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Bacterial Profile and Their Antimicrobial Resistance Pattern among Adult Patients with Suspected Bloodstream Infection at Jimma University Medical Center, Ethiopia

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ABSTRACT

Introduction: *Bacterial blood stream infection is a major public health problem that results in a high rate of morbidity and mortality. If not diagnosed early, it will continue to be a serious condition. On time diagnosis and appropriate medication are needed to save the lives of the affected. The study was designed to determine the bacterial profile and their antimicrobial resistance pattern among adult patients with suspected bloodstream infection at Jimma University Medical Center, Ethiopia.* ***Materials and Methods:*** *A hospital based cross sectional study was conducted at Jimma University Medical Center from March 15,2019 to September 30, 2019. A consecutive sampling technique was used. Ten milliliters of blood (two 5 ml from two different sites) were collected aseptically and inoculated into Tryptic soya broth before being incubated at 37°C for seven days. Those show the growth of microorganisms was identified by biochemical tests, and then antimicrobial sensitivity tests were done for the isolated organism. The data was entered into epidata version 3.1 and analyzed by SPSS version 23. Logistic regression with a significance level of P 0.05 was used.* ***Result:*** *A total of 271 blood culture tests were enrolled, of which 60 (22.14%) were culture positive. The predominant bacteria isolated from blood culture were S. aureus 16 (26.67%), followed by Coagulase negative staphylococci 12 (20%), and E. coli 12 (20%). Salmonella species and S. pneumoniae are both responsible for the same 2 (3.33%). Gram positive and gram negative bacteria constituted 32 (53.33%) and 28 (46.67%), respectively. The overall multidrug resistance in the present study was 46 (76.67%). The range of resistance for gram positive and gram negative was from 0% to 93.7% and 0% to 100%, respectively.* ***Conclusion:*** *The overall culture confirmed prevalence of blood isolates in* *adult patients suspected of having bloodstream infection was high. Ciprofloxacin, gentamicin, and meropenem were the most effective drugs for the treatment of bacterial bloodstream infection in adult patients.*

Keyword: Adult, Antimicrobial resistance pattern, Bloodstream infection

Abbreviations and Acronym: AOR: Adjusted Odd Ratio; ATCC: American Type Culture Collection; BSI: Bloodstream Infection; CI: Confidence Interval; CLSI: Clinical and Laboratory Standards Institute; COR: Crude Odd Ratio; ESKAPE: *Enterococcus, S. aureus, K. pneumoniae*, A. *baumannii, P. aeruginosa* and *E. coli*; ESBL: Extended-spectrum beta-lactamase; GNB: Gram Negative Bacteria; GPB: Gram Positive Bacteria; KIA: Klingler Iron Agar; JUMC: Jimma University Medical Center; ICU: Intensive Care Unit; LDC: Lysine Decarboxylase; MRSA: Methicillin Resistance *Staphylococcus aureus*; MRCoNS: Methicillin Resistance Coagulase Negative Staphylococci; MHA: Muller Hinton Agar; Spp: Species; SPSS: Statistical Package for Social Science; TSB: Tryptic Soya Broth

INTRODUCTION

Blood Stream Infection (BSI) is a potential life threatening infection with mortality rate ranging from 20 to 50% and is one of the major causes of death throughout the world [1]. Bloodstream infection is caused by different microorganisms, of which bacteria is the most common cause of bloodstream infection [2]. It can be as a primary or secondary infection [3]. Normally, the bloodstream is a sterile environment, but several types of bacteria live on or in different body parts of the human body as normal flora. When bacteria enter the circulating blood from their normal residence, they cause bloodstream infection [4]. Both gram negative and gram positive bacteria were responsible for causing the bloodstream infection [5].

The pathogenesis of bloodstream infection involves complex interactions between the invading bacteria and the defense mechanisms of the host [6]. If not diagnosed early, BSIs continue to be severe, as severe sepsis, septic shock, and multisystem organ dysfunction will occur [7].

After onset, a bacterial cell or product like bacterial endotoxin (lipopolysaccharide) of gram negative, lipoteichoic acid, peptidoglycan, and extracellular products (toxins, enzymes, and the like) of gram positive bacteria triggers the host immune response that may handle infection or result in further complications to different body parts [2].

Currently, antibiotic resistance is recognized as a global health problem that has been escalated by world health organizations to one of the top health challenges facing the 21st century [8]. Early identification of the causative pathogen results in lower case fatality rates and reduced development of antibiotic resistance due to mutations in the genomes of microbes and improper selection of antibiotics used for treatment [9,10]. Blood culture remains the most practical and reliable method for diagnosis and management of blood stream infection as it allows the detection of causative pathogens with their drug susceptibility for optimization of antibiotic therapy [10,11].

The majority of complicated cases of bloodstream infection are caused by drug resistant bacteria [12]. This may result in a considerable economic and human cost, especially if infection is caused by ESKAPE [13,14]. When looking only at a part of the impact of AMR, the continued rise in resistance by 2050 would lead to 10 million people dying every year and a reduction of 2% to 3.5% in gross domestic product.

It costs the world up to 100 trillion dollars in the United States. Antibiotic resistant bacteria are getting increased day by day alarmingly, hence results infections either more difficult to treat or untreatable [15,16].

In our country, Ethiopia, few studies were reported regarding bacterial profile and their antimicrobial resistance pattern on the blood culture isolates from adult patients. However bacterial profile of blood stream infection and bacterial antibiotic resistance is a dynamic that vary from region to region even from time to time in the same area. Therefore, routine investigation may play an important role in providing an updated status of the bacterial profile and its drug resistance pattern.

Therefore, this study was undertaken to investigate the bacterial profile and antibiotic resistance pattern among adult patients suspected of having bloodstream infection at Jimma University Medical Center, Jimma, Ethiopia.

MATERIALS AND METHODS

A hospital based cross sectional study was conducted at Jimma University Medical Center from March to September 2019. All adult patients greater than or equal to 18 years of age who were clinically diagnosed with blood stream infection at JUMC during the study period were included in the study. A consecutive sampling technique was used.

Data collection procedures

Sociodemographic and clinical data: After physicians identify those patients who have fulfilled the criteria for bloodstream infection according to the medical record an interview administered questionnaire was used to collect data on sociodemographic characteristics and other clinical data.

Blood sample collection and transportation: About 10 ml of venous blood was collected from two different sites of vein aseptically by disinfecting with 70% alcohol and 2% tincture of iodine. The collected blood samples (5 ml) were inoculated into each bottle containing 45 ml of sterile Tryptic soya broth (Oxoid Ltd). The inoculated bottles were then labeled with the patient's identification number, date, and time of collection. Labeled blood culture bottles were transported within 30 minutes to the laboratory for culture and antibiotic susceptibility testing.

Sample processing

Isolation and identification: Manual blood culture system was used to grow microorganism from blood. Blood culture bottles were incubated at 35-37°C with daily inspection for visible microbial growth for 7 days by observing visually for any of the following: turbidity, gas production, hemolysis and/or coagulation of broth. For blood cultures that show signs of microbial growth, subcultures were made onto MacConkey agar (Oxoid Ltd, UK), blood agar and chocolate agar plates (Difco TM and Accumix). MacConkey agar and blood agar plates were incubated in aerobic whereas the chocolate agar plates were in a candle jar at 35-37°C for 24 to 48 hrs. For blood culture that did not show sign of microbial growth, blindly sub culturing was also performed at the 2nd, 5th and 7th day of an inoculation. Blood culture results with no microbial growth after 7 days were recorded as culture negative. For positive blood culture the isolates were identified with macroscopic colony characteristics, gram staining result and biochemical test. Identification panels including Bacitracin and Optochin sensitivity, catalase and Coagulase test for gram positive bacteria and kligler iron agar (carbohydrate fermentation test and gas production), Simon citrate agar (citrate utilization test), oxidase test, urea agar (urease test), LIA agar (Lysine decarboxylase test) and SIM (sulfur production, Indole and motility test) were done for gram negative bacteria following standard procedures.

Antibiotic susceptibility test: Antibiotic susceptibility testing was performed using the Kirby-Bauer agar disc diffusion method according to Clinical Laboratory Standards Institute (CLSI, 2017) guidelines. Pure colonies from subculture plates were picked and transferred to a tube containing 3 mL of sterile normal saline and mixed thoroughly to make the suspension homogenous until its turbidity was equivalent to that of 0.5 McFarland. Then the suspension was swabbed onto Mueller Hinton agar (for S. pneumoniae, Muller-Hinton agar with 5% sheep blood was used) and then incubated at 37°C for 18-24 hours. The zone of inhibition was measured and interpreted according to the standardized table supplied by CLSI. Based on the CLSI recommendation, antibiotic discs (Oxoid Ltd and Liofilchem): penicillin G (P, 10 IU), amoxicillin clavulanic acid (AMC, 30 µg), ampicillin (AMP, 10 µg), ciprofloxacin (CIP, 5 µg), trimethoprim sulphamethoxazole (SXT, 25 µg), gentamicin(CN, 10 µg), ceftriaxone (CRO, 30 µg), erythromycin (E, 10 µg), cefotaxime (CXT, 30 µg), cefoxitin (FOX, 30 µg), ceftazidime (CAZ, 30 µg), clindamycin (CLN, 2 µg), chloramphenicol (CAF, 30 µg), cefepime (CFP, 30 µg), tetracycline (TE, 30 µg), doxycycline (DO, 30 µg) and meropenem (M, 10 µg) was used.

Quality control

Susceptible strains of *E. coli* (ATCC 25922), *S. aureus* (ATCC 25923) and *P. auroginosa* (ATCC 27853) were used as a reference strains for identifications and drug susceptibility testing. The media was checked for its performance and sterility.

Data processing and analysis

Data on socio-demographic factors and other clinical variables were entered into Epidata version 3.1 and analyzed with SPSS version 23 statistical software. Binary logistic regressions were used to see associations between explanatory and outcome variables. The results were summarized in Tables, charts, and text. A P-value of less than 0.05 was considered statistically significant.

RESULTS

Background characteristics

A total of 271 study participants suspected of bloodstream infection were enrolled in the study. Among these, 138 (50.9%) were females and 123 (49.1%) were males, with a female to male ratio of 1.12. The mean age of the study participants was 40.25 years. The majority of 97 (35.8%) of the study participants were found to be in the 18-33 age group, while the minority of 19 (7%) were older than 60 years. In our study, most of the study participants (144, or 53.2%) were married. One hundred eight (39.9%) of the study participants had primary school while 63 (23.2%) had 9^{th} and above grade. Almost 157 (58%) of the study participants were rural dwellers. 55.4% of the 150 people polled had a known comorbidity (Table 1).

Table 1 Sociodemographic characteristics in respect to culture result of adult patients suspected of having blood stream infection at Jimma University Medical Center from March 15, 2019-September 30, 2019

		Culture result		
		Positive	**Negative**	**Total**
Sex	Male	26	97	123
	Female	34	104	138
Age	18-33 years	16	81	97
	34-48 years	22	68	90
	49-60 years	18	47	65
	60 + years	4	15	19
Marital status	Married	38	106	144
	Single	10	62	72
	Divorced	6	27	33
	Widowed	6	16	22
Residence area	Rural	38	119	157
	Urban	22	92	114
Educational level	No formal Education	38	62	100
	Primary school	18	90	108
	Secondary & above	4	59	63
Admission unit/	Medical ward	22	98	120

	Surgical ward	8	30	38
Dep't	Intensive care unit	14	37	51
	Outpatient department	16	46	62
Comorbidity	NO	12	109	121
	YES	48	102	150

Culture result

Among 271 patients suspected of having a blood stream infection, 60 (22.1%) were found to be culture positive for 9 different bacteria and 211 (77.9%) were culture negative. The overall rate of isolation was 32 (53.3%) for gram-positive and 28 (46.7%) for gram-negative bacteria. Among a total of 60 isolates of bacteria, *S. aureus* 16 (26.7%) was the predominant isolate (Figure 1).

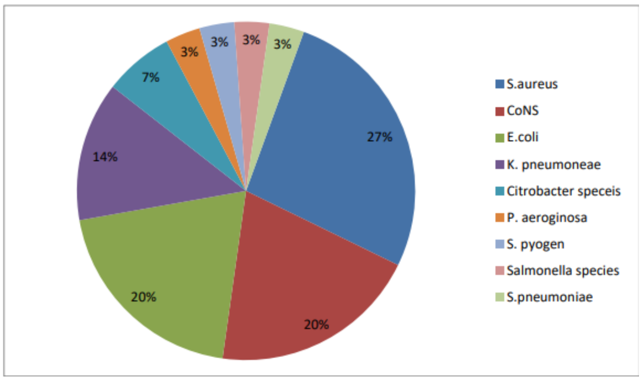

Figure 1 Types and frequency of bacterial isolates from blood culture of adult patients suspected of having bloodstream infection at Jimma University Medical Center from March 15, 2019-September 30, 2019

Types and frequency of bacterial isolate across patients admission unit/ department in hospital

Among 60 of blood culture isolates 44 (73.33%) of isolates from inpatients and the rest 16 (26.67%) was from outpatient department. Out of the 44 of isolates from inpatients, most 22 (50%) of them were from medical ward and least 8 (18.2%) of them were from surgical ward (Table 2).

Table 2 Frequency of bacterial isolate of adult patients suspected of blood stream infection across patient location in hospital at Jimma University Medical Center from March 15, 2019-September 30, 2019

Isolated bacteria	Admission unit/ Department				Total
	Inpatient			Outpatient	
	Medical ward	Surgical ward	Intensive care unit	Outpatient department	
S. aureus	8	0	4	4	16
CoNS	4	4	4	0	12
E. coli	2	4	2	4	12
K. pneumoniae	4	0	2	2	8

citrobacter spp.	2	0	0	2	4
S. pyogenes	0	0	0	2	2
S. pneumoniae	0	0	2	0	2
Salmonella spp.	0	0	0	2	2
P. auroginosa	2	0	0	0	2
Total	22	8	14	16	60

Multivariate analysis for background characteristics of respondents

All bivariate results that had a p-value of <0.25 (age, patient admission unit/dep't in the hospital, educational status and having comorbid) were subjected to multivariate binary logistic regression model. With multivariate logistic regression analysis: educational level (no formal education) and having comorbid were independent associated factors for the occurrence of positive blood culture due to bacteria.

The odds of positive blood culture among respondent who had no formal education were 9.63 times more likely as compared to those who had secondary school and above (AOR=9.63, 95% CI=2.046-45.32, P=0.04). Comorbidity increased the risk of developing blood stream infection by 4.580 times compared to those who did not have comorbidity (AOR=4.580, 95% CI=1.701-12.332, P=0.003) (Table 3).

Table 3 Multivariable analyses for socio demographic and others clinical variables among adult patients of suspected blood stream patients at Jimma University Medical Center from March 15, 2019-September 30, 2019

		Culture result			AOR (95% CI)	P value
		Positive	Negative	Total		
Educational level	No formal education	38	62	100	9.630 (2.046-45.32)	0.04**
	Primary school	18	90	108	3.055 (0.612-15.193)	0.172
	Secondary & above	4	59	63	R	
Age	18-33 years	16	81	97	R	
	34-48 years	22	68	90	1.504 (0.470-4.810)	0.492
	49-60 years	18	47	65	1.671 (0.501-5.597)	0.403
	60 + years	4	15	19	0.674 (0.093-4.904)	0.697
Patient admission unit/ dep't	Medical ward	22	98	120	R	
	Surgical ward	8	30	38	0.939 (0.230-3.827)	0.93

	Intensive care unit	14	37	51	2.443 (0. 770-7.750)	0.129
	Outpatient department	16	46	62	1.083 (0.324-3.622)	0.897
Comorbidity	NO	12	109	121	R	
	YES	48	102	150	4.580 (1.701-12.332)	0.003**
Key: **=variables that are statistically significant.						

Antibiotics resistance pattern of gram positive bacteria

Among the gram positive bacteria high resistance was observed to ampicillin 30 (94%) and penicillin G 26 (81%) and low resistance to clindamycin 10 (32%), chloramphenicol 6 (18.75%) and doxycycline 4 (13%). No gram positive isolates were resistance to ciprofloxacin. Among *isolated S. aureus* and *CoNS*, 4 (25%) and 8 (67%) were resistant to Cefoxitin respectively (Table 4).

Table 4 Antibiotics resistance pattern of gram positive bacteria among adult patients suspected of having blood stream infection at Jimma University Medical Center from March 15, 2019-September 30, 2019

Species of Bacteria	**Number /Percent of strains resistance to:**												
	P	**AMP**	**AMC**	**CRO**	**CLN**	**CIP**	**CN**	**FOX**	**CAF**	**SXT**	**TE**	**E**	**DO**
S. aureus n=16	14/88	16/100	10/5	6/38	4/25	0/0	2/13	4/25	4/25	10/75	10/63	6-38	2/13
CoNS n=12	12/100	12/100	8/67	6/0	4/33	0/0	0/0	8/67	2/17	4/33	6/50	8/67	2/17
S. pyogenes n=2	0/0	2/100	0/0	0/0	2/100	0/0	0/0	0/0	0/0	2/100	0/0	2/100	0/0
S. pneumo-niae, n=2	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Total= 32	26/81	30/94	20/63	12/38	10/32	0/0	2/6	12/38	6/19	18/56	16/50	16/50	4/13
Key: CRO: ceftriaxone, P: penicillin G, AMP: ampicillin, E: erythromycin, SXT: trimethoprim sulphamethoxazole, CN: gentamycin, CAF: chloramphenicol, CIP: ciprofloxacin, TE: tetracycline, DO: doxycycline, AMC: amoxillin clavulanic acid, FOX: cefoxitin, CLN; clindamycin.													

Antibiotic resistance pattern of gram negative bacteria

According to our study GNB show a high resistance to ampicillin 28 (100%), erythromycin 24 (86%), tetracycline 24 (86%) and trimethoprim sulphamethoxazole 24 (86%) and low level of resistance rate to ciprofloxacin 2 (7.14%) and gentamicin 2 (7.14%) and no resistant gram negative bacteria to Meropenem (Table 5).

Table 5 Antibiotics resistance pattern of gram negative bacterial isolates of adult patients suspected of having blood stream infection at Jimma University Medical Center from March 15, 2019-September 30, 2019

Species of Bacteria	Number /Percent of strains resistance to												
	AMP	AMC	CRO	CAZ	CXT	CAF	CIP	E	CN	TE	CFP	M	SXT
E. coli. n=12	12/100	6/50	12/100	10/83	10/83	4/33	2/17	12/100	0/0	12/100	10/83	0/0	10/83
K. pneumoniae. n=8	8/100	2/25	6/75	6/75	6/75	4/50	0/0	8/100	2/25	6/75	4/50	0/0	8/100
P.aurоginosa. n=2	2/100	2/100	2/100	2/100	2/100	0/0	0/0	2/100	0/0	2/100	2/100	0/0	0/0
Citrobacter spp. n=4	4/100	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	2/50	0/0	0/0	4/100
Salmonella spp. n=2	2/100	2/100	2/100	2/100	2/100	0/0	0/0	2/100	0/0	2/100	0/0	0/0	0/0
Total. n=28	28/100	12/43	22/79	20/71	20/71	8/29	2/7	24/86	2/7	24/86	16/57	0/0	24/86

Key: CRO: ceftriaxone, AMP: ampicillin, E: erythromycin, SXT: trimethoprim sulphamethoxazole, CN: gentamycin, CAF: chloramphenicol, CIP: ciprofloxacin, TE: tetracycline, DO: doxycycline, CTX: cefotaxime, CFP: cefepime, AMC: amoxillin clavunate, CAZ: Ceftazidime, CXT Cefotaxime, M: Meropenem.

Multidrug resistant bacteria isolated from inpatients verses outpatients

Out of 60 bacterial isolates 46 (76.67%) were Multidrug Resistant (MDR). Among isolates from inpatients 36/44 (81.81%) were MDR while isolates from respondent in outpatient department 10/16 (62.5%) were MDR (Figure 2).

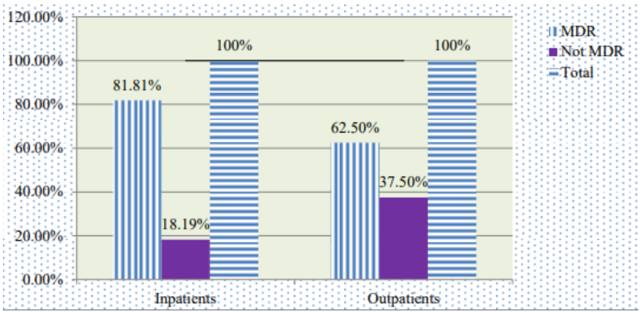

Figure 2 Multidrug resistant bacteria isolated from inpatients versus outpatients among adult patients of having suspected blood stream infection at Jimma University Medical Center from March 15, 2019-September 30, 2019

DISCUSSION

Clinically, BSI is associated with high morbidity and mortality and considerably impacts on health care costs, especially when caused by antimicrobial-resistant bacteria. In our study the overall isolation rate of bacteria from blood culture of 271 adult patients was 60 (22.14%). This was relatively comparable with previous study conducted in Gondar 18.2%, two studies in India 18.6% and 18.62% [18-20]. It was higher than finding reported from other study in Jimma 8.8%, [21] Tanzania 13.4%, [15] New York City (12.6%) and Nepal 13.8% [22,23]. However, our finding is lower than the finding of others research done in different parts of Ethiopia like Addis Ababa 32.8%, [24] Mekelle 28% [25] and Bahirdar 39.2% and other country like Egypt 36.86%, two study in India and 31.2% [26-29]. The most possible explanation for variation in BSI rates among these studies could be due to the difference in study population, blood culture system, volume/number of blood culture, Content of used media [30], geographical location, the study design, and application of infection control policies within/between countries.

The result of this study showed that Gram-positive bacteria 32 (53.33%) were more frequently isolated from blood than gram negative bacteria 28 (46.67%). Although there was a difference in terms of prevalence, other studies also reported the predominance of gram positive bacteria. Studies in Jimma 60.9% and 39.1%, [21], 53.3% and 46.7%, [17] Gondar 64.34% and 35.66% [31] and 69% and 31%, [18] Addis Ababa 74.2% and 23.8% [24] and other countries like Tanzania 82.1% and 17.9, [15] India 57.8% and 42.2% [32] which represent gram positive bacteria and gram negative bacteria respectively. However, our finding was in contrast to other studies reported where gram negative bacteria were more frequently isolated than gram positive bacteria such as in Bahirdar (52.3% and 47.7%), [26] two studies in India (58.3% and 41.9%) [19] and (69.2% and 30.8%) [33]. This dissimilarity might be due to epidemiological variation of the bacteria responsible for bloodstream infection and the incidence and etiology of BSI have continuously changed over the period of time [34].

Among the blood isolates of the present study, *S. aureus* was the predominant isolate, accounting for 16 (26.67%). Even though there was prevalence difference, others study also show *S. aureus* as a predominant blood isolates: like in, Jimma 40%,[17] Addis Ababa 50%, [24] Bahir Dar 22.7%, [26] Mekelle 37.5% [25]. But this was different from other studies in which CoNS was their predominant blood isolates such as in Jimma 26.1%, [21] in Gondar 31.6% [31] and 42.3%, [18] in Brazil 40.7% [35] and in Tanzania 67.4% [15]. *CoNS* were the second most common gram-positive isolates in our findings. It has long been considered a blood contaminant, but currently it has become an important pathogen in hospital acquired bloodstream infections as a result of the expanding use of invasive medical devices. The alternative reason for the highest prevalence of these two bacteria could be that they are commonly found in the hospital environment, which might contaminate admitted patients and also be found as the most common skin commensal that may get access to blood during medical procedures and increase the infection rate since most of our respondents were admitted patients.

E. coli is the most common blood isolate of gram negative bacteria in our study. Similar study in Tanzania [15] and India [36] showed that *E. coli* as the most common blood isolate of gram negative bacteria. In contrast to our finding other study in Australia [37] and Nepal reported that *Salmonella Spp*. as the most common blood isolate of gram negative bacteria, which is the least prevalent in our study. Other studies in India report *P. aeruginosa* as the predominant blood isolate of gram-negative bacteria [38]. The reason for the predominance of *E. coli* in our study may be due to the most common isolate of hospital acquired infection in the study area [39] and its relationship with the high-risk of surgical procedures, especially in the digestive or urinary tract that release bacteria into the blood. Disparity in the prevalence of these etiologic agents of bloodstream infection in different studies might also be due to epidemiological variation, differences in etiologic agents, and seasonal variation.

Most of our blood isolates 48 (80%) were from patient who had chronic illness. According to our study, blood culture of patients who had underlined comorbidity were 4.580 times more likely to be positive when compared with those who had no underlined Comorbid (AOR=4.580, 95% CI=1.701-12.332, P=0.003). In consistence to our study others studies also agree that patients who had underlined chronic illness were more risk to develop BSI [40,41]. This may be related with immune compromised status of such patients, in frequently use of invasive procedure, frequently hospitalization status for management of their chronic illness [42]. The odds of being blood culture positive among respondents who had no formal education were 9.630 times more likely as compared to those who had secondary school and above (AOR=9.630, 95% CI=2.046-45.32, P=0.04). This may be due to a gap in knowledge about prevention of infection.

In our study, another important point was the high antibiotic resistance rate that may cause a serious therapeutic challenge to the management of bloodstream infections. Antibiotic susceptibility pattern of gram positive bacteria shows that they have a high level of resistance against Ampicillin 30 (94%) and Penicillin G 26 (81%) and low level of resistance to gentamicin 2 (6%), doxycycline 4 (13%), chloramphenicol 6 (19%), clindamycin 10 (32%). However, no resistant was observed to Ciprofloxacin which is in line with the previous studies conducted in Jimma [21]. Several studies reported similar findings, namely a low level of gentamicin resistance (28.6%) [21] clindamycin (3.4%) [24] and high level of resistance to penicillin (83.5%), [24] (85.7%) [21] and ampicillin (90%). [31] In contrast to our result others studies report low level of resistance to ampicillin (40.8%) and penicillin (51%) [31]. This variability may be related to the frequency of use of these drugs, their cost, practice of self-medication, and the implementation of policies regarding the control of emergencies of drug-resistant bacteria that vary greatly across a country [43].

Methicillin Resistant *Staphylococcus aureus* (MRSA) is a worldwide issue associated with significant morbidity and mortality [44]. There were 16 and 12 isolates of *S. aureus* and *CoNS* in our study, of which 4 (25%) and 8 (67%) were methicillin resistant, respectively (Cefoxitin disc was used). This is similar to study in Tanzania (23.3%) MRSA [15]. It is lower when compared to other previous studies in the same area that revealed 100% and 33.33% of the isolates were MRSA and MRCoNS, respectively [21]. Other studies like studies in New York City 6 (40%) and 21 (75%) [22] and Brazilian 38.5% and 100% [42] MRSA and MRCoNS respectively also report higher finding. But lower finding was reported from Eastern Nepal (40%) MRCoNS, [23] 50.8% of Brazilian. This may be due to the incidence of MRSA Blood Stream Infection (BSI) showing high geographical variability as well as temporal variation [45].

According to our study GNB showed high resistance to ampicillin 28 (100%) erythromycin 24 (86%) tetracycline 24 (86%) and trimethoprim sulphamethoxazole 24 (86%). Similar results from other studies suggest high resistance to ampicillin (100%) tetracycline (88.9%) and trimethoprim sulpha methoxazole (88.9%) [21], ampicillin (88.5%) and trimethoprim sulphamethoxazole (80%) [24]. However, other studies reveal that low levels of resistance to erythromycin (35.0%) and trimethoprim sulphamethoxazole (25.0%). [15] In our study low level of resistance rate to ciprofloxacin 2 (7.14%) and gentamycin 2 (7.14%) and no resistant gram negative bacteria to meropenem. More than two thirds of the gram negative bacteria in our study were resistant to commonly used cephalosporin drugs. It is obvious that cephalosporin drugs are one of the most frequently used antibiotics for both inpatients and outpatients. This could be the reason for the high level of resistance since there is a positive linear relationship between the frequency of antibiotic use and antibiotic resistance [46]. The overall multidrug resistance in the present study was 46 (76.67%). It was consistent with the previous studies conducted in the same area (80%) [17]. This was higher when compared to the findings of other studies, like the study in Mekelle (59%) [25] but lower than the finding of the study in Jimma (86.96%). Among 46 (76.67%) multidrug resistant bacteria, 26 (56.5%) were due to gram negative bacteria, and the rest, 20 (43.5%) were due to gram positive bacteria. These points to the rapid emergence of multidrug resistant gram negative bacteria rather than gram positive bacteria, which is consistent with previous research in the field [21].

All *K. pneumoniae* all *E. coli* and 62.5% of isolated *S. aureus* were multidrug resistant, according to our findings. This might be due to the hospital environment favoring the circulation of drug resistant bacteria since most of our isolates were from inpatients and the most common causes of health care associated infection in the study area were these three bacteria [39]. The other possible factors that may determine the high prevalence of multidrug resistance of gram negative bacteria may be due to the increased emergence of ESBL producers like *E. coli* and *K. pneumoniae*. Plasmid coding for ESBL enzyme may also harbors additional beta lactamase and furthermore gene conferring resistance to other antimicrobial classes results limit response of bacteria to different antibiotics.

CONCLUSION

The overall culture confirmed prevalence of blood isolates in adult patients suspected of having bloodstream infection was high. The most common gram-positive and gram-negative bacteria causing adult bloodstream infections were *S. aureus* and *E. coli*, respectively. Ciprofloxacin, gentamicin, and meropenem were the most effective drugs for the treatment of bacterial bloodstream infections in adult patients.

ETHICAL CONSIDERATIONS

We conducted our study in compliance with recognized international standards and the principles of the Declaration of Helsinki. Ethical clearance was acquired from Jimma university institute of health research ethics review board prior to the commencement of the study. Data were collected after full written consent had been obtained from each participant.

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AUTHOR CONTRIBUTIONS

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal and agree to be accountable for all aspects of the work.

REFERENCES

[1] Bhandari, Prashubha, et al. Etiology of bloodstream infection and antibiotic susceptibility pattern of the isolates. *Asian Journal of Medical Sciences*, Vol. 7, No. 2, 2015, pp. 1-5.

[2] Martinez, Raquel M and Donna M, Wolk. Bloodstream Infections. *Microbiology spectrum*, Vol. 4, No. 4, 2016, pp. 4.

[3] Singer, Mervyn, et al. The Third International Consensus Definitions for Sepsis and Septic Shock. J*AMA*, Vol. 315, No. 8, 2016, pp. 801-810.

[4] McFarland, Lynne V. Normal flora: diversity and functions. *Microbial Ecology in Health and Disease*, Vol. 12, No. 4, 2000, pp. 193-207.

[5] Diekema, Daniel J, et al. The Microbiology of Bloodstream Infection: 20-Year Trends from the SENTRY Antimicrobial Surveillance Program. *Antimicrobial Agents and Chemotherapy*, Vol. 63, No. 7, 2019, pp. e00355-19.

[6] Salomão, Reinaldo, et al. Bloodstream Infections: Epidemiology, Pathophysiology and Therapeutic Perspectives. Infection and Drug Resistance. *Infection*, Vol. 1, No. 2, 1999, pp. 1-5.

[7] Laupland, Kevin B, et al. Severe bloodstream infections: A population-based assessment*. *Critical Care Medicine*, Vol. 32, No. 4, 2004, pp. 992-997.

[8] Leung, Emily, et al. The WHO policy package to combat antimicrobial resistance. *Bulletin of the World Health Organization*, Vol. 89, No. 5, 2011, pp. 390-392.

[9] Laxminarayan, Ramanan, et al. Antibiotic resistance—the need for global solutions. *The Lancet Infectious Diseases*, Vol. 13, No. 12, 2013, pp.1057-1098.

[10] Hall, Keri K, and Jason A. Lyman. Updated Review of Blood Culture Contamination. *Clinical Microbiology Review*s, Vol. 19, No. 4, 2006, pp.788-802.

[11] Munson, Erik L, et al. Detection and Treatment of Bloodstream Infection: Laboratory Reporting and Antimicrobial Management. *Journal of Clinical Microbiology*, Vol. 41, No. 1, 2003, pp. 495-497.

[12] O'Neill, J. The Review on Antimicrobial Resistance 2014.

[13] Zhen, Xuemei, et al. Economic burden of antibiotic resistance in ESKAPE organisms: a systematic review. *Antimicrobial Resistance and Infection Control,* Vol. 8, No. 1, 2019, pp. 1-23.

[14] Frieden, DT. Antibiotic resistance threats in the United States. *Center for disease control and prevantion*, 2013.

[15] Moyo, M, et al. Bacteria isolated from bloodstream infections at a tertiary hospital in Dar es Salaam, Tanzania – antimicrobial resistance of isolates. South *African Medical Journal*. Vol. 100, No. 12, 2010, pp. 835-838.

[16] Wasihun, Araya Gebreyesus, et al. Bacteriological profile and antimicrobial susceptibility patterns of blood culture isolates among febrile patients in Mekelle Hospital, Northern Ethiopia. *Springerplus*, Vol. 4, No. 1, 2015, pp. 314.

[17] Kumalo, Abera, et al. Bacterial Profile of Adult Sepsis and their Antimicrobial Susceptibility Pattern at Jimma University Specialized Hospital, South West Ethiopia. *Health Science Journal*, Vol. 10, No. 2, 2016, pp. 1.

[18] Dagnew, Mulat, et al. Bacterial profile and antimicrobial susceptibility pattern in septicemia suspected patients attending Gondar University Hospital, Northwest Ethiopia. *MC Research*. Vol. 6, No. 1, 2013, pp. 1-7.

[19] Waghmare, AS, Bindu, MH and Reddy CM. Bacterial Isolates and antibiotic Susceptibility Pattern in Blood Stream Infections Suspected Patients Attending a Teaching Hospital in Telangana, India. *International Journal of Current Microbiology Application Science*, Vol. 4, No. 7, 2015, pp. 741-748.

[20] Sweta, Oza, et al. Bacteriological profile and antibiogram of blood culture isolates from patients of rural tertiary care hospital. *Indian J Microbiol Mycol,* Vol. 4, No. 3, 2016, pp.1-7.

[21] Zenebe, Tizazu, et al. Invasive bacterial pathogens and their antibiotic susceptibility patterns in jimma university specialized hospital, jimma, southwest ethiopia. *Ethiopian Journal of Health Science*, Vol. 21, No.1, 2011, pp. 1-8.

[22] Orsini, Jose, et al. Microbiological profile of organisms causing bloodstream infection in critically ill patients. *Journal of Clinical Medical Research*, Vol. 4, No. 6, 2012, pp. 371-377.

[23] Khanal, B, et al. Multidrug resistant blood culture isolates: An experience from a tertiary care hospital in Eastern Nepal. *International Journal of Infectious Diseases*, Vol. 45, 2016, pp. 97.

[24] Kitila, K. Terfa, et al. Assessment of Bacterial Profile and Antimicrobial Resistance Pattern of Bacterial Isolates from Blood Culture in Addis Ababa Regional Laboratory, Addis Ababa, Ethiopia. *Clinical Microbiology: Open Access*, Vol. 07, No. 312, 2018, pp. 2.

[25] Hailu, Derese, et al. Bacterial blood stream infections and antibiogram among febrile patients at Bahir Dar Regional Health Research Laboratory Center, Ethiopia. *Ethiopian Journal of Science and Technology*, Vol. 9, No. 2, 2016, pp. 103-112.

[26] Tohamy, Sally Tohamy, et al. Prevalence of multidrug-resistant gram-negative pathogens isolated from febrile neutropenic cancer patients with bloodstream infections in egypt and new synergistic antibiotic combinations. *Infection and Drug Resistance*, Vol.11, 2018, pp. 791.

[27] Sahoo, Debananda, et al. Bacteriological Analysis of Blood Culture Isolates in Patients with Sepsis in A Tertiary Care Hospital of Eastern India. *International Journal of Contemporary Medical Research*, Vol. 3, No. 12, 2016, pp. 3448-3450.

[28] Vasudeva, Nikita, Prem Singh Nirwan, and Preeti Shrivastava. Bloodstream infections and antimicrobial sensitivity patterns in a tertiary care hospital of India. *Therapeutic advances in infectious disease*, Vol. 3, No. 5, 2016, pp.119-127.

[29] Magadia, Raul R, and Melvin P. Weinstein. laboratory diagnosis of bacteremia and fungemia. *infectious disease clinics*, Vol. 15, No. 4, 2001, pp. 1009-1024.

[30] Abebaw, Abtie, et al. The bacterial profile and antibiotic susceptibility pattern among patients with suspected bloodstream infections, Gondar, north-west Ethiopia. *Pathology and Laboratory Medicine International*, Vol.10, 2018, pp. 1-7.

[31] Prakash, K. P, Vinod Arora, and P. P. Geethanjali. Bloodstream Bacterial Pathogens and their Antibiotic Resistance Pattern in Dhahira Region Oman*.* *Medical Journal*, Vol. 26, No. 4, 2011, pp. 240-247.

[32] Sahoo, Debananda, et al. Bacteriological Analysis of Blood Culture Isolates in Patients with Sepsis in A Tertiary Care Hospital of Eastern India. *International Journal of Contemporary Medical Research*, Vol. 3, No. 12, 2015, pp.77-83.

[33] Parajuli, Narayan Prasad, et al. Evaluating the Trends of Bloodstream Infections among Pediatric and Adult Patients at a Teaching Hospital of Kathmandu, Nepal: Role of Drug Resistant Pathogens. *Canadian Journal of Infectious Diseases and Medical Microbiology*, Vol. 2017, 2017, pp.10

[34] Gohel, Kalpesh, et al. Bloodstream Infection: The Influence of Risk Factors, Etiology and Antimicrobial Therapy on Mortality Rates. *Journal of Nursing and Care*, Vol. 6, No. 391, 2017, pp. 2167-1168.

[35] Gohel, Kalpesh, et al. Bacteriological profile and drug resistance patterns of blood culture isolates in a tertiary care nephrourology teaching institute. *BioMed research international*, Vol. 2014, 2014, pp. 153-747.

[36] Bhandari, Prashubha, et al. Etiology of bloodstream infection and antibiotic susceptibility pattern of the isolates. *Asian Journal of Medical Sciences*, Vol. 7, No. 2, 2015, pp.71-75.

[37] Patil, Asmita Ashok, and J. D. Pratibha. Bacterial Profile and Resistance Pattern of Bacterial Isolates from Blood Culture-a Five Year Study in Tertiary Care Teaching Hospital. *European Journal of Pharmaceutical and Medical Research*, Vol. 3, No. 4, 2016, pp. 373-377.

[38] Gashaw, Mulatu, et al. Emergence of high drug resistant bacterial isolates from patients with health care associated infections at Jimma University medical center: a cross sectional study. *Antimicrobial Resistance and Infection Control*, Vol. 7, No. 1, 2018, pp. 138.

[39] Aliyu, Sainfer, et al. Prevalence and risk factors for bloodstream infection present on hospital admission. *Journal of Infection Prevention*, Vol. 19, No. 1, 2018, pp. 37–42.

[40] Ge, Jing, et al. The incidence, risk factors and outcomes of early bloodstream infection in patients with malignant hematologic disease after unrelated cord blood transplantation: a retrospective study. *BMC infectious diseases*, Vol. 18, No. 1, 2018, pp. 654.

[41] Fram, Dayana, et al. Risk factors for bloodstream infection in patients at a Brazilian hemodialysis center: a case-control study. *BMC infectious diseases*, Vol. 15, No. 1, 2015, pp. 158.

[42] Alemkere, Getachew, Admasu Tenna, and Ephrem Engidawork. Antibiotic use practice and predictors of hospital outcome among patients with systemic bacterial infection: Identifying targets for antibiotic and health care resource stewardship. *PLoS One*, Vol. 14, No. 2, 2019, pp. 212-661.

[43] Widmer, Andreas F, Botond Lakatos, and Reno Frei. Strict infection control leads to low incidence of methicillin-resistant Staphylococcus aureus bloodstream infection over 20 years. *Infection Control and Hospital Epidemiol*, Vol. 36, No. 6, 2015, pp. 702-709.

[44] Diekema, DJ, et al. Survey of Infections Due to Staphylococcus Species: Frequency of Occurrence and Antimicrobial Susceptibility of Isolates Collected in the United States, Canada, Latin America, Europe, and the Western Pacific Region for the sentry Antimicrobial Surveillance Program, 1997–1999. *Clinical Infectious Diseases*, Vol. 32, No. 2, 2001, pp. S114-S132.

[45] Bronzwaer, Stef LAM, et al. (2002). The Relationship between Antimicrobial Use and Antimicrobial Resistance in Europe. *Emerging Infectious Diseases*, Vol. 8, No. 3, 2002, pp. 278-281.

[46] Poulou, Aggeliki, et al. Modified CLSI Extended-Spectrum NL-Lactamase (ESBL) Confirmatory Test for Phenotypic Detection of ESBLs among Enterobacteriaceae Producing Various NL-Lactamases. *Journal of clinical microbiology*, Vol. 52, No. 5, 2014, pp. 1483-1489.