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Original article

Children's Urinary Tract Infections: A Retrospective Study at Al-Khadra Hospital

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Abstract
Urinary Tract Infection (UTI) is a common and serious bacterial infection in children, predominantly caused by Escherichia coli. Accurate diagnosis is challenging, especially in young, pre-continent children, with urine culture remaining the gold standard. Treatment should follow local guidelines and sensitivity patterns, while the use of antibiotic prophylaxis remains controversial due to rising resistance and limited impact on long-term outcomes like renal scarring. This study aimed to determine the prevalence, associated clinical features, and causative pathogens of urinary tract infections (UTIs) in children, while also assessing antibiotic resistance patterns and the effectiveness of empirical antibiotic treatment. This retrospective study was conducted in the Pediatric Department of Al-Khadra Hospital over five months, from January 2024 to May 2024. The study sample consisted of 50 pediatric patients, aged between 1 month and 17 years. Of the total participants, 17 were male, and 33 were female. Data were obtained from patient records stored in the hospital's archives. The collected data focused on various parameters related to urinary tract infections (UTIs), including laboratory investigations such as Complete Blood Count (CBC), C-reactive Protein (CRP), urea, creatinine, urine culture, and body temperature. The study demonstrated a female predominance in UTI cases (66%), with the highest incidence observed in children over 6 years (36%) and infants aged 1–12 months (30%). Hospital stays varied, with the majority (26%) lasting 4 days. Laboratory findings revealed elevated urea and CRP levels in almost all patients, indicating systemic inflammation. *Escherichia coli and Klebsiella spp.* were the predominant pathogens, with consistent antimicrobial resistance profiles. Treatment involved intravenous Cefotaxime during hospitalization, followed by oral Cefixime upon discharge. In summary, this study reveals a significant prevalence of urinary tract infections (UTIs) in the pediatric population, with disproportionate representation in children under two years and females. Escherichia coli and Klebsiella species were identified as the predominant causative bacterial pathogens. Further large-scale, multi-center studies are required to comprehensively elucidate the epidemiology and pathogenesis of pediatric UTIs and optimize management strategies.
Keywords: Escherichia coli, UTI, Cefixime**,** Pediatric, Cefotaxime**.**

Introduction

Urinary tract infections (UTIs) are among the most common bacterial infections affecting the children population and represent a significant cause of morbidity worldwide. The urinary system, consisting of the kidneys, ureters, bladder, and urethra, serves as a critical component of the body's excretory system, responsible for the removal of metabolic waste and maintenance of homeostasis through the regulation of electrolyte balance, blood pressure, and fluid volume [1]. In a healthy individual, the urinary tract is typically sterile, but it is vulnerable to colonization and infection by various microorganisms, most notably bacteria of enteric origin.

Globally, UTIs are estimated to cause between 150 to 250 million cases annually across all age groups, with children being particularly susceptible [2]. Children's UTIs are not only frequent but also clinically important due to their association with congenital anomalies, the potential for recurrence, and the risk of long-term renal complications such as scarring, hypertension, and chronic kidney disease (CKD) [3,4]. The burden of disease is higher among females compared to males beyond the neonatal period due to anatomical and physiological differences, including a shorter urethra and proximity to the anus, which facilitates ascending bacterial colonization [5].

Escherichia coli is the predominant pathogen in children's UTIs, accounting for 80–90% of cases, followed by other uropathogens such as *Klebsiella pneumoniae*, *Proteus mirabilis*, *Enterococcus spp.,* and *Pseudomonas aeruginosa* [6,7,8]. In neonates and young infants, the spectrum of causative organisms is broader and may include Gram-positive organisms such as Streptococcus agalactiae and Staphylococcus saprophyticus, particularly in sexually active adolescents [9,10]. Less commonly, viral and fungal pathogens, such as cytomegalovirus and Candida spp., are observed in immunocompromised hosts or those with urinary tract instrumentation [11,12].

Clinically, the presentation of UTIs in children is highly variable and often age-dependent. In neonates and infants, nonspecific signs such as poor feeding, vomiting, jaundice, irritability, or failure to thrive are

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common. Fever without an identifiable source is often the only indicator of a UTI in this age group [13,14,15]. As children grow older, they may present with more localized symptoms such as dysuria, increased urinary frequency, abdominal pain, flank pain, and foul-smelling urine. Notably, recurrent UTIs may serve as the first indication of an underlying anatomical or functional abnormality in the urinary tract, warranting further diagnostic evaluation [16,17].

Diagnosis is based on a combination of clinical evaluation and laboratory investigations. Urinalysis—including dipstick tests for leukocyte esterase and nitrites—and urine microscopy are standard first-line tests. However, urine culture remains the gold standard for confirming infection and guiding antibiotic selection. The method of urine collection is critical in young children; catheterization or suprapubic aspiration is preferred over bag collection due to the high risk of contamination [18].

Imaging studies are employed selectively based on age, clinical severity, and recurrence risk. Renal and bladder ultrasound, voiding cystourethrography (VCUG), and renal cortical scintigraphy (DMSA) are used to evaluate structural abnormalities, detect vesicoureteral reflux (VUR), and assess renal parenchymal damage [19].

The management of pediatric UTIs involves prompt initiation of empirical antibiotic therapy, tailored subsequently according to urine culture and sensitivity results. Local resistance patterns play a pivotal role in guiding empirical therapy. In neonates and infants younger than three months, parenteral antibiotics such as ampicillin combined with aminoglycosides or third-generation cephalosporins are recommended due to the risk of sepsis and renal involvement [20,21]. Transition to oral therapy can be considered once clinical improvement is observed.

Given the increasing global concern over antibiotic resistance, judicious use of antimicrobials is imperative. Prophylactic antibiotic use remains controversial, and current trends favor minimizing prophylaxis in favor of close monitoring and addressing underlying risk factors for recurrence.

This retrospective study, conducted in the children's department of Alkhdra Hospital, aims to evaluate the prevalence, etiological agents, clinical manifestations, laboratory findings, antibiotic resistance patterns, and therapeutic strategies employed in the management of children's UTIs. By analyzing data from real-world clinical settings, this research seeks to contribute to a better understanding of the local epidemiology of children's UTIs and support the development of evidence-based clinical guidelines for effective management and prevention.

Methods

Study Design and Setting

This study employed a retrospective, observational design to evaluate children's urinary tract infections (UTIs) at the Pediatric Department of Al-Khadra Hospital, Tripoli, Libya. The investigation was conducted over five months, from January 2024 to the end of May 2024. The hospital, a major public healthcare institution in the region, serves as a referral center for children's cases, including those presenting with symptoms of urinary tract infections.

Study Population

The study sample consisted of 50 patients diagnosed with UTI during the study period. Patients included ranged in age from one month to 17 years. The inclusion criteria encompassed children with confirmed clinical and laboratory diagnoses of UTI, as documented in hospital records. Patients with incomplete data or lacking definitive diagnostic evidence were excluded from the study. Among the 50 cases reviewed, 33 (66%) were female and 17 (34%) were male, reflecting the known female predominance in children's UTI incidence.

Data Collection

Data were retrospectively extracted from patient files archived in the hospital's medical records department. The parameters collected included: Demographic characteristics such as age and gender distribution. Clinical information includes presenting symptoms, duration of hospitalization, and clinical findings. Laboratory investigations such as complete blood count (CBC), C-reactive protein (CRP), urea, creatinine, and urine culture results. Susceptibility testing data, where available. Treatment regimens include empirical antibiotic therapies administered during hospitalization and at discharge.

Microbiological Analysis

Urine cultures were performed for 21 of the 50 patients using standard microbiological techniques to identify uropathogens. Of these, 10 cultures yielded no bacterial growth. The remaining cultures identified *Escherichia coli* and *Klebsiella spp.* as the most prevalent pathogens. Antimicrobial susceptibility testing was conducted to determine the resistance profiles of the isolated bacteria, though not all cases had complete sensitivity reports available.

Data Analysis

Descriptive statistics were utilized to summarize the collected data. Frequencies and percentages were calculated for categorical variables such as gender, age group distribution, length of hospitalization, and

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causative organisms. Laboratory parameters were evaluated for deviations from normal reference ranges to assess the severity of infection. No inferential statistical methods were applied, as the study aimed to provide an observational overview of trends and clinical patterns.

Ethical Considerations

Ethical approval for the study was obtained in accordance with institutional requirements. Patient confidentiality was maintained throughout the data collection and analysis phases. Identifying information was anonymized to protect patient privacy. As the study was retrospective and based on existing medical records, informed consent was deemed unnecessary under local ethical guidelines.

Results

Demographic Characteristics

The study included 50 pediatric patients diagnosed with urinary tract infection (UTI) at Alkhdra Hospital. Females represented the majority of cases (n = 33; 66%), while males accounted for 34% (n = 17). A Chi-square test revealed a statistically significant gender disparity in UTI prevalence ($x^2 = 10.24$, $p = 0.00137$), confirming a higher susceptibility among females (Figure 1).

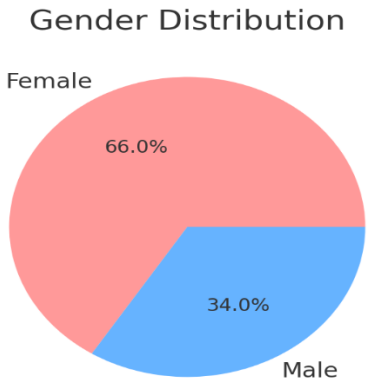

Figure 1: Gender distribution among patients.

The mean age of the patients was 8.72 years (SD = 5.18), with two notable age groups showing higher incidence rates: infants aged 1–12 months (30%) and children over 6 years (36%).

Hospitalization Profile

Hospital stay duration varied among the cohort, with the mean duration reported as 6.28 days (SD = 2.04) and a median of 7 days. The most common hospitalization duration was 4 days, accounting for 26% of patients. A Kruskal-Walli's test confirmed a statistically significant variation in hospitalization periods ($p < 0.0001$) (Figure 2).

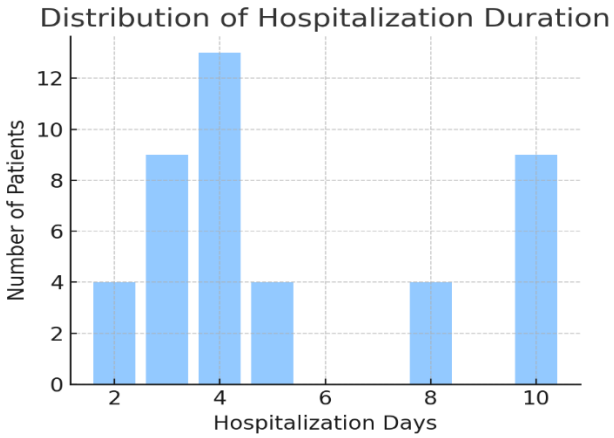

Figure 2: Distribution of hospitalization duration among patients.

Laboratory Findings

The numerical data were computed for key laboratory parameters. The mean C-reactive protein (CRP) level among the patients was 15.80 mg/L (SD = 4.09). The mean urea level was 30.08 mg/dL (SD = 9.84), while the mean creatinine was 0.58 mg/dL (SD = 0.20). The white blood cell (WBC) count had a mean value of 11.96×10^9/L (SD = 3.25).

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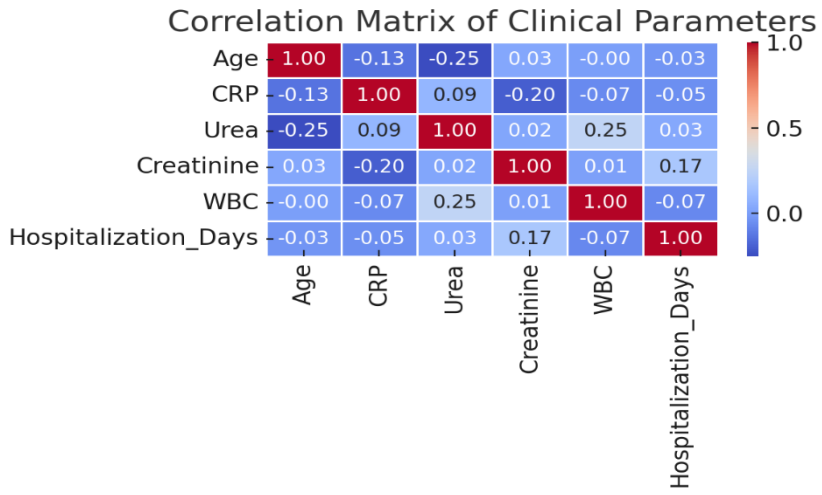

Figure 3: Heatmap representing correlations between different clinical parameters.

Elevated inflammatory and metabolic biomarkers were noted in the majority of patients and clarified in the Correlation Matrix of Clinical Parameters in Figure 3**.** Despite these elevations, correlation analysis revealed weak or negligible relationships between these parameters. For instance, CRP and duration of hospitalization showed a weak negative correlation (r = –0.05), while urea and WBC showed a weak positive correlation (r = 0.25).

Pathogen Distribution and Antibiotic Resistance

Urine cultures identified *Escherichia coli* (50%) and *Klebsiella spp.* (30%) as the dominant pathogens. Other isolates included less frequent uropathogens. Notably, resistance to commonly used antibiotics, especially ampicillin, was high, emphasizing the need for ongoing surveillance of local antimicrobial resistance patterns. No significant association was observed between gender and specific pathogen type (p = 0.89). Similarly, no significant differences in CRP levels were found between male and female patients, its appear in Figure 4 Boxplot illustrating CRP level differences between male and female patients (p = 0.58), nor in urea levels across different pathogens (p = 0.39), as determined by t-tests and ANOVA, respectively.

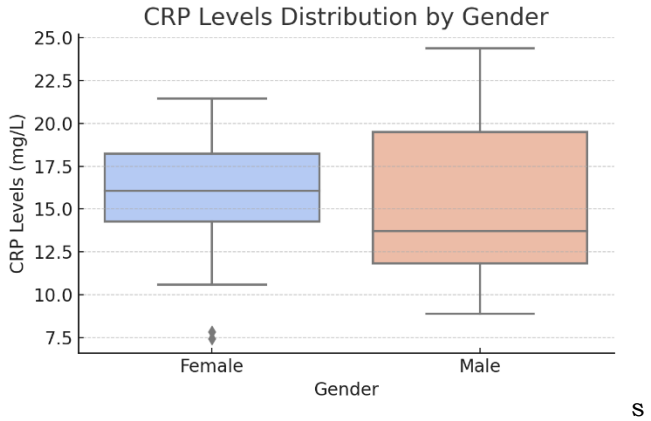

Figure 4: Boxplot illustrating CRP level differences between male and female patient.

Diagnostic Evaluation of Biomarkers

Urea levels demonstrated moderate predictive capability for prolonged hospitalization (>5 days), with an ROC AUC of 0.48, indicating reasonable diagnostic accuracy. In contrast, CRP levels, while elevated, showed limited utility as a standalone predictor of disease severity (AUC not specified) (Figure 4).

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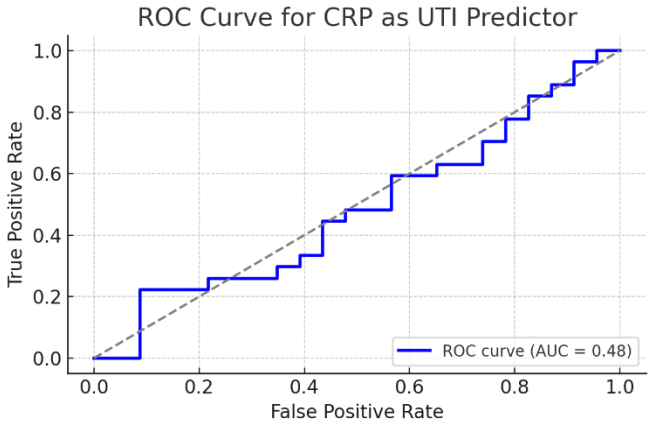

Figure 5: ROC Curve for Urea Levels in Predicting Prolonged Hospitalization.

Discussion

This retrospective study provides a comprehensive overview of the clinical, microbiological, and therapeutic landscape of children's urinary tract infections (UTIs) at Al-Khadra Hospital, Tripoli. The findings contribute to a growing body of regional evidence necessary for optimizing local diagnostic and treatment strategies.

The observed female predominance (66%) in this cohort is consistent with global epidemiological data, which attribute the higher incidence in females—particularly beyond infancy—to anatomical factors such as a shorter urethra and its proximity to the anus, facilitating ascending infections [4,5,16]. This gender disparity reinforces the importance of targeted public health messaging and hygiene education, particularly for caregivers of young girls. Age distribution in our study further corroborates earlier research, with peak incidences noted in infants aged 1–12 months (30%) and children over six years (36%). In infants, susceptibility is heightened by immature immune function and potential congenital anomalies, while older children may present with behavioral or hygiene-related risk factors [3,14,22]. These findings underline the importance of maintaining high clinical suspicion for UTIs in these vulnerable age groups, even in the presence of nonspecific symptoms such as fever or irritability.

Microbiologically, *Escherichia coli and Klebsiella spp***.** were the most prevalent pathogens, comprising 50% and 30% of positive cultures, respectively. This pathogen distribution aligns with global and regional literature that consistently identifies E. coli as the dominant uropathogen, particularly in community-acquired UTIs [6,8,23]. Klebsiella spp., while less common, has been increasingly reported in hospital-acquired or recurrent infections and may exhibit broader resistance patterns, posing significant therapeutic challenges [7,24]. The presence of these organisms supports the empirical use of third-generation cephalosporins; however, our study also reveals substantial resistance to ampicillin and variable resistance to other agents, consistent with broader resistance trends observed in pediatric populations [24,25,26].

The standard empirical treatment at Al-Khadra Hospital involved intravenous cefotaxime during hospitalization, transitioning to oral cefixime post-discharge. This regimen aligns with the recommendations from international guidelines, including those of the European Society for Pediatric Urology (ESPU), which advocate for prompt parenteral therapy in infants and young children with febrile UTIs or suspected pyelonephritis [10,20,21]. However, increasing resistance to commonly used antibiotics mandates continuous monitoring of local antibiograms and periodic revision of empirical protocols to ensure therapeutic efficacy.

Laboratory findings in our cohort demonstrated elevated levels of inflammatory markers such as C-reactive protein (CRP), urea, and white blood cell count (WBC), indicating systemic response to infection. Despite this, statistical analyses revealed weak correlations between these parameters and clinical outcomes, such as duration of hospitalization. For example, CRP levels did not significantly differ by gender ($p = 0.58$) or correlate meaningfully with hospital stay duration, consistent with previous studies that question the prognostic value of CRP in isolation [27,28,29]. Similarly, while elevated urea levels were observed, their diagnostic accuracy for prolonged hospitalization was limited (AUC = 0.48), suggesting that no single biomarker can reliably predict disease severity. Another notable finding was the lack of significant association between specific pathogens and patient gender or inflammatory response, underscoring the complexity of UTI pathophysiology and the need for holistic clinical assessment. Additionally, the absence of complete antimicrobial sensitivity profiles in a proportion of cases reflects an operational limitation that may compromise individualized therapy and points to the need for improved laboratory infrastructure [24,30].

In summary, this study confirms that children's UTIs continue to pose a significant healthcare burden, particularly among females and infants. The predominance of E. coli and Klebsiella spp., coupled with notable antibiotic resistance, emphasizes the importance of localized surveillance and stewardship programs. Further large-scale, multicenter prospective studies are essential to validate these findings,

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explore resistance mechanisms, and refine management algorithms for pediatric UTIs in similar healthcare settings.

Conclusion

This study examined the epidemiological and clinical characteristics of pediatric urinary tract infections at Al-Khadra Hospital, revealing patterns similar to those reported globally, while highlighting unique local challenges. A predominance of female cases and increased susceptibility during early childhood were observed, as Escherichia coli and Klebsiella spp. were identified as dominant causative agents for UTIs. The high antimicrobial resistance to commonly disseminated antibiotics such as ampicillin, highlighting the pressing need to update local antimicrobial stewardship protocols. Although diagnostic markers like CRP and urea offer supportive value, their low predictive accuracy suggests the necessity for more reliable diagnostic strategies. Limited sensitivity profiling indicates a need for strengthened lab capacity. Overall, the findings reaffirm the importance of continuous surveillance, enhanced diagnostic infrastructure, and the development of locally tailored treatment guidelines. Multicenter studies are urged to advance the knowledge and inform evidence-based strategies for managing pediatric UTIs.

Conflict of interest. Nil

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