Original Article

# FREQUENCY, DISTRIBUTION AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF BACTERIAL ISOLATES FROM BLOOD CULTURE IN A TERTIARY CARE HOSPITAL

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## ABSTRACT

**Objective:** Blood stream infections remain a serious problem which can lead to morbidity and mortality. It needs immediate and prompt treatment by antibiotics and empirical antibiotic therapy can benefit the patient. This study was done to determine the pattern of bacterial isolates yielded from blood culture specimens and the antibiogram of these isolates to help in providing guidelines for initiation of an appropriate antibiotic therapy for septic patients.

**Material and Methods:** This descriptive cross-sectional study was conducted at microbiology department, Lahore General Hospital from January to December 2018. Total 2379 blood culture bottles were received and frequency of different bacterial isolates and their antimicrobial susceptibility pattern was determined according to CLSI guidelines.

**Results**: Total 267/2379 blood culture specimens showed positive growth. It represents 11.22 %. Amongst these Gram-positive cocci were predominant microorganisms (112/267). It was followed by non-fermenters (102/267) and Enterobacteriaceae (52/267). Only 1 sample showed growth of Candida species. Out of total 112 Gram positive cocci, Staphylococcus aureus and coagulase negative Staphylococcus species were 56.25 % and 41.96 % respectively. MRSA accounted for 58.7 %. Amongst enterobacteriaceae 55.76 % were E.coli and Klebsiella species were 34.6 %. Among 102 non-fermenters, 68.6 % were Acinetobacter species and 31.37 % were Pseudomonas species. Overall, the most predominant microorganism isolated was Acinetobacter species (26.2 %). The members of Enterobacteriaceae showed 13.4 % and 15.3 % susceptibility to 3$^{rd}$ and 4$^{th}$ generation cephalosporins. The carbapenem were found most sensitive i.e. 75%.

**Conclusion:** The results of this study will help to determine the etiology of sepsis and their susceptibility and resistance pattern. This will pave the way for formulating a local antibiotic policy for blood stream infections.

**Key Words:** Antimicrobial susceptibility, Bacterial isolates, Blood culture.

**This article can be cited as: Imran F, Khan JK, Ajmal AN, Asif A, Malik M. Frequency, distribution and antimicrobial susceptibility pattern of bacterial isolates from blood culture in a tertiary care hospital. Pak J Pathol. 2019: 30(2): 40-44.**

## INTRODUCTION

Blood stream infection is a life-threatening condition with 35-50 % mortality rate [1]. Central lines, in-dwelling catheters, invasive diagnostic or therapeutic procedures and infection in an organ may lead to septicemia. Compromised immune status of the patient and comorbid conditions constitute the major risk factors for blood stream infections [2]. Gram positive bacteria, Gram negative bacteria and fungi like candida are the major causative agents. These blood stream infections have a wide range of clinical manifestations. They may be clinically asymptomatic or have devastating complications like shock, multiorgan dysfunction, disseminated intravascular coagulation and even death [3]. Increased resistance is seen among microorganisms causing blood stream infections including Klebsiella, Pseudomonas, Acinetobacter, Citrobacter species and Staphylococcus aureus [4]. Blood culture remains the gold standard diagnostic investigation and it requires 48-72 hours. Before definitive diagnosis, empirical antibiotic therapy is needed which can be lifesaving and depends upon the local antibiogram [5-7]. Lack of knowledge of common prevailing pathogens in the specific geographical location and their sensitivity pattern to antibiotics can result in inappropriate use of empirical antibiotics, causing further worsening of clinical condition of patients and promoting the emergence of antimicrobial resistant strains [8]. Local antibiograms are an essential tool for appropriate institution of antibiotic therapy [9]. These are a vital component of antimicrobial stewardship program which aims to ensure appropriate institution of antibiotics and prevent emergence and dissemination of resistant pathogens [10]. This study was carried out to determine the frequency of different organisms causing blood stream infections and their antibiotic

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*Received: **27 Mar 2019**; Revised **02 Apr 2019**; Accepted: **22 May 2019***

susceptibility pattern which can serve as a guideline for initiating empirical antibiotics in our clinical settings.

## MATERIAL AND METHODS

It was a descriptive cross-sectional study conducted at Microbiology Department, Lahore General Hospital from January to December 2018. Total 2379 blood culture bottles were received having appropriate amount of blood in Tryptic Soy Broth (TSB) with sodium polyanethole sulfonate (SPS). The bottles were incubated aerobically at 37°C overnight. The samples were sub cultured on blood agar and MacConkey agar plates. The growth obtained was identified by colony morphology, Gram staining, rapid tests like catalase test, oxidase test, coagulase test and a series of different biochemical tests (4). Antimicrobial susceptibility testing (AST) was done by Kirby-Bauer disc diffusion method according to the latest guidelines of Clinical and Laboratory Standards Institute (CLSI) [11]. The data was analyzed using MS Excel

## RESULTS

Out of 2379 blood culture specimens, 267 (11.22 %) samples yielded growth. Out of positive blood cultures, 112 (41.95 %) were Gram positive, 52 (19.47 %) were members of Enterobacteriaceae and non-fermenters were 102 (38.20 %). Only one blood culture specimen yielded growth of Candida species as shown in Table-1. The overall frequency of microorganisms isolated from blood culture specimens is shown in Figure-1. Out of 112 Gram positive microorganisms, 63 (56.25 %) isolates were Staphylococcus aureus, 47(41.96 %) were coagulase negative staphylococci (CONS) and 2(1.78 %) isolates were identified as Enterococcus species. Out of 63 Staphylococcus aureus, 37 (58.73 %) were MRSA.

The resistance pattern of Gram-positive cocci is shown in Table-2 and Table-3. Both enterococcus isolates were sensitive to linezolid and vancomycin

**Table-1: Distribution of microbial isolates from blood culture by conventional method (n=267).**

| Microbial isolates | Number n= 267 |
|---|---|
| Gram positive cocci | 112 |
| Non fermenters (Pseudomonas & Acinetobacter species) | 102 |
| Enterobacteriaceae | 52 |
| Fungi | 01 |

**Table-2: Antimicrobial resistance pattern of staphylococcus aureus and staphylococcus species (coagulase negative).**

| Antibiotics | Staphylococcus aureus (n=63) | Staphylococcus Species (coagulase negative) (n=47) |
|---|---|---|
| Cefaclor | 37 | 30 |
| Cefoxitin | 37 | 30 |
| Cotrimoxazole | 39 | 34 |
| Tetracycline | 29 | 24 |
| Linezolid | 0 | 0 |
| Amoxicillin/ Clavulanic acid | 37 | 30 |
| Levofloxacin | 43 | 32 |
| Clindamycin | 29 | 18 |
| Gentamicin | 29 | 18 |
| Doxycycline | 15 | 13 |
| Clarithromycin | 39 | 38 |
| Erythromycin | 43 | 36 |
| Penicillin | 60 | 41 |
| Ciprofloxacin | 44 | 33 |
| Azithromycin | 46 | 37 |
| Cefuroxime | 37 | 30 |
| Vancomycin | 0 | 0 |

**Table-3: Antimicrobial resistance pattern of enterococcus species.**

| Antibiotics | ***Enterococcus Species*** **(n=2)** |
|---|---|
| Doxycycline | 2 |
| Erythromycin | 2 |
| Penicillin | 1 |
| Ciprofloxacin | 2 |
| Azithromycin | 2 |
| Vancomycin | 0 |
| Linzolid | 0 |
| Tetracycline | 2 |
| Levofloxacin | 2 |
| Ampicillin | 1 |

Among 52 Enterobacteriaceae, 29 were *E.coli*, 18 were *Klebsiella* species, 2 each of *Citrobacter* species and *Enterobacter* species and 1 isolate was *Providencia* species. Members of Enterobacteriaceae showed increased resistance to 3rd and 4th generation cephalosporins along with quinolones. Enhanced resistance was seen among Pseudomonas and Acinetobacter species. Six members of Enterobacteriaceae and seven non-fermenters were extremely drug resistant (XDR) and were sensitive to colistin only. The antibiogram of Enterobacteriaceae and non-fermenters is shown in Table-4 and Table-5 respectively.

**Table-4: Antimicrobial resistance pattern of Enterobacteriaceae.**

| Antibiotics | E coli (n=29) | Klebsiella species (n=18) | Enterobacter species (n=2) | Citrobacter species (n=2) | Providencia species (n=1) |
|---|---|---|---|---|---|
| Amoxicillin/ Clavulanic acid | 86.2% | 83.3% | 100% | 50% | 0% |
| Cefepime | 82.7% | 83.3% | 100% | 100% | 0% |
| Ceftriaxone | 89.6% | 88.8% | 100% | 50% | 0% |
| Ceftazidime | 86.2% | 83.3% | 100% | 100% | 0% |
| Gentamicin | 62% | 61.1% | 0% | 50% | 0% |
| Amikacin | 41.3% | 44.4% | 50% | 100% | 0% |
| Doxycycline | 86.2% | 77.7% | 100% | 50% | 0% |
| Cotrimoxazole | 82.7% | 94.4% | 100% | 0% | 0% |
| Ciprofloxacin | 100% | 72.7% | 50% | 100% | 0% |
| Levofloxacin | 93.1% | 72.7% | 50% | 100% | 0% |
| Tetracycline | 86.2% | 94.4% | 100% | 100% | 0% |
| Meropenem | 17.2% | 38.8% | 0% | 50% | 100% |
| Imipenem | 20.6% | 38.8% | 0% | 0% | 100% |
| Cefoperazone/ Sulbactam | 44.8% | 55.5% | 0% | 50% | 0% |
| Piperacillin+ Tazobactam | 51.7% | 61.1% | 0% | 0% | 0% |

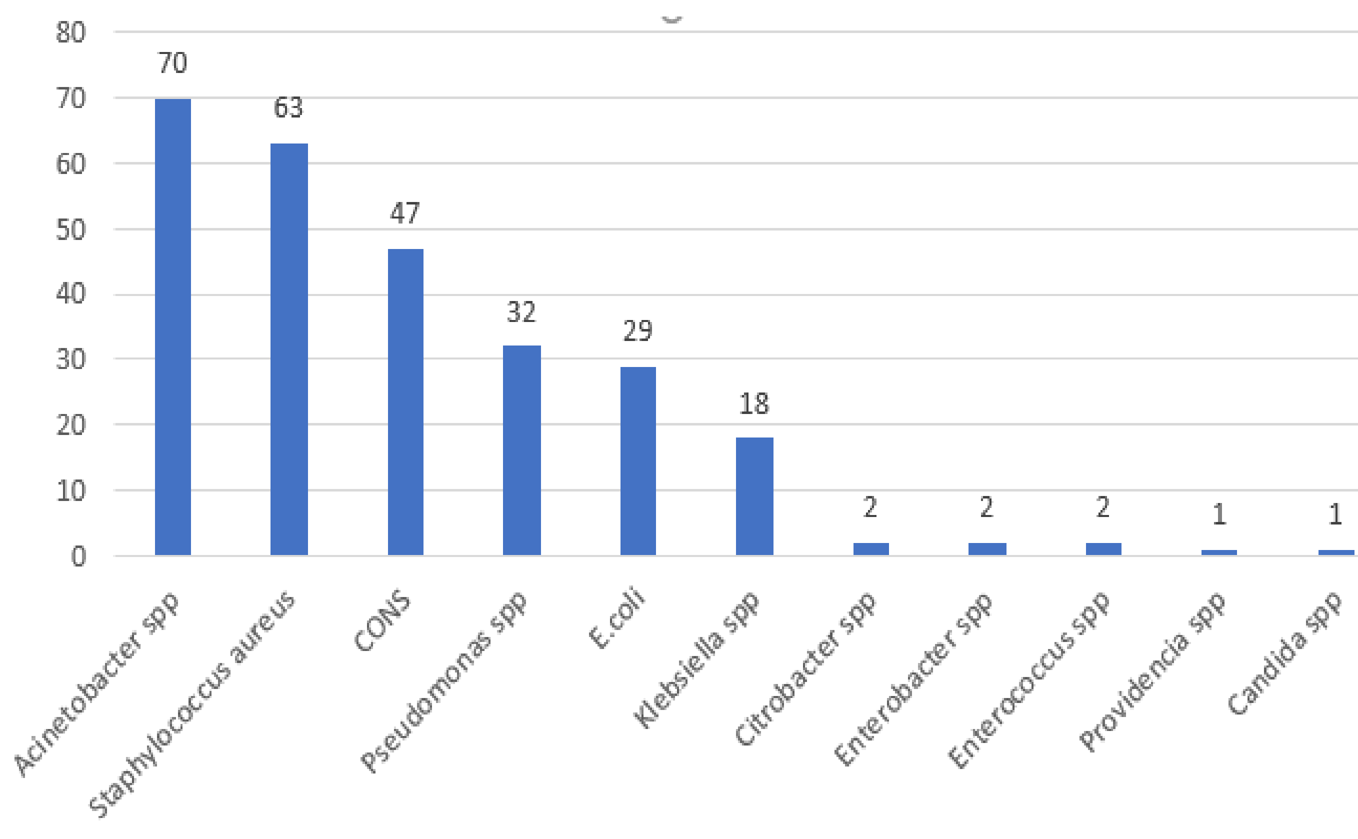


**Figure-1: Frequency of microorganisms isolated from blood culture**

**Table-5: Antimicrobial resistance pattern of Non-fermenters.**

| Antibiotics | Pseudomonas species (n=32) | Acinetobacter species (n=70) |
|---|---|---|
| Cefoperazone/ Sulbactam | 37.5% | 92.8% |
| Gentamicin | 56.2% | 60% |
| Piperacillin + Tazobactam | 37.5% | 67.1% |
| Imipenem | 37.5% | 48.5% |
| Piperacillin | 53.1% | - |
| Ciprofloxacin | 62.5% | 71.4% |
| Amikacin | 37.5% | 52.8% |
| Cefepime | 68.7% | 46.8% |
| Meropenem | 31.2% | 58.5% |
| Ceftazidime | 68.7% | 75.7% |
| Levofloxacin | 68.7% | 77.1% |
| Cotrimoxazole | - | 81.4% |
| Ceftriaxone | - | 82.8% |
| Ampicillin-Sulbactam | - | 71.4% |
| Doxycycline | - | 31.4% |

## DISCUSSION

Blood stream infections pose a major health threat. Annually 31.5 million cases of sepsis occur worldwide and 5.3 million people die due to sepsis [12]. Hospital stay, health care costs and mortality rate increase due to such infections. Immediate antibiotic therapy is required for such infections. For this, antibiogram of the local hospital should be available for empirical treatment to reduce antibiotic resistance [13].

In this study, 11.22 % of blood culture samples yielded growth. This percentage is comparable to a study carried out in Rawalpindi in which 16 % of the blood culture specimen yielded positive growth [14]. A study conducted in Lahore yielded growth in 27.9 % of blood culture specimens [15]. The blood culture positivity rate in an Indian study came out to be 16.5 % [4]. Various factors like volume of blood, number of blood culture received and prior antibiotic therapy can lead to variation in positivity of blood culture specimen [16]. This low positivity can be due to self-medication or some prior antibiotic therapy.

The predominant microorganisms were Gram positive cocci followed by non-fermenters and Enterobacteriaceae. A study conducted in India also showed higher prevalence (52.67 %) of Gram-positive organisms [17]. Nonetheless, Gram negative microorganisms were predominant in a study conducted in Lahore with prevalence rate of 53.2 % [18]. In Nepal, there was also predominance of Gram-negative rods that accounted for 65.8 % of total blood samples [19]. In this study, 58.77 % of the isolated *Staphylococcus aureus* were MRSA. In a study conducted in Karachi, 38.7 % of *Staphylococcus aureus* were methicillin resistant (20). In addition to that 35 % MRSA were also reported by Ahmadey and Mohammad [21]. *Acinetobacter species* (26.2 %) were the most predominant microorganism isolated in this study. Barati *et al.* also showed that blood stream infections due to *Acinetobacter species* were 32 % [22]. Kalpesh Gohel *et al.* studied higher prevalence of *E.coli* and *Klebsiella species* (25 %) from blood culture specimens [23]. Enterobacteriaceae showed decreased susceptibility to 3$^{rd}$ and 4$^{th}$ generation cephalosporins i.e. 11.5 % and 15.3 % respectively. This resistance pattern is similar to a study in Rwanda in which increased resistance pattern to cephalosporins was seen among Gram negative rods [24]. Quinolone susceptibility for Enterobacteriaceae was 11.5 % and is in accordance with a study in Rawalpindi which also showed decreased sensitivity to Quinolones [14]. Carbapenems were noted to be sensitive for 75 % isolates. A similar trend was studied by Fayyaz *et al.* [14]. Pseudomonas species showed increased susceptibility to piperacillin tazobactam (TZP) i.e. 62.5 %. Higher susceptibility pattern (76 %) to TZP was also seen among Pseudomonas species in a study conducted in Islamabad in 2016 by Azmat *et al.* [25]. In case of *Acinetobacter species* 68.75 % of samples showed susceptibility to doxycycline which is in accordance to a study conducted in Lahore which showed 55.12 % sensitivity to doxycycline [26]. Infection control and prevention programs should be properly implemented at all hospitals to reduce antibiotic resistant pathogens [27, 28].

## CONCLUSION

This study describes the predominance of Gram-positive cocci as the causative agent of sepsis. It also showed the susceptibility and resistance pattern of bacterial isolates causing sepsis. Empirical treatment strategies largely depend on the available data of the pathogens and resistance pattern. For this reason, local data is mandatory for timely start of empirical antibiotics as well as for devising an appropriate antibiotic stewardship plan in hospitals.

## AUTHORS CONTRIBUTION

**Fareeha Imran:** Paper writing, Data collection, Literature review, Statistical analysis.

**Jalees Khalid Khan:** Literature review.

**Aasma Noveen Ajmal:** Paper writing, Proof reading.
**Amina Asif & Muna Malik:** Literature review.

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