

<http://www.pjbs.org>

PJBS

ISSN 1028-8880

**Pakistan
Journal of Biological Sciences**

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Prevalence Patterns of Community-based and Nosocomial Urinary Tract Infection Caused by *Escherichia coli*

¹Sobia Rafique, ¹Arifa Mehmood, ¹Mazhar Qayyum and ²Ali Abbas Qazilbash

¹ Department of Biological Sciences, University of Arid agriculture, Rawalpindi, Pakistan

² Sustainable Development Policy Institute, Islamabad, Pakistan

Abstract: A total of 200 urine samples were collected from suspected *E. coli* associated UTI patients. Antibiotic sensitivity of isolates was carried out against commercially available antibiotics using the disc diffusion method on Mueller-Hinton Agar. The incidence of *E. coli* was found to be higher in females than in males, as out of 200 urine samples, 132 were females and 68 were males. With regards to age-wise distribution, this study revealed that among the females the incidence was reported in all age categories with the highest being in the post-menopausal and the infant age groups, while for males the incidence was high in the older age group (above 50 years). The prevalence of *E. coli* was more in out – patients (OPD) than the in- patients (IPD) as there were 141 OPD samples and 95 IPD samples, thereby indicating that this infection also has a community-based source of transmission. *E. coli* isolates were reported to be the most sensitive to imipenem and tazobactam, while the greatest resistance of these isolates was against ampicillin and trimethoprim sulfamethoxazole.

Key words: UTI, *E. coli*, nosocomial & community-based infections

Introduction

In humans, *E. coli* is the most common cause of urinary tract infection (UTI). Approximately 85% of urethra cystitis is caused by *E. coli* (Guentzel, 1991).

UTI causing *E. coli* usually originate in large intestine as resident or transient members of colon flora and may exist as the dominating or minority strain. Strains that cause UTI are selected from fecal flora due to their special adaptation of urinary tract epithelial mucosa. Moreover, strains of *E. coli* isolated from UTI in immune competent hosts differ from the strains isolated from the host-compromised by instrumentation (e.g. catheterization) or by other defect of urinary tract (Mahon and Manuselis, 1995).

In the urinary tract, the multiplication of organisms interferes with normal function of involved organ that causes the disease. UTIs are found in all age groups, beginning with neonates. The incidence of UTIs in men is extremely low from adulthood to the age of 65 years and is associated with anatomic abnormalities or prostatic disease, with resultant instrumentation. However, during this time as many as one fifth of women experiences asymptomatic UTI. The frequency of UTIs increases, for both sexes in the patients older than 65 years (Thomas, 1995).

As in females, the urethra is short and the area around the urethral opening is densely colonized with potential pathogens that make the females susceptible to UTI. Urinary tract infections are developed in the hospitalized patients more frequently than the out-patients. The difference is due to the general ill conditions of the hospitalized patients and the higher probability of urinary tract instrumentation (Ronald and Alfa, 1991).

Community-acquired and nosocomial infections, especially urinary tract infections, predispose the causative agent to antibiotic resistance. A major clinical problem is urinary tract infection worldwide. Most women experience at least one infection and many suffer multiple recurrences. The most common nosocomial infections are catheter-associated UTI that are frequent source of bacteremia. Although conventional antibiotics are usually quite effective in treating, or preventing UTI, but resistance to antimicrobials is rapidly emerging among uro-pathogens (Stamm and Norby, 2001).

Most of *E. coli* strains were normally sensitive to most of antibiotics and chemotherapeutic agents, but in recent years resistance has been encountered in many cases. Therefore, to minimize the hazards of drug resistance and to avoid economic losses on treatment, it is advisable to perform antibiotic sensitivity test. Most of the isolates show resistance towards cephaloridine, cephradine, cephalexin, cephalosin, flumequine, gentamycin and tetracycline (Hameed *et al.*, 1995).

There is a gradual increasing antibiotic resistance in both community and nosocomially acquired UTI causing uro-pathogens. Even in women with acute uncomplicated UTI, increasing resistance to ampicillin (30% - 40%), cephalothin (20%-30%), and TMP-SMX (15% - 20%) has been demonstrated in causative *E. coli* (Gupta *et al.*, 1999).

With such prevailing conditions, complicated with the fact that poor personal hygiene practices and excessive use of antibiotics in Pakistan, this study was designed to ascertain prevalence pattern of *E. coli* as causative agent among UTI patients and to determine if there is a correlation with reference to community-based and nosocomial infections in Islamabad. In addition the antibiotic sensitivity pattern will be determined to evaluate the extent of resistivity amongst strains of *E. coli* associated with UTI.

Materials and Methods

Two hundred urine samples from patients referred by doctors as suspected UTI were collected and transported to the laboratory at the Department of Biological Sciences, University of Arid Agriculture, Rawalpindi.

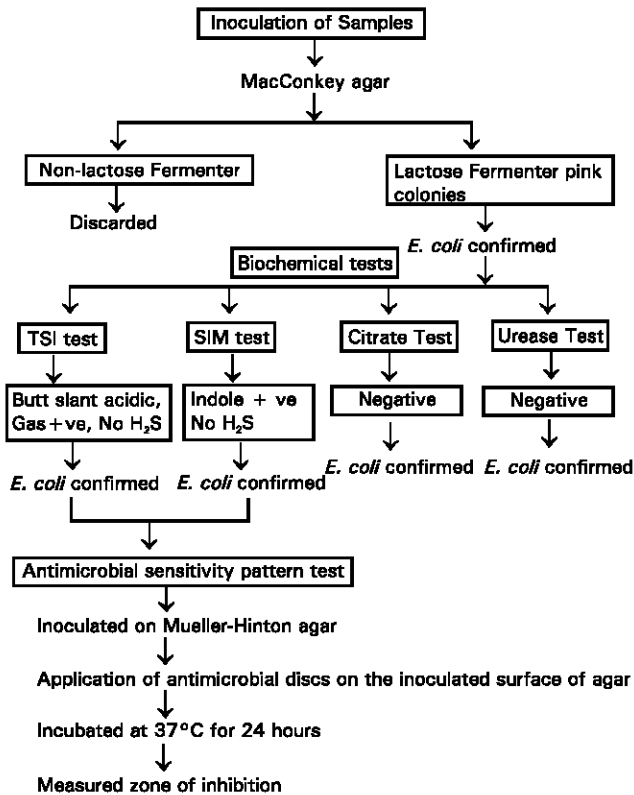
The urine samples were subsequently cultured on MacConkey agar and incubated for 24-48 hours at 37°C. *E. coli* colonies were identified initially morphologically and the species was verified by biochemical tests, such as Triple-Sugar Iron (TSI), Sulfur Indole Motility (SIM), citrate and urease tests (Annexure 1).

Antibiotic sensitivity test for *E. coli*: After confirmation that the isolates were indeed *E. coli*, a suspension was made by mixing colonies in peptone water. This suspension was streaked on Mueller – Hinton Agar plate using sterile cotton swab. Commercially available antibiotic discs were applied on inoculated surface of agar and the plates were incubated at 37°C for 24 hours. Susceptibility of *E. coli* to antibiotics was determined according to the size of zone of inhibition (Thomas, 1995).

Results and Discussion

All 200 urine samples, taken from confirmed UTI cases, were found to be positive for *E. coli*. The sex-wise distribution pattern showed a decided inclination towards one sex as, there were 132 urine samples were from female and 68 from male patients. The patient status also revealed a unique pattern in that of these 200 UTI patients, 141 were outpatients (OPD) and 59 were in-patients (IPD). Of the OPD samples, 95 were from females and 46 from males (Table 1).

As for the age-wise prevalence pattern of *E. coli* associated UTI, this study showed an interesting pattern, in that there was a higher incidence of the ailment amongst the menopause and post-



Annexure 1: Flow chart of *E. coli* isolation and identification

Table 1: Sex wise and In-patients and out patients incidence of *E. coli*

SEX	NO. OF PATIENTS	OPD	IPD
Females	132	95	36
Males	68	46	23
Total	200	141	59

Table 2: Age wise incidence of *E. coli* isolated from urine samples

Age Range (Years)	Females	Males	
Infancy – Childhood	0 – 9	18	2
Adolescence - Teenage	10 – 19	7	0
Reproductive age	20 – 29	19	14
	30 – 39	12	5
	40 – 49	14	8
Menopause	50 – 59	17	8
	60 – 69	24	15
Post-Menopause	70 – 79	14	11
	80 – 89	7	5

menopausal group of women. Of the 132 female UTI cases, 76 (58%) were above the age of 40 years – the age normally taken as being the onset of menopause (Raz, 2001). However, what is more interesting is that 56 of the female UTI cases were in the pre-menopausal age category, with 18 amongst infants and children (Table 2). In males, the incidence was higher in the older age categories, in that of the 68 UTI cases, 39 (57%) were above 50 years of age. Interestingly, the results of this study show that, in the 20 – 29 years age category, both males and females showed an unusually high incidence of UTI, 14 male and 19 female cases were reported (Table 2).

Antibiotic sensitivity of *E. coli* isolated from urine samples showed that imipenem and tazobactam were the most effective drugs as 199 and 198 of the *E. coli* isolates were found to be sensitive to these drugs, respectively. One hundred and fifty-seven (78.5%) of the *E. coli* isolates were found to be resistant to ampicillin and trimethoprim-sulfamethoxazole/co-trimexazole (Table 3).

Table 3: Antibigram of *E. coli* isolated from urine samples

Antibiotics	Sensitive	Resistant	Intermediate
Imipenem	199	1	
Tazobactam - Tazocin	198	2	
Amikacin	198	2	
Nitrofuratoin	181	19	
Ceftizoxime	164	36	
Cefepime	160	39	1
Cefpirom – Cefrom	147	53	
Tobramycin	141	58	1
Aztreonam – Azactam	137	63	
Ceftriaxone – Rocephin	131	68	1
Gentamicin	127	73	
Cefotaxime – Claforan	125	75	
Cefpodoxime – Orelox	119	81	
Cephaclo	110	75	
Ciprofloxacin – Ciproxin	108	92	
Norfloxacin	107	92	1
Ofloxacin – Tarivid	105	95	
Ampicillin	43	157	
Trimethoprim-Sulfamethoxazole/ Co-Trimaxazole	43	157	

E. coli is an important pathogen in human and the most common cause of UTI. *E. coli* causes approximately 85% of urethra and bladder infections. UTI causing *E. coli* originate in large intestine, organisms travel up the urethra to the bladder and ascend further to kidneys – resulting more often than not in what is termed as an “ascending infection” (Guentzel, 1991).

In this study under discussion, all 200 urine samples collected showed *E. coli* as the causative agent of UTI and that such cases were predominantly found in females, especially among the very young and the elderly. The age-wise distribution pattern of *E. coli* associated UTI, reported in this study, showed that in female UTI cases incidence was more common in the post-menopausal age group, as 76 of the 132 positive cases belonged to 40 years plus age category. What was also interesting to note in this study, was that 18 cases of UTI were found among the very young girls (0 – 9 years old). This shows that not only are women more susceptible to UTI, as their urethra is short and the area around urethra opening is densely colonized with potential pathogens, but also girl children are also prone to UTI, especially those not yet toilet-trained. Among post-menopausal women, anatomic or functional defects may be contributing factors of UTI, as there is a decrease in the estrogen level that results in the colonization of *E. coli*. Such findings have also been reported by other researchers (Ronald and Alfa, 1991; Raz, 2001). In addition, in the very young, the condition is also prevalent which may be due to the poor personal hygiene practices and inadequate training and awareness. Among males, although the incidence rate was much less, the trend of infection was similar, in that the rate of UTI was high in the elderly, i.e. 39 cases among the 50 years and older age group. These findings are in agreement with those reported by other researchers (Stamm and Norby, 2001).

An interesting point to note here is that the study under discussion revealed that in the 20 – 29 years age group – the reproductive age - the incidence of *E. coli* associated UTI was high in both sexes. In this age category 19 women and 14 men were found to be positive for UTI, an aspect that needs to be further investigated as to cause of such an incidence. There seems to be too much of coincidence to just label it as other physiological, or medical reasons behind these findings. Of course it may be argued that these patients may have undergone some type of urinary bladder surgery that may have required catheterization (Ronald and Alfa, 1991; Stamm and Norby, 2001). But then again this was not established in our study.

As for the patient status, this study revealed that there was higher rate of community-based than nosocomial UTI. There were 141 OPD, as compared to 59 were IPD cases of urinary tract infection. This is contrary to the findings of other researchers (Ronald and Alfa, 1991). The reason for this difference may be a culmination of reasons stemming from poor hygienic conditions within our community, our house-hold, a lack of education and

proper personal hygiene practices. Plus with the high incidence amongst women, it may be plausible to assume that these women have small children who have not been toilet-trained, or during washing may contaminate their hands, nails etc. Furthermore another rationale for the high rate of community-based infection may be due to the fact that in a society such as that found in Pakistan, female illnesses are not taken that seriously, as compared to male illnesses, which may result in girls and women being asked to stay at home in search for a 'home remedy' for their ailment, rather than being sent to hospitals, where treatment may be too costly.

As for the IPD cases, it is well-documented that hospitalized patients and the higher probability of catheterization (Ronald and Alfa, 1991; Stamm and Norby, 2001; Raz, 2001; Sotto *et al.*, 2001).

Antibiotic sensitivity patterns of *E. coli* isolates from UTI patients revealed that imipenem and tazobactam were the most effective in that over 99% of isolates were sensitive to these antibiotics. As for the resistant strains, the isolates of this study were found to be highly resistant to Trimethoprim – sulfamethoxazole and ampicillin. These findings are in agreement with those reported by other researchers (Gur *et al.*, 1999; Talan *et al.*, 2001).

The resistance of *E. coli* against the antibiotics has been increasing gradually in Pakistan and may be attributed to the non-compliance of patients, easily availability of antibiotics in market without any prescription. Furthermore, this study has highlighted the need for clinicians to perform culture sensitivity tests before prescribing any antibiotic to ensure proper and effective therapy and curb the chances of spread of resistance.

The infections in OPD are community based, and their increased numbers are a reflection on the lack of awareness, education and hygienic conditions within our society as a whole. The infections in IPD are hospital acquired, nosocomial infections, which may be due to numerous factors, including poor patient care in the hospitals, catheterization and other surgical procedures related to the lower abdomen, bowl region (Ronald and Alfa, 1991; Stamm and Norby, 2001; Raz, 2001; Sotto *et al.*, 2001).

Therefore, as a general rule, to control the spread of community-based infections, greater awareness of UTI should be spread through the use of print and electronic media, school-going children should be educated about personal hygiene. With regards to nosocomial infections, better patient care must be emphasized in hospitals, through stricter regimes and administration (Raz, 2001; Sotto *et al.*, 2001).

References

- Guentzel, M.N., 1991. *Escherichia, Klebsiella, Enterobacter, Serratia, Citrobacter and Proteus*. In: Baron, S. (Ed.), *Medical Microbiology* (3rd ed.). Churchill Livingstone, New York. pp: 377–388.
- Gupta, K., D. Scholes and W.E. Stamm, 1999. Increasing prevalence of antimicrobial resistance among uro-pathogens causing acute uncomplicated cystitis in women. *JAMA*, 281: 736–8.
- Gur, D., G. Kanra, M. Ceyhan, G. Seemeer, B. Kanra and M. Kaymakogla, 1999. Epidemiology and antibiotic resistance of gram – negative urinary pathogenic in pediatric patients. *Turk. J. Pediatr.*, 41: 37–42.
- Hameed, A., F. Hassan, T. Javed and M. Azam, 1995. Resistance of enteropathogenic *E. coli* to traditional and third generation antibacterials. *Pak. J. Livestock. Poult.*, (3): 84–88.
- Mahon, C.R., G. Manuselis Jr., 1995. Enterobacteriaceae. In: Mahon, C.R., Manuselis, Jr., G., (Eds.), *Text book of Diagnostic Microbiology*. WB Saunders company, Philadelphia, USA, pp: 447–489.
- Raz, R., 2001. Hormone replacement therapy or prophylaxis in postmenopausal women with recurrent UTI. *J. Infect. Dis.*, 183 (Suppl) : 74–76.
- Ronald, A.R. and M.J. Alfa, 1991. Microbiology of the Genitourinary system. In: Baron, S. (Ed.), *Medical Microbiology* (3rd ed.). Churchill Livingstone, New York, pp: 1169–1176.
- Sotto, A., C.M. De Boever, P. Fabbro-Peray, A. Gouby, D. Sirost and J. Jourdan, 2001. Risk factors for antibiotic – resistant *Escherichia coli* isolated from hospitalized patients with urinary tract infections: a prospective study . *J. Clin. Microbiol.*, 39: 438–444.
- Stamm, W.E. and S.R. Norby, 2001. Urinary tract infections: Disease panorama and Challenges. *J. Infect. Dis.*, 183: 1–4.
- Talan, D.A., W.E. Stamm and T.M. Hooton, 2001. Comparison of ciprofloxacin (7days) and trimethoprim – sulfamethoxazole (14 days) for acute uncomplicated pyelonephritis in women a randomized trail. *JAMA.*, 283: 1583–90.
- Thomas, J.G., 1995. Urinary tract infections. In: Mahon, C.R., Manuselis, Jr., G., (Eds.), *Text book of Diagnostic Microbiology*. WB Saunders company, Philadelphia, USA 1995; 949–969.