Gender and Age Dependent Bacteriological Etiology of Community-Acquired Blood Stream Infection

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Abstract

Background: Bloodstream infection constitutes one of the most serious situations in infectious disease. Objective: The purpose of the present study was to determine the gender and age dependent etiology of community-acquired urinary blood stream infection. Methodology: This was a retrospective analysis of blood samples from clinically suspected cases of blood stream infection. Samples were collected at Ad-din Women’s Medical College Hospital, Dhaka & Rushmono Specialized Hospital, Dhaka from January 2018 to September 2018. All the samples were collected from inpatient’s and outpatient’s department of our hospital during the study period and processed in Microbiology laboratory. The BD BACTEC FX40 automated blood culture method was used to isolate bacterial pathogens and antimicrobial susceptibility test was performed by Kirby-Bauer disc diffusion method. Results: A total of 483 (16.1%) pathogens were isolated from 3018 bacteremia suspect patient blood specimens. Gram-negative cocci (58.4%) were predominant organisms recovered followed by Gram-positive bacilli (41.6%). Majority of BSI were caused by Gram negative bacteria predominantly Salmonella Typhi (31.1%). Salmonella species was found less prevalent in the children (55%) and more frequent in the age groups 16 to 30 years (85.0%) and more than 60 years (100.0%). Acinetobacter species was found less prevalent in age group 16 to 30 years (7.5%). Escherichia coli was found only few prevalent in the 1 to 15 (0.5%) and higher frequent in the age groups 16 to 30 years (2.5%). Salmonella species isolates appeared to be sensitive to ceftriaxone (91.3%), meropenem (90.7%) and cotrimoxazole (76%). Sensitivity rates of ciprofloxacin, gentamycin and levofloxacin were 87.3% for coagulase-negative Staphylococcus species (CoNS). Conclusion: Both patients’ age and gender are significant factors in determining bloodstream infection.

Keywords: Gender; age group; drug sensitivity; blood stream infection

Introduction

Blood stream infections caused by bacteria range from self-limiting to life-threatening. Microbial invasion of the bloodstream can have very serious immediate consequences such as shock, multiple organ failures, and disseminated intravascular coagulopathies. Changing patterns of epidemiology, lack of proper antimicrobial guidelines in the locality, the emergence of antimicrobial resistance, and paucity of good diagnostic facilities are the major factors connected to the surge in BSI associated morbidity and mortality¹. Previous studies revealed that the number of cases of BSI are increasing worldwide²,³. Blood stream infection caused by bacteria are among the main causes of mortality and morbidity across the globe,¹

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Introduction

Causes of mortality and morbidity across the globe, antimicrobial guidelines in the locality, the emergence of epidemiology, lack of proper treatment strategies and infection control programs.

Changing patterns of epidemiology, for instance, the emergence of drug-resistant strains among Salmonella Typhi and Acinetobacter species have been reported as a cause of bacteremia with variation in distribution from place to place. As an example, Salmonella enterica is a frequently isolated pathogen from blood samples in both African and Asian regions, however, their serotypes differ substantially. Salmonella Paratyphi is the predominant organism in the Salmonella group in Africa whereas Salmonella Typhi is the most frequently isolated organism in Asia. Besides their isolation rate and their antibiotic susceptibility pattern varies substantially. Depending on the age, the severity of infection, other risk factors and the mortality rate for BSI varies between 4.0 and 41.5%. Globally, bloodstream infection affects about 30 million people leading to 6 million deaths with 3 million newborns and 1.2 million children suffering from sepsis annually.

Changing patterns of epidemiology, lack of proper antimicrobial guidelines in the locality, the emergence of antimicrobial resistance and paucity of good diagnostic facilities are connected to the surge in BSI associated morbidity and mortality. Increasing antimicrobial resistance is a worldwide concern. It is a serious challenge for health care professionals in prescribing suitable antimicrobial therapy as many bacterial pathogens have developed resistance to most of the antibiotics. Early diagnosis plays a crucial role in managing BSI, and hence, prompt detection of such infections is a critical function of clinical microbiology laboratories. Blood culture is a vital tool for the detection of BSI and remains the gold standard for bacteremia detection. Empiric antimicrobial therapy is based on knowledge of the microbial profile and their antimicrobial sensitivity patterns, clinical and epidemiological data. Irrational use of drugs has led to an increase of multidrug-resistant bugs and thus worsened the condition.

In most of the cases, antimicrobial therapy is initiated empirically before the results of blood culture are available. Selection of right antibiotic for empiric therapy is of utmost importance. Continuous monitoring trends in the microbiology of BSI pathogens and their antibiotic susceptibility patterns are therefore important to guide empiric antibiotic treatment strategies and infection control programs. Therefore, the purpose of the presents study was to determine the gender and age dependent etiology of community acquired blood stream infection.

Methodology

Study Settings & Population: This was a retrospective observational analysis a total of 3018 samples from clinically suspected cases of blood stream infection were collected at Ad din Medical College and Hospital, Dhaka from January 2018 to September 2018. All the samples were collected from inpatient’s and outpatient’s department of our hospital during the study period and processed in Microbiology laboratory.

Blood Culture Procedure: About 10 ml of venous blood for adults and 2-3 ml for children was collected aseptically using 70.0% alcohol and 2.0% tincture iodine and transferred in to automated blood culture bottles. The BD BACTEC FX40 automated blood culture method was used. In case of a positive growth, the BD BACTEC FX40 automatically gives an alert. Blood culture bottles were with no alert signal of bacterial growth after recommended days of incubation is considered culture negative. The positive bottles were sub cultured on MacConkey’s agar, blood agar and chocolate agar media. The chocolate agar plates were incubated inside a candle jar to provide 5.0 to 10.0% CO2, whereas the other two agar plates (blood agar and MacConkey’s agar) were incubated aerobically for 18 to 24 h at 37°C.

Isolation and Identification of Bacteria: Isolates were further processed according to standard operating procedure (SOP) of the laboratory for its complete identification. Pure cultures of bacterial isolates were subsequently subjected to species identification and confirmation. Gram positive isolates were identified using catalase and coagulase tests. Isolates of members of Enterobacteriaceae family were identified biochemically by means of a series of tests: catalase, indole, citrate, urease, H2S production and triple-sugar iron. Non lactose fermenting Gram negative bacteria were identified by indole, triple-sugar iron, urease, oxidase and catalase tests.

Procedure of Antimicrobial susceptibility tests: Antimicrobial susceptibility tests were performed by using the Kirby-Bauer disc diffusion method and susceptibility patterns were determined following CLSI guidelines. Diameters of the zone of inhibition...
were measured to the nearest millimeter and categorized as sensitive, intermediate and resistant according to CLSI guidelines. Isolates were classified as either susceptible or resistant to an antibiotic and all the isolates with intermediate resistance were classified as resistant. Culture media and antibiotic discs used in the study were obtained from Oxoid Ltd., UK. Quality control for media was done by randomly taking the prepared culture media and incubating overnight to see for any growth. In this study multi-drug resistance (MDR) was defined as simultaneous resistance to more than two antimicrobial agents. Isolates of *Salmonella Typhi* were further tested for methicillin resistance according to the CLSI guidelines by using cefoxitin disc.

**Statistical Analysis:** Statistical analysis was performed by Windows based software named as Statistical Package for Social Science (SPSS), versions 22.0 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Continuous data were expressed as mean, standard deviation, minimum and maximum. Categorical data were summarized in terms of frequency counts and percentages. Chi-square test was used for comparison of categorical variables and Student t test was applied for continuous variables. Every efforts were made to obtain missing data. A two-sided P value of less than 0.05 was considered to indicate statistical significance. Differences between case and control were tested.

**Ethical Consideration:** All procedures of the present study were carried out in accordance with the principles for human investigations (i.e., Helsinki Declaration) and also with the ethical guidelines of the Institutional research ethics. Formal ethics approval was granted by the local IRB. As this was a retrospective study, no consent form is needed to perform the study.

**Results**

This study shows 150 (31.1%) were males and 333 (68.9%) were females. From 483 isolates recovered from patients, the spectrum of microbes included 201 (41.6%) Gram-positive cocci (GPC) and 282 (58.4%) Gram-negative bacilli (GNB). *Salmonella* was the most frequently Gram-negative isolated blood borne bacterial pathogen in this study accounting for 31.1% of the total isolates. CoNS was the most Gram-positive isolated blood borne bacterial pathogen according to 39.1% (Table 1).

<table>
<thead>
<tr>
<th>Type of growth</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram negative</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>150</td>
<td>31.1</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>87</td>
<td>18.0</td>
</tr>
<tr>
<td><em>Enterobacter</em></td>
<td>33</td>
<td>6.8</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>9</td>
<td>1.9</td>
</tr>
<tr>
<td><em>Klebsiella</em></td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>Gram positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>CoNS</em></td>
<td>189</td>
<td>39.1</td>
</tr>
<tr>
<td><em>Staph. Aureus</em></td>
<td>12</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Table 1: Distribution of bacteria isolated from blood sample (n=483)

<table>
<thead>
<tr>
<th>Type of growth</th>
<th>Male</th>
<th>Female</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram negative</td>
<td>92(61.3%)</td>
<td>189(56.7%)</td>
<td>0.001</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>77(51.3%)</td>
<td>73(21.9%)</td>
<td>0.001</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>14(9.3%)</td>
<td>73(21.9%)</td>
<td>0.016</td>
</tr>
<tr>
<td><em>Enterobacter</em></td>
<td>1(0.7%)</td>
<td>33(9.6%)</td>
<td>0.001</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>0(0.0%)</td>
<td>9(2.7%)</td>
<td>0.001</td>
</tr>
<tr>
<td><em>Klebsiella</em></td>
<td>0(0.0%)</td>
<td>2(0.6%)</td>
<td>0.031</td>
</tr>
<tr>
<td>Gram positive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>CoNS</em></td>
<td>51(34.0%)</td>
<td>138(41.4%)</td>
<td>0.001</td>
</tr>
<tr>
<td><em>Staph. Aureus</em></td>
<td>7(4.7%)</td>
<td>6(1.8%)</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Table 2: Distribution of Bacteria Isolated from Blood Sample according to Gender (n=483)

*Salmonella* was found less prevalent in the children (55%) and more frequent in the age groups 16-30 years (85%) and >60 years (100%). *Acinetobacter* was found less prevalent in age group 16-30 years (7.5%) and more frequent in the age groups <1 years (22.7%) and 1-15 years (15.7). *Enterobacter* was found less prevalent in the 1-15 years (1%) and more frequent in the age groups 31-59 years (100%) and <1 years (9.7%). *E. coli* were found only few prevalent in the 1-15 (0.5%) and higher frequent in the age groups 16-30 years (2.5%). *Klebsiella* was found in less than 1 year (0.8%). *Staphylococcus aureus* was found only 1-15 years (6.3%). CoNS was found less prevalent in the 16-30 (2.5%) and more frequent in the age groups less
Introduction

Infections caused by bacteria are among the main public health problems. Antimicrobial guidelines in the locality, the emergence of multidrug-resistant bugs and thus worsened the mortality range from 4 to 41.5%. Pseudomonas aeruginosa, Enterococcus faecalis, and Enterobacter are the most frequently isolated organisms in Asia. Each year, bacterial pneumonia affects about 30 million people leading to 6 million deaths. Bloodstream infections (BSIs) remain the gold standard for bacteremia detection. Culture is a vital tool for the detection of BSIs and remains the gold standard for the diagnosis of bacteremia. Blood culture is a primary method for the detection of BSIs and is a fundamental function of clinical microbiology laboratories. Blood cultures are used to prompt the diagnosis of such infections, which is critical for the timely administration of appropriate antimicrobial therapy.

Isolates

Isolates were identified by indole, triple-sugar iron, urease, and other biochemical reactions. Antibiotic susceptibility testing was performed using the disk diffusion method for aerobic bacteria. The sensitivity of the isolates was determined using the standard CLSI (Clinical and Laboratory Standards Institute) guidelines. The results indicated that ciprofloxacin, gentamycin, and levofloxacin were 87.3% for coagulase-negative Staphylococcus spp. (CoNS). Staphylococcus spp. were most sensitive (91.7%) to the action of vancomycin and (83.3%) to amikacin.

Sensitivity rates of vancomycin were 93.6% and ciprofloxacin, gentamycin, and levofloxacin were 87.3% for coagulase-negative Staphylococcus spp.

Table 3: Distribution of bacteria isolated from blood sample according to age and gender (n=483)

<table>
<thead>
<tr>
<th>Organism</th>
<th>Gender</th>
<th>&lt;1 yrs</th>
<th>1-15 yrs</th>
<th>16-30 yrs</th>
<th>31-59 yrs</th>
<th>≥60 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>238</td>
<td>191</td>
<td>40</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>203</td>
<td>95</td>
<td>21</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Salmonella</td>
<td>All</td>
<td>4(1.4%)</td>
<td>105(55.0%)</td>
<td>34(85.0%)</td>
<td>0(0.0%)</td>
<td>7(100.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>0(0.0%)</td>
<td>58(60.4%)</td>
<td>19(100.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>4(2.0%)</td>
<td>47(49.5%)</td>
<td>15(71.4%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>All</td>
<td>54(22.7%)</td>
<td>30(15.7%)</td>
<td>3(7.5%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>0(0.0%)</td>
<td>17(14.6%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>54(26.6%)</td>
<td>16(16.8%)</td>
<td>3(14.3%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Enterobacter</td>
<td>All</td>
<td>23(9.7%)</td>
<td>2(1.0%)</td>
<td>1(2.5%)</td>
<td>7(100.0%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>0(0.0%)</td>
<td>1(1.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>23(11.3%)</td>
<td>1(1.1%)</td>
<td>1(4.8%)</td>
<td>7(100.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>E. coli</td>
<td>All</td>
<td>7(2.9%)</td>
<td>1(0.5%)</td>
<td>1(2.5%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>7(3.4%)</td>
<td>1(1.1%)</td>
<td>1(4.8%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Klebsiella</td>
<td>All</td>
<td>2(0.8%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2(1%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Staph. aureus</td>
<td>All</td>
<td>12(6.3%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>0(0.0%)</td>
<td>6(6.3%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0(0.0%)</td>
<td>6(6.3%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>CoNS</td>
<td>All</td>
<td>41(21.5%)</td>
<td>1(2.5%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>34(97.1%)</td>
<td>17(17.7%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>113(55.7%)</td>
<td>24(25.3%)</td>
<td>1(4.8%)</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Drug-sensitivity Profiles of Gram-negative Isolates

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Salmonella (n=150)</th>
<th>Acinetobacter (n=87)</th>
<th>Enterobacter (n=33)</th>
<th>E. coli (n=9)</th>
<th>Klebsiella (n=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>89(59.3%)</td>
<td>13(14.9%)</td>
<td>15(45.5%)</td>
<td>1(11.1%)</td>
<td>0(00)</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>82(54.7%)</td>
<td>6(6.9%)</td>
<td>21(63.6%)</td>
<td>1(11.1%)</td>
<td>2(100)</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>137(91.3%)</td>
<td>57(65.5%)</td>
<td>23(69.7%)</td>
<td>1(11.1%)</td>
<td>2(100)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>97(64.7%)</td>
<td>50(57.5%)</td>
<td>17(51.5%)</td>
<td>8(88.9%)</td>
<td>0(00)</td>
</tr>
<tr>
<td>Cotrimoxazole</td>
<td>114(76%)</td>
<td>45(51.7%)</td>
<td>9(27.3%)</td>
<td>7(77.7%)</td>
<td>2(100)</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>77(51.3%)</td>
<td>37(42.5%)</td>
<td>10(30.3%)</td>
<td>1(11.1%)</td>
<td>2(100)</td>
</tr>
<tr>
<td>Imipenem</td>
<td>14(9.3%)</td>
<td>13(14.9%)</td>
<td>1(3%)</td>
<td>0(00)</td>
<td>0(00)</td>
</tr>
<tr>
<td>Levofoxacin</td>
<td>25(16.7%)</td>
<td>65(74.4%)</td>
<td>15(45.5%)</td>
<td>0(00)</td>
<td>0(00)</td>
</tr>
<tr>
<td>Meropenem</td>
<td>136(90.7%)</td>
<td>10(11.5%)</td>
<td>21(63.6%)</td>
<td>6(66.7%)</td>
<td>0(00)</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>76(50.7%)</td>
<td>35(40.2%)</td>
<td>10(30.3%)</td>
<td>2(22.2%)</td>
<td>0(00)</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>85(56.7%)</td>
<td>0(00)</td>
<td>8(24.2%)</td>
<td>0(00)</td>
<td>0(00)</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>0(00)</td>
<td>66(75.9%)</td>
<td>0(00%)</td>
<td>5(55.6%)</td>
<td>0(00)</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>77(51.3%)</td>
<td>28(32.3%)</td>
<td>16(48.5%)</td>
<td>5(55.6%)</td>
<td>1(50%)</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>81(51.4%)</td>
<td>0(00)</td>
<td>27(81.8%)</td>
<td>4(44.4%)</td>
<td>0(00)</td>
</tr>
</tbody>
</table>
(CoNS). *Staphylococcus spp.* were most sensitive (91.7%) to the action of vancomycin and (83.3%) to amikacin (Table 5).

**Table 5: Drug-sensitivity profile of Gram-positive isolates**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>CoNS (n=189)</th>
<th>Staph. aureus (n=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>164(86.7%)</td>
<td>10(83.3%)</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>49(25.9%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>105(55.6%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>165(87.3%)</td>
<td>9(75%)</td>
</tr>
<tr>
<td>Cotrimoxazole</td>
<td>119(63%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>165(87.3%)</td>
<td>8(66.7%)</td>
</tr>
<tr>
<td>Imipenem</td>
<td>48(25.4%)</td>
<td>7(58.3%)</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>165(87.3%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Meropenem</td>
<td>37(19.6%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>110(58.2%)</td>
<td>6(50.0%)</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>96(50.8%)</td>
<td>5(41.7%)</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>171(93.6%)</td>
<td>11(91.7%)</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>92(48.7%)</td>
<td>0(0.0%)</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>97(51.3%)</td>
<td>0(0.0%)</td>
</tr>
</tbody>
</table>

**Discussion**

Bacterial or fungal bloodstream infections are common among adults and children. This study reveals the importance of bloodstream infections in the different age and gender of patients.

In this study, *Salmonella* (31.1%) was the predominant gram-negative bacteria followed by *Acinetobacter* (18%), *Enterobacter* (6.8%), *E. coli* (1.9%) and *Klebsiella spp.* (0.4%) and *S. aureus*. CoNS (39.1%) (Table-1) was predominant gram-positive bacteria. Several studies from Bangladesh have identified *S. Typhi* as a common cause of bloodstream infection in this region and reported *Salmonella species* to be responsible for almost half of the disease burden associated with BSI in Dhaka. More or less similar observations have been seen in cases of bacteremia in different countries, though the proportion and prevalence of the bacterial agents varied. As the only source of Salmonella infection is the infected human and fecal contamination of drinking water and food supplies, the highest percentage of Salmonella isolates in this study indicate the necessity of proper waste management and infection control practices. Over the past two decades, CoNS, the usual skin commensals are increasingly being considered bloodstream pathogens in select settings. Improper methods of blood collection and the presence of long standing intravascular catheters are recognized as possible modes of spread of BSI by CoNS. In fact, two studies reported CoNS as the most common isolate causing BSIs in ICU patients.

This study showed that prevalence of bloodstream infection following data stratification was not consistent across all age groups further divided by gender. *Salmonella* was found less prevalent in the children (55%) and more frequent in the age groups 16-30 years (85%) and >60 years (100%). *Acinetobacter* was found less prevalent in age group 16-30 years (7.5%) and more frequent in the age groups 10-<1 years (22.7%) and 1-15 years (15.7%). *Enterobacter* was found less prevalent in the 1-15 years (1%) and more frequent in the age groups 31-59 years (100%) and <1 years (9.7%). *E. coli* was found only few prevalent in the 1-15 (0.5%) and higher frequent in the age groups 16-30 years (2.5%). *Klebsiella* was found in <1 years (0.8%). *Staph aureus* was found only 1-15 years (6.3%). CoNS was found less prevalent in the 16-30 (2.5%) and more frequent in the age groups <1 years (61%) and 1-15 years (21.5%). This finding are consented with previous studies Magliano et al. This study shows *Salmonella* were more frequent in male than female which was 51.3% versus 21.9%. All others organism were found more frequent in female than male. The deference was statistically significant (*p*<0.05). Kiffer et al conducted a study comparable to ours, in terms of patient’s population (both males and females of any age), number of isolates (35 782), and selected age groups. They also found lower percentage of *E. coli* isolation in patients younger than 13 years or older than 60 years (69.0% and 68.8%) as compared to the age group 13–60 years (79.7%) ; higher difference in *E. coli* rates of isolation, between males and females, in the youngest (27.2%) and the oldest (25.8%) age groups with respect to the 13–60 years age group (8.9%); a higher prevalence of *E. faecalis* (16.4%) and *P. aeruginosa* (14.7%) in males older than 60 years, approximately three and six times higher, respectively, as compared to females of the same age group.

In this study found a high percentage of *Salmonella* isolates appeared to be sensitive to ceftriaxone (91.3%), meropenem (90.7%) and cotrimoxazole (76%) which is consistent with studies carried out in Nepal, Pakistan and Bangladesh. This might give us some hope that in future we can again start using these antimicrobials for treatment to *Salmonella*. This finding shows 64% and 54.7% Salmonella Typhi were susceptible to amikacin and azithromycin. A study from Nepal also reported a low rate of azithromycin resistance among tested antibiotics.

In this study *Acinetobacter* were found to be sensitive (75.9% and 74.4%) to levofloxacin and vancomycin.
which were consistent with other studies. Enterobacter were susceptible to tetracycline and ceftriaxone (78.9%) and (81.8%) which is consistent with studies carried out in Nepal, India and Pakistan. This might give us some hope that in the future we can again start using these antimicrobials for treatment to Enterobacter. This study observed sensitivity of E. coli was 88.9% to ciprofloxacin, 77.7% to cotrimoxazole and 66.7% to meropenem. Similar findings have been observed across Saudi Arabia and China. Klebsiella isolates showed sensitivity rate of 100% to azithromycin, ceftriaxone, cotrimoxazole and gentamycin. However other studies from India, Nepal and Ethiopia showed all the isolates of Gram-negative bacteria were susceptible to cotrimoxazole and meropenem. In this study, CONS was mostly sensitive to vancomycin (93.6%). The sensitivity rates of ciprofloxacin, gentamycin and levofloxacin were 87.3% for Coagulase-negative Staphylococcus spp. (CoNS) which were consistent with other studies. They reported CoNS infections were amenable to levofloxacin, gentamycin, and chloramphenicol (90% sensitivity). Enterococcus spp. had mixed sensitivities toward gentamycin, chloramphenicol, and tetracycline. Ampicillin was however totally effective for Enterococcus spp. Alpha and beta hemolytic Streptococcus spp. were uniformly sensitive to penicillin and other beta lactam antibiotics. Staphylococcus spp. were most sensitive (91.7%) to the action of vancomycin and (83.3%) to amikacin. Ciprofloxacin and gentamycin where other alternatives Staphylococcus spp. isolates were highly responsive (75% and 66.7%). Similar study Banik et al. Staphylococcus spp. were most responsive (100%) to the action of teicoplanin, vancomycin, and chloramphenicol. Gentamicin and levofloxacin were other alternatives responsive (~90%) to gentamicin, clindamycin, quinolones, and chloramphenicol besides erythromycin and tetracycline.

Conclusion
In a nutshell, this study reveals that, Salmonella species significantly cause blood stream infection in males of age group of 16-30 years whereas all other microorganisms are more prevalent among females. E.coli species are less frequent among patients younger than 13 years and older than 60 years. Salmonella species shows highest sensitivity towards meropenem and ceftriaxone. Gram positive organisms are most sensitive to vancomycin and amikacin.

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None

Conflict Of Interest
The authors have no conflicts of interest to disclose.

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Authors’ contributions
Dr. Nafisa Rashid conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Dr. Ritu Saha & Dr. Tanara Jahan contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Dr. Md. Mahbub Rahman, Dr. Nasrin Akther Maya and Dr. Asma Ul Hosna involved in the manuscript review and editing. All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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