

Comparison of antimicrobial resistance pattern in hospital versus community-acquired infections in pediatric patients

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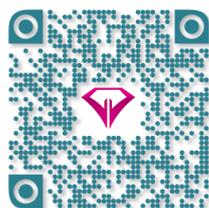
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ABSTRACT

Background & Objective: Nosocomial infection is one of the most daunting challenges to the global health care system. The current study aimed to compare the antimicrobial resistance pattern in hospital versus community-acquired infections in pediatric patients in Besat Hospital, Hamadan, Iran.

Materials & Methods: The current study was carried out on all patients with a hospital-acquired infection (HAI) who were hospitalized in Besat Hospital, Hamadan, Iran, for 48 hours. Moreover, patients with community-acquired infections (who had an infection before hospitalization) were also included in the current study. E-test and Kirby-Bauer disk diffusion test were utilized to determine antimicrobial susceptibility patterns according to the report test/CLSI M100/S27 guidelines. Antibiotic resistance patterns in both patients with hospital and community-acquired infections were separately recorded. Subsequently, the obtained data were analyzed by SPSS software (version 16).

Results: A number of 43 and 68 patients showed HAI and CAI, respectively. The most common HAI and CAI were blood-stream infection and urinary tract infection (UTI) with a prevalence of 69.8%, and 73.5%, respectively. The most frequent organisms isolated from CA and HA-infections were *E. coli* and *Staphylococcus aureus* with a prevalence of 67.9%, and 30.2%, respectively. The highest level of resistance in Gram-negative bacteria was observed against cotrimoxazole and ceftriaxone. Furthermore, the highest resistance in Gram-positive organisms was against clindamycin. The prevalence rates of MRSA isolates in HAI and CAI were reported as 46.2% and 36.9%, respectively.

Conclusion: The obtained results indicated the high resistance to several antibiotics that can be used as promising choices in the treatment of both CA and HA-infections. It is recommended that region-specific monitoring studies be carried out in order to assist the clinician to select the accurate empirical therapy.

Keywords: Pediatric, Drug resistance, Nosocomial infection, Community-acquired infection



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Introduction

Nosocomial infection or a healthcare-associated infection (HAI) is known as one of the serious challenges posed to the global health care system (1). Just 1.7 million HAIs were reported in the USA in 2002(2). It accounts for 99000 deaths and the annual cost of more than 30 million dollars just in the USA (3). Moreover, other countries reported a high frequency of these infections (4). In a nutshell, 8.7 % of the admitted patients around the world are suffering from nosocomial infections (5). In European countries, the prevalence of

HAIs in the general pediatric ward is about 1% (1), while it was reported as 23.6 % in the neonatal intensive care wards (6). It is worthy to note that other hospital infections are contracted from the application of medical invasive devices or aggressive procedures. Among these infections, the most prevalent HAI is urinary tract infection (UTI) and the most prevalent life-threatening hospital-acquired infection is recognized to be hospital-acquired pneumonia (2).

In addition to these three important groups of HAIs, infections that are related to the use of invasive devices and surgical wound infections are the common causes of nosocomial infections and mortality resulted from hospitalized patients (7). There are some common causes of concerns in HAI groups of pediatrics and neonates (8). They include defects of skin barriers, immature immune system, particularly in preterm infants, anomalous bacterial defenses and migration of granulocyte, reduction in maternal IgG level in the first months of life, and lower activity of mucous membrane. In the USA, more than 30% of hospital infections, 70% of which are contracted in intensive care units (ICU), are caused by Gram-negative bacilli. Enterobacteriaceae are the most common causative microbial agents amongst Gram-negative bacilli which cause hospital-acquired infections (9). Unfortunately, the number of resistant Gram-negative bacilli consisting of Enterobacteriaceae producing extended-spectrum β -lactamases (ESBLs) or carbapenemases, *Pseudomonas aeruginosa*, and *A. baumannii* are on the rise worldwide (1).

It is noteworthy that the prevalence of ESBL-producing *Enterobacteriaceae* family reached up to 60% nowadays (10). Furthermore, the rate of nosocomial infections caused by resistant Gram-positive cocci, such as *Enterococcus*, *Staphylococcus* has increased to 30% and 50%, respectively (11). It is of utmost importance to determine the pattern of antimicrobial resistance and its trend in each hospital for the selection of an appropriate empiric antibiotic regimen (12). With this background in mind, the current study aimed at comparing the pattern of antimicrobial resistance between hospital and community-acquired infections during 6 months of 2016 in pediatric cases in Besat Hospital, Hamadan, Iran.

Materials and Methods

Study population

This retrospective descriptive cross-sectional survey was carried out in the pediatric intensive care unit (PICU), pediatric hematology, and other pediatric wards of Besat Hospital, Hamadan, during 6 months of 2016.

Inclusion criteria

During the study period, all patients who had eligible criteria for each kind of nosocomial infection were enrolled in the study using a checklist. The definition of nosocomial infection was similar to that provided by the Centers for Disease Control and Prevention (CDC) (12). To determine the infection type (nosocomial or community-acquired) and clinical samples (tracheal culture, urine, blood, wound, and other samples), all patients (Patients and clinical specimens) were evaluated by the infection control team.

Sampling method

Census sampling method was used for sampling. Thereafter, cultural process and susceptibility testing were

performed on clinical specimens which were sent to the laboratory. All patients hospitalized with an infection and positive culture without the history of recent hospitalization were separately recorded and analyzed to compare the pattern of antibiotic resistance of HAIs with CA infections during this period.

Detection of microorganisms

After delivering clinical samples to the laboratory, they were immediately cultured on proper media, such as Blood agar, MacConkey agar, EMB, and Nutrient agar and then incubated overnight. After 24 h, the presence of cocci, Bacillus, and Gram-positive/negative bacteria was detected using macroscopic (Colonies shape) and microscopic (Gram-staining) techniques. Subsequently, Catalase/ Oxidase, OF, TSI, Urease, IMViC tests growth on mannitol Salt Agar medium 6%, Growth/in the presence of salt, growth at 25, 37, and 42°C and other microbiology and biochemical tests were used to identify the genus and species of bacteria.

Antibiotic susceptibility testing

To intent upon antimicrobial susceptibility pattern, the Kirby Bauer Disk Diffusion test was utilized as it was recommended in the CLSI /M100-S27 guidelines (13). Cefoxitin disk diffusion was used to determine methicillin resistance *S. aureus* (MRSA). In addition, E-test was used to determine the susceptibility of bacteria against Meropenem, Colistin, and Vancomycin. The antibiotic disks which were used in the current study were provided from MAST Company (UK). These antibiotic disks included Ceftriaxone (30 μ g), Cefazidime (30 μ g), Cefepime (30 μ g), Gentamicin (10 μ g), Ciprofloxacin (5 μ g), Co-trimoxazole, Piperaciline-tazobactam, Ampi-Sulbactame (20/10 μ g), Imipenem (10 μ g), Meropenem (10 μ g), Colistin(10 μ g), Cefazolin (30 μ g), Erythromycin (30 μ g), Clindamycin(30 μ g), Cefoxitine (30 μ g), Cloxacillin (30 μ g), and Vancomycin.

Statistical analysis

The obtained data were analyzed in SPSS software (version 16.0) using descriptive statistics. The Ethics Review Board of the Hamadan University of Medical Sciences approved the study. (IR.UMSHA.REC. 1395.352).

Results

Characterization of study participants

The present study was conducted on 43 patients who were hospitalized for more than 48 h in Besat Hospital, Hamadan, Iran, as well as 68 individuals who were hospitalized in the same wards due to community-acquired infections. Notably, 42.6% and 60.5% of patients with community-acquired infections and hospital-acquired infections were males, respectively. The mean age of patients with community-acquired infection and hospital infection was reported as 2.17 and 5.27 years, respectively. The most collected samples from patients with community-acquired infections were urine samples with a frequency of 50 (73.5%). On the other hand, most samples achieved

from patients with hospital-acquired infection were related to blood samples (BSI) with the occurrence of 30 (69.8%).

Main results

The most common organisms recovered from community-acquired and hospital-acquired infections were *E. coli* and *S. aureus* with a prevalence of 67.6% and 30.2%, respectively (Table 1). As evidenced by the findings, the least resistance in the community-acquired infections against *E. coli* was related to Colistin and Meropenem with a prevalence of 0%, followed by Imipenem and Cefepime with the prevalence of 2.2% and 8.9%, respectively. Conversely, the highest resistance was pertinent to Co-trimoxazole with a frequency of 64.4%, followed by ceftriaxone (27.6%). *Klebsiella* has a high sensitivity to most antibiotics and showed the highest resistance to Co-trimoxazole (75%). Among hospital-acquired infections caused by *E. coli*, the minimum resistance was against Colistin, Meropenem, and Gentamicin with a frequency of 0%, followed by piperacillin/tazobactam (10%). Moreover, the highest resistance in *E. coli* was against Co-trimoxazole with a prevalence of 40%. In addition, in *Klebsiella pneumoniae* isolated from hospital-acquired infections, the minimum resistance was against Colistin, Imipenem, Meropenem, and Piperacillin-tazobactam (0%), and 42.9 % of isolates were resistant to Co-trimoxazole.

In *Acinetobacter baumannii*, the least resistance was to ciprofloxacin with the occurrence of 16.6%, followed by meropenem, gentamycin, colistin, and piperacillin-tazobactam with the frequency of 33.2%. While, the highest resistance was against Co-trimoxazole (66.7%), (Table 2). In community-acquired infections caused by *S. aureus*, the least resistance was to vancomycin (0%), followed by ciprofloxacin (18.2%), and the highest resistance was to clindamycin with a prevalence of 54.5%. In the case of hospital-acquired infections, Vancomycin was the most effective antibiotic for infections caused by *S. aureus* and the most resistance in this organism was observed against clindamycin with a prevalence of 53.8%. About 36.4% of *S. aureus* which were retrieved from community-acquired infections was MRSA, as compared to 42.6% of *S. aureus* isolates which were recovered from hospital-acquired infections. Of these community-acquired MRSA isolates, 45.5% were resistant against Co-trimoxazole and 66.6% were resistant to clindamycin.

Notably, no resistance was reported against vancomycin and ciprofloxacin in *S. aureus* isolated from both community and hospital-acquired infections (Table 3). In community-acquired UTI caused by *E. coli*, the least resistance was to imipenem, meropenem (2.9%), and piperacillin-tazobactam (8.9%), while the highest resistance was related to Cotrimoxazole (74.3%), followed by ceftriaxone (28.6%). In hospital-acquired UTI caused by *Escherichia coli* (*E. coli*), the lowest

resistance was to Meropenem, piperacillin-tazobactam, and gentamicin (0%), and the highest resistance was to Co-trimoxazole (90%). In *Klebsiella* produced community-acquired infection, 100% of isolates were resistant to Co-trimoxazole.

In general, in Gram-negative bacteria caused by community-acquired-UTI, the highest resistance was to Cotrimoxazole with a prevalence of 71.4%, followed by gentamycin and ceftriaxone with a prevalence of 24.5%, and with no resistance against Colistin and Meropenem. Moreover, the resistance rates against Imipenem and Cefepime were reported as 2% and 8.2%, respectively. The antibiotic susceptibility results of Gram-negative bacteria which cause bloodstream infection (BSI) indicated that the highest resistance was to Ceftriaxone in community-acquired infections with a prevalence of 31.6%, followed by tazocin and gentamycin with the prevalence of 10.5%. However, no resistance was reported to Colistin. Nonetheless, in Gram-negative bacteria which caused hospital-acquired infections, the most resistance was reported to Ceftriaxone with a frequency of 37.5% and the least resistance was to Colistin, gentamycin, and tazocin with the prevalence of 12.5%.

In Gram-positive organisms which caused community-bloodstream infections, no resistance was observed to vancomycin (0%). Moreover, the resistance rate against ciprofloxacin and cefoxitin was estimated at 16.7%, whereas the highest resistance was to clindamycin (50%). On the other hand, in Gram-positive organisms which caused hospital-acquired bloodstream infection, the most resistance was to erythromycin with a prevalence of 53.8%, followed by cefoxitin with the prevalence of 46.2%. Nevertheless, no resistance was observed against vancomycin (0%). Frequencies of MRSA isolates in community and hospital-acquired bloodstream infections were reported as 16.7%, and 46.2%, respectively.

Discussion

In The present study demonstrated that the most common organisms isolated from both community and hospital-acquired infections in pediatrics patients were *E. coli* and *S. aureus* with a prevalence of 67.6% and 30.2%, respectively. These findings were inconsistent with the studies conducted in India (14) and Turkey (15) which found that *E. coli* and *S. aureus* were most prevalent. Moreover, the highest resistance was observed against Co-trimoxazole in *E. coli* which caused both community-acquired and hospital-acquired infections. Therefore, due to its high resistance, Co-trimoxazole is not recommended as the mainstay of treatment for empirical therapy in both types of infections. This could be due to indiscriminate prescribing of these antibiotics to pediatric outpatients.

Table 1. Oligonucleotide primers used for RT-PCR

Variables		Community acquired infection (%)	Hospital acquired infection (%)	p-value (chi ²)
Samples	Urine	50(73.5)	7(16.3)	0.001
	Blood	9(13.2)	30(69.8)	
	Wound	5(7.3)	5(11.6)	
	Other*	4(5.9)	1(2.3)	
Microorganisms	<i>Staphylococcus aureus</i>	11(16.2)	13(31)	0.001
	<i>Streptococcus</i>	2(2.9)	1(2.3)	
	<i>E. coli</i>	45(66.2)	10(23.8)	
	<i>Acinetobacter</i>	0(0.00)	6(14.3)	
	<i>Klebsiella</i>	4(5.9)	7(16.7)	
	Other	6(7.3)	5(11.6)	

*: CSF, secretions, respiratory, Abscess, and Ascites

Table 2. Results of susceptibility test in gram negative organisms based on the infections types

Antibiotics	Susceptibility	Community acquired infection			Hospital acquired infection			
		<i>E.coli</i> N=45	<i>Klebsiella</i> N=4	<i>Other</i> N=6	<i>E. coli</i> N=10	<i>klebsiella</i> N=7	<i>Pseudomonas</i> N=2	<i>Acinetobacter</i> N=6
Ceftriaxone	S	30(68.2)	3(75/0)	4(50/0)	8(80)	(% 4.71) 5	2 (100.0)	1(16.7)
	I	3(6.7)	1 (25)	0(0/0)	0(00.0)	0	0(00.0)	2(33.3)
	R	12(27.6)	0(00.0)	2(50/0)	2(20)	2 (28.6 %)	0(00.0)	3(50.0)
Ceftazidime	S	36(80/0)	3(75/0)	4(50/0)	8(80)	6 (85.7 %)	2 (100.0)	3(50.0)
	I	4(8.9)	1(25/0)	1(25/0)	0(00.0)	0	0(00.0)	0(00.0)
	R	5(11/1)	0(00.0)	1(25/0)	2(20/0)	1 (14.3)	0(00.0)	3(50.0)
Cefepime	S	37(82/2)	4 (100.0)	4(50/0)	8(80/0)	6 (85.7 %)	2 (100.0)	3(50.0)
	I	4(8.9%)	0(00.0)	1(25/0)	0(00.0)	0	0(00.0)	1(16.7)
	R	4(8.9%)	0(00.0)	1(25/0)	2(20/0)	1 (14.3)	0(00.0)	2(33.3)
Gentamicin	S	33(73.3)	4 (100.0)	3(50.0)	10 (100.0)	5 (71.4 %)	2 (100.0)	4(66.7)
	I	1(2.2%)	0	0	0	1 (14.3)	0	0
	R	11(24.4)	0(00.0)	3(50%)	0(00.0)	1 (14.3)	0(00.0)	2(33.3)
Ciprofloxacin	S	37(82.2)	3(75/0)	5(75/0)	7(70/0)	6 (85.7 %)	2(100/0)	4(66.7)
	I	0(00.0)	0(0.0)	0(00.0)	0(0.0)	0	0(00.0)	1(16.7)
	R	8(17/8)	1(25/0)	1(25/0)	3(30/0)	1 (14.3)	0(00.0)	1(16.6)
Co-trimoxazole	S	16(35.6)	1(25/0)	4(75/0)	6(60/0)	4 (57.1)	1(50/0)	1(16.6)
	I	0(0/0)	0(0/0)	0(0/0)	0(00.0)	0	0(00.0)	1(16.6)
	R	29(64.4)	3(75/0)	2(25/0)	4(40/0)	3 (42.9)	1(50/0)	4(66.7)
Piperaciline-tazobactame	S	39(86/7)	4 (100.0)	6(100.0)	9(90/0)	7 (100)	(100.0)2	4(66.7)
	R	6(13/3)	0(00.0)	0(00.0)	1(10/0)	0	0(00.0)	2 (33.3 %)
Ampi-Sulbactame	S	7(63.6)	1(50.0)	1 (50.0)	3(37.5)	5 (71.4 %)	1(50/0)	2(33.3)
	I	3(27.3)	1(50.0)	1(50/0)	4(50.0)	0	1(50/0)	0(00.0)
	R	1 (9.1)	0(00.0)	0(00.0)	1 (12.5)	2 (28.6 %)	0(00.0)	4(66.7)
Imipenem	S	44(97/8)	3(75/0)	5(75/0)	8(80/0)	7 (100)	2(100/0)	3 (50.0)
	R	1(2.2)	1(25.0)	0(0/0)	2(20.0)	0	0(00.0)	3 (50.0)
Meropenem	S	45(100.0)	4 (100.0)	6(100.0)	9(90.0)	7 (100)	2 (100.0)	3 (50.0)
	I	0(0/0)	0(0.0)	0(0/0)	0(7/69)	0	0(00.0)	1(7/16)
	R	0(0/0)	0(0/0)	0(0/0)	1 (10.0)	0	0(00.0)	2(2/33)
Colistin	S	(100.0)45	4 (100.0)	6(100.0)	(100.0)10	7 (100)	2(100.0)	4 (66.7 %)
	R	0(0/0)	0(00.0)	0(00.0)	0(0/0)	0	0(00.0)	2 (33.3 %)

Table 3. Results of susceptibility testing in gram positive organisms based on the infections

Antibiotics	Susceptibility	Community acquired infection			Hospital acquired infection		
		Other N=2	<i>S. aureus</i> N=11	<i>Streptococcus</i> N=2	Other N=1	<i>S. aureus</i> N=13	<i>Streptococcus</i> N=1
Cefazolin	S	1 (50.0)	8 (72.7)	2 (100.0)	1 (100.0)	9 (69.2)	0 (00.0)
	R	2 (50.0)	3 (23.7)	0 (00.0)	0 (00.0)	4 (30.8)	1 (100.0)
Erythromycin	S	1 (50.0)	5 (45.5)	1 (50.0)	1 (100.0)	4 (30.8)	0 (00.0)
	I	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	1 (7.7)	0 (00.0)
Clindamycin	R	1 (50.0)	6 (54.5)	1 (50.0)	0 (00.0)	8 (61.5)	1 (100.0)
	S	1 (50.0)	3 (27.3)	1 (50.0)	1 (100.0)	6 (46.2)	1 (50.0)
	I	0 (00.0)	1 (9.1)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Ciprofloxacin	R	1 (50.0)	7 (63.6)	1 (50.0)	0 (00.0)	7 (53.83)	0 (00.0)
	S	1 (50.0)	7 (63.6)	1 (50.0)	1 (100.0)	10 (76.9)	0 (00.0)
	I	0 (00.0)	2 (18.2)	1 (50.0)	0 (00.0)	0 (00.0)	1 (100.0)
Cotrimoxazole	R	1 (100.0)	2 (18.2)	0 (00.0)	0 (00.0)	3 (23.1)	0 (00.0)
	S	1 (50.0)	6 (54.5)	1 (50.0)	0 (00.0)	8 (61.5)	0 (00.0)
Cefoxitine	R	1 (50.0)	5 (45.5)	2 (100.0)	1 (100.0)	6 (46.2)	0 (00.0)
	S	2 (100.0)	6 (54.5)	3 (75.0)	1 (100.0)	2 (66.7)	3 (75.0)
Cloxacillin	I	0 (00.0)	1 (9.1)	0 (00.0)	0 (00.0)	1 (7.7)	0 (00.0)
	R	0 (00.0)	4 (36.4)	0 (00.0)	0 (00.0)	6 (46.2)	1 (100.0)
Vancomycin	S	1 (50.0)	4 (36.4)	1 (50.0)	1 (100.0)	8 (61.5)	0 (00.0)
	I	0 (00.0)	2 (18.2)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
	R	1 (50.0)	5 (45.5)	1 (50.0)	0 (00.0)	5 (38.5)	1 (100.0)

Discussion

In The present study demonstrated that the most common organisms isolated from both community and hospital-acquired infections in pediatrics patients were *E. coli* and *S. aureus* with a prevalence of 67.6% and 30.2%, respectively. These findings were inconsistent with the studies conducted in India (14) and Turkey (15) which found that *E. coli* and *S. aureus* were most prevalent. Moreover, the highest resistance was observed against Co-trimoxazole in *E. coli* which caused both community-acquired and hospital-acquired infections. Therefore, due to its high resistance, Co-trimoxazole is not recommended as the mainstay of treatment for empirical therapy in both types of infections. This could be due to indiscriminate prescribing of these antibiotics to pediatric outpatients.

As evidenced by the obtained results, no resistance was found against Colistin and Meropenem in Gram-negative microorganisms which caused the community-acquired infections, followed by Imipenem and

Cefepime with the prevalence of 2.2%, and 8.9%, respectively. Consequently, Meropenem can be used as the first-line treatment empirically in critically ill patients with HA-sepsis until obtaining the results of culture and susceptibility test. However, in CA-infections, cefepime can be used as an acceptable antibiotic in the empirical regime. In *A. baumannii*, the minimum of resistance was reported against ciprofloxacin which was probably owing to the no or at least use of this antibiotic in the pediatric ward. In CA and HA-infections caused by Gram-positive cocci, no resistance was observed against vancomycin; however, 36.4% of CA-*S. aureus* and 42.6% of HA-*S. aureus* were resistant to cefoxitin (MRSA). In addition, the highest resistance in *S. aureus* was reported against clindamycin which indicates that these medicines should not be prescribed in empirical therapy.

There exists a high resistance of methicillin in MRSA strains with a high percentage of prevalence in hospitalized

patients suspected to Gram-positive infectious agents. In this case, vancomycin empirical prescription and utilization should be undertaken until getting the results of culture and susceptibility testing. In community-acquired infections which are caused by *E. coli*, the highest resistance was to Cotrimoxazole with a frequency of 64.4%, followed by Ceftriaxone (27.6%). In line with these results, a study conducted in Tehran in 2007 found that the most common organism was *E. coli* with a prevalence of 51.4%, and the most resistance was against Ampicillin and the least one was to ciprofloxacin, ofloxacin, and amikacin (16). Whereas, in a study performed in Bahrami Hospital, Tehran, the most common reported isolates were *P. aeruginosa* (24.3%) and *Klebsiella pneumoniae* (18.6%) (17). The prevalence of pathogenesis is roughly similar in the distinct regions all around the world despite the fact that antimicrobial resistance patterns are markedly different.

This difference in antibiotic resistance patterns in various parts of the world is attributed to the immoderate and infelicitous antibiotics utilization, geographical difference, and the difference in prescribing the antibiotic regimes (15). *E. coli* was recognized as the most prevalent organism in UTI which is consistent with the results of previous studies (18,19). Moreover, our findings revealed that *E. coli* isolated from UTI in both CA and HA infections had the same antimicrobial pattern since Imipenem was the most active agent against *E. coli* and the most resistant one to Cotrimoxazole. In the present study, 100% of *K. pneumoniae* isolated from community-acquired infections were resistant to Cotrimoxazole. Whereas, all isolates were susceptible to almost all antibiotics in acquired-hospital infections. In accordance with these results, a study conducted by Yuksel et al. (2006) conducted on UTI in Turkey revealed that the most common causative agent was *E. coli*, followed by *K. pneumoniae*. Moreover, resistance to ampicillin and Cotrimoxazole in all isolates was another noteworthy result of the mentioned study (20). In community-acquired UTI, we reported 100% resistance against Cotrimoxazole; nonetheless, it should be omitted from the drug regime in the treatment of children-UTI. Instead, the low level of resistance to Imipenem and Meropenem can be a reasonable alternative in the treatment of UTI (20, 21).

In community-acquired bloodstream infection (CA-BSI) caused by Gram-negative bacteria, the highest resistance was reported against ceftriaxone with a prevalence of 31.6%, while no resistance was described against Colistin. Whereas in hospital-acquired bloodstream infection (HA-BSI), the most resistance was against ceftriaxone with a prevalence of 37.5% and the lowest was against Colistin/gentamicin and tazocin with a frequency of 12.5%. Consequently, the prescription of gentamicin or Piperacillin/Tazobactam rather than ceftriaxone can be the proper choice in BSI cases.

Furthermore, in Gram-positive organisms which caused CA-BSI, the least resistance was against vancomycin (0%), while the highest was to clindamycin (50%). Nevertheless, among Gram-positive organisms which developed HA-BSI, the most resistance was to cefoxitin with a prevalence of 46.2% and the least resistance to vancomycin (0%). Therefore, in patients with HA-BSI, vancomycin can be a suitable choice for empirical treatment. In the current study, MRSA which caused community and hospital-acquired bloodstream infections was reported as 16.7% and 46.2%, respectively. However, the reported prevalence of MRSA was 79% in a study (five-year evaluation) conducted by Pourakbari et al. in Iran within 2001-2005. This prevalence was very higher than the value obtained in the current study; moreover, the mentioned study was performed on the patients who suffered from BSI (22).

As mentioned earlier, the antimicrobial pattern of BSI caused by gram-negative isolates in community-acquired infections was consistent with the hospital-acquired one. The best choice for antibiotic therapy was Imipenem or Meropenem, whereas ceftriaxone seemed to be ineffective. In Gram-positive cocci, the most resistance was observed to clindamycin and erythromycin and the most susceptibility was detected to vancomycin. In a study carried out in Nepal within 2006-2008 on neonatal sepsis, the most frequent organisms isolated from blood culture samples were *Klebsiella*, followed by *S. aureus*. Moreover, the most effective antibiotic against Gram-negative organisms was cefoperazone/sulbactam and vancomycin in Gram-positive bacteria (23). As illustrated by the obtained results, a number of factors have increased the resistance against antimicrobial drugs. They include adequate staff, state health laws, hygiene in medical processes, control measures, stringent hospital policy regarding diagnosis and treatment of hospital-acquired infections, ongoing training and education, limited medical methods and medical device use, proper application of disinfectants-washers, and antimicrobial medicines (24). Geographic variations in the prevalence of pathogens and profiles of antibiotic susceptibility necessitate continuous monitoring and lead to the selection of best therapeutic options (25).

Taking everything into account, the present study pointed to the high resistance of Gram-negative isolates against Cotrimoxazole and ceftriaxone, as well as clindamycin in Gram-positive isolates. Consequently, it can be used as a good guide for describing the empirical treatment in CA and HA infections. Moreover, the results suggested that Cefepime can be a promising choice for empirical treatment in UTI cases. Furthermore, a combination of gentamycin and vancomycin can be used as an empirical regime in hospital-sepsis.

Conclusion

In addition, the findings of the current study were indicative of the high resistance to several antibiotics that can be used as excellent choices in the treatment of both CA and HA-infections. On a final note, it is recommended that region-specific monitoring studies be carried out in order to assist the clinician to select the accurate empirical therapy.

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Conflict of Interest

Authors declared no conflict of interests.

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