Original Research Article

https://doi.org/10.20546/ijcmas.2018.701.097

Occurrence of Antimicrobial Sensitivity Pattern for Methicillin Resistant *Staphylococcus aureus* and Methicillin Resistant Coagulase Negative *Staphylococcus* Isolated from Various Clinical Samples in a Tertiary Care Hospital, Jaipur, India

Jogender*, Jitendra, Sheetal Sharma and Suman Rishi

Department of Microbiology, NIMS Medical College and Hospital, Jaipur, Rajasthan-303121, India

*Corresponding author

**A B S T R A C T**

Methicillin resistant *Staphylococcus* (MRS) is problematic, as the therapeutic outcome of MRS infection is much worse than those caused by methicillin sensitive strain. This study was conducted to determine the occurrence and antimicrobial sensitivity pattern of MRSA and MRCoNS isolated from different clinical samples. MRSA and MRCoNS were identified among 215 *Staphylococcus* isolates, isolated from various clinical samples. All isolates were identified as per CLSI guideline and AST pattern was determined by Kirby Bauer disc diffusion method. A total of 215 *Staphylococcus* isolates were processed of which 122(56.74%) were coagulase positive *Staphylococcus aureus* and 93 (43.26%) isolates were Coagulase negative *Staphylococcus*. Among 122 coagulase positive *Staphylococcus aureus* 64(52.46%) were MRSA, whereas among 93 CoNS, 36 (38.7%) were MRCoNS. Among the MRSA and MRCoNS isolates maximum resistance was seen with Penicillin-G which was 90.62% and 88.88% and both MRSA and MRCoNS was least with Vancomycin and Linezolid (100%). The regular surveillance of MRSA and MRCoNS will be useful for select an appropriate antibiotic and for limiting use of powerful antibiotic like Vancomycin as initial treatment and life threatening staphylococcal infection.

**Keywords**

MRSA, MRCoNS, CLSI, AST, Surveillance, *Staphylococcus*

**Article Info**

Accepted: 06 December 2017
Available Online: 10 January 2018

**Introduction**

*Staphylococci* are Gram-positive cocci, arranged in grape-like clusters. They are non-motile, non- sporing, occasionally capsulated and are facultative anaerobes that grow better under aerobic than anaerobic conditions. *Staphylococci* are classified as coagulase positive *Staphylococcus aureus* and coagulase negative *Staphylococci* (CoNS) (Collee *et al.*, 1996). *Staphylococcus aureus* has been renowned as an important cause of human disease for more than 100 years (Lowy *et al.*, 1998) *Staphylococcus aureus* is recognized as a cause of a wide range of infections, ranging from minor skin infections and chronic bone infections to devastating septicemia and endocarditis (Chambers *et al.*, 2005) Significant events in the evolution of *S. aureus* have included the development of methicillin
resistance, now a problem for many hospitals around the world. The recent emergence of community strains of *S. aureus* that are not only methicillin resistant but also harbor genes associate with increased virulence has become a therapeutic challenge (Chambers *et al.*, 2001; Vandenesch *et al.*, 2003). Both endemic and epidemic MRSA infections occur globally as infected and colonized patients in hospitals mediate the dissemination of these isolates and hospital staff assists further transmission (McDonald *et al.*, 1997).

Most of the *S. aureus* infections caused by Methicillin sensitive *S. aureus* (MSSA) that are usually susceptible to major class of anti-Staphylococcal antibiotics. But resistance to multiple antibiotics among the *Staphylococci* isolates in hospitals has been recognized as one of the major challenges in hospital infection control (Majumder *et al.*, 2001).

Coagulase – negative *Staphylococci* (CoNS) is a group of opportunistic pathogen causing wide spectrum of disease in humans. Its association with increased number of hospital acquired infections has been documented (Koksal *et al.*, 2009; Sohn *et al.*, 2001).

Until recently, Methicillin Resistant *Staphylococci* (both MRSA and MRCoNS) were predominantly nosocomial pathogens causing hospital acquired infections (Majumder *et al.*, 2001) but Methicillin resistant Staphylococcal (MRS) strains are now being increasingly isolated from community acquired as well (Basak *et al.*, 2010, Naimi *et al.*, 2003). MRSA and MRCoNS carry multiple antimicrobial resistance determinants conferring resistance to beta lactams (penicillin, cephalosporing and carbapenems) and non-beta - lactam antibiotics (macrolides, amino glycosides, fluoroquinolones and lincosamides). Multiple drug resistance make them difficult to treat and limiting treatment options to glycopeptides antibiotics like vancomycin and teicoplanin (Mehdinejad *et al.*, 2008; Shorman *et al.*, 2008). MRS infections represent a burden for both patients and healthcare system because of their associated high morbidity, mortality and increased hospitalization cost. Hence this study is designed to trace the resistance trends of *Staphylococci* with special reference to methicillin resistance in a tertiary care hospital, Jaipur, Rajasthan.

**Materials and Methods**

**Study design**

The study was conducted in Department of Microbiology, NIMS Medical College and Hospital, Jaipur from December 2016 to May 2017.

The study included those patients from whom *Staphylococci* have been isolated among different clinical samples submitted to Microbiology Laboratory for culture and sensitivity and excluded the specimens were *Staphylococci* isolates have been considered contamination due to Laboratory or skin flora.

**Isolation and identification of clinical specimens**

A total of 215 Coagulase positive and Coagulase negative *Staphylococci* isolates were obtained from various clinical specimens including pus, blood, urine, high vaginal swab (HVS), sputum, ET Secretions, stool, and catheter tip. These isolates were subjected to methicillin resistance screening using cefoxitin disc diffusion method.

The clinical specimens were inoculated on 5% sheep blood agar, MacConkey agar and incubated at 37°C aerobically for 24h. *S. aureus* was identified based on Gram's stain morphology, colony characteristics, and positive catalase and coagulase tests.
All the clinical specimens were collected from the patients, submitted to the microbiology laboratory for the sample processing according to standard protocols and the antimicrobial sensitivity was determined according to Clinical Laboratory Standard Institute (CLSI) guidelines.

Bactec culture bottles were used for the collection of blood and body fluids that are loaded in Bactec system according to the manufacturer instructions. On the detection of growth in the Bactec system, further sample processing was done.

**Antimicrobial susceptibility testing**

The antibiotic susceptibility pattern of all the confirmed *S. aureus* and CoNS were determined by modified Kirby-Bauer disc diffusion method against the following antibiotics as per CLSI guidelines 2017: Penicillin (10 μg), erythromycin (15 μg), clindamycin (2 μg), gentamycin (10 μg), vancomycin (30 μg), linezolid (15 μg), nitrofurantoin, norfloxacin and cefoxitin as per CLSI guideline.

Muller-Hinton agar used to perform all antimicrobial susceptibility tests, and the interpretation criteria were taken according to CLSI guideline.

**Detection of MRSA and MR CoNS**

**Cefoxitin (30 μg) disc diffusion test (Himedia Mumbai)**

The isolated samples were subjected to cefoxitin disc diffusion test by using 30 μg discs. A suspension, equivalent to 0.5 McFarland standard was prepared from each strain. Then, a swab was taken and dipped into the suspension and lawn culture was done on MHA plate after that plate was incubated at 37°C for 18-24 h and zone of inhibition was measured. An inhibition zone diameter of ≤21 mm was considered as cefoxitin resistant reported as methicillin-resistant and ≥22 mm was reported as cefoxitin sensitive indicating methicillin-sensitive.

**Statistical analysis**

The data were recorded and analyzed using Microsoft Excel (2007 Version). Results are presented in frequency (number) and percentage (%).

**Results and Discussion**

In our study, 215 *Staphylococcus* isolates were collected from various clinical samples among the IPDs, OPDs and ICUs patients in NIMS medical college and hospital, Jaipur, Rajasthan India.

The highest percentage of *Staphylococcus* isolates was obtained from Urine samples (51.2%), followed by pus (16.7%), Sputum (7.91%), ET Secretion (7.91%) etc (Table 1).

Out of 215 isolates 64 was MRSA followed by 58 isolates of MSSA, 36 isolates of MRCoNS and 57 isolates of MSCoNS. Among the 64 MRSA highest percentage was obtained from Urine 38(67.86%) followed by Pus 16(53.33%), ET Secretions 6(54.55%) and sputum 2(18.18%). Among the 36 MRCoNS highest percentage was obtained from Urine 35(35.19%) followed by Blood 5(45.45%), ET Secretion 4(66.67%) and Pus 3(50%).

Out of 215 isolates 64 was MRSA followed by 58 isolates of MSSA, 36 isolates of MRCoNS and 57 isolates of MSCoNS. Among the 64 MRSA highest percentage was obtained from Urine 38(67.86%) followed by Pus 16(53.33%), ET Secretions 6(54.55%) and sputum 2(18.18%). Among the 36 MRCoNS highest percentage was obtained from Urine 35(35.19%) followed by Blood 5(45.45%), ET Secretion 4(66.67%) and Pus 3(50%).

Among isolates, maximum MRSA was found from 40-49 age group, MSSA from 30-39 age group, MRCoNS and MSCoNS were obtained from 20-29 age group (Table 4 and 5). From
total isolates male ratio is higher than female in MRSA (1:0.82) and MSSA (1:0.93) but the female ratio is higher than male in MRCoNS (0.8:1) and MSCoNS (0.78:1) (Table 6). Among the total isolates, MRSA and MRCoNS were highly resistant than MSSA and MSCoNS. Among the MRSA maximum resistant was seen with Penicillin-G (90.62%), followed by Erythromycin (87.5%), Clindamycin (82.81%), Norfloxacin (81.57%), Gentamycin (54.68%) and Nitrofurtoin (7.89%). Among the MRCoNS maximum resistant was seen with Penicillin-G (88.88%), followed by Norfloxacin (84.21%), Erythromycin (80.55%), Clindamycin (75%), Gentamycin (38.88%), and Nitrofurantoin (5.26%). Lenezolid and Vancomycin were 100% sensitive with among the isolates (Tables 7–9).

Table 1: Distribution of *Staphylococcus* isolates from various clinical samples

| Clinical Specimens | No. of isolates | Percentage |
|--------------------|-----------------|------------|
| Urine              | 110             | 51.2       |
| Pus                | 36              | 16.7       |
| Sputum             | 17              | 7.91       |
| ET secretions      | 17              | 7.91       |
| Blood              | 17              | 7.91       |
| HVS                | 8               | 3.72       |
| Ear Swab           | 6               | 2.79       |
| Catheter tip       | 2               | 0.93       |
| Stool              | 1               | 0.47       |
| CSF                | 1               | 0.47       |
| Total              | 215             | 100        |

Table 2: Isolation of Coagulase positive and Coagulase Negative *Staphylococcus* isolates from various clinical samples

| Clinical Specimens | No. of *S. aureus* | % | No. of CoNS | % |
|--------------------|--------------------|---|-------------|---|
| Urine              | 56                 | 45.9 | 54          | 58.1 |
| Pus                | 30                 | 24.6 | 6           | 6.45 |
| Sputum             | 11                 | 9.02 | 6           | 6.45 |
| ET secretions      | 11                 | 9.02 | 6           | 6.45 |
| Blood              | 6                  | 4.92 | 11          | 11.8 |
| HVS                | 3                  | 2.46 | 5           | 5.38 |
| Ear Swab           | 3                  | 2.46 | 3           | 3.23 |
| Catheter tip       | 1                  | 0.82 | 1           | 1.08 |
| Stool              | 0                  | 0    | 1           | 1.08 |
| CSF                | 1                  | 0.82 | 0           | 0    |
| Total              | 122                | 100  | 93          | 100  |
### Table 3: Isolation of Methicillin resistance and Methicillin sensitive *Staphylococcus aureus* isolates from various clinical samples

| Clinical Specimens | No. of S. aureus | No. of MRSA | %   | No. of MSSA | %   |
|--------------------|------------------|-------------|------|-------------|------|
| Urine              | 56               | 38          | 67.86 | 18          | 32.14 |
| Pus                | 30               | 16          | 53.33 | 14          | 46.67 |
| Sputum             | 11               | 02          | 18.18 | 09          | 81.82 |
| ET secretions      | 11               | 06          | 54.55 | 05          | 45.45 |
| Blood              | 6                | 01          | 16.67 | 05          | 83.33 |
| HVS                | 3                | 01          | 33.33 | 02          | 66.67 |
| Ear Swab           | 3                | 00          | 00   | 03          | 100   |
| Catheter tip       | 1                | 00          | 00   | 01          | 100   |
| Stool              | 0                | 00          | 00   | 00          | 00    |
| CSF                | 1                | 00          | 00   | 01          | 100   |
| Total              | 122              | 64          | 52.46 | 58          | 47.54 |

### Table 4: Isolation of Methicillin resistance and Methicillin sensitive *Coagulase negative Staphylococcus* isolates from various clinical samples

| Clinical Specimens | No. of CoNS | No. of MRCoNS | %   | No. of MSCoNS | %   |
|--------------------|-------------|---------------|------|---------------|------|
| Urine              | 54          | 19            | 35.19 | 35            | 64.81 |
| Pus                | 6           | 03            | 50   | 03            | 50   |
| Sputum             | 6           | 01            | 16.67 | 05            | 83.33 |
| ET secretions      | 6           | 04            | 66.67 | 02            | 33.33 |
| Blood              | 11          | 05            | 45.45 | 06            | 54.55 |
| HVS                | 5           | 02            | 40   | 03            | 60   |
| Ear Swab           | 3           | 01            | 33.33 | 02            | 66.67 |
| Catheter tip       | 1           | 00            | 00   | 01            | 100   |
| Stool              | 1           | 01            | 100  | 00            | 00   |
| CSF                | 0           | 00            | 00   | 00            | 00   |
| Total              | 93          | 36            | 38.71 | 57            | 61.29 |

### Table 5: Distribution of Staphylococcal isolates according to age group

| Age Group | No. of MRSA | %   | No. of MSSA | %   | No. of MRCoNS | %   | No. of MSCoNS | %   |
|-----------|-------------|------|-------------|------|---------------|------|---------------|------|
| 0-9       | 00          | 0    | 00          | 0    | 02            | 5.55 | 09            | 15.79 |
| 10-19     | 05          | 7.81 | 10          | 17.24 | 05            | 13.89 | 05            | 8.77   |
| 20-29     | 09          | 14.06 | 11          | 18.97 | 12            | 33.33 | 21            | 36.84 |
| 30-39     | 12          | 18.75 | 12          | 20.69 | 07            | 19.44 | 09            | 15.79 |
| 40-49     | 14          | 21.88 | 09          | 15.52 | 05            | 13.89 | 03            | 5.26   |
| 50-59     | 09          | 14.06 | 03          | 5.17  | 01            | 2.77  | 04            | 7.01   |
| 60-69     | 12          | 18.75 | 04          | 6.89  | 04            | 11.11 | 05            | 8.77   |
| 70-79     | 02          | 3.12  | 07          | 12.07 | 00            | 0     | 01            | 1.75   |
| 80-89     | 01          | 1.56  | 02          | 3.44  | 00            | 0     | 00            | 0      |
| 90-99     | 00          | 0     | 00          | 0     | 00            | 0     | 00            | 0      |
| Total     | 64          | 100   | 58          | 100   | 36            | 100   | 57            | 100   |
Table. 6 Distribution of Staphylococcal isolates according to sex

| Organism  | Male | Female | Ratio (M:F) |
|-----------|------|--------|-------------|
| MRSA      | 35   | 29     | 1:0.82      |
| MSSA      | 30   | 28     | 1:0.93      |
| MRCoNS    | 16   | 20     | 0.8:1       |
| MSCoNS    | 25   | 32     | 0.78:1      |

Table. 7 Antimicrobial resistant pattern of MRSA isolates

| Name of Antibiotic | No. of Sensitive Organism | % | No. of Resistant | % |
|--------------------|---------------------------|---|-----------------|---|
| Penicillin-G       | 6                         | 9.37 | 58  | 90.62 |
| Clindamycin        | 11                        | 17.18 | 53  | 82.81 |
| Erythromycin       | 8                         | 12.5 | 56  | 87.5  |
| Linezolid          | 64                        | 100 | 0     | 0    |
| Vancomycin         | 64                        | 100 | 0     | 0    |
| Gentamycin         | 29                        | 45.31 | 35  | 54.68 |
| Norfloxacin        | 7                         | 18.42 | 31  | 81.57 |
| Nitrofurentoin     | 35                        | 92.10 | 3  | 7.89  |

Table. 8 Antimicrobial resistant pattern of MSSA isolates

| Name of Antibiotic | No. of Sensitive Organism | % | No. of Resistant Organism | % |
|--------------------|---------------------------|---|---------------------------|---|
| Penicillin-G       | 22                        | 37.93 | 36  | 62.06 |
| Clindamycin        | 39                        | 67.24 | 19  | 32.75 |
| Erythromycin       | 30                        | 51.72 | 28  | 48.27 |
| Linezolid          | 58                        | 100 | 0    | 0    |
| Vancomycin         | 58                        | 100 | 0    | 0    |
| Gentamycin         | 52                        | 89.65 | 6   | 10.34 |
| Norfloxacin        | 9                         | 50  | 9   | 50    |
| Nitrofurentoin     | 18                        | 1000 | 0   | 100   |

Antimicrobial resistant pattern of MRCoNS isolates

| Name of Antibiotic | No. of Sensitive Organism | % | No. of Resistant Organism | % |
|--------------------|---------------------------|---|---------------------------|---|
| Penicillin-G       | 4                         | 11.12 | 32  | 88.88 |
| Clindamycin        | 9                         | 25  | 27  | 75    |
| Erythromycin       | 7                         | 19.44 | 29  | 80.55 |
| Linezolid          | 36                        | 100 | 0   | 0     |
| Vancomycin         | 36                        | 100 | 0   | 0     |
| Gentamycin         | 22                        | 61.11 | 14  | 38.88 |
| Norfloxacin        | 3                         | 15.78 | 16  | 84.21 |
| Nitrofurentoin     | 18                        | 94.74 | 1   | 5.26  |
Table 9  Antimicrobial resistant pattern of MSCoNS isolates

| Name of antibiotics | No. of sensitive organism | (%)  | No. of resistant organism | (%)  |
|---------------------|---------------------------|------|---------------------------|------|
| Penicillin-G        | 22                        | 38.59| 35                        | 61.40|
| Clindamycin         | 29                        | 50.87| 28                        | 49.12|
| Erythromycin        | 24                        | 42.10| 33                        | 57.89|
| Lenezolid           | 57                        | 100  | 0                         | 0    |
| Vancomycin          | 57                        | 100  | 0                         | 0    |
| Gentamycin          | 50                        | 87.71| 7                         | 12.28|
| Norfloxacin         | 16                        | 45.71| 19                        | 54.28|
| Nitrofurantoin      | 33                        | 94.28| 2                         | 5.71 |

There is a growing concern about the rapid rise in resistance of *S. aureus* to antimicrobial agents. In India, the importance of MRSA as a problem has been recognized relatively late. The prevalence of MRSA varies in different parts of India and is not uniform. Reports from a Delhi hospital showed a prevalence rate of 51.6% in 2001, whereas it was reported as 38.44% in the same hospital in 2008 (Rajaduraipandi et al., 2006). A recent study (Sangeeta Joshi et al., 2003) found the prevalence to be 42% in 2008 and 40% in 2009. In a study at Aligarh, India (Dar JA et al., 2006) it was shown that 35.1% of *S. aureus* and 22.5% of coagulates-negative staphylococcal isolates were resistant to methicillin.

In another study (Rajaduraipandi et al., 2006) conducted in Tamil Nadu, out of 906 strains of *S. aureus* isolated from clinical samples, 250 (31.1%) were found to be methicillin resistant. Our study had MRSA prevalence is 52.46% and MRCoNS 38.71% and most of MRSA infection seen in Male patients 35 and most of MRCoNS infection seen in females about 20 numbers. This variation in prevalence may be because of several factors like healthcare facilities available in the particular hospital, implementation and monitoring of infection control committee, rationale antibiotic usage which varies from hospital to hospital.

Maximum samples of the MRSA isolated were from the urine samples i.e. 38(67.8%) followed by Pus, ET secretion and sputum samples as shown in table 3 and in MRCoNS isolates from Urine 54 (58%) followed by Blood (11.8%), Pus (6.45) shown in table 2. Some other Indian studies where they show throat swabs and wound swabs were the main source MRSA and MRCoNS infection (Anupurba et al., 2003).

MRSA strains were more resistant to all antibiotics except for Linezolid and Vancomycin. The present study shows high resistance to Penicillin 58%, Erythromycin 56% and clindamycin 53%, this is in accordance with other studies (Saikia et al., 2009; Kumari et al., 2008). In case of MRCoNS were more resistant to all antibiotics except for Linezolid and Vancomycin and show resistance to other antibiotics like Penicillin 22%, Erythromycin 29% and clindamycin 27%. In urine samples for both organisms shows nitrofurantoin resistance is very low like MRSA only 3% and MRCoNS only 1% reported.

Most common reason for multi-drug resistant MRSA is indiscriminate use of antibiotics without drug sensitivity testing which may be due to due to lack of advanced laboratory facilities or negligence on the part of medical practitioners or patients poor economic status.
Coagulase-negative staphylococcus (CoNS) is a group of opportunistic pathogens causing wide spectrum of diseases in humans. Recently MRCoNS have been associated with increased number of infections in hospitalized patients (Koksal et al., 2007; Shamsadh Begum et al., 2011).

The present study showed a high level prevalence of MRSA and MRCoNS strains resistance against widely used antimicrobial agents which routinely used in microbiology lab. The regular surveillance of MRSA and MRCoNS will also be useful for selecting an appropriate antibiotic, to know the changing trends of antibiotic susceptibility pattern, for developing hospital antibiotic policy and for limiting the use of powerful antibiotics like Vancomycin as initial treatment and save it for the treatment of resistant and life-threatening staphylococcal infections.

References

Anupurba, S., MR Sen, G Nath, BM Sharma, AK Gulati, TM Mohapatra. Prevalence of methicillin resistant Staphylococcus aureus in a tertiary referral hospital in eastern Uttar Pradesh. Ind J Med. Microbiol 2003;21(1):49-51

Basak S.; Mallick, S.K.; Bose, S. 2010. Community associated methicillin-resistant Staphylococcus aureus (CA-MRSA)-An emerging Pathogen: Are we aware? J Clin Diag Res. 4(1), 2111-2115.

Chambers HF 2001. The changing epidemiology of Staphylococcus aureus? Emerg Infect Dis 7: 178-182.

Chambers ST 2005. Diagnosis and management of staphylococcal infections of pacemakers and cardiac defibrillators. Intern Med J 35 Suppl 2: S63-71.

Collee JG, RS Miles, Watt B. Test for the identification of Bacteria. In: Collee JG, Fraser AG, Marmion BP, Simmons A, editors. Mackie and McCarteny Practical Medical Microbiology. 14th edn. New York: Churchill Livingstone; 1996. p. 131-49.

Dar JA, Thoker MA, Khan JA, Ali A, Khan MA, Rizwan M, et al., Molecular epidemiology of clinical and carrier strains of methicillin resistant Staphylococcus aureus (MRSA) in the hospital settings of north India. Ann Clin Microbiol Antimicrob 2006; 5: 22.

Koksal F, Yasar H, Samasti M. Antibiotics resistant patterns of coagulase-negative Staphylococcus strains from blood cultures of septicemic in Turkey Microbiol Res 2007; 16: 31-4.

Koksal, F., Yasar, M. and Samasti, M. Antibiotic resistant patterns of coagulase-negative staphylococcus strains from blood cultures of septicemic in Turkey. Microbiol. Res., 2009; 164: 404-410.

Kumari N, Mohapatra TM, Singh YI. Prevalence of Methicillin-Resistant Staphylococcus aureus (MRSA) in a Tertiary-Care Hospital in Eastern Nepal. J Nepal Med Assoc 2008; 47(170): 53-6.

Lowy FD 1998. Staphylococcus aureus infections. N Engl J Med 339: 520-532.

Majumder D, Bordoloi JS, Phukan AC, Mahanta J. Antimicrobial susceptibility pattern among methicillin resistant staphylococcus isolates in Assam. Indian J Med Microbiol. 2001; 19: 138-140.

McDonald M - The epidemiology of methicillin resistant Staphylococcus aureus: Surgical relevancy 20 years on. Aust N Z J Surg 1997; 67: 682-5.

Mehdinejad, M. Sheikh, A.F. Jolodar, A. 2008. Study of methicillin resistance in Staphylococcus aureus and species of coagulase negative Staphylococci isolated from various clinical
specimens. *Pak J Med Sci* 24(5):719-724.

Naimi, T.S. Kathleen, H. Kathryn, C. Stephanie, M.B. David, J. B. Jerome, E. Susan, K. J. Francois, V. Scott F. Carol, O. Richard, N. D. Ruth, L. 2003. Comparison of community and health care associated Methicillin resistant *Staphylococcus aureus* infection. JAMA 290: 2976-2984.

Rajaduraipandi K, Mani KR, Panneerselvam K, M, Bhaskar M, Manikandan P. Prevalence and antimicrobial susceptibility pattern of methicillin resistant *Staphylococcus aureus*: a multicentre study. Indian J Med Microbiol 2006; 24: 34-8.

Saikia L, Nath R Choudhary B, Sarkar M. Prevalence and antimicrobial susceptibility pattern of methicillin resistant *Staphylococcus aureus* in Assam. Indian J Crit Care Med 2009; 13:156-8.

Sangeeta Joshi, Pallab Ray, Vikas Manchanda, Jyoti Bajaj, D.S. Chitnis, Vikas Gautam. Methicillin resistant *Staphylococcus aureus* (MRSA) in India: Prevalence and susceptibility pattern. Indian J Med Res 2013; 137(2): 363–369.

Shamsadh Begum, E., Dr. N. Anbumani, Dr. J. Kalyani, Dr. M. Mallika. Prevalence and antimicrobial susceptibility pattern of Coagulase-negative *Staphylococcus*. International Journal of Medicine and Public Health 2011; 1(4): 59-62.

Shorman, M.A. Atom, A.M. Abuharfeil, N.M.; Al-Majali, A.M. 2008. Identification of methicillin resistant *Staphylococcus aureus* (MRSA) and methicillin resistant coagulase-negative *Staphylococcus* (CoNS) in clinical settings. Am J Infect Dis 4(2): 156-161.

Sohn, A., Garrett, D. and Sinkowitz-Cochran, R. Prevalence of nosocomial infections in neonatal intensive care unit patients: results from the first national point-prevalence survey. *J Pediatr*, 2001; 136: 821-27.

Vandenesch F, Naimi T, Enright MC, Lina G, Nimmo GR, Heffernan H, et al., 2003. Community-acquired methicillin-resistant *Staphylococcus aureus* carrying Panton-Valentine leukocidin genes: worldwide emergence. Emerg Infect Dis 9: 978-984.

How to cite this article:

Jogender, Jitendra, Sheetal Sharma and Suman Rishi. 2018. Occurrence of Antimicrobial Sensitivity Pattern for Methicillin Resistant *Staphylococcus aureus* and Methicillin Resistant Coagulase Negative *Staphylococcus* Isolated from Various Clinical Samples in a Tertiary Care Hospital, Jaipur, India. *Int.J.Curr.Microbiol.App.Sci.* 7(01): 794-802.

doi: [https://doi.org/10.20546/ijemas.2018.701.097](https://doi.org/10.20546/ijemas.2018.701.097)