ISSN: 2588-4115; Infection Epidemiology and Microbiology. 2019;5(4):33-41

Etiology and Antimicrobial Resistance Pattern of Sepsis and Urinary Tract Infections in HIV-Infected Patients from Southwestern Iran

ARTICLE INFO

Article Type
Original Research

Authors
Nahal Hadi, *PhD*[1,2*]
Zahra Sakhaee, *MD*[2]

How to cite this article
Hadi N. Sakhaee Z, Etiology and Antimicrobial Resistance Pattern of Sepsis and Urinary Tract Infections in HIV-Infected Patients from Southwestern Iran. Infection Epidemiology and Microbiology. 2019;5(4): 33-41

[1]Department of Bacteriology and Virology, School of medicine, Shiraz University of Medical Sciences, Shiraz, Iran
[2]Bioinformatics and Computational Biology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

**** Correspondence***
Address: Department of Bacteriology & Virology, School of Medicine, Shiraz University of Medical Sciences, Imam Hossein Sq, Shiraz, Iran.
Phone: 0098713 2304356
nahalhadi@gmail.com

Article History
Received: October 21 ,2019
Accepted: December 30 ,2019
Published: January 8 ,2019

ABSTRACT

Backgrounds: Sepsis is a systemic inflammatory response syndrome triggered by an infectious agent and an important cause of admission to intensive care units (ICU), especially in immunodeficient patients. The aim of this study was to determine the spectrum of bacterial etiology and antibacterial susceptibility pattern of sepsis and urinary tract infections (UTIs) in Iranian HIV-infected patients.

Materials & Methods: This retrospective cross-sectional study was conducted on HIV/AIDS patients for a period of ten years from January 2005 to January 2015 at two major hospitals in southwestern Iran. Standard microbiological methods were used for the isolation and identification of bacteria from samples. Antimicrobial susceptibility tests were done using disk diffusion method.

Findings: Out of 228 samples collected, the frequency of culture-positive blood and urine samples was 23.2% (n = 53) and 9.6% (n=22), respectively. Among culture-positive blood samples, *Staphylococcus aureus* (N = 17, 32.1%) and *Pseudomonas* (N = 5, 9.4%) were the main etiologic agents. While among 22 culture-positive urine samples, the predominant bacteria were *Enterococci* (N = 7, 31.8%) and *Escherichia coli* (N = 5, 22.7%). Antibacterial susceptibility testing results showed that Gram-positive bacteria were mostly susceptible to vancomycin, rifampin, and co-trimoxazole; meanwhile, Gram-negative bacteria were mostly susceptible against tobramycin, amoxicillin/clavulanate, and aztreonam.

Conclusions: In summary, this study findings highlighted the emergence and spread of opportunistic infections and a high level of antibiotic resistance among HIV-infected patients; therefore, restricted infection control strategies must be pursued in these hospitals.

Keywords: Sepsis, Urinary tract infections, HIV/AIDS, Antibiotic resistance

CITATION LINKS

[1] Moreira J. The burden of sepsis in critically... [2] Taramasso L, Tatarelli P, Di Biagio A. Bloodstream... [3] Martin GS. Sepsis, severe sepsis and septic shock: Changes in... [4] Girum T, Wasie A, Worku A. Trend of HIV/AIDS for...[5] Brechtl JR, Breitbart W, Galietta M, Krivo S, Rosenfeld B. The use of... [6] Greenberg JA, Lennox JL, Martin GS. Outcomes for critically... [7] Artero A, Zaragoza R, Camarena JJ, Sancho S, Gonzalez R, Nogueira JM. Prognostic factors of mortality in... [8] Khademi F, Yousefi-Ava-rvand A, Sahebkar A, Ghanbari F, Vaez H. Bacterial... [9] Ebrahim-Saraie HS, Motamedifar M, Mansury D, Halaji M, Hashemizadeh Z, Ali-Mohammadi Y. Bacterial etiology and ... [10] Motamedifar M, Zamani K, Hassanzadeh Y, Pashoutan S. Bacterial etiologies and... [11] Varma JK, McCarthy KD, Tasaneeyapan T, Monkongdee P, Kimerling ME, Buntheoun E, et al. Bloodstream... [12] Clinical and Laboratory Standards Institute. M-100S24: Performance standards... [13] Jaspan HB, Huang LC, Cotton MF, Whitelaw A, Myer L. Bacterial disease... [14] Gayle HD, Hill GL. Global impact of human immunodeficiency virus and... [15] Akbari M, Akbari M, Naghibzadeh-Tahami A, Joulaei H, Nasiriyan M, Hesampour M, et al. Prevalence... [16] Mayanja BN, Todd J, Hughes P, Van der Paal L, Mugisha JO, Atuhumuza E, et al. Septicaemia in ... [17] Phe T, Vlieghe E, Reid T, Harries AD, Lim K, Thai S, et al. Does HIV status affect the aetiology, bacterial resistance... [18] Nadjm B, Mtove G, Amos B, Walker NF, Diefendal H, Reyburn H, et al. Severe febrile illness in adult hospital ... [19] Mohammadnejad E, Jalaimanesh S, Mahmoodi M. Clinical syndrome... [20] Novosad SA, Sapiano MR, Grigg C, Lake J, Robyn M, Dumyati G, et al. Vital signs: ... [21] Farajnia S, Alikhani MY, Ghotaslou R, Naghili B, Nakhlband A. Causative agents and... [22] Derese B, Kedir H, Teklemariam Z, Weldegebreal F, Balakrishnan S. Bacterial profile... [23] Alebachew G, Teka B, Endris M, Shiferaw Y, Tessema B. Etiologic... [24] Mootsikapun P. Bacteremia in... [25] Pouladfar G, Basiratnia M, Anvarinejad M, Abbasi P, Amirmoezi F, Zare S. The... [26] Ghassabi F, Hashempour T, Moghadami M, Davarpanah MA, Kalani M, Chatrabnous N, et al. Bacterial...

[DOR: 20.1001.1.25884107.2019.5.4.5.2]

[DOR: 20.1001.1.25884107.2019.5.4.5.2]

Introduction

Bloodstream infection is a systemic inflammatory response syndrome trigered by an infectious agent and an important cause of admission to intensive care units (ICU) [1, 2]. In general, bloodstream infection due to serious complications including acute organ dysfunction and hemodynamic instability is responsible for a significant rate of mortality in ICU [3]. According to the latest UNAIDS reports, 78 million of population have become infected with human immunodeficiency virus (HIV), and 35 million have died from AIDS-related illnesses worldwide [4]. Although the exact number of HIV-positive adults and children in Iran is not clear, recent estimates have suggested that approximately 60,000 HIV-positive cases live in Iran. According to the previous hospital-based reports, respiratory failure and bloodstream infection are the main causes of ICU admission among HIV-infected individuals, respectively. However, bloodstream infection is responsible for 15–30% of all ICU admissions among HIV-infected patient, and the bloodstream infection rate among HIV-infected patient is more than 1,000 cases per 100,000 patients [1]. Despite the fact that the introduction of highly active antiretroviral therapy (HAART) promotes and improves the quality of life of HIV-infected patients, acquired immune deficiency syndrome (AIDS) as a serious threat to global public health often needs critical care support in ICU [5, 6]. Several risk factors contribute to the HIV-infected patients to be susceptible to bacterial infections, including deficiency in humoral and cell-mediated immunity, followed by low CD4+ lymphocyte count, phagocytic cell dysfunction, and skin and mucous membrane defects [7]. Therefore, HIV-infected patients may be predisposed to systemic bacterial infections such as bloodstream infection and more at risk of urinary tract infections (UTIs) [8-10]. However, as to the best of our knowledge, there are a few data on the prevalence, etiologic agents, and the antimicrobial susceptibility pattern of bloodstream and urinary tract infections among HIV- positive patients in this region.

Objectives: The aim of this study was to determine the spectrum of bacterial etiology and antibacterial susceptibility pattern of bloodstream infection and UTIs in Iranian HIV-infected patients.

Materials and methods

This retrospective cross-sectional study was conducted on HIV/AIDS patients for a period of ten years from January 2005 to January 2015 at two major hospitals of Nemazee and Faghihi, affiliated to Shiraz University of Medical Sciences, southwestern Iran. During the study period, demographic and clinical information of HIV/AIDS patients suspected to bloodstream infection and UTIs were recorded based on the compatible clinical manifestations sought by the physicians. This study was approved by the Ethics Committee of Shiraz University of Medical Sciences and was in accordance with the declaration of Helsinki. However, the committee waived the informed consent, because only the medical records were used, and the details were also kept strictly confidential.

Specimens and bacterial identification: Using sterile conditions, 2 - 5 mL venous blood samples were gained from HIV/AIDS patients by the attending nurses and injected in BACTEC™ blood culture bottles. All bottles were incubated at 37°C aerobically condition in the BACTEC™ system (Model: 9050 and 9120) (Becton Dickinson, NJ, USA) for seven consecutive days [11]. Standard bacteriological methods were used for the bacteria isolation and identification from subculture samples. Moreover, the midstream urine samples were collected in a clean container. Samples were cultured on blood agar or MacConkey agar (HiMedia, India) using a standard calibrated loop (0.01 mL), and the plates were incubated at 37°C for 24 hours. The grown bacteria were examined for colony morphology as well as Gram staining characteristics and were identified using standard microbiological methods.

Antimicrobial susceptibility testing: Antimicrobial susceptibility testing was performed for all bacterial isolates using disk diffusion method on Mueller-Hinton agar (Oxoid) according to the Clinical and Laboratory Standards Institute (CLSI) recommendations [12]. The selected antimicrobial disks (HiMedia, India) and the results interpretation for each pathogen were based on CLSI recommendations.

Statistical analysis: The analysis was performed using SPSS™ software, Version 21.0 (IBM Corp., USA). The results were presented as descriptive statistics in terms of relative frequency. Values were expressed as mean ± standard deviation (continuous variables) or the group percentage (categorical variables).

Findings

During a 10-year study period, out of 228 HIV-infected patients suspected to bloodstream infection and UTIs, 191 (83.8%) and 37 (16.2%) cases were male and female, respectively. Out of 228 collected samples, the number of culture-positive blood and urine specimens was 53 (n = 23.2%) and 22 (n=9.6%), respectively. Out of 53 culture-positive blood samples, the most frequent Gram-positive bacteria were *S. aureus* (N = 17, 32.1%) and *S. epidermidis* (N = 5, 9.4%), while the most frequent Gram-negative bacteria were *Pseudomonas* spp. (N = 5, 9.4%), *Salmonella non typhi* (N = 5, 9.4%), and *E. coli* (N = 4, 7.5%). Furthermore, among 22 culture-positive urine samples, the predominant Gram-positive bacterium was *Enterococci* spp. (N = 7, 31.8%), while *E. coli* (N = 5, 22.7%) was the most frequent Gram-negative bacterium. The detailed results of bacterial isolation from urine and blood cultures in HIV-infected patients are shown in Table 1.

Antibacterial susceptibility testing results indicated that among Gram-positive bacteria, *S. aureus* showed a high resistance against penicillin (100%) and tetracycline (76.5%), while the highest resistance of *Enterococci* was observed toward tetracycline (90%) and ampicillin (80%). In addition, the most effective antibiotic against *S. aureus* and *Enterococci* isolates was rifampin; meanwhile, among coagulase-negative *Staphylococci* (CoNS) isolates, chloramphenicol was the most effective antibiotic. *Enterobacteriaceae* and *Pseudomonas* spp. isolates showed a high level of resistance against tetracycline (88.2%) and aztreonam (72.7%), whereas the isolates were mostly susceptible to aztreonam (88.2%) and tobramycin (81.8%). The full results of antibiotic resistance patterns of Gram-positive and Gram-negative pathogens from blood and urine samples of HIV-positive patients are presented in Table 2.

According to the history of patients, 49 (21.5%) patients were co-infected by Hepatitis C virus, and 33 (14.5%) cases had a history of drug injection. Moreover, the mortality rate was 16.2%, and the remaining cases were discharged from hospitals.

Discussion

HIV causes AIDS and is a significant problem for global public health. AIDS as a disease has had economically a huge impact on communities and public health [13-14]. According to data reported by the WHO, the rate of AIDS epidemic in Iran is dramatically growing [15]; therefore, due to the high prevalence of opportunistic infections such as bloodstream infections (BSIs) and UTIs in these patients, the mortality rate has increased [2]. Therefore, routine surveillance

[DOR: 20.1001.1.25884107.2019.5.4.5.2]

Table 1) The detailed results of bacterial isolation among urine and blood cultures in HIV-infected patients

Isolate	HIV Positive		Total
	Urine	Blood	
Gram-positive	**10**	**30**	**40**
Staphylococcus aureus	-	17	17
Staphylococcus epidermidis	1	5	6
Enterococci	7	3	10
Pneumococci	-	2	2
Coagulase-negative staphylococci	1	1	2
Streptococci	1	-	1
Bacillus	0	2	2
Gram-negative	**12**	**23**	**35**
Escherichia coli	5	4	9
Pseudomonas spp.	2	5	7
Alcaligenes spp.	-	4	4
Salmonella non *typhi*	-	5	5
Enterobacter spp.	1	2	3
Klebsiella spp.	1	1	2
Citrobacter spp.	1	2	3
Acinetobacter spp.	2	-	2
Yeast	3	1	4
Candida non *albican*	5	-	5
Diphteroid	0	4	4

Table 2) Antimicrobial susceptibility patterns of pathogens isolated from Blood and urine cultures

Bacteria	Antimicrobial Agent	Resistant No. (%)	Susceptible No. (%)
S. aureus (N = 17)	Penicillin	17 (100)	0
	Gentamicin	10 (58.8)	7 (41.2)
	Tetracycline	13 (76.5)	4 (23.5)
	Erythromycin	12 (70.5)	5 (29.5)
	Clindamycin	10 (58.8)	7 (41.2)
	Ciprofloxacin	7 (41.2)	10 (58.8)
	Rifampin	4 (23.5)	13 (76.5)
	Cefoxitin	7 (41.2)	10 (58.8)
	Co-trimoxazole	6 (35.2)	11 (64.8)
Streptococcus spp. (N = 3)	Erythromycin	2 (66.6)	1 (33.4)
	Ceftriaxone	1 (33.4)	2 (66.6)
	Clindamycin	2 (66.6)	1 (33.4)
	Chloramphenicol	0	3 (100)
	Penicillin	1 (33.4)	2 (66.6)
	Co-trimoxazole	1 (33.4)	2 (66.6)
	Vancomycin	0	3 (100)
Enterococci (N = 10)	Ampicillin	8 (80)	2 (20)
	Vancomycin	4 (40)	6 (60)
	Erythromycin	7 (70)	3 (30)
	Tetracycline	9 (90)	1 (10)
	Ciprofloxacin	5 (50)	5 (50)
	Rifampin	2 (20)	8 (80)
Coagulase negative *Staphylococci* (N = 8)	Ciprofloxacin	4 (50)	4 (50)
	Tetracycline	6 (75)	2 (25)
	Rifampin	3 (37.5)	5 (62.5)
	Erythromycin	5 (62.5)	3 (37.5)
	Chloramphenicol	0	8 (100)
	Gentamicin	3 (37.5)	5 (62.5)
	Penicillin	7 (87.5)	1 (12.5)
	Cefoxitin	5 (62.5)	3 (37.5)
	Co-trimoxazole	3 (37.5)	5 (62.5)

Continue to Table 2

Bacteria	Antimicrobial Agent	Resistant No. (%)	Susceptible No. (%)
Pseudomonas spp. (N =11)	Ciprofloxacin	4 (36.4)	7 (63.6)
	Amikacin	3 (27.3)	8 (72.7)
	Ceftazidime	4 (36.4)	7 (63.6)
	Aztreonam	8 (72.7)	3 (27.3)
	Imipenem	5 (45.4)	6 (54.6)
	Tobramycin	2 (18.2)	9 (81.8)
Salmonella non typhi (N =5)	Ciprofloxacin	0	5 (100)
	Ceftazidime	0	5 (100)
	Ampicillin	1 (20)	4 (80)
	Co-trimoxazole	0	5 (100)
	Chloramphenicol	0	5 (100)
Enterobacteriaceae (N =17)	Amoxicillin/clavulanat	5 (29.4)	12 (70.6)
	Aztreonam	2 (11.8)	15 (88.2)
	Cephalothin	12 (70.6)	5 (29.4)
	Cefoxitin	12 (70.6)	5 (29.4)
	Cefotaxime	13 (76.5)	4 (23.5)
	Ceftazidime	14 (82.3)	3 (17.7)
	Cefepime	12 (70.6)	5 (29.4)
	Tetracycline	15 (88.2)	2 (11.8)
	Gentamicin	12 (70.6)	5 (29.4)
	Ciprofloxacin	12 (70.6)	5 (29.4)
	Imipenem	13 (76.5)	4 (23.5)
	Co-trimoxazole	12 (70.6)	5 (29.4)
Acinetobacter spp. (N =2)	Imipenem	0	2 (100)
	Ciprofloxacin	0	2 (100)
	Ampicillin-sulbactam	1 (50)	1 (50)
	Ceftazidime	0	2 (100)
	Gentamicin	0	2 (100)
	Amikacin	1 (50)	1 (50)
	Tetracycline	0	2 (100)

is necessary to determine the etiology of BSIs and UTIs in order to be able to choose appropriate therapy for the management of HIV-infected population.

In the present study, the rate of bacterial isolation from the examined blood samples was found to be 23.2%. This finding was relatively in accordance with the findings of other studies conducted in Malawi (23%), Cambodia (19%), and Tanzania (17%) [16-18]. However, the isolation rate in this study was higher than that reported by Mohammadnejad et al. (2010) (9.9 %) among HIV/AIDS hospitalized patient [19]. The present study results showed that the frequency of culture-positive urine samples was 15.7%. This finding was lower than those reported in Nigeria (40.4%) and USA (25%), but consistent with those reported in Iran (13.2%) and Ethiopia (14%) [20-22]. These variations in bacterial isolation rate suggest that some considerations such as differences in geographical distribution, diagnostic methods, infection control policies, and received clinical care or self-medication may have affected the obtained results.

In the present study, the most common bacterial agent of BSIs was *S. aureus,* followed by *Enterobacteriaceae*. Previously, several authors from the United States, Ethiopia, and Thailand reported that *S. aureus* was the main bacterial agent of bloodstream infection in HIV-infected patients, consistent with the present study results [23]. In addition, several studies reported that *Enterobacteriaceae*, particularly *E. coli* was the most prevalent Gram-negative pathogen in HIV/AIDS-infected patients [13, 24].

Based on the present study results, Gram-negative bacteria were found in 54.5% of patients with UTIs. Among these bacteria, *E. coli* was the most common species. Moreover, among Gram-positive pathogens, *Enterococci* strains were the most prevalent isolates. These findings were consistent with the findings of other studies showing *E. coli* and *Enterococci* as the most common uropathogenic bacteria [25].

In the present study, *S. aureus* isolates as the predominant agent of BSIs showed a high susceptibility toward rifampin and co-trimoxazole; 41.2% of which were MRSA, as well. In agreement with the present study findings, Ghassabi et al. (2017) showed that *S. aureus* isolates were completely susceptible to rifampin and co-trimoxazole, while they were resistant to penicillin G [26]. In addition, the antibiotic susceptibility pattern of other Gram-positive isolates such as *Enterococci* and CoNS revealed that most of the isolates were multidrug resistant (MDR), and only vancomycin and chloramphenicol were effective against them. Thus, these antibiotics could be considered as the drug of choice for empirical therapy of infections caused by these pathogens in this region.

Conclusion

In summary, this study results introduced *S. aureus* and *E. coli* as the most common causative agents of BSIs among HIV-infected patients in this region. Hopefully, some locally available antibiotics were effective against the majority of Gram-positive and Gram-negative bacteria isolated in this study. The present study findings highlighted the emergence and spread of opportunistic infections and high level of antibiotic resistance among HIV-infected patients; therefore, restricted infection control strategies must be pursued in these hospitals.

Acknowledgements: We are thankful to all Members of the Department of Bacteriology and Virology and Shiraz University of Medical Sciences.

Ethical Permissions: The study protocol was approved by the Ethics Committee of

[DOR: 20.1001.1.25884107.2019.5.4.5.2]

Shiraz University of Medical Sciences.
Conflicts of interests: The authors declare that they have no competing interests.
Authors's Contribution: NH, ZS: Designed, and supervised the study and revised the manuscript.
Fundings: This study was supported by Shiraz University of Medical Sciences with grant No. 93-8880.

Reference

1. Moreira J. The burden of sepsis in critically ill human immunodeficiency virus-infected patients--A brief review. Braz J Infect Dis. 2015;19(1):77-81.
2. Taramasso L, Tatarelli P, Di Biagio A. Bloodstream infections in HIV-infected patients. Virulence. 2016;7(3):320-8.
3. Martin GS. Sepsis, severe sepsis and septic shock: Changes in incidence, pathogens, and outcomes. Expert Rev Anti Infect Ther. 2012;10(6):701-6.
4. Girum T, Wasie A, Worku A. Trend of HIV/AIDS for the last 26 years and predicting achievement of the 90–90-90 HIV prevention targets by 2020 in Ethiopia: a time series analysis. BMC Infect Dis. 2018;18(1):320.
5. Brechtl JR, Breitbart W, Galietta M, Krivo S, Rosenfeld B. The use of highly active antiretroviral therapy (HAART) in patients with advanced HIV infection: Impact on medical, palliative care, and quality of life outcomes. J Pain Symptom Manag. 2001;21(1):41-51.
6. Greenberg JA, Lennox JL, Martin GS. Outcomes for critically ill patients with HIV and severe sepsis in the era of highly active antiretroviral therapy. J Crit Care. 2012;27(1):51-7.
7. Artero A, Zaragoza R, Camarena JJ, Sancho S, Gonzalez R, Nogueira JM. Prognostic factors of mortality in patients with community-acquired bloodstream infection with severe sepsis and septic shock. J Crit Care. 2010;25(2):276-81.
8. Khademi F, Yousefi-Ava-rvand A, Sahebkar A, Ghanbari F, Vaez H. Bacterial co-infections in HIV/AIDS-positive subjects: A systematic review and meta-analysis. Folia Med. 2018;60(3):339-50.
9. Ebrahim-Saraie HS, Motamedifar M, Mansury D, Halaji M, Hashemizadeh Z, Ali-Mohammadi Y. Bacterial etiology and antibacterial susceptibility patterns of pediatric bloodstream infections: A two year study from Nemazee hospital, Shiraz, Iran. J Compr Ped. 2016;7(1):e29929.
10. Motamedifar M, Zamani K, Hassanzadeh Y, Pashoutan S. Bacterial etiologies and antibiotic susceptibility pattern of urinary tract infections at the pediatric ward of Dastgheib hospital, Shiraz, Iran: A three-year study (2009 - 2011). Arch Clin Infect Dis. 2016;11(2):e28973.
11. Varma JK, McCarthy KD, Tasaneeyapan T, Monkongdee P, Kimerling ME, Buntheoun E, et al. Bloodstream infections among HIV-infected outpatients, Southeast Asia. Emerg Infect Dis. 2010;16(10):1569-75.
12. Clinical and Laboratory Standards Institute. M100-S24: Performance standards for antimicrobial susceptibility testing: Twenty-fourth informational supplement. Wayne PA: Clinical and Laboratory Standards Institute (CLSI); 2014, 34(1).
13. Jaspan HB, Huang LC, Cotton MF, Whitelaw A, Myer L. Bacterial disease and antimicrobial susceptibility patterns in HIV-infected, hospitalized children: A retrospective cohort study. PloS One. 2008;3(9):e3260.
14. Gayle HD, Hill GL. Global impact of human immunodeficiency virus and AIDS. Clin Microbiol Rev. 2001;14(2):327-35.
15. Akbari M, Akbari M, Naghibzadeh-Tahami A, Joulaei H, Nasiriyan M, Hesampour M, et al. Prevalence of HIV/

[DOR: 20.1001.1.25884107.2019.5.4.5.2]

AIDS among Iranian prisoners: A review article. Addict Health. 2016;8(3):195-206.
16. Mayanja BN, Todd J, Hughes P, Van der Paal L, Mugisha JO, Atuhumuza E, et al. Septicaemia in a population-based HIV clinical cohort in rural Uganda, 1996-2007: Incidence, aetiology, antimicrobial drug resistance and impact of antiretroviral therapy. Trop Med Int Health. 2010;15(6):697-705.
17. Phe T, Vlieghe E, Reid T, Harries AD, Lim K, Thai S, et al. Does HIV status affect the aetiology, bacterial resistance patterns and recommended empiric antibiotic treatment in adult patients with bloodstream infection in Cambodia? Trop Med Int Health. 2013;18(4):485-94.
18. Nadjm B, Mtove G, Amos B, Walker NF, Diefendal H, Reyburn H, et al. Severe febrile illness in adult hospital admissions in Tanzania: A prospective study in an area of high malaria transmission. Trans R Soc Trop Med Hyg. 2012;106(11):688-95.
19. Mohammadnejad E, Jalaimanesh S, Mahmoodi M. Clinical syndrome in HIV/AIDS resulting in hospitalization based on the CD4 count. J Mazandaran Univ Med Sci. 2010;19(74):70-7.
20. Novosad SA, Sapiano MR, Grigg C, Lake J, Robyn M, Dumyati G, et al. Vital signs: epidemiology of sepsis: Prevalence of health care factors and opportunities for prevention. MMWR Morb Mortal Wkly Rep. 2016;65(33):864-9.
21. Farajnia S, Alikhani MY, Ghotaslou R, Naghili B, Nakhlband A. Causative agents and antimicrobial susceptibilities of urinary tract infections in the northwest of Iran. Int J Infect Dis. 2009;13(2):140-4.
22. Derese B, Kedir H, Teklemariam Z, Weldegebreal F, Balakrishnan S. Bacterial profile of urinary tract infection and antimicrobial susceptibility pattern among pregnant women attending at antenatal clinic in Dil Chora Referral Hospital, Dire Dawa, Eastern Ethiopia. Ther Clin Risk Manag. 2016;12:251-60.
23. Alebachew G, Teka B, Endris M, Shiferaw Y, Tessema B. Etiologic agents of bacterial sepsis and their antibiotic susceptibility patterns among patients living with human immunodeficiency virus at Gondar University teaching hospital, Northwest Ethiopia. BioMed Res Int. 2016;2016:5371875.
24. Mootsikapun P. Bacteremia in adult patients with acquired immunodeficiency syndrome in the northeast of Thailand. Int J Infect Dis. 2007;11(3):226-31.
25. Pouladfar G, Basiratnia M, Anvarinejad M, Abbasi P, Amirmoezi F, Zare S. The antibiotic susceptibility patterns of uropathogens among children with urinary tract infection in Shiraz. Medicine. 2017;96(37):e7834.
26. Ghassabi F, Hashempour T, Moghadami M, Davarpanah MA, Kalani M, Chatrabnous N, et al. Bacterial etiology and antibiotic resistance pattern of septicemia in HIV and non-HIV patients admitted to tertiary care hospitals, Shiraz, South of Iran. Cell Mol Biol (Noisy-le-grand). 2017;63(9):115-21.

[DOR: 20.1001.1.25884107.2019.5.4.5.2]