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Incidence of Multidrug-Resistant UTI

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ABSTRACT

Background: Children are experiencing more difficult-to-manage UTIs as a result of the worldwide rise of multidrug-resistant pathogens. **Methodology:** It was a cross-sectional observational study. The study was conducted at Sheikh Khalifa Bin Zayed Al Nahyan/Combined Military Hospital, Muzaffarabad, Azad Jammu and Kashmir, Pakistan. 215 patients were included in the study. A standardized data collection questionnaire was used to collect data on biosociodemographics such as age, gender, and history of UTIs. Data analysis was done using IBM SPSS version 25. Chi-square was applied to find the association between MDR UTI and other variables such as the presence of UTI, antibiotic use, hospitalization requirement, as well as recurrent UTI**.** Multivariate logistic regression was applied to evaluate independent risk factors for MDR-UTI, which was expressed as adjusted Odds Ratios with 95% CI. **Results:** In this investigation on the epidemiology of multidrug-resistant UTI in children aged one to fifteen years, 53 percent were female, and 47 percent of cases were male, and all 104 multiple drug-resistant UTI cases fell into this category, indicating a significant correlation (p=0.00). Multiple drug-resistant UTI was substantially related to hospitalisation, since all 80 hospitalised patients had the condition (p-value = 0.00). gender (p-value = 0.767) was not a significant predictor of multiple drug-resistant urinary tract infection, and the unreliable model coefficients indicate potential data limitations. **Conclusion:** The study found a substantial link between multiple drug-resistant UTIs, hospitalization, and UTI presence. All multiple drug-resistant UTI cases were in children with confirmed UTI. through carbapenems were the most used antibiotics, there was no significant relationship between drug type and multiple drug-resistant UTI. These findings underline the importance of effectively preventing and managing multiple drug-resistant UTIs in pediatric patients.

INTRODUCTION

Due to genetic variances in strains and modifications in the access and frequency of antibiotic use, the pattern of antibiotic resistance varies globally (1). Regardless of these differences, it has been observed globally that community-acquired uropathogens that cause UTI have become significantly more resistant to oral antibiotics in terms of both AMR and MDR. (2) An overall average yearly enhancement of 2.7 percent in drug-resistant phenotypes is shown by modeling of uropathogen surveillance data gathered in America between 2011 and 201(3)

UTIs that are resistant to at least on antibiotic in three or more drug classes are referred to as MDR UTIs. In addition to a uresis, which is a combination of pyuria, bacteria, hematuria or nitrites, and urine culture indicating 10^5 colony forming units per millimetre in women or 10^3 colony forming units per millimetre in men, the diagnosis needs symptoms like urgency, frequency, as well as dysuria. The prevalence of multidrug-resistant bacteria is increasing, which presents problems for patients with cancer and those who are immunocompromised. (4) A prevalent bacterial illness that frequently contributes to morbidity in both hospitalized and outpatient settings is UTI. Clinical expertise has shown that uropathogens in both developed countries as well as developing countries commonly exhibit antibiotic resistance to conventional antibiotics. Options for therapy are severely restricted to certain antimicrobial drugs, including carbapenem, colistin, and Fosfomycin, because resistance to newer and more efficient antimicrobials is not an exception. (5,6)

The risk of a post-antibiotic future is increased by AMR, which is a significant health and financial burden.

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Additionally, AMR worsens patient health and extends stays in hospitals. (7,8). UTIs in intensive care unit patients in India are studied for prevalence, microbial composition, and antibiotic resistance trends. Gram-negative microorganisms (bacteria), primarily E. coli and Klebsiella pneumoniae, were responsible for most illnesses. MDR rates were high, especially in elderly patients and those who had been catheterized for an extended time. The results emphasize the necessity of ongoing monitoring and focused measures to address antimicrobial resistance in ICUs. (9)

This study aims to evaluate the epidemiology of MDR UTI in children, focusing on the association between antibiotic use, hospitalization, and recurrent UTI.

METHODOLOGY

Over six months, a cross-sectional observational study was conducted at Sheikh Khalifa Bin Zayed Al Nahyan/Combined Military Hospital, Muzaffarabad, Azad Jammu and Kashmir, Pakistan. Patients with UTIs verified by urine culture and sensitivity tests were included in the studies. Data was collected following the approval of the synopsis. The study duration was from December 18, 2022, to June 18, 2023. Based on the literature review and an empirical approach, the sample size has been found as 215 (10). Using predetermined inclusion and exclusion criteria, patients were collected from the OPD. The study included patients of all ages and genders with a urine culture confirmed UTI, who had not taken antibiotics within 48 hours of sample collection, and gave informed consent. Patients on immunosuppressive drugs, those with polymicrobial infections, and those with inadequate medical records and missing culture reports were not included. A standardized questionnaire was used to collect data on biosociodemographics such as age, gender, history of UTI, and catheterization. Data analysis was done using IBM SPSS version 25. The chi-square test was applied to determine the relationship between categorical variables, including gender, age groups, and the occurrence of MDR-UTI. Multivariate logistic regression was applied to evaluate independent risk factors for MDR-UTI, which was expressed as adjusted Odds Ratios with 95% CI. P-values less than 0.05 were regarded as statistically significant.

RESULTS

Table 1 shows descriptive statistics for 215 children with multidrug-resistant urinary tract infections (UTIs). The children's ages range from 1 to 15, with an average of 8.12 years (SD=4.49). 53% of the participants are women, while 47% are men. A UTI was found in 74.4% of cases, while 25.6% did not have one. Furthermore, 48.4% of the children had MDR UTIs, while 51.6% did not.

Table 1

Descriptive Statistics of Multidrug-Resistant UTI in Children (N=215)

Variables	Frequency	Percentage	Minimum	Maximum	Mean	Std Deviation
Age of the children	215	-	1	15	8.12	4.492
Gender						
Female	114	53.0%				
Male	101	47.0%				
UTI Presence						
No	55	25.6%				
Yes	160	74.4%				
MDR UTI						
No	111	51.6%				
Yes	104	48.4%				

Figure 1 depicts a bar chart with the percentage of various antibiotics used., Carbapenems are the most used antibiotics, 27.90%, followed closely by fluoroquinolones at 27%. Cephalosporins and penicillins had comparable utilization rates of 22.30% and 22.80%, respectively.

Figure 1

Percentage of Antibiotics Used

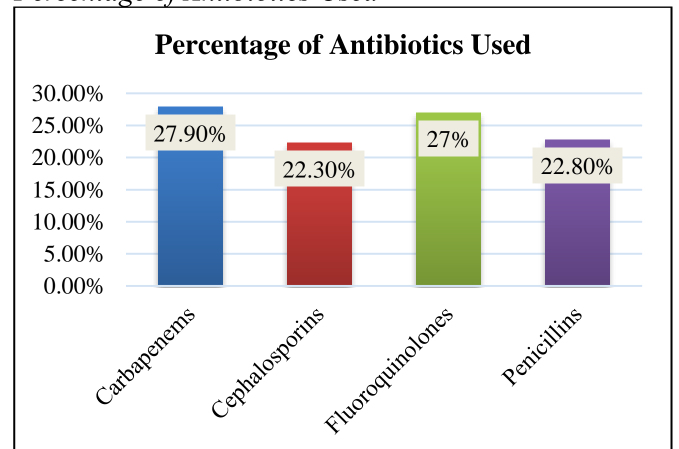

Table 2 shows a crosstabulation of UTI presence vs multidrug-resistant (MDR) UTI. Of the 215 cases examined. 55 (25.6%) did not have a UTI, whereas 160 (74.4%) had a diagnosed UTI. Notably, all 104 cases of MDR UTI were among individuals who had a UTI, demonstrating a strong relationship (p-value = 0.00). In contrast, no one who did not have a UTI had an MDR UTI. This implies a strong link between UTI presence and the risk of MDR UTI.

Table 2

UTI Presence vs. MDR UTI Crosstabulation

UTI Presence	MDR UTI: No	MDR UTI: Yes	Total	p-value
No	55 (49.5%)	0 (0.0%)	55 (25.6%)	
Yes	56 (50.5%)	104 (100%)	160 (74.4%)	0.00
Total	111 (100%)	104 (100%)	215 (100%)	

A crosstabulation of antibiotics used and the prevalence of multidrug-resistant (MDR) UTIs in children is shown

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in Table 3. It compares the use of antibiotics in children with and without multidrug-resistant UTIs by classifying the data into four groups: carbapenems, cephalosporins, fluoroquinolones, and penicillins. Out of the 215 cases in the sample, 111 (51.6%) were classified as non-MDR UTIs and 104 (48.4%) as MDR UTIs the most used antibiotics were carbapenems (27.9%), followed by cephalosporins (22.3%), penicillins (22.8%), and fluoroquinolones (27.0%). There is no statistically significant association between the type of antibiotic administered and the incidence of MDR UTI in children, according to the p-value of 0.681.

Table 3
Crosstabulation of Antibiotics Used and Multidrug-Resistant (MDR) UTI in Children

Antibiotics Used	MDR UTI: No	MDR UTI: Yes	Total	p-value
Carbapenems	33 (29.7%)	27 (26.0%)	60 (27.9%)	0.681
Cephalosporins	24 (21.6%)	24 (23.1%)	48 (22.3%)	
Fluoroquinolones	32 (28.8%)	26 (25.0%)	58 (27.0%)	
Penicillins	22 (19.8%)	27 (26.0%)	49 (22.8%)	
Total	111 (100%)	104 (100%)	215 (100%)	

A cross-tabulation analysis of hospitalization needs related to multidrug–resistant urinary tract infection (MDR UTI) is shown in Table 4. 111 (100%) of the 215 patients who did not need hospitalization were MDR UTI negative, while 24 (23.1%) were MDR UTI positive. However, 76.9% of MDR UTI-positive cases were MDR UTIs, with all 80 hospitalized patients (37.2% of the total) having MDR UTIs. MDR UTI positivity significantly raises the risk of needing hospital admission, according to this significant connection (p-value = 0.00), which implies a high correlation between MDR UTI and hospitalization.

Table 4
*Hospitalization Required * MDR UTI Crosstabulation*

Hospitalization Required	MDR UTI: No	MDR UTI: Yes	Total	p-value
No	111 (100.0%)	24 (23.1%)	135 (62.8%)	0.00
Yes	0 (0.0%)	80 (76.9%)	80 (37.2%)	
Total	111 (100.0%)	104 (100.0%)	215 (100.0%)	

Table 5 shows a cross-tabulation of recurrent urinary tract infections (UTI) and multidrug-resistant (MDR) UTIs in children. Among the 215 children tested, 131 (60.9%) had no recurring UTIs, while 84 (39.1%) did. Among those without recurrent UTI, 82 (73.9%) did not have MDR UTI, while 49 (47.1%) did. In contrast, among children with recurrent UTI, 29 (26.1%) did not have MDR UTI, whereas 55 (52.9%) did. The p-value of 0.00 indicates a statistically significant association between recurring UTI and MDR UTI.

Table 5
Crosstabulation of Recurrent UTI and Multidrug-Resistant (MDR) UTI in Children

Recurrent UTI	MDR UTI: No	MDR UTI: Yes	Total	p-value
No	82 (73.9%)	49 (47.1%)	131 (60.9%)	0.00
Yes	29 (26.1%)	55 (52.9%)	84 (39.1%)	
Total	111 (100%)	104 (100%)	215 (100%)	

Table 6 shows a logistic regression study of risk factors for multidrug- resistant urinary tract infection (UTI, as well as their corresponding coefficient (b), standard errors (S.E), Wald statistic, degrees of freedom (df), significance values (Sig), odds ratio (exp (B)), and 95% confidence intervals (CI) for Exp (B). gender was not found to be a significant predictor (P=0.713; odds ratio=1.208). The occurrence of UTI and hospitalization results in exceptionally large negative coefficients, indicating model insurability. UTI also did not have a significant association with MDR UTI (P=0.767, odds ratio=0.859)

Table 6
Logistic Regression Analysis of Risk Factors for Multidrug-Resistant (MDR) UTI

Variable	B	S.E.	Wald	df	Sig.	Exp(B) (Odds Ratio)	95% C.I. for Exp(B)
Gender (1)	0.189	0.512	0.136	1	0.713	1.208	0.442 – 3.296
UTI Presence (1)	-20.307	5417.012	0.000	1	0.997	0.000	0.000
Hospitalization Required (1)	-22.051	4489.492	0.000	1	0.996	0.000	0.000
Recurrent UTI (1)	-0.152	0.513	0.088	1	0.767	0.859	0.314 – 2.349

DISCUSSION

UTI ranks second in medical literature in the United States and European nations and third globally in terms of infectious pathologies, after digestive problems. and infections of the respiratory tract. They are a significant cause of illness and death in both hospitalized and outpatient patients, accounting for between 25 and 50% of all infections in the latter group. (11) In addition to being a significant financial burden on medical centers and national economies, infection of the urinary tract also has a significant economic impact due to lost workdays. Based on the precise detection of the pathogenic organisms, it frequently calls for appropriate, potent antibiotics. (12)

According to our research, children get UTIs frequently, and a sizeable percentage of them have multidrug resistance. No significant predilection is suggested by the gender disturbing balance. The results highlight the

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need for more investigation into the mechanism if resistance into the mechanisms of resistance risk factors, and efficacious treatment approaches for pediatric MDR UTIs. The increasing incidence of pediatric multidrug-resistant UTIs highlights the necessity of cautious antibiotic use and clinically proven therapeutic approaches. (13). According to another study, children have UTIs frequently, and the most common uropathogens are Escherichia coli and Klebsiella, some of which are multidrug resistant. (14)

According to our data, carbapenems are used the most, with fluoroquinolones coming in second. Penicillins and cephalosporins are used at comparable rates. Significantly, all multiple drug-resistant urinary tract infection instances were among urinary tract infection patients, suggesting a strong correlation. On the other hand, none of the people who didn't have a urinary tract infection had a multiple-drug-resistant urinary tract infection. It also suggests that the probability of multiple drug-resistant urinary tract infections and the presence of urinary tract infections are strongly correlated. Compared to non-multiple drug-resistant urinary tract infections, multiple drug-resistant urinary tract infections have been linked to more complications, recurrences, and deaths. (15) Some risk factors for drug-resistant and resistant to multiple drugs community infections of the urinary tract include age, comorbidity, hospitalization, prior antimicrobial exposure, and living in a care facility. (16)

We studied the association between the prevalence of MDR urinary tract infections in children and the use of antibiotics. The results show that the most commonly used antibiotic were carbapenems, followed by cephalosporin's, penicillin's and fluoroquinolones the type if antibiotic given and risk of developing an multiple drugs resistance urinary tract infection did not statistically correlate, despite differences in patterns in pediatrics UTIs may be influenced by variables other than antibiotics used is linked to a higher chance of hospitalized children acquiring resistant to multiple drugs organisms, other factors might also play a role in resistance patterns. (17)

The need for hospitalization is strongly associated with MDR UTIs, or multidrug-resistant urinary tract infections. While all hospitalized individuals had MDR UTI, the majority of non-hospitalized patients did not. This implies that having an MDR UTI significantly raises the risk of needing to be admitted to the hospital. Mortality and intensive care unit stays are greater among hospitalized patients with multidrug-resistant UTIs (18). The association between hospitalization needs and multidrug-resistant UTIs identified risk factors for multidrug-resistant UTIs in community members. (19)

Antimicrobial stewardship programs serve an important role in decreasing the selection of resistant organisms by incorrect or excessive antibiotic usage. (20) The utility of antibiotic prophylaxis for urinary tract infections in avoiding organisms from becoming resistant is debatable. While it has been shown to reduce febrile urinary tract infections in VUR patients, it may also increase the incidence of MDR organisms UTIs due to selection pressure. The randomized intervention for children with vesicoureteral reflux trial discovered that prophylaxis reduced febrile UTIs by half while increasing the prevalence of trimethoprim-sulfamethoxazole-resistant E. coli, or Escherichia coli urinary tract infections, from 16 percent to 63 percent, with no significant increase in resistant E. coli stool colonization. (21)

CONCLUSION

The study shows a strong association between multidrug-resistant urinary tract infections (MDR UTI) and both hospitalization and recurrent UTI. All multiple-drug-resistant UTI cases were found among children with confirmed UTI, emphasizing a significant association between UTI presence and multiple-drug-resistant UTI. Although carbapenems were the most commonly used antibiotics, there was no significant relationship between the type of antibiotic and the occurrence of multiple-drug-resistant UTI. Children with multiple-drug-resistant UTIs were more likely to require hospitalization and experience recurrent infections. These findings highlight the clinical impact of MDR UTI on pediatric patients, emphasizing the need for effective prevention and management strategies.

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