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Prevalence of Bacterial Isolates Related to the Meningitis and Bacteremia in two Hospitals During 2016-2017

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ABSTRACT

Background & Objective: Hospitals niche as a source and repository for microbial infections are playing a significant role in the health of hospitalized patients. Bacteria are playing an essential role in human and animal blood infections and meningitis. The prevalence of bacterial agents and their susceptibility patterns are fundamental goals of current research.

Materials & Methods: Sampling was carried out in two main educational hospitals, Sari City, Iran, from April 2016 to March 2017. After traditional biochemical tests, susceptibility testing of isolates was performed taking advantage of Kerby-Bauer. Subsequently, the frequency of related bacterial agents to meningitis and bacteremia and their susceptibility patterns were analyzed.

Results: Frequencies of bacterial isolates in Bouali and Imam Hospitals for meningitis (1.9%, 3.5%), bacteremia (31.9%, 26.3%), and urinary tract infection (UTI) were screened (66.2%, 70.1%). *Staphylococcus aureus* (41.7%) *and Streptococcus pneumoniae* (45%) were the highest isolates of meningitis in the mentioned hospital. These values to bacteremia were as follows: Gram-negative *Staphylococci* (30.7%), *Escherichia coli* (30%). *Coagulase- negative Staphylococci* isolates recovered from meningitis were completely sensitive to ciprofloxacin and Gentamycin. In addition, *P. aeruginosa,* Klebsiella and Acinetobacter spp showed higher than 90% resistance against ampicillin. *E. coli*, *Klebsiella spp* and *S. aureus* showed 100% resistance to amoxiclav; while *Klebsiella spp* were completely sensitive to amoxiclav.

Conclusion: Given the bacterial isolates detected from hospital wards and following the findings prompt diagnosis method is essential to control infections and the proper use of effective antibiotics.

Keywords: Antibiotic resistance pattern, Meningitis, Bacteremia, Hospital-acquired infections

Introduction

Nosocomial infections are the infections that affect hospitalized patients during their stay in the ward and patients symptoms might appear either when they are being hospitalized and/or after the patients are discharged **(1)**.

Bacteria are found abundantly in the media particularly in hospitals **(2)**. These are often opportunist pathogens and are able to generate various types of hospital-acquired infections such as bacteremia, meningitis, respiratory system infection, urinary tract infection, surgery wound infections and so on **(3, 4)**. The importance of bacteria in medical centers could be discussed from many aspects. Due to the antibiotic resistance, the members of this genus increases in an accelerated rate so far that currently, with the development of highly resilient strains, treating bacteria-generated infections has been facing challenges **(5)**. Meningitis has been noted as an overwhelming disorder with high mortality and morbidity rates (170000 case per year) **(6)**. Blood infection is the reaction of the defense system in the body against infectious agents such as bacteria, viruses, or fungi. In some cases, *Pseudomonas aeruginosa (P. aeruginosa)* is isolated from blood infections as well **(7)**. Nosocomial infections might cause meningitis, i.e., inflammation of meninges in peripheral areas of the brain and spinal cord. Despite antibiotic treatment, bacterial meningitis causes extensive damages and mortality. Studies conducted in Iran showed that *Streptococcus pneumoniae* (*S. pneumoniae*) was responsible for 30% of meningitis cases, *Haemophilus influenza (H. influenza)* for 15%, *Coagulase-negative staphylococci* for 14% and *Neisseria meningitides* (*N. meningitidis*) for 13%. Generally, nosocomial infections not only increase the costs due to prolonged hospital stay,and going through diagnostic and treatment measures for detecting the routes of microorganisms transmission in hospital environment; they also cause high mortality and illness rate.

Regarding the essential impact of bacteria in bacteremia and meningitis; and the necessity to improve knowledge on the prevalence of developing the diseases and identifying bacterial agents related to such cases, in order to facilitate infection control in certain hospitals, the present study aims at assessing the presence of bacteria and their susceptibility patterns against antibiotics.

Materials and Methods

In this cross-sectional study, the bacterial isolates of the two laboratories in Imam Khomeini and Bouali Hospitals of Sari, Iran, were studied from April 2016 to March 2018.

Samples including morning midstream urine, blood, stool, wound discharge, cerebro-spinal fluids (CSF), and respiratory specimens were aseptically collected by sterile containers and carried to the laboratory as soon as possible . Bacterial isolates were identified via morphologic features including colony specification, gram staining, and standard biochemical diversity following standard methods **(8)**.

Clinical specimens collection:

Sampling was carried out based on the previously published literature **(9)**. Samples from suspected meningitis patients (1-4 ml) were recovered before any antibiotic therapy by a sterile syringe and sent to the laboratory or transferred to a transport medium (Trans-Isolate (T-I) medium) for more than one hour delay. Identification of bacterial isolates was done immediately in microbiological laboratories as much as possible. Direct CSF samples were centrifuged at 1000 G for 15 minutes and sediments were used for gram staining and primary plating accomplished in blood and chocolate agar media. Blood samples were collected by a sterile syringe (1-3 ml from child and 5-10 ml from an adult) and recovered blood was inoculated in blood culture bottles and incubated in 35-37°C with ~5% CO_2 (or in a candle-jar) for further procedure **(9)**.

Detecting the bacterial specimens:

Specimens suspicious of bacteremia and meningitis which were sent to the hospital laboratories were cultured in blood agar, chocolate agar, MacConkey agar, Eosin methylene blue agar **(10)** and Mannitol salt agar. All culture media were supplied from Merck, Germany, and were then incubated at 37℃ temperature for 24 hours **(10)**.

Detecting anaerobic bacteria:

From the Thioglycollate broth medium the specimen were cultured on egg yolk agar (Merck, Germany) and anaerobic blood agar (Merck, Germany); the plates were then incubated with anaerobic container (Gaspack, Merck, Germany) containing 3-5 percent CO_2 at 37 ℃ for 48 hours. The Gram staining was performed and for observing anaerobic bacteria, biochemical tests such as catalase, lipase, fermentation of given glucose, growth in bile esculin, urease and nitrate generation were done (all media and tests were Merck, Germany brands). The vancomycin antibiogram pattern (30 µg), kanamycin (30 µg) and colistin (10 µg) (all antibiotics were supplied from Rosco, Denmark) were used in order to detect various kinds of bacillus bacteria, gram negative and positive unselective anaerobic cocci bacteria **(11, 12)**.

Susceptibility testing:

The antibiotic susceptibility test was accomplished in accordance with the CLSI instructions on Mueller- Hinton Agar (Merck, Germany) based on disc diffusion method **(13)**. Regarding those standards, the antibiotics associated with Gram Negative and positive bacteria were selected separately; and the antibiotics to which the detected bacteria had already developed natural resistance were not used in the study. Some mentioned antibiotics originally were not recommended to some bacterial isolates but based on the empirical therapy policies are mentioned.

The discs which were used in Gram positive bacteria were gentamycin (10 µg), erythromycin (15 µg), ciprofloxacin (5 µg), clindamycin (15 µg), oxacillin (1 µg), and, vancomycin (30 µg) for genus *staphylococci*. Methicillin (5unit), erythromycin (15 µg), gentamycin (10 µg) and clindamycin (15 µg) were used for *pneumococci*. In addition, for Gram negative bacteria, ampicillin (10 µg), co- amoxiclav (500 µg/125 µg), ceftazidime (30 µg), imipenem (10 µg) gentamycin (10 µg), ciprofloxacin (5 µg), cephalexin (30 µg), co-trimoxazole (23.75+1.25 µg) and cefazolin (30 µg) for *P. aeruginosa;* and, ampicillin (10 µg), cefepime (30 µg), ceftriaxone (30 µg), ceftazidime (30 µg), cefixime (5 µg), imipenem (10 µg), nalidixic acid (30 µg), gentamycin (10 µg) and ciprofloxacin (5 µg) were used for *Enterobacteriaceae* genus. (All antibiotics were supplied from Patanteb Iran). The antibiotic resistance pattern of the bacteria isolated from clinical specimens was defined by using the disk diffusion test in Kirby–Bauer method based on Clinical Standards Institute and CLSI **(13)**. *E. coli* ATCC 25922, *K. pneumoniae* ATCC 7881, *S. epidermidis* 12228 and *S. aureus* ATCC 43300 were used as positive controls.

Statistical Analysis:

In this study, we used the SPSS software version 20 for the analysis of collected data. The Exact Fisher test was used for assessing the relationship between qualitative variables if needed and the *p* value<0.05 was considered as the significant level.

Ethical Statement:

The ethical statement IR.MAZUMS.REC.1397.1296 was the criterion for performing all stages of this study.

Results

Of the 634 positive specimens recovered from Bouali and Imam Hospitals, *Escherichia coli* (*E. coli*) (39.4%), *Staphylococcus epidermidis* (*S. epidermidis*) (17.8%) and other Coagulase –negative staphylococci (11%) were the most common pathogens found in the recovered specimens. Those three microorganisms constitute around two thirds (68.2%) of total pathogens. (Fig.1).

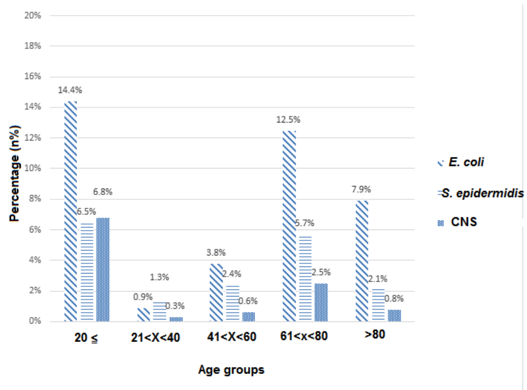

Figure 1. The percents of frequency of microorganisms: *E. coli, S. epidermidis and Coagulase- negative Staphylococci* were among the most common microorganisms in the whole specimens (as per age group at Boali and Imam Khomeini Hospitals).

In general, among the 634 cases, 420 (66.2%) urine, 202 (31.9%) blood and 12 (1.9%) CSF specimens were evaluated.

The most common frequency of the specimen recovered from intensive care unit (ICU) was 16.6%, followed by internal wards (15.9%), neurology (14.5%), infection, allergy and pediatrics (10.4%). The ophthalmology ward (0.5%), ENT. (1.1%) and men and women's ward (1.6%) had the least prevalence in terms of frequency of culture specimen. In general, in the internal diseases, neurology, ICU, ER, infectious, children allergy, Surgery, Neonatal Intensive Care Unit (NICU), Pediatrics and ENT, *E. coli* was the most prevalent pathogen agent in hospital-acquired infections. In the neonates ward, *S. epidermidis* and *coagulase- negative staphylococcus coagulase* were the most common pathogens. In PICU Ward, *pseudomonas aeruginosa* was the most common pathogen. In oncology, ophthalmology, male and gynecology wards, *S. epidermidis* was the most common microorganism responsible for nosocomial infections. *Enterococci* was detected only in one **(1)** case and it was only in emergency ward. *Streptococcus viridance* was detected only in three **(3)** patients, two **(2)** were inpediatric ward and one **(1)** case was in the internal ward. *Serratia* was identified only in two patients in surgery ward. *H. influenza* was observed in two cases (one in oncology and one in surgery ward), *Candida* was detected in the specimens extracted from 3 patients in ICU (Based on the hospitals laboratory reports), pediatric intensive cares (PICU) and Neonatal intensive care unit (NICU). *Salmonella* was detected in 2 wards, emergency and PICU. *Proteus* was found in two ENT, male and females wards. In general, no statistically significant difference was found between microorganisms and the hospital wards (P= 0.298).

From urine cultures *E. coli* (37.5%), *S. epidermidis* (14.2%) and *P. aeruginosa* (4.7%) were isolated. The main responsible bacteria for bacteremia were *coagulase –negative staphylococci* (9.8%), *S. epidermidis* (3.5%), and *P. aeruginosa* (3.5%); respectively. Coagulase-negative staphylococci, *S. pneumoniae* and *H. Influenza* were the most meningitis-related isolates.

In the meningitis, the *Coagulase- negative Staphylococci* specimens were completely sensitive to, ciprofloxacin and Gentamycin while they were resistant to Methicillin 100%. *S. pneumoniae* was sensitive to amikacin and Gentamycin. No drug resistance was seen in *H. Influenza*. *S. epidermidis* was completely sensitive to co-amoxiclav, co-trimoxazole, gentamycin, oxacillin and vancomycin; on the other hand, it showed resistance to ciprofloxacin. In Bacteremia *E. coli*, the specimens were completely sensitive to amikacin, cefotaxime, ciprofloxacin and Nitrofurantoin; while, they were resistant against amoxiclav and nalidixic acid. In general, *E. coli*, *S. epidermidis*, *P. aeruginosa* and *Coagulase-negative Staphylococci* were completely sensitive to amikacin; and, *Klebsiella spp* and *S. aureus* showed 93.3% sensitivity to amikacin. Ampicillin had 100% sensitivity against *S. epidermidis*; however, *P. aeruginosa*, Klebsiella and Acinetobacter showed more than 90% resistance against ampicillin. *E. coli*, *Klebsiella spp* and *S. aureus* showed 100% resistance to amoxiclav; while *Klebsiella sp* was completely sensitive to amoxiclav. *Acinetobacter* was resistant against ceftriaxone. *S. epidermidis, P. aeruginosa, Klebsiella spp, Coagulase- negative Staphylococci, S. aureus* and *Acinetobacter* were highly resistant against cephalexin. *S. epidermidis, K. pneumoniae* and *Acinetobacter* ishowed full resistance to Ceftazidime. *P. aeruginosa* was resistant against cefazolin, clindamycin and nitrofurantoin. Of the total 202 cases of positive blood culture specimens, there were only two pathogens responsible for bacteremia symptoms in the Neurology Ward which consisted of *Coagulase-negative Staphylococci* and *Klebsiella sp.* (Table 1- 2). (Susceptibility testing of G+ and G$^-$isolated was listed in Table 3, 4).

Table 1. **The frequencies of specimens associated with bacteremia, meningitis and urinary tract infections in two target hospitals regarding the wards from which the specimens were taken.**

Hospital ward	Bouali Hospital			Imam Khomeini Hospital		
	Urinary tract infection	Bacteremia	Meningitis	Urinary tract infection	Bacteremia	Meningitis
Internal & Gynecology	87 (20.7%)	12 (5.9%)	2 (16.7%)	101 (25.3%)	43 (28.6%)	-
Neurology Surgery	88 (21%)	2 (1%)	2 (16.7%)	85 (21.3%)	15 (10%)	12 (60%)
ICU	64 (15.2%)	41 (20.3%)	2 (16.7%)	88 (22%)	28 (18.7%)	8 (40%)
Emergency	56 (13.6%)	9 (4.5%)	-	61 (15.3%)	64 (42.7%)	-
Total Specimens	420 (100%)	202 (100%)	12 (100%)	400 (100%)	150 (100%)	20 (100%)

Table 2. **Frequencies of antibiotic-resistant bacterial isolates in the two target hospitals.**

Antibiotic	Boali Hospital			Imam Khomeini Hospital		
	Urinary tract infection	Bacteremia	Meningitis	Urinary tract infection	Bacteremia	Meningitis
Amikacin	18 (4.3%)	8 (4%)	1 (50%)	42 (10.5%)	85 (56.7%)	14 (70%)
Ampicillin	252 (60%)	74 (36.6%)	3 (100%)	240 (60%)	63 (42%)	7 (35%)
Ceftriaxone	128 (30.5%)	76 (37.6%)	-	253 (63.2%)	57 (38%)	1 (5%)
Cefixime	-	-	-	262 (65.5%)	-	-
Ceftazidime	79 (18.8%)	26 (12.9%)	-	124 (31%)	61 (40.7%)	-
Cefotaxime	-	41 (20.3%)	2 (22.2%)	138 (34.5%)	-	4 (20%)
Cefazolin	-	24 (11.9%)	2 (40%)	245 (61.3%)	97 (64.7%)	-
Ciprofloxacin	-	22 (10.9%)	1 (14.3%)	241 (60.3%)	69 (46%)	14 (70%)
Co-trimoxazole	51 (12.1%)	44 (21.8%)	2 (28.6%)	278 (69.5%)	103 (68.7%)	-
Gentamycin	72 (17.1%)	44 (21.8%)	2 (25%)	66 (16.5%)	33 (22%)	12 (60%)
Imipenem	61 (14.5%)	24 (11.9%)	-	72 (18%)	56 (37.3%)	16 (80%)
Nalidixic acid	152 (36.2%)	-	-	322 (80.5%)	-	-
Nitrofurantoin	-	-	-	117 (29.3%)	-	-
Vancomycin	9 (2.1%)	8 (4%)	-	35 (8.8%)	3 (2%)	0 (0%)

Table 3. **Antibiotic resistance in Gram Positive isolates. Some antibiotic susceptibility was done based on the empirical therapy.**

	Staphylococcus epidermidis	*Staphylococcus saprophyticus*	*Staphylococcus aureus*	*Other Coagulase negative Staphylococci*	*Streptococcus pneumoniae*	*Viridans Streptococci*	*Bacillus*
Ampicillin	resistant	-	-	-	-	-	-
Co-amoxiclav	sensitive	-	resistant	-	-	-	sensitive
Amikacin	sensitive	-	93.3% sensitive	sensitive	-	-	sensitive
Erythromycin	-	-	resistant	resistant	-	-	-

	Staphylococcus epidermidis	*Staphylococcus saprophyticus*	*Staphylococcus aureus*	*Other Coagulase negative Staphylococci*	*Streptococcus pneumoniae*	*Viridans Streptococci*	*Bacillus*
Oxacillin	sensitive	-	-	-	-	-	sensitive
Ceftazidime	resistant	sensitive	-	sensitive	sensitive	-	sensitive
Cefixime	-	-	-	sensitive	-	-	-
Cephalexin	resistant	-	resistant	resistant	-	-	-
Cefotaxime	-	-	-	-	-	sensitive	sensitive
Ciprofloxacin	resistant	-	-	sensitive	sensitive	-	-
Cefazolin	-	resistant۷۵٪	-	-	-	sensitive	-
Gentamycin	sensitive	-	-	sensitive	sensitive	sensitive	-
Clindamycin	resistant	-	-	-	-	-	-
Co-trimoxazole	sensitive	-	-	-	-	resistant	sensitive
Methicillin	-	-	-	resistant	resistant	-	-
Nitrofurantoin	sensitive	-	-	-	-	-	resistant
Nalidixic acid	-	-	resistant	-	-	-	-
Vancomycin	98.1% sensitive	-	80% sensitive	92.3% sensitive	-	sensitive	sensitive

Table 4. **Antibiotic resistance in Gram Negative isolates.**

	Escherichia coli	*Enterobacteriaceae*	*Acinetobacter*	*Proteus*	*Salmonella*	*Serratia*	*Pseudomonas Aeruginosa*	*Klebsiella*	*Klebsiella pneumoniae*	*Haemophilus Influenza*
Ampicillin	82.3% resistant	-	resistant	-	resistant	resistant	resistant 97.7%	resistant 97.4%	resistant 87.5%	resistant
Co-amoxiclav	resistant	_	_	-	-	-	-	resistant	sensitive	-
Amikacin	-	-	-	-	sensitive	sensitive	sensitive 97.7%	sensitive 78%	-	sensitive
Imipenem	-	-	-	sensitive	sensitive	sensitive	-	-	-	sensitive
Ceftazidime	-	-	resistant	-	-	sensitive	resistant 86.7%	-	resistant	-
Cefixime	resistant	-	-	-	-	-	resistant	-	resistant	-
Cephalexin		resistant	resistant	sensitive	resistant	resistant	resistant 95.5%	resistant	-	-
Cefepime	resistant	-	-	-	-	-	resistant	-	-	-
Cefotaxime	sensitive	resistant	-	-	resistant	sensitive	-	-	-	-

	Escherichia coli	*Enterobacteriaceae*	*Acinetobacter*	*Proteus*	*Salmonella*	*Serratia*	*Pseudomonas Aeruginosa*	*Klebsiella*	*Klebsiella pneumoniae*	*Haemophilus Influenza*
Ceftriaxone	-	-	resistant	sensitive	-	sensitive	-	-	sensitive 73.3%	-
Ciprofloxacin	sensitive	resistant	-	-	sensitive	-	-	-	-	-
Cefazolin	-	-	resistant	-	-	-	resistant	-	-	-
Gentamycin	-	-	-	sensitive	-	sensitive	-	-	-	sensitive
Clindamycin	-	-	-	-	-	-	resistant	-	-	-
Co-trimoxazole	--	-	sensitive	-	-	-	-	resistant 87.5%	-	-
Nitrofurantoin	sensitive	sensitive	-	-	sensitive	-	resistant	-	resistant	-
Nalidixic acid	resistant	-	-	-	-	-	-	-	-	-
Vancomycin	-	-	-	-	-	-	-	-	sensitive	-

Discussion

Any organs of human body might show symptoms of infection in the hospital; however, among hospital-acquired infections, the urinary tract infection (42%), lower respiratory system infection or pneumonia (15% to 20%), infections associated with surgical wounds (24%) and infections of blood circulatory system (5%-10%) are of specific importance **(14)**. In this study, out of 1024 clinical samples, frequencies of meningitis in two screened hospitals (Boali and Imam) were 1.9% and3.5% respectively, the amounts of bacterial rates to bacteremia were 31.9% and 26.3% as well. *S. aureus* (41.7%) *and S. pneumoniae* (45%) were the highest isolates in the mentioned hospitals for meningitis.

A published study in 2012 on 57112 hospitalized patients revealed that 592 of the patients had been affected by hospital-acquired infections. The rate of total prevalence of nosocomial infections was reported 1.03% which was mainly in the burns unit. The most common hospital-acquired infection was seen in the wound infections (44.6%); and the most common organisms were *P. aeruginosa* and *Acinetobacter spp*., **(15)**. In our study, *E. coli* (39.4%), *S. epidermidis* (17.8%), Coagulase- negative *Staphylococci (*11%) are the rampant isolates found in the extracted specimen, which are similar to the Zahedi's findings who reported the most common bacteria isolated in all specimen were *E. coli* (48.8%), *S. epidermidis* (22.9%) and *K. pneumoniae* (12%) (16), while in the studies conducted by Davoudi and her colleagues *A. baumanni* and *P. aeruginosa* were detected as the most common organisms **(15)**. Based on the previously published findings, higher bacterial isolates related to the meningitis were *N. meningitis* (43%), *H. influenza* (13.6%). *K. pneumoniae* (13.7%) and *S. aureus* (11.1%) were detected as lower bacterial isolated rates in the mentioned study **(6)**. At the current research out of 634 positive samples, *S. aureus* (41.7%) *and S. pneumoniae* (45%) were the highest isolates in the mentioned hospital for meningitis. The number of clinical speciemens, and geographical distributions of sample source are mentioned as the difference reasons.

Development of resistance to antibiotics in the pathogen bacteria poses one of the medical challenges across the world. This problem is more considerable in countries with irregular and unreasonable antibiotic consumption **(17)**. In our study, *Coagulase-negative Staphylococci* and *S. pneumoniae* were the most meningitis causative agents. In another published study, the most common bacteria were *S. pneumoniae* and *S. aureus* **(18)** which was almost similar to the results of our study. Regarding the study conducted in the United States, the most common bacteria isolated from the neonates were *Type B- H. Influenza* (45%), S. *pneumoniae* (18%) and *N. meningitides* (14%) (18); while another similar research reported that in 70% of the 1-5 year- old children *E. coli*, Beta- hemolytic *Streptococci*, *H. Influenza*, *N. meningitides* and *S. pneumoniae* were screened **(19)**. Laxer reported that, *S. pneumoniae* was identified as the main meningitis causative agent in children **(20)**. In the study of Youssefi, the results of antibiogram of organisms separated from meningitis patients showed that Gram positive bacteria, the *S. pneumoniae* and Alfa-hemolytic Streptococci revealed good sensitivity to many of the tested antibiotics especially the antibiotics of *Aminoglycosides* family such as kanamycin and gentamycin, as well as the antibiotics of cephalosporin family such as cephalexin and cefotaxime; however, they showed relatively high resistance to the antibiotics of Beta Lactam family including amoxicillin and ampicillin. On the other hand, the Gram positive bacteria including *S. aureus* and S. *epidermidis* showed relatively higher resistance than most antibiotics used in this study; and their highest sensitivity was against the cminoglycosides (canamycin and centamycin) **(21)**. In our study, coagulase –negative *Staphylococci* were completely sensitivity to cefixime, cefotaxime, ciprofloxacin and gentamycin; on the other hand, it was 100% resistant to methicillin. *S. pneumoniae* was sensitive to ceftazidime, ciprofloxacin and gentamycin, while it was completely resistant to methicillin.

In the present study; amikacin showed high sensitivity for *E. coli, S. epidermidis, P. aeruginosa* and *S. aureus* related infections. Given the findings and comparing them with published paper showed that the antibiotic resistance exists in the strains of *E. coli* separated from urinary tract infections; therefore, using new drugs such as Imipenem is recommended **(22)**.

Previously published studies revealed that, the most common bacteria in the blood culture were *Coagulase-negative Staphylococci, Klebsiella* spp., and *E. coli* **(23)**. In addition, in a conducted study in India (2015), the Gram positive bacteria were the most common agents (65.8%) and among those bacteria, *Coagulase-negative Staphylococci* (88.5%) were the most prevalent strains **(24)**. In the present study, the most common bacteria in the blood specimens were *Coagulase- negative Staphylococci*, *S. epidermidis* and *K. pneumoniae*; respectively, which are in agreement with the previous studies. Hemmati reported that, the more prevalent Gram Positive bacteria extracted from the blood specimens of hospitalized patients in ICU, were *Coagulase- negative Staphylococci* (35.6%) and *S. aureus* (21.8%); and the most common Gram Negative bacteria were *E. coli* (19.8%) and *K. pneumoniae* (10.9%) **(25)**.

Conclusion

Regarding the bacterial isolates from the target hospital wards and in view of the antibiotic resistance pattern as assessed in strains, our study indicated that the rates of bacterial meningitis and bacteremia in mentioned hospitals were high. Therefore, the elimination and control of bacteremia and bacterial meningitis requires a fundamental attention. Resistance to selected antibiotics as the treatment tools could be life threatening, so it is necessary to evaluate and select effective antibiotics for etiological agents. Finally, designing an efficient method for eliminating bacteria in the hospitals and selecting a suitable medical method with a suitable antibiotic regimen should be taken into close consideration.

Restrictions:

Responsible genes to antibiotic resistance and genetic relationship between the resistant strains are not determined and these are the limitations of this study. Moreover, bacterial isolates were basically identified by biochemical features.

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Conflict of Interest

The authors declare that they have no competing interests.

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