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Bacterial Profile of Adult Sepsis and their Antimicrobial Susceptibility Pattern at Jimma University Specialized Hospital, South West Ethiopia

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Abstract

Background: Sepsis is a common and highly fatal clinical syndrome that is characterized by systemic inflammatory response syndrome due to infection. The aim of this study was to determine bacterial profile of adult sepsis and their antimicrobial susceptibility pattern at Jimma University Specialized Hospital.

Methods: This laboratory based prospective cross sectional study was performed in 95 adult septic cases in Jimma University specialized hospital during the period of March to June 2013. Blood cultures were performed to isolate bacteria and susceptibility to antibiotics was assessed as per standard procedures of microbiological methods. The data was analyzed using SPSS for windows version 16.0 software.

Results: From a total of 95 suspected septic cases involved in this research, 15 (15.8 %) were positive to eight different types of bacteria. Gram positive organisms were isolated in 53.3 % of these episodes with Staphylococcus aureus being the most frequent, while Gram negative accounted for the remaining 46.7 % with Escherichia coli being the commonest isolate among Gram negative bacteria. The isolates showed high rates of resistance to most antibiotics tested *in-vitro*. The ranges of resistance to Gram positive bacteria were 0 % to 100 %, and to Gram negative from 14.3 % to 85.7 %. In our study multi-drug resistance (resistance to three or more drugs) was observed in 80 % of isolates. Of this 87.5% and 71.4 % accounted for Gram positive and Gram negative bacteria respectively (P=0.438).

Conclusion: *S. aureus* and *E. coli* were the most common Gram positive and Gram negative organisms causing adult sepsis, respectively. Ciprofloxacin was the most effective compared with other drugs tested against the Gram positive and Gram negative bacteria. Multi-drug resistance was detected in 80 % of the isolates. The detection of multi-drug resistant isolates may further limit therapeutic options. Therefore, routine bacteriological profile examination along with their antibiotic resistance patterns must be a necessary component in the management of adult sepsis. A knowledge of these patterns is essential when local polices on the use of antibiotics are being devised.

Keywords: Adult sepsis; Bacterial profile; Antimicrobial susceptibility pattern

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Background

Sepsis is a common and highly fatal clinical syndrome that is characterized by systemic inflammatory response syndrome due to infection. It is a final common pathway of many infectious processes, e.g. bacterial, viral, fungal and parasitic infection in critically ill patients. Sepsis syndrome is a spectrum of diseases; SIRS [systemic inflammatory response syndrome] with possible infection in one end to severe sepsis, septic shock and multiple organ failure in the other end [1-4]. The burden of sepsis on health care is extensive in number; it is the leading cause of death in non-coronary intensive care units (ICUs) [1,2,5,6].

Worldwide, 31.5 million cases of sepsis occur annually and 5.3 million people have died annually [5]. Though the burden of the sepsis in developing countries is expected to be heavy enough and also the likelihood of implementing internationally accepted management of septic patients in low income countries is questionable, only few studies were conducted in investigating the epidemiology and in providing viable alternative approaches in management system, particularly in resource limited sub-Saharan African countries [7].

In developed countries, Gram positive bacteria were the most frequently identified in patients with sepsis. In different studies conducted in HICs, the leading Gram positive organisms isolated were *S. aureus, Enterococcus species, S. pneumoniae* while organisms such as *E.coli, K. pneumoniae, Acinetobacter baumannii* and *Pseudomonas species* constituted the most common Gram negative species [1,8-12].

The bacteriology of bloodstream infections across LMICs varies substantially depending on regional and population characteristics. In a meta-analysis of 19 prospective studies on community-acquired bacteraemia in Africa, the most common organisms isolated were *Salmonella species* (predominantly non-Typhi), *S. pneumoniae*, and Gram negative organisms such as *E. coli* [13].

Empirical antibiotic use is needed to eradicate the microbe that causes sepsis. However, many bacterial pathogens have become resistant to antibiotic regimens posing a serious public health concern with economic and social implications throughout the world. The number of immunocompromized people and bacterial drug resistance is on the increase in developing countries such as Ethiopia [14]. Unregulated over- the- counter sale of these antimicrobials, mainly for self-treatment of suspected infection, and to a lesser extent use of sub-therapeutic doses of antibiotics in animals in Ethiopia are possible factors for the dissemination of drug resistant pathogens in the environment [15].

Therefore, this study was undertaken to investigate bacterial profile of adult sepsis and their antimicrobial susceptibility pattern at Jimma University Specialized Hospital, Jimma, Ethiopia.

Methods

A prospective cross-sectional study was conducted at Jimma University Specialized Hospital from March, 2013 to June, 2013.

Any adult patients ≥18 years of age who presented to emergency outpatients, intensive care unit and medical ward of Internal Medicine departement during the study period with more than or equal to two of the systemic inflammatory response syndrome (SIRS) criteria as defined by ACCP/SCCM consensus conference (temperature >38°C or <36°C, heart rate >90 beats/ minute, or respiratory rate >20 breaths/minute, WBC >12,000 cells/mm^3, <4000 cells/mm^3 or >10 % immature [band] forms) and had a suspected infection according to medical record. Participants who presented with non-medical illness like trauma and surgical emergencies were excluded. A purposive sampling technique was used to collect the study sample.

Data collection and laboratory procedure

The physicians measured body temperature, heart beat rate and respiratory rate of all patients. After obtaining written informed consent, for those who have fulfilled the criteria of sepsis, all relevant data including demographic, clinical, and laboratory data were recorded and filled on questionnaire. All data were collected using well-structured questionnaire prepared by research team.

Two blood samples (5 ml from two different sites) were collected aseptically from each patient for routine blood culture before the beginning of antibiotic treatment. The vein puncture site was properly disinfected with 70 % alcohol and 2 % tincture of iodine before collecting approximately a total of 10ml blood for culture. It was transferred into blood culture bottles of Tryptone Soy Broth (TSB) (Oxoid, Hampshire, UK) maintaining a minimum of 1:10 dilution. The bottles were labelled with patient's name, patient's identification number, date and time of collection. The bottles containing specimens were transported within 30 minutes to the laboratory of medical microbiology, Jimma University.

Blood culture bottles were incubated at 37°C and inspected daily for presence of visible microbial growth for 7 days by observing visually for any of the following including visualization of discrete colonies, turbidity, haemolysis, gas production and/or coagulation of broth. For blood cultures that show signs of microbial growth, subcultures were made onto blood, chocolate and MacConkey agar (Oxoid, Hampshire, UK). The blood agar and MacConkey agar plates was incubated in aerobic whereas the chocolate agars in microaerophilic atmosphere using a candle jar at 37°C for 24 to 48 hrs. Bacterial growth on the subcultures was identified by their characteristic appearance such as colony morphology, Gram reaction and other specific identification panels for biochemical reactions using the standard method [15]. Members of the family *Enterobacteriaceae* and other Gram negative were identified by indole, urease, H_2S and gas production, citrate utilization, motility test, lysine decarboxylase in LIA, oxidase test and carbohydrate fermentation reaction in KIA. For Gram positive bacteria coagulase, catalase and optochin susceptibility tests were used [16,17].

Antimicrobial susceptibility testing for all blood culture isolates was done on Mueller-Hinton agar plates following the standardized Kirby Bauer disc diffusion technique according to the criteria of the Clinical and Laboratory Standards Institute (CLSI) of 2011 [18].

The following drugs were used at the given concentrations: Ampicillin (AMP) (10 µg), Amoxicillin-Clavulanic Acid (AMC) (30 µg), Ceftriaxone (CRO) (30 µg), Cephalothin (KF) (30 µg),

Ciprofloxacin (CIP) (5 µg), Chloramphenicol (C) (30 µg), Doxycycline (DO) (30 µg), Erythromycin (E) (15 µg), Gentamicin (CN) (10 µg), Kanamycin (K) (30 µg), Cefoxitin (CXT) (30 µg), Penicillin-G (P) (10 IU), Streptomycin (S) (10 µg), Tetracycline (TE) (30 µg), Trimethoprim-Sulphamethoxazole (TMP-SXT) (1.25/23.75µg) and Vancomycin (V) (30 µg). The isolates was classified as sensitive, intermediate, and resistant according to the standardized table supplied by the Clinical and Laboratory Standards Institute (CLSI) [18,19]. The quality of culture media and antimicrobial susceptibility were checked using standardized reference strains of *P. aeruginosa* (ATCC-27853), *S. aureus* (ATCC-25923) and *E. coli* (ATCC-25922).

Data analysis

Statistical analyses were performed by using SPSS version 16.0 software program. Comparisons were made using Chi-square test or Fisher exact tests. Logistic regression was used to explain the dependent variable based on the independent variable. A p-value of <0.05 was considered indicative of a statistically significant.

Ethical clearance

Ethical approval for the study was obtained from Jimma University, College of public health and medical sciences research committee and publication office. Letter of support was also obtained from the clinical Director of Jimma University Specialized Hospital. Written informed consent was secured from each participant.

Results

A total of 95 study participants clinically diagnosed with adult sepsis were included in this study. The socio-demographic characteristic of study participants is summarized in **Table 1**. Out of the 95 patients, 42(44.2 %) were males and 53(55.8 %) were females (P=0.145) with an overall sex distribution ratio of 1:1.26. Their age ranged between 18 and 80 years with median age of 37 years and mean ± SD, 39.9 ± 1.59.

Table 1 Socio-demographic characteristics of adults with sepsis at Jimma University Specialized Hospital, Jimma, Ethiopia.

Socio-demographic characteristics		Number (%)
Sex	Male	42 (44.2)
	Female	53 (55.8)
Age	18-40 years	59 (62.0)
	41-59 years	18 (19.0)
	60 + years	18 (19.0)
Marital status	Married	80 (84.2)
	Single	14 (14.7)
	Widow	1 (1.1)
Educational status	No formal education	65 (68.4)
	Write and read only	5 (5.3)
	1-7 grade	10 (10.5)
	8-12 grade	11 (11.6)
	12+	4 (4.2)
Occupation	Farmer	34 (35.8)
	Government employed	3 (3.2)
	Student	8 (8.4)
	Unemployed	1 (1.1)
	House wife	44 (46.3)
	Private business	5 (5.3)

Clinical and laboratory characteristics

The clinical and laboratory characteristics of adult sepsis cases are summarized in **Table 2**. An abnormal temperature was found in 76.8 % of patients. The most prevalent clinical features were tachypnea manifested by a raised respiratory rate in 94 of 95 cases (98.9 %) and tachycardia in 93 out of 95 (97.9 %) patients.

The main infection sites were: respiratory tract, (31/95; 32.6 %), followed by gastrointestinal tract, (19/95; 20.0 %) and urinary tract, (13/95; 13.7 %). More than twelve present (12/95) of cases had more than one site infection involved. From the total clinically suspected cases of sepsis, the underlying comorbidities were identified in 66(69.5 %). The comorbidities included HIV/AIDS 20(21.0 %), heart failure 16(16.8 %), chronic renal disease 9(9.5 %), haematological malignancy 7(7.4 %), diabetes mellitus 6(6.3 %), stroke 5(5.3 %); whereas chronic liver disease, solid malignancy and chronic obstructive pulmonary disease each accounted for 1.0 % of cases.

Bacterial isolates

Out of 95 blood cultures 15 had positive for different bacteria species, with a culture positivity rate of 15.8 %. From which 53.3 % were for Gram positive bacteria and 46.7 % for Gram negative bacteria. As it is shown on **(Table 3)**, the predominant isolates were *S. aureus* and *E. coli* from the total isolate that constitute for Gram positive and Gram negative organisms, respectively. About 2(13.3 %) were Coagulase negative *Staphylococci* of total isolates. Among Gram negative bacteria, *Enterobacteriaceae* group were *E. coli*, *K. pneumoniae*, *P. aeruginosa, Salmonella species, Enterobacter species* and *Citrobacter species.*

Multivariate analysis

Multiple logistic regression analysis was done to see the effects of Socio-demographic characteristics mentioned on **Table 4** the culture positivity. In our study, most of the sepsis patients were females 53(55.8 %), however, there was no association between sex of patient and blood culture result (P=0.145). Majority of the patients 59(62.1 %) were between the age of 18 and 40 years. However, there is no association between bacterial isolates and age categories (P=0.866) as shown **Table 4**.

Antimicrobial susceptibility pattern

The susceptibility pattern of bacteria was checked using sixteen drug discs. The susceptibility patterns of Gram positive bacteria (n=8) isolated from blood culture of adults suspected with sepsis against 15 antimicrobial agents are presented in **Table 5**. The ranges of resistance for Gram positive isolates were from 0 % – 100 %. All isolates of Gram positives showed resistance against penicillin-G (8/8; 100 %); but they showed high susceptibility to most of the other antimicrobials tested: ceftriaxone (7/8; 87.5 %), chloramphenicol (7/8; 87.5 %), ciprofloxacin (7/8; 87.5 %), amoxicillin-clavulanic acid (6/8; 75 %), cephalothin (5/8; 62.5 %) and erythromycin (5/8; 62.5 %). From total of six *S.aures,* two (33.3 %) were methicillin resistant (MRSA) (cefoxitin disc used) whereas the remaining four of them (66.7 %) were methicillin sensitive (MSSA). In another case, both of CoNS isolate from the positive were methicillin sensitive. None of CoNS and *S. aureus*

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Table 2 Descriptive clinical and laboratory presentations of adults with sepsis at Jimma University Specialized Hospital, Jimma, Ethiopia.

Clinical and laboratory characteristics		Mean (SD)
SIRS criteria	Temperature in °C ,mean (SD) Heart rate in beat/min, mean (SD) Respiratory rate in breath/min, mean (SD) WBC in cells/ml, mean (SD) SBP in mmHg, mean (SD) DBP in mmHg, mean (SD)	38.0 (3.1) 112.4 (17.4) 34.0 (11.2) 11398.6 (10832.2) 104.9 (22.1) 65.4 (13.6)
GCS*	GCS mean (SD)	13.7 (2.4)
Hos. length of stay	Mean days (SD)	15.3 (9.8) days
Other clinical and laboratory characteristics		**Number (%)**
Site of infection	Respiratory Tract Gastro intestinal tract Urinary tract Nervous system Soft tissue/skin, Bone Cardiovascular system Multiple site infection Unknown	31 (32.6 %) 19 (20.0 %) 13 (13.7 %) 10 (10.5 %) 4 (4.2 %) 2 (2.1 %) 12 (12.6 %) 4 (4.2 %)
Comorbidities	Chronic renal disease Heart failure Stroke Diabetes mellitus Haematological malignancy HIV/AIDS Other	9 (9.5 %) 16 (16.8 %) 5 (5.3 %) 6 (6.3 %) 7 (7.4 %) 20 (21.0 %) 3 (3.2 %)
Hospital outcome	Death Discharged with improvement	18 (18.9 %) 77 (81.1 %)

Key: Other*= includes (Chronic liver disease, Solid malignancy, Chronic obstructive pulmonary disease). **DBP=** Diastolic Blood Pressure, **EOPD**=Emergency Out Patients Department, **GSC=** Glasgow Comma Scale, **SBP**= Systolic Blood Pressure, **SD**=Standard Deviation.

Table 3 Bacterial isolates and their frequency from blood culture in adults with sepsis at Jimma University Specialized Hospital, Jimma, Ethiopia.

Gram reaction Percentage	Bacterial isolates		Number
Gram positive n=8 (53.3 %)	*Staphylococcus aureus*	6	40.0
	Coagulase negative *Staphylococci*	2	13.3
	Escherichia coli	2	13.3
Gram negative n=7 (46.7 %)	*Citrobacter species*	1	6.7
	Enterobacter species	1	6.7
	K. pneumoniae	1	6.7
	P. aeruginosa	1	6.7
	Salmonella species	1	6.7
Total		**15**	**100**

Key: CoNS: Coagulase negative *Staphylococci.*

strains was resistant to vancomycin. The susceptibility patterns of Gram negative bacteria (n=7) isolated from blood culture of adults suspected with sepsis against 11 antimicrobial agents are presented in **Table 6**. Antimicrobial resistance levels for the Gram negative organisms, causing adult sepsis ranged from 14.3 % to 85.7 %. Single *Pseudomonas aeruginosa* isolate was sensitive to ciprofloxacin and gentamicin. An isolate of *Enterobacter species* was sensitive to all drugs except cephalothin. In general ciprofloxacin was the effective drugs against the tested Gram positive and Gram negative bacteria (86.7 %; 13/15) shown in **Table 4 and 5**. From the total of fifteen isolates tested for antimicrobial susceptibility, multiple drug resistance (resistance to three or more drugs) was observed in 12 of 15 (80 %). Of which 7 of 8 (87.5 %) were from Gram positive and 5 of 7 (71.4 %) were seen in Gram negative bacteria (*P=0.438*) as shown in **Table 7**.

Discussion

Globally, the burden of sepsis on health care is substantial [1,2]. Blood culture remains the gold standard of diagnosis to isolate the etiologic agents for sepsis. This study found that 15 (15.8 %) out of 95 total blood sample screened from suspected sepsis cases were positive for the presence of bacteria **(Table 3)**. The isolation rate of this study is comparable with the rates reported from other developing countries where routine blood culture was performed such as in Uganda (12.6 %) [20] and in Nigeria (18.0 %) [21]. However, it may be lower compared to other studies reported in Uganda (26.0 %) [22], Zambia (24.2 %) [23], and Macedonia (34.2 %) [24-27]. The possible explanation for this variation might be due to the low number of study population, lesser duration of study period as well as the study was conducted only on one study site. Moreover, patients probably received clinical care, including antimicrobial agents, in other health care setting before coming to the study referral hospital. However, information regarding patients' clinical history before referral, including the use of antimicrobial agents and types of antibiotics were not available in the referral document.

In the present study, Gram positive organisms were found as (53.3 %) causing sepsis, whereas the Gram negative bacteria (46.7 %). However, our finding was in contrast to other studies reported where Gram negative bacteria were the commonest isolated bacteria than Gram positive such as in Uganda (53.2 % and 38.3 %) [20] and in Jalandhar (India) (58.46 % and 38.46 %) [28]. This variation of etiologic agents from country to country might be due to geographical locations, epidemiological variation/difference in etiologic agents. The other factors might also be due to nature of patient population, limited sample size and span of study time.

Among blood isolated Gram positive organisms, especially *S. aureus* (6/15;40 %),was the predominant cause of sepsis in adult, this was lower than reports from developing countries where they found 61 % [21] and 59.2 % [23] of their total isolates were *S. aureus.* This is similar with those reported from developed countries in which 30 % and 28.1 % of their isolate were *S. aureus* [9,10]. But this was different from other studies in which *S. pneumoniae* [26,28], CoNS [12,29] was predominant isolates.

In this study, the second Gram positive isolates were CoNS (2/15; 13.3 %). This finding was in contrast to other studies in Uganda [20,22], in which *S. pneumoniae* was the second frequent isolates. In this study finding, there was no *S. pneumoniae* isolated. This difference might be due to difference in blood culturing system and the content of culture media. However, the reports from other studies also showed that Coagulase negative S*taphylococci* was second Gram positive isolate [30] which agree with the

Table 4 Socio-demographic characteristics of Adult septic patients in relation to blood culture results at Jimma University Specialized Hospital.

Variable		Culture result		OR [95 % CI]	P-value
		Positive n (%)	Negative n (%)		
Sex	Female	11 (20.8 %)	42 (79.2 %)	0.402 [0.118-1.369]	P=0.145
	Male	4 (9.5 %)	38 (90.5 %)		
	Total	15 (15.8 %)	80 (84.2 %)		
Age	18-40	10 (17 %)	49 (83 %)	0.943 [0.474-1.876]	P=0.866
	41-59	1 (5.6 %)	17 (94.4 %)		
	60 +	4 (22.2 %)	14 (77.8 %)		
	Total	15 (15.8 %)	80 (84.2 %)		
Educational status	No formal education	11 (17 %)	54 (83 %)	1.432 [0.809-2.535]	P=0.218
	Write and read only	2 (40 %)	3 (60 %)		
	1-7 grade	2 (20 %)	8 (80 %)		
	8-12 grade	0 (0 %)	11 (100 %)		
	12+	0 (0 %)	14 (100 %)		
	Total	15 (15.8 %)	80 (84.2 %)		

Table 5 Antibiotic resistance pattern of Gram positive bacterial isolates from blood culture in adults with sepsis at Jimma University Specialized Hospital, Jimma, Ethiopia.

Species of Bacteria	Number of strains (%) resistance to														
	AMP	AMC	CRO	KF	C	CIP	DO	CN	TE	K	SXT	CXT	P	E	VA*
***S.aures* (n=6)**	5(83.3)	2(33.3)	1(16.6)	3(50)	0(0)	1(16.6)	0(0)	0(0)	4(66.7)	0(0)	0(0)	2(33.3)	6(100)	3(50)	0(0)
***CoNS* (n=2)**	1(50)	0(0)	0(0)	0(0)	1(50)	0(0)	0(0)	0(0)	1(50)	0(0)	0(0)	0(0)	2(100)	0(0)	0(0)
Total (n=8)	6(75)	2(25)	1(12.5)	3(37.5)	1(12.5)	1(12.5)	0(0)	0(0)	5(62.5)	0(0)	0(0)	2(25)	8(100)	3(37.5)	0(0)

Table 6 Antibiotic resistance pattern of Gram negative bacterial isolates from blood culture in adults with sepsis at Jimma University Specialized Hospital, Jimma, Ethiopia.

Species of Bacteria	Number of strains (%) resistance to										
	AMP	AMC	CRO	KF	C	CIP	DO	CN	TE	S	SXT
Escherichia coli (n=2)	2 (100)	0 (0)	1 (50)	1 (50)	1 (50)	1 (50)	1 (50)	2 (100)	2 (100)	2 (100)	2 (100)
Enterobacter species (n=1)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Klebsiella pneumonia n=1)	1 (100)	0 (0)	1 (100)	1 (100)	1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	1 (100)	1 (100)
Pseudomonas aeruginosa (n=1)	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	1 (100)	1 (100)
Citrobacter species (n=1)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)
Salmonella species (n=1)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total (n=7)	6 (85.7)	1 (14.3)	4 (57.1)	5 (71.4)	3 (42.9)	1 (14.3)	4 (57.1)	2 (28.6)	5 (71.4)	4 (57.1)	4 (57.1)

Key: AMP: Ampicillin; AMC: Amoxicillin-Clavulanic acid; CRO: Ceftriaxone; KF: Cephalothin; C: Chloramphenicol; CIP: Ciprofloxacin; DO: Doxycycline; CN: Gentamicin; TE: Tetracycline K: Kanamycin; P: Penicillin G; SXT: Trimethoprim-sulphamethoxazole; CXT: Cefoxitin; E: Erythromycin; VA*: Vancomycin (**Based on CLSI, 2007**).

present findings. The significance of *CoNS* when isolated from blood culture should be considered. In most studies CoNS were considered contaminant [20,22]. They have long been dismissed as culture contaminants, but now they are potentially important pathogens and their increasing incidence has been recognized. In recent years, *CoNS* become an important nosocomial pathogen and health-care related infections partly as results of the increasing use of medical devices such as long-term indwelling catheters, vascular grafts, and prosthetic heart valves and joints [31,32].

Gram negative organisms were accounted for 46.7 % of septic cases in the present finding, with *E. coli* was the leading Gram negative species with frequency of 13.3 % and other Gram negative bacteria such as *P. aeruginosa, K. pneumoniae, Enterobacter species, Citrobacter species and Salmonella species* each accounts 6.7 %. Similar studies also reported *Escherichia coli* as the most frequently isolated organism [9,28,33,34]. In contrast to our finding; however, other studies reported from sub-Saharan African countries that non-typhoidal *Salmonella* as leading Gram negative bacteria [20,22]. This difference might be due to patient population in which most of the critically ill patients/septic patients were often younger with a higher prevalence of human immunodeficiency virus (HIV) infection. In the other case the variation of etiological agents of sepsis may reflect the changing demography of sepsis in developing countries, which might be related to the geographical variations [27].

The antibiotic resistance pattern of Gram positive and Gram negative organisms, isolated from blood culture to the most

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Table 7 Antibiogram patterns showing resistance of isolates to three or more antibiotics to the bacterial isolates from blood culture in adults with sepsis at Jimma University Specialized Hospital, Jimma, Ethiopia.

Blood bacterial isolate	Resistance antibiogram	Number
Gram Positive		
CoNS (n=1)	P,C,TE	1
S. aureus (n=6)	P,AMP,TE P,CXT P,AMP,E,KF,CRO P,AMP,TE,CIP P,AMP,TE,E,KF,AMC P,AMP,TE,E,KF,AMC,CXT	1 1 1 1 1 1
Gram Negative		**Number**
Citrobacter species (n=1)	AMP,KF,TE,DO	1
E.coli (n=2)	AMP,S,SXT,TE,CN, KF,C AMP,S,SXT,TE,CN,DO,CIP,CRO	1 1
K. pneumoniae (n=1)	AMP, S,SXT,TE, KF,C,DO,CRO	1
P.aeruginosa (n=1)	AMP,S,SXT,TE,KF,C,AMC,DO,CRO	1

Key: AMP: Ampicillin; AMC: Amoxicillin-Clavulanic acid; CXT: Cefoxitin CRO: Ceftriaxone; KF: Cephalothin; C: Chloramphenicol; CIP: Ciprofloxacin; DO: Doxycycline; E: Erythromycin; CN: Gentamicin; P: Penicillin-G; S: Streptomycin; SXT: Trimethoprim-sulphamethoxazole; TE: Tetracycline.

relevant antibiotics have demonstrated low resistance rates to ciprofloxacin (12.5 % and 14.3 %), amoxicillin-clavulanic acid (25 % and 14.3 %) and gentamicin (0 % and 28.6 %) respectively. Amongst the Gram positive organism's high resistance was observed with ampicillin (75 %) which is consistent with other study in India where the rate of resistance was 73.6 % [35]. In the present finding, vancomycin was a highly active drug against Gram positive organisms with 100 % sensitivity. Similarly in other studies vancomycin was highly effective drug against Gram positive bacteria [27,36,37]. However, this should not be expected that vancomycin activity continues for a long time as, there have been reports of vancomycin resistant *S. aureus* (VRSA) from studies [28,38].

Among S. *aureus* strains isolated from blood culture (2/6; 33.3 %) were MRSA (Cefoxitin disc used) and none of Coagulase negative *Staphylococci* were resistant. Our finding were comparable with other studies reported in India in which (42.4 %) of *S. aures* was MRSA [39] and in Nigeria (24.7 %) [20]. In the current study, among the antibiotics used for susceptibility testing for Gram-negative isolates, amoxicillin-clavulanic acid was very effective against *Enterobacteriaceae,* whereas for *P. aeruginosa* isolated in this study has gentamicin and ciprofloxacin were highly active. High percentage of Gram negative isolates showed in vitro susceptibility to combination therapy consisting of amoxicillin-clavulanic acid. The efficacy of amoxicillin-clavulanic acid on *Enterobacteriaceae* may be related to the activity of clavulanic acid, which inhibits beta-lactamase produced by these bacteria.

Most bacteria isolates showed resistance to most commonly used drugs. Infection with multidrug-resistant (MDR) organisms is becoming more common, making the choice of empirical antimicrobial therapy challenging. In our study multiple drug resistance (resistance to three or more drugs) was observed in total 12/15 (80 %). Multiple drug resistances were seen with 7/8 (87.5 %) and 5/7 (71.4 %) of Gram positive and Gram negative bacteria (P=0.438) respectively. Among Gram positive, all the *S. aureus* and one *CoNS* isolates were multi-drug resistant, while in Gram negatives, MDR were observed in *K. pneumoniae, Citrobacter species, P. aeruginosa* and *E. coli*. The high frequency of MDR might be a reflection of inappropriate use of antimicrobials, lack of laboratory diagnostic tests, unavailability of updated guideline for the selection of antibiotics.

High level resistance to different antibiotic was seen among Gram negative bacteria with 71.4 % of isolates showing multi-drug resistance. These finding is in comparable with study conducted in developing country in which 81.57 % of the isolates were showing MDR [26] and the most common resistance was seen to ampicillin in all isolated bacteria. Other studies have also reported similar MDR for their isolated Gram negatives [35,40].

In generally, in the present study ciprofloxacin was shown to be the effective drug against the tested Gram positive and Gram negative bacteria isolates. Similar findings have been reported in different studies done in Ethiopia and in Iran [14,15,41]. A general overview of the antibiogram of all the bacterial isolates indicates that Gram positive bacteria exhibited a greater level of antimicrobial resistant (ranging between 0 % – 100 %) than Gram negative bacteria (14.3 % - 85.7 %) to various antibacterial agents employed during the study period.

Since this study has been done on one health care location and the shorter study period employed, we performed relatively lower number of cultures over the four months period. As a result, the finding may not be truly representative. Nevertheless, the data are of value as a basis for future study with respect to bacterial profile and antimicrobial susceptibility of sepsis in Ethiopia.

Conclusion

In present study both Gram negative and Gram positive bacteria were responsible for adult sepsis. *S. aureus* and *E.coli* were among the most common Gram positive and Gram negative organisms identified causing adult sepsis, respectively. Multi-drug resistance was detected in 80 % of isolates. Therefore, routine bacteriological profile examination along with their antibiotic resistance patterns must be a necessary component in the management of adult sepsis. A knowledge of these patterns is essential when local polices on the uses of antibiotics are being devised.

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