

Original Research Article

Bacteriological Profile of Pus Samples and their Antibiotics Susceptibility Pattern in Tertiary Care Hospital

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ABSTRACT

Background: Pyogenic infections continue to be a major clinical concern and may be caused by a wide array of microorganisms, frequently involving mixed flora that necessitates the use of antimicrobial agents. The widespread misuse and overuse of antibiotics have accelerated the emergence of drug-resistant strains, posing challenges to effective treatment. Although the predominant bacterial species isolated from pus specimens often remain relatively consistent, their patterns of antimicrobial susceptibility are subject to variation across time and settings. In this context, the present study was designed to determine the bacteriological profile of pus isolates and to evaluate their antibiotic susceptibility trends.

Material and methods: A retrospective study was carried out from September 2024 to September 2025. 170 pus samples were collected during study period were included. The samples were cultured on BHIA and MacConkey agar. After aerobic incubation at 37° C for 18-24 hours, organisms were identified by standard methods and antibiotic susceptibility was tested by Kirby Bauer disc diffusion method. and Methicillin resistant Staphylococcus aureus (MRSA) by Cefoxitin 30 µg disc

Results: Of 170 pus samples collected, 100 (58.82 %) pus samples were positive cultures and no growth was in 58 pus samples (34.11%) , in 12 sample (7.05%) mixed growth seen. *S. aureus* 33(33%) was most common Gram positive isolate and *E.coli* 32 (32%), was most common gram negative isolate. MDR seen in 10 (10%) and MRSA in 13(13%) *S. aureus* isolates. Most of gram negative isolates were susceptible to Amikacin (87.1%), Chloramphenicol (88.9%) and Netilin (83.3%) and gram positive isolates to doxycycline (96.7%), Chloramphenicol (96.2%) and linezolid (93.9%).

Conclusion: In our observations, resistance against beta-lactam group antibiotics was found to be significantly higher, posing a major clinical concern. Addressing this issue requires strict avoidance of indiscriminate antibiotic use. In addition, continuous monitoring of resistance patterns is essential for formulating effective treatment guidelines that can help lower both morbidity and mortality rates.

Keywords: pyogenic, pus culture, wound infection, antibiogram, Staphylococcus aureus, MRSA, antimicrobial susceptibility

INTRODUCTION

Pyogenic infections represent inflammatory conditions characterized by localized accumulation of pus, which arises due to active multiplication of microorganisms and the ensuing host immune response. Pus typically appears as a thick, whitish or yellow exudate containing degenerating leukocytes, necrotic tissue, and cellular debris^{1,2}. The likelihood of developing wound infections is influenced by multiple factors such as the nature and extent of the wound, the bacterial load, and the host's immune competence³. In India, the reported incidence of wound sepsis varies between 10% and

33%, reflecting regional differences in healthcare settings and infection control practices⁴. The causative agents of pyogenic infections show wide geographical variation and may differ even among hospitals within the same region⁵. A diverse range of organisms—including bacteria, fungi, viruses, and protozoa—can be implicated, with mixed bacterial infections being common⁶.

Among the bacterial etiologies, *Staphylococcus aureus* continues to be the most predominant pathogen, accounting for approximately 20–40% of isolates, while *Pseudomonas aeruginosa* is frequently encountered in postoperative and burn wound infections, comprising around 5–15% of cases. Other frequently isolated organisms include *Escherichia coli*, *Klebsiella* spp., *Proteus* spp., and *Enterococcus* spp., all of which contribute significantly to the burden of wound infections^{7,8}.

The rational selection of an appropriate antimicrobial regimen requires precise identification of the causative organism, a clear understanding of the infection's pathogenesis, and careful consideration of the pharmacological properties of the drug⁹. However, the global surge in antimicrobial resistance (AMR), primarily resulting from the inappropriate and excessive use of antibiotics, has become a serious threat to public health, particularly with respect to Gram-negative pathogens^{10,11}. Bacteria possess remarkable genetic adaptability, allowing them to develop resistance through mutations or the horizontal transfer of resistance genes, leading to multidrug-resistant (MDR) phenotypes¹². Once confined to critically ill or immunocompromised patients, MDR infections are now increasingly reported even among healthy individuals¹³. The rise of these resistant organisms further complicates the management of infectious diseases, particularly during outbreaks and the emergence of novel pathogens¹⁴.

Therefore, targeted antibiotic therapy based on microbial isolation, species identification, and susceptibility testing from appropriate clinical specimens remains the gold standard for effective management. This study was thus undertaken to determine the bacteriological profile and corresponding antibiotic susceptibility patterns of organisms isolated from wound infections in our tertiary care setting¹⁵.

MATERIAL AND METHODS

This retrospective study was carried out in the Department of Microbiology, GMERS Medical College and Hospital, Gotri, Vadodara, Gujarat, over a one-year period from 20 September 2024 to 20 September 2025. All pus specimens received in the microbiology laboratory during the study period were included for analysis. Relevant socio-demographic data and laboratory findings were retrieved from the laboratory record registers using a structured data collection sheet. Pus samples were collected aseptically in sterile, leak-proof containers and immediately processed in the laboratory by gram staining then Each sample inoculated onto Blood agar and MacConkey agar plates and incubated aerobically at 37°C for 18–24 hours. The bacterial isolates obtained were identified based on their colony morphology and subjected to a series of standard biochemical tests for confirmation, following established microbiological protocols.

Antimicrobial susceptibility testing (AST) was performed on Mueller–Hinton agar by the Kirby–Bauer disc diffusion technique in accordance with the Clinical and Laboratory Standards Institute (CLSI) guidelines (15). The antibiotic discs used for Gram-negative isolates included ampicillin (10 µg), amoxycylav (20/10 µg), gentamicin (10 µg), amikacin (30 µg), ciprofloxacin (5 µg), ceftazidime (30 µg), cefotaxime (30 µg), meropenem (10 µg), and piperacillin–tazobactam (100/10 µg). For Gram-positive organisms, the antibiotics tested were cotrimoxazole (1.25/23.75 µg), erythromycin (5 µg), clindamycin (2 µg), chloramphenicol (30 µg), tetracycline (30 µg), linezolid (30 µg), and vancomycin specifically done to evaluate resistance for *S.aureus* by E-test method. High-level gentamicin (HLG) was specifically used to evaluate resistance among *Enterococcus* isolates.

Detection of methicillin-resistant *Staphylococcus aureus* (MRSA) was carried out using the ceftoxitin disc diffusion method. A bacterial lawn culture of *S. aureus* was prepared on Mueller–Hinton agar, followed by placement of a 30 µg

cefoxitin disc. After incubation at 37°C for 24 hours, isolates showing an inhibition zone diameter of ≤ 21 mm were interpreted as methicillin resistant, in accordance with CLSI criteria.

RESULTS

Of 170 pus samples collected, 100 (58.82 %) were positive cultures, which included 52(30.5%) Gram negative and 48(28.3%) Gram positive bacteria. Mixed growth was seen in 12 (7.05%) samples and no growth in 58 (34.11%) samples. Middle age group of 19-45 years 46 (46%) was most commonly affected age group. Males 61(61%) were commonly affected than females 39(39%). (Table no-1), Out of the 100 isolates, 90% were from the inpatient department, and 10% were from the outpatient department., most of them were from surgery department (55%), and after that (14%) from orthopedic department. (Table no.-2)

S. aureus 33 (33%) was most common isolate followed by *E.coli* 32 (32%), *Pseudomonas* spp. 18(18%), *Klebsiella pneumoniae* 9 (9%), *Enterococcus* spp. 4 (4%), *Proteus* spp. 2 (2%) and *Acinetobacter* spp. 2 (2%) (Fig-1).

Most of gram-positive isolates sensitive to doxycycline (96.7%) Chloramphenicol (96.2%) and linezolid (93.9%). (Table no.-3) And gram-negative isolates were susceptible to Amikacin (87.1%), Chloramphenicol (88.9%) and Netilin (83.3%). (Table no-4)

Table-1: Distribution according to age group and Gender

Age Group	Male (n=61)	Female (n=39)	Total (n=100)	Percentage%
1-18 years	8	6	14	14%
19-45 years	29	17	46	46%
>45years	24	16	40	40%

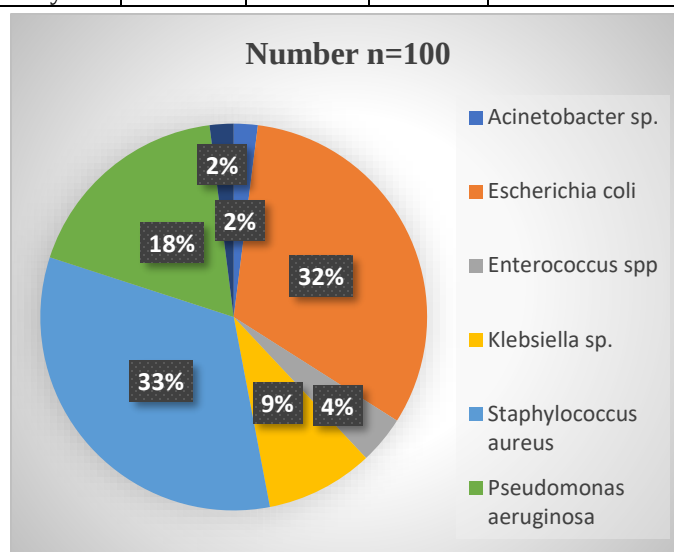


Figure-1: Organism Isolated in Pus

Table-2: Ward wise distribution

Ward	No. of Isolates (N-100)	Percentage
Surgery	55	55%
Orthopaedic	14	14%
Ent	7	7%
Medicine	5	5%
Paediatric	1	1%
Obgy	3	3%
Derma	5	5%
Opd	10	10%
Total	100	100%

Table-3: Antimicrobial sensitivity pattern of Gram-Positive cocci

Antimicrobial drugs	Staphylococcus aureus (n-33) (sensitivity%)	Enterococcus spp (n-4) (sensitivity%)
Penicillin	0%	100%
Cefoxitin	33.3 %	-
Co-Trimoxazole	81.5%	-
Erythromycin	39.4%	100%
Clindamycin	66.7%	-
Chloramphenicol	96.2%	-
Linezolid	93.9%	100%
Vancomycin	92%	100%
High Level Gentamicin	-	100%
Doxycycline	96.7%	100%

Table-4: Antimicrobial sensitivity pattern of Gram-Negative Bacilli

Antimicrobial Drug	Acinetobacter spp (n-2) (sensitivity%)	Escherichia coli (n-32) (sensitivity%)	Pseudomonas aeruginosa (n-18) (sensitivity%)	Klebsiella spp (n-9) (sensitivity%)	Proteus spp(n-2) (sensitivity%)
Ampicillin	-	11.11%	-	-	0
Amoxycillin	-	17.2%	-	0	0
Gentamicin	0 %	64.5%	94.4%	71.4%	100%
Amikacin	0 %	87.1%	88.9%	71.4%	100%
Ciprofloxacin	0 %	11.1%	77.8%	28.6%	0
Ceftazidime	0 %	23.3%	88.9%	42.9%	-
Cefotaxime	0 %	19.4%	-	28.6%	100%
Ceftriaxone	-	15.4%	-	28.6%	100%
Piperacillin Tazobactam	0 %	25.8%	88.9%	42.9%	100%
Meropenam	0 %	44.8%	100%	50%	0
Netilin	-	83.3%	100%	57.1%	100%
Chloramphenicol	-	88.9%	-	100%	100%

DISCUSSION

Pyogenic infections represent one of the most frequent bacterial conditions encountered in clinical microbiology. They are characterized by intense inflammatory reactions at the site of infection, often culminating in the accumulation of pus. Such infections may arise from a single pathogen or involve multiple bacterial species acting synergistically. The organisms most frequently implicated include *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella* spp., and *Proteus* spp.

In the present study of 170 pus specimens, 100 samples (58.8%) yielded positive bacterial growth. Gram-negative bacilli accounted for a slightly higher proportion (52%) than Gram-positive cocci (48%). Among individual species, *S. aureus* was the dominant isolate (33%), followed by *E. coli* (32%) and *Pseudomonas* spp. (18%). The majority of isolates (90%) originated from hospitalized patients, predominantly from surgical wards. Infections were more common among males (61%) and in the age group of 19–45 years (46%), which is consistent with the higher exposure to trauma and surgical interventions in this demographic.

Comparison with Other Studies

In the present study, a total of 170 pus samples were examined, out of which 100 (58.8%) demonstrated positive bacterial growth. This culture positivity rate aligns closely with that observed by Firdaus S, Shome B et al.¹⁷ (62.6%) and Sajjanar V et al.¹⁸ (71.4%), but remains lower than the findings of Wadekar MD et al.¹⁶ who reported 85.5% positivity. On the contrary, Khanapara P et al.¹⁹ noted a comparatively lower yield (32.2%) from pus cultures. (table no.5) The variation among studies may be attributed to differences in the patient population, the stage of infection at sampling, pre-analytical factors such as prior antibiotic use, and regional antimicrobial resistance trends.

Table-5: Comparison of no. of isolates (%)

Parameter	Present study (%)	Wadekar MD et al(2019) ¹⁶	Firdaus S, Shome B et al (July2021) ¹⁷	Sajjanar V et al(2023) ¹⁸	Khanapara P et al (2025) ¹⁹
Total isolates	100/170	101/118	642/1025	250/350	322/1000
culture positivity (%)	58.82%	85.50%	62.63%	71.42%	32.20%

The most frequently isolated Gram-positive cocci in this study was *Staphylococcus aureus* (33%), followed by most frequently isolated Gram negative bacilli was *Escherichia coli* (32%) and *Pseudomonas aeruginosa* (18%). Similar findings were recorded by Sajjanar V et al.¹⁸, who identified *S. aureus* as the major isolate (34.5%), while *Pseudomonas* (22%) and *E. coli* (20%) were next in order. Wadekar MD et al.¹⁶ and Firdaus S, Shome B et al.¹⁷ also reported *S. aureus* as the predominant organism, although the relative frequencies differed. In contrast, Parth et al.¹⁹ found *Pseudomonas aeruginosa* (35.4%) as the leading isolate. (Table no. 6)

Gender-wise distribution revealed a higher prevalence of infection among males (61%), which corroborates the findings of Wadekar MD et al.¹⁶ (63.6%), Sajjanar V et al.¹⁹ (56.9%), and Khanapara P et al.¹⁹ (64.3%). (Table no. 7) This male predominance is generally linked to increased exposure to trauma, outdoor activity, and occupational injuries that predispose to wound infections.

Table-6: Comparison of isolated organisms

Organism Isolated in Pus	Present study (%)	Wadekar MD et al(2019) ¹⁶	Firdaus S, Shome B et al(2021) ¹⁷	Sajjanar V et al(2023) ¹⁸	Khanapara P et al (2025) ¹⁹
Acinetobacter sp.	2%	2.50%	11.21%	1.20%	11.18%
Escherichia coli	32%	13.60%	11.60%	20%	16.14%
Enterococcus spp	4%	1.70%	2.65%	1%	-
Klebsiella sp.	9%	5.10%	21.80%	28.80%	11.80%
Staphylococcus aureus	33%	22.90%	30.06%	34.45%	12.74%
Pseudomonas aeruginosa	18%	14.40%	13.55%	22%	35.40%
Proteus spp	2%	4.20%	6.23%	0.80%	12.74%

Table-7: Gender wise comparison

Parameter	Present study (n-100)	Wadekar MD et al(2019) (n-118) ¹⁶	Firdaus S, Shome B et al (July2021) (n-1025) ¹⁷	Khanapara P et al (2025) (n-322) ¹⁹
Male	61%	75(63.6%)	575 (56.09%)	207(64.28%)
Female	39%	43 (34.4%)	450 (43.90%)	115 (34.72%)

Antimicrobial Susceptibility Trends

Gram-Positive Cocci (GPC)

Among Gram-positive organisms, *S. aureus* isolates in the present study showed excellent susceptibility to Linezolid (96.9%), Vancomycin (92%), Chloramphenicol (96.2%), and Doxycycline (98.3%), while moderate susceptibility was seen with Clindamycin (66.7%) and Erythromycin (69.7%). These findings are comparable to those reported by Firdaus S, Shome B et al.¹⁷ and Sajjanar V et al.¹⁸, where both Linezolid and Vancomycin exhibited 100% efficacy. Wadekar MD et al.¹⁶ also demonstrated similar Linezolid sensitivity (96.2%). Khanapara P et al.¹⁹ reported 95.1% sensitivity to Linezolid and 97.5% to Doxycycline, reaffirming the continued reliability of these agents against *S. aureus*. (Table no.8)

Resistance to Cefoxitin (33.3%) observed in this study is indicative of Methicillin-resistant *Staphylococcus aureus* (MRSA), correlating with findings from Khanapara P et al.¹⁹ (48.1%) and Sajjanar V et al.¹⁸ (28.6%). This emphasizes the increasing burden of MRSA across tertiary care hospitals in India. Universal resistance to Penicillin (100%) across all studies underscores its limited therapeutic value in the current clinical context.

Gram-Negative Bacilli (GNB)

Among Gram-negative isolates, the highest sensitivity was observed to Amikacin (69.5%) and Gentamicin (66.1%), followed by Piperacillin–Tazobactam (51.5%) and Meropenem (38.9%). These observations are consistent with those of Sajjanar V et al.¹⁸, who reported strong sensitivity to Amikacin (84.0%) and Gentamicin (70.8%). Firdaus S, Shome B et al.¹⁷ also recorded similar findings (Amikacin 76.1%, Gentamicin 56.3%). However, Khanapara P et al.¹⁹ reported lower sensitivity rates (Amikacin 36.7%, Gentamicin 35.4%), indicating increased resistance in their study population. (Table no.9) The declining effectiveness of β -lactam antibiotics such as ampicillin and amoxicillin across all studies reflects the widespread presence of β -lactamase-producing strains.

Table-8: Comparison of Antimicrobial sensitivity pattern of Gram-Positive Cocci

Antimicrobial drugs	Present study	Wadekar MD et al(2019) (n-118) ¹⁶	Firdaus S, Shome B et al (July2021) (n-1025) ¹⁷	Sajjanar V et al(2023) (n-250) ¹⁸	Khanapara P et al (2025) (n-322) ¹⁹
Cefoxitin	33.30%	-	-	28.60%	48.10%
Co-Trimoxazole	81.50%	58.20%	55.33%	66.60%	-
Erythromycin	69.70%	55.75%	79.50%	10.50%	46.34%
Clindamycin	66.70%	51.60%	85.58%	52.40%	68.29%
Chloramphenicol	96.20%	69.75%	79.35%	-	-
Linezolid	96.95%	96.27%	100%	100%	95.12%
Vancomycin	92%	100%	100%	100%	-
High Level Gentamicin	100%	57.25%	80.66%	63.40%	49.90%
Doxycycline	98.35%	-	-	68.40%	97.56%

Interpretation and Implications:

The bacterial profile and antimicrobial resistance pattern noted in the present study are in close agreement with those reported by other tertiary care hospitals across India.¹⁶⁻¹⁹ The predominance of *S. aureus*, *E. coli*, and *Pseudomonas aeruginosa* underscores their significance as major pathogens in suppurative infections. Variations in susceptibility trends likely stem from local antibiotic practices, infection control measures, and regional antibiotic stewardship policies.

The persistently high sensitivity of Gram-positive organisms to Vancomycin and Linezolid supports their continued use as reliable agents. However, the declining efficacy of β -lactams and cephalosporins among Gram-negative isolates calls for rational antibiotic usage and regular surveillance to curb the rise of multidrug resistance. Strengthening microbiological diagnostic capacity and implementing antibiotic stewardship programs remain essential steps toward effective infection control in hospital settings.

Table-9: Comparison of Antimicrobial sensitivity pattern of Gram-Negative Bacilli

Antimicrobial drugs	Present study	Wadekar MD et al(2019) (n-118) ¹⁶	Firdaus S, Shome B et al (July2021) (n-1025) ¹⁷	Sajjanar V et al(2023) (n-250) ¹⁸	Khanapara P et al (2025) (n-322) ¹⁹
Ampicillin	2.22%	46%	26.19%	12.44%	4.76%
Amoxycillin	3.44%	65.44%	42.24%	20.85%	6.14%
Gentamicin	66.06%	68.92%	56.30%	70.84%	35.41%
Amikacin	69.48%	73.78%	76.17%	84.02%	36.74%
Ciprofloxacin	23.50%	72.22%	44.62%	35.51%	14.72%
Ceftazidime	31.02%	55.32%	24.59%	50.44%	22.50%
Cefotaxime	30%	55.32%	59.28%	68.48%	14.39%
Ceftriaxone	29%	-	-	-	14.39%
Piperacillin Tazobactam	51.52%	85.04%	86.54%	65.92%	58.54%
Meropenam	38.96%	89.30%	85.74%	66.40%	82.66%

CONCLUSIONS

This study demonstrates that *S. aureus* and *E. coli* together constitute the majority of pus isolates in our centre, with high retained susceptibilities to doxycycline, chloramphenicol and aminoglycosides. Continued local surveillance, rationalization of empirical antibiotic policies based on these data.

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