



# Pyogenic Infections in Eastern Nepal with Special Reference to Staphylococcus Aureus

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## Introduction

Pyogenic infection is referred to bacterial infection that leads to severe local inflammation with production of pus. The clinical presentation of wound infection can vary from superficial to highly invasive or disseminated disease through various cellular mechanisms associated with virulence of pyogenic bacteria.<sup>1</sup> Although a wide variety of pathogens have been implicated in pyogenic infections, Staphylococcus aureus (*S. aureus*) is overwhelmingly the most common etiology.<sup>2,3</sup>

*S. aureus* is a widespread cutaneous pathogen and the leading cause of Nosocomial infections as well as community onset infections globally due to its ability to adapt to a changing environment.<sup>1</sup> MRSA associated morbidity and mortality around the world is increasing although first reported in the 1960s and is now reported with resistance in approximately 50% - 80% of all *S. aureus* infections.<sup>4,5,6</sup>

Therefore, this study was aimed to determine the spectrum of clinically significant bacteria in pyogenic

## Abstract

**Introduction:** Pyogenic infections are significant clinical condition associated with wide variety of pyogenic bacteria, predominantly Staphylococcus aureus. A rising trend of multi-drug resistance pathogens, in particular methicillin resistant Staphylococcus aureus (MRSA) are reported with pyogenic infections globally. It is important to identify the microbial pathogen for rapid institution of optimal antimicrobial agent in early stage to overcome the life threatening complications. This study was planned to determine the clinically significant bacterial profile of pyogenic infection special reference to Staphylococcus aureus and its antimicrobial susceptibility pattern.

**Methods:** A Descriptive cross-sectional study was conducted at B. P. Koirala Institute of Health Sciences. Wound swabs and pus aspirates were collected from each patient suspecting pyogenic infection. Following standard microbiological methods, isolation and identification was done in the Department of Microbiology. Antimicrobial susceptibility test along with MRSA detection was performed following Clinical and Laboratory Standard Institute.

**Results:** Of the 1863 specimens, culture was positive in 50.8% of cases. Staphylococcus aureus (39.5%) was the leading cause of pyogenic infection followed by Escherichia coli (12.2%), Acinetobacter baumani complex (10.1%). Staphylococcus aureus was sensitive to vancomycin (100%), linezolid (100%), amikacin (79.70%), cotrimoxazole (77.60%), gentamicin (64.53%), ciprofloxacin (46.06%), cefalexin (37.6%), ceftriaxone (34.66%), erythromycin (27.46%), penicillin (6.66%), ceftazidime (37.86%). Staphylococcus aureus was multidrug resistant with methicillin resistant rate of 51.2 %.

**Conclusion:** Pyogenic wound infections predominately caused by high rates of methicillin resistance Staphylococcus aureus with multiple drug resistance is highly alarming. Therefore, continuous surveillance should be done to update the resistance pattern and guide rational use of antibiotics.

**Keywords:** Methicillin resistance staphylococcus aureus, multi-drug resistance, pyogenic infection, Staphylococcus aureus

infections with special reference to *S. aureus* and to determine the status of resistance to commonly used antimicrobials. The appropriate knowledge of the pathogens and antibiogram profile would provide an opportunity to advocate the evidence based approaches for the management of patients.

## Methods

This descriptive cross sectional study was conducted in the department of Microbiology, BPKIHS, Dharan from September 2021 to February 2022. All the specimens from suspected pyogenic infections such as pus aspirate and wound swab received in lab during the study period were included and processed for identification of organisms. All samples derived were inoculated onto blood and MacConkey agar (HIMEDIA LABORATORIES) and incubated at 35°C for 24 and 48 hours, respectively. No growth on culture media was considered sterile. The bacterial pathogens grown were identified up to species level by standard microbiological techniques like colony morphology, gram stain and several biochemical tests for gram positive and gram negative bacteria.<sup>7</sup>

Antimicrobial susceptibility test of the isolates along with MRSA detection was determined by Kirby Bauer Disc-Diffusion assay on Muller Hinton agar (MHA) according to Clinical and Laboratory Standards Institute (CLSI) guidelines.<sup>8</sup> *Escherichia coli* ATCC 25922 and *Staphylococcus aureus* ATCC 25923 were used as control and tested along with the test strain.

Ethical clearance was obtained from the Institutional Review Committee of BPKIHS (Code No.: IRC/2155/021).

All data collected were entered in MS excel 2010 and converted into statistical package for social sciences (SPSS) 21.0 version for statistical analysis. For descriptive analysis, frequency, percentage and ratio was calculated and tabular and graphical presentation were done.

## Results

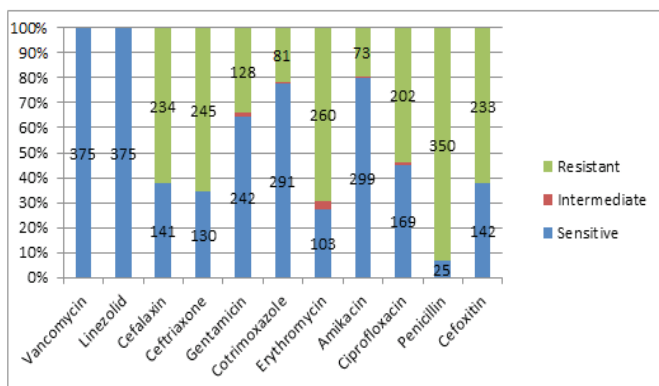
Throughout the study period, 1863 specimens (612 wound swab and 1251 pus aspirate) were obtained among which 948 (50.8%) yielded bacterial growth confirming pyogenic infections. Single bacterial growth was obtained in 833 (87.8%) while mixed growth including *S. aureus* with Enterobacteriaceae in 31 (3.2%), *S. aureus* with Non-Enterobacteriaceae in 27 (2.8%) and other mixed infections in 57 (6.01%). The most common organism isolated was *Staphylococcus aureus* (39.5%) followed by *Escherichia coli* (12.2%), *Acinetobacter baumani* complex (10.1%), and *Klebsiella pneumoniae* (7.9%) as shown in table 1. A total of 1,063 bacterial pathogens were recovered.

**Table 1.** Bacterial isolates associated with pyogenic infection (n = 948) (50.8%)

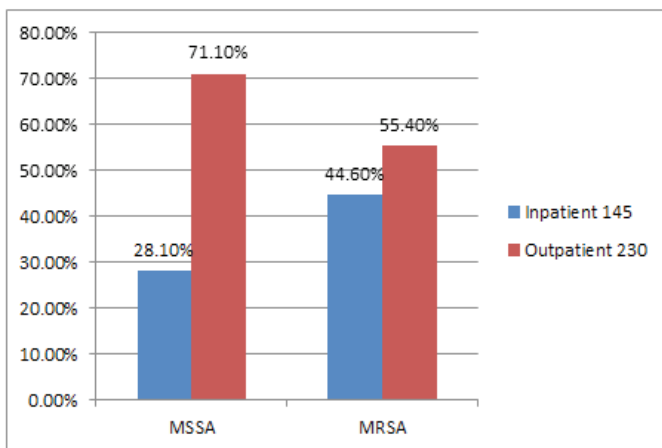
Bacterial isolates	Frequency	Percent
<b>Gram positive isolates</b>		
<i>Staphylococcus aureus</i>	375	39.5
<i>Enterococcus</i> species	47	4.9
<b>Gram negative isolates</b>		
<i>Escherichia coli</i>	116	12.2
<i>Acinetobacter baumani</i> complex	96	10.1
<i>Klebsiella pneumoniae</i>	75	7.9
<i>Pseudomonas aeruginosa</i>	66	6.9
<i>Enterobacter</i> species	17	1.7
<i>Klebsiella oxytoca</i>	12	1.2
<i>Proteus mirabilis</i>	12	1.2
<i>Proteus vulgaris</i>	5	0.5
<i>Citrobacter koseri</i>	4	0.4
<i>Citrobacter freundii</i>	4	0.4
<i>Morganella morganii</i>	2	0.2
<i>Serratia marcescens</i>	2	0.2
<i>Staphylococcus aureus</i> with Enterobacteriaceae	31	3.2
<i>Staphylococcus aureus</i> with Non-Enterobacteriaceae	27	2.8
Other Mixed Infections	57	6.01
Total	948	
<b>Yeast cells other than <i>Candida albicans</i></b>	17	

*S. aureus* (n=375) was the most common cause of pyogenic infections in patients attending at our centre. Among these, 195 (52.0%) were males and 180 (48.0%) were females with the age range of 4 months to 92 years and mean age of 35.3± 19.9 years. The majority of the patients (46.4%) were in the age group of 15-40 years followed by 26.1% in 41 – 60 years, 16.3% in <15 years and 11.2% in >60 years of age. There were 230 (61.3%) community acquired (CA) and 145 (38.7%) hospital acquired infections (HAI).

The predominant isolate *S.aureus* was sensitive to vancomycin (100%), linezolid (100%), amikacin (79.70%), cotrimoxazole (77.60%), gentamicin (64.53%) and showed high degree of resistance to penicillin (93.33%), erythromycin (69.33%), ceftriaxone (65.33%), cephalixin (62.4%) and ciprofloxacin (53.86%). Cefoxitin resistance was found to be in 62.13% of isolates indicating MRSA as shown in figure 1. Majority of isolates were multiple drug resistant (MDR, non-susceptible to  $\geq 1$  agent in  $\geq 3$  antimicrobial categories) too. Out of 230 community acquired infections (CAI) and 145 hospital acquired infections (HAI), percentage of MRSA was 55.40% and 44.60% respectively as shown in figure 2.



**Figure 1:** Antimicrobial susceptibility pattern of *S. aureus*



**Figure 2.** Distribution of MRSA among patients

## Discussion

Pyogenic infection, although preventable and curable are commonly experienced in developing countries like Nepal and continues to be challenging issues as wound fails to heal and the patients suffer from morbidity and treatment costs. Therefore, continuous effort should be made to update knowledge regarding etiology and their antibiogram to reduce the cost to health services

and associated complications.

In this study, bacterial pathogens were obtained from 948 (50.8%) patients showing wound infections. This finding is consistent with the study from Nepal reporting bacterial growth rate of 50.0%<sup>9</sup> and 50.7%<sup>10</sup> respectively. However, it is higher than the study reported from Ethiopia (40%)<sup>11</sup> and lower than that from Nepal (64.9%)<sup>2</sup>, India (61.54%)<sup>12</sup> and Italy (69.5%)<sup>13</sup> respectively. This study was conducted in a tertiary health care setting in a country where antibiotics are available over the counter which could be considered as the factor responsible for less culture positivity. Patients might have reported to other health care setting and received antimicrobials before presenting to BPKIHS. Moreover, majority 833 (87.8%) of the specimens showed monomicrobial growth, while the remaining revealed mixed growth including *S. aureus* with Enterobacteriaceae in 31 (3.2%), *S. aureus* with Non-Enterobacteriaceae in 27 (2.8%) and other mixed infections in 57 (6.01%). This finding is consistent with previous report from Nepal<sup>2</sup> and Gondar.<sup>14</sup> The reason might be poor wound care and chronicity. *S.aureus* (39.5%) was the major cause of wound infections which is comparable to several studies.<sup>13,14</sup> This outcome confirms the fact that *S.aureus* maintain the infection and delay wound healing by producing potent virulence factor.<sup>13</sup> In particular, *S.aureus* demonstrated high rates of resistant to commonly used antimicrobial agents is the prime concern as they are associated with CAI and HAI. Isolates were resistant to penicillin, erythromycin, ceftriaxone, cephalixin, ciprofloxacin and gentamicin. The present study did not document any resistance to glycopeptides and linezolid. This result is in agreement with study done in Nepal.<sup>2,15,16</sup> Unfortunately, now the growing concern is the rapid increase of MRSA associated wound infections not only in hospitals but also in the community in patient with no apparent risk factors in recent years. Therefore, common Staphylococcal infections will be much more difficult to treat.<sup>17</sup> In this study, 62.13% of the *S.aureus* were methicillin resistant. This finding is quite high when compared to previous report from our centre (38%) in 2018<sup>18</sup> and other report by Rijal et al. (32%)<sup>2</sup> but lower when compared to Sapkota et al. (70.64%).<sup>19</sup> Out of 230 community acquired infections (CAI) and 145 hospital acquired infections (HAI), percentage of MRSA was 55.40% and 44.60% respectively. At one time MRSA was thought to be the hospital acquired pathogen. However, in recent years, community acquired MRSA (CA-MRSA) strains have emerged as a notable cause of infection without exposure to health care system of individuals. High rates of CA-MRSA infections have been documented in several studies.<sup>20-22</sup> This may be the result of tremendous use of antimicrobials

without prescription available over the counter and inappropriate infection control practices.

## Conclusion

As the title of this research indicates pyogenic infections are still frequently seen most commonly caused by *Staphylococcus aureus*, importantly MRSA to an alarming level. This report also call attention for the need of antimicrobial stewardship program in hospitals, continuous monitoring of resistance patterns to guide appropriate therapy and rational use of antimicrobial agents and to restrict the rapid emergence of multidrug resistant. Considering this data, the available antibiotics should be used cautiously due to limited discovery of new classes of antimicrobial agents.

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