

# Culture and sensitivity patterns of bacteriological agents in children admitted to a tertiary care hospital

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## ABSTRACT

**Background:** Culture from various infected body fluids is one of the commonly used investigations to establish the etiology of infections and helps clinicians to select appropriate antimicrobial therapy. This study is aimed to determine the culture and sensitivity patterns of bacteriological agents grown in children admitted to a tertiary care center.

**Patients and methods:** This descriptive cross-sectional study was conducted at the Department of Pediatric Medicine, The Children's Hospital and the Institute of Child Health, Lahore from April 2019 to December 2019. All admitted children of age  $\leq 15$  years who fulfilled the criteria of systemic inflammatory response syndrome and sepsis were enrolled in the study. Blood and other body fluids were cultured in appropriate medium as indicated. Profile of microorganisms grown and their sensitivity patterns were noted and recorded on a predesigned data sheet. Statistical analysis was performed by SPSS v.22.

**Results:** A total of 500 patients were enrolled in the study. Eighty-three of them (16.6%) had growth of different microorganisms on culture and were further analyzed. Total 58 of these 83 (69.87%) were  $<5$  years of age, Male to female ratio was 1.2:1. Blood culture was positive in 36 patients (43.37%). Cultures from throat swabs, sputum and tracheal secretions showed growth of organisms in 15 (18.10%), while cerebrospinal fluid culture was positive in 14 (16.87%) and urine culture in 11 (13.25%). Microorganism isolated were: *Klebsiella spp.* (15.66%), *Salmonella spp.* (14.45%), *Escherichia coli* (13.25%), *Staphylococcus aureus* (12.04%), *Acinetobacter* (12.04%), *Streptococcus pyogenes* (10.84%), *Pseudomonas aeruginosa* (10.84%), *Enterobacter spp.* (7.23%) and *Stenotrophomonas maltophilia* (3.61%). *Klebsiella spp.* and *E. coli* showed resistant to various antibiotics including penicillin, co-amoxiclav, cephalosporin, fluoroquinolones and nalidixic acid. *Salmonella spp.* was mostly sensitive to meropenem and azithromycin. *Staphylococcus aureus* was sensitive to cephalosporin, amikacin, vancomycin and linezolid.

**Conclusion:** Commonest micro-organism isolated were *Klebsiella spp.*, *Salmonella spp.*, *Escherichia coli*, *Staphylococcus aureus* and *Streptococcus pyogenes*. Resistance to commonly used antibiotics was observed in most cultures, which is a whistle blower against inappropriate use of these drugs.

**Keywords:**

Culture, Blood, Urine, Pus, Antibiotics, Sensitivity, Resistance, Children

## INTRODUCTION:

Systemic inflammatory response syndrome (SIRS) is an inflammatory cascade that is initiated by the host response to an infectious or noninfectious triggering agent.<sup>1</sup> This is triggered when the host defense system does not adequately recognize and/or clear the triggering event. Sepsis is a fatal condition as a result from a systemic inflammatory response to infection, mainly caused by bacterial agents leading to symptomatic bacteremia, which causes high morbidity and mortality in children.<sup>2-4</sup> Sepsis in children presents with fever  $>38.5^{\circ}\text{C}$ , tachycardia, difficulty in breathing, malaise, lethargy, decreased appetite or refusal to feeds

and is considered a medical emergency that demands urgent intervention.<sup>1,4,5</sup> Any delay in treatment of this life-threatening condition results in fatal outcome, hence prompt treatment with antimicrobials is indicated.<sup>5</sup> The gold standard for diagnosing sepsis is the isolation of bacterial agents from blood culture.<sup>6</sup> However, bacteriological cultures and antibiotic susceptibility tests take several days for finality, it is recommended to start empirical antibiotic therapy immediately. The biggest dilemma with empirical antibiotic treatment is the emergence of antibiotic resistance.<sup>5,7</sup> Most likely reason is the injudicious and widespread use of inappropriate antibiotics and is a serious problem that can drag the world into pre-antibiotic era.<sup>8,9</sup> There is a need of periodic analysis of the patterns and sensitivity of organisms isolated and the results need to be published for the awareness of the relevant and managing physician for facilitating a better health care. Knowledge of the common causative agents

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causing sepsis and their antimicrobial susceptibility patterns to locally available antibiotics will result in appropriate empirical therapy and will play a significant role in reducing the risk of antibiotic resistance.<sup>10</sup> Blood culture and cultures from various infected body secretions is one of the simplest and commonly used investigations to establish the etiological agent of infections. Early diagnosis, accurate identification of the bacteria and antimicrobial susceptibility causing infections provides vital information to clinicians to start appropriate antimicrobial therapy.<sup>11</sup> This study is designed to determine the bacteriological profile and sensitivity patterns of antimicrobial agents isolated from various cultures in a tertiary care hospital.

### PATIENTS AND METHODS

This cross-sectional study was conducted in the Department of Pediatric Medicine, The Children's Hospital and the Institute of Child Health, Lahore, from April 2019 to December 2019. All children of age  $\leq 15$  years who were admitted and fulfilled the criteria of SIRS and pediatric sepsis were enrolled in the study. The criteria for SIRS included two out of 4 parameters, one of which must be abnormal temperature or abnormal leukocyte count. Core temperature  $>38.5^{\circ}\text{C}$  ( $101.3^{\circ}\text{F}$ ) or  $<36^{\circ}\text{C}$  ( $96.8^{\circ}\text{F}$ ) (rectal, bladder, oral, or central catheter).<sup>2</sup> Tachycardia: Mean heart rate  $>2$  SD above normal for age in absence of external stimuli, chronic drugs or painful stimuli or unexplained persistent elevation over 0.5-4 hour or in children  $<1$  year old, persistent bradycardia over 0.5 hour (mean heart rate  $<10$ th percentile for age in the absence of vagal stimuli,  $\beta$ -blocker drugs, or congenital heart disease).<sup>3</sup> Respiratory rate of  $>2$  SD above normal for age or acute need for mechanical ventilation not related to neuromuscular disease or general anesthesia.<sup>4</sup> Elevated or depressed leukocyte count for age (not secondary to chemotherapy) or presence of  $>10\%$  of immature neutrophils. Pediatric sepsis is defined when patient fulfills the criteria for SIRS in the presence of a suspected or proven infection.<sup>12</sup> Those children who has taken antibiotics  $>5$  days were excluded from the study. Blood and other body fluids from different sites including urine, cerebrospinal fluid, pleural fluid, sputum, throat swab, tracheal secretions, ear and skin swabs were cultured as per clinical indication. Bacteriological organisms were isolated and antimicrobial sensitivity to different drugs was performed. Among the positive culture reports, the bacteriological profile and sensitivity of antimicrobial agents were noted. Permission was taken from the

institutional review board of the hospital. Data was recorded on a predesigned datasheet. Statistical analysis was done by SPSS v.22, percentages were calculated and expressed in graphs and tabulated form.

### RESULTS

Out of 500 enrolled patients, 83 (16.6%) grew different microorganisms on culture and are described further. Among these 83 culture positive patients, 55.4% were male and male to female ratio was 1.2:1. Thirty eight of 83 (45.7%) were less than 1 year of age, 20 (24%) were between 1-5 years of age, 13 (15.6%) were between 5-10 years and 12 (14.4%) were between 10-15 years of age. Thirty-six patients (43.37%) had growth of organisms in blood. Culture of throat swabs, sputum and tracheal secretions, altogether were positive in another 15 patients (18.10%), followed by cerebrospinal fluid culture positive in 14 of them (16.87%), while urine culture was positive in 11 (13.25%), local swabs (skin and ear) cultures were positive in 5 (6%) and culture of pleural fluid was positive in 2 (2.4%). (Figure 1).

The commonest microorganism isolated was *Klebsiella spp.* (15.6%), followed by *Salmonella spp.* (14.45%), *Escherichia coli* (13.25%), *Staphylococcus aureus* (12.04%), *Acinetobacter* (12.04%), *Streptococcus pyogenes* (10.84%), *Pseudomonas aeruginosa* (10.84%), *Enterobacter spp.* (7.23%) and *Stenotrophomonas maltophilia* (3.61%) (Figure 2).

Antibacterial sensitivity revealed increasing resistance to first line antibiotics to most of the organisms. *Klebsiella spp.* and *E. coli* were resistant to many routinely used antibiotics including penicillin, co-amoxiclav, cephalosporin, flouroquinolones and naladixic acid while sensitive to meropenem, sulbactam/cefoperazone and nitrofurantoin. *Salmonella spp.* was extensively resistant to co-amoxiclav, cephalosporin and flouroquinolones. It was found to be highly sensitive to meropenem and azithromycin (83.33%) while it was sensitive to co-amoxiclav and ciprofloxacin in 50% of cases. *Streptococcus pyogenes* was found sensitive to most of the commonly used antibiotics while *Staphylococcus* was resistant to penicillin and co-amoxiclav, 60% sensitive to cephalosporin while highly sensitive to amikacin, vancomycin and linezolid. Hospital-acquired organisms, like *Acinetobacter*, was found highly resistant to all groups of antibiotics. *Pseudomonas* and *Enterobacter* were sensitive to amikacin in 90% and 33% respectively. Both of them were also sensitive to

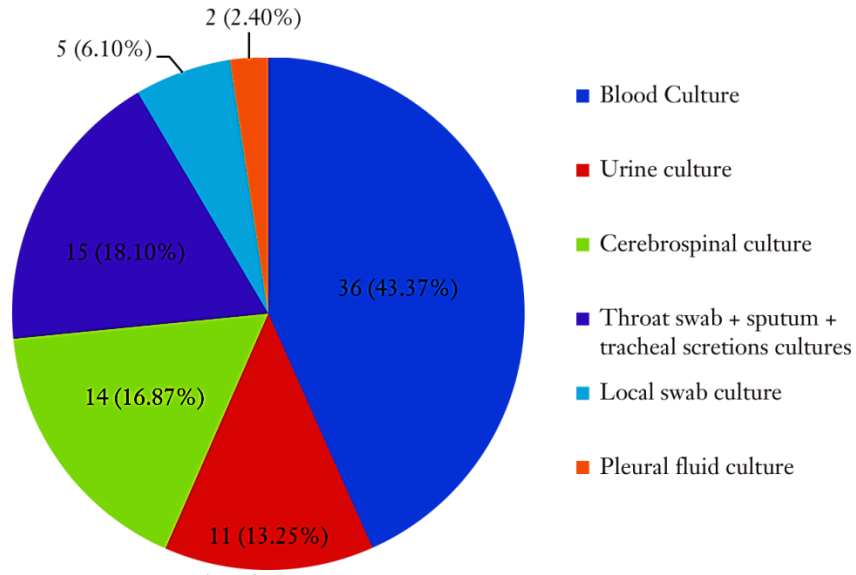


Figure 1. Frequency of sites of culture isolation. (n=83)

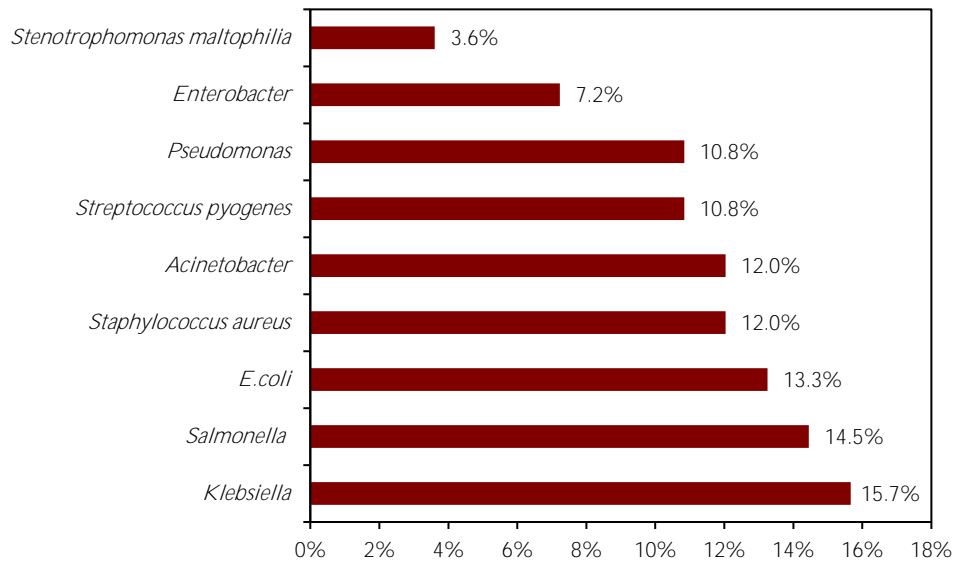


Figure 2. Profile of bacteriological organisms from various cultures. (n=83)

Meropenem and sulbactam. *Stenotrophomonas* was rarely grown organism in only 3 patients, however it was found to be sensitive to co-amoxiclav, ceftriaxone, levofloxacin, sulbactam and meropenem (66.66%) (Table 1).

**DISCUSSION**

Bacterial pathogens are becoming more and more resistant to commonly used antibiotics. Despite introduction of new antibiotics, empiric treatment of patients with infections became a major challenge for physicians.<sup>13</sup> Male preponderance (55%) was noted.

These results are consistent with study by Negussie and coauthors (males=54.7% and with M:F ratio was 1.2:1.<sup>14</sup> In this study, most of the isolated pathogens were gram negative bacteria (64.6%). Similar results have been described by Ashtiani and colleagues who reported gram negative organisms comprising to 65%, in their study.<sup>15</sup> Moreover, in present study, most common isolated gram-negative organism was *Klebsiella spp.* comprising to about 16% followed by *Salmonella spp.* comprising to 14% and *E. coli* to 13%, while the most common gram-positive organism was *Staphylococcus aureus* (12.04%) followed by *Streptococcus pyogenes*

Table 1. Microorganisms resistant to different antibiotics (n=83)

Antibiotics	<i>Klebsiella</i> spp. (n=13)	<i>Salmonella</i> spp. (n=12)	<i>E. coli</i> (n=11)	<i>Acinetobacter</i> (n=10)	<i>S. aureus</i> (n=10)	<i>Pseudomonas</i> (n=9)	<i>St. pyogenes</i> (n=9)	Enterobacter (n=6)	<i>St. maltophilia</i> (n=3)
Penicillin	-	-	2 (18.18%)	-	6 (60%)	-	-	-	-
Co-amoxiclav	7 (53.84%)	4 (33.33%)	6 (54.54%)	10 (100%)	6 (60%)	9 (100%)	-	6 (100%)	1 (33.33%)
Amikacin	8 (61.53%)	-	3 (27.27)	9 (90%)	1 (10%)	1 (11.11%)	-	2 (33.33%)	-
Cefuroxime	12 (92.3%)	8 (66.67%)	9 (81.81)	9 (90%)	6 (60%)	8 (88.89%)	5 (55.56%)	6 (100%)	2 (66.67%)
Ceftriaxone	12 (92.3%)	8 (66.67%)	9 (81.81)	8 (80%)	6 (60%)	6 (66.67%)	-	6 (100%)	1 (33.33%)
Ciprofloxacin	8 (61.53%)	6 (50%)	2 (18.18)	7 (70%)	-	2 (22.22%)	-	6 (100%)	1 (33.33%)
Levofloxacin	6 (46.15%)	8 (66.67%)	2 (18.18)	7 (70%)	-	4 (44.44%)	-	6 (100%)	-
Sulbactam/cefoperazone	5 (38.46%)	2 (16.66%)	7 (63.63)	5 (50%)	-	4 (44.44%)	-	1 (16.67%)	1 (33.33%)
Meropenem	4 (30.76%)	2 (16.66%)	4 (36.36)	8 (80%)	-	4 (44.44%)	-	2 (33.33%)	1 (33.33%)
Nitrofurantoin	3 (23.07%)	-	-	-	-	-	-	-	-
Nalidixic acid	7 (53.84%)	-	6 (54.54)	-	-	-	-	-	-

\**E. coli* = *Escherichia coli*, \*\**S. aureus* = *Staphylococcus aureus*, \*\*\* *St. pyogenes* = *Streptococcus pyogenes*, §*St. maltophilia* = *Stenotrophomonas maltophilia*

(10.84%). Almost similar pattern of organisms was also observed in an earlier report.<sup>16</sup> In a study conducted by Roy and coresearchers, the most common isolated organism was *Staphylococcus aureus* in 44% of his cases, followed by enterococcus in 7% and *E. coli* in 4.6%.<sup>17</sup> In another study, most common bacterial isolates were gram positive and the commonest organism was *Staphylococcus aureus* followed by *Escherichia coli* and citrobacter.<sup>18</sup> Most of organisms in this study were resistance to commonly used antibiotics. Another study has also observed that there was increasing resistance to gram positive organisms against ampicillin, cephalosporin and aminoglycosides. While most of the gram-negative organisms (96%) were multidrug resistant.<sup>19</sup> Empirical antibiotic treatment must be reconsidered because most of the bacteria isolated show high rate of resistance to most commonly prescribed drugs like co-amoxiclav, cephalosporins and quinolones etc. Therefore, selection of antimicrobial drug should be based on culture and sensitivity findings to prevent further drug resistance.

## CONCLUSION

Commonest micro-organisms isolated were gram negative pathogens like *Klebsiella* spp., *Salmonella* spp. and *Escherichia coli* while common gram-positive pathogens were *Staphylococcus aureus* and *Streptococcus pyogenes*. Most of these organisms were resistant to commonly used antibiotics. It is recommended to conduct such descriptive studies from time to time at a tertiary care center to periodically determine their bacteriological profile and antimicrobial sensitivity. Rationale use of antibiotics according to culture and sensitivity should be strictly practice to prevent further drug resistance.

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