Original Research Article

Bacteriological profile and antimicrobial susceptibility patterns of secondary infections in burn patients: a cross-sectional and observational study in a tertiary care hospital of eastern India

Tirtharaj Halder[1],Suhena Sarkar [2] ,BiyankaSau[3],Krishna Kumar [4], Swagata Laxmi Kayal[5], Subhranil Mal [6],DhritimanMaitra[7*]

[1]Non-academic Junior Resident, Department of IHBT,Medical College and Hospital Kolkata,West Bengal,India
[2]Associate Professor, Department of Pharmacology, Medical College and Hospital Kolkata,West Bengal,India

[3]Associte Professor, Department of Microbiology, Sarat Chandra Chattopadhyay Government Medical College and Hospital,Uluberia,
[4]PhD(Population Studies), M.Phil(Population Studies),Msc.(Population Studies), BSc. (Statistics), Department of Biostatistics, ICMR-RM NIHR,Patna, Bihar,India
[5]Post Graduate Trainee, Department of Pharmacology, Medical College and Hospital Kolkata, West Bengal,India
[6]3rd Proff Part 2 MBBS, Medical College and Hospital, Kolkata, West Bengal,India
[7] Associate Professor, Department of General Surgery, Medical College and Hospital Kolkata,West Bengal,India

Received: 02-09-2026 / Revised: 22-10-2026 / Accepted: 01-11-2026

Abstract

Burn patients, specifically severe cases, are at a high risk of developing bacterial infections compared to others.Many advancements have reduced the incidence of burn wound infections over the last few decades and these include timely antimicrobial therapies , both topical and systemic, early excision and closure of burn wounds and the introduction of infection control measures in modern burn units such as isolation facilities.

Keywords: bacteriological,profile,antimicrobial

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Infections persist as an important complication and cause of mortality in burn patients.Nosocomial bacterial infections have been one of the major concerns in the healthcare system. [1-4]Disrupted skin barrier, involvement of larger burnt area, immunocompromised effects of burns and prolonged stays at the hospitals were major risk factors for initiating infection[5-8] Burn patients, specifically severe cases, are at a high risk of developing bacterial infections compared to others[2].Many advancements have reduced the incidence of burn wound infections over the last few decades and these include timely antimicrobial therapies , both topical and systemic, early excision and closure of burn wounds and the introduction of infection control measures in modern burn units such as isolation facilities. Deaths due to hypovolemia and hyperosmolar shock are uncommon now due to the advancement of resuscitation methods in burn patients.Meanwhile, sepsis is now the commonest cause of death following burn injury and contributes to almost 75-85% of all burn victims' deaths[11-13].Systematic review and meta analysis has shown that gram negative organisms predominate a burn wound. It establishes that burn wound infection does not differ significantly between burn centers. Whilst burn wound infection is not exclusive to these bacteria, it is hoped that reporting the presence of a common group of organisms termed as 'target organism' facilitates clinical practice and targets research towards a defined clinical demand. Pseudomonas,Klebsiella, E.coli, Proteus, Acinetobacter, staphylococcus are the commonest group of organisms isolated from clinically infected burn wounds regardless of the centers. It is however acknowledged that there could be other bacteria that could infect burn wounds and it is important to monitor emerging infections. Knowing the target organisms and their timely surveillance of resistance patterns to various classes of antibiotics may contribute to timely clinical treatment by describing the right antibiotics and to facilitate a rationalized, targeted and expedited antimicrobial

*Correspondence
Dr. Subhranil Mal
3rd Proff Part 2 MBBS, Medical College and Hospital, Kolkata, West Bengal,India
E-mail:subhranilmal @gmail.com

development[14,15]Global antibiotic resistance partnership(GARP) recommends national surveillance of antibiotic resistance and antibiotic use which will give better information to underpin decisions on standard treatment guidelines and monitor changes over time[7].Hence the present study has been designed to gather evidence-based significant data about the pattern of antibiotic resistance and sensitivity in burn patients admitted in Medical College, Kolkata to enrich the data sources and reduce the lacunae of the same.Studies of wound microbiology, particularly in burn injuries and surgical site infections , suggest a shift in bacterial colonisation over time. In the initial phase after injury,Gram-positive organisms such as Staphylococcus aureus , predominate. However, with the increasing duration of stay at the hospital, these organisms are gradually replaced by Gram-negative organisms such as Pseudomonas aeruginosa , Klebsiella spp., Acinetobacter spp.,and Escherichia coli[15-18] Lawrence and Lilly (1972) advocated the use of quantitative methods for studying burn wound bacteriology , emphasising the importance of microbial load in determining invasive infection.Quantitative studies offer an efficient and more accurate understanding of burn wounds and the systemic infection that can result from heavy wound colonization[10].Despite advances in burn wound management, burn wound infections remain a major challenge even in modern burn care units and continue to be a leading cause of morbidity and mortality in burn patients[24-27] Church et al.(2006) emphasized that organisms such as Staphylococcus aureus, Pseudomonas aeruginosa and Acinetobacter species are frequently responsible for invasive burn wound infections and that timely microbiological monitoring is crucial for the patient. Similar studies have been reported in developing countries as well, such as in Nigeria, Pakistan and Turkey among others.Studies with similar bacteriological patterns, in case of burn wound infections,are found in India as well. Sharma and Hans[28], in a three-year study from Delhi, reported a high burden of bacterial infections among burn patients, stressing the importance of early diagnosis and treatment. Further studies on the bacteriology of burns revealed that Gram-negative organisms, mainly Pseudomonas aeruginosa, were commonly associated with burn wound infections[29,30]In a five -year study on aerobic bacterial isolates from burn patients and their antibiograms, Agnihotri et al., (2004), reported the predominance of pathogens like Pseudomonas klebsiella and Staphylococcus aureus, with increasing resistance to commonly used antibiotics.[31]Similar studies indicated changing trends in bacterial isolates and highlighted the emergence of multidrug-resistant organisms in burn units[20,12]..Burn wound infections are not only caused by bacterial pathogens but by fungal pathogens as well[32].. Polymicrobial infections increase the complications in burn wound patients,making it increasingly difficult to manage and treat them in hospital settings.With longer stays at the hospital, these patients likely develop multi-drug resistance[14].A study conducted by Nityadarshini et al.(2025)[11] showed that Carbapenem-resistant Gram - negative bacteria is particularly concerning in Burn ICU patients with 83.5% of patients reporting Carbapenem resistance. This is associated with higher TBSA, longer hospital stays and mortality. Buzaid et al., (2011)[5]reported methicillin-resistant Staphylococcus aureus in a tertiary surgical and trauma unit , emphasizing its significance in hospital-acquired infections.These studies underscore the complex and dynamic nature of the burn wound infections,posing significant challenges to patient management in hospitals due to their high morbidity,prolonged hospital stay, intensive resource requirements and increasing multi-drug resistance,further complicating the treatment outcomes. Hence, there is a need for systematic and cross-sectional studies in resource -scarce regions to generate region -specific data on microbial profiles and antimicrobial susceptibility patterns,enabling efficient infection control strategies,guiding empirical antibiotic therapy and improving overall patient care and outcomes in burn units.Despite multiple studies on burn wound infections, there is lack of recent, region – specific data from Eastern India, particularly focusing on secondary infections acquired after hospital admission. Most available studies are either retrospective or do not adequately correlate microbiological findings with clinical parameters such as burn severity and burn characteristics. Furthermore, evolving antimicrobial resistance patterns necessitates updated data to guide rational antibiotic therapy.Furthermore, given the rising global concern of antimicrobial resistance in burn units, there is a need for updated, region -specific data from tertiary care centres in Eastern India.The present study aims to address this gap by evaluating the current bacteriological profile and antimicrobial susceptibility pattern of secondary infections in burn patients, which will help in rational antimicrobial therapy and improve patient care and management in hospitals.A similar study was conducted

in SUM Hospital, Odisha, "Evaluation of Burn WounMicrobes and their Antibiotic d Susceptibility Pattern" by Rout et al. (2025) , which showed that the predominant microbes isolated from burn wounds were Pseudomonas aeruginosa, followed by Klebsiella pneumoniae and Acinetobacter baumannii , and the occurrence of infections was more often in male patients than females. The study also mentioned that the primary factor influencing multidrug resistance was the total body surface area burnt. In another study, " Burn Wound microbiology and antimicrobial resistance patterns in a tertiary care burn unit in Northeast India" by Parthapratim Dutta et al. (2025) , it was shown that there was a shift in microorganisms causing secondary infections of burn wounds,from Gram-positive to multi-drug resistant Gram-negative organisms,predominantly Pseudomonas and Acinetobacter. It also emphasized that the causative organisms were mostly resistant to Cephalosporins, fluoroquinolones, beta -lactams and that regular surveillance and proper usage of antibiotics are essential for improving patient outcomes.[33,34]

Aim and objectives

The study aimed to investigate the recent trends in the bacteriological profile associated with secondary infections in burn patients and their antimicrobial sensitivity and resistance,to assess the prevalence of multi drug-resistant organisms including MRSA and Carbapenem resistant Gram-Negative bacilli,toanalyse the association between burn characteristics (TBSA, depth) and the occurrence of secondary bacterial infections as well as to correlate the degree of burn with the type of microbial flora of secondary infections of burn patients admitted in Burn Unit of Department of General Surgery, Medical College and Hospital, Kolkata.

Material and methods

This cross-sectional observational study was conducted for six months in the Burn Unit of the Department of General Surgery, in collaboration with the Departments of Microbiology and Pharmacology, at Medical College and Hospital, Kolkata. We enrolled patients of any age or sex admitted with thermal, electrical or chemical burns. Hospital records from the preceding six months showed 66 burn admissions. Adding a 10% allowance for dropouts gave a target of 73 patients, and all 73 were recruited.Patients with burns covering more than 10% of total body surface area (TBSA) who showed clinical signs of wound infection (pus, discolouration or foul odour) and gave informed consent were included. Patients with burns under 10% TBSA, those who died within 24 hours of admission, those on long-term antibiotics, those with superficial burns that did not need admission, immunocompromised patients, and anyone who declined consent were excluded.On day 3 of admission (no earlier than 72 hours after arrival), wound swabs were taken under aseptic conditions and sent to the Microbiology Department. The samples were Gram stained, cultured and put through biochemical tests to establish the bacteriological profile of secondary burn wound infections. Organism identification and antimicrobial resistance patterns were determined with the VITEK and BD BACTEC systems as laid out in the study protocol. ATCC reference strains for Gram-positive and Gram-negative bacteria were used for quality control.A structured case record form captured demographic details of patients including age, sex, cause of burn, burn depth and TBSA involved. Culture results and antibiograms were recorded alongside these and analysed to look for links between burn characteristics and secondary bacterial infection. Data was entered into Microsoft Excel and analysed in SPSS. Demographic, clinical and microbiological features were summarised with descriptive statistics, with categorical variables reported as frequencies and percentages. Associations between categorical variables were tested with the chi-square test where appropriate, and $p < 0.05$ was taken as statistically significant.

Sample size calculation

A census-based sampling method was adopted to maximize inclusivity and minimize selection bias. Based on hospital records, a total of 66 burn patients were admitted over the preceding six -month period. Assuming a similar admission trend during the study duration, the entire accessible population was taken as the sampling frame. Since the study aimed to include all eligible burn patients (census method), the total population method was employed. To account for the potential attrition, including loss to follow up, early discharge against medical advice, referral, mortality prior to assessment, or incomplete data collection, an additional 10% attrition was incorporated.

Attrition adjustment

10% of 66=6.6 ~7patients

Adjusted sample size=66+7=73 patients

Thus, the final projected sample size was 73 patients, ensuring adequate power to compensate for anticipated attrition while maintaining our comprehensive population representation.

ETHICAL CONSIDERATIONS:

Prior ethical clearance had been taken before commencing the study from the IEC (Ref No.MC/KOL/IEC/3100/03/2026, dated 10/03/2026) in

order to safeguard participant rights and welfare.Unique identification numbers were assigned to the participants and access was restricted to authorized personnel only to maintain the confidentiality of participant information throughout the study.Participation was voluntary, informed consent was taken, wherever applicable,and the participants had the right to refuse or withdraw from the study without affecting their treatment.

Results

Objective 1: To correlate the degree of burn with the type of microbial flora of secondary infections of burn patients admitted in Burn Unit of Department of General Surgery, Medical College and Hospital, Kolkata

Table 1. Demographic and clinical profile of burn patients, Kolkata

Total patients	**n = 73**
***Age (in yrs.)**	43.78 ± 19.55
#Gender	
Male	15 (20.55)
Female	58 (79.45)
***Length of stay**	5.43± 2.36
***TBSA (%)**	44.38 ± 22.01
#Types of burn	
Thermal	69 (94.52)
Electric	2 (2.74)
Chemical	2 (2.74)
#Degree of burn	
Second	28 (38.36)
Third	45 (61.64)
# Mortality	
Survived	46 (63.01)
Dead	27 (36.99)
*Continuous variables are presented in means ± standard deviation	
#Categorical variables are presented in frequency (percentage)	

Table 2. Bivariate distribution and chi-square test for microbial type and degree of burn among burn patients, Kolkata

	Degree of burn [n, (%)]			Chi-sq. value	p-value
Microbial type	**Third**	**Second**	**Total**		
Gram negative	29 (85.29)	5 (14.71)	34 (100)	2.18	0.14
Gram positive	5 (62.50)	3 (37.50)	5 (100)		
Total	34 (80.95)	8 (19.05)	42 (100)		
• **Total 73 patients, in 31 patients no growth of bacteria was observed**					

Table 2 shows out of total 73 patients, 31 patients had no growth of bacteria/secondary infection. In 42 patients, the majority of the patients (29, 85.29%) with gram negative microbial type had third degree of burn and only 5 (14.71%) patients had second degree of burn. On the other hand, in the gram-positive microbial type, out of total 8 patients, 5 patients suffered from third degree burns. microbial type data were not available for 31 patients. Moreover, the chi-square test showed there is no statistically significant association (p=0.14) between microbial type and degree of burn among burn patients.

Objective 2: To analyse the association between burn characteristics (TBSA, depth), and the occurrence of secondary bacterial infections.

Table 3. Univariate distribution of organism isolated (secondary infection agents) from burn patients, Kolkata

Organism isolated	Freq.	Percent
Acinetobacter baumannii complex	5	6.85
Bacillary contamination	1	1.37
Citrobacter amalnaticus	1	1.37
E.Coli	11	15.07
Klebsiella pneumonia	2	2.74
Klebsiella spp	7	9.59
No Growth	30	41.10
Proteus mirabilis	1	1.37
Pseudomonas aeruginosa	7	9.59
S. Aureus	8	9.59
Staphlycoccus hemolyticus	1	1.37
Total	73	100

Table 4. Univariate distribution of TBSA (%) among burn patients, Kolkata

TBSA (%)	Frequency	Percent
<30	27	36.99
30-50	21	28.77
51-70	13	17.81
71-90	12	16.44
Total	73	100.00

Table 5. Results of Chi-square test.

Pearson chi -sq value= 100.00	P-value= <0.001

The chi-sq. test showed that there exists strong and significant correlation between TBS (%) and organism isolated (secondary infection agents)

Objective 3:To investigate the recent trends in the bacteriological profile associated with secondary infections in burn patients and their antimicrobial sensitivity and resistance

Table 6. Trends of secondary infection rate among burn patients, Kolkata

Month	Frequency	Percent	Total
January	16	66.67	24
February	9	60.00	15
March	5	45.45	11
April	1	14.29	7
May	6	66.67	9
June	5	71.43	7
Total	42	57.50	73

Table 6 shows trends of secondary infections by months (January to June, 2026). January reported highest infection rate (66.67%, N=24) and April recorded lowest infection rate of 14% (N=7).

Table 7. Trends in the bacteriological profile associated with secondary infections in burn patients, Kolkata

	January	February	March	April	May	June	Total
Bacteriological profile	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	N (%)

Acinetobacter baumannii complex	2 (12.5)	2 (22.2)	-----	-------	1 (16.7)	------	5 (12)
E.Coli	5 (31.3)	2 (22.2)	-----	------	1 (16.7)	3 (60.0)	11 (26)
Klebsiella pneumoniae	1 (6.3)	-----	-----	------	1 (16.7)	------	2 (5)
Klebsiella spp	2 (12.5)	1 (11.1)	2 (40.0)	------	1 (16.7)	1 (20.0)	7 (17)
Proteus mirabilis	1 (6.3)	-----	-----	-----	-----	------	1 (2)
Pseudomonas aeruginosa	2 (12.5)	3 (33.3)	1 (20.0)	------	1 (16.7)	------	7 (17)
S Aureus	3 (18.8)	1 (11.1)	1 (20.0)	1 (100.0)	1 (16.7)	------	7 (17)
Citrobacter amalnaticus	-------	-------	1 (20.0)	-----	-----	-----	1 (2)
Staphlycoccus hemolytics	------	-------	------	------	------	1 (20.0)	1 (2)

Table 7 shows trends of bacterium profile by months (January to June, 2026). We found out of 73 patients; 42 patients had secondary infections. 16 patients got affected with infection in January, 9 in February, 5 in march, 1 in April, 6 in May and 5 in June. E. coli bacteria caused the secondary infection in majority of burn patients (11, 26%), followed by Klebsiellaspp (7, 17%), Pseudomonas aeruginosa (7, 17%) and S Aureus (7, 17%).

Objective 4: **To assess the prevalence of multidrug-resistant organisms including MRSA and Carbapenem resistant Gram-Negative bacilli**.

The prevalence of Carbapenem resistant Gram-Negative bacilli and MRSA was found to be 46.6 % (32/73) and 1.3% (1/73) among burn patients (Table8).

Table 8. Descriptive analysis of Carbapenem resistant Gram-Negative bacilli and MRSA associated with secondary infections in burn patients, Kolkata

	Frequency	Percent
Carbapenem resistant Gram-Negative bacilli	**34**	**46.58**
Break-up: Profile of Gram-Negative Bacteria		
Acinetobacter Baumannii complex	5	6.85

E.Coli	11	15.07
Pseudomonas Aeruginosa	7	9.59
Klebsiella pneumonia	2	2.74
Klebsiella spp	7	9.59
Citrobacter amalnaticus	1	1.37
Proteus mirabilis	1	1.37
----------MRSA----------		
MRSA	**1**	**1.37**

Discussion

In the present study, evaluation of 73 burn patients admitted to the Burn Unit, Department of General Surgery, Medical College and Hospital, Kolkata,was done over a period of six months, from January to June 2026. 42 patients (57.50%) showed secondary bacterial infections indicating a substantial burden of infection among the study population. Escherichia coli emerged as the predominant species,followed by Klebsiella spp., Pseudomonas aeruginosa and Staphylococcus aureus. Antimicrobial resistance was demonstrated by a major proportion of the bacterial isolates with prevalence of carbapenem-resistant Gram-negative bacilli being 46.6% and methicillin-resistant Staphylococcus aureus (MRSA) being 1.3%.Church et al. described the susceptibility of burn wounds to microbial infection following disruption of the normal skin barrier, while Gupta et al. emphasized on the current need toward active microbial surveillance in all clinical settings and prudent use of antibiotics[6,9].Gram-negative organisms constituted 80.95% whereas Gram-positive organisms constituted 21.42% of the secondary infections profile. E.coli was the principal isolate, prevalent in 26% cases, followed by Klebsiella spp. (7%), P. aeruginosa (17%) and S. aureus (17%). The preponderance of Gram-negative organisms is consistent with the findings of several studies investigating burn wound infections in different geographical settings. Bayram et al.,Atoyebi et al and Ahmad et al. assessed the bacteriological profile of burn wound isolates in Turkey, Nigeria and Pakistan respectively highlighting the importance of geographical and institutional variations in the microbiological profile of burn infections[1,3,4]. Although Pseudomonas aeruginosa has frequently been reported as the most common isolate in burn wounds, our study identified E. coli as the primary microbe.Such variations may be related to differences in patient characteristics, hospital environments, infection-control practices and local microbial ecology.The secondary infections also showed varying rates over the six-month study period. January recorded the highest number of infections, with 16 cases among 24 admitted patients, corresponding to an infection rate of 66.67%. April recorded the lowest infection rate, at 14.29%.The infection rate subsequently increased during May and June, reaching 66.67% and 71.43%, respectively. These findings demonstrate month-to-month variation in the occurrence of secondary infections among burn patients. However, the observed pattern should be interpreted cautiously, as the number of patients admitted during each month varied and the study was conducted over a relatively short period. Thongchompu and Panya investigated the epidemiology and risk factors of burn injuries during the cold season in a regional hospital in Northeast Thailand, highlighting the relevance of seasonal patterns in burn epidemiology[17].Nevertheless, further studies involving larger populations and longer observation periods would be required to establish whether the monthly variations observed in the present study reflect a consistent seasonal trend.Females constituted most of our samples: 58 of the 73 patients (79.45%) were females and 15 (20.55%) were males. Thermal burns accounted for nearly all injuries, 69 patients (94.52%). Electrical and chemical burns were rare, with two cases each (2.74%).The predominance of thermal burns sustained during cooking may reflect the domestic circumstances and occupational roles of individuals in the study population. Sharma et al. examined the bacteriological profile of burn patients and the antimicrobial susceptibility patterns of burn wound isolates, providing relevant evidence regarding the clinical characteristics of patients presenting with burn

injuries[18]. The age distribution in the present study showed that the 31–50-year age group constituted the largest group, with 24 patients, followed by the 10–30-year age group, with 23 patients. Similar observations regarding the occurrence of burn injuries among younger adults have been reported by Sapna G. in a study of bacterial and fungal profiles of burn wound infections[19].These findings emphasise the importance of preventive measures, particularly in domestic settings, alongside timely clinical management of burn injuries.Antimicrobial resistance represented another important finding of the present study. The prevalence of carbapenem-resistant Gram-negative bacilli was reported as 46.6% among the study population. The Gram-negative isolates included E. coli (15.7%), Klebsiella spp. (9.59%) and P. aeruginosa (9.59%), in addition to other Gram-negative organisms. The emergence of resistance to carbapenems is particularly concerning because carbapenems are considered as one of the important therapeutic agents for severe multidrug resistant infections.Nityadarshini et al. investigated bacteriological profiles and antimicrobial resistance patterns in a tertiary Burns ICU, specifically examining carbapenem resistance and bacterial invasion[11].Rathod et al.also reported the emergence of multidrug-resistant bacterial strains among burn wound isolates in a tertiary care centre in Maharashtra[12]while Guo, Xu and Yue conducted a systematic review and meta-analysis examining antimicrobial resistance patterns among P. aeruginosa wound isolates from Chinese burn patients and Alqarni et al. described resistance patterns in a tertiary-care burn unit[2,8]. These studies collectively emphasise the growing challenge posed by antimicrobial resistance in burn care and support the need for regular antimicrobial susceptibility testing and institution-specific antibiotic policies.We found MRSA in 1.3% of our patients. Although this is a low proportion, MRSA is still clinically significant because it can cause severe wound infections and resist the beta-lactam antibiotics commonly used for treatment. Buzaid et al. studied the prevalence of MRSA strains among hospitalised patients in Benghazi, Libya, and their sensitivity towards various antibiotics[5].Taneja et al. reported heavy MRSA contamination of burn wounds and advised strict hand hygiene and barrier precautions to protect wounds from infection[15].These findings point to the need for ongoing surveillance, antimicrobial stewardship and sound infection-control practice to track resistance trends and improve the condition of burn units.The present study also demonstrated a statistically significant association between total body surface area (TBSA) involved in burns and the isolated organisms, with a reported Pearson chi-square value of 100.00 and a p-value of less than 0.001. Patients with greater TBSA involvement were observed to have a higher burden of secondary bacterial infection. Extensive burns result in a greater loss of the protective skin barrier and may be associated with disturbances in immune function, fluid balance and physiological homeostasis, thereby increasing susceptibility to infection. Church et al. discussed the relationship between burn severity, disruption of the skin barrier and the development of burn wound infections[6]. Roy et al. also examined microbial infections in burn patients and highlighted the clinical importance of burn severity in the assessment and management of these infections[14]. The association observed in the present study underscores the importance of close clinical monitoring and appropriate microbiological evaluation in patients with extensive burns.Burn depth was also an important clinical characteristic in the study population. Of the 42 patients who developed secondary wound infections, 34 (80.95%) had third-degree burns and eight (19.05%) had second-degree burns. Gram-negative organisms were isolated from 34 patients, of whom 29 (85.29%) had third-degree burns and five (14.71%) had second-degree burns. Gram-positive organisms were isolated from eight patients, of whom five (62.50%) had third-degree burns and three (37.50%) had second-degree burns.These findings indicate that third-degree burns constituted the majority of infected cases in the present study. Rowan et al. reviewed advances in burn wound healing and treatment, while Roy et al.highlighted the fact that third degree burns fully destroy the epidermal and dermal layers of skin which may provide favourable conditions for microbial proliferation[13-15]. Gram-negative organisms were isolated more often from patients with third-degree burns, but the difference was not statistically significant. Burn depth should therefore be interpreted together with other clinical and microbiological parameters, not used on its own to predict which type of organism is causing the infection.

Conclusion

The present study highlights the fact that secondary bacterial infection remains a major determinant of morbidity and mortality in burn patients, with Gram Negative organisms as the major isolate and substantial rates of multidrug resistance further complicating the scenario. Infection risk correlating with the extent of TBSA and degree of burn reinforces the need for stringent infection control and surveillance, antimicrobial stewardship and regularly updated antimicrobial policies in the Burn Unit.

REFERENCES

1. Ahmad M, Hussain SS, Khan MI, Malik SA. Pattern of bacterial invasion in burn patients at the

Pakistan Institute of Medical Sciences, Islamabad. . 2006;19(1):18-21.
2. Alqarni MS, Attar M, Alshammari S, Ambon B, Al Zhrani AA, Alghamdi A, et al. Common resistance patterns in the burn unit of a tertiary care center: a retrospective observational study. Cureus. 2023;15(8):9
3. Atoyebi O, Sowemimo G, Odugbemi T. Bacterial flora of burn wounds in Lagos, Nigeria: a prospective study. Burns. 1992;18(6):448-51.
4. Bayram Y, Parlak M, Aypak C, Bayram I. Three-year review of bacteriological profile and antibiogram of burn wound isolates in Van, Turkey. Int J Med Sci. 2013;10(1):19-23. doi:10.7150/ijms.4723.
5. Buzaid N, Elzouki A, Taher I, Ghenghesh KS. Methicillin-resistant Staphylococcus aureus (MRSA) in a tertiary surgical and trauma hospital in Benghazi, Libya. J Infect Dev Ctries. 2011;5(10):723-6.
6. Church D, Elsayed S, Reid O, Winston B, Lindsay R. Burn wound infections. ClinMicrobiol Rev. 2006; 19(2):403-34.
7. Global Antibiotic Resistance Partnership (GARP)-India Working Group. Rationalizing antibiotic use to limit antibiotic resistance in India. Indian J Med Res. 2011;134(3):281-94.
8. Guo L, Xu H, Yue Z. Antibiotic resistance pattern of Pseudomonas aeruginosa wound isolates among Chinese burn patients: a systematic review and meta-analysis. Asian Pac J Trop Med. 2022;15(1):17-25.
9. Gupta M, Naik AK, Singh SK. Bacteriological profile and antimicrobial resistance patterns of burn wound infections in a tertiary care hospital. Heliyon. 2019;5(12):12-18
10. Lawrence JC, Lilly HA. A quantitative method for investigating the bacteriology of skin: its application to burns. J ExpPathol. 1972;53(5):550-9.
11. Nityadarshini N, Biswas J, Singhal M, Saha S, Sagar T, Singh K, et al. Bacteriological profile and antimicrobial resistance patterns in clinical isolates from a tertiary Burns ICU: a retrospective comparative analysis of carbapenem resistance and invasion. J Burn Care Res. 2025:1
12. Rathod VS, Kasturi, Raut SS. Emergence of multi-drug resistant strains among bacterial isolates in burn wound swabs in a tertiary care centre, Nanded, Maharashtra, India. Int J Res Med Sci. 2017;5(3):973.
13. Rowan MP, Cancio LC, Elster EA, Burmeister DM, Rose LF, Natesan S, et al. Burn wound healing and treatment: review and advancements. Crit Care. 2015;19:243.
14. Roy S, Mukherjee P, Kundu S, Majumder D, Raychaudhuri V, Choudhury L. Microbial infections in burn patients. Acute Crit Care. 2024;39(2):214-25.
15. Taneja N, Chari PS, Singh M, Singh G, Biswal M, Sharma M. Evolution of bacterial flora in burn wounds: key role of environmental disinfection in control of infection. Int J Burns Trauma. 2013;3(2):102-7.
16. Dhar S, Saraf R, Singh K, Raina B. Microbiological profile of chronic burn wounds among patients admitted in burn unit. JK Sci. 2007;9(4):182-5.
17. Thongchompu A, Panya S. Epidemiology and risk factors of burn injuries during the cold season in regional hospital in Northeast Thailand: a retrospective study. Ann Burns Fire Disasters. 2026;39(2):85-94.
18. Sharma L, Srivastava H, Pipal DK, Dhawan R, Purohit PM, Bhargava A. Bacteriological profile of burn patients and antimicrobial susceptibility pattern of burn wound isolates. IntSurg J. 2017;4(3):1019-23. .
19. Sapna G. Bacterial and fungal profile of burn wound infections in tertiary care center. Indian J Burn. 2015;23(1):71-5.
20. Mehta, M., Dutta, P., & Gupta, V. Bacterial isolates from burn wound infections and their antibiograms: An eight-year study. Indian Journal of Plastic Surgery, 2027;40(1), 25.
21. Dewani NT, Budi AS, Koendhori EB. Antibiotic resistance in bacteria on burn wound patients: A review of current literature. International Journal of Scientific Advances.2024; 5(6):9
22. Alrawi, M., Crowley, T., & Pape, S. (2014). Bacterial colonisation of the burn wound: A UK experience. Journal of Wound Care, 23(5), 274–277.
23. Devi, A. R., Vijayalakshmi, J., Kumari, S. S., & Kumar, A. P. (2023). A study on time related changes in bacterial pattern in burn wound infections and their antibiogram in a tertiary care hospital. International Journal of Pharmaceutical and Clinical Research 2024, 16(1):1
24. Li GH, Hua C, Hsing C, Wai S, Chih KT. (1989). Analysis of microbiological flora in the blood and wounds of burn patients. 5, 199-200.
25. Gopalakrishnan, R., Rajendran, S., Ravikumar, N., & Ravikumar, S. (2016). The role of quantitative bacteriology on burn wound management. International Surgery Journal, 595–602.
26. Pruitt, B. A., McManus, A. T., Kim, S. H., & Goodwin, C. W. (1998). Burn wound infections: current status. World Journal of Surgery, 22(2), 135–145.

27. Maitz, J., Merlino, J., Rizzo, S., McKew, G., &Maitz, P. (2023). Burn wound infections microbiome and novel approaches using therapeutic microorganisms in burn wound infection control. Advanced Drug Delivery Reviews, 196, 114769.
28. Sharma, S., & Hans, C. (1996). Bacterial infections in burns patients: a three years study at RML Hospital, Delhi. PubMed, 28(2), 101–106.
29. Pednekar, S., Dohe, V., Deshpande, S., Kamble, S., Bharadwaj, R., &Shouche, Y. (2010). An outbreak of Pseudomonas aeruginosa in a burn unit. Burns, 36(7), e130– e131.
30. Revathi, G., Puri, J., & Jain, B. (1998). Bacteriology of burns. Burns, 24(4), 347–349.
31. Agnihotri, N., Gupta, V., & Joshi, R. (2004). Aerobic bacterial isolates from burn wound infections and their antibiograms—a five-year study. Burns, 30(3), 241–243.
32. Mundhada, S., Waghmare, P., Rathod, P., &Ingole, K. (2015). Bacterial and fungal profile of burn wound infections in Tertiary Care Center. Indian Journal of Burns, 23(1), 71.
33. Rout, S., Kumar, R., Kar, S., &Sahu, K. K. (2024). Evaluation of Burn Wound Microbes and their Antibiotic Susceptibility Pattern. Biomedicine, 45(1), 48–56.
34. 34. Dutta, P., Puro, V., Luwang, T. J., &Bordoloi, U. K. (2025). Burn wound microbiology and antimicrobial resistance patterns in a tertiary care burn unit in Northeast India. Burns Open, 13, 100439.

Conflict of Interest: Nil
Source of support: Nil