

Critical care units	No. sampled	No. positive for *S. aureus*	No. positive for MRSA
Gen ICU	70	12	2
PICU	38	8	1
NICU	52	8	1
POST OP	10	1	1
CICU	21	5	0
NEPHROLOGY ICU	2	1	0
NEUROLOGY ICU	7	0	0

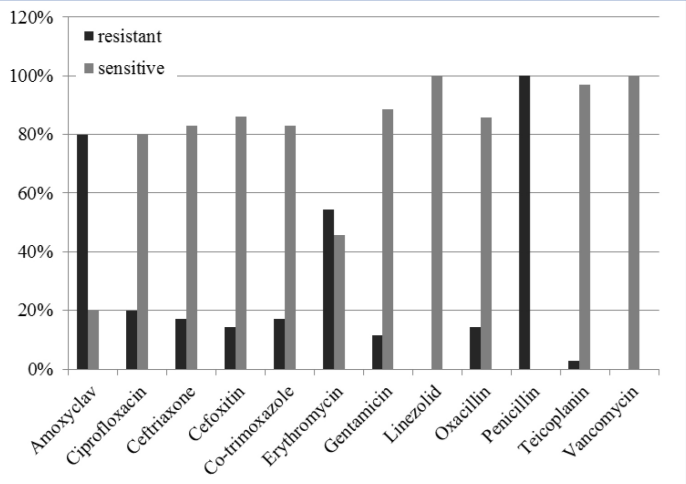
[Table/Fig-3]: Hospital Critical care units related *S. aureus* & MRSA carriage status
GenICU: Intensive Care Unit (for adults); PICU: Paediatric Intensive Care Unit NICU: Neonatal Intensive Care Unit; CCIU: Cardiac Intensive Care

Designation	No. sampled (%) n=200	No. positive for *S. aureus*	No. positive for MRSA
Doctor	40 (20)	13	0
Internee	4 (2)	0	0
Staff Nurse	110 (55)	15	3
Hospital auxiliary	6 (3)	0	0
Student nurse	22 (11)	3	0
Housekeeping	15 (7.5)	4	2
Physiotherapist	3 (1.5)	0	0

[Table/Fig-4]: Profession/cadre related distribution *S. aureus* and MRSA carriage status



[Table/Fig-5]: Antibiotic susceptibility profile of *S. aureus* isolates



[Table/Fig-6]: Antibiotic susceptibility profile of MRSA isolates

The antibiotic susceptibility patterns of *S. aureus* and MRSA isolates have been shown in [Table/Fig-5 and 6] respectively. While all isolates of *S. aureus* were resistant to penicillin, resistance to amoxyclav and erythromycin was 80% and 54% respectively. All the 5 isolates of MRSA showed a sensitivity rate of 100% to vancomycin and linezolid, 80% sensitivity to teicoplanin and gentamicin, 40% sensitivity to erythromycin and 20% sensitivity to ciprofloxacin. Further, the Minimum Inhibitory Concentration (MIC) of vancomycin in all the 5 isolates of MRSA was found to be < 2 µg /ml by broth dilution method. Repeat samples which were obtained from the participants confirmed carriage of MRSA and they expressed the same pattern of antibiotic susceptibility like that which was seen in earlier MRSA isolates.

DISCUSSION

It is necessary to detect the MRSA carriers among health care workers (HCWs) in hospitals, particularly those who work in the critical care areas. These individuals act as a potential source of infection to their patients, causing nosocomial infections and thereby, causing extended stays in the hospital. The best methods which can be used for controlling this, are regular screening of the HCWs and taking the appropriate preventive measures. The prevalence of MRSA varies between institutions and geographic areas. The differences in the study design, such as the sample size and the method which is employed for MRSA detection, may account for the disparity in the carriage rate. Literature search done by Albrich and Harbarth from January 1980 to March, 2006, which involved 127 investigations and screening of 33, 318 health-care participants, revealed that 4.6% of the health care personnel were either infected or colonized with MRSA [13]. They also reported 41 studies which involved 10,589 participants, which revealed a carriage rate of 23.7% of methicillin sensitive *S.aureus.* Indian studies revealed an MRSA carriage rate of 1.8% from Pondicherry [19], that of 6.6% from Delhi [20] and that of 2% from Madurai [21]. A MRSA carriage of 2% was reported from Nepal [22]. Outside India, a very high MRSA nasal carriage rate of 38.9% was reported from Nigeria [23]. According to the findings of our study, nasal carriage of *S. aureus* among healthcare workers who were involved in the management of critically ill patients was 17.5%. The *S.aureus* carriage was particularly high among doctors (32.5%) and housekeeping personnel (26.7%), followed by nursing staff (13.6%) and student nursing trainees (13.6%). However, the MRSA carriage rate among health care personnel who were involved in the critically ill patients was only 2.5%., which was significantly lower than that of 4.6% ($p < 0.01$) which was reported in a meta-analysis of 127 investigations which was done around the world, which involved screening of 33,318 healthcare workers the world over [13]. Our finding for MRSA was marginally high as compared to the earlier report (1.8%) which was obtained from Pondicherry [19], but it was significantly low as compared to the findings of studies which were carried out in other two parts of India, Assam (11.48%) and Bangalore (10%) respectively [24,25]. We have effectively functioning Hospital Infection Control Committee policies, which may be responsible for absence of MRSA carrier state among doctors, internees, student auxiliary staff, student nursing trainees and physiotherapists. However, we cannot ignore the fact that a high MRSA carriage rate was observed among female housekeeping staff (13.3%), followed by a low carriage rate among female nursing staff (2.7%). Repeated isolation of MRSA from these staff confirmed the findings. This finding cannot be ignored, as according to unpublished data from the medical records of our hospital, the occurrence of hospital acquired MRSA infection was between 22-25%. This underscores not only the need to develop more stringent hospital infection control policies, but also to create awareness among housekeeping and nursing staff by educating them, to eradicate MRSA carriage. Further, such actions would help in the prevention of MRSA transmission to their family members [26,27]. Moreover, the financial burden of handling such nosocomial and community spreads of MRSA infection would be considerable and hence, MRSA has been considered a public health issue with economic consequences [28]. Molecular typing was not conducted on the MRSA strains in our study and therefore, it was not possible to establish as to whether strains were shared in a particular hospital unit or across the units. Therefore, it may be desirable to conduct a molecular typing of MRSA in the epidemiological perspective. All five MRSA isolates were sensitive to both vancomycin and linezolid, though our hospital records documented 8% vancomycin intermediate *S. aureus* (VISA). They also showed variable susceptibility patterns to other antibiotics such as teicoplanin and gentamicin sensitivity (80%), erythromycin sensitivity (40%) and ciprofloxacin sensitivity (20%). The absence of vancomycin resistance of MRSA, which is compelled by its low toxicity and easy availability, connotes that not only can it be used in eradication of MRSA carrier state of healthcare workers, but also for treatment of cases which result from outbreaks of MRSA infection. Mupirocin is the topical antibiotic of choice for the decolonization of MRSA, as it is very effective for this use [29]. In our study, as the MRSA

carriers did not give their consents, we could not try decolonization with mupirocin. Many of the reports on vancomycin resistance, which have been made by private diagnostic laboratories, are based on disc diffusion method. Vancomycin, being a macromolecular antibiotic, doesn't properly diffuse through the agar. As a result, the reporting on VISA or VRSA, based on the results of disc diffusion alone, may not be acceptable [30]. Agar dilution or broth dilution technique is a more appropriate method for finding the MIC and hence, for determining vancomycin susceptibility. Our MRSA strains were found to be sensitive to vancomycin, both by disc diffusion and broth dilution methods. Mannitol Salt Agar was found to be very useful for the quick identification of *S. aureus*. However, the option of using oxacillin blood agar for selective isolation of MRSA is always useful. Usage of cefoxitin discs was found to be convenient over that of oxacillin discs for the determination of MRSA.

CONCLUSION

In our study, nasal carriage of *S. aureus* among healthcare workers who were involved in the management of critically ill patients was 17.5%. The *S.aureus* carriage was particularly high among doctors (32.5%) and housekeeping personnel (26.7%). However, the MRSA carriage rate among health care personnel who were involved in the critically ill patients was only 2.5%. We have an effectively functioning Hospital Infection Control Committee, the policies of which may be responsible for absence of MRSA carrier state among doctors, internees, student auxiliary staff, student nursing trainees and physiotherapists. However, we cannot ignore the fact that a high MRSA carriage rate was observed among female housekeeping staff (13.3%), followed by a low carriage rate among female nursing staff (2.7%). This underscores the fact of creating awareness among housekeeping and nursing staff by educating them, to eradicate MRSA carriage.

ACKNOWLEDGEMENT

This work was supported by Indian Council of Medical Research (ICMR) STS 2011 Project. We are grateful to Kasturba Medical College, Mangalore, 'Manipal University', for providing all the facilities for carrying out this work. We are thankful to all our departmental technical staff for their excellent technical support. We are grateful to all the participants of critical health care units of our institution for their kind cooperation.

REFERENCES

[1] Foster TJ. The *Staphylococcus aureus* "superbug". *J Clin Invest.* 2004; 114: 1693-96.
[2] Deresinski S. Methicillin-resistant *Staphylococcus aureus*: an evolutionary, epidemiologic, and therapeutic odyssey. *Clin Infect Dis*. 2005; 40: 562-73.
[3] Fluit AC, Wielders CL, Verhoef J, Schmitz FJ. Epidemiology and susceptibility of 3,051 *Staphylococcus aureus* isolates from 25 university hospitals participating in the European SENTRY study. *J Clin Microbiol.* 2001; 39: 3727-32.
[4] Herwaldt LA. Control of ethicillin-resistant *Staphylococcus aureus* in the hospital setting. *Am.J. Med.* 1999; 106: 11S-18S.
[5] Zahar JR, Clec'h C, Tafflet M, Garrouste-Orgeas M, Jamali S, Mourvillier B, et al. Is methicillin resistance associated with a worse prognosis in *Staphylococcus aureus* ventilator-associated pneumonia? *Clin. Infect. Dis.* 2005; 41: 1224-31.
[6] Mulqueen J, Cafferty F, Cormican M, Keane JD, Rossney A. Nasal carriage of ethicillin-resistant *Staphylococcus aureus* in GPs in the West of Ireland. *Brit J General Practice.* 2007; 57(543): 811-13.
[7] Akoua Koffi C, Dje K, Toure R, Guessennd N, Acho B, Faye Kette H, et al. Nasal carriage of methicillin-resistant *Staphylococcus aureus* among healthcare personnel in Abidjan (Cote d'Ivorine). *Dakar Med.* 2004; 49:70-74.
[8] Von Eiff C, Becker K, Machka K, Stammer H, Peters G. Nasal carriage as a source of *Staphylococcus aureus* bacteremia.Study Group. *New Engl J Med.* 2001; 344: 11-16.
[9] Eveillard M, Martin Y, Hidri N, Boussougant Y, Joly-Guillou ML. Carriage of methicillin-resistant *Staphylococcus aureus* among hospital employees: prevalence, duration, and transmission to households. *Infect Control Hosp Epidemiol.* 2004; 25(2): 114-20.
[10] Cesur S, Cokca F. Nasal carriage of methicillin-resistant *Staphylococcus aureus* among hospital staff and outpatients. *Infect Control Hosp Epidemiol.* 2004; 25: 169-71.
[11] Simpson AHRW, Dave J, Cookson B. The value of routine screening of staff for MRSA. *J. Bone Joint Surg.* 2007; 89: 565-66.
[12] Vonberg PR, Stamm-Balderjahn S, Hansen S, Zuschneid I, Ruden H, Behnke M, et al. How Often Do Asymptomatic Healthcare Workers Cause Methicillin-Resistant *Staphylococcus aureus* Outbreaks? A systematic evaluation. *Infect. Control Hospital Epidemiol*. 2006; 27: 1123-27.
[13] Albrich WC, Harbarth S. Healthcare workers: Source, vector or victim of MRSA. *Lancet Infect. Dis.* 2008; 8: 289-301.
[14] Cheesbrough M. District Laboratory Practise in Tropical Countries. Part 2. Cambridge University Press, Cambridge, 2009; 62-68.
[15] Bauer AW, Kirby QMM, Sherns J C, Turik M. Antibiotic susceptibility testing by standardized single disk method. *Am J. Clin. Path.* 1966; 45: 493-96.
[16] CLSI. Surveillance for Methicillin-Resistant *Staphylococcus aureus*: Principles, Practices, and Challenges; A Report. *CLSI document X07-R*. Wayne, PA: Clinical and Laboratory Standards Institute; 2010.
[17] Clinical and Laboratory Standard Institute: Methods of dilution antimicrobial susceptibility testing for bacteria that grow aerobically: approved standard M7-A7, ed 7, Wayne, PA, 2006, CLSI.
[18] Clinical and Laboratory Standards Institute / NCCLS Performance standards for antimicrobial disc susceptibility tests: approved standard M2-A9. 9th ed. Wayne PA: Clinical and Laboratory Standards Institute; 2006.
[19] Mathanraj S, Sujatha S, Sivasangeetha K, Parija SC. Screening for methicillin-resistant *Staphylococcus aureus* carriers among patients and health care workers of a tertiary care hospital in Southern India. *Indian J. Med. Microbiol.* 2009; 27: 62-64.
[20] Goyal R, Das S, Mathur M. Colonisation of methicillin resisitant Staphylococcal aureus among health care workers in a tertiary care hospital of Delhi. *Indian J of Med. Sciences* 2002; 56 (7): 321-24.
[21] Vinodhkumaradithyaa A, Uma A, Srinivasan M, Ananthalakshmi I, Nallasivam P, Thirumalaikolundusubramanian P. Nasal Carriage of Methicillin – Resistant *Staphylococcus aureus* among Surgical Unit Staff. *Jpn. J. Infect. Dis.* 2009; 62: 228-29.
[22] Shakya B, Shrestha S, Mitra T. Nasal carriage rate of methicillin resistant *Staphylococcus aureus* among at National Medical College Teaching Hospital, Birgunj, Nepal. *Nepal Med. Coll. J.* 2010; 12(1): 26-29.
[23] Fadeyi A, MAN Adeboye, A Fowotade, C Nwabuisi, BO Bolaji, BO, Oyedepo O, et al. Methicillin Resistant *Staphylococcus aureus* Carriage amongst Healthcare Workers of the Critical Care Units in a Nigerian Hospital. *Am J Infect Dis.* 2010; 6(1):18-23.
[24] Rongpharpi SR, Hazarika N K, Kalita H. The Prevalence of Nasal Carriage of *Staphylococcus aureus* Among Healthcare Workers at a Tertiary Care Hospital in Assam with Special Reference to MRSA. *J Clin Diagn Res*. 2013; 7(2): 257-60.
[25] Malini J, Shruti A Harle, Padmavathy M, Umapathy BL, Navaneeth BV, Keerthi Mannan J, Girish MS. Methicillin resistant *Staphylococcus aureus* Carriage among the Health Care Workers in a Tertiary Care Hospital. *J.Clin Diagn Res*. 2012; 6(5): 791-93.
[26] Halablab MA, Hijazi SM, Fawzi MA, Ara GF. *Staphylococcus aureus* nasal carriage rate and associated risk factors in individuals in the community. *Epidemiol. Infect* 2010; 138: 702-06.
[27] Ciftci IH., Koken R, Bukulmez A, Ozdemir M, Safak B, Cetinkaya Z. Nasal carriage of *Staphylococcus aureus* in 4-6 age groups in healthy children in Afyonkarahisar, Turkey. *Acta Paediat.* 2007; 96: 1043-46.
[28] Mireille G, Pierre-Alexandre L, Donald H, Colin V. Methicillin-resistant *Staphylococcus aureus*: A public health issue with economic consequences. *Can. J. Infect. Dis. Med. Microbiol.* 2007; 18: 27-34.
[29] Edward A, Bell Pharm D, BCPS. Mupirocin: an effective choice for the reduction of nasal carriage and transmission during outbreaks. *Infectious disease in children. Pediatric Annals*. 2007.
[30] Janet Fick Hindler, James H. Jorgensen. Antimicrobial susceptibility testing: in Text book of diagnostic Microbiology Connie R. Mahon, Donald C. Lehman and George Manuselis (eds) Third edition, *Elsevier Publications*, 2007; 319-54.

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Microbiology, KMC, Mangalore, India.
2. Final Year MBBS Student, Department of Microbiology, KMC Mangalore, India.
3. Professor, Department of Microbiology, KVG Medical College, Sullia, India.
4. Associate Professor, Department of Microbiology, KMC, Mangalore, India.
5. Assistant Professor, Department of Community Medicine, KMC, Mangalore, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Radhakrishna M,
Associate Professor, Department of Microbiology, Kasturba Medical College, Mangalore -575001, India.
Phone: +919448163835, E-mail: radhakrishna.bhat@manipal.edu

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Oct 29, 2012**
Date of Peer Review: **Jan 20, 2013**
Date of Acceptance: **Oct 18, 2013**
Date of Publishing: **Dec 15, 2013**