

## PATTERN OF BACTERIAL UROPATHOGEN IN DIABETIC HOSPITALIZED PATIENTS IN MARDAN MEDICAL COMPLEX, MARDAN

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### Abstract

**Background:** Diabetes mellitus (DM) is a chronic metabolic disorder that affects a significant proportion of the global population and is associated with increased susceptibility to infections, particularly urinary tract infections (UTIs). The altered immune response and glycosuria in diabetic patients create a favorable environment for bacterial growth, leading to recurrent and complicated UTIs.

**Objective:** This study aimed to evaluate the pattern and prevalence of bacterial uropathogens among diabetic hospitalized patients at Mardan Medical Complex, Mardan, Pakistan.

**Methods:** A cross-sectional study was conducted from December 2024 to May 2025, involving 129 diabetic patients admitted to Mardan Medical Complex. Ethical approval was obtained from the institutional review board. Clean-catch midstream urine samples were collected and cultured on CLED agar. Bacterial identification was performed based on colony morphology, selective and differential media characteristics, and standard biochemical tests.

**Results:** Among the 129 patients, 62% were female and 38% were male, with a mean age of  $39.26 \pm 18.77$  years. The highest infection rate occurred in the 31–40-year age group (18%), followed by 41–50 and 51–60 years (16% each). A total of 77.51% of urine samples showed positive bacterial growth, while 29 samples had no growth, and 5 showed mixed growth. The most frequently isolated pathogen was Escherichia coli (50%), followed by Candida spp. (10%) and Enterobacter spp. (10%).

**Conclusion:** UTIs are highly prevalent among diabetic hospitalized patients, with *E. coli* being the predominant pathogen. These findings highlight the need for stringent infection control measures and regular microbiological surveillance.

## INTRODUCTION

Diabetes mellitus (DM) an endocrinological disorder most common globally associated with high morbidity, complications and ultimately lead to death. DM is linked with urinary tract infections (UTIs), especially upper UTIs.<sup>1</sup> This is the reason that diabetes changes the normal host system which could be a possible cause of the development of UTIs.<sup>2</sup> In 2021, approximately 537 million adults (20-79 years) according to the International Diabetes Federation (IDF), are living with diabetes, which is probably elevated to 643 million by 2030 and 783 million till 2045.

UTIs are common infections observed with DM in the case of all age groups. In humans “the urinary tract” is among the second most frequent site for bacterial infection, associated with pain and discomfort. The promising mechanism of UTI in the case of DM patients might be neuropathy triggered by hyperglycemia subsequently causing neurogenic bladder, urinary stasis, and increasing chance of UTI infection. The pattern of Susceptibility to UTIs in diabetic patients is very high compared to nondiabetics.<sup>3</sup> In various pieces of literature, it is observed that *Escherichia coli* (*E. coli*) is the predominant one followed by *Klebsiella pneumonia* (*K. pneumoniae*), and *Enterococci* other bacteria such as *Enterobacter*, *Proteus species.*, are mostly involved.<sup>4</sup>

A subset of extraintestinal pathogenic *E. coli* (ExPEC) known as Uropathogenic *E. coli* (UPEC) is that are responsible for hospital-acquired and community UTIs. Uropathogenic strains that are epidemiologically associated with cystitis and pyelonephritis that is distinct from the non-pathogenic *E. coli*.<sup>5</sup> While *E. coli* are an incredible and diverse entero-bacterial species that usually inhabits the colon as an innocuous fecal flora. However, it may become an opportunistic pathogen depending upon the health status of a person leading to a wide variety of intestinal and extra-intestinal diseases.<sup>6</sup>

The rise of drug-resistant UTIs is elevated both in community as well as in the healthcare setups. UPEC isolates had a strong positive correlation with multi-drug resistance. As a consequence of which there is an alarming increase in antibiotic resistance making it almost impossible to treat the infection. Moreover, studies have unveiled the fact that over-prescription of antibiotics along with inadequate information regarding virulence traits of UPEC affect the pattern of drug resistance and pathogenesis.<sup>7,8,9</sup>

According to one cross-sectional study by Ahmad *et al.*, (2020) in Peshawar, Pakistan a total of 400 Diabetics, patients observed for the presence of Uropathogenic symptomatic UTI, 51% of patients having microbial growth, in which *E. coli* was the most dominant one with 71%, followed by *Klebsiella pneumonia*, *Pseudomonas aeruginosa* (*P. aeruginosa*), *Enterococcus* and *Candida* spp., with 17.1%, 6.83%, 5.85%, and 0.98%, respectively.<sup>10</sup> Another study from Lahore, Pakistan noticed the prevalence and antibiotic susceptibility assay of uropathogens in tertiary care hospitals. The most dominant organism was *E. coli* followed by *Klebsiella*, *Proteus*, and *Pseudomonas*.<sup>11</sup> According to previous investigation the overall prevalence of diabetic UTI was 14%.<sup>12</sup> A recent cross-sectional study by Masood *et al.*, (2024) in Peshawar, Pakistan, observed that among Diabetics patients the presence of Uropathogenic symptomatic UTI, in which *E. coli* was the most dominant one with 38.8%, followed by *Candida* spp., *Enterococcus faecalis*, *Pseudomonas*, *Klebsiella* and *Proteus mirabilis*, with 19%, 11.8%, 10%, and 9.5%, respectively.<sup>13</sup>

Limited published data is available regarding the prevalence of uropathogens including Gram positive as well as the Gram negative bacteria involved in UTIs. There is a need to investigate the pattern of uropathogens in diabetics patients, also their antibiotic susceptibility profile in Khyber Pakhtunkhwa (KP), Pakistan. Therefore, this study aimed to determine the prevalence of common

uropathogens in diabetic patients visiting the Mardan Medical Complex, Mardan.

#### MATERIALS AND METHODS:

This was basically a cross sectional study conducted at Medical A ward, Mardan Medical Complex, Mardan, from July 2024 to January 2025. The sample size was 129, using a 14% proportion uropathogen in patients with diabetics<sup>12</sup>, a 95% Confidence interval, and a 6% margin error using WHO online sample size calculator. For sampling techniques, a nonprobability consecutive sampling method was applied with minimum of 06 months from the date of approval of the synopsis. Sample selection was done using the inclusion criteria as all diabetic patients having urinary tract infections (UTIs) of all ages and both males and females, patients with or without lower urinary tract symptoms for upper UTI) or showing frequent pus cells on urine routine examination were included. Samples with improper handling, those patients who received antibiotics within the last 72 hours of their presentation were also excluded.

#### DATA COLLECTION PROCEDURE

The study was ethically approved from the hospital's ethical and research committee. All patients fulfilling the inclusion criteria and presenting with UTIs complication were enrolled in the study in hospitalized patients admitted to the Medical A Unit. Written informed consent was obtained from all the included patients observed in this study.

All the included patients have a detailed history and clinical examination. After inclusion, a urine sample was obtained from all the patients and immediately sent to the hospital laboratory for observing the uropathogens using standard microbiological procedures. The urine sample was found positive if isolates grew in counts of  $\geq 10^4$  colony-forming units (CFU/ml) in patients having UTI complications. All the information like age, sex duration of UTI, and diabetes mellitus, were recorded in a pre-design

proforma. Exclusion criteria was strictly followed to control bias in this study.

#### Bacterial identification

All the bacterial identification was done using standard microbiological procedures. Initially all the bacterial isolates growth obtained from Cysteine Lactose Electrolyte Deficient (CLED) media was processed for Gram staining procedures. After confirmation of UTI by performing a simple urine routine examination, the samples were streaked on CLED (agar media and incubated at 37°C for 18 to 24 hours. Yellowish *E. coli* colonies appeared on CLED agar, and these were subculture onto Eosine Methylene Blue agar (EMB media) selective for *E. coli* and Bile Esculin Agar for the identification of *Enterococcus faecalis*. The check the isolates growth characteristics, selective and differential media was used further identification was done using the biochemical tests.

#### DATA ANALYSIS PROCEDURE:

All the data were entered and analyzed in SPSS (version 22). Mean  $\pm$ SD or median (IQR) was be calculated for numerical variables like age. Frequencies and percentages were calculated for categorical variables like diabetes mellitus, gender. All the results were presented as tables and graphs.

#### Results

##### Patients demographic details

Out of a total of 129 isolates 80 (62%) were identified in female patients which is dominate as compared to male in 49 (38%) of isolates (Figure 1). The **mean age** was  $\approx 39.26$  years' **standard deviation** was  $\approx 18.77$  years. Out of a total of 129 isolates the most dominant infection was found in the age group of (31-40) (18%) followed by 41-50 and 51-60 in (16%) patient each only, while rest of the details are shown in table no 1.

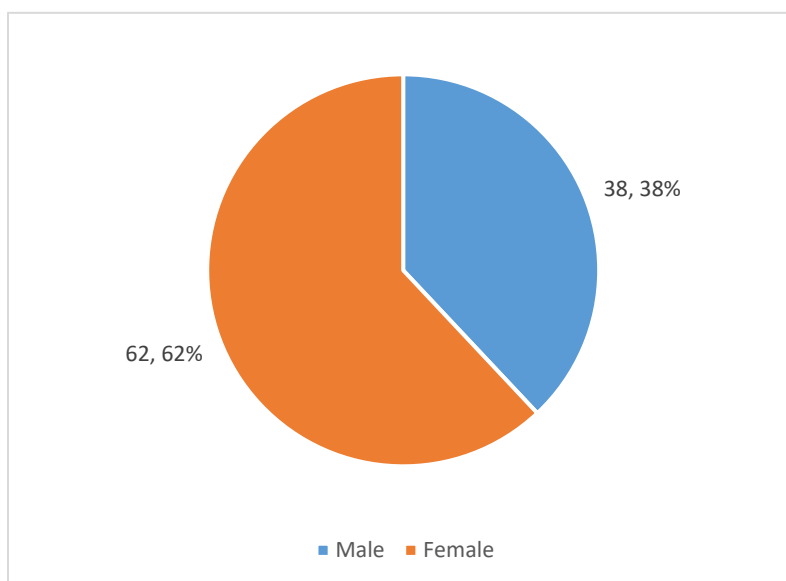


Figure 1; shows the gender distribution of patients

Table 1 shows the Isolates distribution according to various Age

| S. NO | Age Group | Frequency | Percentage% |
|-------|-----------|-----------|-------------|
| 1     | 11-20     | 8         | 6.20%       |
| 2     | 21-30     | 20        | 15.50%      |
|       |           |           |             |
| 3     | 31-40     | 40        | 31%         |
| 4     | 41-50     | 34        | 26.35%      |
| 5     | 51-60     | 16        | 12.40%      |
| 6     | 61-70     | 11        | 8.52%       |

#### Classification of Urinary Tract infections (UTIs) in diabetes patients

growth as shown in Table 2.

Out of a total of 129 urine samples 100 (77.51%) gives the positive culture while the 29 shows no growth and only five isolates were positive for mixed

Table 2 shows the Classification of UTI infections in diabetes patients

| S. No | Classification of UTI | Frequency (N) | Percentages % |
|-------|-----------------------|---------------|---------------|
| 1     | Positive              | 100           | 77.51         |
| 2     | Negative              | 29            | 22.48         |
| 3     |                       |               |               |

### Duration of diabetes among UTIs patients

Among 129 patients, 60 (46.5%) have duration of more than five years' duration of history of diabetes, followed by 3 year of duration history in 50 (38.75%) of patients and 19 patients with prevalence rate of

14.72% have more 1 year of history of duration of diabetes having UTI infection.

### Microorganism isolated from UTIs in diabetes patients

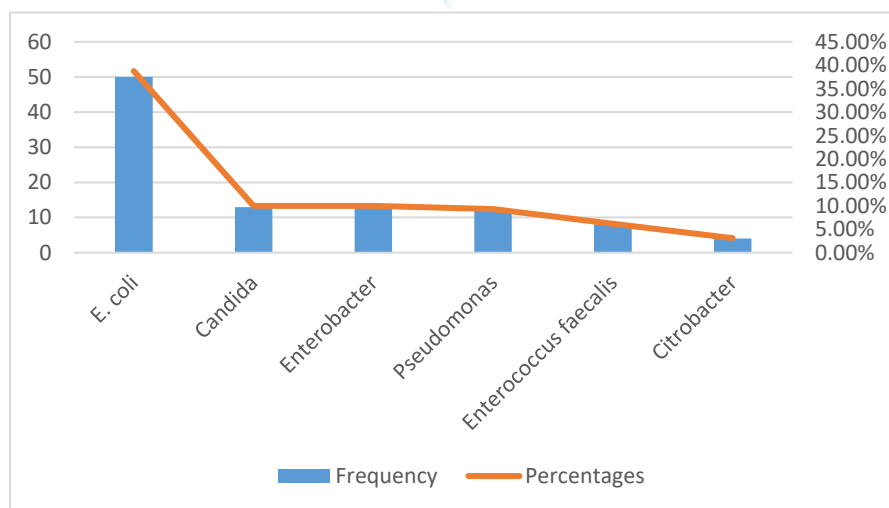
Standard microbiological procedures were applied to identify the microorganism causing UTI in diabetes

**Table 3: Type of microorganism isolated from diabetes patients having UTIs**

| S. No | Organism isolated            | Frequency | Percentage |
|-------|------------------------------|-----------|------------|
| 1     | Mixed growth                 | 5         | 3.87%      |
| 2     | <i>E. coli</i>               | 50        | 38.75%     |
| 3     | <i>Candida</i>               | 13        | 10%        |
| 4     | <i>Enterobacter</i>          | 13        | 10%        |
| 5     | <i>Pseudomonas</i>           | 12        | 9.30%      |
| 5     | <i>Enterococcus faecalis</i> | 8         | 6.20%      |
| 6     | <i>Citrobacter</i>           | 4         | 3.1%       |
| 7     | No growth                    | 24        | 18.60%     |

patients. Out of a total of 129 patients, 100 urine showed positive results for bacterial growth, 24 urine samples were remained negative for culture and only 5 urine samples were positive for mixed growth. Out of 100 positive urine culture the most dominant microorganism isolated from UTI patients was *E. coli* in 50% of isolates followed by *Candida* and

*Enterobacter* in 10% of each, *Pseudomonas* was fourth one dominant pathogen, among the Gram positive pathogen the common bacterium known as *Enterococcus faecalis* was found in 6. 20% of isolates, the frequency and percentages are shown in table 3 and figure 2.



**Figure 2: Frequency and Percentages of microorganism isolated from UTIs patients**

## Discussion

The pattern of bacterial uropathogens in diabetic hospitalized patients presents a critical area of study due to their increased susceptibility to urinary tract infections (UTIs). Diabetes alters immune function and urinary tract integrity, often leading to more severe infections. Identifying common pathogens and resistance patterns helps guide effective empirical treatment. In the current study, most of UTIs was found in female hospitalized diabetic patients. The UTIs infection was found in 62% of cases which supports the findings of a previous study from Pakistan and observed that out of 350 DM patients, 64.29% of female was infected as compared to male patients.<sup>14</sup> another previous investigation from Lahore, Pakistan also reported that UTI were more predominant in female in 76.3% of cases.<sup>15</sup> Another few studies from various cities of Pakistan reported the *E. coli* predominance in 82.35% of patients in Mardan,<sup>16</sup> and in 38.8% of patients in Peshawar region,<sup>13</sup> and 70% from Islamabad.<sup>17</sup> these all studies are similar to the current study that *E. coli* was the predominant pathogen isolated from UTIs but somehow the percentages are different these might be due to number of sample size, some studies included both diabetic and non-diabetic patients, study duration, education level and geographical locations. Another possible reason for *E. coli* dominance is normal flora that also act as an opportunistic pathogen and female anatomy is also one of the risk factor associated with UTIs.

The most common bacteria involved in UTI infection in the case of diabetic patients is recorded as *E. coli*.<sup>18,22</sup> UTIs are among the most common medical conditions observed in all age groups with DM. Other than *E. coli* other organism are also play a key role in the UTIs, such as *Klebsiella*, *Pseudomonas*, *Enterococcus* and *Proteus mirabilis*. As in the current investigation *E. coli* was recorded as one of the dominant organism in 38.75% isolates, similar study in 2024 from Peshawar also noticed the predominant microorganism in UTIs as *E. coli* in 37% of patients, followed by *Klebsiella*, *Pseudomonas*, *Enterococcus*, *Proteus mirabilis* 23.9%, 6.3%, 12%, and in 10.9% of patients.<sup>17</sup> Few studies from Pakistan also reported the prevalence of euro pathogen in diabetic patients, in which *E. coli* (71%) was the most

dominant one, followed by *Klebsiella pneumonia* Spp (17.1%), *P. aeruginosa* (6.83%), *Enterococcus* (5.85%), and *Candida* spp., in 0.98% of isolates.<sup>10</sup> Another investigation from Peshawar also reported *E. coli* was dominant pathogen encountered in 79% of cases, and *Enterococcus faecalis* in 12.7% while *Enterobacter cloacae* was found in 3.1% patients.<sup>23</sup> All these studies support the current findings but somehow the percentages are different this might be that some studies have large number of samples size, and also the geographical areas. *Candida* is also isolated from UTIs patients suffering with diabetic. As in this study, 10% of patients were remained positive for candida infection, similar findings were also reported from Iran that 37.7% of case were positive for candida spp., This study highlights the presence of *E. coli* in most of the cases, some large sample size studies as well as the longitudinal studies needed to proper address the issues, because stay in hospital is also one of the major cause of UTIs in DM patients. Strict policy will have required to overcome such type of infection in hospitalized patients.

## Conclusion:

The current study highlights the pattern of uropathogen in DM patients, in which *E. coli* was the most predominant one, other than this bacterium Gram positive and also the fungal pathogen is also found.

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**Conflicts of Interest:** None.

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