Bloodstream Bacterial Pathogens and Their Antibiotic Resistance Patterns in Rasht, Iran

Abdol-Rasoul Sobhani [1], Mahin Mallaei [2], Samaneh Kazemi [2*]

[1]Department of Pharmacology, School of Medicine, Guilan University of Medical Sciences, Rasht, Iran.

[2] Vice-chancellor of Research and Technology, Guilan University of Medical Sciences, Rasht, Iran.

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ABSTRACT

Background**:** The increasing bloodstream infection mainly in developing countries is one of the most important health care systems concern. And, the choice of antimicrobial treatment for septicemia is often empirical and based on the knowledge of local antimicrobial activity patterns of the most common bacteria causing such bloodstream infections. This study was carried to identify the microbial profile in the blood culture isolates and their antibiotic susceptibility patterns.

Methods**:** This retrospective cross sectional study was done at Razi Hospital, Rasht, Iran over a period of thirteen months from August 2012 to September 2013. Bacteria were identified by various biochemical tests and antimicrobial susceptibility testing of the isolates was performed by Kirby-Bauer disc diffusion method.

Results**:** Out of 953 identified isolates, Gram-negative isolates 482 (50.58%) were followed by Gram-positive isolates 471 (49.42%). Among Gram-positive organisms *Staphylococcus epidermidis* was the highest with 255 (54%) records and in Gram-negative bacteria *Pseudomonas* spp. was highest with 241 (50%) records. There were 467 (49.0%) positive blood culture reports for males and 487 (51.0%) for females. *Pseudomonas* spp. (134 reports) and *S. epidermidis* (162 reports) were the most common pathogens in male and woman, respectively. In 15-44 years old age group, *Pseudomonas* spp. and in 45-75< years age group, *S. epidermidis* were identified as the most common. *S. epidermidis* isolates were more resistant to Erythromycin, Oxacillin and Doxycycline. *Pseudomonas* spp. isolates had more resistant to imipeneme, amikacin and cefalexin.

Conclusion**:**It can be concluded that bacterial resistance to antibiotics which used against bloodstream infections can make complication in treatment of infection cause by these pathogens.

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*Corresponding Author: Samaneh Kazemi, Vice-Chancellor of Research and Technology, Guilan University of Medical Sciences, Rasht, Iran.

Tel: +98-13-33362547, *E-mail*: kazemi_samane@ymail.com

Introduction

Bacterial bloodstream infection (BSI) vocalizes a significant public health problem and is important reason of mortality and morbidity in hospitalized patients. About 200,000 cases of bacteraemia occur annually with mortality rates ranging from 20-50% worldwide (1).

Bacteriemia has an increasing trend in some regions of the world. The isolated bacteria are so much and their associated diseases require immediate and invasive management with antimicrobial drugs. Illustrative and correct use of these agents needs knowing of common pathogens and drug resistance pattern in the region (2).

Blood stream infection may results from an infection in an organ or tissue. However, the primary site is not often evident (1). Both Gram-negative and Gram-positive bacteria can cause bloodstream infections and that can be differs from different locality and/or different time (3). It is necessary for documented results obtained from analysis of blood culture to developing the antibiotic policy for affective management of septicemia (1).

Bacterial antibiotic resistant is remaining as an alarming problem in therapy for bloodstream infections (4, 5). There are four main mechanisms by which resistance can occur: (i) Prevention of access to target by reduced cell membrane permeability and/or increased efflux, (ii) changes in antibiotic targets by mutation, (iii) modification (and protection) of targets and (iv) direct modification of antibiotics (6).

Identification of various microorganisms in patient’s blood is one of the immense diagnostic and prognostic matters. Blood cultures are required in the diagnosis and treatment of the etiologic agents or sepsis. Bacterial and fungal pathogens remain an important reason of BSI. Bacterial pathogens isolated from BSI are the main reason of considerable patient mortality and morbidity (7).

Researchers have reported significant changing orientations in the epidemiology, microbiology and clinical issues as well as prognostic significance of positive blood cultures over a period of time (4). For these cases, supervision of bloodstream infections from blood cultures and their antibiotic resistance patterns are biotic to the care of patients and prevention of BSI. Many interventions have proven to be effective (8-11).
This study was performed to find the relative frequency of Gram-negative and Gram positive bacteria that causing septicemia in patients and determined antibacterial resistance pattern till clinicians can select the best choice antibiotic therapy.

Materials and methods

Source of data

This retrospective cross sectional study was conducted after getting approval from Institutional ethics committee. Data collected from records of 954 patients referred to Razi Hospital laboratory from August 2012 to September 2013.The variables were investigated including: age and sex of patients, microbial species, and drug resistance as recorded in antibiograms forms.

Sampling and identification of bacteria

All the samples of blood, which were collected under strict aseptic precautions constitute the study material and were analyzed. All positive samples were subjected to Gram stain followed by inoculation on Blood and MacConkey agar and incubated at 37°C for 48 hrs. The bacteria were identified based on the colony morphology, colony gram stain and biochemical reactions. Biochemical test was undertaken to classify bacteria at species level such as Catalase, Coagulase, MR-VP, Mannitol salt agar (MSA), Novobiocin and Optochin disk for Gram positive and Oxidase, Indole, Citrate, Urea, Triple sugar

iron (TSI), Lysine decarboxylase, Arginine and Ornithine and Motility test for Gram negative bacteria following standard procedures.
All media and materials used in this study were obtained from (Merck Co. Darmstadt, Germany). Antibiotics were provided from (Padtan-TEB Co., Tehran, Iran).

Antimicrobial susceptibility test

Antimicrobial susceptibility tests were done by Kirby-Bauer disk diffusion method. A suspension of bacteria with optical density of 0.5 McFarland turbidity standard (1.5×10^8) was made. A 0.1 ml portion of suspension was cultured on Muller-Hinton Agar and disks containing antibiotic were placed onto the surface of the medium. After incubation, the zones of inhibition surrounding the disks were measured and compared with the standard for each antibiotic according to Clinical and Laboratory Standard Institute (CLSI-M45-P-2006) guidelines against investigated bacteria.

The following antibiotics were used (µg/disc): cefalexin (30), cefazolin (30), cephalotine (30), chloramphenicol (30), eftizoxime (30), erythromycin (15), cefotaxime (30), vancomycine (30), rifampin (5), Co-trimoxazole (1.25/23.75), trimethoprim (5), tetracycline (30), imipeneme (10), amikacin (30), penicillin (10), pipracilin (100), ampicillin (10), nitrofurantoin (300), doxycycline (30), oxacillin (1), ceftriaxon (30), cefepime (30), gentamicine (10), ciprofloxacine (5), ceftazidim (30).

Statistical analysis

Data was analyzed by Diagrammatic representation utility in SPSS 22 software.

Results

From 953 identified isolates, Gram-negative isolates 482 (50.58%) were followed by Gram-positive isolates 471 (49.42%).

Among the total 471 (49.42%) Gram-positive isolates recovered, *S. epidermidis* 255 (54%) followed by *S. aureus* 136 (29%) and *S. saprophyticus* 27 (6%) had the most frequency. Table 1 shows relative frequencies for isolated Gram positive bacteria.

Table 1. Relative frequency for Gram positive bacteria in positive blood culture.

Microorganism	no. (%)
S. epidermidis	255 (54)
S. aureus	136 (29)
S. saprophyticus	27 (6)
Enterococcus spp.	24 (5)
Nonhemolytic streptococci	15 (3)
Micrococcus spp.	9 (2)
Streptococcus alpha hemolytic	2 (0.41)
Gram positive cocci	2 (0.41)
Streptococcus beta hemolytic	1 (0.2)
Total	471 (100)

Among the total 482 (50.58%) Gram-negative bacteria isolated *Pseudomonas* spp. 241 (50%) followed by *Escherichia coli* 124 (26%) and *Acinetobacter* spp. 55 (11%) had the most frequency. Table 2 shows relative frequencies for isolated Gram negative bacteria.

Table 2. Relative frequency for Gram negative bacteria in positive blood culture.

Microorganism	no. (%)
Pseudomonas spp.	241 (50)
Escherichia coli	124 (26)
Acinetobacter spp.	55 (11)
Enterobacter spp.	33 (7)
Citrobacter spp.	22 (5)
Stenotrophomonas maltophilia	3 (1)
*Klebsiella*spp.	2 (0.42)
Proteus sp.	1 (0.21)
Serratia sp.	1 (0.21)
Total	482 (100)

Out of 954 culture positive processed, there were 467 (49.0%) positive blood culture reports for males and 487 (51.0%) for females. Table 3 shows relative frequencies for different bacteria in positive blood culture reports by sex of patients. There were 257 (26.9%) cases of *S.*

epidermidis, 241 (25.3) cases of *Pseudomonas* spp. and 136 (14.3) cases of *S. aureus* (the most common) in isolated bacteria. For males, *Pseudomonas* spp. (134 reports) and for females, *S. epidermidis* (162 reports) were the most common isolated bacteria.

Table 4 shows relative frequencies for isolated bacteria according to ages of patients. In 15-44 years age group, *Pseudomonas* spp. (62 reports, 34.4%), in 45-64 years age group *S. epidermidis* (87 reports, 24.7%), in 65-74 years age group *S. epidermidis* (57 reports, 29.1%), in 75<years age group *S. epidermidis* (72 reports, 31.9%) had highest frequencies.

Table3. Relative frequency for different bacteria in positive blood culture reports by sex of patients*

Microorganism	Sex		Total/no. (%)
	Male/no. (%)	Female/no. (%)	
S. epidermidis	95 (20.3)	162 (33.3)	257 (26.9)
Pseudomonas spp.	134 (28.7)	107 (22.0)	241 (25.3)
S. aureus	75 (16.1)	61 (12.5)	136 (14.3)
Escherichia coli	60 (12.8)	64 (13.1)	124 (13.0)
Acinetobacter spp.	32 (6.9)	24 (4.9)	56 (5.9)
Enterobacter spp.	19 (4.1)	12 (2.5)	31 (3.2)
S. saprophyticus	15 (3.2)	12 (2.5)	27 (2.8)
Entercoccus spp.	11 (2.4)	13 (2.7)	24 (2.5)
Citrobacter spp.	11 (2.4)	11 (2.3)	22 (2.3)
Nonhemolytic streptococci	8 (1.7)	7 (1.4)	15 (1.6)
Micrococcus spp.	2 (0.4)	7 (1.4)	9 (0.9)
Stenotrophomonas maltophilia	1 (0.2)	2 (0.4)	3 (0.3)
Gram positive cocci	1 (0.2)	1 (0.2)	2 (0.2)
Streptococcus alpha hemolytic	1 (0.2)	1 (0.2)	2 (0.2)
Klebsiella spp.	1 (0.2)	1 (0.2)	2 (0.2)
Proteus sp.	1 (0.2)	0 (0.0)	1 (0.1)
Sterratia sp.	0 (0.0)	1 (0.2)	1 (0.1)
Streptococcus beta hemolytic	0 (0.0)	1 (0.2)	1 (0.1)
Total	467 (100.0)	487 (100.0)	954 (100.0)

Table 4. Relative frequencies of drug resistances according to the type of the organisms and age-groups*

Microorganism	Age (years)/no. (%)				Total/no. (%)
	15-44	45-64	65-74	>75	
S. epidermidis	41 (22.8)	88 (24.7)	57 (29.1)	72 (31.9)	257 (26.9)
Pseudomonas spp.	62 (34.4)	85 (24.1)	51 (26.0)	43 (19.0)	241 (25.3)
S. aureus	25 (13.9)	60 (17.0)	27 (13.8)	24 (10.6)	136 (14.3)
Escherichia coli	17 (9.4)	48 (13.6)	28 (14.3)	31 (13.7)	124 (13.0)
Acinetobacter spp.	11 (6.1)	21 (6.0)	8 (4.1)	16 (7.1)	56 (5.9)
Enterobacter spp.	5 (2.8)	11 (3.1)	5 (2.6)	10 (4.4)	31 (3.2)
S. saprophyticus	4 (2.2)	8 (2.3)	4 (2.0)	11 (4.9)	27 (2.8)
Entercoccus spp.	5 (2.8)	12 (3.4)	4 (2.0)	3 (1.3)	24 (2.5)
Citrobacter spp.	3 (1.7)	8 (2.3)	7 (3.6)	4 (1.8)	22 (2.3)
Nonhemolytic streptococci	3 (1.7)	5 (1.4)	2 (1.0)	5 (2.2)	15 (1.6)
Micrococcus spp.	2 (1.1)	1 (0.3)	3 (1.5)	3 (1.3)	9 (.9)
Stenotrophomonas maltophilia	0 (0.0)	2 (0.6)	0 (0.0)	1 (0.4)	3 (.3)
Gram positive cocci	0 (0.0)	0 (.0)	0 (0.0)	2 (0.9)	2 (.2)
Streptococcus alpha hemolytic	1 (0.6)	1 (0.3)	0 (0.0)	0 (0.0)	2 (.2)
Klebsiella spp.	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.4)	2 (.2)
Sterratia sp.	1 (0.6)	0 (.0)	0 (0.0)	0 (0.0)	1 (.1)
Proteus sp.	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	1 (.1)
Streptococcus beta hemolytic	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	1 (.1)
Total	180 (100.0)	352 (100.0)	196 (100.0)	226 (100.0)	954 (100.0)

Table 5. The highest resistance of bacteria against antibiotics.

		Antibiotic																								
Isolated bacteria (no. (%))		Ciprofloxacine	Gentamicine	Ceftazidim	Oxacillin	Amikacin	Doxycycline	Ceftriaxon	Tetracycline	Cefotaxime	Co-trimoxazole	Imipeneme	Cefepime	Chloramphenicol	Erythromycin	Vancomycine	Rifampin	Pipracilin	Penicillin	Nitrofurantoin	Ceftizoxime	Cefazolin	Ampicillin	Trimethoprim	Cephalotine	Cefalexin
Gram positive	A	85 (33.6)	45 (20.6)	58 (18.3)	164 (56.2)	9 (11.1)	84 (54.9)	41 (16.0)	49 (32.2)	45 (21.4)	39 (31.7)	-	3 (1.6)	11 (21.2)	79 (61.2)	1 (12.5)	12 (35.3)	0 (0.0)	30 (24.6)	2 (4.2)	12 (17.1)	10 (13.3)	7 (18.4)	1 (16.7)	-	1 (50.0)
	B	42 (16.6)	28 (12.8)	24 (7.6)	96 (32.9)	2 (2.5)	43 (28.1)	17 (6.6)	29 (19.1)	23 (11.0)	11 (8.9)	1 (0.9)	2 (1.1)	4 (7.7)	32 (24.8)	0 (0.0)	7 (20.6)	-	13 (10.7)	0 (0.0)	11 (15.7)	3 (4.0)	4 (10.5)	1 (16.7)	-	-
	C	8 (3.2)	6 (2.8)	10 (3.2)	21 (7.2)	0 (0.0)	8 (5.2)	11 (4.3)	9 (5.9)	15 (7.1)	7 (5.7)	-	1 (0.5)	2 (3.8)	13 (10.1)	1 (12.5)	6 (17.6)	-	9 (7.4)	-	4 (5.7)	2 (2.7)	-	-	-	-
	D	8 (3.2)	4 (1.8)	1 (0.3)	2 (0.7)	4 (4.9)	7 (4.6)	1 (0.4)	2 (1.3)	-	-	-	1 (0.5)	1 (1.9)	1 (0.8)	5 (62.5)	4 (11.8)	0 (0.0)	19 (15.6)	8 (16.7)	-	-	14 (36.8)	0 (0.0)	-	-
	E	1 (0.4)	3 (1.4)	-	-	1 (1.2)	2 (1.3)	-	2 (1.3)	1 (0.5)	2 (1.6)	-	0 (0.0)	-	1 (0.8)	1 (12.5)	4 (11.8)	-	8 (6.6)	5 (10.4)	-	-	8 (21.1)	-	-	-
	F	5 (2.0)	3 (1.4)	-	8 (2.7)	2 (2.5)	4 (2.6)	-	1 (0.7)	-	-	-	-	-		-	-	-	-	-	-	-	2 (5.3)	-	-	-
	G	1 (0.4)	2 (0.9)	-	1 (0.3)	1 (1.2)	-	-	-	-	-	-	0 (0.0)	-	1 (0.8)	-	-	-	0 (0.0)	0 (0.0)	-	-	1 (2.6)	-	-	-
	H	1 (0.4)	1 (0.5)	-	-	0 (0.0)	1 (0.7)	-	-	-	-	-	-	-		-	-	-	2 (1.6)	1 (2.1)	-	-	2 (5.3)	-	-	-
	I	-	-	-	-	-	1 (0.7)	-	1 (0.7)	0 (0.0)	1 (0.8)	-	-	0 (0.0)	1 (0.8)	0 (0.0)	0 (0.0)	-	-	-	-	-	-	-	-	-
Gram negative	J	30 (11.9)	61 (28.0)	103 (32.5)	-	43 (53.1)	2 (1.3)	105 (40.9)	31 (20.4)	84 (40.0)	36 (29.3)	64 (55.7)	85 (45.7)	23 (4.2)	-	-	-	37 (44.6)	33 (27.0)	12 (25.0)	22 (31.4)	22 (29.3)	-	2 (33.3)	-	1 (50.0)
	K	57 (22.5)	43 (19.7)	57 (18.0)	-	2 (2.5)	-	61 (23.7)	19 (12.5)	26 (12.4)	17 (13.8)	9 (7.8)	36 (19.4)	6 (11.5)	-	-	-	11 (13.3)	6 (4.9)	8 (16.7)	13 (18.6)	21 (28.0)	-	1 (16.7)	1 (33.3)	-
	L	9 (3.6)	11 (5.0)	44 (13.9)	-	11 (13.6)	-	3 (1.2)	1 (0.7)	2 (1.0)	0 (0.0)	36 (31.3)	45 (24.2)	0 (0.0)	-	-	-	27 (32.5)	-	-	1 (1.4)	-	-	1 (16.7)	-	-
	M	2 (0.8)	4 (1.8)	10 (3.2)	-	2 (2.5)	1 (0.7)	7 (2.7)	2 (1.3)	4 (1.9)	8 (6.5)	0 (0.0)	5 (2.7)	2 (3.8)	1 (0.8)	0 (0.0)	1 (2.9)	5 (6.0)	1 (0.8)	6 (12.5)	2 (2.9)	11 (14.7)	-	0 (0.0)	1 (33.3)	-
	N	2 (0.8)	5 (2.3)	7 (2.2)	-	2 (2.5)	-	9 (3.5)	5 (3.3)	8 (3.8)	2 (1.6)	2 (1.7)	5 (2.7)	2 (3.8)	-	-	-	2 (2.4)	-	5 (10.4)	4 (5.7)	5 (6.7)	-	-	1 (33.3)	-
	O	0 (0.0)	1 (0.5)	2 (0.6)	-	1 (1.2)	-	-	-	-	-	2 (1.7)	2 (1.1)	-	-	-	-	1 (1.2)	-	-	-	-	-	-	-	-
	P	2 (0.8)	1 (0.5)	1 (0.3)	-	0 (0.0)	-	1 (0.4)	1 (0.7)	2 (1.0)	-	1 (0.9)	-	1 (1.9)	-	-	-	-	1 (0.8)	1 (2.1)	1 (1.4)	1 (1.3)	-	-	-	-
	Q	0 (0.0)	0 (0.0)	-	-	1 (1.2)	-	1 (0.4)	-	-	-	-	1 (0.5)	-	-	-	-	-	-	-	-	-	-	-	-	-
	R	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 (0.0)	-	-	-	-	-	-
Total of resistance isolates against antibiotic (no. (%))		253 (100.0)	218 (100.0)	317 (100.0)	292 (100.0)	81 (100.0)	153 (100.0)	257 (100.0)	152 (100.0)	210 (100.0)	123 (100.0)	115 (100.0)	186 (100.0)	52 (100.0)	129 (100.0)	8 (100.0)	34 (100.0)	83 (100.0)	122 (100.0)	48 (100.0)	70 (100.0)	75 (100.0)	38 (100.0)	6 (100.0)	3 (100.0)	2 (100.0)
Total of isolates with antibiotic (no.)		836	823	461	408	395	383	382	348	306	287	261	253	250	199	186	179	148	128	108	105	98	39	11	3	3

A: *Staphylococcus epidermidis*, **B:** *Staphlococcus aureus*, **C:** *Staphylococcus saprophyticus*, **D:** *Enterococcus* spp., **E:** Nonhemolytic streptococci, **F:** *Micrococcus* spp., **G:** *Streptococcus* alpha hemolytic, **H:** Gram positive cocci, **I:** *Streptococcus* beta hemolytic, **J:** *Pseudomonas* spp., **K:** *Escherichia coli*, **L:** *Acinetobacter* spp., **M:** *Enterobacter* spp., **N:** *Citrobacter* spp., **O:** *Stenotrophomonas maltophilia*, **P:** *Klebsiella* spp., **Q:** *Serratia* sp., **R:** Proteus sp.

The highest resistance of isolated bacteria against antibiotics and relative frequencies of resistances for isolated bacteria against antibiotics are shown in table 5.

Among Gram positive bacteria, *S. epidermidis*, *S. aureus* and *S. saprophyticus* had the highest frequency. Among the antibiotics used for *S. epidermidis* and *S. aureus*, they showed the highest resistant to erythromycin, oxacillin and doxycycline. *S. saprophyticus* showed more resistant to erythromycin, rifampin and vancomycine.

Among Gram positive bacteria, *Pseudomonas* spp., *Escherichia coli* and *Acinetobacter* spp. had the highest frequency. *Pseudomonas* spp. had the most resistant to imipeneme, cefalexin and amikacin. *E. coli* and *Acinetobacter* spp. showed the most resistant to cephalotine, cefazolin, ceftriaxon and pipracilin, imipeneme, cefepime, respectively.

Discussion

The newest world economic forum global risks reports have listed antibiotic resistance as one of the greatest threats to human health. It is estimated that in Europe 25,000 people die each year because of multidrug resistant of bacterial infections and this costs the European Union economy €1.5 billion annually. In the United States, more than 2 million human are infected with bacterial antibiotic resistant annually, with 23,000 deaths as a direct result. With increased resistance to existing antibiotics, there is a lack of new agents in development (6).

Isolates that are resistant to a wide range of antimicrobial antibiotics often led to BSI (12). The present study broadly illustrates the BSI bacterial spectrum and antimicrobial resistance pattern of 945 isolated bacteria in Rasht region, Iran. The data demonstrated the pattern of antimicrobial resistance among bacterial pathogens isolated from bloodstream infections.

According to our results, *Pseudomonas* spp. with 241 (50%) relative frequency and *S. epidermidis* with 255 (54%) relative frequency were the most common isolates among Gram negative and Gram positive bacteria, respectively (Tables 1 and 2).

Pseudomonas spp. are the major causes of nosocomial infections causing mortality and morbidity as these infections are serious to eradicate. There is a global emergence of multidrug resistant isolates of *Pseudomonas*. The transmission of infection during patient treatment in hospital can happen by direct contact with surfaces (14). Our results conforms to other study which *Pseudomonas* spp. were the most common bacterial organism causing blood stream infections in Children's Medical Center, Tehran, Iran (13).

S. aureus and *S. epidermidis* are two major opportunistic pathogens of Staphylococci genus which colonize a sizable ratio of the human population. *S. epidermidis* epidemiological studies have historically been limited, because of the fact that *S. epidermidis* isolates are often considered to be contaminants, as contrary to the disease causing microorganism. However, *S. epidermidis* infections are an increasing reason of concern, due to the high distribution of meticillin resistance amongst the isolates and their durability on domiciled devices, often resulting in replacement of the device, which causes more traumas and is costly (15).

There is rare data on blood bacteremia caused by *Staphylococcus* spp. in hospitals of Iran. Mohammadi et al. (2014) studied neonatal bacteremia isolates and their antibiotic resistance pattern in Sanandaj, Iran. They reported 7.6% positive for bacterial growth amongst 355 blood cultures from which 74% were *Staphylococcus* spp. (16).

In this study, relative frequency of bacteria approximately was same among male and female patients. There were 467 (49.0%) positive blood culture reports for males and 487 (51.0%) for females (Table 3).

Our results demonstrated that the most infection were in 45-64 years age with 352

(37%) relative frequency. In addition, in 15-44 years age group, *Pseudomonas* spp. and in 45-75<years age group, *S. epidermidis* were identified as the most common (Table 4).

In present retrospective cross sectional study, number of microbial isolates implemented to survey antibiotic resistance was variable. Therefore, communities with more than 50 samples used to interpret the results of antibiotic resistance for achieve more accurate results. Due to this limitation, bacteria showed highest resistance against cefazolin with 75 reports (from 98 samples) and cefepime with 186 reports (from 253 samples) (Equivalent 76.53% and 73.51%), respectively. In addition, vancomycine with 8 reports (from 186 samples) (Equivalent 4.3%) had lowest resistance to isolated isolates (Table 5).

Cefazolin and other first generation antibiotics are very active against Gram-positive bacteria and some gram-negative bacteria (17). Their broad spectrum of activity can be depended to their improved consistency to many bacterial Beta-lactamases compared to penicillins (18). For treat moderate to severe nosocomial pneumonia, infections caused by multiple drug resistant (MDR) microorganisms (e.g. *P. aeruginosa*) and empirical treatment of febrile neutropenia is usually reserved from cefepime (19).

Conclusion

Studies to determine the microorganisms and their antibiotic resistant associated with BSI are further considered necessary and the current study presents the baseline for such future studies. Also, we suggest examining the antibiotic resistance of microorganisms with use of the same number of isolates for each antibiotic. Our study suggests that the common isolates and pattern of antibiotic resistance were different in some areas and this subject requires further studies in the future. Also, to reduce the incidence of infections due to MDR bacteria, we suggest implementation of the strict antibiotic policy guidelines and followed by monitoring of antibiotic susceptibility patterns of such pathogens including *Pseudomonas* spp. and *S. epidermidis* that were identified as the most common pathogens in present study.

Conflict of interest

None declared conflicts of interest.

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