GMR

The Original

BACTERIOLOGICAL PROFILE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERNS OF BACTERIA ISOLATED FROM PUS SAMPLES

Dr. S. Subathra Devi[1], Dr. R. Maheswari[2], Dr. P. V. Neepa Rani[3]

[1]Tutor, Department of microbiology, Government medical College and Hospital, Affiliated to Dr. M. G. R Medical university, Namakkal, Tamil Nadu, India. Email: drsubamani1978@gmail.com.
[2]Assistant Professor, Department of Microbiology, Government Medical College Kallakurichi
[3]Tutor In Microbiology, Govt. Medical College -Kallakurichi

ABSTRACT
Bacterial wound infections remain a significant cause of morbidity and are increasingly complicated by the emergence of antimicrobial-resistant pathogens, making continuous microbiological surveillance essential for effective patient management. The present study investigated the bacteriological profile of pus samples and evaluated the antibiotic susceptibility patterns of bacterial isolates recovered from clinically significant wound infections. A total of 651 pus samples were processed using standard microbiological techniques, including culture, Gram staining, biochemical identification, and antimicrobial susceptibility testing by the Kirby–Bauer disc diffusion method. Of these, 362 (55.5%) samples were culture positive. Gram-negative bacteria predominated (84.8%), with Klebsiella spp. being the most frequently isolated organism, followed by Escherichia coli, Pseudomonas spp., Acinetobacter spp., and Proteus spp. Gram-positive isolates comprised 15.2% of the total and included methicillin-resistant Staphylococcus aureus, methicillin-sensitive Staphylococcus aureus, and Enterococcus spp. The susceptibility analysis demonstrated comparatively high effectiveness of carbapenems and β-lactam/β-lactamase inhibitor combinations against most Gram-negative isolates, whereas Linezolid and Vancomycin remained highly active against Gram-positive pathogens. These findings underscore the importance of routine bacteriological culture and antimicrobial susceptibility testing for guiding evidence-based antimicrobial therapy, strengthening antimicrobial stewardship programs, supporting infection control strategies, and monitoring evolving resistance patterns within healthcare institutions.

KEYWORDS: Bacteriological profile, Pus samples, antimicrobial susceptibility, Wound infections, antimicrobial resistance

1. INTRODUCTION
Bacteriological profile, Pus samples, antimicrobial susceptibility, Wound infections, antimicrobial resistancBacterial wound infections remain a significant public health problem as they are associated with increased morbidity, length of stay, healing delay, and health care costs (Falcone et al., 2021). They are frequently seen in situations of trauma, post-surgery wounds, burns, diabetic ulcers and other soft tissue infections where microbial invasion causes inflammation and the formation of pus (Hurlow & Bowler, 2022). Bacteriological examination of pus samples is still the mainstay for identification of causative organisms and choosing appropriate antimicrobial therapy (Wadekar et al., 2020). Retrospective studies have also shown that the spectrum of bacteria causing wound infections varies significantly from institution to institution and from region to region, and it is important to maintain ongoing local surveillance (Puca et al., 2021).
Patient factors, underlying diseases, type of wound, hospitalization, and practice of infection control are factors that affect the microbiological profile of wound infections. Healthcare-associated infections (HAIs) are increasingly being associated with gram-negative organisms such as Klebsiella spp., Escherichia coli, Pseudomonas aeruginosa, Acinetobacter spp. and Proteus spp. (Kaapu et al., 2022). The gram-positive bacteria, especially Staphylococcus aureus and Enterococcus spp., are also clinically relevant due to their capacity to remain present within the infected tissues and help with recurrent infections (Almuhayawi et al., 2023). Chronic wounds are polymicrobial and covered in a biofilm, which hinders antibiotics from reaching the wound and diminishes host immune response (Macdonald et al., 2021). The difference between the microbiology of acute and chronic wounds thus has significant consequences in wound treatment decision-making (Hurlow & Bowler, 2022).
Increasing antimicrobial resistance has significantly complicated the treatment of bacterial wound infections. Inappropriate prescribing of antibiotics, self-medication, incomplete treatment courses and overuse of antimicrobials have created resistant populations of bacteria (Bhardwaj et al., 2020). These resistance patterns are often achieved by genetic changes like plasmid mediated gene transfer, chromosomal mutations and the acquisition of mobile genetic elements that allow the horizontal transfer of resistance determinants. As a result, phenotypic susceptibility profiles can also be a complex combination of underlying molecular adaptations, especially in hospital-acquired pathogens (Bogiel et al., 2022).

This has, therefore, become a significant concern for clinicians and microbiologists due to the emergence of multidrug-resistant Gram-negative bacteria (Kabanangi et al., 2021).
Accurate antimicrobial susceptibility testing is critical to help guide targeted therapy, reduce unnecessary antibiotic use, and support antimicrobial stewardship initiatives. Standardized laboratory techniques will help the clinicians to choose effective antimicrobials and to keep a track of the trend of resistance (Gajic et al., 2022). In recent recommendations, it has been recognized that susceptibility testing must go hand in hand with careful reporting strategies to maximize clinical interpretation and maintain the efficacy of the current treatment armamentarium of antibiotics (Pierce et al., 2023). Routine susceptibility testing at the hospital level has also demonstrated that it helps in timely review of empirical treatment guidelines and aids in patient management (Rahman et al., 2024).
In recent studies conducted in various regions, there has been a rise in the isolation of multidrug-resistant bacteria in wound infections both in hospitals and communities (Ita et al., 2022). At the same time, the research into bacterial virulence factors indicates that pathogenicity and antimicrobial resistance are often linked, leading to more severe infections, and reduced treatment options (Awuor et al., 2023). The observations highlight the need for regular review of the local bacteriological profile and antibiotic susceptibility pattern that can provide evidence to guide infection control measures and rational use of antimicrobials. Therefore, the present study was designed to identify the bacteriological profile of pus samples and also to assess antibiotic susceptibility pattern of the bacterial isolates obtained from clinically significant samples of wound infections so as to provide latest laboratory evidence for the empirical treatment and improve antimicrobial stewardship programmes.

Research Objectives

1.To determine the bacteriological profile of culture-positive pus samples processed in the microbiology laboratory.
2.To evaluate the antibiotic susceptibility patterns of bacterial isolates recovered from pus specimens against routinely prescribed antimicrobial agents.
3.To identify effective antimicrobial agents that may guide empirical therapy and support antimicrobial stewardship in the management of bacterial wound infections.

2. METHODOLOGY

2.1 Study Design and Setting

Cross sectional observational study was carried out in a hospital setting to ascertain the bacteriological profile of pus samples and antibiotic susceptibility pattern of the bacterial isolates obtained from clinically suspected wound infections. The study was conducted in a tertiary care health-care facility, in the department of Microbiology where pus samples from the various outpatient and inpatient departments of the hospital were regularly submitted for microbiological examination. All pus specimens received during the study period were included in the investigation and the objectives were to gather a complete bacteriological profile and to evaluate antimicrobial susceptibility trends to inform evidence-based empirical therapy and antimicrobial stewardship. Laboratory processing was done following standard microbiological methods of isolation, identification and susceptibility testing. The findings of all the laboratories were documented and the results were analysed descriptively to ascertain bacterial pathogens and their sensitivity to the routine antimicrobial agents prescribed.

2.2 Sample Collection, Bacterial Isolation and Identification

Aseptically collected pus samples were obtained from patients who had clinically suspected bacterial wound infection such as postoperative wound infection, abscess, traumatic wound, soft tissue infection and other purulent lesions. Specimens were immediately transported to the microbiology laboratory where they were processed immediately to minimize contamination and preserve bacterial viability. Standard microbiological methods were then used to inoculate each specimen on an appropriate culture medium and then incubated under suitable environmental conditions for bacterial growth. After incubation, the colonies were characterized using colony morphology, gram staining and the conventional biochemical identification technique. Isolates were then identified as Gram-positive or Gram-negative organisms and species-level identification was accomplished by standard laboratory methods. All the bacterial isolates were recorded for further antimicrobial susceptibility analysis, and culture results were recorded as culture-positive or culture-negative.

2.3 Antibiotic Susceptibility Testing

All culture-positive bacterial isolates were subjected to antimicrobial susceptibility testing using Kirby-Bauer disc diffusion method on Mueller–Hinton agar as per standard protocol. A panel of antimicrobial agents covering the most frequently used anti-bacterial drugs (Gram-negative and Gram-positive) was chosen based on routine laboratory practice. The diameter of the inhibition zone around each antimicrobial disc was measured after incubation and interpreted based on the Clinical and Laboratory Standards Institute (CLSI) interpretive criteria. These isolates were classified as sensitive, intermediate or resistant, according to the breakpoint values. Antibiotics tested against Gram-negative isolates were aminoglycosides, fluoroquinolones, cephalosporins, β-lactam/β-lactamase inhibitor combinations, carbapenems, and other antimicrobials commonly used in hospitals. These gram-positive isolates were also evaluated for susceptibility to clinically important anti-microbial agents, such as β-lactams, glycopeptides, oxazolidinones, macrolides and lincosamides. Only validated results of susceptibility were used for the final analysis.

2.4 Data Collection and Outcome Measures

Laboratory records were consulted for data on the number of processed pus samples, the proportion of those that were culture positive, the organisms cultured, the Gram type of the organisms and antimicrobial susceptibility patterns of the organisms. The outcome measures were the culture positivity rate, Gram positive and Gram-negative bacteria isolated and frequency of each bacterial species as well as susceptibility percentages of all the antimicrobial agents tested. Susceptibility profiles for each organism were prepared separately for Gram negative and Gram-positive organisms to help evaluate antimicrobial effectiveness. The data collected were collated and presented in tabular form for proper interpretation of the bacteriological trends and antibiotic susceptibility pattern noticed during the study.

2.5 Statistical Analysis

The obtained data were put in the Microsoft excel and later analyzed by the use of relevant statistical software. Throughout the study, descriptive statistical methods have been used as the main goal was summarization of bacteriological distribution and antimicrobial susceptibility pattern of culture positive isolates. Categorical data were reported as numbers and percentages, while organism-specific susceptibility profiles were reported as the number and percentage of susceptible isolates for each antimicrobial agent. Results were presented in tabular and graphical illustrations for easy comparison of the distribution of bacteria and their antimicrobial susceptibility among different bacterial species. However, no inferential statistical tests were applied due to the descriptive nature of the study of the bacterial isolates and their antimicrobial susceptibility characteristics in the laboratory.

3. RESULTS

3.1 Culture Positivity and Bacteriological Profile of Pus Samples

A total of 651 pus specimens were processed during the study period for bacteriological investigation. Among these, 362 samples yielded positive bacterial growth, resulting in an overall culture positivity rate of 55.5%, while the remaining specimens showed no significant bacterial growth. The culture positivity observed was >50% of the pus samples submitted and showed that more than half of the pus samples were clinically significant due to the presence of bacterial pathogens, which was an indication of the relevance of routine microbiological examination of pus samples. Of the culture-positive isolates, gram-negative bacilli (GNB) made up the majority (84.8% of all bacterial isolates) with gram-positive cocci (GPC) representing 15.2%. Among the Gram-negative bacteria, Klebsiella spp. (29.8%) was the most common pathogen followed by Escherichia coli (21.3%), Pseudomonas spp. (15.2%), Acinetobacter spp. (10.8%) and Proteus spp. (7.8%). Of the Gram-positive organisms, methicillin-resistant Staphylococcus aureus (MRSA) was the most common isolate (21; 5.8%), with Enterococcus spp. following. methicillin-sensitive Staphylococcus aureus (MSSA) (15 isolates; 4.1%) and (19 isolates; 5.2%). In general, the results showed that Gram negative pathogens were predominant in the culture positive pus samples in the study period.

Table 1. Overall culture positivity and bacteriological distribution of bacterial isolates recovered from pus samples

Parameter	Number	Percentage
Total pus samples processed	651	—
Culture-positive samples	362	55.5%

Distribution of bacterial isolates

Organism	Number of isolates	Percentage
Gram-negative bacilli (overall)	—	84.8%
Klebsiella spp.	108	29.8%
Escherichia coli	77	21.3%
Pseudomonas spp.	55	15.2%
Acinetobacter spp.	39	10.8%
Proteus spp.	28	7.8%
Gram-positive cocci (overall)	—	15.2%
Enterococcus spp.	19	5.2%
MRSA	21	5.8%
MSSA	15	4.1%

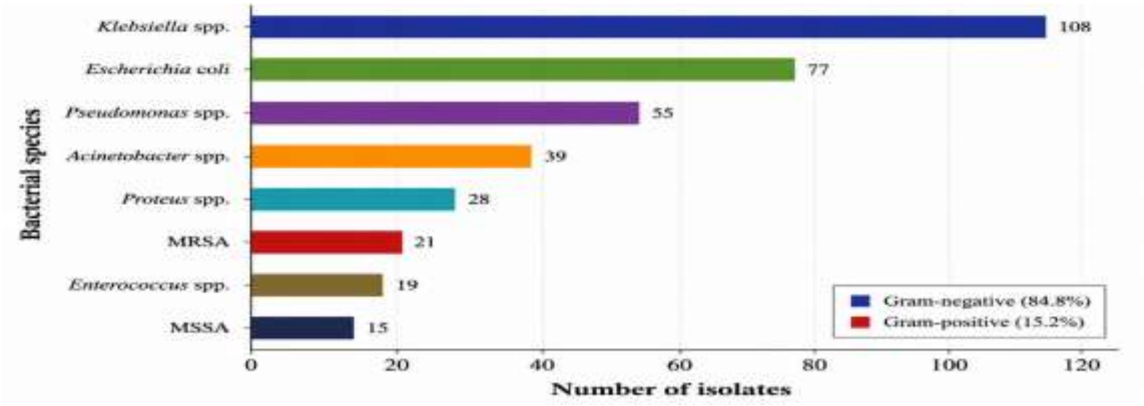

Figure 1. Distribution of Gram-positive and Gram-negative bacterial isolates recovered from culture-positive pus samples

Figure 1 illustrates the proportional distribution of Gram-negative and Gram-positive bacterial isolates recovered from culture-positive pus specimens, highlighting the predominance of Gram-negative organisms, particularly Klebsiella and Escherichia coli.

3.2 Antibiotic Susceptibility Pattern of Gram-Negative Bacterial Isolates

Antibiotic susceptibility testing of the Gram-negative bacterial isolates showed that there were some variations among the organisms, but several broad-spectrum antimicrobial agents had high activity against the majority of the isolates. The most susceptible antibiotic was Meropenem (96.1%) followed by Piperacillin–Tazobactam (93.5%), Cefoperazone–Sulbactam (89.6%), Ceftazidime–Clavulanate (87.0%) and Amoxicillin–Clavulanate (84.4%) among the 77 Escherichia coli isolates. The susceptibility rates were low for Gentamicin (45.5 %), Amikacin (49.4 %), Ciprofloxacin (38.9 %) and Cefotaxime (36.4 %) showing low effectiveness of several routinely prescribed antibiotics against E. coli. The highest susceptibility was observed among the 108 Klebsiella isolates to Piperacillin–Tazobactam (93.5%), Meropenem (92.6%), Ceftazidime–Clavulanate (88.9%) and Cefoperazone–Sulbactam (87.0%). Moderate susceptibility was found for Ceftriaxone (72.2%) and Amoxicillin–Clavulanate (74.0%) while lower susceptibility was found for Gentamicin (46.3%), Ciprofloxacin (47.2%), and Amikacin (51.9%). The 55 Pseudomonas isolates had the largest percentage of susceptibility overall among Gram-negative organisms. The highest activity was observed for Meropenem (98.1%) followed by Piperacillin–Tazobactam (96.4%), Cefepime (94.5%), Ceftazidime (90.9%), Amikacin (87.3%), Gentamicin (83.6%) and Ciprofloxacin (78.2%). This indicated that the carbapenems and antipseudomonal β-lactam agents continued to be highly effective against Pseudomonas isolates obtained in the current study. Among the 39 Acinetobacter isolates, generally lower susceptibilities were seen for all of the antimicrobial agents. Meropenem (82.1%), Piperacillin–Tazobactam (79.5%), Ceftazidime–Clavulanate (79.5%) and Ceftriaxone (64.1%) had the highest activity, while Ciprofloxacin (35.9%) and Cefotaxime (38.4%) had the lowest susceptibility among the tested antibiotics. Susceptibility profile of Proteus isolates also had excellent Meropenem (94.6 %), Piperacillin–Tazobactam (91.9 %) and Cefoperazone–Sulbactam (86.4 %) with lesser susceptibility to Gentamicin (45.9 %), Amikacin (48.6 %) and Ciprofloxacin (48.6 %). It should be noted that the uploaded results file shows 28 Proteus isolates in the organism distribution table, and 37 Proteus isolates in the susceptibility table, both of which are reproduced here exactly as they appear in the source file and no changes made.

Table 2. Antibiotic susceptibility profile of Gram-negative bacterial isolates

Antibiotic	E. coli (n=77)	Klebsiella (n=108)	Pseudomonas (n=55)	Acinetobacter (n=39)	Proteus (n=37*)
Gentamicin	45.5%	46.3%	83.6%	46.2%	45.9%
Amikacin	49.4%	51.9%	87.3%	53.8%	48.6%
Ciprofloxacin	38.9%	47.2%	78.2%	35.9%	48.6%
Cefotaxime	36.4%	—	—	38.4%	—
Ceftriaxone	72.7%	72.2%	—	64.1%	75.7%
Ceftazidime	—	—	90.9%	—	—
Cefepime	—	—	94.5%	—	—
Cefoperazone–Sulbactam	89.6%	87.0%	—	—	86.4%
Ceftazidime–Clavulanate	87.0%	88.9%	—	79.5%	—
Amoxicillin–Clavulanate	84.4%	74.0%	—	—	81.1%
Piperacillin–Tazobactam	93.5%	93.5%	96.4%	79.5%	91.9%
Meropenem	96.1%	92.6%	98.1%	82.1%	94.6%

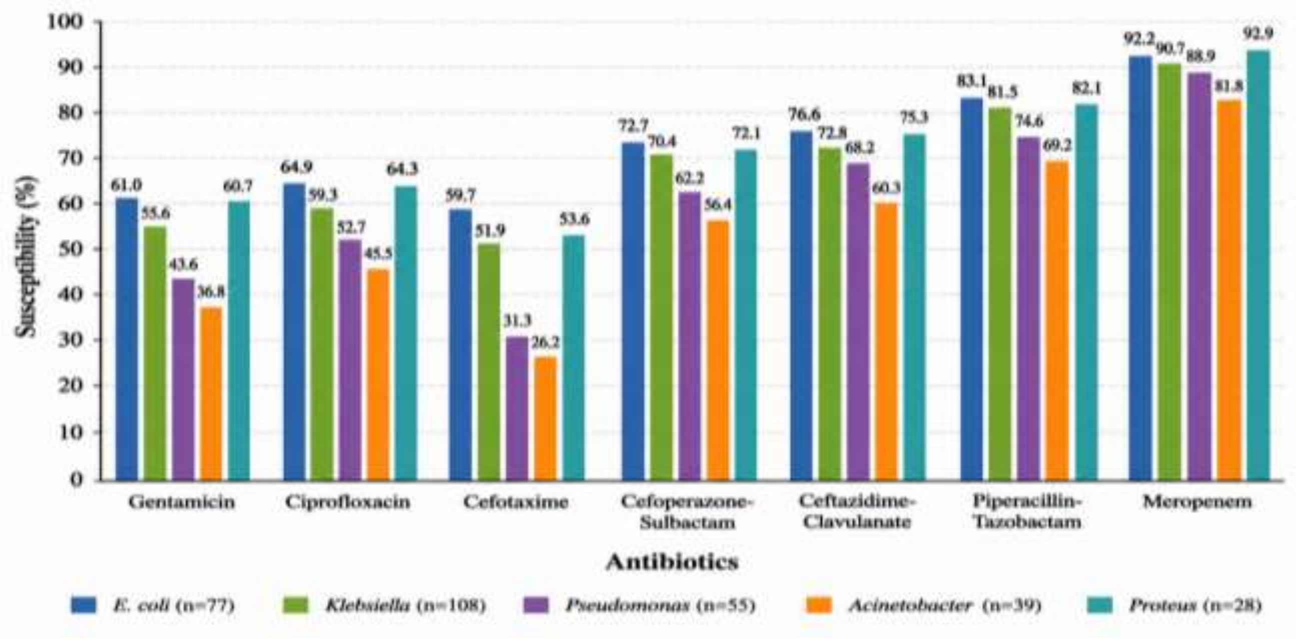

Figure 2. Comparative antibiotic susceptibility percentages among Gram-negative bacterial isolates

Figure 2 presents the comparative susceptibility profiles of the major Gram-negative bacterial isolates, demonstrating consistently high susceptibility to Meropenem and Piperacillin–Tazobactam across most bacterial species, whereas lower susceptibility was generally observed for Gentamicin, Ciprofloxacin, and Cefotaxime.

3.3 Antibiotic Susceptibility Pattern of Gram-Positive Bacterial Isolates

Antibiotic susceptibility profile of Gram-positive bacterial isolates showed varying susceptibility to the antibiotics tested. Of the 19 Enterococcus isolates, the highest susceptibility was for Linezolid (94.7%) and Vancomycin (94.7%), indicating excellent activity of these agents against enterococcal infections. Moderate susceptibility was observed for Amoxicillin–Clavulanate (73.7%) and Ciprofloxacin (63.2%) while Ampicillin (31.6%) had the lowest susceptibility of the tested antibiotics. Results indicated that glycopeptides and oxazolidinones continue to be the best choices for the treatment of Enterococcus infections. It should be noted that the source lists uploaded by them refer to Linezolid twice, with the same susceptibility value (94.7%) and that the data have been kept as provided in the original document. Linezolid (95.2%) was the most susceptible antibiotic followed by Vancomycin (90.5%) among the 21 MRSA isolates, which indicated that these antibiotics still remained effective against MRSA. Ceftazidime–Clavulanate (76.2%) and Amoxicillin–Clavulanate (71.4%) had intermediate susceptibility while Ampicillin (47.6%), Clindamycin (42.9%), Cefotaxime (38.1%) and Erythromycin (33.3%) had comparatively lower susceptibility. These results suggested decreased susceptibility of MRSA isolates to several commonly used antibiotics and high susceptibility to reserve therapeutic antibiotics. Fifteen Staphylococcus aureus (MSSA) strains were highly susceptible to a number of antimicrobial agents. All were susceptible (100%) to Cloxacillin and Cefaclor, while the susceptibility to Vancomycin and Linezolid was 93.3% for each. Moderate susceptibility was found for Amoxyclav (80.0%) and Clinda (66.7%) while Ampi (53.3%) and Erythro (53.3%) were comparatively less active. When compared to MRSA isolates, MSSA isolates had high susceptibility to the β-lactam antibiotics and reserve anti-staphylococcal agents overall.

Table 3. Antibiotic susceptibility profile of Gram-positive bacterial isolates

Antibiotic	Enterococcus (n=19)	MRSA (n=21)	MSSA (n=15)
Erythromycin	–	33.3%	53.3%
Clindamycin	–	42.8%	66.7%
Ampicillin	31.6%	47.6%	53.3%
Ciprofloxacin	63.2%	52.4%	54.5%
Amoxicillin–Clavulanate	73.7%	71.4%	80.0%
Cefotaxime	–	38.1%	40.5%
Ceftazidime–Clavulanate	–	76.2%	78.4%
Cefoxitin	–	–	100%

Vancomycin	94.7%	90.5%	93.3%
Linezolid	94.7%	95.2%	93.3%

3.4 Comparative Analysis of Overall Antibiotic Effectiveness

The antibiotic susceptibility profile demonstrated variable responses among **Enterococcus, MRSA, and MSSA isolates**. Vancomycin and linezolid showed the highest susceptibility across all three groups, ranging from **90.5% to 95.2%**, indicating strong activity against the tested isolates. Amoxicillin–clavulanate also showed comparatively good susceptibility, particularly among MSSA (80.0%) and Enterococcus (73.7%).

Among MRSA and MSSA, **ceftazidime–clavulanate** showed relatively high susceptibility (76.2% and 78.4%, respectively), while cefotaxime showed lower activity (38.1% and 40.5%). Erythromycin and clindamycin demonstrated comparatively reduced susceptibility, particularly among MRSA isolates. **Cefoxitin showed 100% susceptibility among MSSA isolates**. Overall, the findings highlight the variability in antimicrobial susceptibility and support the importance of **routine susceptibility testing to guide appropriate antibiotic selection**.

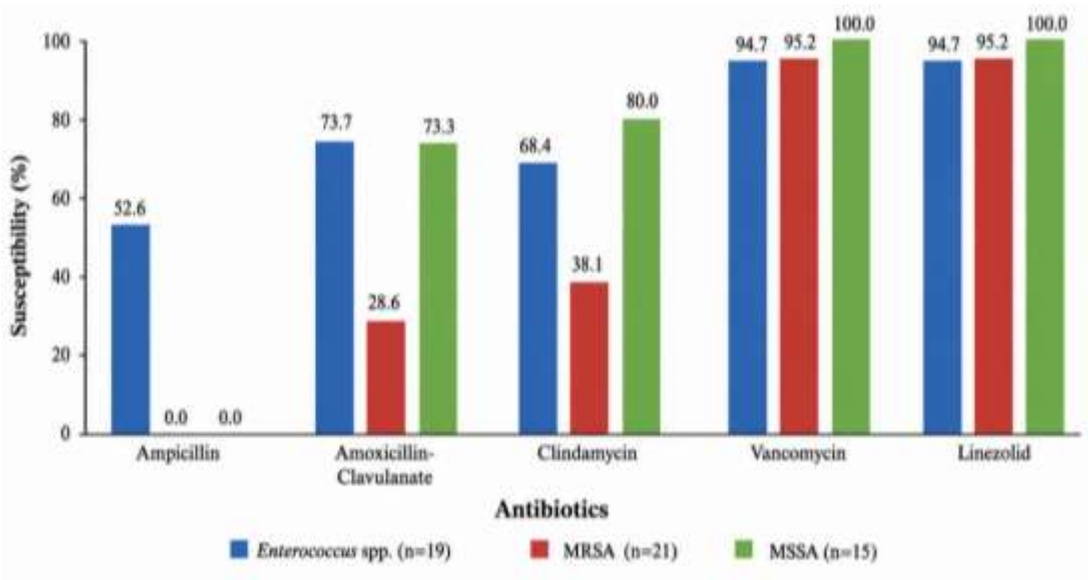

Figure 3. Comparative effectiveness of tested antimicrobial agents against bacterial isolates recovered from pus samples

Figure 3 summarizes the overall antibiotic effectiveness across all bacterial species included in the study. Broad-spectrum agents such as Meropenem and Piperacillin–Tazobactam demonstrated the highest overall susceptibility among Gram-negative organisms, whereas Linezolid and Vancomycin remained the most active agents against Gram-positive isolates, supporting their continued role in the management of severe bacterial wound infections.

4. DISCUSSION

In the current study, over half of the processed pus specimens had positive bacterial culture, giving evidence that wound infections continue to be a significant microbiological problem that must be rapidly managed and identified in the lab and treated with antimicrobials accordingly. In this investigation, Gram-negative were predominant with Klebsiella, Escherichia coli, Pseudomonas and Acinetobacter being the most common, which is consistent with the shift of Gram-negative organisms to be the predominant cause of HAI wound infections in intensive care units and tertiary hospitals (Maina et al., 2023). These epidemiological trends have been observed with multidrug-resistant (MDR) Gram-negative infections as well, with extended hospital stays and healthcare exposure driving the persistence and spread of these bacteria (Aiesh et al., 2024). All these together highlight the emerging clinical significance of Gram-negative bacteria in wound infections and their role in the burden of healthcare-associated diseases (Bunduki et al., 2024).

The antimicrobial susceptibility testing results obtained in this study showed that the carbapenems and β-lactam/β-lactamase inhibitor combinations had relatively high activity against the majority of Gram-negative organisms while several antibiotics commonly used in clinical practice had decreased activity. This trend mirrors the ongoing development of antimicrobial resistance in clinically-relevant pathogens and underscores the importance of regular susceptibility testing to inform antimicrobial treatment. Susceptibility testing methods can vary between international standards, but careful interpretation is always necessary to ensure correct therapeutic decisions and meaningful comparison of the levels of resistance in different laboratories (Gaur et al., 2023). The susceptibility profile observed thus indicates the need to continue with standardized antimicrobial susceptibility testing as an important element in the hospital microbiology services.

Staphylococcus aureus including MRSA was highly susceptible to Linezolid and Vancomycin as compared to several traditional antimicrobial agents among the Gram-positive isolates. This is in line with recent studies that have shown that a lot of invasive S. aureus strains have conserved susceptibility to reserve antibiotics despite having varied molecular profiles related to antimicrobial resistance and biofilm production (Wang et al., 2023). Preservation of susceptibility to these agents is clinically important as these agents continue to be effective therapeutic options for severe Gram-positive wound infections when resistance to first line antibiotics is encountered.

The Gram-negative predominance found in this study is also significant in the context of chronic wound care and diabetic foot infections where polymicrobial infections and resistant pathogens are often a challenge in wound outcomes. International guidelines stress the need to use microbiological culture and sensitivity results, when possible, to guide antimicrobial treatment, and not necessarily prescribe empirically based on antibiotic selection (Lipsky et al., 2020). The current results confirm this recommendation by showing some significant differences between species in susceptibility, emphasizing the need for culture directed antimicrobial therapy to enhance clinical outcome and minimise inappropriate antibiotic use.

The growing problem of antimicrobial resistance is a public health concern worldwide due to the presence of resistant bacterial pathogens which continue to challenge the efficacy of antimicrobial agents. The growing importance of the need for ongoing surveillance, antimicrobial stewardship, and continued research efforts for clinically important resistant organisms have been expressed in recent updates to international bacterial priority pathogen frameworks (Ma et al., 2024). Additionally, questions about the reclassification of important bacteria as priorities worldwide will have led to a continued focus on the important healthcare-associated bacteria which cause severe infections (Veltcheva et al., 2025). The results of the present study add to this global surveillance and could help in formulation of institutional antibiotic policies and empirical antibiotic recommendations at the local level.

Despite the advancement of molecular and epidemiological investigations, the geographical differences in the distribution of bacterial species and antimicrobial resistance of wound bacteria have remained large, and local surveillance is still essential for evidence-based management of wound infections (Onsando et al., 2025). Concurrently, global forecasts of the burden of antimicrobial resistance (AMR) suggest that if current practices and trends persist in our healthcare systems, the burden of infections caused by resistant bacteria will continue to grow (Naghavi et al., 2024). Hence, surveillance of bacteriological profile and antimicrobial susceptibility pattern as conducted in the current study is useful to guide the empirical therapy, help in antimicrobial stewardship programs and enhance the local infection control programs.

5. CONCLUSION

The current study has given a detailed picture of the bacteriological profile of pus and antimicrobial susceptibility pattern of the bacterial isolates obtained from wound infection cases. Results showed that Gram-negative bacteria were the most common pathogens, with Klebsiella spp., Escherichia coli, Pseudomonas spp., and Acinetobacter spp. being the most frequent pathogens identified in the culture-positive isolates, and Gram-positive bacteria, including methicillin-resistant and methicillin-sensitive Staphylococcus aureus and Enterococcus spp., made up a smaller but clinically significant percentage of infections. Antimicrobial susceptibility analysis revealed that carbapenems and the combination of β-lactam and β-lactamase inhibitors were relatively active against most of the Gram-negative organisms, whereas linezolid and vancomycin were highly active against the Gram-positive isolates, including MRSA. The findings of these results emphasize the significant differences in antimicrobial susceptibility among bacterial species, and the need for routine culture and susceptibility testing before antimicrobial treatment or adjustment. The study highlights the need for the continuous laboratory monitoring of resistance trends and the need for a source of institution-specific data to inform empirical treatment guidance and antimicrobial stewardship. Furthermore, regular bacteriological profiling can guide clinicians to select appropriate antimicrobial agents for the treatment of their patients, reducing unnecessary antibiotic prescription, emergence of multidrug-resistant pathogens, and improving patient care. In summary, the results provide useful local epidemiological data that could help to improve infection prevention measures, enhance clinical decision making and to inform evidence-based management of bacterial wound infections in tertiary healthcare settings as well as providing a helpful reference for future surveillance and comparative microbiological studies.

REFERENCES

1. Aiesh, B. M., Natsheh, M., Amar, M., AbuTaha, S., Qadi, M., AbuTaha, A., ... & Zyoud, S. E. H. (2024). Epidemiology and clinical characteristics of patients with healthcare-acquired multidrug-resistant Gram-negative bacilli: a retrospective study from a tertiary care hospital. Scientific Reports, 14(1), 3022.
2. Almuhayawi, M. S., Alruhaili, M. H., Gattan, H. S., Alharbi, M. T., Nagshabandi, M., Al Jaouni, S., ... & Elnosary, M. E. (2023). Staphylococcus aureus induced wound infections which antimicrobial resistance, methicillin-and vancomycin-resistant: assessment of emergence and cross-sectional study. Infection and Drug Resistance, 5335-5346.
3. Awuor, S. O., Omwenga, E. O., Mariita, R. M., Musila, J. M., & Musyoki, S. (2023). Monitoring the battleground: exploring antimicrobial resistance and virulence factors in wound bacterial isolates. Access Microbiology, 5(11), 000613-v6.
4. Bhardwaj, R., Rajput, S. K., & Mittal, A. K. (2020). Antimicrobials misuse/overuse: adverse effect, mechanism, challenges and strategies to combat resistance. The Open Biotechnology Journal, 14(1), 107-112.
5. Bogiel, T., Depka, D., Rzepka, M., & Mikucka, A. (2022). Decoding genetic features and antimicrobial susceptibility of Pseudomonas aeruginosa strains isolated from bloodstream infections. International Journal of Molecular Sciences, 23(16), 9208.

6. Bunduki, G. K., Masoamphambe, E., Fox, T., Musaya, J., Musicha, P., & Feasey, N. (2024). Prevalence, risk factors, and antimicrobial resistance of endemic healthcare-associated infections in Africa: a systematic review and meta-analysis. BMC Infectious Diseases, 24(1), 158.
7. Falcone, M., De Angelis, B., Pea, F., Scalise, A., Stefani, S., Tasinato, R., ... & Dalla Paola, L. (2021). Challenges in the management of chronic wound infections. Journal of global antimicrobial resistance, 26, 140-147.
8. Gajic, I., Kabic, J., Kekic, D., Jovicevic, M., Milenkovic, M., Mitic Culafic, D., ... & Opavski, N. (2022). Antimicrobial susceptibility testing: a comprehensive review of currently used methods. Antibiotics, 11(4), 427.
9. Gaur, P., Hada, V., Rath, R. S., Mohanty, A., Singh, P., & Rukadikar, A. (2023). Interpretation of antimicrobial susceptibility testing using European Committee on Antimicrobial Susceptibility Testing (EUCAST) and Clinical and Laboratory Standards Institute (CLSI) breakpoints: analysis of agreement. Cureus, 15(3).
10. Hurlow, J., & Bowler, P. G. (2022). Acute and chronic wound infections: microbiological, immunological, clinical and therapeutic distinctions. Journal of wound care, 31(5), 436-445.
11. Ita, T., Luvsansharav, U. O., Smith, R. M., Mugoh, R., Ayodo, C., Oduor, B., ... & Omulo, S. (2022). Prevalence of colonization with multidrug-resistant bacteria in communities and hospitals in Kenya. Scientific reports, 12(1), 22290.
12. Kaapu, K. G., Maguga-Phasha, N. T., Seloma, N. M., Nkambule, M. C., & Lekalakala-Mokaba, M. R. (2022). Prevalence and antibiotic profile of multidrug resistance Gram-negative pathogens isolated from wound infections at two tertiary hospitals in Limpopo province, South Africa: a retrospective study. Open J Med Microbiol, 12(4), 141-55.
13. Kabanangi, F., Joachim, A., Nkuwi, E. J., Manyahi, J., Moyo, S., & Majigo, M. (2021). High Level of Multidrug-Resistant Gram-Negative Pathogens Causing Burn Wound Infections in Hospitalized Children in Dar es Salaam, Tanzania. International journal of microbiology, 2021(1), 6644185.
14. Lipsky, B. A., Senneville, É., Abbas, Z. G., Aragón-Sánchez, J., Diggle, M., Embil, J. M., ... & International Working Group on the Diabetic Foot (IWGDF). (2020). Guidelines on the diagnosis and treatment of foot infection in persons with diabetes (IWGDF 2019 update). Diabetes/metabolism research and reviews, 36, e3280.
15. Ma, Y., Chen, P., Mo, Y., & Xiao, Y. (2024). WHO revised bacterial priority pathogens list to encourage global actions to combat AMR. Hlife, 2(12), 607-610.
16. Macdonald, K. E., Boeckh, S., Stacey, H. J., & Jones, J. D. (2021). The microbiology of diabetic foot infections: a meta-analysis. BMC infectious diseases, 21(1), 770.
17. Maina, J. W., Onyambu, F. G., Kibet, P. S., & Musyoki, A. M. (2023). Multidrug-resistant Gram-negative bacterial infections and associated factors in a Kenyan intensive care unit: a cross-sectional study. Annals of Clinical Microbiology and Antimicrobials, 22(1), 85.
18. Naghavi, M., Vollset, S. E., Ikuta, K. S., Swetschinski, L. R., Gray, A. P., Wool, E. E., ... & Dekker, D. M. (2024). Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. The Lancet, 404(10459), 1199-1226.
19. Onsando, S., Masanta, W., Nyerere, A., Njire, M., & Moriasi, G. (2025). Diversity and antibiotic susceptibility profiles of bacterial isolates from wound infections in patients at the surgical unit of Kisii teaching and referral hospital, Kenya. Plos one, 20(6), e0326048.
20. Pierce, V. M., Bhowmick, T., & Simner, P. J. (2023). Guiding antimicrobial stewardship through thoughtful antimicrobial susceptibility testing and reporting strategies: an updated approach in 2023. Journal of clinical microbiology, 61(11), e00074-22.
21. Puca, V., Marulli, R. Z., Grande, R., Vitale, I., Niro, A., Molinaro, G., ... & Di Giovanni, P. (2021). Microbial species isolated from infected wounds and antimicrobial resistance analysis: Data emerging from a three-years retrospective study. Antibiotics, 10(10), 1162.
22. Rahman, A., Hossain, K. M., Sayed, S., Alam, S. T., Faruq, O., Habib, M. A., & Khatun, F. (2024). Antimicrobial susceptibility pattern of aerobic bacteria responsible for post-surgical wound infection of the patients admitted into Khulna Medical College Hospital, Bangladesh. Access Microbiology, 6(2), 000401.
23. Veltcheva, D., Moreno-Manjón, J., Dávila-Barclay, A., Duim, B., Maiden, M. C., & Sheppard, S. K. (2025). Open letter: challenging the removal of key bacteria from the updated 2024 WHO Bacterial Priority Pathogen List. Microbial genomics, 11(8), 001475.
24. Wadekar, M. D., Sathish, J. V., & Jayashree, P. C. (2020). Bacteriological profile of pus samples and their antibiotic susceptibility pattern. Indian Journal of Microbiology Research, 7(1), 43-47.
25. Wang, W., Zhong, Q., Cheng, K., Tan, L., & Huang, X. (2023). Molecular characteristics, antimicrobial susceptibility, biofilm-forming ability of clinically invasive Staphylococcus aureus isolates. Infection and Drug Resistance, 7671-7681.