

Shifting Bacterial Profiles in Burn Wound Infections: An Observational Study

Shivdas M. Mali¹ Vijay S. Mane² Gourav Bharat Deshmane³, Sadhana Kakaso Pawar⁴,
Chhaya Jawlikar⁵, Dr. Nimty Raina Ambardar⁶

1 Assistant Professor, Department of General Pathology and Microbiology, Bharati Vidyapeeth Deemed to be University, Dental College and Hospital Pune Mob No- 9561626858

E.mail ID : shivdas.mali@bharativedyapeeth.edu, ORCID ID: 0000-0002-9526-1750

2 Assistant Professor, Department of Microbiology, SSPM Medical College and Lifeline Hospital Sindhudurg Mob. No. 9892786357

Email: vijayshreemane14@gmail.com

3 Assistant Professor of Pharmacology, Bharati Vidyapeeth Deemed to be University, Dental College and Hospital Pune. Mob.No. 9028833583

E.mail ID: gourav.deshmane@bharativedyapeeth.edu , ORCID ID: 0000-0001-8688-959X

4 Assistant Professor of Biochemistry, Bharati Vidyapeeth Deemed to be University Dental College and Hospital Pune no.9922908569

Email ID: sadhana.gawade@bharativedyapeeth.edu, ORCID ID: 0000-0003-1686-5837

5 Assistant Professor of Biochemistry, D Y Patil Dental School Pune,

Email ID: jawlikarbharati312@gmail.com, ORCID ID: 0009-0004-7126-5695

6 Assistant Professor of Physiology, D Y Patil Dental School Pune

Email ID: nimtyraina.nr@gmail.com, ORCID ID: 0000-0003-0204-68076

Corresponding author: Gourav Bharat Deshmane, Assistant Professor of Pharmacology, Bharati Vidyapeeth Deemed to be University, Dental College and Hospital Pune. Mob.No. 9028833583

E.mail ID: gourav.deshmane@bharativedyapeeth.edu , ORCID ID: 0000-0001-8688-959X

Cite this paper as: Shivdas M. Mali, Vijay S. Mane, Gourav Bharat Deshmane, Sadhana Kakaso Pawar, Chhaya Jawlikar, Dr. Nimty Raina Ambardar (2024). Shifting Bacterial Profiles in Burn Wound Infections: An Observational Study. *Frontiers in Health Informatics*, Vol.13, No.8, 6850-6859

Abstract:

Introduction:

In India the bacterial infection is major problem in the management of burn cases. Burn provides a suitable site for bacterial multiplication. It contributes significantly both in morbidity and mortality. Indiscriminate use of antibiotics to treat the patients will develop antibiotic resistance in the bacteria present in the burn wound.⁴

Material and Methods:

A total 87 patients with superficial and deep burn were studied bacteriologically. Wound discharge was collected from burnt skin lesion with sterile swab stick at first week of patients' admission and subsequently weekly interval. Specimen was examined microscopically by using Grams staining and inoculated aerobically on Blood agar and MacConkey agar. Identification of isolates was done by standard biochemical tests.

Results:

In this study higher incidence of burn was reported in females at the age group of 16–30 years. Thermal burns etiology was reported common type of injury. Coagulase positive staphylococcus was predominant organism at first week of post burn. *P.aeruginosa* was predominant organism at second week of post burn and onwards.

Most common isolated organism were *P.aeruginosa* (40%) followed by *Klebsiella pneumoniae* (28%), *E.coli* (22%), *S. aureus* (21%) and *Proteus* spp (8%).^{2,3}

Conclusion:

In this study *Ps. aeruginosa* seems to be significant pathogen affecting the burn wounds at second week and onward. However coagulase positive staphylococcus was predominant organism at first week of burn and then decreased in numbers. Coagulase negative staphylococci and Enterobacteriaceae have important role cause infection of burn wound.

Keywords: Burn wound infections, Staphylococci, *Pseudomonas aeruginosa*, TBSA, Isolation and Identification

INTRODUCTION:

The burn wound is not sterile even immediately following injury; few micro-organisms can be recovered from the burn surface. The bacterial flora of infected wounds is varied and may change considerably during the healing period of two to six weeks.^{6,8,9} The high and increasing incidence of staphylococcal infection is due to spread from hospital reservoirs.²⁸

Burn provides a suitable site for bacterial multiplication. It is richer and more persistent source of infection than surgical wound, because a large tissue is exposed for longer period. The clinical consequence of infection in burn may be very serious hence large proportion of mortality seen in burn patients.⁵

In India the bacterial infection is major problem in the management of burn cases. It contributes significantly both in morbidity and mortality. Staphylococci, Streptococci, *Pseudomonas*, and Enterobacteria microorganisms invade the burn wound and cause sepsis. They also observed the bacterial flora of wound may change considerably during healing period.⁹

The cross infection incidence increased in burn ward. Hence burn should be treated in special units than general ward. They should be nursed in separate rooms to other patients in ward, to prevent the transfer of their bacteria.¹⁵

The hands of staff are an important vehicle and that hand washing makes a significant contribution to the control of hospital-acquired infection.^{14,16}

Hospital infection control programs are designed to detect and monitor hospital-acquired infections and to prevent or control their spread. Hospitals have multidisciplinary infection control committees, which should include one or more representative from the microbiology laboratory.¹⁹

Prophylactic and antimicrobial regimens have played an important role to control of infection in burn patients.

The microorganisms proliferate on and in the nonviable eschar. Hence penicillin is as prophylactic antibiotic given to burn patient, mainly against Gram positive colonization. But incidence of Gram negative micro organism increased in post burn period.⁹ Due to

indiscriminate use of antibiotics to treat the patients will develop antibiotic resistance in the bacteria present in the burn wound.⁴

NEED OF THE STUDY:

Burn injuries are among the most devastating forms of trauma, and infections are the leading cause of death in hospitalized burn patients. The microbial colonization of burn wounds is not static—it evolves over time, often changing from gram-positive microbial flora to gram-negative, hospital-acquired, and multidrug-resistant organisms.

This study will help to develop standardized guidelines for monitoring and managing burn wound infections. This study helps to assess the current epidemiological trends of infections in the hospitals and it helps to implement customized infection control policies. It will also help to develop integrated care models on patient outcomes.

AIM:

To study the bacterial trends in burn wound infections during the course of hospitalization with a focus on the change in microbial flora

OBJECTIVES:

- To isolate and identify organism from burn wound.
- To study the pattern of burn wound infections at different stages of hospitalization.
- To compare our study with other studies in India.

MATERIAL AND METHODS:

Inclusion Criteria:

Patients of all age groups and genders admitted in burn ward of PVDP District Hospital Sangli.

Burn patients with clinical signs of wound infection.

Patients hospitalized for ≥ 7 days.

Patients who provided informed consent.

Exclusion Criteria:

Patients with superficial burns only.

Patients discharged or deceased within 48 hours of admission.

Patients on long-term antibiotics before admission

Specimen collection and processing: Specimen was collected aseptically and transported

to Department of Microbiology Government Medical College Miraj

Burn wound discharge was collected from burnt skin lesion with sterile swab stick at first week of patients' admission with taking all sterile precautions in duplicate.²⁴

Subsequently weekly interval two swabs were collected before dressing with taking universal precautions^{9, 10, 24}.

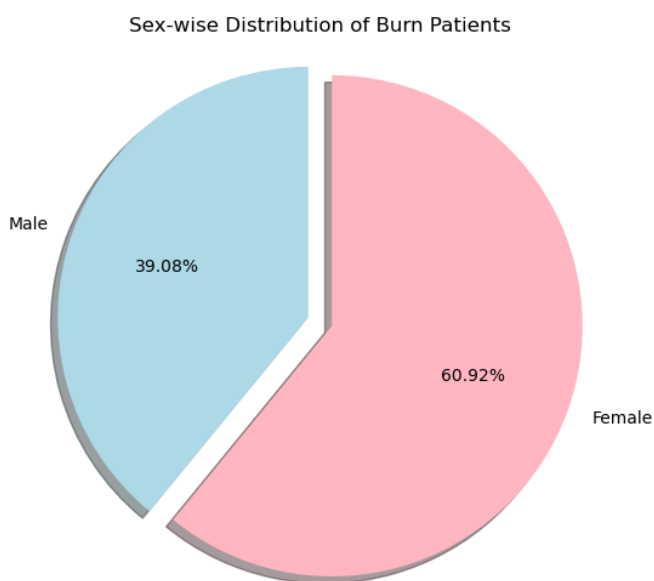
One swab was utilized in making a direct smear and staining it by Grams staining. Gram stain reports were noted^{7,9}.

Another swab was inoculated on Blood agar and MacConkey agar and incubated overnight at 37⁰c

A colony smear of each colony was done and it was stained by Grams stain. The final identifications of organisms were done by standard methods. All the media, reagents and tests were prepared and performed by standard procedure²³.

RESULTS:

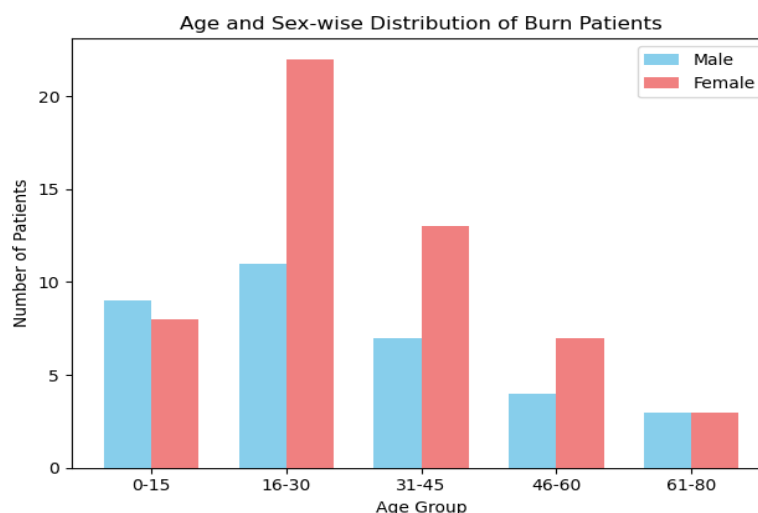
Figure No. 1. Gender distribution:



Out of a total of 87 patients included in the study, **53 (60.91%) were females** and **34 (39.09%) were males**, indicating a higher incidence of burn injuries among female patients.

Figure No 2.

Showing Age and gender wise distribution:



The highest number of burn cases was observed in the age group of **16–30 years**, accounting for **33 patients (37.93%)** of the total study population.

Table No. 1.

Showing distribution of cases according to etiology of burn.

Sr. No	Type of burn	No of cases
1	Thermal burn	65 (74.71%)
2	Scalding burn	20 (22.99%)
3	Chemical burn	01 (01.15%)
4	Electrical burn	01 (01.15%)
Total		87 (100%)

In the present study, **thermal burns** were the most common type of injury, observed in **65 cases (74.71%)**.

Table No. 2.

Showing distribution of burn patients according to extent of burn.

Sr. No.	Extent of burn in %	Total no of patients
1	10-40	58 (66.66%)
2	41-60	15 (17.24%)
3	61-100	14 (16.09%)
Total		87 (100%)

The majority of patients, **58 (66.66%)**, had burns involving **1–40% of the total body surface area (TBSA)**.

Table No. 3.

Showing distribution of organisms isolated from burn wounds at different intervals. Coagulase positive staphylococcus was predominant organism at first week of post burn. *Ps. aeruginosa* was predominant organism at second week of post burn and onwards.

This study showing following distribution of organisms isolated from burn wounds at different intervals.

Sr. No	Isolated organisms	At 1st week	At 2nd week	At 3rd week
1	<i>P.aeruginosa</i>	18 (20.69%)	19 (41.30%)	15 (45.45%)
2	Coagulase positive staphylococci	30 (34.48%)	09 (19.57%)	06 (18.18%)
3	Coagulase negative staphylococci	14 (16.09%)	07 (15.22%)	03 (09.09%)
4	<i>E. coli</i>	04 (04.60%)	Nil	Nil
5	<i>Klebsiella pneumonia</i>	04 (04.60%)	Nil	Nil
6	<i>Citrobacter. diversus</i>	01 (01.15%)	Nil	Nil
7	<i>Citrobacter freundii</i>	02 (02.29%)	02 (04.35%)	01 (03.30%)
8	<i>Proteus. Vulgaris</i>	02 (02.29%)	Nil	Nil
9	<i>Proteus. Mirabilis</i>	Nil	01 (02.17%)	01 (03.50%)
10	<i>P.aeruginosa</i> + Coagulase negative staphylococci	03 (03.45%)	02 (04.35%)	03 (09.09%)
11	<i>P.aeruginosa</i> + Coagulase positive staphylococci	01 (01.15%)	05 (10.86%)	02 (06.06%)
12	<i>P.aeruginosa</i> + <i>Klebsiella pneumonia</i>	02 (02.29%)	Nil	Nil
13	<i>P.aeruginosa</i> + <i>E.coli</i>	02 (02.29%)	Nil	Nil
14	<i>P.aeruginosa</i> + <i>C. diversus</i>	Nil	01 (02.17%)	01 (03.50%)
15	<i>P.aeruginosa</i> + <i>C. freundii</i>	Nil	Nil	01 (03.50%)
Total		88	46	33

In this bacteriological study, Coagulase-positive *Staphylococci* was the predominant organism isolated during the first week post-burn, while *Pseudomonas aeruginosa* emerged as the predominant pathogen from the second week onwards. Overall, the most commonly isolated organism was *P.aeruginosa*, accounting for 40% of isolates, followed by *Klebsiella pneumonia*. (28%), *Escherichia coli* (22%), Coagulase-positive *Staphylococci* (21%), and *Proteus* spp. (8%).

DISCUSSION:

The present study revealed a higher incidence of burn injuries among female patients (60.91%), with the 16–30 years age group being the most affected, accounting for 37.93% of the total study

population. These findings suggest that young adult females are particularly vulnerable to burn injuries. This pattern may be attributed to socioeconomical roles in many developing regions, where women in this age group are more frequently engaged in domestic activities such as cooking and handling hot liquids or open flames, thereby increasing their exposure to thermal hazards.

Consistent with this, thermal burn was the most common type of injury observed, present in 74.71% of cases. This high proportion reflects the predominance of flame and scald injuries in household settings. The correlation between thermal burns and the young female demographic highlights the need for targeted burn prevention strategies at the household level, including the promotion of safe cooking practices, use of protective clothing, and improved kitchen safety measures.

These findings are in line with previous literature, which has similarly reported that young females, particularly in low- and middle-income countries, are at greater risk for thermal burn injuries. Therefore, public health interventions focusing on education, behavioral change, and environmental safety could significantly reduce the burden of burn injuries in this vulnerable group.

This study analyzed the bacterial profile of burn wounds across three intervals: the 1st, 2nd, and 3rd weeks post-injury. A total of 88 isolates were identified in the first week, decreasing to 46 in the second week and 33 in the third week. This decline may reflect wound healing, antimicrobial treatment, or reduced sampling.

Pseudomonas aeruginosa emerged as the most persistent and dominant pathogen, increasing in prevalence from 20.69% in the first week to 45.45% by the third week.

Coagulase-positive *Staphylococcus* showed a marked decline over time, from 34.48% in the first week to 18.18% in the third week. This suggests early colonization followed by suppression or displacement by more resilient organisms.

Coagulase-negative *Staphylococcus* also declined steadily, indicating a similar pattern of early presence with reduced long-term survival.

Transient organisms such as *E. coli*, *Klebsiella pneumoniae*, *Citrobacter diversus*, and *Proteus vulgaris* were isolated only in the first week, suggesting they may be early contaminants or less competitive in the wound environment.

Mixed infections involving *P.aeruginosa* and other organisms became more noticeable in later weeks.

P.aeruginosa and Coagulase positive *Staphylococci* increased from 1 case in week 1 to 5 in week 2. The incidence of Coagulase positive and coagulase negative staphylococci are higher at first week of post burn period and subsequently the emergence of Gram negative organisms reported due to control of Gram positive bacterial infections with penicillin and other broad spectrum antibiotics. At the 3rd and 4th week post burn period.

Staphylococci was found during 1st week post burn but were replaced during 2nd week by Gram negative organisms. The colonization of *S.aureus* with *P.aeruginosa* was reported predominantly. The presence of *Streptococcus pyogenes* was always seen as serious threat to the patients.

The incidence of *P.aeruginosa* in the burn ward was increased due to control of *Staphylococcus* by using many antibiotics. The fatal *Pseudomonas* infection in severely burned patients initially was reported.

High incidence of *P.aeruginosa* infection from burn ward was reported in longer hospitalized patients.

The incidence of Gram negative bacilli was increased in post burn period. *P.aeruginosa* was predominant organism isolated from burn wound *E. coli*, *Proteus* species, *Klebsiella pneumoniae* isolated in large number at 3rd or 4th week post burn period.²⁷

Mixed infection of *P.aeruginosa* and *Klebsiella pneumoniae* were reported in post burn period.

The prevalence of *Klebsiella pneumoniae* with *P.aeruginosa* was reported predominantly also prevalence of *Klebsiella pneumoniae* with *Proteus* species and *S.aureus* was reported.⁸

Most common isolated organism were *P.aeruginosa* (40%) followed by *Klebsiella pneumoniae* (28%), *E.coli* (22%), *S. aureus* (21%) and *Proteus* spp (8%).

CONCLUSION:

The present study highlights a significant public health concern regarding burn injuries, particularly among young adult females. This demographic vulnerability is likely linked to domestic roles in developing regions, where women are more exposed to thermal hazards during household activities.

Safe cooking practices, protective clothing, and improved household safety practices can be targeted prevention strategies

The bacteriological analysis revealed dynamic changes in wound colonization over time: *P.aeruginosa* was increasingly dominant bacteria. Early colonizers like *Staphylococcus* species tend to decline, while mixed infections strains isolated prominently. These findings focus the importance of timely and targeted hospital infection control strategies in burn care.

These findings align with the literature and emphasize the importance of public health interventions focused on education, behavioral change, and environmental safety to reduce the burden of burn injuries and associated infections.

The battle for complete elimination of wound infection will continue and with adequate surveillance and with the proper co-ordination of clinician and microbiologist

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