Correlation of Demographic Profile and Antibiotic Resistance in Patients with Urinary Tract Infection Attending a Teaching Hospital in Kolkata

Authors

Nilay Chatterjee[1], Reena Ray(Ghosh)[2], Mitali Chatterjee[3], Sandip Chattopadhyay[4]

[1]Dept.of Biomedical Laboratory Science & Management,Vidyasagar Univ. Midnapore

[2,3]Faculty, Dept. of Microbiology, R.G.Kar Medical College & Hospital, Kolkata.

[4]Faculty, Dept. of Biomedical Laboratory Science & Management, Vidyasagar Univ. Midnapore

Corresponding Author

Dr. Reena Ray (Ghosh)

Faculty, Dept. of Microbiology R.G.Kar Medical College & Hospital Kolkata - 700004

ABSTRACT

The aim of this study was to determine the bacterial aetiology of Urinary Tract Infection (UTI) with their resistance to commonly used antimicrobial drugs and their correlation with age, sex and marital status of the patient. A total of 303 urine specimens, collected from suspected cases of UTI were processed and 77 significant monomicrobial cultures were obtained. E.coli was the most common uropathogen isolated, which constituted 37.6% of the total samples followed by Klebsiella (16.8%), Enterococcus (15.6%), Staphylococcus aureus (12.98%), Acinetobactor spp. (6.49%), Proteus spp.(5.19%), Streptococcus spp.(3.89%) & Pseudomonas spp.(1.29%). Females (52.48%) were found more vulnerable to UTI compared to males (47.52%).The percentage of resistance seen in different uropathogens to various antimicrobial agents were: 84.4% to Nalidixic Acid(NA), 83.1% to Cefpodoxim(CPD), 77.9% to Cefdinir(CDR), 75.3% to Augmentin(Amoxy-clav,AG), 53.2% to Piperacillin(PC), 48.0 to Ciprofloxacin(RC), 46.7% to Norfloxacin(NX), 36.4% to Furadantin(FD), 18.2% to Netilmycin(NT) and 15.6% to Polymyxin-B(PB). The percentage of antimicrobial resistance among different uropathogens varied between 84.4% and 15.6%. Maximum resistance to Nalidixic acid was offered by E. coli irrespective of any age group. E.coli showed resistance to majority of antibiotics (except Nalixdic acid and Norfloxacin) in male. The resistance pattern of E.coli against each antimicrobial agent in relation to marital status showed that majority of the antimicrobial agents (except Furadantin, Polymyxin-B and Augmentin) were not effective in controlling infection in married

persons. Thus E. coli was found as the commonest etiological agent of urinary tract infection in both sexes. This study also revealed the strong association between demographic profile of the patient with occurrence of UTI and resistance to antibiotics in uropathogens.

Keywords: *Urinary Tract Infection, Escherichia coli, Resistance pattern, Antibiotic sensitivity*

INTRODUCTION

Urinary tract infection (UTI) is defined as colonization of a pathogen occurring anywhere along the urinary tract kidney, ureter, bladder & urethra [1]. Symptoms of lower urinary tract infection includes painful urination and either increased frequency of urination or urge to urinate (or both), while those of pyelonephritis include fever and flank pain in addition to the symptoms of a lower UTI. UTI are one of the most prevalent extra – intestinal bacterial infections [2]. Nowadays, it represents one of the most common diseases encountered in medical practice affecting people of all ages from neonates to the geriatric age group [3]. Worldwide, about 150 million people are diagnosed with UTI each year [4]. Urinary tract infection (UTI) is one of the most common infections observed in clinical practice among community and hospitalized patients [5]. In fact, urinary tract infections are the second most common infections after infections of the respiratory tract [6], and constitute a great proportion of prescription of antibiotics. Inappropriate and empirical use of wide spectrum antibiotics, insufficient hygiene, immunosuppression and prolonged hospitalization are some of the major aetiological factors that elevate the chances of infection [7,8]. Women are especially prone to UTI. Twenty five to 35% of all

females suffer from UTI at some stage in their lives [9]. UTI in men are not as common as in women but can be very serious when they do occur [10]. **It is expected that in course of time, microbes will become more resistant because of their new mutants [11].** Women are more susceptible to UTI than men due to short urethra, absence of prostatic secretion, and sexual activity. The physical changes that take place during pregnancy can make more susceptible to an infection. Hormonal changes create the ideal environment for UTI-causing bacteria (usually *Escherichia* coli) to flourish. Most infections are due to gram-negative aerobic bacilli normally found in the gastrointestinal (GI) tract. The antibiotic sensitivity pattern of a particular organism is known to change with time [12, 13]. Antibiotic resistance pattern vary in different areas [14]. Probable causes may be continued use of the similar antibiotic for a prolonged period, irrational use of antibiotics in inadequate dosage for an inadequate duration for treatment. The prevalent pathogens of UTI have been found to be resistant to most chemotherapeutic agents [15], though the antimicrobial susceptibilities of these pathogens are highly predictable. Development of resistance to these antimicrobial agents in UTI cases will therefore affect future treatment and management of the infection with these drugs. Knowledge of

etiological agents of UTIs and their sensitivities to available drugs are of immense value to the rational selection and use of antimicrobial agents and to the development of appropriate prescribing policies [16]. Data obtained are essential to optimize the treatment and avoid the emergence of bacterial resistance, which is responsible for the increasing number of therapeutic failure [17].

The present study was intended to ascertain antimicrobial resistance among various uropathogens and its correlation with the demographic profile.

MATERIAL & METHODS

A Prospective study was performed on 303 patients with suspected cases of UTI, in the Department of Microbiology, R.G.Kar Medical College and Hospital in Kolkata, situated in eastern India. Urine specimen collected from both indoor & outdoor patients, received in the Department of Microbiology were included in the study. A single, clean voided midstream urine sample was collected from each of 303 patients with suspected UTI. Detailed history and the demographic profile of each patient were noted. Each urine sample was subjected to wet mount preparation and inoculation onto culture media. Isolation and identification of the causative bacteria were done following standard protocol. Antimicrobial susceptibility testing was done by Kirby Bauer disk diffusion method as per CLSI guidelines. Antibiotic discs obtained commercially (manufacturer-- Hi-media laboratories, Mumbai) used were Augmentin (Amoxy-clav,AG,30mcg), Piperacillin (PC,100mcg), Polymyxin-B (PB,300U), Netilmycin (NT,30mcg), Cefdinir (CDR,5mcg), Cefpodoxime (CPD,10mcg), Nalidixic acid (NA,30mcg), Furadantin (FD,300mcg), Norfloxacin (NX,10mcg), Ciprofloxacin (RC,5mcg).

RESULTS

The overall sex distributions of the patients are 47.52% (144) males and 52.48% (159) females. (Table 1)
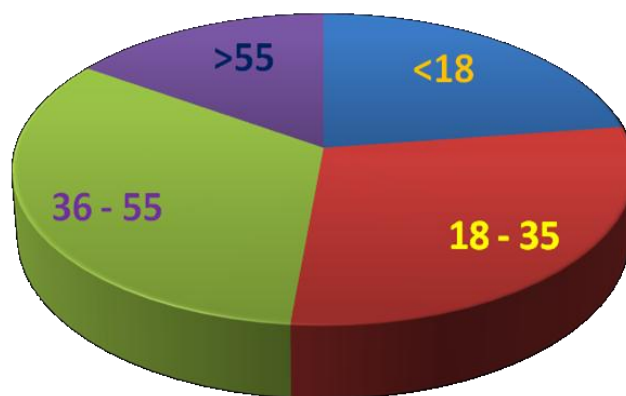
Table 1: Sex distribution of the patient

TOTAL	Males		Females	
(n = 303)	No.	%	No.	%
303	144	47.52	159	52.48

The majority of the patients were in the age – group 36 – 55 years (33%) and maximum numbers of positive cultures are found in this age group. (Table 2; Fig. 1)

Table 2: Age distribution of the patient

Years< 18		18 – 35 yrs.		36–55yrs.		> 55yrs.		Total	
No.	%	No.	%	No.	%	No.	%	No.	%
69	22.77	87	28.71	100	33	47	15.51	303	100

Fig. 1 : Distribution of Patients according to the Age

The sex distribution of the 77 positive cultures was 49.35% (38) males and 50.64% (39) females. The difference in distribution by sex and culture results was not statistically significant. (Table 3)
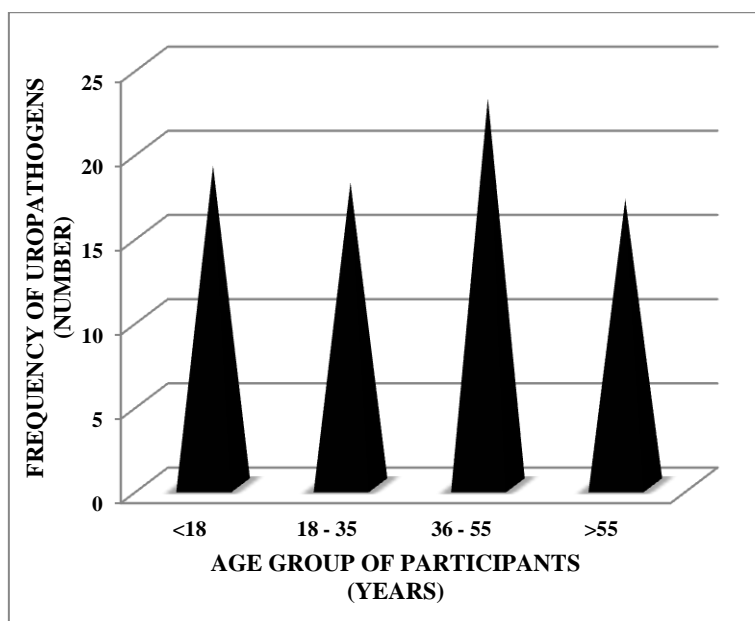
Table 3: Sex distribution in positive culture

Marital Status	Males		Females	
	No.	%	No.	%
Total	38	49.35	39	50.64

In this study UTI was more prevalent in the age group of 36 – 55 years and *E.coli* (42.8%) was the most commonly isolated uropathogen irrespective of any age groups. [Table 4; Fig2]

Table 4: Distribution of Uropathogens in different age group of the patients (n,%)

Isolates	< 18 (n = 19)		18 – 35 (n = 18)		36 – 55 (n = 23)		> 55 (n = 17)		Total (n = 77)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Escherichia coli	8	42.1	3	16.6	11	42.8	7	41.2	29	37.66
Klebsiella sp	2	10.5	4	22.0	2	8.7	5	29.4	13	16.88
Proteus sp	2	10.5	2	11.0	0	0	0	0	4	5.19
Pseudomonas sp	0	0	1	5.5	0	0	0	0	1	1.29
Acinetobacter sp	2	10.5	1	5.5	0	0	2	11.7	5	6.49
Enterococcus sp	4	21.0	4	22.0	3	13.0	1	5.8	12	15.58
Staphylococcus aureus	0	0	2	11.0	5	21.7	3	17.6	10	12.98
Streptococcus sp	1	5.3	1	5.5	1	4.3	0	0	3	3.89
Total	19	24.7	18	23.37	23	29.9	17	22.1	77	100

Fig. 2 : Distribution of Positive cultures in different age group

E.coli was the most prevalent uropathogens in both (Male, 14; Female, 15) sexes. [Table 5]

Table 5: Distribution of uropathogens versus sex (n,%)

Isolates	Male		Female		Total (n = 77)	
	No.	%	No.	%	No.	%
Escherichia coli	14	18.18	15	19.48	29	37.66
Klebsiella sp	7	9.09	6	7.79	13	16.88
Proteus sp	3	3.89	1	1.29	04	5.19
Pseudomonas sp	1	1.29	0	0	01	1.29
Acinetobacter sp	3	3.89	2	2.59	05	6.49
Enterococcus sp	5	6.49	7	9.09	12	15.58
Staphylococcus aureus	4	5.19	6	7.79	10	12.98
Streptococcus sp	00	0	03	3.89	03	3.89
Total	37	48.05	40	51.94	77	100

The distribution of different uropathogens versus marital status of the patients shows, married males (35.06%) were more affected than females (33.76%)[Table 6]

Table 6 : Uropathogen distribution versus Marital status (n%)

ISOLATES	MALE				FEMALE			
	SINGLE		MARRIED		SINGLE		MARRIED	
	NO.	%	NO.	%	NO.	%	NO.	%
Escherichia coli	4	5.19	11	14.28	4	5.19	10	12.98
Klebsiella sp	1	1.29	6	7.79	2	2.59	4	5.19
Proteus sp	1	1.29	2	2.59	1	1.29	0	0
Pseudomonas sp	1	1.29	0	0	0	0	0	0
Acinetobacter sp	1	1.29	2	2.59	1	1.29	1	1.29
Enterococcus sp	3	3.89	2	2.59	4	5.19	3	3.89
Staphylococcus aureus	0	0	4	5.19	0	0	6	7.79
Streptococcus sp	0	0	0	0	1	1.29	2	2.59
Total	11	14.28	27	35.06	13	16.88	26	33.76

The percentages of resistance seen among different uropathogens to various antimicrobial agents are: 84.4% to Nalidixic Acid(NA), 83.1% to Cefpodoxim (CPD), 77.9% to Cefdinir(CDR), 75.3% to Augmentin(AG), 53.2% to Piperacillin(PC), 48.0 to Ciprofloxacin(RC), 46.7% to Norfloxacin(NX), 36.4% to Furadantin(FD), 18.2% to Netilmycin(NT) and 15.6% to Polymyxin-B(PB). The percentages of antimicrobial resistance among different uropathogens varied between 84.4 and 15.6%. The isolated bacterial strains show wide differences in their susceptibility to the tested antimicrobial drugs. (Table 7)

**Table 7:** Antimicrobial Resistance of Uropathogens (n%)

ORGANISMS	AG	PC	PB	NT	CDR	CPD	NA	FD	NX	RC
TOTAL (77)	75.3	53.2	15.6	18.2	77.9	83.1	84.4	36.4	46.7	48.0

Below 18 years age group, high resistance against Augmentin (88.9%), Cefdinir (88.9%) & Nalixdic acid (88.9%) in *E.coli* were noticed [Table 8] where as in 18 – 35 years age group, maximum resistanance to Nalixdic acid (100%) were noticed. In 36 – 55 years, 100% resistance to Cefdinir & Nalidixic acid were seen(Fig 3).

Above 55years, high resistance against Cefdinir (100%), Cefpodoxime (100%) and Nalidixic acid (100%) are also an important finding. (Fig.4). Hence Nalidixic acid should be considered as resistant drug to combat UTI caused by E.coli especially above 18 years of age [Table- 8].

Table 8: Age group versus antimicrobial resistance in *E.coli*

AGE GROUP (YEARS)	AG	PC	PB	NT	CDR	CPD	NA	FD	NX	RC
<18 (9)	88.9	77.8	11.1	0	77.8	88.9	88.9	11.1	66.7	66.7
18 – 35 (3)	66.7	66.7	0	0	66.7	66.7	100	0	66.7	66.7
36 – 55 (11)	81.9	81.9	18.2	36.4	100	90.1	100	27.3	81.8	90.1
>55 (6)	66.7	50.0	16.7	0	100	100	100	0	50.0	50.0
TOTAL (29)	79.31	72.41	13.79	13.79	89.65	86.20	96.51	13.79	58.62	62.66
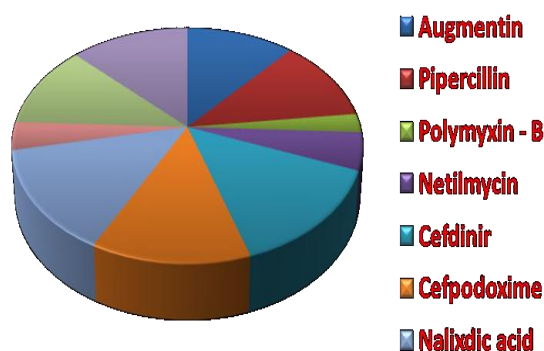
Fig .3: Resistance pattern of *E. coli*

(Age Group :36-55 years)
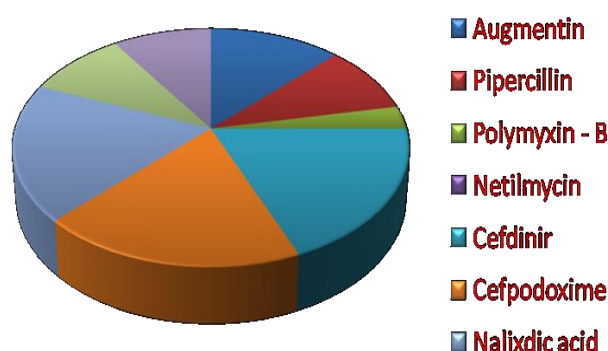
Fig .4 : Resistance pattern of *E. coli*

(Age Group :>55 years)

Table 9: Antimicrobial resistance pattern of *E.coli* in relation to sex distribution

SEX	AG	PC	PB	NT	CDR	CPD	NA	FD	NX	RC
MALE	86.7	80.0	26.7	20.0	93.3	93.3	93.3	20.0	66.7	73.3
FEMALE	71.4	64.3	0	7.1	85.7	78.6	100	7.1	71.4	71.4
TOTAL (29)	79.31	72.41	13.79	13.79	89.65	86.20	96.51	13.79	58.62	62.66

Table 10: Marital status and resistance pattern of *E.coli*

SEX	AG	PC	PB	NT	CDR	CPD	NA	FD	NX	RC
SINGLE	88.9	66.6	22.2	0	88.9	66.6	88.9	22.2	55.5	55.5
MARRIED	85.0	80.0	0	25.0	95.0	85.0	100	20.0	85.0	85.0
TOTAL (29)	79.31	72.41	13.79	13.79	89.65	86.20	96.51	13.79	58.62	62.66

DISCUSSION

The present study delineates the correlation of demographic profile with uropathogens causing UTI and its antimicrobial resistance. Out of total cases (303), the overall sex distributions of the patients are 47.52% (144) males and 52.48% (159) females as shown in Table -1. According to the age distribution, majority of the patients are in the age group of 36 – 55 years. The sex distribution in the positive cultures reveal, 49.35% (38) culture positive samples are obtained from male patients compared to 50.64% (39) from females. Though this differences in culture positivity in male and female are not statistically significant.

The age group versus uropathogens [Table-4, Fig-2] reveals the frequency of urinary tract infection in different age groups. Prevalence of urinary tract infection increases with age in both women & men [18]. Our result shows highest culture positive cases (29.87%) in the age group 36 – 55 years.

The sex distribution of patient in our study shows females are more affected (52.48%) than males (47.52%). This observation in our study corroborates well with other studies conducted by Akram et al in 2007[20] and Dimitrov ES et al in 200[[21].The elevated incidence of infection among females is related to differences between the male and female genitourinary system in anatomy and microflora[19]. *E.coli* is the most common micro organism causing Urinary Tract Infections in both male & female. This finding is similar to studies done among the UTI patients from Pakistan, Nigeria, Britain and South Africa [22 – 25]. Among the nine(9) different strains of uropathogens that are identified in this study, *E.coli* (37.66%) is the most predominant organisms followed by *Klebsiella* spp (16.88%) which is in conformity with other studies [26, 27].

The isolated bacterial strains showed wide variation in their susceptibility to antimicrobial drugs. The most effective antimicrobial agents are found to be Polymyxin – B (84.4% of the isolates were susceptible) & Netilmycin (81.8%). The reason may be exposures to these antimicrobials are limited so far their cost and tolerability is concerned.

There is variation of antimicrobial resistance in different uropathogens in different age groups. Significantly higher proportion of resistance to Cephalosporin & Fluoroquinolone in uropathogens are found in higher age group. Thus, age related changes in host physiology may influence the effect of antimicrobial agents on the uropathogens. Hence age of the patient is definitely a crucial factor in selection of antibiotic while treating a case of UTI. These similarities and differences in the type and distribution of uropathogens in relation to demographic profile may result due to several factors like environmental conditions, host factors, effect of healthcare and education programme, socioeconomic conditions and hygiene practices in different places of each country.

Regarding resistance pattern of *E.coli* to different antimicrobial agents in relation to sex revealed high resistance of Cefdinir, Cefpodoxime, Augmentin(Amoxy-clav), Pipercillin &

Ciprofloxacin in males while in female increased resistance were seen in *Escherichia coli* against Nalixdic acid & Norfloxacin. Urinary isolates of *E.coli* obtained from male patients exhibited increased antibiotic resistance irrespective of type of antibiotic compared to female patients. A recent 10 year study of community UTI in Portuguese patients also identified differences in antibiotic susceptibility related with the patient's sex. The authors reported that urinary isolates of *E.coli* were significantly more resistant to fluoroquinolone, penicillin, and first and second generation cephalosporin among men compare to women [28].

The resistance pattern of *E.coli* against each antimicrobial agent in relation to marital status of the patients showed that the isolates were resistant to majority of the antimicrobial agents (Nalixdic acid, Cefdinir, Cefpodoxime, Norfloxacin, Ciprofloxacin, Piperacillin*)* in married persons compared to single. High resistance of Nalixdic acid (100%) and Cefdinir (95%) are also noticed in married person.

CONCLUSIONS

This prospective observational & crossectional study on UTI patients showed that sex, marital status and age definitely influence aetiology and antibiotic resistance of uropathogens. These factors should be taken into consideration to improve the management of this infection especially in the selection of appropriate antibiotics by the physicians. However, this type of study would be helpful to guide clinicians

while selecting antimicrobials for the treatment of common infection like UTI. Thus antimicrobial resistance and eventually treatment failure could be avoided which might lead to decreased morbidity and mortality in developing countries like India.

REFERENCES

1. Steven L. Chang, MD, Linda D. Shortliffe, MD. Pediatric Urinary Tract Infections. *Peditr Clin N Am* 2006 ; 53 : 379 – 400.

2. Manikandan S., Ganesapandian S., Singh M. and Kumaraguru A.K. Antimicrobial Susceptibility Pattern of urinary Tract Infection Causing Human Pathogenic Bacteria. *Asian Journal of Medical Sciences* 2011; 3 : 56 – 60.

3. Kunin, C.M. Urinary tract infections in females. *Clin. Infect. Dis*.1994; 18: 1 – 12.

4. Gupta, K.. Increasing antimicrobial resistance and the management of uncomplicated community acquired urinary tract infections. Int. J. Antimicrob. Agents, 2001; 135: 41 – 50.

5. Topley N, William JD Urinary tract infections in adults. Med Interne. 1991; 4: 3064 – 3070.

6. Mandel G, Bennett JE, Dolin R. Principles and practice of infection disease. 5th ed. Churchill Livingstone; 2000; 773 – 805.

7. Sweih NA, Jamaal W and Rotimi VO. Spectrum and Antibiotic Resistance of Uropathogens Isolated from Hospital and Community Patients with Urinary Tract

Infections in Two Large Hospitals in Kuwait. Med Princ Pract. 2005; 14: 401 – 407.

8. Khan AU and Zaman MS. Multiple Drug Resistant Pattern in Urinary Tract Infection Patients in Aligarh. Biomedical Research. 2006; 17: 179 – 181.

9. Charania S. Siddiqui P. Hayat L. A study of urinary infections in school going female children. J. Pak. Med. Assoc., 1980; 30: 165 – 170.

10. Ahmed B, Wanaiza, Akhter M, Hasan M and Alam MK. Sensitivity Pattern of Urinary Tract Pathogens to anti-microbial drugs at a tertiary level hospital in Bangladesh. J. Dhaka National Med. Coll. Hos. 2011; 17 : 18 – 21

11. Orrett FA, Shurland SM. The changing patterns of antimicrobial susceptibility of urinary pathogens in Trinidad. Singapore Med J 1998; 39 : 256 – 259.

12. Wilina Lim, Khin Khin Tint, Ng TK, Tsang DNC and Que TL Current status of bacterial resistance to antibiotics in Hong Kong. *J Hong Kong Med Assoc* 199; 43 : 152 – 158.

13. Adeyemo AA, Gbadegesin RA, Onyemenem TN, Ekweozor CC, Urinary tract pathogens and antimicrobial sensitivity patterns in children in Ibadan, Nigeria.*Ann Trop Paediatr.* 1994; 14: 271 – 274.

14. Doton TM. A simplified approach to urinary tract infection. Hosp Pract 1995; 332: 21 – 28.

15. Okonko, I.O., L.A. Ijandipe, A.O. Ilusanya, O.B. Donbraye – Emmanuel, A.A.Ogum, O.A. Akanbi, J. Ejembi and T.O.C. Faleye, 2009. Detection of Urinary Tract Infection (UTI) among Pregnant Women in Oluyoro Catholic Hospital, Ibadan, South – Western Nigeria. Malaysian J. Microbiol., (in press)

16. El-Astal Z. Bacterial pathogens and their antimicrobial susceptibility in Gaza Strip, Palestine. Pakistan J. Med. 2005; 20: 365 – 370.

17. Singh, J.A., R. Upshur and N. Padayatchi. XDR – TB in South Africa; no time for denial or complacency. PLoS Med. 2007; 44 - 50.

18. Jharna Mandal, N. Srinivas Acharya, D. Buddhapriya & Subhash Chandra Parija Antibiotic resistance pattern among common bacterial uropathogens with a special reference to Ciprofloxacin resistant *Escherichia coli*`` Indian J Med Res 2012 136, pp 842-849

19. Strom BL. Et al. Sexual activity, contraceptive use, and other risk factors for symptomatic bacteriuria. A case-control study. *Annals of internal medicine*, 1987; 10 : 816 – 823.

20. Akram M, Shahid M, Khan AU. Etiology and Antibiotic Resistance Patterns of Community – acquired Urinary Tract

Infections in J N M C Hospital Aligarh, India. Ann Clin Microbiol Antimicrob. 2007; 6:4.

21. Dimitrov ES, Udo EE, Emara M, Awni F, Passadilla R, Etiology and Antibiotic Susceptibility Patterns of Community – Acquired Urinary Tract Infections in a Kuwait Hospital. Med Princ Pract, 2004; 13:334 – 339.

22. Meher TI, Adnan S, Khan H, Khan TM, Noor U, Imam I, Iqbal S. E.coli, urine super bug and its antibiotic sensitivity. J. Med. Sci. 2010; 18: 110 – 113.

23. Iuwaezuoke JC, Zogbulie JN. Antibiotic Sensitivity pattern in urinary tract pathogens in Port – Harcourt, Nigeria. J. Appl.Sci.Envviron. Mgt. 2006; 10: 103 – 107.

24. Barretta SP, Savagea MA, Rebeca MP, Guyota A, Andrewsb N, Shrimptone SB. Antibiotic sensitivity of bacteria associated with community acquired urinary tract infection in Britain. Journal of Antibacterial Chemotherapy. Volume 44. Issue 3. Pp. 359 – 365.

25. T.M Habte; S Dube, N. Ismail; AA Hoosen. Hospital and community isolates of uropathogens at a tertiary hospital in South Africa. SAMJ, S. Afr. Med. J. 2009; Vol.99 no.8.

26. Khan AU and Zaman MS. Multiple Drug Resistance Pattern in Urinary Tract Infection Patients in Aligarh, Biomedical Research, 2006; 17: 179 – 181.

27. De Francesco MA, Ravizzola G, Peroni L, Negrini R, Manca N. Urinary Tract Infections in Bresca, Italy; Etiology of Uropathogens and Antimicrobial Resistance of Common Uropathogens. Med.Sci Monit. 2007; 13 : 136 – 144.

28. Linhares I, Raposo T, Rodrigues A, Almeida A. Frequency and antimicrobial resistance patterns of bacteria implicated in community urinary tract infection; a ten – year surveillance study (2000 – 2009). BMC Infect Dis. 2013; 13:19.