Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 496-504 | ISSN:2251-6727

A Retrospective Analysis of Prevalence, Bacteriological Characteristics, and Antibiotic Sensitivity Patterns of Urinary Tract Infection in a Tertiary Care Hospital

Vankodoth Sireesha[1], Gandla Kumara Swamy[2*]

1. Department of Pharmacy Practice, Chaitanya (Deemed to be University), Gandipet, Himayath nagar (vil), Hyderabad 500075, Telangana, India.
2. Department of Pharmaceutical Sciences, Chaitanya (Deemed to be University), Gandipet, Himayath nagar (vil), Hyderabad 500075, Telangana, India.

Corresponding Author

Kumaraswamy Gandla, Department of Pharmacy, Chaitanya (Deemed to be University), Gandipet, Himayath nagar (vil), Hyderabad 500075, Telangana, India.

(Received: 27 September 2025 Revised: 05 October 2025 Accepted: 10 November 2025)

KEYWORDS

Urinary tract infection, etiological factors, retrospective study, Antibiotics

ABSTRACT:

Urinary tract infections (UTIs) are frequent infections that doctors treat as inpatients or outpatients. The study was done to assess the etiological factors, susceptibility to bacteria, and use of antibiotics for UTIs. For 18 months, a retrospective analysis including 200 patients (n=200) was conducted in a tertiary care facility. Pregnant and lactating women, postpartum women, geriatric male and female patients, outpatients, inpatients, including those in the intensive care unit, and pediatric patients were all excluded. To gather the necessary data, a data collection form was created. Information was gathered on the patient's demographics, medical history, comorbid conditions, lab results, and recommended course of therapy. In order to determine the most likely etiology of UTI, etiological factors were examined. Male patients who were >55 years of age were more affected with UTIs as compared to females (n=50). Comorbid conditions like diabetes mellitus (47.5%) and hypertension (55%) were followed by the same combination (35%) and kidney-related disease (32.5%), respectively. Parameters like CRP levels (55%) and abnormal serum creatinine (n=30) in both males and females were also evaluated with significant effect (**p=0.0086). Amongst the organisms, gram-negative bacteria (n=140), followed by fungi (n=28) and gram-positive bacteria (n=20), were reported. In the treatment, carbapenems (40%), followed by cephalosporins (25%) and a combination of other drugs (15%), were reported. The study concluded that, when an etiological factor for the UTIs is known, it would be easier to heed a proper treatment with the prescription of a suitable antibiotic so that further complications and resistance are under control. Hence, analysing and assessing the cause for UTIs is extremely important for successful treatment.

Introduction

Bacteria that enter the urinary tract through the urethra and grow in the bladder are usually the cause of urinary tract infections (UTIs) [1]. Although they can affect anyone, women are more likely to get them. Some women get recurrent UTIs on a regular basis. Although UTIs can be annoying and severe, they typically go away in a few days and can be treated with medication. The most frequent offender is the gastrointestinal tract bacterium *E. coli*. UTIs can also be brought on by other bacteria, fungi, and in rare instances, viruses. There are an estimated 150 million urinary tract infections (UTI) worldwide each year, making them a frequent bacterial infection [2]. Millions of cases of urinary tract infections (UTIs) are recorded each year, and they affect people of all ages and genders globally. UTIs are a major cause of morbidity in women of all ages as well as in older men. Any part of the urinary tract, including the kidneys, ureters, bladder, and urethra, can be impacted by urinary tract infections (UTIs) [3]. Adult males under 50 have a very low incidence of UTIs, whereas women are 30 times more likely to get them. About 35-45 % of nosocomial infections are UTIs that are obtained in a hospital [4]. UTI symptoms can range from pyelonephritis and

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(6), 496-504 | ISSN:2251-6727

septicaemia to moderate, asymptomatic cystitis. Serious side effects such recurring infections, sepsis-related pyelonephritis, preterm birth in expectant mothers, and kidney impairment in young children can arise from untreated UTIs. Furthermore, complications from improper use of antibiotics may lead to a high risk of antibiotic resistance [5].

Some patients have persistent UTI symptoms. Urine tests do not reveal an infection, and short-term treatments are ineffective. This could indicate that you have a persistent, long-term UTI. Bacteria infiltrating the bladder lining may be the cause of this. Chronic UTIs can be challenging to diagnose since urine tests may not always detect the infection and the symptoms may resemble those of other illnesses [6,7]. Long-term use of antibiotics may be necessary to treat chronic UTIs. The quality of life may be significantly impacted by persistent UTIs [8].

The genesis of UTIs is significantly influenced by underlying host variables, such as age, diabetes, spinal cord injury, or catheterization. Significant illness and invasive disease can be caused by less virulent organisms that infrequently cause disease in a urinary tract that is physically or metabolically normal. Furthermore, studies conducted in Spain between 1985 and 1994 found that the prevalence of group B streptococcal bacteraemia in nonpregnant people increased, especially in older patients and those with diabetes and other underlying comorbidities. International research also points to a rise in *Enterococcus* and *Candida* species as uropathogens [9,10].

Sepsis, which can be fatal, can result from 2–4% of these infections.
More than two episodes of symptoms over a period of six months or more than three episodes over a period of twelve months are referred to have recurrent UTIs [11]. It is not advised to treat asymptomatic bacteriuria in individuals who have recurrent UTIs because it has been demonstrated to raise the chance of developing symptomatic UTI episodes in the future. Clinical signs alone are not always reliable for UTI diagnosis and treatment, and the diagnostic error rate might reach 30%. Urine samples are the most dependable specimen type utilized to confirm the presence of a UTI when laboratory procedures are used [12]. In addition to some fungi, gram-positive and gram-negative bacteria can also cause urinary tract infections. *Escherichia coli*, also known as *E. coli*, is the most significant and prevalent etiological agent, and is most common cause of UTIs, accounting for 50% of hospital-reported cases and 90% of community-reported cases. *Klebsiella pneumoniae, Staphylococcus saprophyticus, Enterococcus faecalis, Group B Streptococcus, Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus aureus, and Candida spp.* are next in line [13]. UTI pathogens are typically naturally occurring gut flora that have moved to the urinary tract, as the most frequent source of infection is usually the colonization of bacteria in the anus and perineum that travels through the urethra.

Furthermore, many of the characteristics of the microorganisms that are typically linked to urinary tract infections (UTIs) are evolving, especially as a result of antibiotic resistance. In an effort to reduce the incidence of resistance and stop its spread, empirical treatment will evolve throughout the coming years. Underlying host variables that exacerbate UTI, such as age, diabetes, spinal cord damage, or catheterization, also have an impact on the aetiology of UTI [14]. Therefore, the aetiology of difficult UTI is more varied than that of uncomplicated UTI, and organisms that seldom cause illness in healthy individuals might cause serious illness in hosts who have underlying immunologic, metabolic, or anatomical conditions.

The current study explored the assessment of etiological factors responsible for the development of UTIs.

Methodology

Study methodology

Study design: A retrospective study was carried out in tertiary care centre for a period of 18 months during January 2024 to May 2025 in 200 patients (n=200).

Inclusion criteria: Out Patients, In-patients including ICU, Pregnant and lactating women, Postpartum women, Geriatric male and female patients

Exclusion criteria: Paediatric patients

Study procedure: A data collection form was designed to collect the required information. The patient demographics, past medical history, comorbid conditions, laboratory parameters, and prescribed treatment were collected. Etiological factors were analysed to assess the probable cause of UTI.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 496-504 | ISSN:2251-6727

Ethics:

The Research project was approved by IEC, CMR College of pharmacy with CMRCP/IEC/2024-25/12.

Statistics: Statistical evaluation was performed with mean, standard deviation and using SPSS version 23.0. Baseline data, causes and treatment strategies were analysed with chi-squared test (qualitative variables) and the variables were assessed.

RESULTS

In total, the number of (n=200) patients were analysed for the occurrence of UTI infection. It was found that females were 85 (42.5 %) and males were 115 (57.5%). Out of 200 patients, 140 (70%) were of > 55 years of age, from them males 90 (78.2%) were accounted higher than females 50 (58.8 %), represented in Table 1.

Table No 1: Occurrence of UTI in based on the age and gender of patients

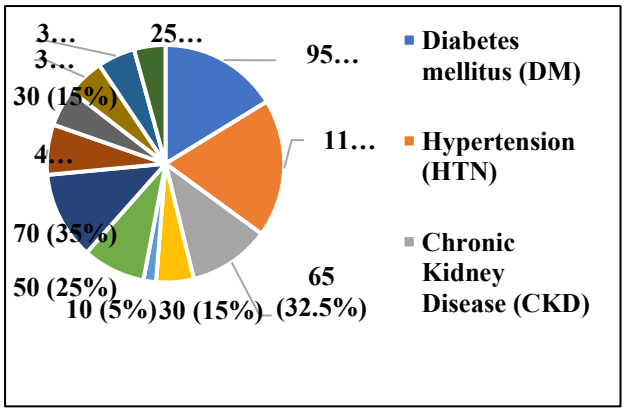
Age in years	Number of patients (n=200) (%)	Females (n)%	Males (n) %
18-30	10 (5)	5 (6.2)	5 (4.5)
31-55	50 (25)	30 (35)	20 (17.3)
>55	140 (70)	50 (58.8)	90 (78.2)
Total – 200 Females – 85 (42.5 %); Males – 115 (57.5%)			

In the record of BMI (Body mass index), out of 200 patients, more than 50% (n=100) of the patients had fallen into category of overweight and obese as shown in Table 2.

Table No 2: Prevalence of UTI (n=200) in accordance with BMI (Body mass index)

BMI (kg/m2)	n=200 (%)
Normal (18.5-21.9)	100 (50)
Over weight (25-29.9)	75 (37.5)
Obese (30-39.9)	25 (12.5)
Morbidity obese (>40)	-

In the evaluation of the causes of UTI, the comordities in the patients were taken into consideration. Hypertension (HTN) was found to be present in (n=110) with 55%, followed by Diabetes mellitus (DM, n=95) with 47.5% and the combination of both was accounted in 70 patients with 35%. The other diseases were chronic kidney disease (CKD), coronary artery disease (CAD) and chronic obstructive disease (COPD) respectively with a non-significant the p – value as shown in the Figure 1.



Mean= 48.75; SD= 29.09; ^{NS}p>0.999; Chi square – 0.0170; df=12; NS = Non=significant

Figure 1: Impact of comorbidities on UTI (n=200)

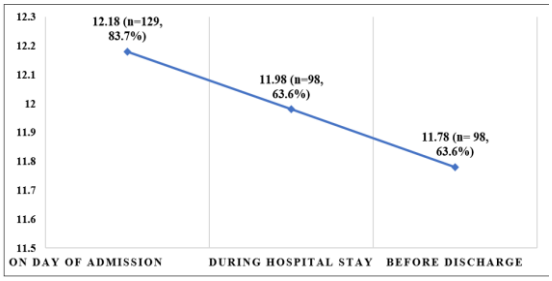
Figure 2 explored the values of WBCs in patients (n=154) of hospital at the time of admission. It was observed that the average WBC count (cells/mm^3) was found to be 12.18 on the day of admission in n=129 (83.7%) hospital, while it was dropped to 11.78 cells/mm^3 (n=98 with 63.6%) before discharge from the hospital. The values were found to be statistically significant (**p=0.0208). PUS cells in the patients were

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(6), 496-504 | ISSN:2251-6727

evaluated in the UTI patients. About 80 % of the patients were reported to have > 5 hpf.

Table No 3: Presence of pus cells in Urinary tract infected patients (n=200)

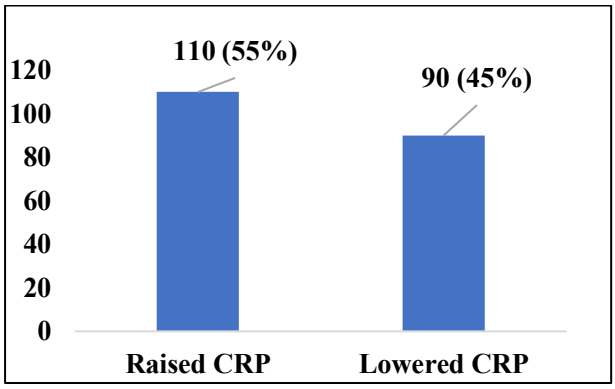
Pus cells (CUE)	n (%)
<2 hpf	15 (7.5)
2-5 hpf	25 (12.5)
> 5 hpf	160 (80)
Mean= 66.67; SD= 66.12; ^{ns}p=0.9825; Chi square – 0.0352; df=2; ns= non-significant	



Mean= 108.3; SD= 14.61; **p=0.0208; Chi square – 7.750; df=2; statistically significant

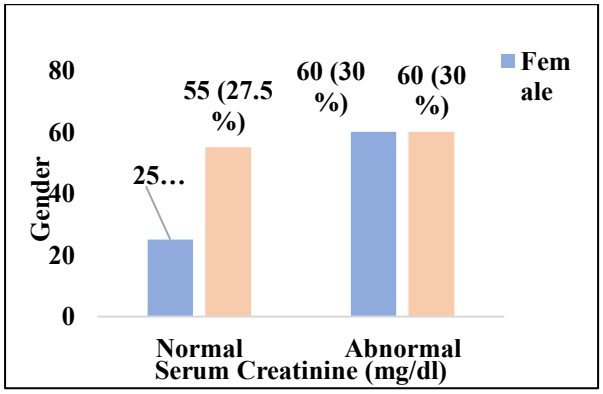
Figure 2: illustrated the average WBC count (cells/mm^3) in days from the day of admission till discharge in in-patients (n=154)

In the evaluation of C-reactive protein (CRP) levels of UTI patients, it was observed that more than 50% (n=110) of the patients suffered from elevated levels, with p value of 0.999. Additionally, serum creatinine levels were reported to be abnormal in (n=60) males and females each, which meant that > 50 % of the total UTIs were experienced with abnormality, with p value (0.0086) as statistically significant as shown in the Figure 3A & B.



Mean= 100; SD= 10; Fischer exact test ^{ns}p>0.999; ns= non-significant

Figure 3A: Showed CRP levels in UTI patients (n=200)



Mean= 50; SD= 50; Chi-square test, chi-square = 6.905; p=0.0086; df=1; Statistically significant

Figure 3B: Showed Serum creatinine levels (mg/dl) in UTI patients (n=200)

With regard to the temperature, amongst 200 patients more than 55 % of them suffered from higher temperatures (98.7-102^{0}F) followed by > 103^{0}F. The p value was found to be statistically non-significant as shown in the Table 4.

Table No 4: Showed the record of temperatures in UTI patients (n=200)

Temperature	n	%
<98.6^{o}F	65	32.5
98.7-102^{o}F	115	57.5
>103^{o}F	20	10

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(6), 496-504 | ISSN:2251-6727

Mean= 66.67; SD= 47.52; Chi-square = 0.00137; ^{ns}p=0.099; df=2; ns=non-significant

The presence of Nitrites was recorded in the UTI patients. It was found that amongst (n=200) patients, 70% of the patients were shown with positive values, while 30% of them have shown negative, with no significant difference statistically (Table 5).

Table No 5: The presence of Nitrites in the UTI patients

Number of patients	Positive n (%)	Negative n (%)
n=200	140 (70)	60 (30)
Mean – 100; SD - 40; Fisher's exact test - ^{ns}p-0.999; ns – non-significant		

In the present study, the record of presence of microorganisms - gram positive and gram negative was analysed. The gram-negative organisms were present in 70% (n=140) of the total number of patients, followed by fungi (14%) and gram-positive bacteria (n=20). Amongst the Gram-negative bacteria *Klebsiella pneumonia* was detected in 60 patients followed by *E.coli* (n=55). The p value (0.999) was found to be statistically non-significant as shown in the Table 6.

Table No 6: The presence of microorganisms in the UTI patients

Causative organisms	**Number of patients (n=200) n (%)**
Gram positive bacteria	**20 (10)**
Staphylococcus aureus	10 (5)
Enterococcus spps	10 (5)
Gram negative bacteria	**140 (70)**
Klebsiella pneumonia	60 (30)
Pseudomonas aeroginosa	25 (12.5)
E.coli	55 (27.5)
Fungi	**28 (14)**
Tricosporon spps	4 (2)
Yeast	8 (4)
Candida non-albicans	4 (2)
Candida albicans	12 (6)
Mixed growth	
Gram +ve and gram-ve	**12 (6)**
Mean = 50; SD = 16.5; df=3; Chi Square – 6.762; ^{ns}p=0.999; ns=non-significant	

In the treatment of the UTIs, Anti-bacterial drugs were given according to the culture test results. Carbapenems like Meropenem, Ertapenem and Faropenem (40% all together) were the first class of drugs prescribed followed by Cephalosporins (25%) and Cefaperazone + sulbactum (12.5%) respectively with statistically significant values (*p=0.0439), as shown in Table 7.

Table No 7: Treatment of UTI with Anti-bacterial drugs

S. No	**Anti-bacterial agents**	**Number of patients n (%)**
1	CARBAPENEMS	
	Meropenem	70 (35)
	Ertapenem	5 (2.5)
	Faropenem	5 (2.5)
2	TETRACYCLINES	
	Minocycline	20 (10)
3	MACROLIDES	
	Clarithromycin	5 (2.5)
4	GLYCOPEPTIDES	
	Vancomycin	5 (2.5)
5	OXAZOLIDIONES	
	Linezolid	5 (2.5)

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 496-504 | ISSN:2251-6727

6	CEPHALOSPORINS	
	Cefoperazone	50 (25)
7	POLYMIXIN B	
	Xolabin	5 (2.5)
8	COMBINATION	
	Cefoperazone+sulbactum	25 (12.5)
	Cefepime+tazobactum	5 (2.5)
	Mean = 18.18; SD=22.28; F-Test - *p=0.0439; F=3.865; df=10	

DISCUSSION

The current study was conducted in 200 patients for a period of more than one year, to analyse the prevalence of UTIs in a tertiary care hospital. Women are more likely than males to get a urinary tract infection (UTI), which is a common bacterial infection that affects many individuals, studies revealed [15]. However, in the present study, more than 50% were males who were > 55 years of age as compared to females.

Although some research indicates a connection between a greater body mass index (BMI) and a higher incidence of UTIs, other studies have not discovered any meaningful association [16]. In particular, some studies suggest that those who are obese (BMI ≥30) may be more prone to UTIs than people who are normal weight. Other research, however, has not found a statistically significant difference in BMI between those who have UTIs and those who do not [17]. In the present study, greater body mass index (BMI) had a higher prevalence of UTIs, as evident with the 50% of patients who were overweight and obese, the results seem to be consistent with the previous research[16]. Urinary tract infections, or UTIs, and concomitant illnesses can raise the likelihood of getting one, complicate diagnosis and treatment, and perhaps result in more serious complications. UTIs are more common in some people with underlying medical disorders, including as diabetes or kidney disease, which can also make treatment more difficult [18]. The comorbid conditions were recorded; hypertensive patients (55%) were of majority with UTI infections followed by Diabetes mellitus (47.5%) and combination of both hypertension and diabetes mellitus (35%). CKD patients were accounted for 32.5% of the total number of patients (n=200) followed by hypothyroidism (25%). The combination of hypothyroidism with the other ailments like hypertension and cardiovascular diseases were also considered as comorbid conditions. In the present study, an average count of WBCs (cells/mm^3) during admission, stay and discharge was recorded in total number of 154 patients. It was observed that the values which were raised at the time of admission was tend to decline in a significant manner at the time of discharge. One indicator of the presence of an infection is the white blood cell (WBC) count, which is a component of the complete blood count (CBC). Leukocytosis, or a high WBC count, frequently denotes an infection or other inflammatory diseases [19].

Pyuria, or the presence of pus cells in the urine, is a symptom of inflammation and may be an indication of a urinary tract infection (UTI). A greater count indicates an infection, but a modest number of pus cells—up to 5 per high power field—is normal [20]. UTIs can be either asymptomatic (with pain and cloudy urine) or symptomatic (with bacteria in the urine, or bacteriuria). About 80% of the total patients suffered from > 5 HPF in the present study. Increased blood levels of the C-reactive protein (CRP) can be a sign of inflammation and, in certain situations, can assist distinguish between upper and lower urinary tract infections (UTIs). The liver produces CRP as a reaction to inflammation, and infections, particularly UTIs, can cause its levels to rise noticeably [21]. The CRP levels were raised by 55% in total number of patients (n=200) in the present study.

Creatinine levels can be impacted by UTIs, particularly if they involve the kidneys (pyelonephritis). Because the kidneys can't filter waste products like creatinine as well, infections can affect renal function and raise blood creatinine levels [22]. On the other hand, urine creatinine may decrease as a result of UTIs, which may be a sign of renal impairment [23]. The serum creatinine levels were raised significantly in 30% of the males and females each in the present study which was consistent with the above studies.

A urinary tract infection (UTI) is frequently indicated by nitrites in the urine. The presence of nitrates in the urine is indicative of a bacterial infection in the urinary system because certain bacteria can change them into nitrites

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 496-504 | ISSN:2251-6727

[24]. In the present study, nitrites were identified in 70% (n=140) of the patients indicative of infection in the urinary tract.

The main cause of urinary tract infections (UTIs) is the presence of bacteria, specifically *Escherichia coli (E. coli)*. Gram-positive and Gram-negative bacteria are among the other organisms that can cause UTIs, particularly in complex infections. Rarely, fungi can also result in UTIs according to the study [25]. In the present study, Gram -ve bacteria was occupied with 70%, followed by fungi (14%) and gram +ve bacteria (10%). In Gram negative bacteria, *Klebsiella pneumoniae* (n=60) was identified in maximum number of patients followed by *Pseudomonas aeruginosa* (n=55), and *Escherichia coli* (n=25) as consistent with the previous studies. Multiple bacteria, not just one, were detected in the urine sample when there was a "mixed growth" in a urine culture (MGUC) [26]. About 6% of the total number of patients were reported to possess with mixed growth in the present study. In the treatment of UTIs, the most prescribed drugs were Carbapenems (40%) followed by Cephalosporins (25%) and Cefaperazone + sulbactum (12.5%). A broad-spectrum class of beta-lactam antibiotics called carbapenems is used to treat severe bacterial infections. They are frequently employed as a last resort to treat serious infections because of their reputation for killing a variety of bacteria, even those that are resistant to other antibiotics [27].

However, age, the use of particular birth control methods, and anatomical issues with the urinary system can all raise the risk. In females, other risk factors include age, poor hygiene, urinary catheters, constipation, dehydration, smoking, and alcohol use. In females, risk factors include female anatomy, sexual activity, hormonal changes, specific birth, control techniques, and past UTIs [28]. The current observational study explored the etiological factors so that different treatment strategies can be executed for successful treatment and any possible prevention.

CONCLUSION

UTIs significantly impair the quality of life for those who are afflicted and cause significant financial and public health costs. The present study reflected the prevalence of UTIs in males as compared to females. The effect of BMI, comorbid condition, WBC count, pus cells, temperature, presence of nitrites, CRP, serum creatinine and presence of microorganisms was found to be responsible and was remarkable. Gram negative bacteria was found to be more accountable than the other organisms for the occurrence of UTIs. The main purpose of the potent antibiotic class known as carbapenems is to treat severe bacterial infections, such as complicated urinary tract infections (cUTIs) as evident with the present study. Knowing the etiological factors aids in determining the causes of illness development there by disease prevention, diagnosis, and treatment all depend on an understanding of etiology. Additionally, antibiotics chosen for UTIs might lead to resistance despite an elaborated culture report. Hence, a thorough depiction of occurrence of UTI might be helpful for control of urinary tract infections.

AUTHORS CONTRIBUTIONS

VS and GS helped come up with the study's concept, work proposal, and supervision; VS gathered patient information, obtained study consent, documented the study, and wrote the manuscript. The manuscript was read and approved by all authors.

FUNDING Nil

CONFLICTS OF INTEREST The authors declared no conflicts of interest.

REFERENCES

1. Tryphena, Cherryl; Sahni, Rani Diana; John, Sushil; Jeyapaul, Shalini; George, Anne; Helan, Jasmine. A retrospective study on the microbial spectrum and antibiogram of uropathogens in children in a secondary care hospital in Rural Vellore, South India. *J Family Med and Prim Care* **2021**, 10(4), 1706-1711. | DOI: 10.4103/jfmpc.jfmpc_2090_20
2. Indian Society of Paediatric Nephrology; Vijayakumar, M; Kanitkar, M; Nammalwar, BR; Bagga, A. Revised statement on management of urinary tract infections. *Indian Pediatr*. **2011**, 48(9), 709-17. PMID: 21992903.
3. Prakash, D; Saxena, R, S. Distribution and antimicrobial susceptibility pattern of bacterial pathogens causing urinary tract infection in urban community of Meerut City, India? *ISRN Microbiol* **2013**;2013:749629 doi: 10.1155/2013/749629

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(6), 496-504 | ISSN:2251-6727

4. Shah, L, J; Vaghela, G, M; Mahida, H. Urinary tract infection: Bacteriological profile and its antibiotic susceptibility in Western India. *Natl J Med Res* **2015**, 5, 71–4.
5. Taneja N, Chatterjee SS, Singh M, Singh S, Sharma M. Paediatric urinary tract infections in a tertiary care centre from north India. *Indian J Med Res* **2010**, 131, 101-5. PMID: 20167982.
6. McCarter, Y.S, Burd, E. M; Hall, G. S; Zervos MSharp SE. Laboratory diagnosis of urinary tract infections **2009** Washington, DC ASM Press.
7. Ahmed, H; Davies, F; Francis, N; Farewell, D; Butler, C; Paranjothy, S. Long-term antibiotics for prevention of recurrent urinary tract infection in older adults: systematic review and meta-analysis of randomised trials. *BMJ Open* **2017**, 7(5), e015233. doi: 10.1136/bmjopen-2016-015233. PMID: 28554926; PMCID: PMC5729980.
8. Williams, G; Craig, J, C. Long-term antibiotics for preventing recurrent urinary tract infection in children. *Cochrane Database Syst Rev* **2019**, 4(4), CD001534. doi: 10.1002/14651858.CD001534.pub4. PMID: 30932167; PMCID: PMC6442022.
9. Muñoz, P; Llancaqueo, A; Rodríguez-Créixems, M; Peláez, T; Martin, L; Bouza, E. Group B *Streptococcus bacteremia* in nonpregnant adults. *Arch Intern Med* **1997** 27, 157(2), 213-6. doi: 10.1001/archinte.1997.00440230087011. PMID: 9009979.
10. Ronald, A. The aetiology of urinary tract infection: Traditional and Emerging Pathogens. *The Amer J Med* **2002**, 49(1), 71-82
11. Gomila, A; Carratalà, J; Eliakim-Raz, N; Shaw, E; Wiegand, I; Vallejo-Torres, L; Gorostiza, A; Vigo, J, M; Morris, S; Stoddart, M; Grier, S; Vank, C; Cuperus, N; Van den, Heuvel, L; Vuong, C; MacGowan, A; Leibovici, L; Addy, I; Pujol, M; COMBACTE MAGNET WP5 RESCUING Study Group and Study Sites. Risk factors and prognosis of complicated urinary tract infections caused by *Pseudomonas aeruginosa* in hospitalized patients: a retrospective multicentre cohort study. *Infect Drug Resist* **2018**, 11, 2571-2581. doi: 10.2147/IDR.S185753. PMID: 30588040; PMCID: PMC6302800.
12. Schmiemann, G; Kniehl, E; Gebhardt, K; Matejczyk, M, M; Hummers-Pradier, E. The diagnosis of urinary tract infection: a systematic review. *Dtsch Arztebl Int* **2010,** 107(21), 361-7. doi: 10.3238/arztebl.2010.0361. Epub 2010 May 28. PMID: 20539810; PMCID: PMC2883276.
13. Chang, S, L; Shortliffe, L, D. Pediatric urinary tract infections. *Paediatric Clin North Am* **2006**, 53(3), 379-400. doi: 10.1016/j.pcl.2006.02.011. PMID: 16716786.
Mareş, C; Petca, R, C; Popescu, R, I; Petca, A; Mulțescu, R; Bulai, C, A; Ene, C, V; Geavlete, P, A; Geavlete, B, F; Jinga, V. Update on Urinary Tract Infection Antibiotic Resistance-A Retrospective Study in Females in Conjunction with Clinical Data. *Life (Basel)* **2024**, 14(1), 106. doi: 10.3390/life14010106. PMID: 38255721; PMCID: PMC10820678.
14. Czajkowski, K; Broś-Konopielko, M; Teliga-Czajkowska, J. Urinary tract infection in women. *Prz Menopauzalny* **2021**, 20(1), 40-47. doi: 10.5114/pm.2021.105382. Epub 2021 Apr 21. PMID: 33935619; PMCID: PMC8077804.
15. Nassaji, M; Ghorbani, R; Tamadon, M, R; Bitaraf, M. Association between body mass index and urinary tract infection in adult patients. *Nephrourol Mon* **2014**, 7(1), e22712. doi: 10.5812/numonthly.22712. PMID: 25738122; PMCID: PMC4330692.
16. Janifer, J; Geethalakshmi, S; Satyavani, K; Viswanathan, V. Prevalence of lower urinary tract infection in South Indian type 2 diabetic subjects. *Indian J of Nephro* **2009**, 19 (3), 107-112.
17. Kucheria, R; Dasgupta, P; Sacks, S, H; Khan, M, S; Sheerin, N, S. Urinary tract infections: new insights into a common problem. *Postgrad Med J* **2005**, 81(952), 83-6. doi: 10.1136/pgmj.2004.023036. PMID: 15701738; PMCID: PMC1743204.
18. Riley, L, K; Rupert, J. Evaluation of Patients with Leukocytosis. *Am Fam Physician* **2015,** 92 (11), 1004-11. PMID: 26760415.
19. Kline, K, A; Lewis, A. L. Gram-Positive Uropathogens, Polymicrobial Urinary Tract Infection, and the Emerging Microbiota of the

Urinary Tract. *Microbiol Spectr* **2016**, 4 (2), 10.1128/microbiolspec.UTI-0012-2012.

20. Zhou, H, H; Tang, Y, L; Xu, T, H; Cheng, B. C-reactive protein: structure, function, regulation, and role in clinical diseases. *Front Immunol* **2024**, 14(15), 1425168. doi: 10.3389/fimmu.2024.1425168. PMID: 38947332; PMCID: PMC11211361.
21. Olenski, S; Scuderi, C; Choo, A; Bhagat Singh, A, K; Way, M; Jeyaseelan, L; John, G. Urinary tract infections in renal transplant recipients at a quaternary care centre in Australia. *BMC Nephrol* **2019**, 20(1), 479. doi: 10.1186/s12882-019-1666-6. PMID: 31881863; PMCID: PMC6935183.
22. Castañeda, D, A; León, K; Martín, R; López, L; Pérez, H; Lozano, E. Urinary tract infection and kidney transplantation: a review of diagnosis, causes, and current clinical approach. *Transplant Proc* **2013**, 45(4), 1590-2. doi: 10.1016/j.transproceed.2013.01.014. PMID: 23726626.
23. Papava, V; Didbaridze, T; Zaalishvili, Z; Gogokhia, N; Maziashvili, G. The Role of Urinary Nitrite in Predicting Bacterial Resistance in Urine Culture Analysis Among Patients With Uncomplicated Urinary Tract Infection. *Cureus* **2022**, 14 (6), e26032. doi: 10.7759/cureus.26032. PMID: 35865430; PMCID: PMC9291437.
24. Zhou, Y; Zhou Z, Zheng L, Gong Z, Li Y, Jin Y, Huang Y, Chi M. Urinary Tract Infections Caused by Uropathogenic *Escherichia coli*: Mechanisms of Infection and Treatment Options. *Int J Mol Sci* **2023**, 24(13),10537. doi: 10.3390/ijms241310537. PMID: 37445714; PMCID: PMC10341809.
25. Folaranmi, T; Harley, C; Jolly, J; Kirby, A. Clinical and microbiological investigation into mixed growth urine cultures. *J Med Microbiol* **2022**, 71(5). doi: 10.1099/jmm.0.001544. PMID: 35635768.
26. Armstrong, T; Fenn, S, J, Hardie, K, R, J, M, M. Profile: Carbapenems: a broad-spectrum antibiotic. *J Med Microbiol* **2021**, 70(12), 001462. doi: 10.1099/jmm.0.001462. PMID: 34889726; PMCID: PMC8744278.
27. Storme, O; Tirán, Saucedo, J; Garcia-Mora, A; Dehesa-Dávila, M; Naber, K, G. Risk factors and predisposing conditions for urinary tract infection. *Ther Adv Urol* **2019,** 2, 11, 1756287218814382. doi: 10.1177/1756287218814382. PMID: 31105772; PMCID: PMC6502981.