



## ETIOLOGY AND DRUG SENSITIVITY PATTERN OF URINARY TRACT PATHOGENS IN DISTRICT MARDAN, PAKISTAN

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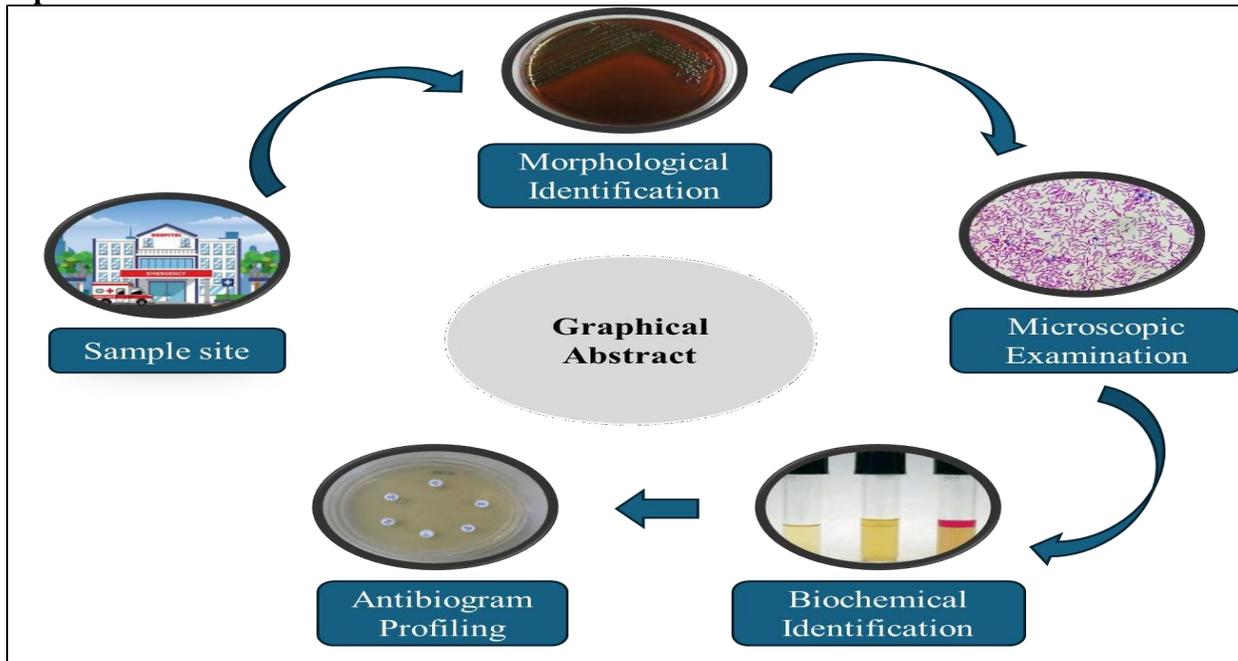
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### ABSTRACT

A urinary tract infection is an infection that attacks the urinary tract. Infection of the upper urinary tract is termed pyelonephritis (kidney infection), whereas infection of the lower urinary tract is referred to as cystitis (bladder infection). Symptoms of cystitis include dysuria and increased urine frequency. In addition to the symptoms of cystitis, pyelonephritis can also cause fever and flank discomfort. Urinary tract infections are more prevalent in females than in males. Samples were obtained from individuals of varying ages and sexes at Mardan Medical Complex, Bacha Khan Medical Complex, and Benazir Bhutto Hospital in Mardan, using sterile containers that were properly labelled. After that, the samples were inoculated onto medium without cysteine and lysine electrolytes. Using biochemical testing and gramme staining, the pathogens were identified. Sensitivity testing was conducted on Muller Hinton medium using the Kirby-Bauer technique. Out of 143 samples, five (5) distinct urinary tract pathogens were identified; 97 of these samples tested positive for *E. coli*, 8 for *Pseudomonas aeruginosa*, 17 for *Enterobacter* species, 13 for *Staphylococcus aureus*, and 8 for *E. faecalis*. Compared to men, women experienced urinary tract infections more frequently. Between the ages of 21–40 and 41–60, urinary tract infections were more common.

## Graphical Abstract



### 1. Introduction

Any infection that impacts the urinary system is referred to as a urinary tract infection (AL *et al.*, 2020). Cystitis (bladder infection) is an infection of the lower urinary system, whereas pyelonephritis (kidney infection) is an infection of the upper urinary tract (Lane *et al.*, 2011). Urgency to pee despite an empty bladder, dysuria, and frequent urination are indicative of a cystitis infection (AL *et al.*, 2020). Fever and flank discomfort are signs of pyelonephritis, in addition to the symptoms of cystitis (Lane *et al.*, 2011). Urinary tract infections are more prevalent in females than in males (Salvatore *et al.*, 2011). Between 2 and 8% of children under the age of 10 get a urinary tract infection each year, while over 50% of women get one in their lifetime (Lane *et al.*, 2011, Mak *et al.*, 2006). The primary cause of urinary tract infections in people who get them frequently is Gramme negative bacteria (Khan *et al.*, 2021). less commonly gram-positive bacteria also cause urinary tract infection i.e. *Staphylococcus saprophyticus* which cause 5 to 15% of UTI in younger female (Lane *et al.*, 2011).

The main cause of urinary tract infection is *E. coli* which causes about 80 to 85% of community acquired urinary tract infection (Khan *et al.*, 2021). Pathogenic strain of *E coli* [UPEC] is the prominent cause of about 90% of urinary tract infection (Croxen *et al.*, 2013, Barzegar *et al.*, 2022).

Healthcare associated with urinary tract infections which are mostly related to urinary catheterization involve a much wider variety of microorganisms such as *E. coli* (27%), *Pseudomonas* (11%), *Klebsiella* (11%), enterococcus (7%) among others and *Candida albicans* (9%) (Croxen *et al.*, 2013, Sievert *et al.*, 2018, Bagshaw *et al.*, 2006). Fever may be the only symptom of urinary tract infection in young children while fatigue and changes in mental health are symptoms of UTI in elderly (Woodford *et al.*, 2011, Lane *et al.*, 2011). Treatment of the urinary tract infection depends upon the age, sex, infecting agent, primary disease of patient and weather it is cystitis or pyelonephritis (Mandal *et al.*, 2012). Short course of antibiotics such as nitrofurantoin or sulfamethoxazole is required in

case of uncomplicated urinary tract infection while a longer course of antibiotics is required in case of complicated UTI (Salvatore *et al.*, 2011).

## 2. Materials and Methods

### 2.1 Study Area and Population

This study was conducted in the Mardan region from March 2021 to January 2022. Mardan is the second largest city of Khyber Pakhtunkhwa. Families are middle class, use homemade food and drink water from bored wells. People have well education and health facilities.

### 2.2 Sample Collection

A total of 143 samples were collected from patients of different sex and age referred by their physicians and the age of patients were ranging from 5 to 70. The samples were collected and labeled carefully in sterile containers.

### 2.3 Methods

Cysteine Lactose Electrolyte Deficient (CLED) medium, MacConkey agar and mannitol salt agar were used to grow each sample. It is a helpful and growth-promoting medium utilized for the identification and distinction of bacteria responsible for urinary tract infections. Because of its electrolyte deficiencies and cysteine and lactose content, it inhibits the swarming of MacConkey agar and proteus species. The plates were incubated for 18 to 24 hours at 34°C under aerobic conditions. Following an incubation period of 18 to 24 hours, colonies were enumerated and subjected to identification procedures, including morphological assessment and other biochemical testing.

The isolated pathogens were then tested against commonly used antibiotics for sensitivity patterns using Kirby Bauer method. 3-5 isolated colonies were added to the normal saline to make bacterial suspension. Lawn was prepared on Muller Hinton media (nutrient media) on a sterilized cotton swab and then 6 antibiotics disk were applied on each plate and incubated for about 18-20 hours.

After incubation for 18-20 hours the zones of inhibition were measured according to the clinical and laboratory standard institute (CLSI).

Amoxicillin, Cefoperazone, Tazobactam, Ceftazidime, Fosfomycin, cefotaxime, nitrofurantoin, cefoxitin, gentamicin, vancomycin, amikacin, linezolid, tigecycline, ciprofloxacin, nitrofurantoin, ticocin, Sulfa-methaxazole-trimethoprim, penicillin and Norfloxacin were used.

## 3. Results

The collected samples were streaked on agar medium and kept in the incubator for 24 hours at 37°C.

Five distinct pathogenic bacterial strains were recovered from a total of 143 clinical samples, comprising 87.83% *E. coli*, 11.88% *Enterobacter* species, 9.09% *Staphylococcus aureus*, 5.58% *Pseudomonas aeruginosa*, and 5.58% *Enterococcus faecalis*. The incidence of urinary tract infections was greater in females than in males, as seen in Table 1. The antibiotic sensitivity pattern varies from Gram Positive Cocci and Gram-Negative Rods shown in Table3 and Table4. The incidence of urinary tract infections was elevated in the age groups of 21-40 and 41-60, as seen in Table 2.

Imipenem, nitrofurantoin and amikacin was the most sensitive antibiotics to Gram negative rods (Sensitivity of imipenem=, Sensitivity of Nitrofurantoin= 87.70%, sensitivity of amikacin= 79.50%). The sensitivity of cefoperazone was also 75.40% and sensitivity of Cefoxitin, Gentamicin and Ceftazidime was less than 50%. The antibacterial drugs that were most susceptible to Gram-positive rods were vancomycin and nitrofurantoin. Sensitivity of Nitrofurantoin is 90.47%, whereas sensitivity of Vancomycin is 76.19%. Linezolid and erythromycin exhibit sensitivity beyond 50%, however sensitivity of Penicillin G and Ciprofloxacin is below 50%.

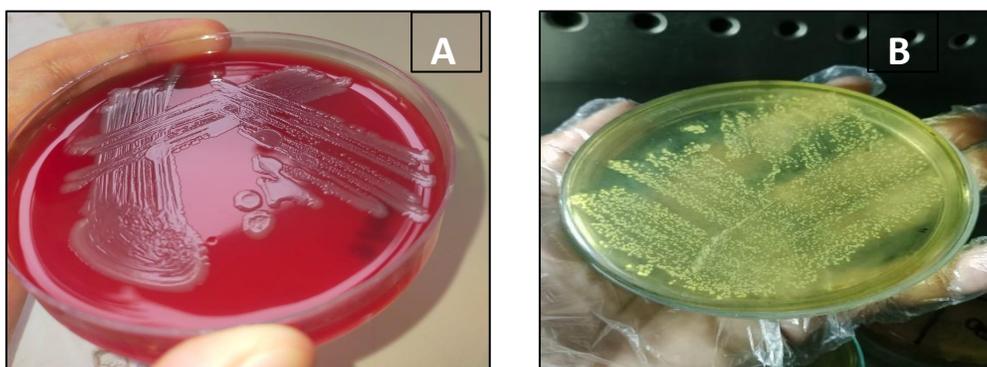
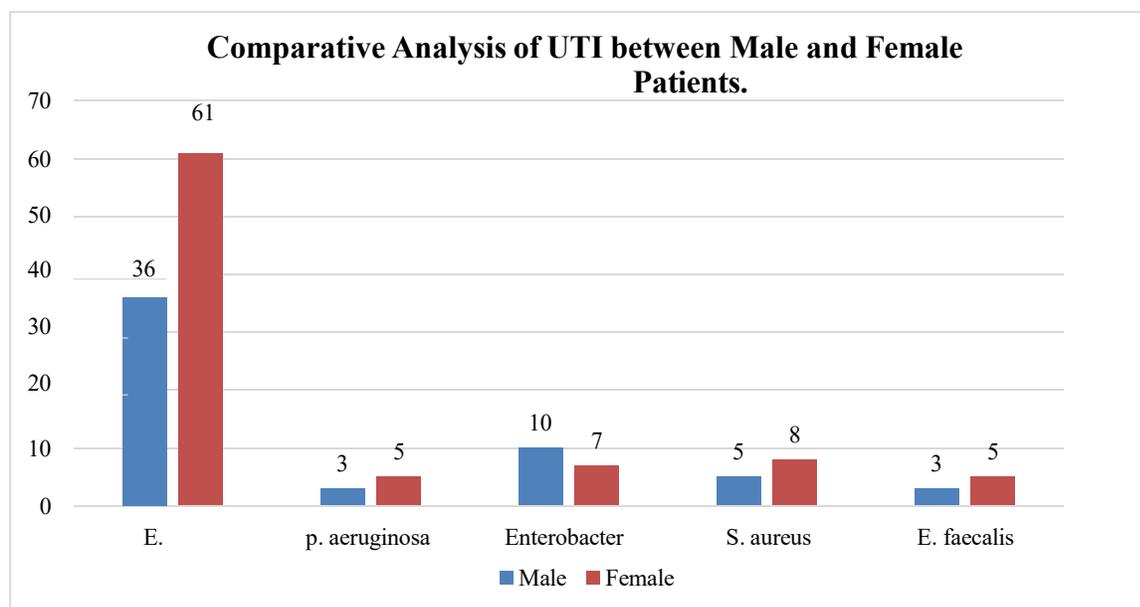


Figure 1. Represent the growth of Staph aureus on MacConkey media (A) and (B) represent the growth of Staph aureus on MSA.

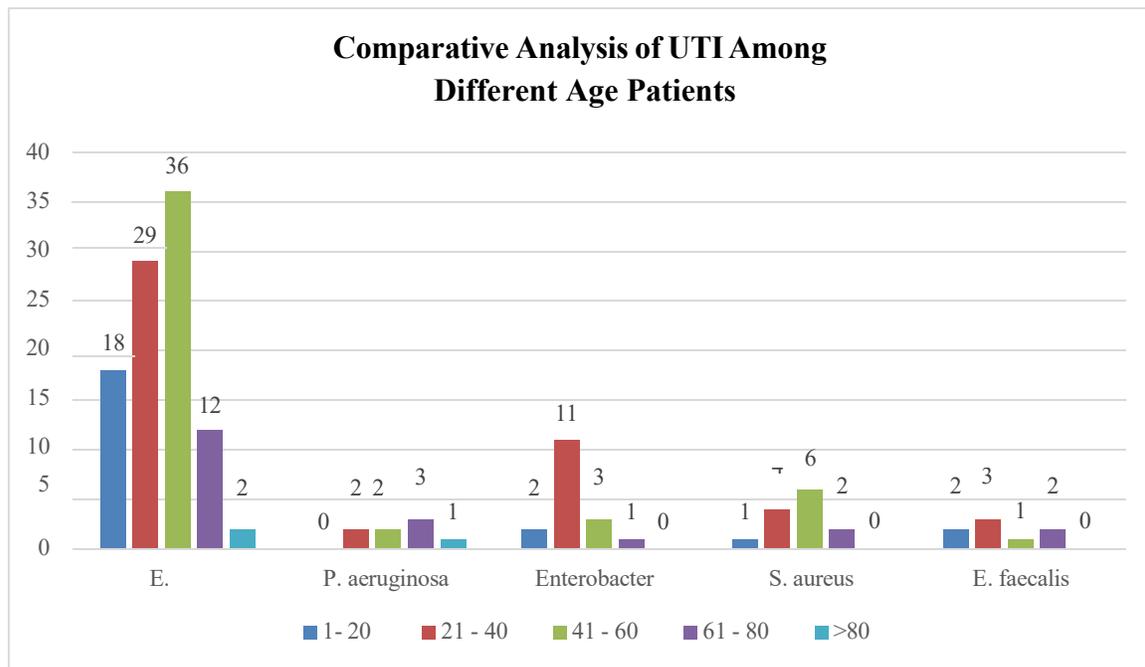
**Table1. Frequency distribution of isolated Uropathogens**

Uropathogens	Male	Female	Total
<i>E. coli</i>	36	61	97
<i>P. aeruginosa</i>	03	05	08
<i>Enterobacter species</i>	10	07	17
<i>Staph aureus</i>	05	08	13
<i>E. faecalis</i>	03	05	08
<b>Total</b>	<b>57</b>	<b>86</b>	<b>143</b>



Age group (years)	<i>E. Coli</i>	<i>P. Aeruginosa</i>	<i>Enterobacter Species</i>	<i>S. Aureus</i>	<i>E. faecalis</i>	Total
1-20	18	00	02	01	02	23
21-40	29	02	11	04	03	49
41-60	36	02	03	06	01	48
61-80	12	03	01	02	02	20
80>	02	01	0	0	00	03
Total	97	08	17	13	08	143

Table2. Frequency distribution of Uropathogens in different age groups.



**Table3. Antibigram profile (Zone of inhibition in mm) of Gram Negative Uropathogenic Bacteria, where S=Sensitive, R=Resistant.**

Antibiotics Pattern	<i>P. aeruginosa</i>		<i>E. Coli</i>		<i>Enterobacter Species</i>	
	S	R	S	R	S	R
Cefoperazone	06	02	72	25	14	03
Tazobactam	07	01	71	26	16	01
Ceftazidime	03	05	23	74	10	07
Cefoxitin	03	05	27	70	05	12
Nitrofurantoin	06	02	85	12	16	01
Amikacin	03	05	79	18	15	02
Gentamycin	07	01	34	63	12	05
Colistin Sulphate	08	00				

**Table4. Antibigram profile (Zone of inhibition in mm) of Gram Positive Uropathogenic Bacteria, where S=Sensitive, R=Resistant.**

Antibiotics Pattern	<i>E. faecalis</i>		<i>S. aureus</i>	
	S	R	S	R
Vancomycin	04	04	12	01
Linezolid	05	03	08	05
Nitrofurantoin	08	00	11	02
Ciprofloxacin	01	07	09	04
Tigecycline	05	03	10	03
Erythromycin	03	05	09	04
Penicillin G	06	02	02	11

#### 4. DISCUSSION

Urinary tract infection is the most common infectious disease in the society, and it is the second common infection in children (Gonzalez *et al.*, 1999). The microbial investigation shows that majority of cases was because of *E. coli* (72%), *Klebsiella pneumoniae* (14%), *Proteus* species (9%), *Staphylococcus* (4%) and *Pseudomonas* was (1%) (Al momani *et al.*, 2006). The urinary tract infection is commonly treated with different classes of antibiotics but in case of severe infection it is treated with antibiotics therapy (Salvatore, *et al.*, 2011). Antimicrobial therapy of UTI is based on the knowledge about the usual microorganism, antibiotic susceptibility and clinical status of the patient (Haller M *et al.*, 2004). Thus, awareness about the cause and Antimicrobial resistant pattern of urinary tract infection causing microorganism is vital.

#### 5. CONCLUSION

Our study reveals that the incidence of urinary tract infections is greater in females than in males. *Escherichia coli* is the predominant bacterium associated with urinary tract infections in both males and females. Gram-negative infections exhibit the greatest sensitivity to imipenem, whereas gram-positive pathogens demonstrate the highest susceptibility to penicillin and vancomycin.

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