Journal of Cardiovascular Disease Research, 12 (1)
ISSN: 0975-3583, 0976-2833
10.31838/jcdr.2021.12.01.36

ORIGINAL ARTICLE

Urinary Tract Infections in Elderly: Uropathogen and Drug Sensitivity Profile

Thomson Ben George[1], Kanitkar Shubhangi[2], Prodduturu Priyanka Reddy[3], Mankoskar Yash Surendrakumar[4], Gonipati Lakshmi Srikanth[5]

[1]Resident, Department of Medicine, Dr. D Y Patil Medical College, Hospital & Research Centre, Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India.

[2]Professor and HOD, Department of Medicine, Dr. D Y Patil Medical College, Hospital & Research Centre, Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India.

[3]Resident, Department of Medicine, Dr. D Y Patil Medical College, Hospital & Research Centre, Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India.

[4]Resident, Department of Medicine, Dr. D Y Patil Medical College, Hospital & Research Centre, Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India.

[5]Resident, Department of Medicine, Dr. D Y Patil Medical College, Hospital & Research Centre, Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India.

Corresponding Author

Thomson Ben George, Resident, Department of Medicine, Dr. D Y Patil Medical College, Hospital & Research Centre, Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India – 411018.

Email address: bengthomson@gmail.com

Received: 10 June 2021; Accepted: 16 July 2021; Published: 20 August 2021

Abstract

Background: With the ever-increasing geriatric population and the challenging nature of treatment of these patients, knowledge of pathogens and empirical medication to be offered helps improve patient outcome. This study was done with the objective of identifying the uropathogens and their drug sensitivity profile, in elderly patients admitted to a tertiary hospital in western India.

Method: All in-patients aging 60 years and above, having symptoms suggestive of urinary tract infection were chosen. Information regarding patients were recorded on a pre structured proforma after taking their informed consent. Only patients with significant growth of organisms on microbiological analysis were included in the final study.

Results: Of the 50 participants of the study, Gram negative organisms were isolated from 90% of the urine cultures; *E.coli* being the most common; followed by *Klebsiella*; *Pseudomonas*; *Citrobacter* and *Proteus*. Among the 10% of gram positive organisms, isolated organisms included *Enterococcus* species and *S.aureus*. The overall culture sensitivity pattern showed that most of the organisms were sensitive to Meropenem and Gentamycin (72%) followed by Amikacin(70%); Ceftazidime Tazobactum and Piperacillin Tazobactum (58% each); Amoxicillin Clavulanic Acid (54%) and Ceftazidime(50%). Sensitivity to the commonly used anti-microbials like Ceftriaxone, Cotrimoxazole and fluoroquinolones was very low.

Conclusion: Availability and knowledge of local antibiograms especially in resource poor settings or in the event that culture reports are unavailable to initiate empirical therapy allow for improved treatment outcomes.

Keywords: UTI, geriatric, uropathogen, drug-sensitivity

Introduction

Urinary tract infection (UTI), is one of the most common outpatient complaints and is being seen increasingly in the rapidly growing geriatric population globally.[1] It is the most common complaint about which for which empirical antibiotics are prescribed, which may be unnecessary for > 50% of the elderly patients in whom it is prescribed. [2,3] Unlike in younger adults, both sexes are equally affected amongst the elderly. Factors contributing to an increased risk of UTI in the elderly include anatomical and hormonal changes associated with aging; presence of co-morbidities (such as neurological, urological, diabetes mellitus, long term catheterization), and long term care facilities available to them.[4,5] Diagnosis and management in this age group are difficult owing to an atypical history and clinical presentation, such as an absence or reduced fever, changes in mental status, and non-specific symptoms such as those of anorexia and lethargy.[2,4,6]Adding to these, are factors such as the prevalence of asymptomatic bacteriuria, limited usage of urine cultures; increasing antibiotic resistance patterns owing to excessive and unwarranted use of anti-microbials.[7] Due to this challenging nature of the disease in the elderly, knowledge of the uropathogen profile and its drug sensitivity pattern proves useful. This study aims to address in part the lack of information on etiology and resistance patterns in elderly Indians, to improve patient outcomes in those admitted to our tertiary care center.

Methods

In this observational study done over two years from August 2018 to September 2020, in-patients 60 years and above were chosen based on clinical features suggestive of urinary tract infections such as fever, dysuria, urgency, frequency, hematuria, abdominal pain, altered sensorium, etc. Mid-stream urine samples were collected and sent for microbiological analysis. Only those with significant growth in the cultures were included in the study (i.e $>10^5$ colony forming units). Those who had undergone recent urological procedures were excluded from the study. Data were collected from patients using a questionnaire after taking their informed consent. Data from the patients were entered in Microsoft Excel and analysis of data was done using EPI-Info 7 software (CDC, USA). The study was initiated after approval from the Institutional Ethics Committee.

Results

Of the 50 patients in the study, there were 64% (32) male and 36% (18) female patients. Patients belonging to the age group of 60-64 years were 36% (18); 65-69 years were 20% (10); 70-74 years were 22% (11); 75-79 were 8% (4); 80-84 years were 8% (4); 85 years and above were 6% (3). It was found that the number of male cases was more than females in all age groups. The mean age was 68.56 ± 8.14 years. Patients who had a Foley's catheter in situ comprised 52% (26). Of all male patients 59.38% (19) were catheterized and of all the female patients, only 38.89% (7) were found to be catheterized. Fifty percent of the study group were diabetics. Of all males, only 40.63% (13) were diabetic while 66.67% (12) of all female patients were diabetic.

Microbiological Profile

Ninety percent (45) isolates were gram-negative on staining and the remaining 10% (5) were gram-positive. Of all the organisms grown in culture, *E.coli* was grown in the maximum number of cases accounting for 54% (27). *Klebsiella spp.* was grown in 22% (11); *Pseudomonas spp.* in 10% (5); *Enterococcus* in 6% (3); *Staphylococcus aureus* in 4% (2); *Citrobacter freundii* in 2% (1) and *Proteus spp.* in 2% (1). It was also noticed that there was no significant difference in the presence of *E.coli and Klebsiella spp.* among male and female patients using the chi-square test (p-value-0.293 and p-value-0.287 respectively).

Sensitivity Pattern

In this study, it was found when studying the overall antibiotic sensitivity pattern that, 72% (36) of the organisms grown were sensitive to both Gentamycin and Meropenem. Sensitivity to Amikacin was seen in 70% (35) isolates; Ceftazidime Tazobactum and Piperacillin Tazobactum in 58 % (29) isolates each; Ceftazidime Clavulatnate in 56%(28) and Amoxicillin Clavulanic Acid in 54% (27) isolates. Overall antibiotic sensitivity pattern and organism-specific sensitivity pattern are shown in Figure 1 and Figure 2 respectively.

Figure 1: Percentage Sensitivity of Isolates to anti-microbials tested

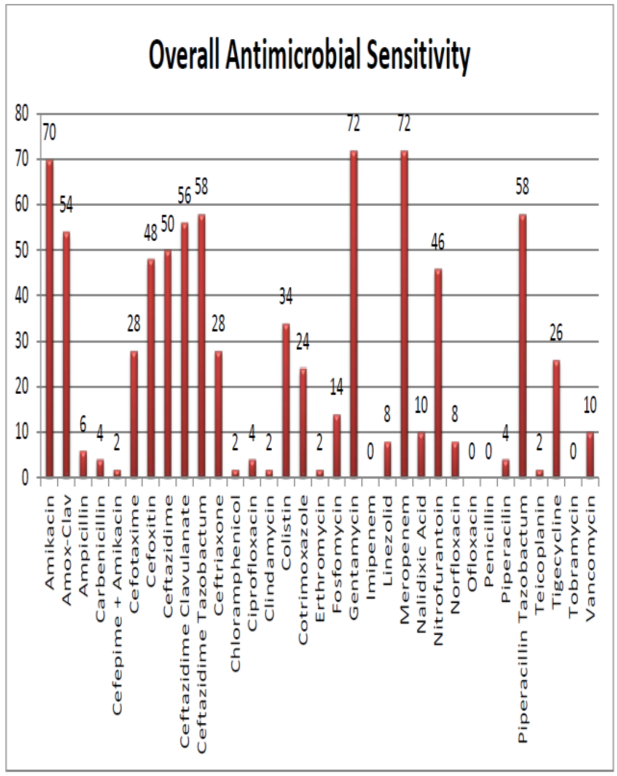

Figure 2: Antibiotic susceptibility of the microorganism

Microorganisms	*E. coli* (*n :27*)	*Klebsiella spp* (*n:11*)	*Pseudo monas spp.* (*n:5*)	*Entero coccus* (*n :3*)	*S. aureus* (*n:2*)	*Citrobacter freundii* (*n:1*)	*Proteus mirabilis* (*n:1*)
Antimicrobials							
Amikacin	26/27	5/11	1/5	-	1/2	1/1	1/1
Amox Clav	16/27	7/11	2/5	-	-	1/1	1/1
Ampicillin	1/27	-	-	1/3	1/2	-	-
Carbenicillin	-	-	2/5	-	-	-	-
Cefepime + Amikacin	1/27	-	-	-	-	-	-
Cefotaxime	12/27	-	1/5	-	-	-	1/1
Cefoxitin	16/27	5/11	1/5	-	1/2	-	1/1
Ceftazidime	16/27	5/11	2/5	-	-	1/1	1/1
Ceftazidime Clavulanate	17/27	6/11	3/5	-	-	1/1	1/1
Ceftazidime Tazobactum	18/27	6/11	3/5	-	-	1/1	1/1
Ceftriaxone	12/27	-	1/5	-	-	-	1/1
Chloramphenicol	1/27	-	-	-	-	-	-
Ciprofloxacin	-	-	1/5	-	1/2	-	-
Clindamycin	-	-	-	-	1/2	-	-
Colistin	9/27	6/11	2/5	-	-	-	-
Cotrimoxazole	2/27	5/11	-	2/3	2/2	1/1	-
Erythromycin	-	-	-	-	1/2	-	-
Fosfomycin	6/27	-	1/5	-	-	-	-
Gentamycin	26/27	5/11	1/5	-	2/2	1/1	1/1
Imipenem	-	-	-	-	-	-	-
Linezolid	-	-	-	3/3	1/2	-	-
Meropenem	25/27	6/11	3/5	-	-	1/1	1/1
Nalidixic Acid	5/27	-	-	-	-	-	-
Nitrofurantoin	19/27	-	-	1/3	2/2	-	1/1
Norfloxacin	3/27	1/11	-	-	-	-	-
Ofloxacin	-	-	-	-	-	-	-
Penicillin	-	-	-	-	-	-	-
Piperacillin	-	-	2/5	-	-	-	-
Piperacillin Tazobactum	18/27	6/11	3/5	-	-	1/1	1/1
Teicoplanin	-	-	-	-	1/2	-	-
Tigecycline	7/27	5/11	1/5	-	-	-	-
Tobramycin	-	-	-	-	-	-	-
Vancomycin	-	-	-	3/3	2/2	-	-

E.coli isolates were found maximally sensitive to Amikacin and Gentamycin (96.29% each) followed by Meropenem (92%); Nitrofurantoin (70.37%); Ceftazidime Tazobactum and Piperacillin Tazobactum at 66.66% each; Ceftazidime Clavulanate at 62.96% and Amoxicillin Clavulanate at 59.25%.

In the Klebsiella group, 63.63% isolates showed sensitivity to Amoxicillin Clavulanate. 54.54% were sensitive to Ceftazidime Clavulanate, Ceftazidime Tazobactum, Colistin, Meropenem, and Piperacillin Tazobactum. 45.45% showed sensitivity to Amikacin, Cefoxitin, Cotrimoxazole, Gentamycin, and Tigecycline. Only 9% showed sensitivity to Norfloxacin.

In the *Pseudomonas* species, 60% of isolates were sensitive to Ceftazidime Clavulanate, Ceftazidime Tazobactum, Meropenem, and Piperacillin Tazobactum. 40% isolates were sensitive to Amoxicillin Clavulanate, Colistin, Carbenicillin, Ceftazidime, and Piperacillin; 20% isolates were sensitive to Amikacin, Ciprofloxacin, Cefoxitin, Ceftriaxone, Fosfomycin, Gentamycin, and Tigecycline. *Enterococcus* isolates were all sensitive to Linezolid and Vancomycin, while all *S.aureus* isolates were sensitive to Vancomycin, Cotrimoxazole, and Gentamycin.

Amongst those catheterized, *E.coli* was the most commonly isolated organism in both catheterized and non-catheterized patients in 42.31% (11). There was no significant difference found in presence of *E.coli* among catheterized and non-catheterized using the chi-square test (*P* 0.149). *Klebsiella* was seen in 26.92% of catheterized patients. There was no statistically significant difference in presence of *Klebsiella* among catheterized and non-catheterized using the chi-square test (*P* 0.499). *Pseudomonas* and *Citrobacter* were found only in catheterized patients (19.23% and 3.85% respectively), while *Proteus* was found in non-catheterized (4.13%). Two patients in the non-catheterized group grew *Enterococcus* as opposed to one in the catheterized. *S.aureus* was isolated from both groups. (1 each).

Isolates from diabetics grew *E.coli* in 56% (14) vs. 52% (13) in non-diabetics. Klebsiella was seen in 24% (6) non-diabetics and 20% (5) diabetics. *Pseudomonas* was seen in 16% (4) diabetics and 4% (1) non-diabetic. *Enterococcus* has also been seen in 8% (2) diabetics as opposed to 4% (1) non-diabetic. *Proteus*, *S.aureus,* and *Citrobacter* were seen only in the non-diabetic group (1, 2 and 1 patient respectively). Statistical analysis revealed that there was no significant difference in the presence of both *E.coli* and *Klebsiella* among diabetic and non-diabetics using the chi-square test (*p-value*-1.0 in both).

Patients landing in sepsis due to UTI comprised 38%(19). Out of these, 57.89%(11)were females while 42.11%(8) were males. There was found a significant association between gender and sepsis using the chi-square test (*p-value*-0.026). *E.coli* was the predominant organism in the sepsis group followed by *Pseudomonas* and *Enterococcus*, while *E.coli* was followed by *Klebsiella* as being the major pathogens in the non-sepsis group. Of all organisms that were grown, 12% were ESBL producers, *E.coli* and Klebsiella being the pathogens involved (4 and 2 respectively).

Discussion

Urinary tract infections account for a quarter of all infections seen in the elderly.[8] Amongst those >65 years, urinary tract infections account for 15.5% who end up requiring hospitalization, and mortality is seen in 6.2%.[9] Age-associated changes in immune function, exposure to nosocomial pathogens, and an increasing number of co-morbidities put the elderly at an increased risk for developing an infection.[10] In our study, the majority of cases were between the age- group 60-69 years (56%) with decreasing frequency with subsequent age groups. This was in concordance with similar Indian studies.[4,11,12] Amongst community-dwelling elderly presenting with symptomatic UTI, and no antibiotic therapy, most of the microbial isolates grown belong to the Enterobacteriaceae family, specifically Escherichia coli, Proteus mirabilis, and *Klebsiella pneumonia*. *Enterococcus* spp. has also been isolated but at a lower frequency than gram-negative bacilli.[13,14] The increased frequency in the prescription of antibiotics coupled with repeated exposure to pathogens acquired during hospitalizations, resulting in a higher incidence of antibiotic-resistant bacteria in this population.[15] With variations in the frequency of isolation of uropathogens, residents of nursing facilities have also been found to have similar bacteria as those hospitalized, isolated from their urine, including potential multidrug-resistant uropathogens.[16] Individuals with chronic indwelling bladder catheters have uropathogens that may be polymicrobial and antibiotic-resistant.[17] In our study *E. coli* accounted for 54% of all UTIs, followed by *Klebsiella* (22%) and Pseudomonas spp. (10%) . This is in concordance with other Indian studies which showed a similar pattern.[4,11,12]

Overall sensitivity in our study was to primarily the carbapenem and aminoglycoside group of antibiotics, followed by cephalosporins and penicillins (both in combinations with beta-lactamase inhibitors).In the study by Swamy et al, *E.coli* was found E. coli sensitive to Imipenem in 94.73% followed by Meropenem (89.47%) and Piperacillin Tazobactum (81.57%). Klebsiella group isolates were sensitive to Imipenem (89.65%) followed by Meropenem (82.75%) followed by Amikacin (75.86%) Organisms were least susceptible to Ceftriaxone followed by Cefoperazone. Similarly, In the study by Kakde et al, *E.coli* isolates were sensitive to the following antibiotics: Imipenem(97.77%); Meropenem (88.88%), and Piperacillin Tazobactum (82.22%). *Klebsiella* group isolates were sensitive to Imipenem (83.33%) ;Meropenem (77.77%) ;Levofloxacin (72.22%) *Pseudomonas* group isolates were sensitive to Imipenem(85.71); Meropenem (78.57%) ; Levofloxacin (64.28%). Organisms were least susceptible to Cefotaxime followed by Ceftriaxone. [4,12]

Quinolones, which are drugs of choice for treating UTIs, were resistant in most of the cases. This could be owing to its increased use, especially in outpatient settings, due to empirical usage.[18,19]Studies have shown that fluoroquinolone resistance is more prevalent in ESBL-producing strains.[20] ESBL-producing microorganisms are resistant to several antibiotics, which may be associated with treatment failure resulting in morbidity and mortality.[21]Mahesh E et al, in their study, found that 56.2% of their infections were caused by ESBL organisms.[11] Alpay et al, in their study also obtained ESBL ratios of 49% and 66% for *E. coli* and *Klebsiella*, respectively.[22]

The presence of diabetes is found in other studies to be one of the most common predisposing factors to the development of urinary tract infections in the elderly population. [4,12] Presence of a higher number of patients with *E.coli* isolated from the urine cultures in diabetics was consistent with studies done by Srinivas et al and Vaishnav et al.[23,24] Studies have shown that this occurrence may be a result of a higher adherence of *E.coli* to the urothelium.[25]

In our study, there was no statistically significant difference in presence of *E.coli and Klebsiella* among diabetic and non-diabetics. A study by Bonadio et al also found no difference in the uropathogen profile or even the antibiotic sensitivity pattern when comparing diabetics and non-diabetics. [26] More studies need to be undertaken to understand catheter-associated UTIs in the elderly population. Studies have indicated that infection rates in catheterized patients account for about 5% per day and that they present predominantly with asymptomatic bacteriuria, in which case antibiotic therapy could lead to drug-resistant organisms.[27]

In the general population, studies have indicated that patients with sepsis due to gram-negative organisms have better outcomes when on combination empirical antibiotic therapy as opposed to monotherapy.[28] This may be considered even in sepsis due to UTIs in the elderly but with caution due to reduced renal function associated with aging.

Conclusion

With the ever-growing population of the elderly, it is imperative to formulate proper guidelines for the diagnosis and treatment of UTI in adults. The challenge of antibiotic resistance and the lack of availability of new antibiotics is proving to make the treatment of UTIs a difficult task. Information from local antibiograms needs to be made use of to initiate empirical therapy in the absence of urine culture reports and thus help improve patient outcomes.

References

1. Foxman B. Epidemiology of Urinary Tract Infections: Incidence, Morbidity, and Economic Costs. Am J Med 2002;113 (1A):5S-13S.

2.Crnich CJ, Jump RL, Nace DA. Improving Management of Urinary Tract Infections in Older Adults: A Paradigm Shift or Therapeutic Nihilism? J Am Geriatr Soc 2017;65(8):1661–3.

3. Nace DA, Drinka PJ, Crnich CJ. Clinical Uncertainties in the Approach to Long Term Care Residents With Possible Urinary Tract Infection. J Am Med Dir Assoc 2014;15(2):133–9.

4. Kakde P, Redkar NN, Yelale A. Urinary Tract Infection in Elderly: Clinical Profile and Outcome. J Assoc Physicians India 2018;66:14–7.

5. Robichaud S, Blondeau JM. Urinary Tract Infections in Older Adults: Current Issues and New Therapeutic Options. Geriatr Aging 2008;11(10):582–8.

6. Matthews SJ, Lancaster JW. Urinary Tract Infections in the Elderly Population. Am J Geriatr Pharmacother 2011;9(5):286–309.

7. Goldstein FW. Antibiotic Susceptibility of Bacterial Strains Isolated from Patients with Community-Acquired Urinary Tract Infections in France. Eur J Clin Microbiol Infect Dis 2000;19(2):112–7.

8. Ruben FL, Dearwater SR, Norden CW, Kuller LH, Gartner K, Shalley A, et al. Clinical Infections in the Noninstitutionalized

Geriatric Age Group: Methods Utilized and Incidence of Infections. Am J Epidemiol 1995;141(2):145–57.

9. Curns AT, Holman RC, Sejvar JJ, Owings MF, Schonberger LB. Infectious Disease Hospitalizations Among Older Adults in the United States From 1990 Through 2002. Arch Intern Med 2005;165(21):2514.

10. Juthani-Mehta M, Quagliarello VJ. Infectious Diseases in the Nursing Home Setting: Challenges and Opportunities for Clinical Investigation. Clin Infect Dis 2010;51(8):931–6.

11. Mahesh E, Medha Y, Indumathi VA, Kumar PS, Khan MW, Punith K. Community-acquired urinary tract infection in the elderly. Br J Med Pract 2011;4(1):a406.

12. Swamy S, Ramaswamy M, Pakale AM. Urinary tract infection in elderly: clinical profile and outcome study done at Kempegowda Institute of Medical Science and Hospital, Bengaluru, India. Int J Res Med Sci 2018;7(1):226.

13. Schaeffer AJ, Nicolle LE. CLINICAL PRACTICE. Urinary Tract Infections in Older Men. N Engl J Med 2016;374(6):562-71.

14. Nicolle LE. Urinary Tract Infections in the Elderly. Clin Geriatr Med. 2009 Aug;25(3):423–36.

15. Smithson A, Chico C, Ramos J, Netto C, Sanchez M, Ruiz J, et al. Prevalence and risk factors for quinolone resistance among Escherichia coli strains isolated from males with community febrile urinary tract infection. Eur J Clin Microbiol Infect Dis 2012;31(4):423–30.

16. van der Donk CFM, Schols JMGA, Driessen CJ, Hagenouw RGP, Meulendijks A, Stobberingh EE. Prevalence and Spread of Multidrug Resistant Escherichia coli Isolates Among Nursing Home Residents in the Southern Part of the Netherlands. J Am Med Dir Assoc 2013;14(3):199–203.

17. Grahn D, Norman DC, White ML, Cantrell M, Yoshikawa TT. Validity of Urinary Catheter Specimen for Diagnosis of Urinary Tract Infection in the Elderly. Arch Intern Med 1985;145(10):1858–60

18. Das R, Perrelli E, Towle V, Van Ness PH, Juthani-Mehta M. Antimicrobial Susceptibility of Bacteria Isolated from Urine Samples Obtained from Nursing Home Residents.

Infect Control Hosp Epidemiol 2009;30(11):1116–9.
19. Cohen AE, Lautenbach E, Morales KH, Linkin DR. Fluoroquinolone-Resistant Escherichia coli in the Long-Term Care Setting. Am J Med 2006;119(11):958–63.
20. De Vecchi E, Sitia S, Romanò CL, Ricci C, Mattina R, Drago L. Aetiology and antibiotic resistance patterns of urinary tract infections in the elderly: a 6-month study. J Med Microbiol 2013;62(6):859–63.
21. Juthani-Mehta M, Quagliarello V, Perrelli E, Towle V, Van Ness PH, Tinetti M. Clinical Features to Identify Urinary Tract Infection in Nursing Home Residents: A Cohort Study.J Am Geriatr Soc 2009;57(6):963–70.
22. Alpay Y, Aykin N, Korkmaz P, Gulduren HM, Caglan FC. Urinary tract infections in the geriatric patients. Pak J Med Sci 2018;34(1):67-72.
23. Srinivas A. Clinical profile of urinary tract infections in diabetics and non-diabetics. Australas Med J 2014;7(1):29–34.
24. Vaishnav B, Bamanikar A, Maske P, Rathore VS, Khemka V, Sharma D. Study of clinico-pathological and bacteriological profile of urinary tract infections in geriatric patients with type 2 Diabetes Mellitus. Int J Curr Res Rev 2015;7(21):13–8.
25. Geerlings SE, Meiland R, van Lith EC, Brouwer EC, Gaastra W, Hoepelman AIM. Adherence of Type 1-Fimbriated Escherichia coli to Uroepithelial Cells: More in diabetic women than in control subjects. Diabetes Care 2002;25(8):1405–9.
26. Bonadio M, Costarelli S, Morelli G, Tartaglia T. The influence of diabetes mellitus on the spectrum of uropathogens and the antimicrobial resistance in elderly adult patients with urinary tract infection. BMC Infectious Diseases 2006;6:54.
27.Nicolle LE. Catheter-related urinary tract infection. Drugs Aging 2005;22:627-39.
28. Micek ST, Welch EC, Khan J, Pervez M, Doherty JA, Reichley RM, *et al.* Empiric combination antibiotic therapy is associated with improved outcome against sepsis due to Gram-negative bacteria: a retrospective analysis. Antimicrob Agents Chemother 2010;54:1742-8.