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# Comparison of In Vitro Activity of Tigecycline and Vancomycin against Methicillin-Resistant Staphylococci: An E-Strip and Broth Microdilution Study

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**Abstract:** ***Methicillin-resistant Staphylococcus aureus (MRSA) and methicillin-resistant coagulase-negative staphylococci (MRCoNS) are important causes of healthcare-associated and community-onset infections. Vancomycin remains a key agent for serious resistant Gram-positive infections, while tigecycline has broad in-vitro activity against staphylococci. Accurate MIC testing is important when reduced glycopeptide susceptibility is suspected. Objective: To compare the in-vitro activity of tigecycline and vancomycin against MRSA and MRCoNS using E-strip MIC testing and broth microdilution (BMD) methods. Methods: This cross-sectional laboratory study was conducted in the Department of Microbiology, Government Medical College, Kota, Rajasthan, from March 2025 to February 2026. Two hundred clinical staphylococcal isolates were identified by standard microbiological methods. Methicillin resistance was assessed using cefoxitin disk diffusion. Vancomycin susceptibility was screened using vancomycin screen agar and evaluated by E-strip and BMD; Tigecycline MICs were assessed by E-strip and BMD. Results: Of 200 isolates, 172 (86.0%) were S. aureus and 28 (14.0%) were CoNS. Among S. aureus, 116/172 (67.4%) were MRSA; among CoNS, 21/28 (75.0%) were MRCoNS. Tigecycline MICs were ≤0.5 µg/mL for all MRSA (116/116) and MRCoNS (21/21) by both E-strip and BMD. Vancomycin E-strip and BMD identified one vancomycin-resistant MRSA isolate (1/116; 0.9%) and no resistant MRCoNS isolates (0/21). The study recorded one MRCoNS screen-agar-positive isolate, but this finding was not confirmed by E-strip or BMD. Conclusion: Tigecycline showed excellent in-vitro activity against all tested MRSA and MRCoNS isolates, including the single MRSA isolate resistant to vancomycin by confirmatory MIC methods. These findings support tigecycline as a potential option for selected Staphylococcal infections.***

**Keywords:** Staphylococcus aureus; coagulase-negative staphylococci; MRSA; MRCoNS; tigecycline; vancomycin; minimum inhibitory concentration; broth microdilution

## 1. Introduction

Staphylococci are important causes of skin and soft-tissue infections, bloodstream infections, device-associated infections, endocarditis, pneumonia, and other invasive diseases. Methicillin resistance complicates treatment because it limits the use of most conventional β-lactams [(1)]. Coagulase-negative staphylococci, particularly in patients with intravascular devices or implanted prosthetic material, are also clinically important and frequently display multidrug resistance.

Vancomycin has long been used for serious infections caused by methicillin-resistant Gram-positive organisms. However, reduced susceptibility and occasional resistance make reliable MIC determination important [(2)]. Tigecycline, a glycylcycline that inhibits protein synthesis by binding to the 30S ribosomal subunit, has activity against many resistant Gram-positive organisms. This study compared the in-vitro susceptibility of MRSA and MRCoNS to Tigecycline and Vancomycin using E-strip and broth microdilution methods in clinical isolates collected.

## 2. Materials and Methods

### Study design and setting

A cross-sectional laboratory study was conducted in the Department of Microbiology, Government Medical College, Kota, Rajasthan, India, and its associated hospitals, from March 2025 to February 2026, following institutional ethics approval.

### Study isolates

A total of 200 clinical staphylococcal isolates from patients of different age groups were included. Organisms were identified using standard microbiological procedures. All procedures were preformed using CLSI [(3)] and EUCAST [(4)] guidelines. Analysis of sample-wise distribution revealed that pus samples were the most common source of Staphylococcus aureus isolates, accounting for 51.7% of cases. Other important sources included sputum (20.35%), urine (11.6%), bone and joint aspirates (3.5%), and CSF (2.9%). Smaller numbers of isolates were also obtained from blood, pleural fluid, suction tips, throat swabs, and other body fluids. Similarly, among CoNS isolates, pus (35.7%) and urine (28.6%) were the most common sources, followed by CSF (17.9%) and blood (10.8%).

| Clinical sample | S. aureus n (%) | CoNS n (%) |
|---|---|---|
| Pus | 89 (51.7%) | 10 (35.7%) |
| Sputum | 35 (20.35%) | 0 (0%) |
| Urine | 20 (11.6%) | 8 (28.6%) |
| Blood | 3 (1.7%) | 3 (10.8%) |
| CSF | 5 (2.9%) | 5 (17.9%) |
| Central line | 1 (0.6%) | 1 (3.6%) |
| Bone / joint aspirates | 6 (3.5%) | 0 (0%) |
| Pleural fluid | 3 (1.7%) | 0 (0%) |
| Peritoneal fluid | 1 (0.6%) | 0 (0%) |
| Suction tip | 3 (1.7%) | 1 (3.6%) |
| Synovial fluid | 1 (0.6%) | 0 (0%) |
| Throat swab | 3 (1.7%) | 0 (0%) |
| Vaginal swab | 1 (0.6%) | 0 (0%) |
| Liver abscess | 1 (0.6%) | 0 (0%) |
| Total | 172 (100%) | 28 (100%) |

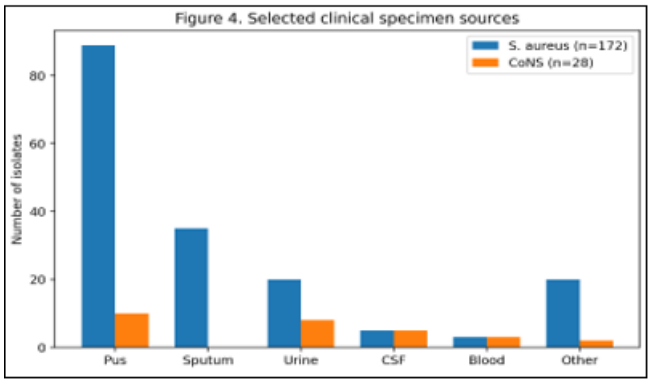



**Figure:** Analysis of sample-wise distribution

**Vancomycin and Tigecycline susceptibility testing**

Vancomycin resistance screening was performed using brain–heart infusion agar containing vancomycin at 6 µg/mL [5]. Vancomycin and Tigecycline MICs were assessed by E-strip and broth microdilution. The study used broth microdilution as the reference quantitative method. Tigecycline susceptibility was interpreted using the MIC threshold of ≤0.5 µg/mL; vancomycin categories were recorded as susceptible (≤2 µg/mL), intermediate (4–8 µg/mL), and resistant (≥16 µg/mL) for Staphylococcal isolates.

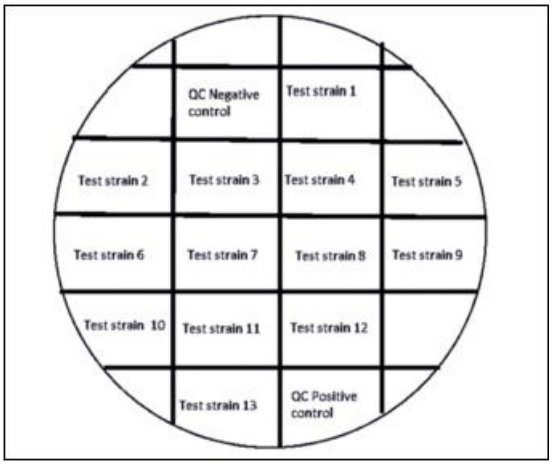



**Figure:** Vancomycin Agar Screen Square Grid Template

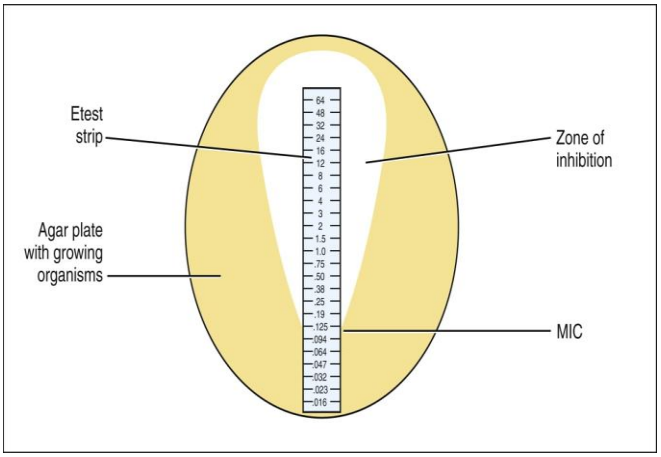



**Figure:** E- strip Test

## 3. Results

The largest age groups were 21–40 years (29.0%) and 41–60 years (28.5%). There was female predominance with 108 (54%) female and 92 (46%) male patients with male to female ratio of 1: 1.17.

| Gender | Number of Patients (n) | Percentage (%) |
|---|---|---|
| Male | 92 | 46 |
| Female | 108 | 54 |
| Total | 200 | 100 |

The isolate set comprised 172 S. aureus and 28 coagulase-negative staphylococci (CoNS). Cefoxitin disk diffusion was used as the phenotypic surrogate for methicillin resistance, according to the laboratory protocol. Isolates were categorized as MRSA/MSSA or MRCoNS/MSCoNS.

| Isolates | Number of Isolates (n) | Percentage (%) |
|---|---|---|
| MRSA | 116 | 58 |
| MSSA | 56 | 28 |
| MRCoNS | 21 | 10.5 |
| MSCoNS | 7 | 3.5 |
| Total | 200 | 100 |

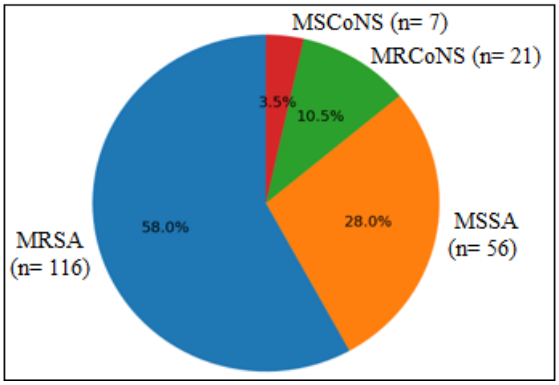


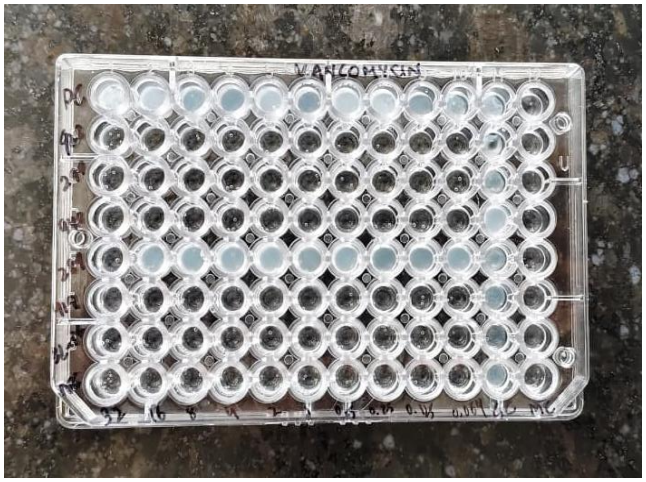

**Figure 1:** Composition of the 200 Staphylococcal Isolates

**Vancomycin Susceptibility**

| Organism | Method | Resistant (VRSA / VRCoNS) n (%) | Intermediate (VISA / VICoNS) n (%) | Susceptible (VSSA/ VSCoNS) n (%) |
|---|---|---|---|---|
| MRSA | VSA | 1 (0.9%) | 0 (0%) | 115 (99.1%) |
| MRSA | E-strip | 1 (0.9%) | 0 (0%) | 115 (99.1%) |
| MRSA | BMD | 1 (0.9%) | 0 (0%) | 115 (99.1%) |
| MRCoNS | VSA | 1 (4.8%) | 0 (0%) | 20 (95.2%) |
| MRCoNS | E-strip | 0 (0%) | 0 (0%) | 21 (100%) |
| MRCoNS | BMD | 0 (0%) | 0 (0%) | 21 (100%) |



**MIC for Vancomycin using E-Strip Method**



**MIC for Vancomycin using Broth Micro-Dilution Method**

One MRSA isolate (0.9%) was categorized as vancomycin-resistant by both E-strip and BMD, while no VISA isolate was reported. All 21 MRCoNS isolates were susceptible by both E-strip and BMD. One MRCoNS isolate showed resistance using Vancomycin screen-agar, whereas E-strip and BMD reported all isolates (21/21) susceptible. This screen-positive result was described as unconfirmed by MIC testing rather than as confirmed VSA.

**Tigecycline Susceptibility**

All MRSA and MRCoNS isolates were reported susceptible to tigecycline by both E-strip and BMD. The single MRSA isolate categorized as vancomycin-resistant remained tigecycline-susceptible by both methods.

| Organism | E-strip susceptible | BMD susceptible | MIC threshold reported |
|---|---|---|---|
| MRSA (n=116) | 116/116 (100%) | 116/116 (100%) | ≤0.5 µg/mL |
| MRCoNS (n=21) | 21/21 (100%) | 21/21 (100%) | ≤0.5 µg/mL |



**MIC for Tigecycline using E-Strip Method**



**MIC for Tigecycline using Broth Micro-Dilution Method**

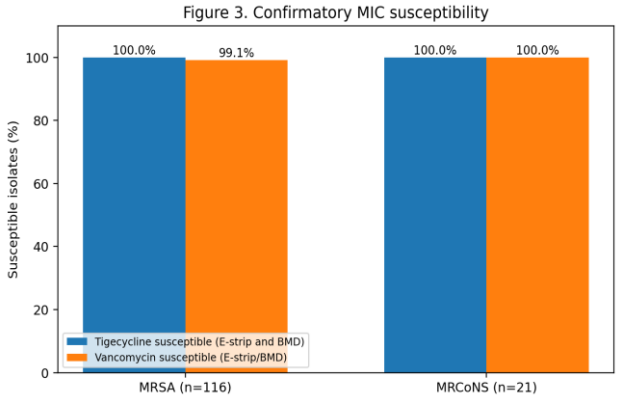



**Figure:** Confirmatory MIC susceptibility to Tigecycline and vancomycin among methicillin-resistant isolates based on E-strip/BMD results.

## 4. Discussion

Age-wise distribution showed that young and middle-aged adults were most commonly affected by Staphylococcal infections. The highest number of isolates was observed in the 21–40 years age group (29%), followed closely by the 41–60 years group (28.5%). Patients aged 61–80 years accounted for 22.5% of cases, whereas 17% of isolates were obtained from patients aged 0–20 years. The least number of cases (3%) were observed in patients older than 80 years. Gender distribution demonstrated a slight female predominance, with 108 (54%) female patients compared to 92 (46%) male patients, resulting in a male-to-female ratio of approximately 1:1.17.

The isolate set comprised 172 S. aureus and 28 coagulase-negative staphylococci (CoNS). The present study found a

substantial burden of methicillin resistance in the clinical staphylococcal collection: 67.4% of S. aureus isolates were MRSA and 75.0% of CoNS were MRCoNS. Isolates were categorized as MRSA/MSSA or MRCoNS/MSCoNS. Because CoNS isolates are often associated with intravascular devices and prosthetic material, their high methicillin-resistance proportion has practical implications for empiric treatment and infection-prevention policies.

Vancomycin resistance was assessed using Vancomycin Screen Agar (VSA), E-strip MIC testing, and Broth Microdilution (BMD) methods. Using the VSA method, 1% of isolates showed vancomycin resistance, including one isolate each of VRSA and VRCoNS. However, confirmatory MIC testing using E-strip and BMD methods revealed only one VRSA isolate (0.5%), while all CoNS isolates remained susceptible. No VISA or VICoNS isolates were detected in the study. Evaluation of tigecycline susceptibility using E-strip MIC testing demonstrated that all 200 Staphylococcal isolates (100%) were susceptible, with MIC values ≤0.5 µg/ml. Similar results were obtained with the Broth Microdilution method, confirming 100% susceptibility of all isolates to tigecycline.

These findings are consistent with the earlier published literature reporting strong tigecycline in-vitro activity against methicillin-resistant staphylococci, including reports by Sader[6] and colleagues, Zhanel[7] and colleagues, Hope[2] and colleagues, and Oksuz[8] and colleagues. The magnitude of susceptibility varies by population, study period, methods, breakpoints, and local antimicrobial exposure

In summary, the study demonstrates a high prevalence of methicillin resistance among Staphylococcal isolates, significant resistance to commonly used antibiotics, and excellent in vitro activity of tigecycline against all isolates. The findings highlight the importance of continuous antimicrobial surveillance and suggest that tigecycline may serve as a promising alternative therapeutic agent, particularly in the management of infections caused by multidrug-resistant Staphylococcus species. Clinical interpretation must remain cautious. Drug selection depends on the infection site, severity, bacteremia/endocarditis status, pharmacokinetics, safety profile, local guidance, and available susceptibility data. The results support consideration of tigecycline for selected susceptible Staphylococcal infections.

## 5. Conclusion

Tigecycline demonstrated 100% in-vitro susceptibility among MRSA (116/116) and MRCoNS (21/21) by both E-strip and BMD in this study. Vancomycin susceptibility by confirmatory MIC testing was 99.1% among MRSA and 100% among MRCoNS, with one vancomycin-resistant MRSA isolate. The data indicate excellent in-vitro activity of tigecycline suggesting that tigecycline may serve as a promising alternative therapeutic agent, particularly in the management of infections caused by multidrug-resistant Staphylococcus species.

## 6. Limitations

The study was conducted at a single tertiary-care centre and included a relatively small number of CoNS isolates. Molecular confirmation of resistance determinants (such as mecA/mecC or van-associated genes) was not performed.

**Ethics approval:**
Ethical approval given by Institutional Ethical Committee Government Medical College, Kota, Rajasthan on 24/02/2025, Order No. F.3() Acad/Ethical Clearance/Batch2023/2025/05.

**Funding:** None

**Conflicts of interest:** None

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