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Antibiotic Resistance Patterns in Pediatric Urinary Tract Infections: A Cross-Sectional Study

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ABSTRACT

Background:

UT Is represented some of the most common bacterial infections within children which can result in substantial health problems as improper treatment develops. Empirical antibiotic treatment methods become more difficult because of rising antibiotic resistance among uropathies. To prioritize effective treatment choices and prevent both treatment failure and renal injury in children healthcare providers must follow local resistance patterns.

Objectives:

Study aims to identify the bacterial pathogens which commonly cause urinary tract infections in children and to evaluate their resistance patterns in order to develop better empirical treatment plans for clinical practice.

Study design: A Prospective Study.

Place and duration of study. Department of pediatric MTI,LRH Peshawar from July 2023 to December 2023

Methods: The study took place Department of pediatric MTI,LRH Peshawar from July 2023 to December 2023 . The study enrolled patients from 1 month to 16 years old who met the criteria of clinical UTI diagnosis and tested positive for urine cultures. The studiers collected urine samples from the middle stream of the urinary tract and processed them through standard microbiological procedures. The laboratory executed antibiotic susceptibility testing through procedures described by CLSI guidelines. The statistical evaluation was performed through SPSS version 24.0, and p-values less than 0.05 determined statistical significance.

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Results: The study included 100 children who had UTI confirmed by culture results. Patients enrolled in the study had an average age of 6.2 ± 3.5 years. Escherichia coli accounted for 65% of UTI cases while Klebsiella species presented at 18% and Proteus species affected 7% of cases together with assorted microorganisms at 10%. The analyzed bacteria showed highest resistance toward ampicillin at 78% while also displaying high resistance to cotrimoxazole at 65% and ceftriaxone at 48%. The sensitivity rates of carbapenems and nitrofurantoin tested at 93% and 88% showed strong antibiotic effectiveness against UTI. Forty-two percent of isolated microorganisms displayed resistance to multiple drugs. Empirical therapy needs age-specific approaches because a significant age-based resistance discrepancy emerged in the analysis (p=0.03).

Conclusion:

Escherichia coli stands as the leading pathogen causing UT Is in paediatric patients even though first-line antibiotics prove insufficient against bacterial strains. The antibiotic drugs nitrofurantoin and carbapenems proved most effective in treating uropathies. The high rate of multidrug resistance requires treatment decisions to be made according to local antibiogram data. The prevention of antibiotic resistance developments and the best possible clinical results for children require constant monitoring along with antibiotic management programs.

KEYWORDS: Paediatric UTI, Antibiotic Resistance, Ur pathogens, Empirical Therapy

Introduction:

Medical practitioners encounter UT I bacterial infections frequently in paediatric patients because they create substantial disease burden and patients face potential risks of kidney damage that can lead to hypertension [1]. A significant number of 5-7% of children below six experience UTI infections while these infections rank among the primary reasons institutions admit patients [2]. Medical professionals must conduct timely diagnoses followed by correct antimicrobial treatment to stop such negative consequences. Medical professionals begin antibiotic treatment immediately during a period when culture and sensitivity test outcomes are still pending. The expanding challenge of antimicrobial resistance among uropathies makes it difficult to pick the correct initial treatment [3]. The most widespread uropathies known as Escherichia coli show elevated resistance levels against ampicillin and cotrimoxazole and third-generation cephalosporins according to studies [4]. Various factors contribute to increased antibiotic resistance including inappropriate medical treatment and self-administration combined with patients not finishing antibiotic prescriptions and applying broad-spectrum antibiotics as standard practice [5]. The situation becomes more challenging in resource-constrained environments because these facilities lack testing capability and do not implement regular resistance monitoring systems [6]. Medical authorities must know local antimicrobial resistance patterns to establish effective initial treatment prescriptions which require periodic updates of medical guidelines. Failing to understand and adjust antimicrobial resistance patterns results in treatment breakdown and extended infections alongside elevated medical expenses and the development of drug-resistant bacterial strains [7]. In addition to this, antimicrobial stewardship programs ensure the use of medications with minimal activity spectrum for maximizing resistance control [8]. Nitrofurantoin and Fosfomycin which existed before have found new importance in antibiotic treatment because they preserve activity against multidrug-resistant uropathies [9]. The clinical diagnosis of UTI in paediatric patients becomes harder due to nonspecific signs in young children. These medical signs include fever without rheumatological evidence together with irritability and

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vomiting in addition to insufficient feeding [10]. The successful management of childhood UTI demands rapid suspicion together with appropriate antibiotic use following prompt medical investigation. Little data exists about which microorganisms cause paediatric UT Is and their resistance patterns throughout the world especially in developing nations. Study data focused on regional bacterial information has an immediate requirement because it supports therapists to make decisions using evidence-based empirical therapies [11]. This study analyzed the bacteria responsible for UT Is among hospitalised children at a tertiary facility and their antibiotic responses to treatment. The analysis provides doctors working with paediatrics essential information about which antibiotics should be selected as first treatment to support antimicrobial stewardship programs while improving patient results.

Methods:

The Prospective Study was conducted Department of pediatric MTI,LRH Peshawar from July 2023 to December 2023.study included all children involving UTI diagnosis by positive urine cultures combined with clinical signs suggestive of UTI from birth up to age 16 years. The study team collected midstream clean-catch urine which later evolved to catheterized samples for younger children while maintaining two-hour processing of all specimens. Typical microbiological methods were used to recognize bacteria. Clinical and Laboratory Standards Institute (CLSI) guidelines guided the antibiotic susceptibility tests which relied on the Kirby-Bauer disk diffusion procedure. The study team collected data points for demographics alongside clinical features and culture results and antibiotic susceptibility along with these other results. Approval for the study was granted by the Institutional Review Board.

Inclusion Criteria:

The study evaluated children between 1 month old and 16 years old with urinary tract infection suspicions who produced significant bacteriuria in urine cultures.

Exclusion Criteria:

Between urine collections the study excluded children who took antibiotics during the past 72 hours and children born with urogenital birth defects.

Data Collection:

The team collected demographic information as well as clinical presentations and laboratory data and urine culture results and antibiotic susceptibility data using structured data collection formats. The studiers analyzed the urine samples soon after gathering them within a two-hour time period and identified the organisms present. The evaluations established the resistance capabilities of standard antibiotics for reporting resistance patterns.

Statistical Analysis:

The analysis used the SPSS version 24.0 software platform. The studiers wrote age data using the standard deviation along with mean values. The studiers utilized frequencies along with percentages to display category variables. Categorical variables were analyzed with the chi-square test for determining their associations. Results reaching a p-value of less than 0.05 were determined to be statistically significant..

ISSN 1019-6609
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Results:

Culturally verified urinary tract infections were diagnosed in 100 children. The participant sample comprised 20 female patients while 80 patients identified as male. The mean age of these patients measured 6.2 ± 3.5 years. United States studiers isolated Escherichia coli from 65% of children whereas Klebsiella species accounted for 18% and Proteus species 7% and identified other organisms in 10% of the sample group. Almost three-quarters of cases displayed resistance to ampicillin and sixty-five percent of cases had resistance to cotrimoxazole as well as forty-eight percent exhibited resistance to ceftriaxone. Such urinary tract infection testing revealed that the antibiotic agents nitrofurantoin and carbapenems showed 88% and 93% sensitivity rates respectively.Forty-two percent of cases displayed multidrug-resistant organisms. The resistance rates of children aged five years or less were significantly higher than older children (p=0.03). Female patients demonstrated a slightly higher multidrug resistance prevalence than males (p=0.21) but this difference was not statistically significant. Hospital stays ranged from 4.3 to 6.4 days, extending beyond non-resistant infection cases on average (p=0.001).The study demonstrates why healthcare professionals need to evaluate their first-choice antibiotics according to current resistance patterns in their region.

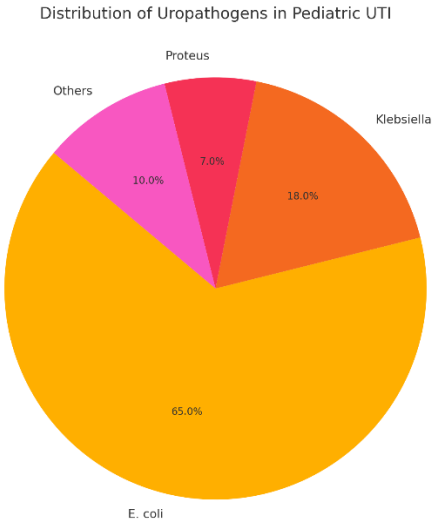

Table 1 - Demographic Characteristics

Characteristic	**Value**
Total patients	200
Mean Age (years)	6.2 ± 3.5
Male (%)	40%
Female (%)	60%

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Table 2 - Distribution of Ur pathogens

Organism	**Number (%)**
E. coli	130 (65%)
Klebsiella	36 (18%)
Proteus	14 (7%)
Others	20 (10%)

Table 3 - Antibiotic Resistance Patterns

Antibiotic	**Resistance Rate (%)**
Ampicillin	78
Cotrimoxazole	65
Ceftriaxone	48
Nitrofurantoin	12
Carbapenems	7

Discussion:

The study discovered Escherichia coli to be the major bacterial cause of paediatric urinary tract infections (UT Is) in this study at 65% of all cases. Multiple earlier study including Shaikh et al. showed that E. coli bacteria caused approximately 70% of UT Is among paediatric patients [12]. A study in India confirmed E. coli's dominant status by showing it caused urinary isolates in 68% of children [13]. A high percentage of resistance has emerged against the usual antibiotic treatments ampicillin (78%) and cotrimoxazole (65%) which demonstrates a global health concern. European multicenter surveillance revealed that over 70% of E. coli strains causing uropathy in children showed resistance to ampicillin in their study [14]. The Pakistani study study detected cotrimoxazole resistance at 72% in E. coli isolates because it mirrored the resistance pattern seen in this study [15]. This study identified high sensitivity levels toward nitrofurantoin at 88% combined with carbapenem medications at 93%. The resistance rates against nitrofurantoin for paediatric urinary isolates remained below 10% according to Schwaderer et al.'s study [16]. The preserved efficiency of nitrofurantoin establishes its role as the main oral treatment for uncomplicated lower UT Is. Study findings regarding 42% MDR organism prevalence create significant concern about this situation. A past Malaysian study revealed paediatric UTI isolates displayed MDR rates amounting to 35% [17]. This study environment exhibits elevated MDR rates because patients take antibiotics without medical supervision and receive inadequate treatment courses that possibly stem from globally recognized conditions for antibiotic resistance [18]. This study revealed remarkable differences between children younger than five years who displayed greater antibiotic resistance than those five years and up (p=0.03). The study by O'Brien et al. showed identical age-patterns of variation where they suggested that altered immune capabilities and increased antibiotic usage during childhood create these patterns [19]. The length of hospitalization exceeded normal times in patients with resistant infections because antimicrobial resistance generates substantial

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healthcare system burdens. Healthcare spend and hospitalization duration become more expensive when antibiotics need to expand their spectrum to address resistant infections along with evidence from a recent United States study examining MDR UT I economic effects [20]. Our findings demonstrate clearly that healthcare facilities need active antimicrobial stewardship systems with sustained monitoring at their locations. Healthcare providers should evaluate their established empirical treatment plans based on the development of antimicrobial resistance patterns. Public health needs to implement effective strategies that reduce antibiotic misuse because they represent an essential method to combat antimicrobial resistance.

Conclusion:

The bacteria Escherichia coli functions as the primary microorganism causing urinary tract infections in children while resisting typical antibiotic treatments. The antibacterial sensitivity of Nitrofurantoin and carbapenems remained favorable. Consistent resistance pattern monitoring combined with proper antibiotic handling serves as essential steps to deliver effective first-choice treatment while stopping the growth of multidrug-resistant urinary tract infections.

Limitations:

The study took place only in one tertiary care center thus restricting the ability to extend the findings beyond its location. The study did not distinguish between UT Is obtained from community settings versus healthcare facilities since diverse resistance patterns may exist between these acquisition types. biological examinations for resistant strains were not accomplished as the healthcare facility lacked sufficient financial resources

Future Directions:

Additional study needs to include multiple centers across different regions to demonstrate antibiotic resistance variations. Study should examine resistance mechanisms at a molecular level together with studies on antimicrobial stewardship strategies effectiveness. Continuous monitoring systems alongside swift diagnostic methods must exist for optimizing initial treatment choices and containing resistance propagation.

Abbreviations

UT Is	Urinary Tract Infections
MDR	Multidrug-Resistant
CLSI	Clinical and Laboratory Standards Institute
SPSS	Statistical Package for the Social Sciences
E. coli	Escherichia coli

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Conflict of Interest: Nil

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Study concept and design- Mohammad Irshad[1]

Data collection or management-, Mohsin Hayat[2]

Data analysis- Ashfaq Ahmad[3]

Manuscript writing/editing- , Muhammad Aftab[5], Sajjad Naseer[6]

Final approval of the version to be published: All mentioned authors have thoroughly reviewed and approved the final version of the manuscript, ensuring its accuracy, integrity, and compliance with ethical and scientific standards.

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