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# Bacteriological Profile of Prosthetic Joint Infections (PJI) in a Tertiary Care Hospital

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## A B S T R A C T

Prosthetic joint infections (PJI) represent a severe complication following arthroplasty, contributing significantly to patient morbidity and substantial healthcare expenditures. This study aimed to characterize the microbiological profile of prosthetic joint infections at a tertiary care hospital. A prospective evaluation was conducted on 66 in-patient samples from individuals admitted to the orthopedic department with a history of PJI between November 2024 and May 2025. Periprosthetic tissue samples were collected and processed according to standard microbiological protocols. Among 66 confirmed PJI cases, a culture positivity rate of 56% was observed. Gram-positive cocci were the predominant pathogens (n=25, 37.8%), including MSSA (n=5, 7.5%), MRSA (n=6, 9%), Staphylococcus other than S.aureus group SoSA (n=8, 12%), *Streptococcus* species (n=4, 6.06%), and *Enterococcus* species (n=2, 3.03%). Gram-negative bacilli accounted for 18.1% of infections (n=12), with *Enterobacter cloacae* complex (n=4, 6.06%), *E. coli* (n=3, 4.5%), *P. aeruginosa* (n=3, 4.5%), *S. marcescens* (n=1, 1.5%), and *K. pneumoniae* (n=1, 1.5%) being isolated. The findings of this study highlight the significant prevalence of both gram-positive cocci, particularly staphylococcal species, and gram-negative bacilli in prosthetic joint infections within our tertiary care setting. This detailed bacteriological profile is crucial for guiding empirical antibiotic therapy and developing targeted infection control strategies to improve patient outcomes and reduce the burden of PJI.

## Introduction

Prosthetic joint replacement surgery, while offering significant improvements in quality of life for patients with severe arthritic conditions, is not without its complications 1. Among these, prosthetic joint infection (PJI) stands out as one of the most challenging and devastating. PJI can lead to prolonged hospitalization, multiple revision surgeries, significant functional impairment, and in severe cases, even limb amputation or mortality. The economic burden associated with PJI is also substantial, encompassing the costs of surgical interventions, prolonged antibiotic therapy, and rehabilitation 2.

The incidence of PJI varies depending on the type of joint replacement and patient comorbidities, but it remains a persistent concern. Knowledge about the specific microbiological agents responsible for PJI is important for effective management. This directly informs the choice of empirical antibiotic regimens, which are often initiated before definitive culture results are available 3.

Despite the growing body of literature on PJI, regional variations in bacteriological profiles are common due to differences in hospital environments, patient populations, and local antibiotic prescribing practices. Local hospital antibiogram, continuous surveillance of the causative organisms can guide infection control practices and antimicrobial stewardship programs, ultimately contributing to better patient outcomes and reduced antibiotic resistance. This prospective study was undertaken at a tertiary care hospital to determine the current bacteriological profile of prosthetic joint infections, aiming for optimising clinical management and infection prevention strategies in our hospital.

## Materials and Methods

### Study Design and Setting

This was a prospective observational study conducted at Krishna Institute of Medical Sciences, Secunderabad, a tertiary care hospital, between November 2024 and May 2025. The study was approved by the institutional ethics committee.

### Patient Population

The study included in-patients admitted to the orthopedic department with a clinical suspicion or confirmed diagnosis of prosthetic joint infection. A total of 66 samples were collected from distinct PJI cases. Inclusion criteria comprised patients with a prosthetic joint (e.g., hip, knee, shoulder) presenting with signs of infection, such as pain, swelling and for whom periprosthetic tissue samples were obtained during surgical procedures. Exclusion criteria included patients with non-infectious causes of prosthetic joint failure, repeated patient population and those from whom adequate samples could not be obtained.

### Sample Collection

Periprosthetic tissue samples were collected surgically during revision arthroplasty or debridement procedures, or via aspiration under strict aseptic conditions inside the operation theatre. Tissue samples from different sites within the infected area were obtained to maximise culture yield. Samples were immediately transported to the microbiology laboratory in sterile containers, without delay to minimize bacterial loss or overgrowth of contaminants.

### Microbiological Processing

All samples were processed according to standard microbiological protocols. Tissue samples were homogenized. Tissue samples were then directly inoculated and were incubated in normal saline to facilitate bacterial release and then inoculated onto blood agar and MacConkey agar. . Enrichment broth - thioglycolate broth, was also inoculated to enhance the recovery of fastidious organisms. Plates were incubated at 37°C under appropriate atmospheric conditions (aerobic, anaerobic, 5% $CO_2$) for up to 5 days to allow for the growth of slow-growing or fastidious organisms.

### Bacterial Identification and Antimicrobial Susceptibility Testing

Bacterial isolates were identified based on standard phenotypic methods, including Gram staining, colony morphology, biochemical tests. Antimicrobial susceptibility testing was performed using the Kirby-Bauer disk diffusion method or automated systems (e.g., VITEK 2) according to Clinical and Laboratory Standards Institute (CLSI) guidelines. Results were interpreted as susceptible, intermediate, or resistant.

### Data Collection and Analysis

Microbiological data were collected and recorded in a standardised format. Descriptive data analysis was performed, focusing on the percentage of different bacterial species isolate0d.

## Results and Discussion

Out of the 66 confirmed cases of prosthetic joint infection, a culture positivity rate of 56 % was achieved. This indicates that in a significant proportion of clinically suspected cases, a causative microorganism was successfully identified through culture. The bacteriological analysis revealed a diverse spectrum of pathogens responsible for PJI in our cohort. The majority of infections were attributed to gram-positive cocci, accounting for 25 isolates, representing 37.8% of the total confirmed cases. Within this group, staphylococcal species were the most prevalent:

Staphylococcus other than *S.aureus* group SoSA (SoSA) species were found in 8 cases (12%), making them the single most frequently isolated pathogen.

Methicillin-resistant *Staphylococcus aureus* (MRSA) was identified in 6 cases (9%).

Methicillin-sensitive *Staphylococcus aureus* (MSSA) was isolated in 5 cases (7.5%)

*Streptococcus* species were responsible for 4 infections (6.06%).

*Enterococcus* species were isolated in 2 cases (3.03%).

Gram-negative bacilli comprised a notable proportion of infections, accounting for 12 isolates, or 18.1% of the total. The specific gram-negative organisms identified included:

*Enterobacter cloacae* complex in 4 cases (6.06%).

*Escherichia coli* in 3 cases (4.5%).

*Pseudomonas aeruginosa* in 3 cases (4.5%).

*Serratia marcescens* in 1 case (1.5%).

*Klebsiella pneumoniae* in 1 case (1.5%).

No fungal infections were specifically mentioned in the provided abstract data.

The findings of this prospective study provide insights into the current bacteriological profile of prosthetic joint infections in our tertiary care setting. Observed culture positivity rate of 54.5%. This underscores the challenges associated with culturing PJI pathogens, often due to biofilm formation, prior antibiotic use, or the presence of fastidious organisms 4, 5, and 6. Efforts to improve culture yield, such as extended incubation periods, sonication of explanted components, and advanced molecular diagnostic techniques, are increasingly being adopted to address this issue at our tertiary care center.

Gram-positive cocci remain the predominant causative agents of PJI in our study which was similar to the study conducted Dragosloveanu S etal 7 contributing of about 37.8% due to hematogenous distribution. Within this group**,** Staphylococcus other than *S.aureus* group (SoSA) emerged as the most common individual pathogen (12%), followed by *Staphylococcus aureus* (MSSA and MRSA combined, 16.5%). Their dominance is due to their ability to form biofilms on prosthetic surfaces, their presence on skin as normal flora, and their introduction during surgery 8. The high prevalence of MRSA (9%) similar to the study conducted by Hays MR *et al.,* 9 is a alarming finding which could be possibly due to the usage of MRSA-specific prophylactic antibiotics such as mupirocin highlighting the need for vigilance in infection control practices and appropriate antibiotic selection, particularly in topical and empirical therapy. The presence of *Streptococcus* and *Enterococcus* species, though less frequent, also emphasizes the need for broad-spectrum empirical coverage.

Proportion of gram-negative bacilli (18.1%) when compared to gram positive cocci similar to the study conducted by Silva RB *et al.,* 10 were isolated. The identification of *Enterobacter cloacae* complex, *E. coli*, and *P. aeruginosa* as significant contributors indicates a potential shift or regional variation in the PJI microbial landscape.

Their increasing incidence is a growing concern due to their intrinsic or acquired resistance mechanisms, which can complicate treatment. *P. aeruginosa*, in particular, is notorious for its ability to form robust biofilms and its multi-drug resistance, often leading to more aggressive and harder-to-treat infections 11. The presence of *Serratia marcescens* and *Klebsiella pneumoniae* further underscores the diverse range of gram-negative pathogens encountered 12.

The bacteriological profile presented in this study has direct implications for clinical practice. The high prevalence of staphylococcal species, including MRSA, necessitates empirical antibiotic regimens that provide effective coverage against these organisms, often incorporating vancomycin or daptomycin initially. However, the significant contribution of gram-negative bacilli warrants careful consideration, especially in patients with risk factors such as immunocompromised status, prior surgeries, or specific exposure history. Early and accurate identification of the causative organism through robust microbiological techniques is crucial for de-escalating antibiotics, minimizing the emergence of resistance, and improving patient outcomes.

**Figure.1** Antibiogram of SoSA

| Gram Positive Organism | Isolates (n) | Benzyl Penicillin (%) | Oxacillin (%) | Gentamicin (%) | Ciprofloxacin (%) | Levofloxacin (%) | Erythromycin (%) | Clindamycin (%) | Linezolid (%) | Daptomycin (%) | Teicoplanin (%) | Vancomycin (%) | Tetracycline (%) | Tigecycline (%) | Cotrimoxazole (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus sp. (SoSA) | 8 | 13% | 0% | 0% | 0% | 0% | 25% | 13% | 88% | 88% | 100% | 100% | 50% | 100% | 88% |

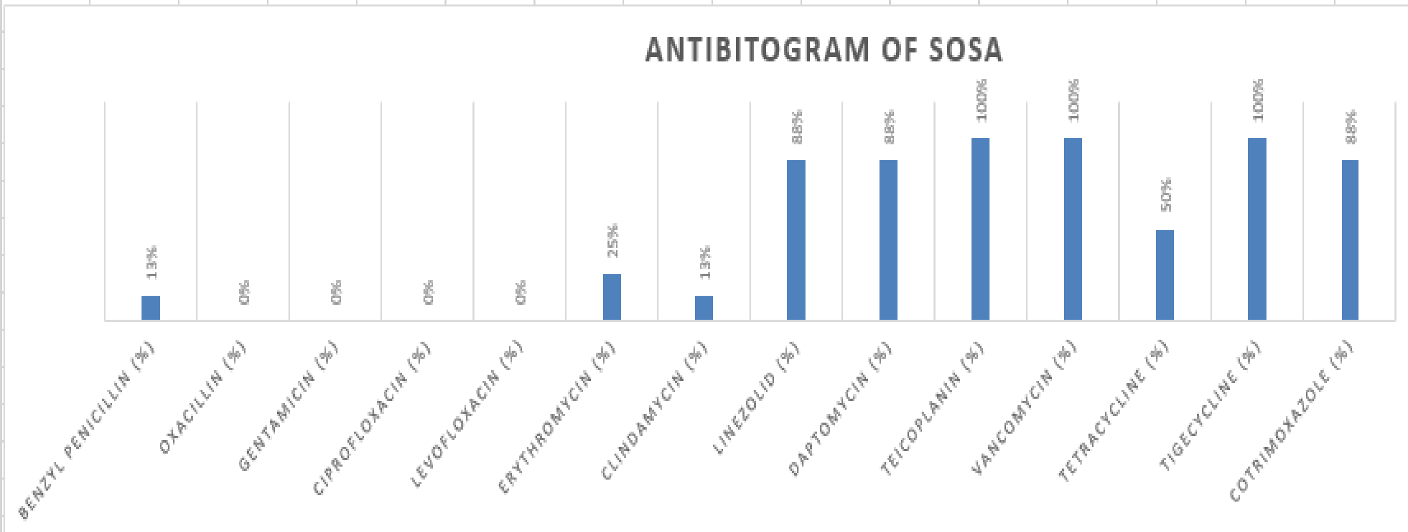



**Figure.2** Antibiogram of MRSA

| Gram Positive Organism | Isolates (n) | Benzyl Penicillin (%) | Oxacillin (%) | Gentamicin (%) | Ciprofloxacin (%) | Levofloxacin (%) | Erythromycin (%) | Clindamycin (%) | Linezolid (%) | Daptomycin (%) | Teicoplanin (%) | Vancomycin (%) | Tetracycline (%) | Tigecycline (%) | Cotrimoxazole (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MRSA | 6 | 0% | 0% | 0% | 0% | 0% | 100% | 100% | 100% | 100% | 100% | 100% | 0% | 100% | 100% |

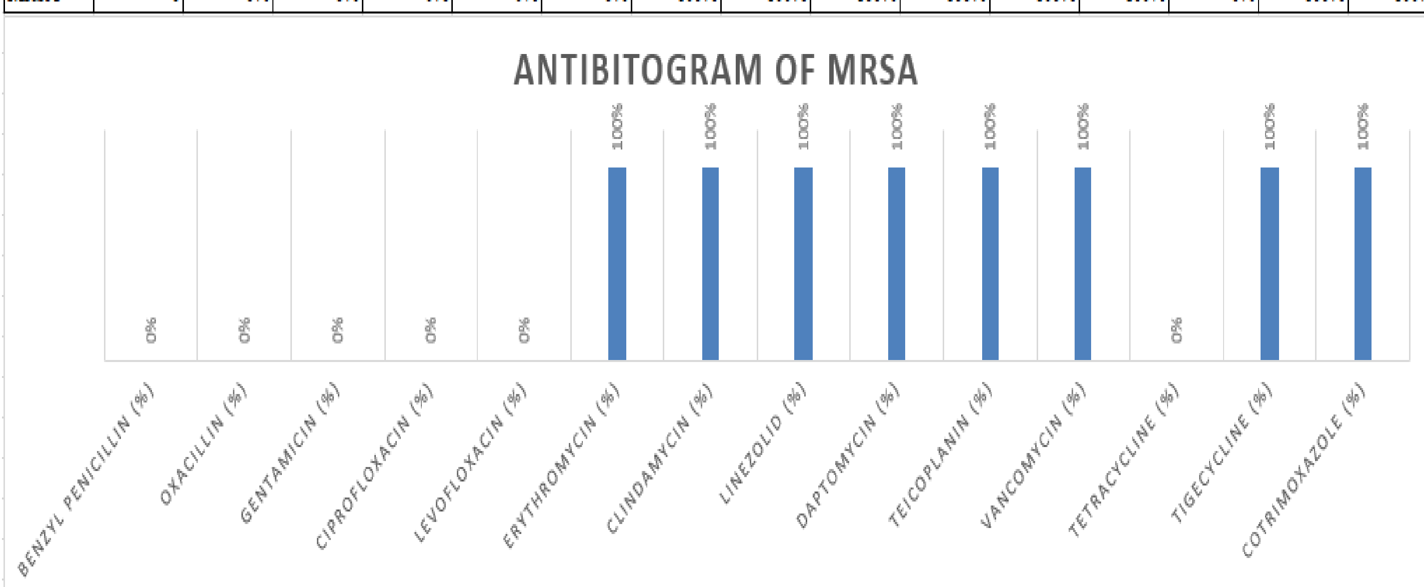


**Figure.3** Antibiogram of MSSA

| Gram Positive Organism | Isolates (n) | Benzyl Penicillin (%) | Oxacillin (%) | Gentamicin (%) | Ciprofloxacin (%) | Levofloxacin (%) | Erythromycin (%) | Clindamycin (%) | Linezolid (%) | Daptomycin (%) | Teicoplanin (%) | Vancomycin (%) | Tetracycline (%) | Tigecycline (%) | Cotrimoxazole (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSSA | 5 | 33% | 100% | 33% | 0% | 0% | 33% | 33% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

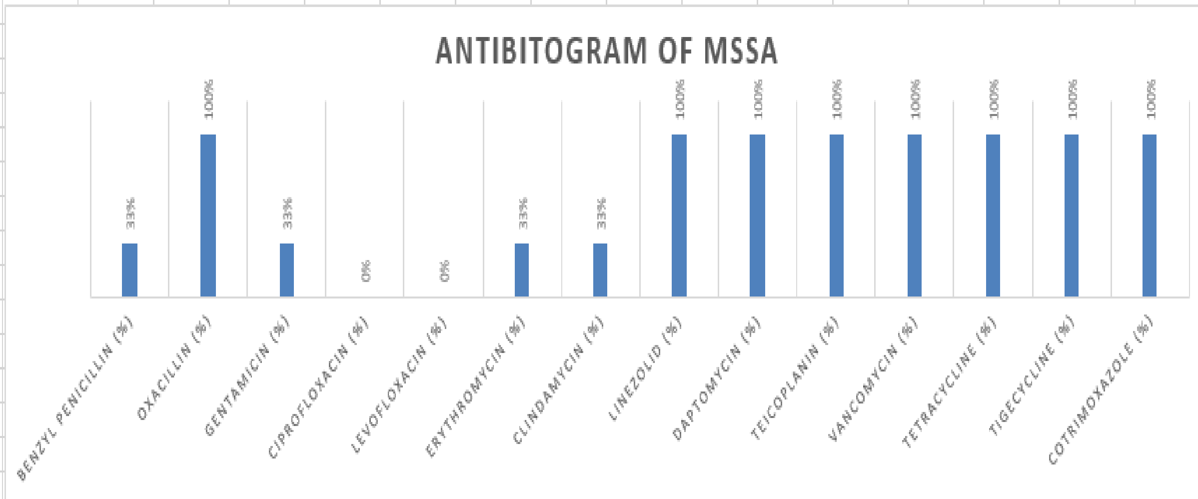
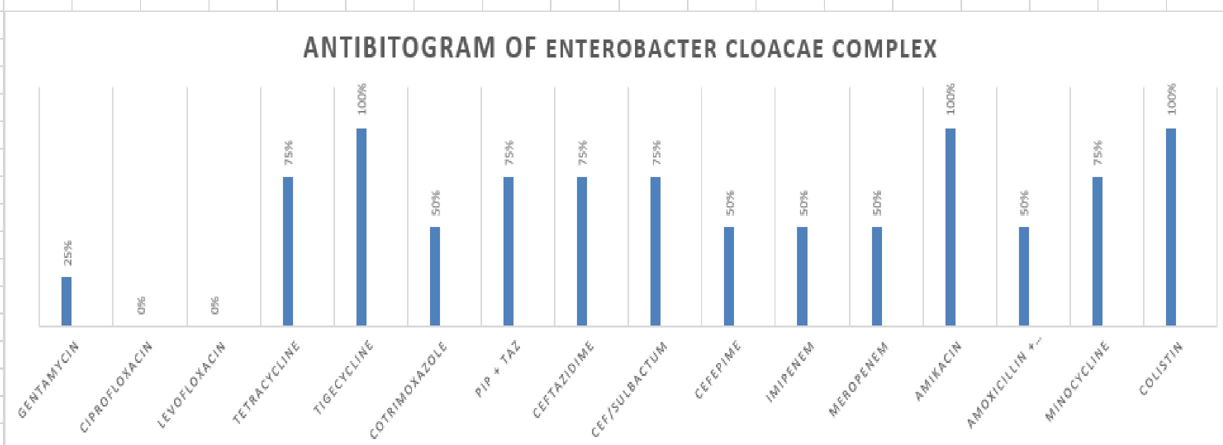



**Figure.4** Antibiogram of *Enterobacter cloacae* complex

| Gram Negative Organism | Isolates (n) | Gentamycin | Ciprofloxacin | Levofloxacin | Tetracycline | Tigecycline | Cotrimoxazole | Pip + Taz | Ceftazidime | Cef/Sulbactum | Cefepime | Imipenem | Meropenem | Amikacin | Amoxicillin + Clavulanic acid | Minocycline | Colistin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Entero.cloacae complex | | 25% | 0% | 0% | 75% | 100% | 50% | 75% | 75% | 75% | 50% | 50% | 50% | 100% | 50% | 75% | 100% |




In conclusion, this prospective study provides the bacteriological profile of prosthetic joint infections at a tertiary care hospital. The findings underscore the continued prominence of gram-positive cocci, particularly staphylococcal species (SoSA, MSSA, MRSA), as major contributors to PJI. Also the study highlights a notable proportion of gram-negative bacilli, including multidrug-resistant organisms, as significant pathogens in this setting. A comprehensive understanding of the PJI pathogens is essential for enhanced patient care and management.

Further research focusing on antibiotic susceptibility patterns and the role of molecular diagnostics in improving culture-negative PJI cases should be considered.

## Author Contributions

Abhishek Velamuri: Conceived the original idea and designed the model the computational framework and wrote the manuscript; K. Navya: Formal analysis, writing review and editing; Shiva Priya Eswaran: Validation, methodology, writing—reviewing

## Declarations

**Ethical Approval** Not applicable.

**Consent to Participate** Not applicable.

**Consent to Publish** Not applicable.

**Conflict of Interest** The authors declare no competing interests.

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