Antimicrobial Practices in Urinary Tract Infection Management: Evidence from a Tertiary Hospital in Oman

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Abstract

Objectives: To assess treatment initiatives in symptomatic and asymptomatic urinary tract infection (UTI) cases, identify effective antibiotics based on culture reports, and evaluate secondary factors such as symptoms, urine white blood cell (WBC), culture correlation, prevalent microbial flora, empirical antibiotic efficacy, and multi-drug resistance (MDR) prevalence.

Methods: A retrospective analysis of urological cases (n=223) with microbial growth on culture was conducted. Data on demographics, symptoms, urine routine and culture analysis, antibiotic sensitivity, and MDR status were collected and statistically analyzed.

Results: In the study, 191 cases were symptomatic, and 32 were asymptomatic, with *Escherichia coli* being the most common organism (55.61%). Nitrofurantoin exhibited high efficacy (75.39% in symptomatic and 78.13% in asymptomatic cases), with no significant difference in MDR bacteria prevalence (P=0.3778) or positive follow-up cultures (P=0.6877) between the two groups.

Conclusions: Nitrofurantoin was highly effective in treating UTIs in our study, but multidrug-resistant strains remain a concern. With limited access to minimum inhibitory concentration (MIC) results and culture sensitivity tests, physicians must consider various factors when prescribing first-line treatments to address MDR. Subsequent treatments should align with culture sensitivity results and clinical guidelines. This study is particularly relevant in the Gulf Cooperation Council region due to its distinct epidemiological and clinical landscape.

Keywords: Urinary Tract Infection, Antimicrobial Resistance, Culture and Sensitivity, Multidrug-Resistant Organisms, Antibiotic Stewardship.

Introduction

Urinary tract infections (UTIs) are the second most prevalent infectious ailment, affecting over 150 million patients worldwide annually, imposing significant healthcare costs and morbidity.[1] The prevalence of UTIs within the Gulf Cooperation Council (GCC) countries, spanning both pediatric and adult populations, exhibited a range of occurrences from 18.6% to 68.7%.[2] It is widely acknowledged within the medical community that the diagnosis and management of UTI patients represent critical phases in clinical practice, posing substantial challenges for healthcare practitioners.[3] With an increasing prevalence of UTIs in the GCC regions, it is necessary to understand the clinical profile and treatment approaches of both symptomatic and asymptomatic UTI cases.

UTIs exhibit a spectrum of manifestations ranging from asymptomatic bacteriuria to pyelonephritis, typically characterized by symptoms including dysuria, urinary frequency, urgency, suprapubic pain, and occasionally hematuria. Asymptomatic UTIs frequently occur among vulnerable populations such as the elderly, pregnant women, and patients with underlying genitourinary conditions or catheterization. Notably, symptomatic UTIs often prompt quicker detection due to identifiable symptoms, thereby attributing a greater burden to asymptomatic cases.[4]

Accurate diagnosis of UTIs remains essential in guiding effective treatment and combating antibiotic resistance.[5] While urinalysis is an initial screening tool, definitive diagnosis often necessitates culture and sensitivity testing.[6] Addressing challenges in obtaining diagnostic reports is imperative to enhance clinical decision-making and mitigate suboptimal UTI management practices. Further studies are warranted to delineate the necessity of treatment and identify optimal antibiotic regimens, fostering more targeted and efficacious UTI interventions.

Gaps persist in understanding the necessity of treatment for symptomatic cases, irrespective of white blood cell (WBC) presence in the urine, and in establishing connections between symptoms, urine WBC counts, culture outcomes, and multidrug-resistant (MDR) organism prevalence. Furthermore, empirical antibiotic treatment for UTIs varies, necessitating awareness of local resistance patterns to ensure appropriate antibiotic selection and stewardship. Ongoing research is exploring alternative diagnostic approaches for swift and accurate UTI detection, especially in cases suspected of resistance. Rapid molecular diagnosis holds the potential for curbing unnecessary antibiotic prescriptions.[7] The rising global prevalence of MDR organisms emphasizes the importance of local epidemiological evaluations to guide therapeutic and stewardship endeavors.

In this context, the primary objectives of this study are twofold: first, to establish the necessity of the treatment of symptomatic and asymptomatic UTI cases, regardless of the presence of white blood cells (WBCs) on routine urine or culture growth; and second, to align treatment with the most sensitive and administrable first-line antibiotic based on culture reports. The secondary objectives included correlating symptoms with WBC ranges on urine routine and growth on urine cultures, identifying the most common pathogen in urine cultures in this hospital, determining the most prescribed first-line antibiotic for empiric treatment before receiving culture reports, and quantifying the prevalence of MDR organisms in this hospital.

Methods

This retrospective observational study analyzed 223 urology cases of both genders, ranging in age from 7 months to 81 years, obtained from electronic medical records of a multi-specialty medical care hospital from January to July 2023.

The sample size for our study was determined by drawing upon previous research conducted by Ziaei and colleagues.[8] Their study likely offered valuable insights into various factors such as effect size, variability, and anticipated outcomes pertinent to the research question or phenomenon under investigation. It is noteworthy that Ziaei et al. considered a sample size of 200 patients in their study.[8] By leveraging this information, we were able to make informed decisions regarding the sample size for our study, ensuring that it would be adequate to achieve the desired statistical power and detect meaningful effects or associations.

Data from both outpatient (OP) and inpatient (IP) cases were selected in the final analysis which included critical patients from the emergency department as well as the intensive care unit (ICU). All the urine samples with the presence of growth on urine culture were included, while the samples isolated with *Candida* sp. and the ones with incomplete information were excluded from the study. Patient demographic information, including date of presentation, age, gender, and admission status, was collected. Data on symptoms, urine routine WBC counts, cultured organisms, antibiotic sensitivity patterns, and MDR status were also documented. Furthermore, information regarding the most sensitive and first-line antibiotics, along with their minimum inhibitory concentration (MIC) values, prescribed antibiotics, and follow-up status, was recorded for each case.

Upon the patient's initial presentation and clinical history, an empiric antibiotic regimen (First-line of treatment) was prescribed, following established clinical protocols. Subsequently, culture and sensitivity testing were conducted to ascertain the infection's microbial etiology and determine the isolated microorganisms' susceptibility to various antibiotics. Following receipt of the culture/sensitivity report, the patient's antibiotic prescription was revised if necessary, prioritizing the use of the most sensitive antibiotic (MIC1) identified in the report. However, if the preferred antibiotic (MIC1) necessitated parenteral administration and the patient could tolerate oral therapy instead of injectable, the second most sensitive antibiotic (MIC2) available for oral administration was 'prescribed', ensuring optimal therapeutic management aligned with the individual patient's clinical needs and microbiological profile.

Urine specimens were collected from participants who presented for UTI treatment using aseptic techniques, including midstream urine collection, catheterization, or suprapubic aspiration. Clean catch urine samples were recommended to minimize contamination in urine cultures.

The specimens were promptly transported to the clinical microbiological laboratory. Urine samples were processed for a routine test and microscopic examination and further streaked onto blood agar and CLED agar plates (Oxoid, UK). Culture plates were incubated for 24 hours at 37°C. Following incubation, single colonies for samples with significant growth were isolated, and microbial identification was performed using the automated VITEK2 System (bioMerieux) based on colony suspensions as per the manufacturer's instructions. UTI was diagnosed when significant growth ($\geq 10^5$ colony-forming units/mL) of a single or more organism/s was observed. The samples with no or insignificant growth in 24 hours of incubation were incubated for another 24 hours, and the same procedures as described above were performed for the significant colonies obtained after 48 hours of incubation. Automated antibiotic susceptibility testing was performed using the VITEK2 System (bioMerieux) as per the manufacturer's instructions.

Data analysis was done using R i386 3.6.3 and Microsoft Excel. Continuous variables are represented by mean ± standard deviation categorical variables are represented by frequency tables. Kruskal Wallis test followed by the Mann-Whitney U test with Bonferroni adjustment/Mann-Whitney U test was used to study the non-normal continuous variable. Shapiro Wilk test was used to test the normality. Categorical data was compared using the Chi-square test; a P-value <0.05 was considered statistically significant.

Results

In this study, the average age of patients was 36.39 years, with females representing 83.41%. Symptomatic UTIs were reported by 85.65% of the patients (Table 1). In patients diagnosed with UTI, an unequal distribution of patients based on gender led to a lack of statistical significance, even though 84.95% of females presented with symptomatic manifestations. Symptomatic patients had a higher mean age (37.62 years), with a statistically significant difference (P = 0.0092).

Table 1: Characteristics of Patients by Demographic Details.

Factor		**n (%)**
Age group in year	0-10	24 (10.76%)
	11-20	8 (3.59%)
	21-30	45 (20.18%)
	31-40	73 (32.74%)
	41-50	27 (12.11%)
	51-60	24 (10.76%)
	61-70	13 (5.83%)
	71-81	9 (4.04%)
Gender	Male	37 (16.59%)
	Female	186 (83.41%)
Presentation	Symptomatic	191 (85.65%)
	Asymptomatic	32 (14.35%)

There was no significant difference observed in the distribution of symptomatic and asymptomatic cases between males and females (P = 0.6777), although a higher representation of UTIs in females was observed within both groups *vs.* males (82.72% *vs.* 17.27%, and 87.5% *vs.* 12.5%, respectively; calculation based on percentage of female/male patients among total number of symptomatic and asymptomatic cases, respectively). Also, symptomatic patients are more prevalent *vs.* asymptomatic cases (89.19% *vs.* 10.81% and 84.5% *vs.* 15.05%, for both males and females, respectively) (Table 2).

Table 2: Comparison of Demographic Data with Type.

Factor		**Symptomatic (n=191)**	**Asymptomatic (n=32)**	**P-value**
Age in years	Mean ± SD	37.62 ± 17.17	29.02 ± 18.69	0.0092 M*
Gender***	Male	33 (89.19%)	4 (10.81%)	0.6777C#
	Female	158 (84.95%)	28 (15.05%)	

*** % is calculated based on column count; M indicates Mann Whitney U-test; C indicates Chi-square test; CS indicates Chi-square test with simulation; #The proportion is not equal in the group, hence the P-value*

Table 3 compares the presence of WBC in symptomatic and asymptomatic groups. Among symptomatic patients, the majority had WBC levels categorized as 3+ (37.7%), followed by NIL (29.32%) and 2+ (16.23%). In contrast, among asymptomatic patients, the highest proportion had NIL WBC levels (53.13%), followed by 1+ (12.5%) and 2+ (12.5%). Statistical analysis indicated a significant difference in the NIL category between the two groups (P= 0.0142). Additionally, while there was no significant difference in the distribution of WBC levels for 1+, 2+, and 4+ categories, a notable trend with a higher percentage of WBC (combination of 3+ and 4+) was observed in symptomatic *vs.* asymptomatic cases (42.41% *vs.* 21.88%, respectively). In the intragroup analysis of symptomatic and asymptomatic cases using the chi-square test, it was found that the distribution of urine white blood cells is not uniformly distributed within symptomatic and asymptomatic UTIs i.e., proportions are significantly different P<0.0001 (Table 3).

Table 3: Comparison of Demographic Data According to the Presence of Urine WBC.

Factor		**Symptomatic (n=191), n (%)**	**Asymptomatic (n=32) n (%)**	**P-value**
Urine white blood cell**	NIL	56 (29.32%)	17 (53.13%)	0.0142C
	1+	23 (12.04%)	4 (12.5%)	>0.99CS
	2+	31 (16.23%)	4 (12.5%)	0.7838CS
	3+	72 (37.7%)	6 (18.75%)	0.0602C
	4+	9 (4.71%)	1 (3.13%)	>0.99CS
P-value		<0.0001C	<0.0001C	

*** % calculated based on Row total; M indicates Mann Whitney U-test; C indicates Chi square test; CS indicates Chi square test with simulation*

In most cases, *Escherichia coli* was the most isolated organism (55.61%). Other major organisms included *Streptococcus agalactiae (S. agalactiae), Klebsiella pneumoniae (K. pneumoniae)*, and *Enterococcus faecalis (E. faecalis)*. Interestingly, *E. faecalis* was more prevalent in asymptomatic cases (12.5%) compared to symptomatic cases (3.66%). *Staphylococcus saprophyticus (S. saprophyticus)* and *Staphylococcus haemolyticus (S. haemolyticus)* were only isolated in symptomatic cases (Figure 1).

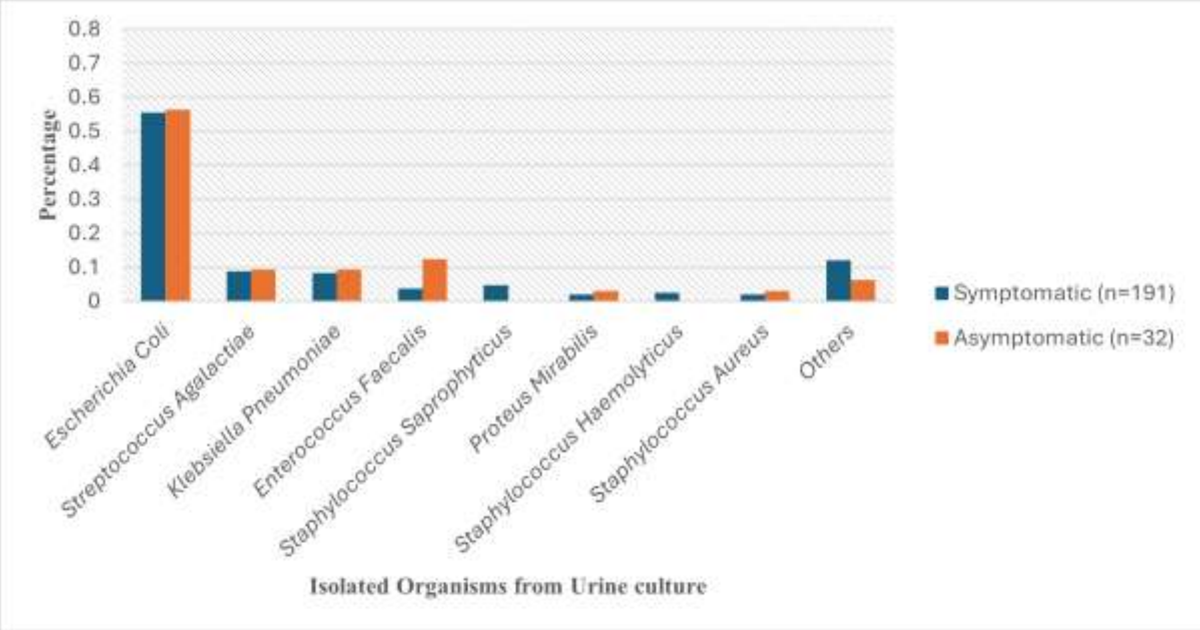

Figure 1: Distribution of Patients by Isolated Organisms.

Table 4 illustrates the distribution of patients by empirically prescribed antibiotics. Levofloxacin and Nitrofurantoin emerged as the most frequently prescribed first-line antibiotics, followed by Augmentin/Amoxicillin + Clavulanic acid in symptomatic cases whereas, Augmentin/Amoxicillin + Clavulanic acid and Ceftriaxone emerged as the most frequently prescribed first-line antibiotics in asymptomatic cases (15.63% each). It has been observed that among the symptomatic group (n=191), 157 patients (82.2%) received treatment, while among the asymptomatic group (n=32), 23 patients (71.88%) were offered treatment (Second line of antibiotic treatment based on MIC 1 results) (Table 4).

Table 4: Distribution of Patients by Antibiotic Prescribed Empirically.

Antibiotic Prescribed	Symptomatic (n=191)	Asymptomatic (n=32)
Nil	34 (17.8%)	9 (28.13%)
Levofloxacin	29 (15.18%)	2 (6.25%)
Nitrofurantoin	28 (14.66%)	2 (6.25%)
Augmentin/ Amoxicillin +Clavulanic	20 (10.47%)	5 (15.63%)
Cefixime	16 (8.38%)	4 (12.5%)
Ceftriaxone	10 (5.24%)	5 (15.63%)
Cefuroxime	10 (4.19%)	2 (9.38%)
Ciprofloxacin	11 (5.76%)	0 (0%)
Cefditoran	6 (3.14%)	2 (6.25%)
Cefdinir	7 (3.66%)	0 (0%)
Fosfolag Sachet/ Fosfomycin	6 (3.14%)	0 (0%)
Others	21 (10.99%)	3 (9.38%)

**Count <5 is combined & shown as Others which includes Cotrimoxazole, Gentamicin, Cefixime, Meropenam, Amikacin etc.*
Note: A difference in total patient number indicates Multiple antibiotic administration to a single patient.

Table 5 illustrates the distribution of patients by antibiotic sensitivity among symptomatic and asymptomatic groups (most sensitive as per the culture report). Nitrofurantoin showed susceptibility in 144 patients (75.39%) among symptomatic cases and in 25 patients (78.13%) among asymptomatic cases. The second most sensitive antibiotic was ciprofloxacin in both symptomatic and asymptomatic cases (32.98% *vs.* 25%, respectively).

Table 5: Distribution of Patients by Antibiotic Sensitivity (First line of Antibiotics as per the Culture Report).

Sensitive Antibiotic	Symptomatic n (%)	Asymptomatic n (%)
Nitrofurantoin	144 (75.39)	25 (78.13)
Ciprofloxacin	63 (32.98)	8 (25)
Cefepime	29 (15.18)	2 (6.25)
Meropenem	21 (10.99)	1 (3.13)
Augmentin/ Amoxiclave	19 (9.95)	4 (12.5)
Levofloxacin	14 (7.33)	4 (12.5)
Moxifloxacin	11 (5.76)	2 (6.25)
Ampicillin	8 (4.19)	1 (3.13)
Gentamicin	6 (3.14)	2 (6.25)
Imipenem	7 (3.66)	1 (3.13)
Others	16 (8.9)	6 (21.88)

Count <6 is combined as others, including Cefuroxime, Cefixime, Ceftazidime, Ceftriaxone, etc.
Note: It's important to note that percentages may exceed 100% and the total number of patients may exceed the sample size due to patients being susceptible to multiple antibiotics. Many patients were prescribed a combination of drugs while some patients were prescribed individual drugs as monotherapy, which is also present in the combined drugs.

Table 6 compares the presence of MDR bacteria and follow-up cultures in all the UTI cases. Specifically, there was no significant difference in the prevalence of MDR bacteria between symptomatic and asymptomatic cases (P=0.3778). Similarly, the presence of positive follow-up cultures did not show a significant association with UTI type (P=0.6877). These findings imply that the presence of MDR bacteria and the necessity for subsequent cultures may not be impacted by the symptomatic manifestation of UTI, regardless of symptom presence or absence.

Table 6: Association of MDR and Follow-Up Culture with Type of UTI.

Factor		Symptomatic (n=191) n (%)	Asymptomatic (n=32) n (%)	Grand Total	P-value
MDR	Yes	9 (4.71%)	0 (0%)	9 (4.04%)	0.3778[CS]
	No	182 (95.29%)	32 (100%)	214 (95.96%)	
Follow up culture	Yes	12 (6.28%)	3 (9.38%)	15 (6.73%)	0.6877[CS]
	No	179 (93.72%)	29 (90.63%)	208 (93.27%)	

Our observations indicate that Nitrofurantoin and Levofloxacin are the most prescribed empirical antibiotics in both symptomatic and asymptomatic cases (Table 4) and Nitrofurantoin confirmed its highest sensitivity in MIC 1 (Figure 2). Levofloxacin was the most frequent antibiotic prescribed for Nitrofurantoin-sensitive cases followed by Augmentin. The clinical indication of Glucose-6-phosphate dehydrogenase (G6PD)-deficiency and the availability of Nitrofurantoin (only one brand available in Oman) could have been the factors in choosing the above antibiotic. In nitrofurantoin-sensitive cases, irrespective of prescribed antibiotics, a consistent median MIC1 of 16 (μg/μl) was observed, indicating uniform sensitivity to nitrofurantoin across both groups (Figure 2).

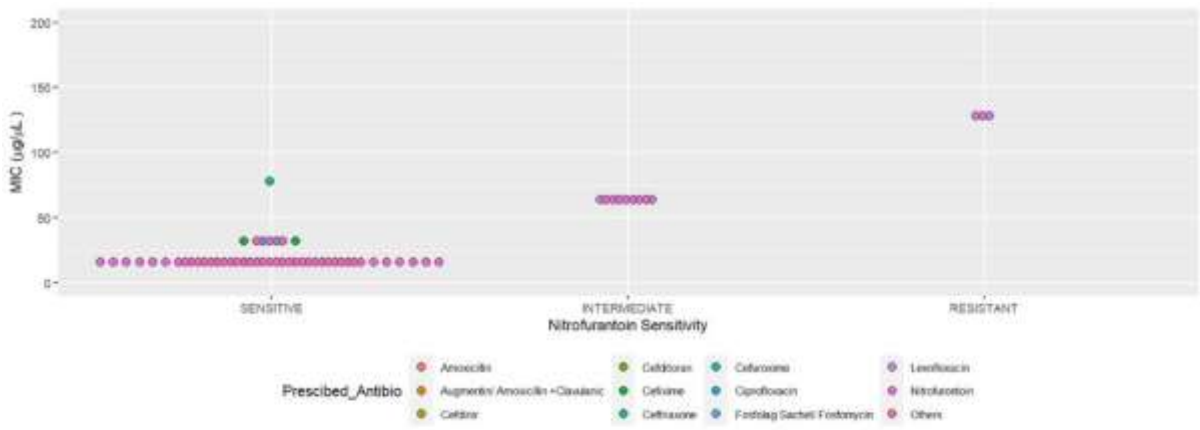

Figure 2: Distribution of MIC by Prescribed Drugs for the Isolates based on Nitrofurantoin Sensitivity.

Discussion

This retrospective observational study investigated the clinical and microbiological factors influencing UTI management in a hospital setting to avoid progression toward urological complications such as pyelonephritis, renal scarring, and bladder dysfunction. The study participants included urology patients suffering from both uncomplicated and complicated UTI (cUTI) and the investigation focused on the management of asymptomatic, symptomatic, and recurrent forms of the condition which was diagnosed using urine cultures which were also tested for antibiotic susceptibility.

The demographic characteristics of the study cohort shed light on UTI epidemiology, with females comprising the majority of participants. This aligns with literature attributing women's higher UTI prevalence to anatomical features, particularly the shorter female urethra. This anatomical characteristic facilitates easier bacterial entry into the urinary system, heightening UTI susceptibility. Understanding these demographic and anatomical factors is crucial for effective UTI prevention and management strategies.[9,10] Bhargava et al. in North India[11] and Mitu et al.in Bangladesh[12] found significantly higher UTI prevalence among females (60.7%-83.5%) compared to males. Tanko Nuhu in Sokoto, Nigeria, also noted a substantial burden of UTIs in females (631 out of 1,120 patients).[13] Sula et al.'s systematic review in Saudi Arabia reported a male-to-female ratio of 1:2 in UTI prevalence,[14] suggesting implications for neighbouring countries like Qatar.

Contrary to the expected age-related increase in UTI prevalence, we observed a departure from this pattern, with a relatively lower proportion of UTI cases in older age groups. Specifically, individuals aged 51-81 years exhibited proportions comparable to those seen in the pediatric population, suggesting a shift from the conventional understanding that UTIs predominantly affect older adults. UTIs pose a substantial risk among elderly women, ranking as the second most common infection in this demographic.[15,16] It represents the primary cause of infection in hospitalized elderly women or those residing in long-term care facilities.[17] A study examining UTIs in older adults (aged ≥65 years) in the United Kingdom from 2004 to 2014 revealed escalating incidence rates among women, ranging from 9-11 cases per 100 person-years in the 65-74 age group to 11.4-14.3 and 14.7-19.8 cases per 100 person-years in the 75-84 and >85 age brackets, respectively. Corresponding rates among men were 2.8-3.0, 5.9-6.1, and 8.1-10.5 cases per 100 person-years. Despite being prevalent among older adults, UTIs may not always manifest with classic symptoms, and vague indicators like confusion or lethargy may be present.[16] Postmenopausal women, due to estrogen deficiency, face an increased UTI risk, while men present with various urological findings elevating their susceptibility, including bladder or kidney stones, enlarged prostate, catheter use, or bacterial prostatitis.[5,17] Recurrent UTIs impose a significant social and economic burden, negatively affecting patient quality of life and healthcare systems globally. Risk factors for both symptomatic UTIs and asymptomatic bacteriuria in the elderly include age-related immune changes, exposure to nosocomial pathogens, multiple comorbidities, and prior UTI history.[17]

In our study, it was noted that incidence of UTI was more prevalent in females compared to males and symptomatic cases were more prevalent *vs.* asymptomatic cases in both genders with similar distribution patterns. Therefore, most UTIs are symptomatic but the asymptomatic cases cannot be neglected. Hence extra care should be taken before diagnosing and considering gender wise distribution of symptomatic and asymptomatic cases.

The correlation between symptoms and urine WBC levels in this study, although not statistically significant, highlights the complexity of UTI diagnosis. Though there was no significant difference in the distribution of WBC levels, an interesting trend with a higher percentage of WBC (WBC 3+ and 4+) was observed in symptomatic cases compared to asymptomatic cases. It was also evident that the absence of urine WBC was more prevalent in asymptomatic cases but it cannot be ruled out for symptomatic cases. However, a higher number of WBCs in urine culture may indicate the severity of the symptomatic cases. But overall urine WBC levels may not serve as a unique marker for distinguishing between symptomatic and asymptomatic patients in the context of UTI. Future studies with larger populations may give some significant outcomes and relevance of urine WBC tests in both case types based on the sensitivity results. While leukocyturia is a common feature of UTIs, its absence does not necessarily rule out infection, especially in asymptomatic or mild cases.[18] Additionally, the variability in urine WBC levels among symptomatic and asymptomatic individuals underscores the limitations of relying solely on this parameter for diagnosis, necessitating a comprehensive clinical assessment and consideration of other factors, including urine culture and sensitivity.

The distribution of isolated organisms provides valuable insights into the microbial etiology of UTIs within the study population. *E. coli* emerged as the predominant pathogen, aligning with its well-established role as the leading cause of UTIs globally.[19,20] Other common pathogens included *S. agalactiae, K. pneumoniae, and E. faecalis,* reflecting the diverse microbial flora implicated in UTIs. Interestingly, the study identified differences in microbial prevalence between symptomatic and asymptomatic cases, with *E. faecalis* exhibiting higher prevalence in asymptomatic cases which is concerning due to its global significance as a UTI causative agent. Previous studies have also documented that *E. coli* and *K. pneumoniae* are the primary etiological agents responsible for cUTI cases.[21-24] This can be explained by the presence of diverse virulence factors that augment their capacity to establish themselves in the urinary tract and elude the host immune system. Among these are adhesins that enable binding to the uroepithelial cells, toxins that might damage host tissues, and mechanisms to evade phagocytosis by immune cells. These result in resistance toward broad-spectrum penicillins, third-generation cephalosporins (cefotaxime, ceftriaxone, and ceftazidime), fourth-generation cephalosporin (cefepime), gentamicin and old fluoroquinolones.[24,25] The presence of urinary catheters significantly increases the risk of infection by both *E. coli* and *K. pneumoniae*, as these devices can provide a direct pathway for bacteria to enter the bladder thereby resulting in various urological complaints of varying degrees based on the bacteria involved.[25]

Asymptomatic bacteriuria (AB) challenges the need for antibiotic treatment, potentially contributing to the emergence of antibiotic resistance. In a study by Nicolle et al., fifty institutionalized elderly women with asymptomatic bacteriuria were enrolled and randomly allocated to receive either therapy for all instances of bacteriuria or no therapy unless symptoms emerged. Throughout a one-year follow-up period, the therapy group demonstrated a reduced prevalence of bacteriuria compared to the no-therapy cohort. However, antimicrobial treatment was associated with an increased incidence of reinfection and adverse drug reactions compared to the absence of therapy.[26] Cai et al. investigated the effects of AB treatment on antibiotic resistance in women with recurrent UTIs. They found that treating AB was associated with higher recurrence rates and increased antibiotic resistance in *E. coli* isolates compared to untreated individuals.[27]

These studies highlight the distinct clinical outcomes associated with treating symptomatic UTIs versus AB. While treating symptomatic UTIs is associated with symptomatic improvement and clinical benefit, treating AB is not only ineffective but also carries the risk of rUTIs, antimicrobial resistance, and increased healthcare costs. These findings underscore the importance of differentiating between symptomatic UTIs and AB and adopting evidence-based approaches to antimicrobial stewardship in clinical practice.[27] The elevated *E. faecalis* prevalence in asymptomatic UTIs warrants further investigation into management strategies and implications. Understanding the microbial composition and antibiotic resistance patterns in asymptomatic UTIs, especially with *E. faecalis* prevalence, is crucial. More research and clinical insights are required to establish effective management approaches for asymptomatic UTIs involving *E. faecalis* and to mitigate potential consequences of antibiotic treatment on antibiotic-resistant bacteria prevalence.

The association between MDR prevalence and UTI type yielded interesting findings. While MDR was detected in a small proportion of symptomatic cases, but no MDR organisms were identified among asymptomatic cases. However, there is no significant inference that can be drawn from these observations.

The study's analysis of MIC values provided valuable insights into antibiotic sensitivity patterns, with several antibiotics demonstrating efficacy against specific uropathogens. Accurate MIC assessment is crucial for effective infection treatment, as elevated MIC levels near breakpoints may indicate potential therapy failure and early signs of resistance. Understanding strain susceptibility to antibiotics utilized in the hospital aids antibiotic stewardship efforts.[28] Furthermore, the efficacy of certain antibiotics, such as Meropenem against MDR *E. coli* strains, highlights their role as valuable therapeutic options in complicated or resistant UTI cases. Our choice of Nitrofurantoin as the first line of therapy in UTI cases was further supported by MIC 1 results, which showed that Nitrofurantoin was the most sensitive antibiotic among the others. Similarly, the frequent prescription of Levofloxacin for Nitrofurantoin-sensitive cases suggests its clinical utility in UTI management owing to several factors. Levofloxacin is a broad-spectrum antibiotic that is effective against a wide range of bacteria commonly implicated in UTIs, including both Gram-positive and Gram-negative bacteria. Levofloxacin may be prescribed in cases where nitrofurantoin is contraindicated or ineffective, such as in patients with known allergies, kidney impairment, or resistance to nitrofurantoin. Additionally, Levofloxacin offers the advantage of once-daily dosing, improves patient compliance, and potentially reduces the risk of the development of resistance.[29] Such insights are crucial for guiding evidence-based treatment decisions and promoting judicious antibiotic use to mitigate the emergence of antibiotic-resistant pathogens.[30] Previously conducted studies reported that 99.4% and 93.3% of the *E coli* isolates obtained were susceptible toward nitrofurantoin while it showed resistance to most groups of antibiotic regimens further establishing it as a treatment of choice even in cUTI cases.[31,32]

Antibiotic susceptibility testing revealed Nitrofurantoin as the most effective antibiotic against uropathogens, particularly in non-MDR cases. Nitrofurantoin's efficacy, low propensity for resistance, favorable safety profile, and broad-spectrum activity highlight its suitability as a first-line treatment for uncomplicated UTIs.[33] Alanazi et al. found that nitrofurantoin demonstrates the highest rate of treatment success and is the most cost-effective antibiotic option for uncomplicated UTIs.[34] The current study identified antibiotics such as Cefepime, Meropenem, and Gentamicin with lower effectiveness, emphasizing the importance of judicious antibiotic selection guided by local susceptibility patterns and antimicrobial stewardship principles.[35]

Overall, first-line antibiotic selection should consider factors like the clinical status of the patient, medical history of the patient, and details of the antibiotics to be prescribed, which will include its antimicrobial spectrum, safety, and local resistance patterns to optimize treatment outcomes while minimizing resistance emergence and adverse effects.

The drawbacks of the present study include its retrospective design, single-centre setting, lack of clinical outcome assessment alongside the lack of classification between complicated and uncomplicated UTIs. The advantages of the present study include the large sample size employed which included patients from the ICU, OPD as well as emergency department which represented a sample with varying degrees of UTI prognosis ranging from uncomplicated to complicated and recurrent cases. The present study highlights the clinical profile and treatment approach to UTIs in the GCC region, emphasizing its importance given the region's distinct clinical and epidemiological landscape. This study emphasizes the importance of urine cultures and susceptibility testing in guiding antibiotic therapy for complicated or recurrent UTIs, while also advocating judicious antibiotic use to combat antimicrobial resistance, especially amid rising MDR prevalence. Future research should adopt prospective, multicentre approaches to enhance generalizability and comprehensively evaluate UTI management efficacy.

Conclusion

The results of the present study reveal that age is a significant factor with regard to management and treatment of UTI among urology patients, especially in GCC countries. Among causative organisms, *Escherichia coli* was found to be the primary pathogen reported in urine cultures, with Nitrofurantoin being the most effective first-line antibiotic. The results was emphasized the importance of follow-up care in managing MDR infections to avoid progression toward serious urological complications. Customized antibiotic therapy based on culture and sensitivity results is crucial for optimizing treatment outcomes and combating antimicrobial resistance. Future research should focus on prospective multicenter studies to confirm these findings and explore new therapeutic approaches and antimicrobial stewardship strategies.

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