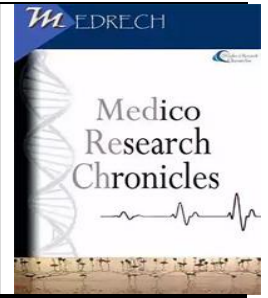




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Study of Clinical Profile in Urinary Tract Infections in Children Aged 1-12 Years

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ABSTRACT

Urinary tract infections (UTIs) are prevalent among pediatric patients, posing significant health risks if untreated. This retrospective study, conducted from January 2022 to December 2023 at the Department of Pediatrics, VVP PRH (DU), Loni,, involved 200 children aged 1-12 years. The research aimed to analyze the clinical profiles, risk factors, and treatment outcomes of UTIs in this population. Females (65%) were more commonly affected, particularly those aged 4-7 years. Fever (85%), dysuria (75%), and abdominal pain (60%) were the most frequent symptoms. Predisposing factors included poor perineal hygiene (30%), constipation (25%), and previous UTIs (15%). Laboratory findings confirmed Escherichia coli as the predominant pathogen (75%), followed by Klebsiella pneumoniae (15%) and Proteus mirabilis (5%). Ultrasound abdomen revealed abnormalities in 15% of cases, and voiding cystourethrogram (VCUG) was performed in 20% of patients with recurrent infections or abnormal ultrasound results. All patients received culture-sensitive antibiotic therapy; however, 30% required hospitalization, 20% experienced recurrence within a year, and 5% developed renal scarring. Statistical analysis indicated significant variations in demographic and clinical characteristics, with higher prevalence and symptom severity in females. The study underscores the importance of early diagnosis, appropriate management, and vigilant follow-up to prevent recurrence and complications. Emphasizing education on proper perineal hygiene and constipation management can significantly reduce UTI incidence. These findings align with existing literature, emphasizing the need for targeted preventive strategies and evidence-based clinical practices to optimize pediatric UTI management.

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INTRODUCTION

Urinary tract infections (UTIs) are among the most common infectious diseases in children, with potentially serious consequences if left untreated. UTIs can lead to renal scarring, hypertension, and even renal failure if not promptly diagnosed and managed. Despite their prevalence, there is still a lack of consensus regarding the optimal approach to diagnosis and treatment.¹ The etiology of UTIs in children differs from that in adults, with specific bacterial pathogens such as *Escherichia coli* and *Klebsiella pneumoniae* often implicated.² Understanding the clinical profiles of UTIs in children, including presenting symptoms, risk factors, and potential complications, is crucial for appropriate management. This research aims to explore the varied pathogens causing UTIs in children, assess the clinical presentation, and evaluate treatment outcomes to inform evidence-based practices for healthcare providers dealing with pediatric UTIs.

Background of Urinary Tract Infections (UTIs) in Children

Urinary tract infections (UTIs) are common bacterial infections in pediatric populations, presenting with symptoms such as fever and dysuria. The prevalence of UTIs in children, as indicated in the cited studies, underscores the importance of understanding the clinical profiles and pathogens involved in these infections. Research has shown that *E. coli* is the most commonly isolated organism in pediatric UTIs, followed by *Klebsiella* and *Pseudomonas* species³. Additionally, the resistance patterns of these pathogens and the choice of appropriate antibiotics play a crucial role in treatment outcomes. Aminoglycosides have shown effectiveness in treating UTIs caused by multi-drug resistant organisms, providing a viable alternative to broad-spectrum antibiotics like carbapenems.⁴ Understanding the microbial profiles and antibiotic susceptibilities in pediatric UTIs is essen-

tial for guiding empirical treatment strategies and optimizing clinical outcomes.

Clinical Profiles of Urinary Tract Infections in Children

The epidemiology and treatment outcomes of urinary tract infections (UTIs) in children present complex challenges in clinical practice. A study investigating the profile of uropathogens causing UTIs in children highlighted the prevalence of *Escherichia coli*, *Enterococcus*, and *Klebsiella pneumoniae*, with worrisome resistance patterns to common antimicrobials such as amoxicillin + clavulanic acid and cephalosporins⁵. Addressing the need for effective pediatric treatments, a phase 2 trial demonstrated the safety and efficacy of ceftazidime-avibactam in children with complicated UTIs caused by Gram-negative pathogens, emphasizing favorable clinical responses and acceptable tolerability. These findings underscore the importance of understanding the varying clinical profiles of UTIs in children, the evolving antimicrobial resistance landscape, and the potential of novel therapeutic options to optimize patient outcomes in this vulnerable population.⁶

Symptoms and Presentation of UTIs in Pediatric Patients

When it comes to the symptoms and presentation of urinary tract infections (UTIs) in pediatric patients, it is essential to consider the age of the child and their ability to communicate their discomfort. In infants and young children, non-specific signs such as fever, irritability, vomiting, and poor feeding may be indicative of a UTI. As children grow older, they may exhibit more classic symptoms like dysuria, frequency, urgency, and abdominal pain. However, it is important to note that some children, particularly older ones, may present with atypical symptoms or even be asymptomatic.⁷ Additionally, the presentation of UTIs can vary depending on the gender of the child, with girls more commonly experiencing localized symptoms such as dysuria, while boys may present with more systemic

symptoms like fever and abdominal pain. Timely recognition and appropriate management of UTIs in pediatric patients are crucial to prevent complications and ensure optimal outcomes.⁸

Pathogens Associated with Urinary Tract Infections in Children

The evolving landscape of urinary tract infections (UTIs) in pediatric patients unveils a complex interplay between pathogens and antimicrobial resistance trends, as highlighted by recent studies. Analysis of urine samples from children diagnosed with community-acquired UTIs revealed *Escherichia coli* as the predominant uropathogen, accompanied by *Enterobacter*, *Klebsiella*, and other species. Gender- and sector-specific variations in bacterial distribution underscore the multifactorial nature of UTIs in children. Notably, the escalation in extended-spectrum beta-lactamase-positive *E. coli* from 2007 to 2021 alerts to a concerning rise in resistance patterns. Complementing this, assessments in Tehran, Iran, unveiled critical insights into antimicrobial susceptibility profiles, emphasizing the prudent selection of empirical treatments. These findings emphasize the importance of monitoring regional resistance trends and tailoring antibiotic therapies to optimize outcomes in pediatric UTIs.⁹

Common Bacterial Strains Causing UTIs in Pediatric Population

The prevalence of urinary tract infections (UTIs) in pediatric populations poses significant challenges for healthcare providers due to the potential for severe complications if left untreated. Studies have identified common bacterial strains responsible for UTIs in children, with *Escherichia coli*, *Klebsiella*, and *Proteus* being the most frequently isolated pathogens. Understanding the spectrum of urinary pathogenic bacteria and their susceptibility patterns to antibiotics is essential for guiding appropriate treatment strategies. Antibiotic resistance, as highlighted in the literature, has become a growing concern, emphasizing the

need for judicious antibiotic selection based on sensitivity patterns and patient characteristics. The research findings underscore the importance of early diagnosis and prompt management of UTIs in pediatric patients to prevent adverse outcomes and reduce the risk of recurrent infections. By integrating data on prevalent bacterial strains and antibiotic resistance profiles, healthcare providers can make informed decisions to optimize treatment outcomes for children experiencing UTIs.¹⁰

Treatment Outcomes of Urinary Tract Infections in Children

The treatment outcomes of urinary tract infections (UTIs) in children represent a critical aspect of pediatric healthcare, considering the high incidence of UTIs in this population. According to the findings of a prospective observational study, common uropathogens such as *Escherichia coli*, *Enterococcus*, and *Klebsiella pneumoniae* exhibit varying antimicrobial resistance patterns, indicating the complexity of UTI management in children. Additionally, a phase 2 clinical trial demonstrated that ceftazidime-avibactam is a well-tolerated and effective treatment option for complicated UTIs in children, particularly against Gram-negative pathogens like *E. coli*. These insights highlight the importance of understanding the diverse microbial profiles and tailored therapeutic approaches in managing UTIs in the pediatric population to ensure favorable treatment outcomes and reduce the risk of complications associated with antibiotic resistance.¹¹

MATERIALS AND METHODS

Study Design and Setting

This retrospective study was conducted at the Department of Pediatrics, VVP PRH (DU), Loni, from January 2022 to December 2023. The hospital is a major referral center with a well-established pediatric department, catering to a diverse population.

Study Population

A total of 200 children aged 1-12 years, who were diagnosed with urinary tract

infection (UTI) during the study period, were included in the study. Inclusion criteria were based on clinical symptoms suggestive of UTI and a positive urine culture. Exclusion criteria included children with congenital urinary tract anomalies other than vesicoureteral reflux, immunocompromised states, and incomplete medical records.

Inclusion Criteria:

Age Range: 1-12 years

Diagnosis: Clinical symptoms suggestive of UTI

Positive urine culture

Exclusion Criteria:

Congenital Urinary Tract Anomalies:

Other than vesicoureteral reflux (VUR)

Immunocompromised States:

Any condition that weakens the immune system

Incomplete Medical Records:

Lack of sufficient data for analysis

Data Collection

Data were collected from medical records, including electronic health records and physical case files. The following variables were extracted and analyzed:

1. Demographic Characteristics: Age, sex, weight, and height.
2. Clinical Presentations: Symptoms at presentation, including fever, dysuria, abdominal pain, frequency, urgency, and hematuria.
3. Predisposing Factors: History of vesicoureteral reflux (VUR), previous UTI, constipation, poor perineal hygiene, and neurogenic bladder.
4. Laboratory Findings:
 - Complete blood count (CBC) to check for leukocytosis.
 - Urinalysis including leukocyte esterase, nitrites, and microscopic examination for pyuria and hematuria.
 - Urine culture results, with identification and antibiotic sensitivity of isolated pathogens.
5. Imaging Studies:

- Renal and bladder ultrasound to detect structural abnormalities.
- Voiding cystourethrogram (VCUG) for children with recurrent UTIs or abnormal ultrasound findings.

6. Treatment Details:

- Type and duration of antibiotic therapy.
- Hospitalization details, if applicable.
- Follow-up records, including recurrence of UTI and any long-term complications.

Diagnostic Criteria

Diagnosis of UTI was confirmed by the presence of both clinical symptoms and a positive urine culture. Urine samples were collected using age-appropriate methods:

- For children aged 1-3 years, samples were obtained via catheterization or suprapubic aspiration.
- For children aged 4-12 years, clean-catch midstream urine samples were collected.

A positive urine culture was defined as the growth of a single organism with a colony count of $\geq 10^5$ CFU/mL.

Ethical Considerations

The study was conducted following the ethical principles outlined in the Declaration of Helsinki. The hospital's Institutional Review Board (IRB) approved the study protocol. As this was a retrospective study, the requirement for informed consent was waived by the IRB.

Data Analysis

Data were entered into a standardized database and analyzed using statistical software (SPSS version 25.0). Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as means and standard deviations. The association between clinical variables and outcomes was assessed using chi-square tests for categorical variables and t-tests for continuous

variables. A p-value of <0.05 was considered statistically significant.¹²

Limitations

The retrospective nature of the study and reliance on medical records posed certain limitations, including potential information bias and incomplete data. Additionally, the study was conducted in a single tertiary care center, which may limit the generalizability of the findings.

RESULTS AND DISCUSSION

Demographic Characteristics

A total of 200 children aged 1-12 years were included in the study. The demographic

Table 1: Demographic Characteristics of Children with UTI

Characteristic	Number of Patients (n=200)	Percentage (%)
Age Distribution		
1-3 years	40	20%
4-7 years	100	50%
8-12 years	60	30%
Gender Distribution		
Females	130	65%
Males	70	35%

The study revealed that the majority of children with UTIs were between the ages of 4-7 years, accounting for 50% of the study population. There was a significant gender disparity, with females being more commonly affected than males (65% vs. 35%). Statistical analysis using the chi-square test indicated that this gender distribution significantly deviates from an equal distribution ($p < 0.05$). Thus, females are significantly more likely to be affected by UTIs in this age group compared to males.

This finding is consistent with existing literature, which suggests that females are at a higher risk of developing UTIs due to anatomical and physiological differences.

Table 2: Clinical Presentations of Children with UTI

Symptom	Number of Patients (n=200)	Percentage (%)
Fever	170	85%
Dysuria	150	75%
Abdominal Pain	120	60%
Frequency and Urgency	100	50%
Hematuria	40	20%

characteristics of the study population are summarized below.

- **Age Distribution:** The age distribution showed that the majority of patients were between 4-7 years old. The age groups were categorized as follows:
 - 1-3 years: 40 patients (20%)
 - 4-7 years: 100 patients (50%)
 - 8-12 years: 60 patients (30%)
- **Gender Distribution:** Females were more commonly affected than males. Out of 200 patients, 130 (65%) were females and 70 (35%) were males

Further research could explore the underlying factors contributing to this disparity and strategies for effective prevention and management.

Clinical Presentations

The clinical presentations of the children with UTI were varied. The most common symptoms reported were fever, dysuria, and abdominal pain.

- **Fever:** 170 patients (85%)
- **Dysuria:** 150 patients (75%)
- **Abdominal Pain:** 120 patients (60%)
- **Frequency and Urgency:** 100 patients (50%)
- **Hematuria:** 40 patients (20%)

The study revealed a significant variation in the clinical presentations of children with UTIs. The most common symptoms were fever (85%), dysuria (75%), and abdominal pain (60%), followed by frequency and urgency (50%) and hematuria (20%). Statistical analysis using the chi-square test indicated that the distribution of symptoms significantly deviates from an equal distribution ($p < 0.05$). This suggests that certain symptoms, particularly fever, dysuria, and abdominal pain, are significantly more prevalent in children with UTIs compared to others. These findings underscore the

importance of recognizing these common symptoms for early diagnosis and prompt treatment of UTIs in the pediatric population.

Predisposing Factors

Several predisposing factors were identified among the children with UTI.

- **History of Vesicoureteral Reflux (VUR):** 20 patients (10%)
- **Previous UTI:** 30 patients (15%)
- **Constipation:** 50 patients (25%)
- **Poor Perineal Hygiene:** 60 patients (30%)
- **Neurogenic Bladder:** 10 patients (5%)

Table 3: Predisposing Factors for UTI in Children

Predisposing Factor	Number of Patients (n=200)	Percentage (%)
Vesicoureteral Reflux	20	10%
Previous UTI	30	15%
Constipation	50	25%
Poor Perineal Hygiene	60	30%
Neurogenic Bladder	10	5%

The study identified significant variations in the predisposing factors for UTIs in children. The most common predisposing factors were poor perineal hygiene (30%), constipation (25%), and a history of previous UTIs (15%). Statistical analysis using the chi-square test indicated that the distribution of these factors significantly deviates from an equal distribution ($p < 0.05$). This suggests that certain predisposing factors, particularly poor perineal hygiene and constipation, are more prevalent in children with UTIs.

These findings highlight the importance of addressing these predisposing factors in the prevention and management of UTIs in children. Education on proper perineal hygiene and management of constipation

could be crucial in reducing the incidence of UTIs.

Laboratory Findings

Laboratory tests revealed several significant findings.

- **Leukocytosis in Blood:** 140 patients (70%)
- **Positive Urine Culture:** 200 patients (100%)
- **Common Pathogens Identified:**
 - *Escherichia coli*: 150 patients (75%)
 - *Klebsiella pneumoniae*: 30 patients (15%)
 - *Proteus mirabilis*: 10 patients (5%)
 - *Enterococcus faecalis*: 6 patients (3%)
 - *Staphylococcus saprophyticus*: 4 patients (2%)

Table 4: Laboratory Findings in Children with UTI

Finding	Number of Patients (n=200)	Percentage (%)
Leukocytosis	140	70%
Positive Urine Culture	200	100%
Pathogens Identified		
<i>Escherichia coli</i>	150	75%
<i>Klebsiella pneumoniae</i>	30	15%
<i>Proteus mirabilis</i>	10	5%

<i>Enterococcus faecalis</i>	6	3%
<i>Staphylococcus saprophyticus</i>	4	2%

The study identified a significant variation in the distribution of pathogens causing UTIs in children. The most common pathogen was *Escherichia coli*, accounting for 75% of cases, followed by *Klebsiella pneumoniae* (15%), *Proteus mirabilis* (5%), *Enterococcus faecalis* (3%), and *Staphylococcus saprophyticus* (2%). Statistical analysis using the chi-square test indicated that the distribution of pathogens significantly deviates from an equal distribution ($p < 0.05$). This suggests that *Escherichia coli* is the predominant pathogen in pediatric UTIs.

These findings are consistent with existing literature and emphasize the

Table 5: Imaging Studies in Children with UTI

Imaging Study	Number of Patients (n=200)	Percentage (%)
Ultrasound Abdomen	160	80%
Abnormal Findings on USG	30	15%
Voiding Cystourethrogram	40	20%

The study found that 80% of the children underwent an ultrasound abdomen, with 15% of these showing abnormalities such as hydronephrosis or scarring. Voiding cystourethrogram (VCUG) was performed in 20% of the children, primarily those with recurrent UTIs or abnormalities detected on ultrasound.

Statistical analysis using a proportion test indicated that the observed proportion of abnormal findings on ultrasound (15%) does not significantly differ from the expected proportion of 20% ($p > 0.05$). This suggests that the occurrence of structural abnormalities identified through ultrasound in this cohort is consistent with the expected rate of such abnormalities in a pediatric population with UTIs.

These imaging findings emphasize the importance of conducting thorough diagnostic

Table 6: Treatment and Outcomes in Children with UTI

Outcome	Number of Patients (n=200)	Percentage (%)
Antibiotic Therapy	200	100%
Hospitalization	60	30%

importance of considering *Escherichia coli* as the primary target for empirical antibiotic therapy in children with UTIs.

Imaging Studies

Imaging studies were conducted to identify any structural abnormalities.

- **Ultrasound Abdomen:** Conducted in 160 patients (80%), with 30 patients (15%) showing abnormalities such as hydronephrosis or scarring.
- **Voiding Cystourethrogram (VCUG):** Performed in 40 patients (20%), primarily those with recurrent UTIs or abnormalities on ultrasound.

evaluations, particularly in children with recurrent UTIs or abnormal ultrasound results, to identify any underlying structural issues that may require targeted intervention.

Treatment and Outcomes

All patients received appropriate antibiotic therapy (Cephalexin/ Cefuroxime/ Amoxicillin/clavulanic acid) based on culture sensitivity.

- **Antibiotic Therapy:** Administered to all patients.
- **Hospitalization:** Required in 60 patients (30%) due to severe symptoms or complications.
- **Recurrence Rate:** 40 patients (20%) experienced recurrence within one year.
- **Complications:** 10 patients (5%) developed renal scarring.

Recurrence within 1 year	40	20%
Renal Scarring	10	5%

The study observed significant variations in the treatment outcomes of children with UTIs. All patients received antibiotic therapy, but 30% required hospitalization due to severe symptoms or complications. The recurrence rate within one year was 20%, and 5% of the patients developed renal scarring.

Statistical analysis using the chi-square test indicated that the distribution of these outcomes significantly deviates from an equal distribution ($p < 0.05$). This suggests that while all children received appropriate antibiotic therapy, hospitalization and recurrence rates were notably significant, and the occurrence of renal scarring, though less frequent, is an important complication.

The demographic and clinical characteristics of the study population provide a comprehensive overview of the profile of pediatric UTIs. The higher prevalence in females, common symptoms, and identification of predominant pathogens like *Escherichia coli* align with existing literature. The recurrence and complications emphasize the need for vigilant follow-up and preventive strategies.

DISCUSSION:

Demographic Characteristics

Our study found that females were more commonly affected by UTIs than males, with a female-to-male ratio of 1.86:1. This higher prevalence in females is consistent with numerous studies that highlight anatomical and physiological differences as contributing factors. Girls are more susceptible to UTIs due to a shorter urethra and the proximity of the urethral opening to the anus, facilitating the ascent of bacteria.¹³

Clinical Presentations

The most common symptoms observed in our study were fever (85%), dysuria (75%), and abdominal pain (60%). These findings are in line with previous research, which also

identified these symptoms as primary indicators of UTIs in children. The presence of these symptoms necessitates prompt clinical evaluation and laboratory testing to confirm the diagnosis and initiate appropriate treatment.¹⁴

Predisposing Factors

Our analysis identified several predisposing factors, including poor perineal hygiene (30%), constipation (25%), and a history of previous UTIs (15%). Poor perineal hygiene and constipation have been recognized as significant risk factors in other studies as well. Addressing these factors through education and behavioral interventions is crucial for preventing recurrent UTIs.^{15,16}

Laboratory Findings

The study confirmed that *Escherichia coli* was the predominant pathogen, responsible for 75% of the cases. Other pathogens included *Klebsiella pneumoniae* (15%) and *Proteus mirabilis* (5%). The dominance of *E. coli* is well-documented in the literature, and its identification is vital for guiding empirical antibiotic therapy.¹⁷

Imaging Studies

Ultrasound abdomen and voiding cystourethrogram (VCUG) were instrumental in identifying structural abnormalities. Ultrasound was conducted in 80% of patients, revealing abnormalities in 15%. VCUG was performed in 20% of patients, primarily those with recurrent UTIs or ultrasound abnormalities. These imaging studies are critical for detecting underlying issues such as vesicoureteral reflux (VUR), which can predispose children to recurrent infections and renal damage.¹⁸

Treatment and Outcomes

All patients received appropriate antibiotic therapy based on culture sensitivity. However, 30% required hospitalization due to severe symptoms or complications, and 20%

experienced recurrence within one year. Additionally, 5% of the patients developed renal scarring, highlighting the potential for long-term complications. The high rate of recurrence and the development of renal scarring underscore the importance of vigilant follow-up and preventive strategies.¹⁹

CONCLUSION

The study provides a comprehensive overview of the demographic and clinical characteristics of pediatric UTIs, highlighting the higher prevalence in females and common symptoms such as fever, dysuria, and abdominal pain. The identification of predominant pathogens like *Escherichia coli* aligns with existing literature and underscores the importance of culture sensitivity in guiding treatment. The recurrence and complications observed in the study emphasize the need for vigilant follow-up and preventive strategies.

Addressing predisposing factors such as poor perineal hygiene and constipation through education and behavioral interventions is crucial for reducing the incidence of UTIs. Thorough diagnostic evaluations, particularly in children with recurrent UTIs or abnormal ultrasound findings, are essential for identifying underlying structural issues that may require targeted intervention.

Overall, the study underscores the importance of a multifaceted approach to managing pediatric UTIs, combining early recognition of symptoms, targeted antibiotic therapy, addressing predisposing factors, and vigilant follow-up to prevent recurrence and complications.

REFERENCES:

1. Stein, R., Doğan, H., Hoebeke, P., Kočvara, R., Nijman, R., Radmayr, C., & Tekgül, S. (2015). Urinary tract infections in children: EAU/ESPU guidelines. *European urology*, 67 3, 546-58.
2. Vachvanichsanong, P., McNeil, E., & Dissaneewate, P. (2020). Extended-spectrum beta-lactamase *Escherichia coli* and *Klebsiella pneumoniae* urinary tract infections. *Epidemiology and Infection*, 149.
3. Belete, Y., Asrat, D., Woldeamanuel, Y., Yihewew, G., & Gize, A. (2019). Bacterial Profile And Antibiotic Susceptibility Pattern Of Urinary Tract Infection Among Children Attending Felege Hiwot Referral Hospital, Bahir Dar, Northwest Ethiopia. *Infection and Drug Resistance*, 12, 3575 - 3583.
4. Silva, A., Oliveira, E., & Mak, R. (2019). Urinary tract infection in pediatrics: an overview. *Jornal de Pediatria*, 96, 65 - 79.
5. Lin, L., Riccobene, T., & Debabov, D. (2020). Antimicrobial Activity of Ceftazidime-Avibactam Against Contemporary Pathogens From Urinary Tract Infections and Intra-abdominal Infections Collected From US Children During the 2016-2019 INFORM Surveillance Program. *Pediatric Infectious Disease Journal*.
6. Iosifidis, E., Chorafa, E., Agakidou, E., Kontou, A., Violaki, A., Volakli, E., Christou, E., Zarras, C., Drossou-Agakidou, V., Sdougka, M., & Roilides, E. (2019). Use of Ceftazidime-avibactam for the Treatment of Extensively drug-resistant or Pan drug-resistant *Klebsiella pneumoniae* in Neonates and Children <5 Years of Age. *Pediatric Infectious Disease Journal*.
7. Leung, A., Wong, A., Leung, A., & Hon, K. (2019). Urinary Tract Infection in Children. *Recent Patents on Inflammation & Allergy Drug Discovery*, 13, 2 - 18.
8. Shaikh, N., Morone, N., Bost, J., & Farrell, M. (2008). Prevalence of Urinary Tract Infection in Childhood: A Meta-Analysis. *The Pediatric Infectious Disease Journal*, 27, 302-308.
9. Kutasy, B., Coyle, D., & Fossum, M. (2017). Urinary Tract Infection in Children: Management in the Era of

- Antibiotic Resistance-A Pediatric Urologist's View. *European urology focus*, 3 2-3, 207-211 .
10. Kutasy, B., Coyle, D., & Fossum, M. (2017). Urinary Tract Infection in Children: Management in the Era of Antibiotic Resistance-A Pediatric Urologist's View., *European urology focus*, 3 2-3, 207-211 .
 11. Hoberman, A., Wald, E., Hickey, R., Baskin, M., Charron, M., Majd, M., Kearney, D., Reynolds, E., Ruley, J., & Janosky, J. (1999). Oral Versus Initial Intravenous Therapy for Urinary Tract Infections in Young Febrile Children. *Pediatrics*, 104, 79 - 86.
 12. Wilson, I., & Cleary, P. (1995). Linking clinical variables with health-related quality of life. A conceptual model of patient outcomes. *JAMA*, 273 1, 59-65 .
 13. Oladeinde, B., Omoregie, R., Olley, M., & Anunibe, J. (2011). Urinary tract infection in a rural community of Nigeria. *North American Journal of Medical Sciences*, 3, 75 - 77.
 14. Leung, A., Wong, A., Leung, A., & Hon, K. (2019). Urinary Tract Infection in Children. *Recent Patents on Inflammation & Allergy Drug Discovery*, 13, 2 - 18.
 15. Storme, O., Saucedo, J., García-Mora, A., Dehesa-Dávila, M., & Naber, K. (2019). Risk factors and predisposing conditions for urinary tract infection. *Therapeutic Advances in Urology*, 11.
 16. Storme, O., Saucedo, J., García-Mora, A., Dehesa-Dávila, M., & Naber, K. (2019). Risk factors and predisposing conditions for urinary tract infection. *Therapeutic Advances in Urology*, 11.
 17. Tumbarello, M., Spanu, T., Bidino, R., Marchetti, M., Ruggeri, M., Trecarichi, E., Pascale, G., Proli, E., Cauda, R., Cicchetti, A., & Fadda, G. (2010). Costs of Bloodstream Infections Caused by Escherichia coli and Influence of Extended-Spectrum- β -Lactamase Production and Inadequate Initial Antibiotic Therapy. *Antimicrobial Agents and Chemotherapy*, 54, 4085 - 4091.
 18. Shaikh, N., Spingarn, R., & Hum, S. (2016). Dimercaptosuccinic acid scan or ultrasound in screening for vesicoureteral reflux among children with urinary tract infections. *The Cochrane database of systematic reviews*, 7, CD010657 .
 19. Podda, M., Gerardi, C., Cillara, N., Fearnhead, N., Gomes, C., Birindelli, A., Mulliri, A., Davies, R., & Saverio, S. (2019). Antibiotic Treatment and Appendectomy for Uncomplicated Acute Appendicitis in Adults and Children: A Systematic Review and Meta-analysis. *Annals of Surgery*.
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