Research article Available online www.ijsrr.org ISSN: 2279–0543

International Journal of Scientific Research and Reviews

Prevalence of Methicillin Resistant *Staphylococcus aureus* (MRSA) at a Tertiary Care Centre – a Retrospective and Prospective study

N. Shanmuga Vadivoo[1]*, M. Niranjana[2], Rewa D Sharda[3], K. Sujatha[4], M. Bavani[5]

[1]Department of Microbiology, Annapoorana medical college & Hospital, Salem, A. P., India
[2,3,4,5]Dept. of Microbiology, Sri S.S. Institute of Higher Med. Sci., Puttaparthy, Ananthpur, A. P., India

ABSTRACT:

Multi drug Resistant Organisms (MDR) have become a global problem and infections with these organisms make the patient management very difficult. The prevalence of MRSA worldwide is alarmingly increasing. Literature evidence indicates that the prevalence can range from 3-66%. Our institute carried out a retrospective analysis for three year period and a prospective study for two year to assess the prevalence of MRSA in this population and to study the antibiotic susceptibility pattern of these isolates. Cefoxitin disc screening test for detecting methiciliin resistance and antimicrobial susceptibility testing on all *S.aureus* isolates was by disc diffusion as per CLSI guidelines. *Staphylococcus aureus* isolates from 2008-2010(retrospective) and for the period 2011& 2012(prospective) were analyzed for methicillin resistance and their antibiotic susceptibilities.A total of 481 *S.aureus* were isolated during the five year period from all the specimens submitted. Of these 118 (24.5%) were MRSA, most of which were isolated from wound specimens from non hospitalized patients. Of the *S.aureus* isolates from out-patients, 87% were Clindamycin susceptible.The susceptibility pattern indicated 100% resistance to β-lactam antibiotics. All of them except one isolate were susceptible to Vancomycin.Eighty seven percent of non hospitalized MRSA isolates were presumptively identified as CA-MRSA based on Clindamycin susceptibility- a surrogate marker of CA-MRSA. As a result, admission screening for MRSA colonization has been implemented in 2011 in addition to routine infection control measures. It is necessary to monitor and have a proper reporting system for all the MDR including MRSA to prevent transmission of these agents in health care facilities and in the community.

KEY WORDS: MRSA, Retrospective and Prospective study

*Corresponding Author

Dr. N. Shanmuga Vadivoo M.D
Associate Professor, Department of Microbiology, Annapoorana medical college & Hospital
Periyaseeragapaadi, SALEM-636 308, INDIA
Mob. No: 7598890927
E-Mail: *shanmugavadivoon@gmail.com*

INTRODUCTION:

Antibiotic Resistant Organisms (AROs) have become a global problem and Infections with these organisms make the patient management very difficult because these Organisms are also usually multi-drug-resistant (MDR). MRSA leads the group of AROs and the Prevalence worldwide is alarmingly increasing and has gone out-of-hand in some countries. This also drains the resources of the healthcare institutions by way of prolonged hospital stay for the patient and treatment with more expensive drugs. Literature evidence indicates that the prevalence can range from 3-66% [1], and many such studies are reported from India [1, 2, 3, 4, 5].With the increased incidence of MRSA, the effectiveness of penicillin and cephalosporin is questioned. In fact many strains of MRSA exhibit resistance to both beta -lactams and amino glycosides[6]. Hence, knowledge of prevalence of MRSA and their antimicrobial profile becomes necessary at a hospital setting for the purpose of selection of appropriate empirical treatment of these infections. Our institute is a tertiary care centre in a rural setting and we carried out retrospective and prospective analysis to assess the prevalence rate of MRSA in this population. Analysis of antibiotic susceptibility pattern of these MRSA isolates was also carried out.

MATERIALS AND METHODS:

This study includes an analysis using electronic hospital information system (eHIS) a database for clinicians & Labs, to determine the Prevalence rates of MRSA infections for a retrospective three year period from 2008 to 2010 and a prospective analysis of the same, for two year period from Jan 2011 to Dec 2012. Staphylococcus aureus isolates from all the clinical specimens received in the Microbiology laboratory over these five years were included for the study. Routine cultures were set up on the clinical samples as per the laboratory protocol. The isolates were identified as *S. aureus* according to standard methods. When S.aureus was isolated, a cefoxitin disc (30 micro gm-Himedia) susceptibility test was set up to screen for Methiciliin resistance as per the CLSI guidelines test procedure. A zone of inhibition less than 21 mm. or any discernible growth within zone of inhibition was indicative of methicillin resistance. The antibiotic susceptibility pattern of all the MRSA strains were determined by modified Kirby Bauer disc diffusion method(as per CLSI Guidelines) against the following antibiotics: penicillin (10 units),Ampicillin (10 mcg)Erythromycin (15mcg), tetracycline (30mcg), cotrimoxazole (25mcg), ciprofloxacin (5mcg) , Linezolid(30 mcg) , Clindamycin (2 mcg) , Rifampicin (5 mcg)and vancomycin (30mg). S. aureus ATCC 25923 was used as a standard control strain.

RESULTS:

Total number of Staphylococcus aureus isolated, including MRSA & MSSA during the five year period from all the specimens submitted is shown in Table: 1. MRSA Prevalence rate was 24.5 %(118 MRSA isolates out off 481 Staphylococcus aureus)

Table: 1- Total number of Staphylococcus aureus (MRSA & MSSA) from 2008 to 2012

	MSSA	MRSA	Staphylococcus aureus (MSSA+MRSA)
2008	39	27	66
2009	96	12	108
2010	62	33	95
2011	66	22	88
2012	100	24	124
Total	363	118(25.4%)	481

MRSA and MSSA isolates from **different clinical specimens** from 2008 -2012, highlighting change in MRSA prevalence rates from 2008- 2012 is shown in Table: 2

Table: 2 - MRSA and MSSA isolates from different clinical specimens during 2008 to 2012

	2008		2009		2010		2011		2012	
	MSSA	MRSA	MSSA	MRSA	MSSA	MRSA	MSSA	MRSA	MSSA	MRSA
Wound swabs	31	**19**	84	**10**	59	**33**	48	**16**	71	**15**
URINE	6	**6**	9	**2**	-	**-**	10	**2**	21	**5**
ET secretions	2	**2**	3	**-**	1	**-**	-	**4**	4	**2**
Blood	-	-	2	-	2	-	-	-	4	**2**
Others	-	-	-	-	-	-	8	-		
Total	39	**27**	96	**12**	62	**33**	66	**22**	100	**24**
Total No of Staph aureus isolates	66		108		95		88		124	
MRSA %	40.9%		11.1%		34.7%		25.0%		19%	

Table three shows MRSA isolates **from different source** (both OP & IP setting). Total number of MRSA from OP setting was 74 isolates (63%), total number of MRSA from IP setting 44 isolates (37.2 %).Among the 118 MRSA isolates, 93 isolates were from wound swabs (79%), 15 from urine (13%) and 10 isolates(9%) from miscellaneous samples (Endo tracheal secretions & blood)

Table: 3 –Percentage of MRSA isolates from different sources.

	Wound swabs		Urine		Miscellaneous		TOTAL
	IP	OP	IP	OP	IP	OP	
2008	6	13	-	6	2	-	27
2009	5	5	-	2	-	-	12
2010	12	21	-	--	-	-	33
2011	4	12	1	1	4	-	22
2012	6	9	2	3	2	2	24
	33	**60**	**3**	**12**	**8**	**2**	**118**
Total	**93(79%)**		**15(13%)**		**10(9%)**		

Details of **93 MRSA isolates of wound specimens** from different clinical departments in OP & IP setting during the five year period is shown in Table: 4 {61 isolates (66%) of MRSA were from out patients and 32 isolates (34.4 %) of MRSA were from Inpatients}

Maximum MRSA positive wound specimens were from Ortho department (57%) followed by CTVS (20.4%) and then Plastic surgery (14 %) and Urology (10 %)

Table-4: Details of 93 MRSA isolates of wound specimens from different clinical departments in OP & IP setting during the five year period

	Orthopaedics		Cardiology		Urology		Plastic surgery	
	Wards /ICU's	OP	Wards /ICU's	OP	Wards /ICU's	OP	Wards /ICU's	OP
2008	5	8		1	1	3	-	2
2009	3	3	-	1	-	1	2	-
2010	-	14	7	4	1	-	4	3
2011	3	6	1	4	-	1	-	1
2012	4	7	1	-	1	1	-	1
	15	38*	9	10*	3	6*	6	7*
Total	53(57%)		19(20.4%)		9(10%)		13(14%)	

Clindamycin sensitivity (Surrogate Marker of CA-MRSA) rates of MRSA isolates for the study period is discussed in Table-5

Table-5: Clindamycin Sensitivity % of all MRSA Isolates

	Clindamycin sensitivity % of All MRSA isolates(118)	Clindamycin sensitivity % of MRSA from Wound specimens(93)
2008	92.5%	93.8%
2009	75%	70%
2010	82.3%	81%
2011	77.2%	75%
2012	50%	50%
TOTAL	77%	87%

Table: 6- Percentage Sensitivity pattern of MRSA against various antimicrobials for the study period

	Sensitivity Percentage (%)				
	2008	2009	2010	2011	2012
Ciprofloxacin	11.1	0	13.9	0	12
Ampicillin	3.7	0	0	9	0
Augmentin	14.8	16.7	0	10	0
Tetracycline	69.2	76	71.4	**68.2**	**50**
Co-Trimxazle	23	16.6	19.4	**9**	**17**
Imipenem	88	75	97.2	100	NT
Erythromycin	42.8	20	48.5	38.1	41
Penicillin	0	0	0	0	0
Vancomycin	100	100	100	100	96
Linezolid	100	83.3	100	100	100
Rifampicin	96.3	100	100	100	82
Clindamycin	92.5	75	82.3	77.2	50
Oxacillin	0	0	0	4.5	0

DISCUSSION:

Prevalence rate of MRSA ranges from 3% to 60% all over the world. Prevalence rates in our hospital was 24.5 %(Table-1).This is almost similar to other studies from our country where in 23.6 and 31.1 % were reported[7, 8]. Higher prevalence rate was also reported from our country ranging from 40% to 60% [2, 5, 9, 10] .This variation in prevalence rates may be due to several factors like infection control practice, health care facilities and antibiotic usage that varies from hospital to hospital. In our study we found MRSA caused one fourth of all Staphylococcus aureus infection.

During the retrospective study period, we observed a fluctuation in overall prevalence rates of MRSA (i.e.) MRSA rates has decreased in 2009 from 40.9 % to 11.1 % and again increased in 2010 to 34.7 %.(Table-2) .In the prospective study period the prevalence rate declined to 25% in 2011 and 19% in 2012.Frequency of MRSA isolated were higher from wound specimens (79%) and from non hospitalized patients (63%) as shown in Table -3 .This is in accordance with other studies where most of the isolates were from wound specimens [2, 8]. Most of the MRSA isolates were from wound specimens sent from Orthopedics outpatient clinic (Table-4).This is similar to other studies where in most of the MRSA isolates were also from orthopedic department [5, 11]

The MRSA isolates from orthopaedic clinics were mostly from patients who were admitted for wound debridement of surgical site infections from outside our hospital with incomplete treatment and who had sustained deep penetrating traumatic wounds for which again incomplete treatment was given. Similarly MRSA isolates from Plastic surgery clinics were from patients with chronic debilitating ulcers, who had undergone treatment outside but with failure. Hence the isolates of MRSA from these two clinics were from non hospitalised patients which is in accordance with other studies[5, 11, 18, 19]

In the Inpatient setting the prevalence rate was 37.3% and total number of MRSA isolated was high during 2010(Table-3). During the 2010 period, all isolates were from wound specimens and predominantly from orthopedics outpatient clinic followed by CTVS inpatient and outpatient clinic. There was a Cluster of Surgical site infection from CTVS unit which added to the increase in prevalence rate during 2010.Surveillance was done to identify the source of the MRSA cluster in CTVS which included environmental surveillance of CTVS OT, ICU Complex, CTVS wards & Nasal carriage of CTVS Staff. The nasal carriage surveillance was done for 65 CTVS staff including surgeons, anesthetist, nursing staff, paramedics and sweepers. Two of the staff (a sweeper and a perfusionist) was found to be positive as MRSA Nasal carriers. Both of them underwent decolonization therapy with Mupirocin ointment for the recommended duration. Hence the source of this cluster of surgical site infection from CTVS department could have been from the nasal carriage of these two staff, or it could have been endogenously from the patients themselves. Nasal MRSA carriers among the health-care workers can be MRSA sources (transfer and spreading) but they are not considered as important a reservoir as the colonized or infectious patients. Though the nasal carriage in the health-care workers can be temporary, there is a risk of MRSA transfer to a patient, especially in hospitals where endemic strains of MRSA occur [12, 13, 14, 15] .These multidrug resistant organisms pose important treatment challenges, and hence preventing their transmission in healthcare facilities is an important patient safety

measure. Therefore whenever there is a suspicion of outbreak, screening for MRSA carriage state for health care workers has to be done.Hence following the three year period of retrospective study (2008-2010), active surveillance of surgical site infection and admission screening for MRSA colonization for patients posted for CTVS surgery was implemented from Jan-2011. This active surveillance helped to bring down the MRSA prevalence rates from 34% in 2010 to 19 % in 2012(Table - 2).

Predominantly the isolates of MRSA at our tertiary centre were from outpatient/community setting which is in accordance with many studies [18, 19]. This PRESUMPTION was based on Clindamycin sensitivity percentage of the isolated MRSA strains which is one of the Surrogate marker of CA-MRSA strains[20,21].The disadvantage of the study was that confirmation of CA-MRSA strains was not done either by molecular method nor by Toxin assay as our tertiary care hospital is a charitable institute .The overall clindamycin sensitivity rate of all the MRSA isolates and clindamycin sensitivity rates for wound isolates for the five year period were analysed as shown in Table -5.The overall clindamycin sensitivity of all isolates declined from 92.5% in 2008 to 50% in 2012.And the Clindamycin sensitivity for wound isolates with specific reference to skin & soft tissue infection also declined from 93.75% in 2008 to 50% in 2012.Hence based on the presumption ,strict infection control measures were implemented at OP setting to prevent the transmission of these MDR organisms from community to Hospital and also at wards and ICU's to control nosocomial rates. These measures along with MRSA nasal colonisation screening has helped to bring down the prevalence rate of MRSA during the prospective study period to 25% in 2011 and further down to 19% in 2012. Also the gradual decrease in clindamycin sensitivity to 70% in 2011 and 50% in 2012 indicates that the spread of MRSA from community setting has declined.

Table -6 shows the pattern of Sensitivity shown by MRSA strains. When we look into overall sensitivity pattern both in wards and OPD together, sensitivity to penicillin was Zero percent throughout our study period from 2008 to 2012.This is in accordance with a study by Bandaru et al [16]. Sensitivity to Ampicillin was lowest next to penicillin, followed by Ciprofloxacin, Cotrimoxazole and Erythromycin. Analysis of the changing pattern of Antibiotics for MRSA isolates for the five year period indicated that, the sensitivity percentage for all the above mentioned antibiotics was declining from 2008 to 2012.Ampicillin, Ciprofloxacin & Cotrimoxazole had less than 25 % sensitivity. Erythromycin and Tetracycline percentage was varying during this period. The sensitivity percentage of Clindamycin slowly declined from 92.5 % in 2008 to 50% in 2012 and Rifampicin to 82%.Linezolid had 100 % sensitivity.

In our study 60.5% isolates were found to be multidrug resistant, to more than three antimicrobials which is in accordance with two other studies[2, 7]. Other studies which show less than 50% MDR resistant strains are Majumdar et al (23.2%) [8] &Bandaru et al [16] (32.09%).All the MRSA strains were sensitive to Vancomycin except one in the present study which is in accordance with other studies. [1, 3, 4, 5]

CONCLUSION:

At our tertiary care centre the overall prevalence rate of MRSA during the five year period was 24.5% and most of them were from wound specimens (79%). The majority of these wound specimens were from outpatient clinic (66%) and Clindamycin susceptibility of the MRSA isolates was 89%.A presumptive conclusion that CA-MRSA strains was seen more when compared to health-care associated strains at our Hospital setting, was based on Clindamycin sensitivity which is one of the surrogate marker for CA-MRSA.There may be many reasons for increased prevalence rates from community when compared to inpatients: wrong and unsupervised prescriptions of antibiotics, easy access for substandard drugs, and rampant abuse of antibiotics. Other reason for increased prevalence of MRSA in community might be due to acquisition of Hospital strains in the community from infected patients, visitors of infected patients and from health care professionals colonized by the Multi drug resistant pathogens. During our retrospective study period there was an increase in prevalence rate of MRSA (34.7 % in 2010) and clindamycin sensitivity rate was 87% indicating prevalence of Community acquired MRSA.As a result, admission screening for MRSA colonization was implemented in 2011 in addition to routine infection control measures which helped in bringing down the prevalence rate of MRSA to 19 % in 2012. At our tertiary care centre Clindamycin and Macrolides are recommended as empirical drug of choice for less severe skin & Soft tissue infections at outpatient setting and Linezolid & Vacomycin for severe soft tissue infections at Inpatient setting as per our hospital antibiogram. It is mandatory to have a Hospital acquired infection surveillance and periodic monitoring of Hospital Antibiogram and have a proper reporting system for all the Antibiotic Resistant Organisms to prevent transmission of these agents in health care facilities and in the community.

ACKNOWLEDGEMENT:

Our heartfelt thanks to Late Dr. Mrs. Prema Bhat, the pioneer of department of Microbiology at our Institute, and because of whom this study was possible.

REFERENCE:

1. Amruthkishan K. Upadhya and Sunil kumar Biradar. Methicillin resistant *Staphylococcus aureus* in a tertiary care hospital in north-east Karnataka: evaluation of the antibiogram Current Research in Medicine and Medical Sciences. 2011; 1 (1): 1-4.
2. S Anupurba, MR Sen, G Nath, BM Sharma, AK Gulati and TM Mohapatra. Prevalence of methicillin resistant staphylococcus aureus in a tertiary referral hospital in eastern Uttar Pradesh. Indian J Med Microbiol.2003; 21(1):49-51.
3. Hare Krishna Tiwari, Darshan Sapkota and Malaya Ranjan Sen. High prevalence of multidrug-resistant MRSA in a tertiary care hospital of northern India. Infection and Drug Resistance. 2008; 1:57–61.
4. Dechen C Tsering, Ranabir Pal and Sumit Kar. Methicillin-resistant *Staphylococcus Aureus*: Prevalence and current susceptibility pattern in Sikkim. Journal of Global infectious diseases. 2011; 3(1): 9-13
5. Shilpa Arora, Pushpa Devi, Usha Arora, and Bimla Devi. Prevalence of Methicillin-resistant *Staphylococcus Aureus* (MRSA) in a Tertiary Care Hospital in Northern India. J Lab Physicians. Jul-Dec. 2010; 2(2): 78–81.
6. Thornsberry C. The development of antimicrobial resistance in staphylococci. J Antimicrob Chemotherap 1998; 21 (Suppl. C):9-16.
7. Rajaduraipandi K, Mani KR, Panneerselvam K, Mani M, Bhaskar M and Manikandan M. Prevalence and antimicrobial susceptibility pattern of methicillin resistant *Staphylococcus aureus*: A multicentre study. Indian J Med Microbiol. 2006; 24: 34–8.
8. Majumder D, Bordoloi JS, Phukan AC and Mahanta J. Antimicrobial susceptibility pattern among methicillin resistant *staphylococcus* isolates in Assam. Indian J Med Microbiol.2001; 19:138–40.
9. Muralidharan S. Special article on methicillin resistant *Staphylococcus aureus*. J Acad Clin Microbiol. 2009; 11:15–6.
10. Tiwari HK and Sen MR .Emergence of vancomycin resistant *Staphylococcus aureus* (VRSA) from a tertiary care hospital from northern part of India. BMC Infect Dis. 2006; 6:156.
11. Srinivasan S, Sheela D, Shashikala, Mathew R, Bazroy J and Kanungo R. Risk factors and associated problems in the management of infections with methicillin resistant *Staphylococcus aureus*. Indian J Med Microbiol. 2006; 24:182–5.

12. Kluytmans J, van Belkum A and Verbrugh H. Nasal Carriage of *Staphylococcus aureus*: Epidemiology, Underlying Mechanism and Assosciated Risk. Clin Microbiol Rev 1997; 10(3):505-20.
13. Johnson PDR, Martin R, Burrell LJ, Grabsch EA, Kirsa SW and O'Keeff e J et al. Effi cacy of an alcohol/chlorhexidine hand hygiene program in a hospital with high rates of nosocomial methicillin resistant *Staphylococcus aureus* (MRSA) infection. MJA 2005; 183(10): 509-14.
14. Muto CA, Jernigan JA, Ostrowsky BE, Richet HM, Jarwis WR and Boyce JM et al. SHEA Guideline for Preventing Nosocomial Transmission of Multidrug-Resistant Strains *Staphylococcus aureus* and *Enterococcus*. Infect Control Hosp Epidemiol 2003; 24:362- 86.
15. Ivanka Matouskova and Vladimir Janout. Current knowledge of methicillin-resistant *staphylococcus aureus* and community-associated methicillin-resistant *staphylococcus aureus.* Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2008, 152(2):191–202.
16. DR. Bandaru Narasinga Rao and R.T. Prabhakar. Prevalence and Antimicrobial Susceptibility pattern of Methicillin Resistant Staphylococcus aureus (MRSA) in and around Visakhapatnam, Andhra Pradesh, India. JPBMS, 2011, 4 (03).
17. Mehta et al. A pilot programme of MRSA surveillance in India. (MRSA Surveillance Study Group).JPGM, 1996: 42; 1: 1-3.
18. Helen W. Boucher and G. Ralph Corey. Epidemiology of Methicillin-Resistant Staphylococcus aureus.Clinical Infectious Diseases. 2008; 46:S:344–9
19. Joel W Beam and Bernadette Buckley. Community-Acquired Methicillin-Resistant *Staphylococcus aureus*: Prevalence and Risk Factors. J Athl Train. 2006; 41(3): 337–340.
20. BVS Krishna, Asha B Patil and MR Chandrasekhar. Community-acquired methicillin-resistant Staphylococcus aureus infections in a south Indian city. Southeast Asian j trop med public health. (June) 2004; 35(2):371-374.
21. Nila Suntharam, Donna Hacek, and Lance R. Peterson. Low Prevalence of Community-Acquired Methicillin-ResistantStaphylococcus aureus in Adults at a University Hospital in the Central United States. J Clin Microbial. April 2001; 39(4): 1669–1671.