



BACTERIAL CAUSATIVE AGENTS OF URINARY TRACT INFECTIONS (UTIs) AND THEIR ANTIBIOTIC SENSITIVITY PATTERN IN KHARTOUM, SUDAN

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ABSTRACT

Background: Urinary Tract Infections (UTIs) are amongst the most prevalent bacterial infections seen in clinical practice particularly in developing countries. **The objective of this study was** to determine the etiological bacterial pathogens of the UTI and their sensitivity to antibiotics. **Methodology:** a cross sectional study carried out in Om Durman Islamic University microbiology laboratory, in Om Durman (Sudan) from March to May 2012, A total of 50 urine samples were collected and subjected to bacteriological identification tests and sensitivity tests. **Results:** Out of 50 urine samples 45 (90%) provided positive growth. *Escherichia coli* was the most common (31.1%) followed by *Klebsiella spp* (13.3%) ,*Staphylococcus aureus* (11.2%), *Proteus spp* and *Pseudomonas aeruginosa* (8.9%), *Salmonellae spp*

and *Enterococcus faecalis* (6.7%), *Enterobacter* and *Staphylococcus epidermidis* (4.4%) and *Staphylococcus saprophyticus* and *Citrobacter*(2.2%). The highest susceptible age to UTI was 41 -50 years (35%) followed by 31-40 (28%), 21-30 (18%), >50 years (14%) and 10-20 years (6%). More cases were observed in females except in age group >50 years. Norfloxacin had the least resistance followed by Ciprofloxacin, Cephalexin and Co-Timoxazole. *E. coli*

found to be highly resistant to Cephalexin, Ciprofloxacin and Co-Trimoxazole(42.9%). Whilst *Klebsiella spp* showed highly resistance (100%) to Cephalexin. Whereas *Staphylococcus auerus* showed highest sensitivity (100%) to used antibiotics. **Conclusion:** The results show that the *E.coli* was the most frequent causative agent in UTIs and antimicrobial resistance patterns of the causes of UTI are highly variable and continuous surveillance of trends in resistance patterns of uropathogens is important. In conclusion; we suggest that empirical antibiotic selection should be based on knowledge of the local prevalence of bacterial organisms and antibiotic sensitivities rather than on universal or even national guidelines.

KEYWORDS: Urinary Tract Infections (UTIs), Antibiotic Susceptibility, Anti Microbial agents, Bacteria, *E.coli*.

INTRODUCTION

The urinary tract contains the urethra, urinary bladder, ureters, and kidneys.^[1] Urinary tract infections (UTIs) are among the most common bacterial infectious diseases encountered in clinical practice, and account for significant morbidity and high medical costs. When it affects the lower urinary tract it is known as a simple cystitis (a bladder infection). Alternatively, it may involve the upper urinary tract, in which case it is known as pyelonephritis.^[2]

UTIs can be grouped into asymptomatic bacteriuria or depending on the site of infection: urethritis, cystitis, or pyelonephritis, and by severity (simple, uncomplicated, complicated, recurrent, or relapsing).^[3]

UTIs are more common in women than men.^[1] In children when a urinary tract infection is associated with a fever, it is deemed to be an upper urinary tract infection.^[4] The most common symptoms are burning with urination and having to urinate frequently and significant pain.^[5] In young children, the only symptom of a urinary tract infection (UTI) may be a fever.^[6]

By far the most common cause (~80%) of UTIs is the gram negative bacteria *Escherichia coli* (*E.coli*). The specific strains that usually cause UTIs are the uropathogenic *E. coli* (UPEC) ^[7,8] with *Staphylococcus saprophyticus* being the cause in 5-10%. Rarely they may be due to viral or fungal infections.^[9] Other bacterial causes UTIs include: *Klebsiella*,

Proteus, *Pseudomonas* and *Enterobacter*.^[4] Urinary tract infections due to *Staphylococcus aureus* typically occurs secondary to blood born infections¹. Urinary tract infections are the problems that are faced by millions of people every year.^[10]

Early initiation of antibiotic treatment following suspicion of UTI is thought to decrease the risk of kidney scarring.^[11] Early and appropriate treatment during the first 24 hours after onset of symptoms however may diminish the likelihood of kidney involvement during the acute phase of the infection.^[12] Delayed treatment may lead to complications such systemic sepsis and abscess formation.^[13]

Antimicrobial resistance of uropathogens is increasing worldwide.^[29] Especially resistance of *E. coli* and other Enterobacteriaceae. In addition Methicillin-resistant *Staphylococcus aureus* (MRSA) and Vancomycin resistant *Enterococcus spp.* They play an important role in hygienic issues in patients.^[14] *E.coli* resistance to B-lactam antibiotics as high as 37.7% and to Trimethoprim–Sulfamethoxazole as 21.3%^[15], thus making these agents inadequate as first line treatment for UTI^[16]. The final choice of antibiotic should be based on pathogen identification and sensitivity test from urine culture.^[17] Cephalosporin and Amoxicillin-Clavulanic acid are the oral antibiotics most often used.^[18] The choice of intravenous antibiotics is usually a Cephalosporin combined with an Aminoglycoside. Although, no particular antibiotic choice has been shown to be superior.^[19, 20] However, it must be noted that the best method of directing antibiotic choice will be based in resistance patterns in a given institution or region. However, following the increasing of *E. coli* and other bacteria to first line antibiotics there has been a rise in the rate of UTIs.^[21] As example; the healthcare costs from UTIs in the U.S. is estimated to be over 2.3 billion dollars per year.^[22]

Objectives

1. To determine the etiological bacterial pathogens of the UTIs.
2. To determine the antibiotic sensitivity pattern of isolated bacteria.

MATERIALS AND METHODS

Study area: A cross sectional study was conduct from March to May 2012 to evaluate UTIs in Khartoum state (Sudan).

Study location: Samples were collected from patients from National Centre for Radiotherapy and Nuclear Medicine.

Statistical analysis: The obtain results were statistically analyze using prevalence by Excel.

Laboratory work: based on Monica Cheesbrough 2006.^[23]

A 50 specimens of clean catch mid-stream urine were collected from patient in sterile, screw capped, leaf proof disposable plastic container, each specimen had been kept in ice for less than one hour till reaching the laboratory.

Isolation of bacteria: Specimens were cultured by inoculation on general, enriched and selective agar and incubated in an atmosphere containing 5% carbon dioxide. Cultures were classified according to the standard criteria used in laboratory; any count of 10^5 /ml of Gram negative pathogen, or Gram positive pathogen in pure growth considered as **Positive** (infection). Currently, bacteria from urine are identified by using identification tests include biochemical tests such as Motility, Indole, Urease medium. Also other tests were conducted include citrate utilization test, oxidase test and carbohydrate fermentation tests using TSI and KIA.

Antimicrobial susceptibility testing: Antibiotic sensitivity test was performed by disc diffusion method (Kirby-Bauer's technique) using commercially available discs (Hi Media, India), and the results were recorded following the instruction of manufacturer. These test discs used included: Cotrimoxazole (1.25/23.75 mcg), Cephalexin (30 mcg), Ciprofloxacin (5mcg) and Norfloxacin (10 mcg).

RESULTS

Bacterial etiology of UTIs in patients admit in National centre for Radiotherapy and Nuclear Medicine (Al Zara hospital) - Khartoum state (Sudan) (during the study period) was determined.

The result of this study revealed that positive specimens which showed positive bacterial growth were 90 % (n=45). However, 10% (n=5) showed negative growth, but the patients had urinary tract infection symptoms. This is may be due to other causative agents not detected by this study, vide table.^[1]

Table (1): The distribution of positive and negative urine samples

Item	Number	%
Positive growth	45	90
Negative growth	5	10
Total of samples	50	100

The present study results determine that in under test samples the most frequency belongs to *E. coli* bacterium (31.1% of the whole sample positive) and in the next class *Klebsiella spp* (13.3%) and *Staphylococcus aureus* (11.2% of the whole sample positive) which all are detailed in table(2)

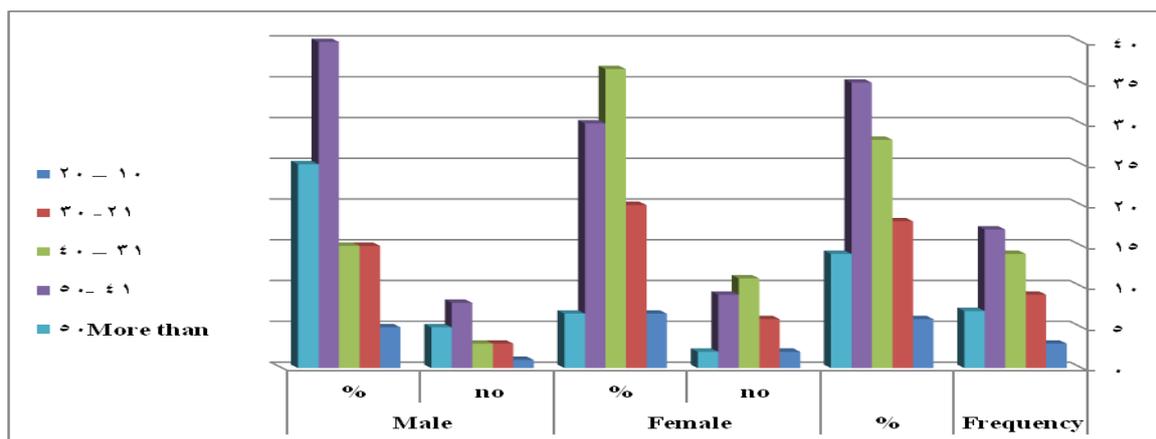
Table (2) Frequency and distribution of isolated pathogens

Organism	Frequency	Percentage %
<i>Escherichia coli</i>	14	31.1
<i>Klebsiella spp</i>	6	13.3
<i>Staphylococcus aureus</i>	5	11.2
<i>Proteus spp</i>	4	8.9
<i>Pseudomonas aeruginosa</i>	4	8.9
<i>Enterococcus faecalis</i>	3	6.7
<i>Salmonellae spp</i>	3	6.7
<i>Staphylococcus epidermidis</i>	2	4.4
<i>Enterobacter</i>	2	4.4
<i>Staphylococcus saprophyticus</i>	1	2.2
<i>Citrobacter</i>	1	2.2
Total	45	100

The highest susceptible age group of patients to UTI was 41 -50 years (34%) followed by 31-40 years (28%), 21-30 years (18%), more than 50 years (14%) and 10-20 years (6%). Comparatively, however, more cases of UTI were observed in females than in males in all age groups except in age group more than 50 years (Table: 3).

Table (3): Prevalence of UTI in different age groups and genders

Age range	Frequency	%	Female		Male	
			no	%	no	%
10 – 20	3	6%	2	66.7	1	33.3
21– 30	9	18%	6	66.7	3	33.3
31 – 40	14	28%	11	78.6	3	21.4
41 – 50	17	34%	9	52.9	8	47.1
More than 50	7	14%	2	28.6	5	71.4
Total	50	100%	30		20	



Prevalence of UTI in different age groups and genders

The antimicrobial potency and spectrum of four selected antimicrobial agents (common used in Sudan), against the UTIs pathogens recorded in the study are summarized in table (4). Norfloxacin had the least resistance followed by Ciprofloxacin, Cephalexin and Co-Trimoxazole respectively.

The sensitivity pattern of bacterial isolates against a number of antibiotics revealed that *E. coli* was the highest bacteria isolated from urinary tract infection exhibited various rate of sensitivity to all used antibiotics (Cephalexin, Ciprofloxacin, Norfloxacin and Co-Trimoxazole) as shown in table (4), followed by *Staphylococcus auerus* which showed highest sensitivity(100%) to all used antibiotic (Table 4).

Table (4) Illustrate antibiotic susceptibility test: sensitivity of isolated bacteria to used antibiotics

Name of isolated bacteria	Cephalexin		Ciprofloxacin		Norfloxacin		Co-Timoxazole	
	S (n) %	R (n)%	S (n)%	R (n)%	S (n)%	R (n)%	S (n)%	R (n)%
<i>Escherichia coli</i>	(8)57.1%	(6)42.9%	(8)57.1%	(6)42.9%	(14)100%	(0)	(8)57.1%	(6)42.9%
<i>Klebsiella SPP</i>	(6)100%	0	(6)100%	(0)	(6)100%	(0)	(5)83.3%	(1)16.7%
<i>Staphylococcus aureus</i>	(5)100%	(0)	(5)100%	(0)	(5)100%	(0)	(5)100%	(0)
<i>Proteus spp</i>	(4)100%	(0)	(4)100%	(0)	(4)100%	(0)	(0)	(4)100%
<i>Pseudomonas aeruginosa</i>	(4)100%	(0)	(4)100%	(0)	(4)100%	(0)	(4)100%	(0)
<i>Enterococcus faecalis</i>	(3)100%	(0)	(3)100%	(0)	(3)100%	(0)	(3)100%	(0)
<i>Salmonellae spp</i>	(3)100%	(0)	(3)100%	(0)	(3)100%	(0)	(3)100%	(0)
<i>Staphylococcus epidermidis</i>	(2)100%	(0)	(2)100%	(0)	(2)100%	(0)	(0)	(2)100%
<i>Enterobacter</i>	(2)100%	(0)	(2)100%	(0)	(2)100%	(0)	(0)	(2)100%
<i>Staphylococcus saprophyticus</i>	(1)100%	(0)	(1)100%	(0)	(1)100%	(0)	(1)100%	(0)
<i>Citrobacter</i>	(1)100%	(0)	(1)100%	(0)	(1)100%	(0)	(1)100%	(0)

DISCUSSION

Urinary tract infections are common conditions worldwide, particularly in developing countries, and the pattern of antimicrobial resistance varies in different regions. This study evaluate the relationships between sex, age, and isolated bacterial agents and antibiotic resistance of UTIs.

This study provides valuable data to compare and monitor the status of antimicrobial resistance among uropathogens to improve efficient empirical treatment. Increasing antimicrobial resistance has been documented globally.^[24, 25]

The study showed a high prevalence of UTIs in females n=30 (60%) than in males n=20 (40%) which correlates with other findings, revealed that the frequency of UTIs is greater in females as compared to males.^{[26, 27] and [30]} The reason behind this high prevalence of UTIs in females is due to close proximity of the urethral meatus to the anus, shorter urethra, sexual intercourse, incontinence, and bad toilet.^[31]

The occurrence of UTIs recorded among the 41-50 years, 34% compared to young age patients (21-30 years, 18%; 10-20 years, 6%) and middle-age patients (31-40 years, 28%) in this study partly similar to the studies done in Kuwait^[32] and Nigeria^[29,33] in which the highest incidence of UTIs was recorded among the age group 20 to 50 years (63.4 and 74.7%, resp.), and lowest among the age group >50 years (13.3 and 10.3%, resp.). However, the results agree with the study done in Japan with a 20-year period in which a trend of increasing complicated UTIs was reported in elderly patients.^[34] The study proved that, the elderly males (≥ 50 years) had a higher incidence of UTIs (71.4%) when compared with the elderly females (28.6%). This finding is similar to a study conducted at a tertiary care hospital in Jaipur, Rajasthan, India.^[30] The main cause behind this increasing incidence of UTI with advancing age in males is due to prostate enlargement and neurogenic bladder.^[35] This factor is also reported by other authors whose studies showed that the prostate disease in males is responsible for the increase in incidence of UTI and decrease in female: male ratio in patients above 50 years.^[36] Females of the age group 31 - 40years were found more susceptible (78.6) to UTI followed by 21-30 years (66.7) ,41-50 years (52.9%), 10-20 years and ≥ 50 years (28.6%). These findings correlate with other reports which showed that females are more prone to UTIs than males during adolescence and adulthood.^[37, 38, 39, 40] The highest incidence of UTIs among female to male ratio was found in the age group of 31 - 40years (3.7 : 1) followed by 10-20 years and 21- 30 years (2 : 1), 41 -50years (1.1 : 1), and

≥50 years (0.4 : 1). These findings differ from other reports^[41, 42] which stated a lower female to male ratio in neonates and young children. The prevalence rate of UTI in boys depends on many factors including congenital malformations and uncircumcised genitalia which are often contaminated.^[41]

A variety of Enteropathogenic bacteria are known to cause UTI worldwide. *E. coli* being the predominant aetiological agent in community practice. Other bacterial agents include species of *Klebsiella*, *Enterobacter*, *Proteus*, *Pseudomonas*, *Staphylococcus*, *Streptococcus* and *Enterococcus faecalis*.^[35, 44] In this study, *E.coli* and *Klebsiella spp* represents (31.1%), (13.3%) respectively, both of them were recorded as the predominant bacteria causes UTIs, this finding similar to the study done by.^[43, 44, and 45] Moreover as is evident from the results, this study demonstrated *E. coli* to be the predominant aetiological agent amongst the gram negative bacilli and *Staphylococcus aureus* amongst gram positive bacteria as the causative agents of UTIs. These findings are similar to other studies conducted by.^[46, 47, and 48]

Other isolated bacteria from UTI cases in this study was *Staphylococcus aureus* (11.2%), *P. aeruginosa* (8.9%), *Proteus spp.* (8.9%), *Enterococcus faecalis* (6.7%), *Salmonellae spp.* (6.7%), *S. epidermidis* (4.4%), *Enterobacter spp.* (4.4%), *S. saprophyticus* (2.2) and *Citrobacter* (2.2). These findings were not correlate with other reports in which *P. aeruginosa* was reported as the second most common bacterial isolate in UTI studies in India^[40] and Lafia, Nigeria^[39] however, these results correlates with others in which *Klebsiella spp* was reported as the second most frequently isolated organism in UTIs.^[49,50]

It must be borne in mind, that the variations in antimicrobial susceptibility in different countries and within states in our country, may depend upon the easy availability of antimicrobial drugs over the counter. Cephalexin, Ciprofloxacin, Norfloxacin and Co-Trimoxazole are very commonly used over the counter drugs for UTIs treatment in our country Also various reports indicate that the level of resistance in different parts of the world varies from 18 to 50 percent which is probably associated with the consumption rate of this drug.^[51, 52]

The results of this study suggest that Norfloxacin had effectiveness(100%) against all isolated bacteria in this study, followed by Ciprofloxacin, the highest sensitivity belongs to all most isolated bacteria (100%), with less sensitivity against *E. coli* (57.1%) this was partially agree

with report stated by Gupta et al^[50], Gales et al^[51], Yousefi et al and^[52] Goettsch et al^[53]. The study reflect, that Cephalexin and Co-Trimoxazole respectively. *E.coli* exhibited (42.9%) resistant to Cephalexin, Ciprofloxacin and Co-Timoxazole. Whereas *Klebsiella spp* showed (100%) resistance to Cephalexin and (83.3%) to Co-Timoxazole, furthermore, *Proteus spp*, *Staphylococcus epidermidis* and *Enterobacter* were showed resistance (100%) to Co-Timoxazole.

CONCLUSION

The study conclude that the *E.coli* was the most frequent causative agent in UTIs and antimicrobial resistance patterns of the causes of UTIs are highly variable and continuous surveillance of trends in resistance patterns of uropathogens is important.

In conclusion; we suggest that empirical antibiotic selection should be based on knowledge of the local prevalence of bacterial organisms and antibiotic sensitivities rather than on universal or even national guidelines.

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REFERENCES

1. Cash P. Proteomic analysis of uropathogenic *Escherichia coli*. *Expert Rev Proteomics* 2014; 11: 43-58.
2. Lane D R. and Takhar SS. Diagnosis and management of urinary tract infection and pyelonephritis. *Emergency medicine clinics of North America* 2011; 29: 3-539-52.
3. National Guideline Clearinghouse. Clinical practice guideline for urinary tract infection in children, 2011; 259-274.
4. Salvatore S S, Salvatore E, Cattoni G, Siesto M, Serati P, Sorice and Torella M. Urinary tract infections in women. *European Journal of Obstetrics. Gynecology and Reproductive Biology*, 2011; 156: 2- 131-6.
5. Bhat R G, T A Katy and FC Place. Pediatric urinary tract infections. *Emergency medicine clinics of North America*, 2011; 29(3): 637-53.
6. Nicolle LE. Uncomplicated urinary tract infection in adults including uncomplicated pyelonephritis. *Urol Clin North Am*, 2008; 35(1): 1-12.

7. Totsika M, Moriel DG, Idris A, Rogers BA, Wurpel, et al. Uropathogenic *Escherichia coli* mediated urinary tract infection. *Curr Drug Targets*, 2012; 13: 1386-1399.
8. Dielubanza EJ, Schaeffer AJ. Urinary tract infections in women. *Med Clin N Am* 2011; 95: 27-41.
9. Amdekar S, V Singh and DD Singh. Probiotic community therapy :immunomodulating approach toward urinary tract infection. *Current Microbiology* 2011; 63(5): 484-90.
10. Tanagho EA and JW Mc Aninch. Editors. *Smiths' General urology*. 15th edition. Philadelphia. McGraw Hill 2000.
11. Doganis D, Sifas K, Mavrikou M, Issaris G, Martirosova A, et al. Does early treatment of urinary tract infection prevent renal damage? *Pediatrics*, 2007; 120: 922-928.
12. Zhanel GG, Hisanaga TL, Laing NM, DeCorby MR, KA Nichol, et al. Antibiotic resistance in *Escherichia coli* outpatient urinary isolates: final results from the North American Urinary Tract Infection Collaborative Alliance. *Int J Antimicrob Agents* 2006; 27: 468-75.
13. Prelog M, Schiefecker D, Fille M, Wurzner R, Brunner A, et al. Febrile urinary tract infection in children: ampicillin and trimethoprim insufficient as empirical mono-therapy. *Pediatr Nephrol* 2008; 23: 597-602.
14. Bjerklund Johansen TE, Cek M, Naber K, Stratchounski L, Svendsen MV, et al. Prevalence of hospital-acquired urinary tract infections in urology departments. *Eur Urol* 2007; 51: 1100-1111.
15. Oreskovic NM, Sembrano EU. Repeat urine cultures in children who are admitted with urinary tract infections. *Pediatrics*, 2007; 119: 325-329.
16. Currie ML, Mitz L, Raasch CS, Greenbaum LA. Follow-up urine cultures and fever in children with urinary tract infection. *Arch Pediatr Adolesc Med*, 2003; 157: 1237-1240.
17. Cheng CH, Tsai MH, Huang YC, Su LH, Tsau YK, Lin CJ, et al. Antibiotic resistance patterns of community-acquired urinary tract infections in children with vesicoureteral reflux receiving prophylactic antibiotic therapy. *Pediatrics*, 2008; 122:1212-1217.
18. Keren R, Chan E. A meta-analysis of randomized, controlled trials comparing short- and long-course antibiotic therapy for urinary tract infections in children. *Pediatrics*, 2002; 109: E70-70.
19. Montini G, Tullus K, Hewitt I. Febrile urinary tract infections in children. *N Engl J Med*, 2011; 365: 239-250.

20. Copp HL, Halpern MS, Maldonado Y, Shortliffe LD. Trends in hospitalization for pediatric pyelonephritis: a population based study of California from 1985 to 2006. *J Urol*, 2011; 186: 1028-1034.
21. Foxman B. The epidemiology of urinary tract infection. *Nat Rev Urol*, 2010; 7: 653-660.
22. Monica Cheesbrough. *Medical laboratory manual for tropical countries*, 2006; 2: 148-323.
23. Jani M, S. Shah, and S. Prajapati. "Antibacterial screening and qualitative phytochemical estimation of selected aquatic plants." *Advances in Biological Research* 2012; 6: 19–23.
24. F R M Rashedmarandi and M Saremi. "A survey on urinary pathogens and their antimicrobial susceptibility among patients with significant bacteriuria." *Iranian Journal of Pathology* 2008; 3: 191–196.
25. V Rajalakshmi and V Amsaveni. "Antibiotic susceptibility of bacterial pathogens isolated from diabetic patients." *International Journal of Microbiological Research*, 2012; 3: 30–32.
26. A García-Morúa, A Hernández-Torres, J L Salazar-de-Hoyos, R Jaime-Dávila, and L S Gómez-Guerra. "Community acquired urinary tract infection etiology and antibiotic resistance in a Mexican population group." *Revista Mexicana de Urología*, 2009; 69: 45-48.
27. H W Boucher, G H Talbot, J S Bradley et al. Bad bugs. No drugs: no ESKAPE! An update from the Infectious Diseases Society of America. *Clinical Infectious Diseases*, 2009; 48: 1–12.
28. B Henry Oladeinde, R Omoregie, M Olley and J A Anunibe. Urinary tract infection in a rural community of Nigeria. *North American Journal of Medical Sciences*, 2011; 3: 75–77.
29. S Sood and R Gupta. Antibiotic resistance pattern of community acquired uropathogens at a tertiary care hospital in Jaipur, Rajasthan. *Indian Journal of Community Medicine*, 2012; 37: 39–44.
30. O A Aiyegoro, O O Igbinosa, I N Ogunmwonyi, E Odjajaro, O E Igbinosa and A I Okoh. Incidence of urinary tract infections (UTI) among children and adolescents in Ile-Ife Nigeria. *African Journal of Microbiological Research*, 2007; 1: 13–19.
31. T S Dimitrov, E E Udo, F Awni, M Emara and R Passadilla. Etiology and antibiotic susceptibility patterns of community-acquired urinary tract Infections in a Kuwait Hospital. *Medical Principles and Practice*, 2004; 13: 334–339.

32. O Omigie, L Okoror, P Umolu and G Ikuuh. Increasing resistance to quinolones: a four-year prospective study of urinary tract infection pathogens. *International Journal of General Medicine*, 2009; 2: 171–175.
33. K Shigemura, K Tanaka, H Okada et al. Pathogen occurrence and antimicrobial susceptibility of urinary tract infection cases during a 20-year period (1983-2002) at a single institution in Japan. *Japanese Journal of Infectious Diseases*, 2005; 5: 303–308.
34. R N Das, T S Chandrashekhar, H S Joshi, M Gurung, N Shrestha and P G Shivananda. Frequency and susceptibility profile of pathogens causing urinary tract infections at a tertiary care hospital in western Nepal. *Singapore Medical Journal*, 2006; 4: 281–285.
35. S Shankel. *Urinary Tract Infections Genitourinary Disorders*. The Merck Manuals Online Medical Library 2007.
36. A S Kolawole, O M Kolawole, Y T Kandaki Olukemi, S K Babatunde, K A Durowade and C F Kolawole. Prevalence of urinary tract infections (UTI) among patients attending Dalhatu Araf Specialist Hospital. Lafia Nasarawa State, Nigeria. *International Journal of Medicinal Medical Sciences*, 2009; 1: 163–167.
37. D H Tambekar, D V Dhanorkar, S R Gulhane, V K Khandelwal and M N Dudhane. Antibacterial susceptibility of some urinary tract pathogens to commonly used antibiotics. *African Journal of Biotechnology* 2006; 5: 1562–1565.
38. M Akram, M Shahid and A U Khan. Etiology and antibiotic resistance patterns of community-acquired urinary tract infections in J N M C Hospital Aligarh India. *Annals of Clinical Microbiology and Antimicrobials* 2007; 6: 4.
39. I Shaifali, U Gupta, S E Mahmood and J Ahmed. Antibiotic susceptibility patterns of urinary pathogens in female outpatients. *North American Journal of Medical Sciences* 2012; 4: 163–169.
40. A N Kebira, P Ochola and S A Khamadi. Isolation and antimicrobial susceptibility testing of *Escherichia coli* causing urinary tract infections. *Journal of Applied Biosciences*, 2009; 22: 1320–1325.
41. E Kalantar, M E Motlagh, H Lornejad and N Reshadmanesh. Prevalence of urinary tract pathogens and antimicrobial susceptibility patterns in children at hospitals in Iran. *Iranian Journal of Clinical Infectious Diseases* 2008; 3: 149–153.
42. Nicolle LE. Epidemiology of urinary tract infection. *Infect Med* 2001; 18: 153–62.
43. Gorbach SL, Bartlett JG, Blacklow NR. *Infectious Diseases*. Philadelphia: Lippincott Williams and Wilkins 2004.

44. Russell LC, Freddy MC, Michael BS, Ralph AL. The predictability of urinary pathogens based on the urinalysis nitrite test in hospitalized patients. *Hospital Pharm J*. 2007; 42(1): 52-6.
45. Orret FA, Davis GK. A comparison of antimicrobial susceptibility profile of urinary pathogens for two years 1999 and 2003. *West Indian Med J*, 2006; 55: 95–9.
46. Gupta V, Yadav A, Joshi RM. Antibiotic resistance pattern in uropathogens. *Indian J Med. Microbiol*, 2002; 20: 96-8.
47. Ryan KJ. Urinary tract infections In: Ryan KJ, Ray CG, ed. *Sherris Medical Microbiology*. New York: McGraw-Hill, 2004; 867–71.
48. Jombo GTA, Ayilara AO, Bello NK, Dakum, Enenebeaku MNO. Antimicrobial susceptibility profiles of uropathogenic bacterial isolates from community and hospital – acquired urinary tract infection in Yobe state , Nigeria. *Journal of Medical laboratory Sciences*, 2005; 14(2): 54-60.
49. Onyemelukwe NF, Obi SN, Ozumba BC. Significant bacteriuria in pregnancy in Enugu, Nigeria. *Journal of College of Medicine*, 2003; 8: 20-22.
50. Gupta, K A, D Scholes and WE Stamm. Increasing of antimicrobial resistance among uropathogens causing acute uncomplicated cystitis in women. *JAMA*, 1999; 281: 736-38.
51. Gales, A C, R N Jones, K A Gordon, H S Sader, W W Wilke and M L Beach, M A Pfaller, G V Doern. Activity and spectrum of 22 antimicrobial agents tested against urinary tract infection pathogens in hospitalized patients in Latin America: report from the second year of the SENTRY antimicrobial surveillance program (1998). *J Anti microb Chemother* 2000; 45(3): 295-303.
52. Yousefi Mashouf R and M Yaghoubi. Study in the relationship between the bacterial factors and laboratory findings in urinary tract infections of adults and the drug sensitivity of strains isolated from patients in health centers of Hamedan September 1997-98. *Journal of Medical Sciences in Kurdistan University*, 1998; 12: 10-16.
53. Goettsch W, W Van Pelt, N Nagelkerke, M G Hendrix, A G Buiting, P L Petit, L.J Sabbe, A J Van Griethuysen and A J De Neeling. Increasing resistance to fluoroquinolones in *Escherichia coli* from urinary tract infections in The Netherlands. *Antimicrob Agents Chemother*, 2000; 46: 223-28.