

Community acquired urinary tract infections (CAUTI) with special reference to antibiogram of *Escherichia coli* and *Klebsiella species*

Yedla Kavita^{1,*}, Mohan Sundaram², Anandi V³

¹Assistant Professor, ²Associate Professor, ³Professor, Vinayaka Missions Medical College & Hospital, Tamil Nadu

***Corresponding Author:**

Email: drkavitapes@gmail.com

Abstract

Aim: *Escherichia coli* and *Klebsiella species* are the most important uropathogens. The present study was undertaken to isolate uropathogens causing community acquired urinary tract infections (CAUTIs) and their antibiogram.

Materials and Methods: A total of 755 clean voided mid-stream urine samples were collected and processed. All the specimens were collected from patients attending various OPDs of our hospital. The specimens were cultured and the isolates were identified using standard microbiological techniques. The antibiotic susceptibility was determined by disc diffusion technique. Simple percentage method was used in analyzing data.

Results: From 755 urine specimens, 197 urine specimens yielded significant bacterial growth accounting for 26.09%. Females (75.13%) are more commonly affected than males (24.87%).

E. coli 119 (60.40%) was the most frequent organism isolated followed by *Klebsiella species* (24.87%). *Klebsiella species* showed high degree of resistance towards the antibiotics tested.

Conclusion: High isolation rate was observed among young females in reproductive age groups. *E. coli* was the predominant bacteria causing UTI followed by *Klebsiella species*. Very high resistance rates were observed towards commonly used antibiotics in community.

Keywords: *Escherichia coli*, Antibiogram, Multi drug resistance.

Introduction

Urinary Tract Infections (UTIs) are among the most common bacterial infections which lead patient to seek medical advice. Approximately ten percent of human population will suffer from UTI at some instant during their life span.¹ Community acquired urinary tract infections are more frequently encountered from rural and semi urban regions.² The clinical severity varies widely in UTI.³ Various microorganisms can cause UTIs, but bacteria are predominantly responsible for causing urinary tract infections.⁴

Bacterial UTIs have been reported in both hospital and community.⁵ Among commonly acquired infectious diseases, urinary tract infection is the one which requires antibiotics and special attention. Both men and women may suffer from UTI. However, females develop UTI predominantly. Without complications UTIs in healthy women have an incidence of 50/1000/year. Majority of women will have UTI at least one time during their life span.⁶ Most common bacteria causing UTI includes, *E. coli*, *K. pneumoniae*, *P. mirabilis*, *Ps. aeruginosa*, *S. aureus*, *E. faecalis* and *S. saprophyticus*.⁷

Significant contribution was made in the management of UTIs with the discovery of antibiotics. In majority of patients, antimicrobial therapy is initiated before the arrival of culture sensitivity reports which may contribute for drug resistance. Usage of antimicrobial agents extensively resulted in the development of multi drug resistance bacteria, which in recent years has become a major problem.⁸

There is great variation worldwide in the patterns of antimicrobial resistance. The current knowledge of predominant bacterial uropathogens that are highly resistance to multiple antibiotics is of primary importance for the initiation of appropriate antimicrobial drugs and the policy making to overcome antibiotic resistance in UTIs.⁹ The antibiogram of community acquired uropathogens has not been studied in detail.¹⁰ Hence, this study aimed at determining the resistance pattern of common uropathogens which required for initiating empiric antimicrobial therapy.

Materials and Methods

This is a prospective observational study in which 755 midstream urine samples collected in the department of clinical microbiology from patients attending various OPDs of our hospital. All the samples were inoculated on Mac Conkey agar and 5% sheep blood agar (Hi Media, India) with the help of calibrated loop. The culture plates were kept in incubator at 37°C for 18 hours. Patients with urine cultures yielding growth of pathogens <10⁵ colony forming units/ml were excluded. Uropathogens were further identified by the morphological and biochemical characteristics.¹¹

Antimicrobial susceptibility of isolates was tested by the Kirby Bauer disk diffusion method.¹²

Multi antibiotic resistant strains were categorized into MDR (Multiple Drug-Resistant), XDR (Extensively Drug-Resistant) and PDR (Pan drug-resistant) as per Center for Disease prevention and Control. MDR bacteria are defined as resistant to at

least three various classes of antibiotics. XDR bacteria are characterized by their sensitivity to single class of antibiotic and the PDR bacteria are resistant to all classes of antibiotics recommended for treatment.^{13,14}

All the data was analysed by simple percentage method.

Quality control: *E. coli* ATCC 25922, *Klebsiella pneumoniae*: ATCC 700603

Results

A total of 755 urine specimens collected in the department of clinical microbiology from various outpatient departments over a period of ten months. 197 urine specimens yielded significant bacterial growth accounting for 26.09%. Females (75.13%) are more commonly affected than males (24.87%). Isolation rate was high among females patients who were 22 years and older (n=99). Majority of male patients (n=37) who suffered from UTI were older than 60 years.

Table 1 describes the frequency of different uropathogens isolated from out patients. *E.coli* (60.40%) was the most commonly isolated organism followed by *Klebsiella* species (24.87%).

Table 1: Distribution of uropathogens in OPD patients

Isolate	Total Number (%)
<i>Escherichia coli</i>	119(60.40%)
<i>Klebsiella</i> species	48(24.36%)
<i>Enterobacter</i> species	9(4.57%)
<i>Staphylococcus aureus</i>	9(4.57%)
<i>Proteus mirabilis</i>	7(3.55%)
<i>Pseudomonas aeruginosa</i>	2(1.02%)
Coagulase negative staphylococci	2(1.02%)
<i>Providencia</i> species	1(0.50%)

Both *E. coli* and *Klebsiella* spp represented 85.28% of all isolated bacteria. Hence, antibiogram was observed particularly to these two organisms. (Table 2)

Table 2: Antibiotic resistance pattern of *E.coli* and *Klebsiella* species

Antibiotic	<i>Escherichia coli</i>	<i>Klebsiella</i> species
Ampicillin	105(88.24%)	45(91.84%)
Amoxiclav	57(47.90%)	29(59.18%)
Trimethoprim/sulfamethoxazole	99(83.19%)	41(83.67%)
Ciprofloxacin	73(61.34%)	33(67.35%)
Gentamicin	102(85.71%)	30(61.22%)
Amikacin	19(15.97%)	7(14.28%)
Ceftriaxone	58(48.74%)	33(67.35%)
Nitrofurantoin	21(17.65%)	9(18.36%)
Piperacillin/tazobactam	5(4.20%)	3(6.12%)
Imipenem	1(0.84%)	3(6.12%)

Higher degree of resistance was exhibited by *Escherichia coli* towards ampicillin(88.24%) followed by gentamicin (85.71%) and Trimethoprim/sulfamethoxazole(83.19%). Low degree of resistance was exhibited to imipenem(0.84%) followed by Piperacillin/ tazobactam(4.20%), amikacin(15.97%)and nitrofurantoin(17.65%). Very least susceptibility was shown by *Klebsiella* species also. Three isolates of *Klebsiella* species showed resistance to imipenem whereas only one isolate of *E.coli* showed resistance. Only four isolates of *Klebsiella* species were susceptible to ampicillin.

Table 3: Pattern of multi drug resistance in *E.coli* and *Klebsiella* species

Isolate	Total Number	MDR (%)	XDR (%)	PDR (%)
<i>Escherichia coli</i>	119	67 (56.30%)	9 (7.56%)	1 (0.84%)
<i>Klebsiella</i> species	49	37 (75.51%)	13 (26.53%)	3 (6.12%)

In our study, 56.30% of *E. coli* 75.51% of *Klebsiella* species were MDR strains. Whereas *Klebsiella* species presented a Extensively Drug-Resistant in 26.53% of the cases compared with only a 7.56% of *E. coli*. Only one isolate of *E.coli* presented the PDR to all antimicrobial agents whereas three isolates of *Klebsiella* species showed resistance to all antimicrobial agents.

Discussion

It is mandatory to know the local prevalence of bacteria and their susceptibility to commonly used antibiotics in community. Due to worldwide disparity in pathogen occurrence and their antibiogram, continuous supervision is needed. In our study, females were more commonly affected than males. Following factors may responsible for higher rate of UTI among females, short urethra and the proximity of the anus to the urethra, due to colonization of urethral resident flora and the vaginal introitus.¹⁵Majority of males in elderly age group were more commonly developed UTIs. Higher incidence of UTI in elderly males is probably due to advancing age, prostate enlargement and neurogenic bladder.¹⁶

Most commonly isolated uropathogen in our study was *E. coli*, corresponding to 60.40 % of the cases. These results are compatible with the earlier studies.^{17,18} Gram negative bacilli have multiple virulent factors responsible for their adherence to host's uroepithelium. Bacterial colonization in mucosal epithelium takes place with the help of adhesins, pili, fimbriae, and P-1 blood group phenotype receptor.¹⁶

Resistance to antimicrobial agents usually occurs as a result of drug modification, target alteration, and

decreased drug entry. It could be the inherent characteristic of a bacteria or acquiring resistance genes by means of mutations.¹⁹

Usually strains isolated from hospitalized patients exhibit antimicrobial resistance, but it is reported increasingly even in community settings. Antibiotic resistance pattern of uropathogens in our study showed the least susceptibility rate. E.coli was least susceptible to commonly used antibiotics such as β lactams, fluoroquinolones and co-trimoxazole. This is in agreement with various studies conducted in Indian communities.^{17,18}

Most commonly used antibiotics for treating CA UTIs are quinolones. Excessive usage of these antibiotics led to considerable resistance among uropathogens. In our study, higher rate of resistance was observed against ciprofloxacin by E.coli and Klebsiella species accounting for 61.34% and 67.35% respectively. Few comparable studies demonstrated that ciprofloxacin resistant E. coli were parallelly resistant to co-trimoxazole and ampicillin. In some studies, E.coli strains which were resistance to fluoroquinolones also exhibited resistance to ampicillin and co-trimoxazole.²¹

Globally various studies has observed that resistance rates for cotrimoxazole among E.coli with uncomplicated UTI ranges from 11-34%.²² According to the study conducted by Arslan et al, 36% resistance to cotrimoxazole and 17% resistance to fluoroquinolones in.²³

In developing countries, the decreased susceptibility to frequently used antimicrobials may due to various reasons such as exposure to suboptimal levels of antimicrobials, exposure to microbes carrying resistant genes, lack of hygiene in clinical environment, usage of antimicrobials in foods/agriculture in addition to that prescriptions not taken for a total duration of therapy, antibiotics for viral infections, antibiotics sold without medical supervision. These factors could contribute to emergency of antibiotic resistance in community.²⁴

A majority of E.coli and Klebsiella showed low degree of resistance to imipenem and piperacillin/tazobactam. In a study conducted by Baby et al, all the Gram negative bacilli were found to be susceptible to imipenem and piperacillin/tazobactam. Majority of Gram negative isolates showed good susceptibility to amikacin also.²⁵The least resistance may be due to the less common use of these injectable antibiotics in community. Good susceptibility was shown towards nitrofurantoin. Various studies also reported good susceptibility of nitrofurantoin.²⁶ Hence, nitrofurantoin can be the apt antibiotic for uncomplicated UTI. The drawback of nitrofurantoin is that it cannot be used in complicated urinary tract infections such as pyelonephritis and septicemia.²⁷

In our study, isolates of E. coli and Klebsiella species were MDR accounting for 56% and 71.51% respectively. According to Hasan et al, multi drug

resistance E.coli was 52.9%.in a tertiary care hospital.²⁸As per study conducted by Mathai et al, 8.4% commensal E.coli showed multi drug resistance.²⁹ However, studies conducted in African countries by Ibrahim et al³⁰ and Eshetie et al³¹showed 92.2% and 87.4% multi drug resistance E. coli strains respectively.

The antimicrobial susceptibility of Klebsiella species was reported in previous studies^{32,33} and varied at the following rates: amoxicillin-clavulanic acid, 0 to 69%; cefotaxime, 43 to 100%; ceftazidime, 40 to 100%; imipenem, 100%; ciprofloxacin, 53 to 100%; nalidixic acid, 51 to 94%; gentamicin, 60 to 100%; amikacin, 100%; trimethoprim-sulfamethoxazole, 0 to 56%; nitrofurantoin, 40 to 78%; tetracycline, 43 to 69%; and fosfomicin, 100%.

The study did not evaluate whether the patients had any comorbidities for UTI, such diabetes mellitus, concurrent sexually transmitted disease or urinary tract structural abnormality. It also did not differentiate between low-risk patients and those who were at a higher risk for UTI due to pregnancy, spinal cord injuries, indwelling catheters, underlying urologic abnormalities or a prior history of UTI. Furthermore the study did not evaluate presence of ESBL producers.

Conclusion

High isolation rate was observed among young females in reproductive age groups. E. coli was the most common causative agent of UTI followed by Klebsiella species. Alarming resistance rates were observed towards commonly used antibiotics in community. Klebsiella species showed more resistance than E.coli. Continuous surveillance of antimicrobial susceptibility pattern helps in initiating the empirical treatment of UTI. Urine culture and sensitivity has to be done before initiating antimicrobial therapy to restrain UTI and its complications.

References

1. Delanghe JR, Langlois MR, Wuyts B, De Buyzere ML. Performance of Urinary Flow Cytometry in Predicting Outcome of Urine Cultures. *Journal of Clinical Microbiology*. 2002;40(6):2314-2315. doi:10.1128/JCM.40.6.2314-2315.2002.
2. Maya AS., P.K., Lakshmi S., A study on prevalence and evaluation of clinical isolates from community acquired infections using different media in semirubar areas. *World Journal of Medical Sciences*, 2010. 5(2): p. 49-53.
3. Ahmed S, Rashid HU. Urinary tract infection in adults: A review. *Bangladesh Renal J*. 1996;15:23-31.
4. Bonadio, M., M. Meini, P. Spitaler and C. Gigli. Current microbiological and clinical aspect of urinary tract infection. *Eur. Urol.* 2001;40:439-445. DOI: 10.1159/000049813
5. Raz R. Antimicrobial resistance of urinary isolates in the community and its relation to antibiotic use. *Isr J Med Sci* 1993;29:207-210.5
6. Sood S, Gupta R. Antibiotic resistance pattern of community acquired uropathogens at a tertiary care hospital in Jaipur, Rajasthan. *Indian J Community Med* 2012;37:39-44.

7. Habte, T., Dube, S., Ismail, N. and Hoosen, A. (2009) Hospital and Community Isolates of Uropathogens at a Tertiary Hospital in South Africa. *South African Medical Journal*,99,584-587.
8. Dash, Muktiresh et al. "Antimicrobial Resistance in Pathogens Causing Urinary Tract Infections in a Rural Community of Odisha, India." *Journal of Family & Community Medicine* .2013;20:20-26.
9. Giamarellou H: Multidrug-resistant Gram-negative bacteria: how to treat and for how long. *Int J Antimicrob Agents* 2010, 36(2):S50-S54.
10. Kothari A, Sagar V. Antibiotic resistance in pathogens causing community acquired urinary tract infections in India: A multicentric study. *J Infect Dev Ctries* 2008;2:354-8.
11. Forbes BA, Sahm DF, Weissfeld AS. Overview of bacterial identification methods and strategies. Bailey and Scott's *Diagnostic Microbiology*, 12th ed., chapter 13. St. Louis: Mosby; 2007.216-47.
12. Bauer, A.W., W.M. Kirby, J.C. Sherris and M. Turck, Antibiotic susceptibility testing by a standardized single disk method. *Am. J. Clin. Pathol.*1966;45:493-496. PMID: 5325707
13. <http://www.cdc.gov/hicpac/pdf/guidelines/MDROGuideline2006.pdf>.
14. Magiorakos, A., Srinivasan, A., Carey, R., et al. Multidrug-Resistant, Extensively Drug-Resistant and Pandrug-Resistant Bacteria: An International Expert Proposal for Interim Standard Definitions for Acquired Resistance. *Clinical Microbiology and Infection*. 2012;18:268-281. <http://dx.doi.org/10.1111/j.1469-0691.2011.03570.x>.
15. O'Regan S, Yazbeck S, Schick E. Constipation bladder instability, urinary tract infection syndrome. *Clin Nephrol* 1985;23:152-155.
16. Das R, Chandrasekhar TS, Joshi HS, Gurung M, Shreshtha N, Shivananda PG. Frequency and susceptibility profile of pathogens causing urinary tract infections at a tertiary care hospital in western Nepal. *Singapore Med J* 2006;474:281-5.
17. Bahadin J, Teo SS, Mathew S. Aetiology of community-acquired urinary tract infection and antimicrobial susceptibility patterns of uropathogens isolated. *Singapore Med J* 2011;52:415-20.
18. 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 Anti-microb* 2007;6:4.
19. K. Poole, "Efflux-mediated antimicrobial resistance," *The Journal of Antimicrobial Chemotherapy*.2005;56:20-51.
20. Karlowsky J A, Hoban DJ, DeCorby MR, Laing NM, Zhanel GG. Fluoroquinolone-resistant urinary isolates of *Escherichia coli* from outpatients are frequently multidrug resistant: Results from the North American Urinary Tract Infection Collaboratory Alliance-Quinolone Resistance study, *Antimicrob Agents Chemother*. 2006;50:2251-4.
21. Van der Starre W. E., van Nieuwkoop C., Paltansing S., et al. Risk factors for fluoroquinolone-resistant *Escherichia coli* in adults with community-onset febrile urinary tract infection. *The Journal of Antimicrobial Chemotherapy*. 2011;66(3):650-656. doi: 10.1093/jac/dkq465.dkq465
22. Kahlmeter G; ECO.SENS. An international survey of the antimicrobial susceptibility of pathogens from uncomplicated urinary tract infections: The ECO.SENS Project. *J Antimicrob Chemother* 2003;51:69-76.
23. Arslan H, Azap OK, Ergonul O, Timurkaynak F; Urinary Tract Infection Study Group. Risk factors for ciprofloxacin resistance Among *E. coli* strain isolated from community acquired urinary tract infections in Turkey. *J Antimicrob Chemother* 2005;56:914-8.
24. Akoachere JE, Yvonne S, Akum NH, Seraphine EN. Etiologic profile and antimicrobial susceptibility of community-acquired urinary tract infection in two Cameroonian towns. *BMC Res Notes*. 2012;5:219. doi: 10.1186/1756-0500-5-219.
25. Baby PS, Appala RB, Mani KR. Detection of Enterobacteriaceae producing CTX-M extended spectrum beta-lactamases from a tertiary care hospital in south India. *Indian J Med Microbiol* 2008;26:163-66.
26. Shaifali I, Gupta U, Mahmood SE, Ahmed J. Antibiotic susceptibility patterns of urinary pathogens in female outpatients. *N Am J Med Sci* 2012;4:163-9.
27. Vasquez Y, Hand WL. Antibiotic susceptibility patterns of community acquired urinary tract infection isolates from female patients on the US (Texas)-Mexico Border. *J Appl Res* 2004;4:321-6.
28. Hasan AS, Nair D, Kaur J, Baweja G, Deb M, Aggarwal P. Resistance patterns of urinary isolates in a tertiary Indian Hospital. *J Ayub Med Coll Abbottabad* 2007;19:39-41.
29. Mathai E, Chandy S, Thomas K, Antoniswamy B, Joseph I, Mathai M, et al. Antimicrobial resistance surveillance among commensal *Escherichia coli* in rural and urban areas in Southern India. *Trop Med Int Health* 2008;13:41-5.
30. Ibrahim, M., Bilal, N. and Hamid. Increased Multi Drug Resistant *Escherichia coli* from Hospitals in Khartoum State, Sudan. *African Health Sciences*.2012;12:368-375.
31. Eshetie, S., Unakalet, C., Gelaw, A., et al. Multidrug Resistant and Carbapenemase Producing Enterobacteriaceae among Patients with Urinary Tract Infection at Referral Hospital, Northwest Ethiopia. *Antimicrobial Resistance and Infection Control*, (2015);4:12.
32. Kehinde A, Adedapo K, Aimakhu C, Odukogbe AT, Olayemi O, Salako B. Urinary pathogens and drug susceptibility patterns of urinary tract infections among antenatal clinic attendees in Ibadan, Nigeria. *J. Obstet. Gynaecol. Res.*2012;38:280-284.
33. Nwadioha SI, Nwokedi EE, Jombo GTA, Kashibu E, Alao O. Antimicrobial susceptibility pattern of uropathogenic bacterial isolates from community- and hospital-acquired urinary tract infections in a Nigerian tertiary hospital. *Internet J. Infect. Dis*. 2010;8:1.10.5580/14f7.

How to cite this article: Kavita Y, Sundaram M, Anandi V. Community acquired urinary tract infections (CAUTI) with special reference to antibiogram of *Escherichia coli* and *Klebsiella speices*. *Indian J Microbiol Res* 2016;3(4):464-467.