**Research Article**

# Bacteriological profile and antibiotic sensitivity patterns of aerobic organisms isolated from pus samples: A study conducted in tertiary care hospital, Mahabubnagar

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## ABSTRACT

**Introduction**: The emergence of pyogenic bacteria during or following trauma, burn injuries, and surgical interventions can lead to inflammation and the development of pus. An enormous financial burden, prolonged hospital stays, and considerable morbidity are the outcomes of wound infections

**Objective:** The objective of the current study is to determine the aerobic bacteria that cause wound infections and to determine the antibiotic susceptibility pattern of the isolated organisms.

**Materials and methods:** A retrospective study was conducted at SVS Medical College and Hospital Mahabubnagar from October 2023 to August 2024. Pus samples were aseptically collected and processed aseptically. Identification and antibiotic susceptibility pattern were done by the Vitek 2 compact system following standard procedures**.**

**Results:** Out of 536 pus samples, 115 samples showed bacterial growth. Most of the bacterial growth were isolated from 21-40 years of age with 41 (36%). Among 115 bacterial isolates, 62(54%) were Gram-positive cocci and 53 (46%) were gram-negative bacilli. Among gram-positive cocci, the highest isolated organism is *Staphylococcus aureus* with 26 (42%). In gram-negative bacilli, the most common organism isolated is *Enterobacter* spp. 13 (24.5%) followed by *Pseudomonas spp.* with 11 (20.8%). 96% of the *Staphylococcus aureus* were sensitive to Linezolid and the least sensitivity was observed with Levofloxacin with 17.3%.

**Conclusion:** The pyogenic wound infections were discovered to be common in the tertiary care hospital with staphylococcus aureus isolated and exhibiting the highest occurrence followed by *Enterobacter and Pseudomonas spp*. When putting empirical treatment options for pyogenic infections into practice, the susceptibility statistics from this article might be worth taking into account.

**Keywords:** Pus; *Staphylococcus aureus*; *Enterobacter*; *Pseudomonas*.

## 1. INTRODUCTION

The presence of pyogenic bacteria after or following trauma, burns, and surgical procedures may trigger inflammation and accumulation of pus [1, 2]. To combat bacteria, the body's immune system dispatches defence cells to the point of the infection site. When these cells accumulate, pus forms, leading to pyogenic infection, which actually delays wound healing and may result in repercussions such as wound disintegration [3]. Wound infections, which frequently occur in hospital settings have been related to both aerobic and anaerobic microbes, it pose a massive monetary burden, prolonged hospital stays, as well as significant morbidity [4]. Globally, the fast spread of antibiotic resistance among pathogenic bacterial isolates poses a severe threat to public health. Multidrug-resistant Gram-negative bacterial strains, including *Acinetobacter baumannii*, *E. coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and Gram-positive organisms such as, Methicillin-*resistant Staphylococcus aureus* (MRSA), have become more frequently linked to

hospital-acquired pus infections in recent decades as a result of widespread antibiotic mis-prescriptions and inadequate dosage regimens [5, 6, 7]. Because of the absence of effective therapies and the sluggish development of new antibiotic classes, the fast proliferation of multidrug-resistant bacteria poses a huge threat to public health globally [7, 8]. Clinicians who treat patients with surgical site infections and skin and soft tissue infections must determine whether an infection is present, evaluate its severity, identify the causative microorganism, prescribe the appropriate antibiotics, and select surgical treatments for purulent and necrotizing infections [3, 9]. The current study goals are to identify the aerobic bacteria that cause wound infections and to ascertain the isolated organisms' pattern of antibiotic susceptibility.

## 2. MATERIALS & METHODS

A retrospective study was conducted at SVS Medical College and Hospital, Mahbubnagar from October 2023 to August 2024 for a period of 11 months. Demographic data and laboratory results were collected from microbiology laboratory registration books by using a standard collection format. Pus samples were aseptically collected using 2 sterile swabs and were kept in a test tube. One swab is inoculated onto nutrient agar, blood agar, MacConkey agar and chocolate agar and the other for gram staining. Plates were incubated at $37^0$c for 24 hours. Identification and antibiotic susceptibility pattern were done by the Vitek 2 compact system following standard procedures.

**Inclusion criteria**:

All known pathogenic gram-positive and gram-negative bacteria isolated from pus samples were included in the study.

**Exclusion criteria**:

Commensals or contaminant bacteria isolated from pus samples were excluded from the study.

**Ethical consideration:**

The SVS Medical College & Hospital Institutional Ethical Clearance Committee provided ethical clearance.

**Statistical analysis:**

MS Excel was used for the analysis.

## 3. RESULTS & DISCUSSION

Out of 536 pus samples collected from different wards of the hospital, 115 samples showed bacterial growth. More positive cultures were isolated from males 94 (82%), followed by females 21 (18%) (Table 1). Most of the bacterial growths were isolated from 41-60 years of age, with 41 (36%). The other age groups with their positive culture percentages are depicted in (Table 2).

**Table1: Positive cultures sex ratio**

| Sex | Positive cultures |
|---|---|
| Males | 94 (82%) |
| Females | 21 (18%) |

**Table 2: Age-wise culture positivity**

| Age | Positive cultures |
|---|---|
| ≤ 20 years | 19 (16%) |
| 21 to ≤ 40 years | 34 (30%) |
| 41 to≤60 years | 41 (36%) |
| > 60 years | 21 (18%) |

**Bacterial isolates:**

Among 115 bacterial isolates, 62 (54%) were gram-positive cocci and 53 (46%) were gram-negative bacilli. Among gram-positive cocci, the highest isolated organism is *staphylococcus aureus* with 26 (42%) followed by *Coagulase-negative staphylococci* with 23 (37%), and *Enterococci spp.* with 8 (12.9%) and *streptococci sp.* with 5 (8.1%) (Table 3).

**Table 3: Gram-positive cocci isolated**

| Gram Positive Cocci | 62 |
|---|---|
| *Staphylococcus aureus* | 26 (42%) |
| *Cons* | 23 (37%) |
| *Enterococci sp.* | 08 (12.9%) |
| *Streptococci sp.* | 05 (8.1%) |

In gram-negative bacilli, the most common organism isolated is *Enterobacter spp.* 13 (24.5%) followed by *Pseudomonas spp.* with 11(20.8%), *Klebsiella spp* 9(17%), *Escherichia coli* 6 (11.3%), *Acinetobacter spp.* and *Serratia spp.* with 5 (9.4%) and the least is *Proteus spp.* 4 (7.6%) (Table 4).

The antimicrobial-sensitive pattern of Staphylococcus aureus is listed in (Table 5). 96% of the organisms were sensitive to Linezolid and

the least sensitivity was observed with Levofloxacin at 17.3%.

**Table 4: Gram-negative bacilli isolated**

| **Gram Negative Bacilli** | **53** |
|---|---|
| *Enterobacter sp.* | 13 (24.5%) |
| *Pseudomonas sp.* | 11 (20.8%) |
| *Klebsiella sp.* | 9 (17%) |
| *Escherichia coli* | 6 (11.3%) |
| *Acinetobacter sp.* | 5 (9.4%) |
| *Serratia sp.* | 5 (9.4%) |
| *Proteus sp.* | 4 (7.6%) |

**Table 5: Antimicrobial sensitivity pattern of *Staphylococcus aureus* and *Cons***

| **GPC Antibiogram** | ***Staphylococcus aureus* (26)** | ***Cons* (23)** |
|---|---|---|
| Antibiotic | % Sensitivity | % Sensitivity |
| Linezolid | 96 | 98 |
| Teicoplanin | 91.3 | 95 |
| Vancomycin | 91.3 | 93 |
| Tigecycline | 91.3 | 91 |
| Daptomycin | 91.3 | 87 |
| Rifampicin | 86.9 | 88 |
| Tetracycline | 82.6 | 95 |
| Clindamycin | 78 | 89 |
| Trimethoprim/ Sulphamethoxazole | 73.9 | 81 |
| Cefoxitin | 69.5 | 89 |
| Erythromycin | 65.2 | 91 |
| Gentamycin | 65.2 | 79 |
| Ciprofloxacin | 21.7 | 54 |
| Levofloxacin | 17.3 | 52 |

The sensitivity pattern of Enterobacteriaceae and non-fermenting isolates are listed in Table 6 & 7 respectively.

**Table 6: Antibiogram of Enterobacteriaceae isolates**

| ***Enterobacteriaceae* Antibiogram** | ***E. coli* (6)** | ***Klebsiella sp.* (9)** | ***Enterobacter sp.* (13)** | ***Proteus sp.* (4)** |
|---|---|---|---|---|
| Antibiotic | % Sensitivity | % Sensitivity | % Sensitivity | % Sensitivity |
| Ceftriaxone | 33.3 | 44.4 | 84.6 | 100 |
| Ertapenem | 83.3 | 88.8 | 84.6 | 100 |
| Imipenem | 83.3 | 44.4 | 76.9 | 50 |
| Meropenem | 83.3 | 66.7 | 76.9 | 100 |
| Piperacillin-Tazobactam | 66.6 | 44.4 | 69.2 | 100 |
| Ciprofloxacin | 66.6 | 33.3 | 76.9 | 100 |
| Gentamicin | 66.6 | 55.5 | 76.9 | 100 |
| Amikacin | 66.6 | 66.7 | 100 | 100 |
| Cefepime | 66.6 | 33.3 | 76.9 | 100 |
| Trimethoprim/ Sulphamethoxazole | 83.3 | 55.5 | 76.9 | 75 |
| Colistin | 66.6 | 100 | 100 | 25 |
| Amoxy-clavulanate | 50 | 44.4 | 61.5 | 75 |
| Levofloxacin | 66.6 | 77.7 | 92.3 | 100 |
| Tigecycline | 83.3 | 100 | 100 | 25 |

## 4. DISCUSSION

If effective infection control measures are not maintained within the hospital, every wound has the potential to become infected, and when a wound fails to heal, the patient becomes ill and requires more expensive care and a longer stay in the hospital. Pus infections have emerged as a major concern for medical practitioners in addition to increasing patient stress.

**Table 7: Antibiogram of Non-fermenters**

| Non fermenters Antibiogram | *Pseudomonas sp.* (11) | *Acinetobacter sp.* (5) | *Serratia sp.* (5) |
|---|---|---|---|
| Antibiotic | % Sensitivity | % Sensitivity | % Sensitivity |
| Trimethoprim/Sulphamethoxazole | 27.2 | 60 | 60 |
| Colistin | 90.9 | 100 | 100 |
| Ceftazidime | 81.8 | 60 | 40 |
| Gentamicin | - | 60 | 40 |
| Piperacillin-Tazobactam | 63.6 | 40 | 100 |
| Levofloxacin | 81.8 | 60 | 40 |
| Minocycline | 45.4 | 100 | 100 |
| Cefepime | 90.9 | 80 | 80 |
| Ceftriaxone | - | - | 80 |
| Aztreonam | - | 60 | - |
| Cefoperazone-Salbactum | 90.9 | 40 | 80 |
| Amikacin | 90.9 | 60 | 40 |
| Ciprofloxacin | 63.6 | - | 40 |
| Tigecycline | - | - | 80 |
| Doripenem | - | - | - |
| Imipenem | 54.5 | 20 | 60 |
| Meropenem | 81.8 | 20 | 60 |

This study provides crucial information about the most common microbes found in pus samples and how susceptible they are to various treatments. These findings may assist determine which antibiotics perform best for a certain bacterial infection.

This work was carried out in the microbiology department of SVS Medical College and Hospital, Mahabubnagar and pus samples were obtained from various departments were 536. A total of 115 (21.4%) bacterial pathogens were identified from pus cultures. However, it was lesser when compared with other studies in India with 58.28% and 84.4%.This could have been caused by poorly maintained hygiene and lack of awareness of the patient's medical care are the main contributing causes to infections linked to health care [10, 11]. Kursheed *et al.*, did a similar study and quoted 49.5% [12].

Among 115 isolates, 21 (18.3%) showed poly-microbial growth and the rest 94 (81.7%) showed pure growth which was in accordance with the study of Manmeet Kaur Gill *et al.*, with 21.5% [13]. Most of the samples in our study belong to

41-60 years with 41 (36%). The result is similar to those of the study by Biradar et al., with 38.28%. This may be due to immunological status, lifestyle diseases and delayed wound care [14]. Males 94 (82%) had a higher infection rate than females 21 (18%) in our study which was similar to previous studies from India by Manmeet *et al.,* [13].

Among the isolates the most predominant organisms isolated were gram-positive cocci with 62 (54%) and gram-negative bacteria with53(46%) which is disagreed with other studies as the majority of the specimens generated were gram-negative bacteria which were superior to gram-positive organisms in accordance with Trojan *et al.,* & Hanumanthappa [15, 16].

Among gram-positive cocci, the predominant organism is *Staphylococci aureus* with 42% which is similar to the study of Kumari et al., Bhumbla *et al.,* & Roopashree *et al.,* [17, 18, 19]. In hospitals, inanimate items, Healthcare workers and other patients can harbour *Staphylococcus aureus.* Furthermore, endogenous illnesses are also possible because *Staphylococcus aureus* is a normal part of the human body flora.

30.5% of *Staphylococcus aureus were* determined to be MRSA as they were showing drug resistance to Cefoxitin which was familiar to Deboral *et al.,* [20]. Other research studies done by Mudassar et al., and Khan et al., had shown 42% & 65% of MRSA in their studies respectively. It is also essential to know that MRSA transmission can differ from place to place and from hospital to hospital. Therefore, additional research would be necessary to address the concerning MRSA situation [21, 22]. MRSA infection rates in our study are less due to effective infection control practices being followed.

*Staphylococcus aureus* has shown the least sensitivity to Ciprofloxacin and Levofloxacin with 21.7% and 17.3% because of target mutation, higher efflux pump activity and decreased permeability and shown highly sensitive to Linezolid with 96% due to its unique mechanism of action, low existing resistance and excellent tissue penetration and Vancomycin with 91% which is similar to the study of Wadekar *et al.,* [23].

According to antibiogram of the present study, the predominant organism among gram-negative bacteria isolated is *Enterobacter* spp. (24.5%) which had shown 100% sensitivity to Minocycline, Amikacin, Tigecycline, Colistin and the least sensitivity for Amoxy-clavulanate with 61.5%.*E.coli* has shown the highest sensitivity to Carbapenems with 83.3%and50% of resistance was shown with minocycline and Amoxy-clavulanate.

In our study, *Klebsiella spp.* has shown resistance to most of the drugs like Ciprofloxacin (33.3%), Imipenem (44.4%) and Cefepime (33.3%) which was in agreement with Jamatia *et al.,* [24]. In non-fermenters highest sensitivity was with colistin and resistance to carbapenems was shown by *Acinetobacter spp.* Pyogenic wound infections in tertiary care hospitals are rising day by day due to multiple interventions, extensive antibiotic use and occasional infection control failures. All of these studies highlight the importance of monitoring antibiotic susceptibility changes and understanding the presence of multidrug-resistant (MDR) bacteria in pus. This study aims to contribute to the existing body of knowledge by evaluating the findings of this relevant research.

This is a retrospective study in which we could not examine significant factors such as the source of infection, the duration of hospital stays, and clinical outcomes. Additionally, the study relied solely on the characterization of bacterial isolates using conventional and automated methods.

## 5. CONCLUSION

Pyogenic wound infections are prevalent in the tertiary care hospital, with *Staphylococcus aureus* identified as the most commonly isolated pathogen, followed by *Enterobacter spp.* and *Pseudomonas spp*. The bacterial isolates exhibited a high to moderate level of resistance to various classes of antibiotics. When formulating empirical treatment options for pyogenic infections, it is important to consider the susceptibility data presented in this article.

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**Conflict of Interest**

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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**Ethical Information**

The SVS Medical College & Hospital Institutional Ethical Clearance Committee provided ethical clearance with approval no: IEC/DHR-01/(03)/2024/047[A].

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