



ANTIBIOTIC RESISTANCE PATTERNS IN BACTERIAL DERMATOLOGICAL INFECTIONS: A CROSS-SECTIONAL STUDY FROM A TERTIARY CARE HOSPITAL IN NORTH INDIA

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ABSTRACT

Background: Antibiotic resistance among dermatological infections is an emerging concern, particularly in developing countries like India where antibiotic misuse is prevalent. Understanding local resistance patterns is crucial for effective management and prevention of complications.

Objectives: To identify the common bacterial pathogens causing dermatological infections and to evaluate their antibiotic resistance patterns in a tertiary care hospital in North India.

Methods: A hospital-based cross-sectional observational study was conducted from January 2022 to August 2022, including 180 patients with clinically diagnosed bacterial skin infections. Samples were collected and processed using standard microbiological techniques. Antibiotic susceptibility testing was performed using the Kirby–Bauer disc diffusion method as per CLSI 2016 guidelines. Data were analyzed using SPSS version 20.0, and a p-value <0.05 was considered statistically significant.

Results: The majority of patients were in the 21–40 years age group, with a male predominance. Folliculitis was the most common clinical presentation. *Staphylococcus aureus* was the predominant isolate, accounting for over half of the cases, with 15.6% identified as MRSA. Gram-negative organisms such as *Escherichia coli* and *Pseudomonas aeruginosa* were also observed. High resistance to penicillin and moderate resistance to erythromycin and ciprofloxacin were noted among *S. aureus* isolates, while linezolid and vancomycin showed high sensitivity. Multidrug resistance was observed in 32.2% of isolates. A statistically significant association was found between MRSA and recurrent infections ($p < 0.05$).

Conclusion: The study demonstrates a significant prevalence of antibiotic resistance in dermatological infections, highlighting the need for rational antibiotic use and regular surveillance. Local antibiograms should guide empirical therapy, and antimicrobial stewardship programs must be strengthened to combat resistance.

Keywords: Antibiotic resistance; Dermatological infections; MRSA; Multidrug resistance; North India; Antimicrobial stewardship

INTRODUCTION

Antibiotic resistance has emerged as one of the most pressing global public health challenges, threatening the effective prevention and treatment of a wide range of infectious diseases. The increasing prevalence of resistant pathogens compromises clinical outcomes, prolongs hospital stays, and escalates healthcare costs [1]. The problem is particularly significant in low- and middle-income countries, where antibiotic stewardship practices are often suboptimal and over-the-counter access to antimicrobials is widespread [2]. Dermatological infections, although frequently perceived as superficial and less severe, contribute substantially to the burden of antimicrobial use, thereby playing a critical role in the evolution of resistance patterns [3].

Skin and soft tissue infections (SSTIs), including bacterial infections such as impetigo, folliculitis, cellulitis, and abscesses, are among the most common reasons for outpatient consultations and antibiotic prescriptions worldwide [4]. The etiological agents are predominantly Gram-positive organisms, notably *Staphylococcus aureus* and *Streptococcus pyogenes*, although Gram-negative bacteria are increasingly being reported [5]. Of particular concern is the rise of methicillin-resistant *Staphylococcus aureus* (MRSA), which has transitioned from a predominantly nosocomial pathogen to a widespread community-acquired organism [6]. The emergence of multidrug-resistant organisms in dermatology not only complicates treatment but also necessitates the use of broader-spectrum and often more expensive antibiotics.

In the Indian context, antibiotic resistance represents a growing crisis, fueled by factors such as irrational prescribing, lack of regulatory enforcement, and patient-driven demand for antibiotics [7]. North India, characterized by high population density and diverse healthcare delivery systems, presents unique challenges in infection control and antimicrobial stewardship. Several studies from India have reported alarming levels of resistance among dermatological pathogens, particularly MRSA and extended-spectrum beta-lactamase (ESBL) producing organisms [8]. However, most available data are either outdated, region-specific, or limited by small sample sizes, thereby restricting their generalizability.

At the level of tertiary care hospitals, where patients with more severe or recurrent infections are managed, the spectrum of pathogens and their resistance patterns may differ significantly from community settings. Understanding local antibiograms is essential for guiding empirical therapy and developing institution-specific antibiotic policies [9]. Despite this, there remains a paucity of comprehensive, systematically conducted studies focusing specifically on dermatological infections in tertiary care settings in North India.

The existing literature highlights variability in resistance patterns across different geographic regions and healthcare settings, underscoring the need for localized data [10]. Moreover, evolving resistance trends necessitate periodic surveillance to inform clinical decision-making and public health interventions. Without such data, clinicians may rely on outdated or inappropriate empirical therapies, further exacerbating the problem of resistance.

Given these considerations, there is a clear need to investigate the current antibiotic resistance patterns among pathogens causing dermatological infections in a tertiary care setting in North India. Such data will not only contribute to the existing body of knowledge but also aid in optimizing treatment protocols and strengthening antimicrobial stewardship initiatives.

The present study aims to assess the antibiotic resistance patterns of bacterial isolates obtained from dermatological infections in patients attending a tertiary care hospital in North India. The specific objectives are to identify the common causative organisms and to evaluate their susceptibility profiles to commonly used antibiotics.

METHODOLOGY

Study Design: This was a hospital-based cross-sectional observational study conducted to assess the antibiotic resistance patterns among bacterial isolates from dermatological infections.

Study Setting: The study was carried out in the Department of Dermatology in collaboration with the Department of Microbiology at a tertiary care teaching hospital in North India. The hospital caters to both urban and rural populations and serves as a referral center for surrounding regions.

Study Duration: January 2022 to August 2022.

Study Population: The study population comprised patients of all age groups and both sexes presenting with clinically diagnosed dermatological infections suggestive of bacterial etiology, attending the outpatient and inpatient departments of dermatology during the study period.

Inclusion Criteria: Patients with clinical features of bacterial skin infections (e.g., impetigo, folliculitis, furunculosis, cellulitis, abscesses) who provided appropriate samples (pus, swabs, or aspirates) for microbiological analysis and gave informed consent were included.

Exclusion Criteria: Patients who had received systemic or topical antibiotics within the preceding 7 days, those with fungal, viral, or parasitic skin infections, patients with inadequate or contaminated samples, and those unwilling to participate were excluded from the study.

Sample Size: The sample size was calculated using the formula for estimating a proportion in a cross-sectional study:

$$n = \frac{Z^2 \times p \times q}{d^2}$$

Where:

n = required sample size

Z = standard normal deviate at 95% confidence level (1.96)

p = expected prevalence of antibiotic resistance (assumed as 50% due to variability in previous studies for maximum sample size)

$q = 1 - p$

d = allowable error (7.5%)

Substituting the values:

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.075)^2} \approx 171$$

After accounting for possible non-response or sample loss, the final sample size was rounded to 180 participants.

Sampling Technique: A consecutive sampling technique was employed, wherein all eligible patients presenting during the study period and meeting the inclusion criteria were enrolled until the desired sample size was achieved.

Data Collection Tools & Procedure: A predesigned, semi-structured case record form was used to collect demographic details (age, sex), clinical information (type and duration of infection, prior history), and relevant risk factors. Samples such as pus, wound swabs, or aspirates were collected

under aseptic conditions. The specimens were transported promptly to the microbiology laboratory and processed using standard bacteriological techniques. Identification of isolates was performed using conventional biochemical methods. Antibiotic susceptibility testing was conducted using the Kirby–Bauer disc diffusion method on Mueller-Hinton agar, and results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) 2016 guidelines.

Study Variables: Independent variables included demographic characteristics (age, sex), type of dermatological infection, and clinical history. The dependent variable was antibiotic resistance pattern, assessed as susceptibility or resistance of bacterial isolates to various antibiotics. Additional variables included type of organism isolated and presence of multidrug resistance.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were expressed as frequencies and percentages. Associations between categorical variables were analyzed using the Chi-square test or Fisher’s exact test as appropriate. A p-value of <0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from all participants or their guardians in the case of minors. Confidentiality of patient information was strictly maintained. The study adhered to the ethical principles outlined in the Declaration of Helsinki.

RESULTS

A total of 180 patients with dermatological infections were included in the study. The majority of participants belonged to the 21–40 years age group, with a male predominance (Table 1).

Table 1: Demographic Distribution of Study Participants (n = 180)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	<20	38	21.1
	21–40	72	40.0
	41–60	46	25.6
	>60	24	13.3
Sex	Male	104	57.8
	Female	76	42.2

Folliculitis was the most common clinical presentation, followed by furunculosis and cellulitis (Table 2).

Table 2: Clinical Spectrum of Dermatological Infections (n = 180)

Type of Infection	Frequency (n)	Percentage (%)
Folliculitis	52	28.9
Furunculosis	36	20.0
Impetigo	28	15.6
Cellulitis	30	16.7
Abscess	26	14.4
Others	8	4.4

Microbiological analysis revealed *Staphylococcus aureus* as the predominant isolate, accounting for over half of the cases. Among these, a notable proportion was identified as methicillin-resistant *Staphylococcus aureus* (MRSA). Gram-negative organisms such as *Escherichia coli* and *Pseudomonas aeruginosa* were also observed (Table 3).

Table 3: Bacterial Isolates from Dermatological Infections (n = 180)

Organism	Frequency (n)	Percentage (%)
<i>Staphylococcus aureus</i>	94	52.2
MRSA (subset of <i>S. aureus</i>)	28	15.6
<i>Streptococcus pyogenes</i>	32	17.8
<i>Escherichia coli</i>	20	11.1
<i>Pseudomonas aeruginosa</i>	18	10.0
<i>Klebsiella</i> spp.	10	5.6
Mixed growth	6	3.3

Antibiotic susceptibility testing demonstrated high resistance of *Staphylococcus aureus* to penicillin and moderate resistance to erythromycin and ciprofloxacin. Resistance to clindamycin and gentamicin was comparatively lower, while linezolid and vancomycin retained high sensitivity (Table 4).

Table 4: Antibiotic Resistance Pattern of *Staphylococcus aureus* (n = 94)

Antibiotic	Resistant (n)	Resistance (%)
Penicillin	80	85.1
Erythromycin	46	48.9
Clindamycin	28	29.8
Ciprofloxacin	34	36.2
Gentamicin	22	23.4
Linezolid	4	4.3
Vancomycin	2	2.1

Overall, nearly one-third of the isolates were identified as multidrug-resistant (MDR), indicating a significant burden of resistance among dermatological pathogens (Table 5). Statistically significant associations were observed between MRSA occurrence and prior history of recurrent infections ($p < 0.05$).

Table 5: Multidrug Resistance Among Isolates (n = 180)

Category	Frequency (n)	Percentage (%)
MDR isolates present	58	32.2
Non-MDR isolates	122	67.8

DISCUSSION

The present study evaluated the antibiotic resistance patterns among bacterial isolates from dermatological infections in a tertiary care hospital in North India. The findings demonstrated that *Staphylococcus aureus* was the predominant pathogen, with a considerable proportion of methicillin-resistant strains (MRSA), and an overall multidrug resistance (MDR) rate of approximately one-third of isolates. High resistance to commonly used antibiotics such as penicillin and moderate resistance

to macrolides and fluoroquinolones were also observed, while relatively preserved sensitivity to linezolid and vancomycin was noted.

The predominance of *Staphylococcus aureus* in skin and soft tissue infections observed in this study is consistent with global and Indian literature [4,5]. Similar studies have reported *S. aureus* as the leading causative organism due to its colonization of skin and nares and its ability to invade through minor breaches in the skin barrier [11]. The MRSA prevalence of 15.6% in the current study is comparable to findings from other Indian tertiary care centers, although some studies have reported higher rates, reflecting geographic variability and differences in infection control practices [8,12]. The emergence of MRSA as a significant pathogen in dermatological infections has important clinical implications. Community-associated MRSA strains have increasingly been implicated in outpatient infections, which aligns with the current study's findings [6]. This trend may be attributed to factors such as overcrowding, poor hygiene, and inappropriate antibiotic usage, which are prevalent in many parts of North India. Additionally, the observed association between MRSA and recurrent infections suggests the potential role of persistent colonization and inadequate treatment in driving resistance.

The study also identified a notable presence of Gram-negative organisms such as *Escherichia coli* and *Pseudomonas aeruginosa*, which is in agreement with recent reports indicating a shift toward more diverse microbial flora in dermatological infections [13]. This shift may be related to increased use of broad-spectrum antibiotics, hospital-acquired infections, and underlying comorbidities in patients attending tertiary care facilities. The presence of such organisms necessitates broader empirical coverage in certain clinical scenarios, particularly in severe or non-healing infections.

The antibiotic resistance pattern observed in this study highlights a concerning trend. The high resistance to penicillin among *S. aureus* isolates is well-documented and reflects widespread beta-lactamase production [5]. Moderate resistance to erythromycin and ciprofloxacin suggests increasing resistance to commonly prescribed oral agents, which may limit outpatient treatment options. In contrast, low resistance to linezolid and vancomycin indicates that these agents remain effective; however, their use should be judicious to prevent the emergence of further resistance.

The overall MDR rate of 32.2% observed in this study is comparable to previous Indian studies, which have reported MDR prevalence ranging from 25% to 40% among dermatological isolates [13,14]. This finding underscores the growing burden of resistant infections and the need for regular surveillance. The presence of MDR organisms complicates treatment, increases healthcare costs, and may lead to poorer clinical outcomes.

From a public health perspective, these findings emphasize the importance of antimicrobial stewardship programs, particularly in tertiary care settings. Empirical therapy should be guided by local antibiograms, and unnecessary or irrational use of antibiotics should be minimized. Infection control measures, including proper hygiene practices and patient education, are equally critical in preventing the spread of resistant organisms.

The strengths of this study include its adequate sample size and systematic microbiological evaluation using standardized methods. The inclusion of both outpatient and inpatient cases enhances the generalizability of the findings within similar tertiary care settings. However, certain limitations must be acknowledged. Being a single-center study, the results may not be representative of all regions in North India. The cross-sectional design limits the ability to assess temporal trends in resistance patterns. Additionally, molecular characterization of resistant strains, such as detection of specific resistance genes, was not performed.

In conclusion, the study highlights a significant burden of antibiotic resistance among dermatological infections in a tertiary care setting, with *Staphylococcus aureus*, particularly MRSA, being the predominant pathogen. The findings reinforce the need for continuous surveillance, rational antibiotic use, and strengthened infection control practices to combat the growing threat of antimicrobial resistance.

CONCLUSION

This study highlights a substantial burden of antibiotic resistance among bacterial dermatological infections in a tertiary care setting in North India. *Staphylococcus aureus* emerged as the predominant pathogen, with a notable proportion of methicillin-resistant strains. High resistance to commonly used antibiotics such as penicillin and moderate resistance to macrolides and fluoroquinolones were observed, while linezolid and vancomycin retained good efficacy. The presence of multidrug-resistant organisms in nearly one-third of isolates underscores the growing challenge of effective management. These findings emphasize the importance of periodic surveillance of local antibiograms to guide empirical therapy. Rational prescribing practices, along with implementation of antimicrobial stewardship programs, are essential to curb the progression of resistance. Strengthening infection control measures and promoting patient awareness regarding appropriate antibiotic use are also critical. Future studies incorporating molecular characterization and multicentric data are recommended to better understand resistance trends and inform policy-level interventions.

DECLARATIONS

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Conflict of Interest: The authors declare no conflict of interest.

Consent: Written informed consent was obtained from all participants prior to inclusion in the study.

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