



# ORIGINAL: Prevalence of Nosocomial Infections in Intensive Care Units in Shahid Sayyad-E-Shirazi Hospital of Gorgan During 2016-2018

Roghieh Gholsha  
Nadia Ashuri  
Mohammad Tajik  
Ahmad Sohrabi  
Maryam Montazeri

Infectious Diseases Research Center, Golestan University of Medical Science, Gorgan, Iran.  
General Practitioner, Golestan University of Medical Sciences, Gorgan, Iran.  
Medical Student, School of Medicine, Sabzevar University of Medical Sciences, Sabzevar, Iran.  
Cancer Control Research Center, Cancer Control Foundation, Iran University of Medical Sciences, Tehran, Iran.  
General Practitioner, Infectious Research Center of Sayyed Shirazi Hospital, Golestan University of Medical Sciences, Gorgan, Iran.

## ARTICLE INFO

Submitted: 23 Dec 2019  
Accepted: 17 Mar 2020  
Published: 31 Jun 2020

### Keywords:

Nosocomial infection;  
Antibiotic resistance;  
Intensive care unit

### Correspondence:

Maryam Montazeri, General Practitioner, Infectious Research Center of Sayyed Shirazi Hospital, Golestan University of Medical Sciences, Gorgan, Iran.

### Email:

Marine.montazeri@yahoo.com

ORCID: 0000-0003-1699-3361

### Citation:

Gholsha R, Ashuri N, Tajik M, Sohrabi A, Montazeri M. Prevalence of Nosocomial Infections in Intensive Care Units in Shahid Sayyad-E-Shirazi Hospital of Gorgan During 2016-2018. Tabari Biomed Stu Res J. 2020;2(2):48-57.

[10.18502/tbsrj.v2i2.3761](https://doi.org/10.18502/tbsrj.v2i2.3761)

## ABSTRACT

**Introduction:** Understanding the pattern of infections in the intensive care unit and the correct pattern of antibiotic use is vital in reducing mortality. Identification of risk factors for nosocomial infection and preventive approaches can be effective in reducing the incidence. This study aimed to evaluate the intensive care unit (ICU) acquired infection.

**Material and Methods:** This cross-sectional study was performed on patients admitted to the ICU of Sayyad Shirazi Hospital during 2016-18. All patients' information recorded and analyzed by SPSS version 16.

**Results:** In this study, the nosocomial infection rate was 3.5%, mostly in individuals over 60 years old. Most of the positive cultures were from two sources of urine and then blood. The organisms observed in nosocomial infections were *Escherichia coli* (16.9%), *Staphylococcus epidermidis* (11.5%), *Enterococci*, and *Enterobacter*. The most commonly used antibiotics were vancomycin and then meropenem. Antibiogram results indicated the highest antibiotic resistance (100%) to cefazolin, piperacillin and clindamycin, and 96.8% to ceftriaxone. Vancomycin and amikacin had the lowest resistance.

**Conclusion:** According to the results of this study, the incidence of nosocomial infection is unavoidable, and its control is the most important health goals of medical centers. Proper treatment interventions are needed to reduce the impact of nosocomial infection.

## Introduction

The application of antibacterial medications in the Intensive Care Unit (ICU) is up to 10-fold higher compared to the other departments of the hospital. Typically, 60-70 percent of ICU patients are receiving antibiotics at any given time (1). These can lead to increasing the rate of antibiotic use and its associated costs (2,

3). Infectious diseases are prevalent in the intensive care unit, and nosocomial infections are observed in 5-30% of patients. Diffuse or limited nosocomial infections caused by the reaction of hospital-acquired pathogens directly to the infectious agents or indirectly to the toxins in the hospital might occur within 48-72 hours after admission with no

obvious symptoms of infection at the time of admission. Also, the disease should not be at the latency period (4). Although ICUs comprise less than 10% of all beds in most hospitals, more than 20% of all nosocomial infections occur in ICUs, causing a significant rate of morbidity and mortality. Gram-negative bacteria are among the leading causes of nosocomial infections, which widely investigated (5-7). However, the spread of these bacteria and origination in nosocomial infections still need further investigations. It is crucial to identify the cause of these infections, and their mode of spread, the type and amount of drug resistance of the bacteria, especially gram-negative organisms isolated from clinical specimens (8). Different investigations consider *pneumonia* as one of the most common infections in the hospital, with mortality rates up to 76% in some cases, such as those with mechanical ventilation (9, 10). The National Nosocomial Infections Surveillance (NNIS) of the United States describes nosocomial *pneumonia* as one of the most common infections in the intensive care unit. The extensive use of mechanical ventilation and tracheal intubation, especially in patients with critical conditions, leads to a high risk of hospital *pneumonia* (11). On the other hand, the use of implanted medical equipment in the patient's body (e.g., central venous catheter, foley catheter, and endotracheal tube) bypass the host's natural defense systems and act as an entry door for pathogens (12).

Understanding the pattern of infections in the ICU and the correct prescribing pattern of antibiotics, as well as identifying the right therapeutic strategies and types of infectious bacteria is of great importance. On the other hand, infections caused by antibiotic-resistant bacteria have become a global health concern and increased costs, duration of hospitalization, the severity of illness, morbidity, and mortality. Hence, identification of the nosocomial infections' risk factors and approaches to prevent them can reduce the incidence rate (13). In this regard, this study aims to evaluate the

infections of the intensive care unit (the type of infection, culture results, antibiotics used, duration of treatment, and final results of treatment) in Shahid Sayyad-E-Shirazi Hospital of Gorgan from 2016 to 2018.

## Methods

This descriptive/cross-sectional study was performed on patients diagnosed with an infection and treated with an antibiotic in ICU in Shahid Sayyad-E-Shirazi Hospital of Gorgan, Iran, from 2016 to 2018 using the census method. After applying the inclusion criteria (admission to ICU, no infection history before ICU admission, positive culture result, age more than 14 years old, complete patient records) and necessary permissions, patients' records were obtained from the Gorgan University of Medical Sciences. All the patients' information, including age, sex, cause of admission, initial diagnosis, final diagnosis, and duration of hospitalization, were recorded. Moreover, information about antibiotic application and type of culture (blood, urine, respiratory secretions, cerebrospinal fluid, stool, and pleural effusion) were recorded for the detection of bacteria, the method of antibiotic administration, and the type of antibiotic used.

Specimens transferred to the laboratory and were cultured in two blood agar and MacConkey agar media. The media were assessed after 24-48h incubation at  $35\pm2^{\circ}\text{C}$ . Differential diagnostic media were used to identify the genus and species of the bacteria (36). Data were analyzed using mean, standard deviation, frequency, percentage, and statistical graphs. The *Chi-square* test investigated the relationship between qualitative variables and different infections. SPSS software v. 16 (SPSS Inc., Chicago, IL, U.S.A.) was used for analyzes. The significance level of the study set at 0.05.

## Results

This study was performed on the records of 1000 patients admitted to the ICU of Sayyed-

E-Shirazi Hospital of Gorgan during 2016-2018. From the total number of patients, specimens were collected from 700 cases, and only 130 cases were culture-positive and showed nosocomial infection. These 130 cases included 56 males (43.1%) and 74 females (56.9%). The average age of patients admitted in this ward was  $64.77 \pm 16.47$  years old, with a minimum age of 18 years and a maximum age of 95 years. In this study, the majority of positive samples were urine and blood specimens (**Table 1**).

**Table 1. Frequency distribution of positive culture source of patients admitted to the ICU**

Source	Frequency (%)
Urine	75 (57.7)
Blood	41 (31.5)
Sputum	8 (6.1)
Wounds	3 (2.3)
Pleural	1 (0.8)
Cvline	1 (0.8)
Stool	1 (0.8)
Total	130 (100)

Out of 130 patients admitted to the ICU with a positive culture, 47 gram-negative organisms (27.2%) were observed, most of which consisted of *Escherichia coli*, followed by *Enterobacter*. Besides, 25 patients were diagnosed with gram-positive organisms, consisted of *Staphylococcus epidermidis* and

*Enterococcus*. Patients admitted to the ICU ward also showed positive fungal cultures, 51 cases were yeast-positive, and 2 cases were candida-positive (**Table 2**). Out of 130 patients admitted to ICU, 100% have used a urinary catheter, and 95.4% used a ventilator. According to Table 4, antibiogram analysis of positive culture specimens revealed that the highest antibiotic resistance was correlated to Cefazolin (100%), Piperacillin (100%), Clindamycin (100%), and Ceftriaxone (96.8%) respectively (**Table 3**).

Moreover, the most abundant source of gram-positive bacteria was blood samples. However, in positive cultures of gram-negative bacteria, a higher percentage of *Citrobacter* was isolated from sputum and blood. Positive fungal cultures were also found to be the most prevalent in urine samples (**Table 4**).

The *Pneumococcus* presented the highest resistance (100%) against aminoglycoside, fluoroquinolones, cephalosporins, and macrolide antibiotics. The positive culture organisms showed the lowest resistance towards anti-MRSAs, and from the microorganisms above, *Escherichia coli* showed 50% resistance against this antibiotic. Gram-negative microorganisms showed the highest antibiotic resistance (100%) to P.R.P.s, aminoglycosides, fluoroquinolones, cephalosporins, and macrolides (**Table 5**).

**Table 2. Frequency distribution of organisms positive for nosocomial culture**

	Organisms	Frequency (%)
<b>Gram-negative bacteria</b>		
	<i>Escherichia coli</i>	22 (16.9)
	<i>Enterobacter</i>	10 (7.7)
	<i>Pseudomonas</i>	5 (3.8)
	<i>Citrobacter</i>	5 (3.8)
	<i>Klebsiella</i>	2 (1.5)
	<i>Acinetobacter</i>	2 (1.5)
	<i>Proteus</i>	1 (0.8)
	<b>Total</b>	47 (27.2)
<b>Gram-positive bacteria</b>		
	<i>Epidermis staph</i>	15 (11.5)
	<i>Enterococcus</i>	6 (4.6)
	<i>Pneumococcus</i>	3 (2.3)
	<i>Staphylococcus aureus</i>	1 (0.8)
	<b>Total</b>	25 (19.2)
<b>Fungi</b>		
	<b>Yeast</b>	61 (46.9)
	<b>Candidate</b>	2 (1.5)
	<b>Total</b>	53 (48.4)

**Table 3. Frequency distribution of antibiotic resistance in positive culture samples**

Antibiogram	Frequency (%)	
	Resistant	Sensitive
Cefazolin	15 (100)	0
Piperacillin	15 (100)	0
Cephalothin	14 (100)	0
Clindamycin	16 (100)	0
Ceftriaxone	30 (96.8)	1 (3.2)
Nalidixic Acid	17 (94.4)	1 (5.6)
Co-amoxiclav	14 (93.3)	1 (6.7)
Cefotaxime	28 (93.3)	2 (6.7)
Imipenem	24 (92.3)	2 (7.7)
Cefalexin	20 (90.9)	2 (9.1)
Gentamicin	29 (90.6)	3 (9.4)
Ciprofloxacin	26 (89.7)	3 (10.3)
Ceftazidime	17 (89.5)	2 (10.5)
Norfloxacin	17 (89.5)	2 (10.5)
Nitrofurantoin	18 (81.8)	4 (18.2)
Carbenicillin	17 (89.5)	5 (22.7)
Amikacin	21 (65.6)	11 (34.4)
Vancomycin	0	4 (100)

Among the patients who died in the ICU, the majority of them showed positive results for blood and urine cultures. The table below also lists the most common organisms found in deceased patients (**Table 6**).

According to **Table 7**, 56 gram-negative bacteria and 35 gram-positive and 117 fungal-positive cultures eventually died.

Also, 50% of positive urine cultures and 34.8% of positive blood cultures were in the age ranged from 30-60 years.

In this study, 16.7% of patients under 30 years and 23.9% of patients aged between 30-60 years were positive for gram-positive bacterial (**Table 8**).

In addition, 64.6% of patients with positive urine culture were hospitalized for less than one week, while 30% were hospitalized for more than one month. Moreover, 15% of *Enterococcus* positive, 30% of *Escherichia coli* positive, and 60% of fungal-positive patients were hospitalized for more than one month (**Table 9** and **Table 10**).

## Discussion

In this study, the rate of nosocomial infection during 2016-2018 was reported at 13%. In studies conducted by Bijari et al. in the Birjand city, Darwishpour et al. in Torbat-E-

Heydariyeh city, and Lari-Pour et al. in the Qom city it was reported 0.9%, 0.7%, and 0.49% respectively, which was lower than our results (14-16). On the other hand, in some other studies such as those conducted by Ghazvini et al. and Ghorbani et al. this rate was higher and closer to 10% (17, 18). The reasons for the differences in results reported by various studies might be due to the differences in the study periods and improvements in nosocomial care surveillance or the number and type of units under investigation (16).

In this study, more than half of the patients with nosocomial infections were female and aged more than 60 years old, which was in accordance with the results of Kermani Burjani's study in 2015, Ghorbanali Zadegan's survey in 2005 and Laripour's in 2007 (14, 19, 20). Older adults are more susceptible to this infection due to changes in their cellular and humoral immune system, physiological changes (reduction of cough reflexes), abnormalities in blood flow and delayed wound healing (21).

In the present study, most of the positive cultures were collected from urine and blood samples. In Darvishpur's study (15), the most prevalent nosocomial infections were related to surgical wounds, with a smaller percentage

**Table 4. Frequency Distribution of Positive Culture Organisms for Nosocomial Infection Based on Positive Culture Origin in Patients with Nosocomial Infections in Intensive Care Units**

	Organism	Blood	Urine	Pleural	Sputum	Stool	CV-line
Gram-negative organisms	<b>Epidermis</b>	13		-	2 (3.3%)	-	-
	<b>Staph</b>	(31.7%)		-	-	-	-
	<b>Enterococcus</b>	2 (4.9%)	4 (5.3%)	-	-	-	-
	<b>Pneumococcus</b>	1 (2.4%)	-	-	-	-	-
	<b>Staphylococcus aureus</b>	2 (4.9%)	1 (16.7%)	-	-	-	-
	<b>Escherichia coli</b>	-	2 (2.7%)	-	-	-	-
Gram-positive organisms	<b>Enterobacter</b>	10 (24.4%)	10 (13.3%)			1 (100%)	-
	<b>Pseudomonas</b>	6 (14.6%)	2 (2.7%)	-	2 (3.3%)	-	-
	<b>Citrobacter</b>	2 (4.9%)	2 (2.7%)	-		1 (100%)	
	<b>Klebsiella</b>	1 (2.4%)	-	1 (16.7%)	-	-	-
Fungi	<b>Acinetobacter</b>	1 (2.4%)	-	-	2 (33.3%)		-
	<b>Proteus</b>	1 (2.4%)	-	-	-	-	-
	<b>Yeast</b>	8 (19.5%)	51 (68%)	-	1 (33.3%)	-	-
	<b>Candidate</b>			-	-	-	-

of self-reported urinary and blood infections. Pleurisy and sputum specimens were the most prevalent in the study of Bijari and Ghorbanali Zadegan (16, 19). In a survey conducted by Sohrabi *et al.* (22) as well as the Laripour's study (14), the majority of the positive cultures for nosocomial organisms were collected from urine samples, in which pneumonia was the second most prevalent nosocomial infection. Most studies in this field have reported lower surgical site infections, which is in accordance with the present study (23).

In this study, the most common organisms observed in nosocomial infections were *Escherichia coli*, *Staphylococcus epidermidis*, *Enterobacter*, and *Enterococcus*, respectively. The most common microorganisms found in urine and blood cultures were *Escherichia coli* and gram-positive cocci, respectively (14). In the Ghorban-Ali-Zadegan study, the most prevalent bacterial isolates were *Staphylococcus aureus*, *Pseudomonas Aeruginosa*, *Acinetobacter*, and *Klebsiella pneumonia* (19). In Bijari's research, the pathogens causing infection were *Klebsiella*, *Pseudomonas*, *Escherichia coli*, and *Staphylococcus aureus*, respectively (16).

In general, the most common microorganisms causing nosocomial infections vary based on the location of the infection, in which viral, bacterial, and fungal factors play an important role (24, 25). According to global studies, viral infections are substantially isolated in wounds. In other studies, the most common microorganisms responsible for the nosocomial infection are *Escherichia coli*, gram-negative cocci, and *Acinetobacter* (14, 16), which is in the same line with the present study. In our study, the level of fungi was significantly high, which is justified by the origin of the infection (urine samples).

In the present study, the most commonly used antibiotics were vancomycin, followed by meropenem. In another study, the most widely used antibiotics were vancomycin, ceftriaxone, imipenem, and clindamycin, which was consistent with the present study (15). In this study, antibiogram results showed the highest antibiotic resistance against cefazolin, piperacillin, clindamycin with 100% resistance, and ceftriaxone with 96.8% resistance. The lowest resistance was observed against vancomycin and amikacin. Therefore, it can be concluded that cefazolin and ceftriaxone should not be used in the treatment of nosocomial infections in the

ICU. In the study performed by Habibian *et al.* in 2008, the antibiogram results of ICU admitted patients showed resistance to zoxim and ciprofloxacin, with 88% and 55%, respectively (26). Antibiotics resistance is highly prevalent regarding third-generation cephalosporins and fluoroquinolones.

In this study, 47% of patients were hospitalized for one week to 30 days. On the other hand, the results showed a higher percentage of patients with positive blood culture were admitted for one week to 30 days, that indicates the deterioration of general conditions of the patients, which has been less than one week for urine cultures. The microorganisms correlated to prolonged hospitalization in ICU patients include *Escherichia coli* (30%), *Enterococcus* (15%), *Enterobacter* (15%), *Pseudomonas* (5%), and fungal factors. In the study of Pezeshkian *et al.* in 2009 (27), the average duration of hospitalization in the ICU was  $18.7 \pm 30$  days, which is consistent with the present study. Nosocomial infection, ventilator use, and history of previous illness were the associated factors that increased the length of hospital stay (28).

In this study, 100% and 95.4% of patients used urinary catheters and ventilators during hospitalization, respectively. Given that a high percentage of patients with nosocomial infection used endotracheal suctioning, ventilator, and urinary catheters; It can be inferred that these therapies make patients more susceptible to the infection.

Moreover, approximately 90% of patients experiencing an infection in the ICU. It was reported that the majority of dead patients showed positive urine (59%) and blood cultures (31%). The most common organisms observed in their cultures included *Staphylococcus epidermidis* (10.3%), *Escherichia coli* (17.1%), and fungi. According to the investigations, urinary tract infections are the most common and fatal nosocomial infections as well as the leading cause of death (28, 29). In our study, however, urinary tract infection was the second leading cause of death. Hence, the mentioned findings illustrate the importance

of preventing urinary tract infections in the ICU.

In the present study, 10% of patients with nosocomial infection survived and recovered. Assessments in the multinational studies have revealed that the mortality rates in the ICU vary from 7% to 20% (28, 30), while this percentage was higher in the present study. It seems that there are other factors such as the presence of underlying diseases, the older age of patients, and the severity of the disease that contribute to the morbidity and mortality of hospitalized patients.

### **Conclusion**

According to the results of this study, the incidence of nosocomial infections in medical centers is inevitable, and one of the highly essential health goals of medical centers is to control and manage this phenomenon. To decrease the incidence of nosocomial infection, on time and proper therapeutic interventions are needed, and the application of catheters should be reduced. Given the sensitivity of the ICU ward, full health care should be taught to the medical staff in these units. In addition, the antibiotic application should be controlled.

### **Acknowledgments**

This project was supported by a grant from the vice chancellor for research of the Golestan University of Medical Science for the thesis. The results presented in this work have been taken from Dr. Nadia Ashuri's thesis.

### **Conflicts of interest**

The authors declare that there is no conflict of interest regarding the publication of this article.

### **Authors' contributions**

All the authors contributed equally to this manuscript.

### **References**

1. Weiss RJ, Montgomery SM, Ehlin A, Dabbagh ZA, Starkl A, Jansson K-Å. Decreasing incidence of tibial shaft fractures between 1998 and 2004: information based on 10,627 Swedish inpatients. *Acta orthopaedica*. 2008;79(4):526-33.
2. Emmerson M. Antibiotic usage and prescribing policies in the intensive care unit. *Intensive care medicine*. 2000;26:S26.
3. Ebrahimzadeh MA, Shokrzadeh M, Ramezani A. Specialized Sari Emam University Hospital in Iran. *Pakistan Journal of Biological Sciences*. 2008;11(2):275-9.
4. Singh N, Victor LY. Rational empiric antibiotic prescription in the ICU. *Chest*. 2000;117(5):1496-9.
5. Ghotaslou R, Ghorashi Z, Nahaei M. Klebsiella pneumoniae In neonatal sepsis: a 3-year-study in the pediatric hospital of Tabriz Iran. *Japanese Journal of Infectious Diseases*. 2007;60(2/3):126.
6. Malik A, Hasani S, Shahid M, Khan H, Ahmad A. Nosocomial *Klebsiella* infection in neonates in a tertiary care hospital: protein profile by SDS-page and klebocin typing as epidemiological markers. *Indian Journal of Medical Microbiology*. 2003;21(2):82.
7. Roberts JA, Paul SK, Akova M, Bassetti M, De Waele JJ, Dimopoulos G, et al. DALI: defining antibiotic levels in intensive care unit patients: are current  $\beta$ -lactam antibiotic doses sufficient for critically ill patients? *Clinical infectious diseases*. 2014;58(8):1072-83.
8. Kollef MH, Fraser VJ. Antibiotic resistance in the intensive care unit. *Annals of internal medicine*. 2001;134(4):298-314.
9. Chastre J, Fagon J-Y. Ventilator-associated pneumonia. *American journal of respiratory and critical care medicine*. 2002;165(7):867-903.
10. Society AT. Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Am J Respir Crit Care Med*. 2005;171:388-416.
11. Salehifar E, Abed S, Mirzaei E, Kalhor S, Eslami G, Ala S, et al. Evaluation of profile of Microorganisms involved in hospital-acquired infections and their antimicrobial resistance pattern in intensive care units of Emam Khomeini hospital, Sari, 2011-2012. *Journal of Mazandaran University of Medical Sciences*. 2013;22(1):151-62.
12. Armand-Lefèvre L, Angebault C, Barbier F, Hamelet E, Defrance G, Ruppé E, et al. Emergence of imipenem-resistant gram-negative bacilli in intestinal flora of intensive care patients. *Antimicrobial agents and chemotherapy*. 2013;57(3):1488-95.
13. Levy SB, Marshall B. Antibacterial resistance worldwide: causes, challenges and responses. *Nature medicine*. 2004;10(12):S122-S9.
14. Laripour M, Farsad S. Incidence of nosocomial infection in one of Qom hospitals (2007). *Iranian Journal of Medical Microbiology*. 2011;5(3):7-17.
15. Darvishpoor K, Rezaei Manesh M. Prevalence of nosocomial infections and microbial causes in Torbat heydariyeh 9dey educational and clinical hospital in 2012 and 2013. 2016;10(1):93-6.
16. Bijari B, Abbasi A, Hemati M, Karabi K. Nosocomial infections and related factors in southern khorasan hospitals. *Iranian Journal of Medical Microbiology*. 2015;8(4):69-73.
17. K G. Nosocomial infections and bacterial agents: neonatal ICU *Tehran University Medical Journal*. 2008;66(5):359-64.
18. Birgani AG, Asadpoor S. Nosocomial infections in intensive care unit of Ahvaz Arya Hospital (2008-2009). *Modern Care Journal*. 2011;8(2).
19. Ghorban AM, ranjbar r, JONEYDI JN, Esfahani A, Esmaeili D, Goudarzi Z. A study on the prevalence of nosocomial infections in ICU patients admitted at Baqiyatallah Hospital. 2008.
20. Hussain RH, Borji E, Mirzadi I, Salehi A, Sivandipur H, Nekhei M, et al. A study on the rate and the types of hospital infection in the trauma ICU departments of Kerman hospitals in the first half of 1393. 2015.
21. Zubiri M. Evaluation of microbial contamination of staff hand and its related factors in ICU hospitals of Kermanshah University of Medical Sciences 2001.

- Kermanshah University of Medical Sciences Journal. 2001;9(2):52-7.
22. Sohrabi MB, Khosravi A, Zolfaghari P, Sarrafha J. Evaluation of nosocomial infections in Imam Hossein (as) Hospital of Shahrood, 2005. Journal of Birjand University of Medical Sciences. 2009;16(3):33-9.
23. Assefzadeh M, Gasemi R, Zoghi F. Common infections of elderly patients admitted in Bou Ali Sina teaching hospital. Journal of Birjand University of Medical Sciences. 2005;12(01).
24. Kuhn D, Ghannoum M. Candida biofilms: antifungal resistance and emerging therapeutic options. Current opinion in investigational drugs (London, England: 2000). 2004;5(2):186-97.
25. Van Houdt R, Aertsen A, Jansen A, Quintana A, Michiels C. Biofilm formation and cell-to-cell signalling in Gram-negative bacteria isolated from a food processing environment. Journal of Applied Microbiology. 2004;96(1):177-84.
26. Habibian R, Imani R, Khoshdel A. Changes of trend of antibiotic susceptibility in isolated bacteria from culture of ICU patients of Shahrekord Ayatollah Kashanani Hospital, IR Iran. Journal of Shahrekord University of Medical Sciences. 2012;14.
27. Pezeshkian Ghotasloo M, Mirinezhad R. Evaluation of common microorganisms in cardiac care unit of Shahid Madani hospital of Tabriz and their antibiotic resistance: Tabriz University of Medical Sciences; 2016.
28. Sedaghat Siyahkal M. Assessing the length of stay and influential factors among general Intensive Care Units in hospitals affiliated to Tehran University of Medical Sciences. Journal of Hospital. 2015;14(4):51-7.
29. Klevens RM, Edwards JR, Richards Jr CL, Horan TC, Gaynes RP, Pollock DA, *et al.* Estimating health care-associated infections and deaths in US hospitals, 2002. Public health reports. 2007;122(2):160-6.
30. Strand K, Walther SM, Reinikainen M, Ala-Kokko T, Nolin T, Martner J, *et al.* Variations in the length of stay of intensive care unit nonsurvivors in three Scandinavian countries. Critical care. 2010;14(5):R175.

**Table 5. Frequency (%) distribution of antibiotic resistance based on organisms in patients with nosocomial infections in intensive care units**

Antibiotic category	Gram-positive organisms				Gram-negative organisms						Fungi		
	<i>Epidermis Staph</i>	<i>Enterococcus</i>	<i>Saprophyte</i>	<i>Pneumococcus</i>	<i>Klebsiella</i>	<i>Escherichia coli</i>	<i>Enterobacter</i>	<i>Pseudomonas</i>	<i>Acinetobacter</i>	<i>Citrobacter</i>	<i>Proteus</i>	<i>Yeast</i>	<i>Candidate</i>
<b>Aminoglycosides</b>	14 (93.3)	5 (83.3)	-	3 (100)	1 (50)	15 (68.2)	5 (50)	3 (60)	2 (100)	4 (80)	1 (100)	51 (83.6)	2 (100)
<b>Piperacillin</b>	12 (80)	3 (50)	-	3 (100)	2 (100)	20 (90.9)	7 (70)	5 (100)	2 (100)	5 (100)	1 (100)	48 (78.8)	-
<b>Anti-MRSA</b>	3 (20)	2 (33.3)	-	1 (33.3)	1 (50)	10 (45.5)	-	1 (20)	-	-	-	24 (39.3)	-
<b>Anti-fungal</b>	15 (100)	4 (66.7)	1 (100)	3 (100)	1 (50)	18 (81.8)	9 (90)	4 (80)	2 (100)	5 (100)	1 (100)	51 (83.6)	-
<b>Anti-aerobic</b>	4 (36.7)	-	-	3 (100)	1 (50)	11 (50)	4 (40)	2 (40)	1 (50)	5 (100)	1 (100)	18 (29.5)	-
<b>Monobactam</b>	9 (60)	1 (16.7)	0	3 (100)	0	7 (31.8)	2 (20)	-	1(50)	4 (80)	1 (100)	22 (36.1)	1 (50)
<b>Fluoroquinolone</b>	13 (86.7)	5 (83.3)	1 (100)	2 (66.7)	2 (100)	16 (72.2)	7 (70)	3 (60)	2 (100)	5 (100)	1 (100)	47 (77)	-
<b>Cephalosporin</b>	10 (66.7)	3 (50)	1 (100)	3 (100)	1 (50)	13 (59.1)	6 (60)	5 (100)	1 (50)	5 (100)	-	37 (60.7)	1 (50)
<b>Macrolide</b>	9 (60)	5 (83.3)	1 (100)	1 (33.3)	1 (50)	14 (63.6)	4 (40)	5 (100)	1 (50)	2 (40)	1 (100)	46 (75.5)	2 (100)

**Table 6. Frequency (%) distribution of final outcome patients with nosocomial infections based on positive culture source**

Source	Died	Improve
Blood	37 (31.6)	4 (30.8)
Urine	69 (59)	69 (59)
Pleural	1 (0.9)	-
Sputum	5 (4.3)	1 (7.7)
Stool	1 (0.9)	-
BAL	2 (1.7)	-
CV-line	-	-

**Table 7. Frequency (%) distribution of ultimate outcome patients with nosocomial infections based on organism type**

	Organism	Died	Improve
Gram-negative organisms	Klebsiella	2 (1.7)	-
	Escherichia coli	20 (17.1)	2 (15.4)
	Enterobacter	10 (8.5)	-
	Pseudomonas	4 (3.4)	1 (7.7)
	Acinetobacter	2 (1.7)	-
	Citrobacter	4 (3.4)	1 (7.7)
	Proteus	1 (0.9)	-
	Total	56 (26.7)	4 (30.8)
	Epidermidis	12 (10.3)	3 (23.1)
	Enterococcus	6 (5.1)	-
Gram-positive organisms	Saprophyte	1 (0.9)	-
	Pneumococcus	3 (2.6)	-
	Total	35 (19.8)	3 (23.1)
	Yeast	57 (48.7)	4 (30.8)
	Candidate	2 (1.7)	-
Fungi	Total	117 (100)	13 (100)

**Table 8. Frequency (%) distribution of age groups of patients with nosocomial infections by organism type**

Organism	Age Groups		
	<30 Year	30-60 Year	>60 Year
<b>Gram-positive organisms</b>	<b>Epidermitis</b>	1 (16.7)	8 (17.4)
	<b>Enterococcus</b>	-	2 (4.3)
	<b>Saprophyte</b>	-	-
	<b>Pneumococcus</b>	-	1 (2.2)
	<b>Total</b>	6 (100)	46 (100)
<b>Gram-negative organisms</b>	<b>Klebsiella</b>	-	-
	<b>Escherichia coli</b>	1 (16.7)	11 (23.9)
	<b>Enterobacter</b>	-	4 (8.7)
	<b>Pseudomonas</b>	-	1 (2.2)
	<b>Acinetobacter</b>	-	1 (2.2)
<b>Fungi</b>	<b>Citrobacter</b>	1 (16.7)	3 (6.5)
	<b>Proteus</b>	-	1 (2.2)
	<b>Total</b>	6 (100)	46 (100)
	<b>Yeast</b>	2 (33.3)	19 (41.3)
	<b>Candidate</b>	-	-
<b>Total</b>		6 (100)	46 (100)
			78 (100)

**Table 9. Frequency (%) distribution of hospital infection patients based on positive culture source**

Source	Duration of hospitalization		
	Less than a week	One week to 30 days	More than 30 days
<b>Blood</b>	12 (25)	23 (37.1)	6 (30)
<b>Urine</b>	31 (64.4)	32 (51.6)	12 (60)
<b>Pleural</b>	1 (2.1)	-	-
<b>Sputum</b>	2 (4.2)	4 (6.5)	-
<b>Stool</b>	1 (2.1)	-	-
<b>Bal</b>	-	1 (1.6)	1 (5)
<b>CV-line</b>	-	-	1 (5)
<b>Wound</b>	1 (2.1)	2 (3.2)	-
<b>Total</b>	48 (100)	62 (100)	20 (100)

**Table 10. Frequency distribution of hospitalized infection patients based on type of organism**

Organism	Duration of hospitalization		
	Less than a week	One week to 30 days	More than 30 days
<b>Gram-positive organisms</b>	<b>Epidermitis</b>	4 (8.3)	10 (16.1)
	<b>Enterococcus</b>	-	3 (4.8)
	<b>Saprophyte</b>	-	1 (1.6)
	<b>Pneumococcus</b>	3 (3.6)	-
	<b>Klebsiella</b>	1 (2.1)	-
<b>Gram-negative organisms</b>	<b>Escherichia coli</b>	8 (16.7)	8 (12.9)
	<b>Enterobacter</b>	-	7 (11.3)
	<b>Pseudomonas</b>	1 (2.1)	3 (4.8)
	<b>Acinetobacter</b>	1 (2.1)	1 (1.6)
	<b>Citrobacter</b>	2 (4.2)	3 (4.8)
<b>Fungi</b>	<b>Proteus</b>	-	-
	<b>Yeast</b>	19 (39.6)	30 (48.8)
	<b>Candidate</b>	-	2 (3.2)