

# Prevalence of Human Pyogenic Skin Infections, Bacterial Pathogens and their Antibiotic Susceptibility Profile

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## Abstract

**Background and objective:** The present study was undertaken to investigate the prevalence of pyogenic skin infections, bacterial pathogens among the infected patients in three major hospitals viz., Bapuji, S.S.I.M.S & R.C, C.G.H of Davangere city, Karnataka, India, and to study antibiotic susceptibility profile of pathogenic isolates.

**Materials and methods:** A total of 114 patients of different age groups were examined for the pyogenic skin infections and screened for antibiotic susceptibility over a period of twelve months by conventional methods.

**Results:** Among 83 pathogenic bacterial isolates obtained from infected cases, 49.3% were from abscess followed by 13.2% from pyoderma, 10.8% from ulcers, 4.8% each from diabetic foot and post operative infections, 6% each from cellulitis and wounds, 3.6% from folliculitis while 1.2% from burn wound infections. *Staphylococcus aureus* was found to be the most prevalent causative agent (68.6%), followed by *Proteus mirabilis* (16.8%), *Pseudomonas aeruginosa* (8.4%) and *Escherichia coli* (6%). The antibiogram showed that 95.6% of *S.aureus* isolates were susceptible to amikacin, penicillin followed by clindamycin (84.7%), erythromycin (69.5%), ciprofloxacin (60.8%) and 58.6% to each methicillin, ofloxacin and oxacillin antibiotics. Among Gram negative bacteria 53.8% of *P. mirabilis* strains were susceptible to amoxicillin followed by cephotaxime (46.1%), ciprofloxacin (30.7%), amikacin (23%), ceftazidime (23%), cefoparazone (15.3%), tobramycin (15.3%) and levofloxacin (7.6%). *P.aeruginosa* isolates of 60% were sensitive to amikacin followed by 40% to each ceftazidime, ciprofloxacin, levofloxacin and tobramycin, 20% to each cephotaxime and cefoparazone, 0% to amoxicillin. *E.coli* isolates of 50% were sensitive to amikacin, ceftazidime followed by 25% to each amoxicillin, cephotaxime, ciprofloxacin, levofloxacin, tobramycin and completely resistant to cefoparazone. In the present study, most of the isolates have shown multidrug resistance and *S.aureus* strains of 41.4% were resistant to methicillin.

**Conclusion:** We report the prevalence of pyogenic skin infections among the patients of different age groups including male and females. *S. aureus* was found to be the most prevalent causative agent, followed by *P.mirabilis*, *P. aeruginosa* and *E. coli*, where most of the isolates were multidrug resistant including *S.aureus* strains resistant to methicillin.

**Key words:** Bacteria, pyogenic, skin infection, prevalence, antibiotics, susceptibility, multidrug resistance

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## Introduction

The pyogenic skin infections such as pyoderma caused by bacteria, ectoparasitic infections are common in developing countries. The factors include low level of hygiene which is poverty related

including difficulties in accessing water; climatic factors and overcrowding living conditions<sup>1</sup>.

Folliculitis, cellulitis and furuncle are the superficial, lower epidermis and deeper pyogenic infections caused by bacteria respectively, where as carbuncle is the result of neglected furuncle. The major causative organisms are *S.aureus*,  $\beta$ -hemolytic *Streptococci*<sup>2,3</sup>, occasionally other causative agents *P.aeruginosa*, *P. mirabilis*, *E.coli*, *Enterobacter* and *Klebsiella spp*<sup>4,5</sup>. The bacterial causative agents *S. aureus*, *P. aeruginosa*, *P. mirabilis* and *E. coli* are found to be predominant bacteria in causing pyogenic skin infections<sup>6</sup> and *S. aureus* is the leading cause of bacterial skin and soft tissue infections<sup>7</sup>. Bacteria recovered from skin and soft tissue infections in the SENTRY antimicrobial surveillance program, 1997 were *S aureus* (42.6%), *P aeruginosa* (11.3%), *Enterococcus spp.* (8.1%), *E.coli* (7.2%), *Enterobacter spp.* (5.2%),  $\beta$ -haemolytic *Streptococci* (5.1%), *Proteus spp*, coagulase-negative *Staphylococci*, *Klebsiella spp*<sup>8</sup>. The Prevalence of multiple resistant *S. aureus* is one of the most common bacteria isolated from skin infections has increased. Methicillin-resistant *S. aureus* (MRSA) is now a major problem and is found in 50% of clinical strains in certain parts of the world<sup>9</sup>. The bacteria *S. aureus*, *P.aeruginosa*, *E.coli*, *Proteus spp*, Coagulase negative *S. aureus*, *Klebsiella spp* and other bacteria were isolated from abscess and skin or decubitus<sup>10</sup>. Isolation and susceptibility testing of organisms make diagnosis to be established and also make drug selection more rational. This study was undertaken to determine the prevalence of human pyogenic infections, bacterial pathogens and to examine their susceptibility to selected antibiotics.

## Materials and Methods

Collection of clinical isolates (swab)

A total of 114 clinical samples of pyogenic skin infections among different age groups including males and females were collected from the patients in three major hospitals viz., Bapuji, SSIMS & RC, CGH of Davangere city, Karnataka, India, using sterile swabs in screw capped tubes (Hi-media Ltd, India), during from January 2007 to December 2007. The samples were subjected for microbiologi-

cal examination in aseptic conditions within 30 minutes to 45 minutes of collection at the department of microbiology, S.S Institute of Medical Sciences and Research Centre, Davangere. All the clinical isolates were identified and characterized by conventional standard microbiological techniques and maintained at 4 to 8°C with periodic subculture for further study.

Antibiotic sensitivity test

The clinical isolates were screened for antibiotic susceptibility by Kirby Bauer's disc diffusion method<sup>11</sup> using the antibiotic discs (Hi-media Ltd,India) on Mueller-Hinton agar according to Clinical and Laboratory Standard Institute (CLSI) guidelines<sup>12</sup> and as per the hospital antibiotic policy. Bacterial suspension of 0.5 Mc Farland standard was used for the test. Antibiotic discs amikacin (30 mcg), ciprofloxacin (5mcg), clindamycin (2 mcg), erythromycin (15mcg), methicillin (5mcg), ofloxacin (5mcg), oxacillin (1mcg) and penicillin G (10units) were used for gram positive and amikacin (30mcg), amoxicillin (30mcg), ceftazidime (30mcg), cephotaxime (30mcg),ciprofloxacin (5mcg), cefoparazone (75mcg), levofloxacin (5mcg), tobramycin (10mcg) for Gram negative bacteria. Finally the results were recorded by measuring the diameter of zone of inhibition of each antibiotic disc and scored as susceptible or resistant. *S. aureus* (MTCC 96), *P.mirabilis* (MTCC 1429), *P.aeruginosa* (MTCC 4676) and *E.coli* (MTCC 739) were used as control strains. *S. aureus* isolates were screened for methicillin resistance using 6 $\mu$ g/ml oxacillin by agar screening as per the guidelines of NCCLS.<sup>13</sup>

## Results

Among 83 potential clinical bacterial isolates obtained from infected cases of this study, 11 (13.2%) were isolated from pyoderma, 41 (49.3%) were from abscess, 9(10.8%) from ulcers, 4 (4.8%) from diabetic foot, 5(6%) from cellulitis, 5(6%) from wounds, 4(4.8%) from post operative infections, 3(3.6%) from folliculitis, while 1(1.2%) from burn wound infections of patients of different age group (Table:1). *S.aureus* was found to be the most prevalent causative agent (68.6%) followed by *P.mirabilis* (16.8%), *P.aeruginosa* (8.4%) and *E.coli*

(6%) (Table:2).

In the age group of 1-15 years of male patients, the prevalence of skin infection among pyoderma was 3.6%, abscess (6%), wound (1.2%) and the prevalence of the causative agents was *S.aureus* (9.3%), *P.aeruginosa*(1.1%). Among female patients of pyoderma (2.3%), abscess (4.8%) and the causative agent was *S.aureus* (7.2%). In the age group of 16-30 years of male patients, the prevalence was pyoderma (2.4%), abscess (9.6%), cellulitis (1.2%), postoperative infections (1.2%), folliculitis (2.4%) and the causative agents were *S.aureus* (12%), *P.aeruginosa* (2.4%), *P.mirabilis* (2.4%). Among female patients of 1.2% each from pyoderma, ulcers and burn wound infections with *S.aureus* (2.4%), *P.mirabilis* (1.2%). In the age group of 31-60 years of male patients of pyoderma (3.6%), abscess

(16.8%), ulcers (7.2%), diabetic foot (2.4%), cellulitis (2.4%),wounds (2.4%) and the causative agents were *S.aureus* (20.4%), *P.aeruginosa* (2.4%), *P.mirabilis* (8.4%), *E.coli* (3.6%). Among female, pyoderma (3.6%), abscess (19.2%), ulcers (7.2%), diabetic foot (3.6%), cellulitis (2.4%), wounds (2.4%) and the causative agents were *S.aureus* (1.2%), *P. mirabilis* (1.2%), and *E.coli* (1.2%). In the age group of more than 60 years of male cases, abscess (7.2%), ulcers (2.4%), diabetic foot (1.2%), cellulitis (2.4%),wounds (2.4%), post operative infections (3.6%), folliculitis (1.2%), the causative agents were *S.aureus* (13.2%), *P.aeruginosa* (2.4%), *P. mirabilis* (3.6%), *E.coli* (1.2%) and among female, abscess (2.4%), the causative agent *S.aureus* was found to be 2.4%. (The data of male and female is not shown separately)

**Table:1 Prevalence of pyogenic skin infections**

Skin infections	Patients of different age groups including male and female				
	1-15 years No (%)	16-30 years No (%)	31-60 years No (%)	> 60 years No (%)	Total (%)
Pyoderma	5 (6)	3 (3.6)	3 (3.6)	0 (0)	<b>11 (13.25)</b>
Abscess	9 (10.8)	8 (9.6)	16 (19.2)	8 (9.6)	<b>41 (49.39)</b>
Ulcers	0 (0)	1 (1.2)	6 (7.2)	2 (2.4)	<b>9 (10.84)</b>
Diabetic foot	0 (0)	0 (0)	3 (3.6)	1 (1.2)	<b>4 (4.81)</b>
Cellulitis	0 (0)	1 (1.2)	2 (2.4)	2 (2.4)	<b>5 (6.02)</b>
Wounds	1 (1.2)	0 (0)	2 (2.4)	2 (2.4)	<b>5 (6.02)</b>
Post operative infections	0 (0)	1 (1.2)	0 (0)	3 (3.6)	<b>4 (4.81)</b>
Folliculitis	0 (0)	2 (2.4)	0 (0)	1 (1.2)	<b>3 (3.61)</b>
Burn wound infections	0 (0)	1 (1.2)	0 (0)	0 (0)	<b>1 (1.2)</b>
<b>Total</b>	<b>15 (18)</b>	<b>17 (20.48)</b>	<b>32 (38.55)</b>	<b>19 (22.89)</b>	<b>83 (100)</b>

**Table:2 Bacterial profile of pyogenic skin infections**

Skin infections	Pathogenic Bacterial isolates				
	<i>S.aureus</i> No (%)	<i>P.aeruginosa</i> No (%)	<i>P.mirabilis</i> No (%)	<i>E.coli</i> No (%)	Total (%)
Pyoderma	8 (9.63)	2 (2.40)	1 (1.2)	0 (0)	<b>11 (13.25)</b>
Abscess	26 (31.32)	3 (3.61)	9 (10.84)	3 (3.61)	<b>41 (49.39)</b>
Ulcers	7 (8.43)	1 (1.2)	1 (1.2)	0 (0)	<b>9 (10.84)</b>
Diabetic foot	1 (1.2)	0 (0)	1 (1.2)	2 (2.40)	<b>4 (4.81)</b>
Cellulitis	3 (3.61)	1 (1.2)	1 (1.2)	0 (0)	<b>5 (6.02)</b>
Wounds	4 (4.81)	0 (0)	1 (1.2)	0 (0)	<b>5 (6.02)</b>
Post operative infections	4 (4.81)	0 (0)	0 (0)	0 (0)	<b>4 (4.81)</b>
Folliculitis	3 (3.61)	0 (0)	0 (0)	0 (0)	<b>3 (3.61)</b>
Burn wound infections	1 (1.2)	0 (0)	0 (0)	0 (0)	<b>1 (1.2)</b>
<b>Total</b>	<b>57 (68.67)</b>	<b>7 (8.43)</b>	<b>14 (16.86)</b>	<b>5 (6.02)</b>	<b>83 (100)</b>

In our study, antibiogram of the bacterial isolates illustrates that *S.aureus* isolates were highly susceptible to amikacin, Penicillin and clindamycin (Table-3). Among Gram negative bacteria.

*P. mirabilis* isolates were highly sensitive to amoxicillin, *Paeruginosa* against amikacin, *E.coli* against amikacin and ceftazidime as compared to other class of antibiotics used and most of them were multidrug resistant. 95.6% of *S.aureus* isolates are sensitive to amikacin, penicillin followed by clindamycin (84.7%), erythromycin (69.5%), ciprofloxacin (60.8%) and 58.6% to each methicillin, ofloxacin and oxacillin antibiotics. *P.mirabilis* strains of 53.8% were sensitive to amoxicillin followed by cephotaxime (46.1%), ciprofloxacin (30.7%), amikacin (23%), ceftazidime (23%), cefoparazone (15.3%), tobramycin (15.3%) and levofloxacin (7.6%). *Paeruginosa* isolates of 60% were sensitive to amikacin followed by 40% to each ceftazidime, ciprofloxacin, levofloxacin and tobramycin, 20% to each cephotaxime and cefoparazone, amoxicillin (0%). *E.coli* isolates of 50% were sensitive to amikacin, ceftazidime followed by 25% to each amoxicillin, cephotaxime, ciprofloxacin, levofloxacin, tobramycin and 0% to cefoparazone (Table-4). The pathogens were resistant to all the other classes of antibiotics tested. The results showed that, these categories

of the isolates were multidrug resistant and some *S.aureus* isolates were found to be methicillin resistant. The comparative antibiotics susceptibility of bacterial isolates obtained from the pyogenic skin infections is shown in table (3and 4).

### Discussion

The main objective of the study was to investigate the prevalence of pyogenic skin infections with reference to bacteria. The study also aims to investigate the prevalence of bacterial causative agents and the antibiotic susceptibility profile among the pathogens isolated from patients of different age groups, which is more rational in selection of the drug for chemotherapy. Suppurative infection of the skin, ear and eye are common occurrences in hospitalized and out patients, wound infection is regarded as the most common nosocomial infection in surgical patients.

The result of this present study showed that the skin infection viz., abscess, which accounted for 49.3% was the leading prevalence followed by pyoderma 13.2%, ulcers 10.8%, cellulitis and wounds (6% each), diabetic foot and post operative infections (4.8% each) , folliculitis 3.6%, and burn wound infections 1.2% in different age group patients.

*S.aureus* was found to be the most prevalent causative agent (68.6%) of pyogenic skin infection followed by *P. mirabilis* (16.8%), *P. aeruginosa* (8.4%) and *E. coli* (6%).

**Table: 3 Antibiotic susceptibility of *S.aureus* isolated from pyogenic skin infections**

Bacteria	Total Number	Antibiotic discs							
		Ak No (%)	Cf No (%)	Cd No (%)	E No (%)	M No (%)	Of No (%)	Ox No (%)	P No (%)
<i>S.aureus</i>	46	44 (95.6)	28 (60.8)	39 (84.7)	32 (69.5)	27 (58.6)	27 (58.6)	27 (58.6)	44 (95.6)

Ak- Amikacin, Cf- Ciprofloxacin, Cd- Clindamycin E- Erythromycin, M- Methicillin, Of- Ofloxacin, Ox-Oxacillin, P- Penicillin G

**Table: 4 Antibiotic susceptibility of Gram negative Bacteria isolated from pyogenic skin infections**

Bacteria	Total Number	Antibiotic discs							
		Ak No (%)	Ac No (%)	Ca No (%)	Ce No (%)	Cf No (%)	Cs No (%)	Le No (%)	Tb No (%)
<i>P.mirabilis</i>	13	3 (23)	7 (53.8)	3 (23)	6 (46.1)	4 (30.7)	2 (15.3)	1 (7.6)	2 (15.3)
<i>P.aeruginosa</i>	10	6 (60)	0 (0)	4 (40)	2 (20)	4 (40)	2 (20)	4 (40)	4 (40)
<i>E.coli</i>	04	2 (50)	1 (25)	2 (50)	1 (25)	1 (25)	0 (0)	1 (25)	1 (25)

Ak-Amikacin, Ac-Amoxicillin,Ca-Ceftazidime, Ce-Cephotaxime, Cf-Ciprofloxacin, Cs-Cefoperazone, Le-Levofloxacin, Tb-Tobramycin

Antibiotic susceptibility test of the present study illustrates that *S.aureus* isolates were highly susceptible to amikacin, penicillin and clindamycin. Among Gram negative bacteria *P. mirabilis* isolates were highly sensitive to amoxicillin, *P.aeruginosa* against amikacin, *E.coli* against amikacin and ceftazidime as compared to other class of antibiotics used and most of them were multidrug resistant. 95.6% of *S.aureus* isolates were sensitive to amikacin, Penicillin followed by clindamycin (84.7%), erythromycin (69.5%), ciprofloxacin (60.8%) and 58.6% to each methicillin, ofloxacin and oxacillin antibiotics. 53.8% of *P. mirabilis* strains were sensitive to amoxicillin followed by cephataxime (46.1%), ciprofloxacin(30.7%), amikacin(23%), ceftazidime(23%), cefoperazone(15.3%), tobramycin (15.3%) and levofloxacin (7.6%). *P.aeruginosa* isolates of 60% were sensitive to amikacin followed by 40% to each ceftazidime, ciprofloxacin, levofloxacin and tobramycin, 20% to each cephotaxime and cefoperazone, amoxicillin (0%). *E.coli* isolates of 50% were sensitive to amikacin, ceftazidime followed by 25% to each amoxicillin, cephotaxime, ciprofloxacin, levofloxacin, tobramycin and 0% to cefoparazone. The pathogenic isolates were resistant to all the other classes of antibiotics tested. This showed that these categories of the isolates were multi drug resistant and *S.aureus* strains of 41.4% were resistant to methicillin.

The development of multidrug resistance among Gram positive and Gram negative bacteria including methicillin resistant *S.aureus* was noticed in the present study which may be due to indiscriminate use of antibiotics. This is one of the major global public health problems alarming health care communities on the usage of antibiotics, which needs skilled medical fraternity, maintenance of hygienic conditions in hospitals, orientation programmes for medical fraternity and also public.

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