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Original Article

# Urinary Tract Infections and Antibiotic Sensitivity Patterns Among Women Referred to Azadi Teaching Hospital, Duhok, Iraq

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**Abstract**

**Background:** Urinary tract infections (UTIs) are very common worldwide. Such an infection is usually treated with empirical antimicrobial therapy. However, there are trends of increasing rates of antibiotic resistance. The aims of this study were to determine the most common bacterial causative agents and their antibiotic sensitivity pattern in women suffering from UTI in Duhok, Kurdistan, northern Iraq.
**Methods:** Urine samples were collected from 371 subjects afflicted with UTI and inoculated directly on blood and MacConkey agar and then incubated at 37°C for 24 hours. Bacterial colonies were determined by standard culture and biochemical characteristics. All isolates were tested for their antibiotic susceptibility.
**Results:** The vast majority of the isolates were Gram-negative and only 2 (0.5%) of them were Gram-positive. The highest infection by Gram-negative bacteria belonged to *Escherichia coli* 276/371 (74.4%) and about 74.2% of which were resistant to amoxicillin/clavulanic acid. Additionally, around 65% of the isolated *E. coli* were resistant to ceftriaxone, ceftazidime, and cefepime. It was found that the Pseudomonas strains were resistant to ceftazidime (42%), ertapenem (75%), and ciprofloxacin (50%).
**Conclusions:** There were increasing rates of antibiotic resistance especially in *E. coli*. Urgent measures are needed to contain such a resistance pattern and a plan for continuous surveillance is required to monitor antibiotic sensitivity pattern.
**Keywords:** UTI, Antibiotic sensitivity, Multidrug resistant, Duhok, Iraq

## Background

The Urinary tract infection (UTI) is a common acquired bacterial infection with an estimation of 150 million episodes worldwide annually (1,2). The community-acquired uncomplicated lower UTI is the most common form that is often handled in primary care units (3). UTIs are more common in female due to shorter urethra which allows microorganisms to travel more easily into the bladder and sexual activities that increase the inoculation of bacteria into the bladder; in addition, delayed post-coital urination with the use of a birth control measures such as diaphragm may further predispose female to recurrent UTI (3,4). It is worth mentioning that persistent symptoms for at least 7 days increases the risk of recurrent infection because of the occult kidney infection especially in females with lower socioeconomic status (3). It was previously revealed that the high resistance rate to the commonly used antimicrobial medications might also play a role in occurrence of complicated and recurrent UTI. Besides, variations in antibiotic resistance have been demonstrated in different geographical regions (2,3,5,6). Therefore, it is recommended that antibiotic resistance pattern for any infection be investigated in different countries since this plays a pivotal role for both correct management and antimicrobial resistance prevention. Furthermore, studying antimicrobial susceptibility patterns may help allocating UTI empirical treatment guidelines. In a previous study conducted in Iraq, recruiting 141 samples of both genders it was found that *Escherichia coli* was the most common infectious agents causing UTI (7). Amongst the gram positive microorganisms, staph species were the most common bacteria causing UTI and were resistant to the most commonly used antibiotics (7-9).

## Objectives

The aims of this study were to determine the most common bacterial causative agents and their antibiotic sensitivity pattern in women suffering from UTI in Duhok, Kurdistan, northern Iraq.

## Patients and Methods

### Sample Collection

Urine samples were collected from 371 UTI afflicted subjects residing in residing in Duhok, Kurdistan, Iraq. Clean catch midstream urine was obtained from the patients to avoid contamination. The collected samples were inoculated on blood and MacConkey agars and then incubated at 37° C for 24 hours. The presence of $\geq 10^5$ identical colonies was considered as microbiological evidence of a UTI. Bacterial colonies were initially classified by gram staining and then determined depending upon standard culture and biochemical characteristics of isolates and identification was performed in accordance with local standards and guidelines.

### Antimicrobial Susceptibility Test

Phoenix system (Becton Dickinson) was used for identification of bacteria and antimicrobial susceptibility testing. The test was performed according to the manufacturer's instructions.

### Ethics Statement

Consent was obtained from patients recruited in the report. This research and method of attaining consent were approved by the scientific committee of the department of sciences, University of Zakho, Kurdistan, Iraq.

## Results

### Patients Characteristics

In this study, 371 female patients were recruited; the majority of these patients were within the age range of 13-45 years. Sixty out of 371 (16.1%) and 70 out of 371 (18.9%) of the patients were older than 45 years old and within the age range of 19-30 years, respectively (Table 1).

### Antibiotics Sensitivity Pattern

The vast majority of the isolates were gram negative and only 2 (0.5%) isolates were gram positive. The highest infection by gram-negative bacteria belonged to *E. coli* (276 isolates, 74.4%) followed by *Klebsiella* species (15.6%) (Table 1). Amongst 276 *E. coli* isolates, about 74.2 % were resistant to amoxicillin/clavulanic acid. In addition, around 65% of isolated *E. coli* were resistant to ceftriaxone, ceftazidime, and cefipime (Table 2). It was found that 31% and 0% of isolated *Klebsiella* strains were resistant to ciprofloxacin and amikacin, respectively (Table 2). Regarding the sensitivity pattern of pseudomonas, it was revealed that 42%, 75%, and 50% of the strains were resistant to ceftazidime, ertapenem, and ciprofloxacin, respectively. The sensitivity of *Proteus* to ciprofloxacin and ceftazidime was found to be 26% and 18.7%, respectively (Table 2).

## Discussion

The UTI is considered to be one of the most widespread infections worldwide. Although every individual is susceptible to UTI, some groups are more vulnerable. Women, in general, are more susceptible to such an infection due to anatomical and physiological features.

The vast majority of national and international guidelines recommend empirical antibiotic therapy for UTI treatment. However, the effectiveness of such an empirical antibiotic treatment relies upon local antimicrobial resistance patterns. It is worth mentioning that the spectrum of microorganisms isolated from subjects suffering from UTI is almost stable and *E. coli* remains as the most prevalent causative agent. In a study conducted in Iran where 1513 patients participated, it was found that *E. coli* was the most common pathogen especially in women. In the same study, *Klebsiella* was observed as the second most common infection (10). In another study carried out in Turkey involving 429 women between the age of 18 to 65 years old, *E. coli* was found to be the most common causative agent of UTI (11). In agreement with this, it was revealed that *E. coli* strains were the most common causative microorganisms of UTI in our locality. It is important to notice that significant changes in bacterial susceptibility profile have been demonstrated over the last decades (12). For example, the average resistance for ampicillin is more than 50% in some countries (12). In a study conducted in Turkey, the resistance rates of *E. coli* for ampicillin, amoxicillin/clavulanic acid, ceftriaxone, ciprofloxacin as well as sulfamethoxazole/trimethoprim were 55.1%, 32.7%, 15.9%, 25.2%, and 41.1%, respectively (11). In the present study, about 75% of the isolated *E. coli* strains were resistant to amoxicillin/clavulanic acid. Moreover, our results showed that around 65% of isolated *E. coli* were resistant to ceftriaxone, ceftazidime, and cefipime. Besides, it was found that 31% and 0% of isolated *Klebsiella* strains were resistant to ciprofloxacin and amikacin, respectively. The resistance pattern of *Klebsiella* to ciprofloxacin was similar to what was found in Africa. However, the sensitivity to amikacin in this study was much better that of found in Africa (0% comparing to 11%) (13). The sensitivity pattern of *Pseudomonas* was alarming as 42%, 75%, and 50% of the strains were

**Table 1.** Distribution of Urine Pathogens According to Age Groups

| Organism | Age Group | | | | Total No.% |
|---|---|---|---|---|---|
| | <18 | 19-30 | 31-45 | >45 | |
| *Staphylococcus* sp. | 0 | 1 | 1 | 0 | 2 (0.5) |
| *Acinetobacter* sp. | 0 | 1 | 6 | 2 | 9 (2.4) |
| *E. coli* | 14 | 46 | 171 | 45 | 276 (74.4) |
| *Klebsiella* sp. | 1 | 13 | 32 | 12 | 58 (15.6) |
| *Pseudomonas* sp. | 0 | 5 | 7 | 0 | 12 (2.8) |
| *Proteus mirabilis* | 3 | 4 | 6 | 3 | 16 (4.3) |
| Total | 18 | 70 | 223 | 60 | 371 (100) |

**Table 2.** Antimicrobial Resistance Patterns of Isolated Uropathogens

| Antibiotic | Organism Number of Isolates (Percent of Resistance) | | | | | |
|---|---|---|---|---|---|---|
| | *E. coli* | *Klebsiella* sp. | *Acinetobacter* sp. | *Pseudomonas* sp. | *Proteus* sp | *Staph* sp. |
| Amikacin | 5 (1.7) | 0 (0) | 2 (22.2) | 2 (16.6) | 4 (25) | 0 (0) |
| Gentamycin | 124 (44.9) | 15 (25.8) | 2 (22.2) | 5 (41.6) | 11 (68.7) | 0 (0) |
| Ertapenem | 13 (4.7) | 2 (3.4) | 5 (55.5) | 8 (66.6) | 0 (0) | 0 (0) |
| Imipenem | 6 (2.1) | 3 (5.1) | 2 (22.2) | 3 (25) | 0 (0) | 0 (0) |
| Meropenem | 7 (2.5) | 0 (0) | 2 (22.2) | 2 (16.6) | 0 (0) | 0 (0) |
| Cefazolin | 169 (61.2) | 33 (56.9) | 4 (44.4) | 4 (33.3) | 8 (50) | 1 (50) |
| Ceftazidime | 178 (64.4) | 30 (51.7) | 2 (22.2) | 5 (41.6) | 3 (18.7) | 1 (50) |
| Ceftriaxone | 181 (65.5) | 28 (48.2) | 4 (44.4) | 7 (58.3) | 9 (56.2) | 1 (50) |
| Cefepime | 179 (64.8) | 28 (48.2) | 2 (22.2) | 4 (33.3) | 7 (43.7) | 1 (50) |
| Aztreonam | 183 (66.3) | 25 (43.1) | 9 (100) | 5 (41.6) | 3 (18.7) | 1 (50) |
| Augmentin | 205 (74.2) | 33 (56.9) | 9 (100) | 12 (100) | 2 (12.4) | 2 (100) |
| Piperacillin-tazobactam | 31 (11.2) | 4 (6.9) | 2 (22.2) | 2 (16.6) | 0 (0) | 0 (0) |
| Bacterem | 176 (63.7) | 7 (12) | 2 (22.2) | 10 (83.3) | 7 (43.7) | 2 (100) |
| Cefoxitin | 26 (9.4) | 11 (18.9) | 6 (66.6) | 4 (33.3) | 1 (6.2) | 1 (50) |
| Nitrofurantoin | 28 (10.1) | 31 (53.4) | 9 (100) | 10 (83.3) | 14 (87.5) | 1 (50) |
| Ciprofloxacin | 148 (53.6) | 18 (31) | 2 (22.2) | 6 (50) | 4 (25) | 2 (100) |
| Norfloxacin | 149 (53.9) | 15 (25.8) | 0 (0) | 4 (33.3) | 4 (25) | 1 (50) |

resistant to ceftazidime, ertapenem, and ciprofloxacin, respectively. The sensitivity of *Proteus* to ciprofloxacin and ceftazidime was reported to be 26% and 18.7% in the current study which was less than what was found in a study in Taiwan (54% and 80%, respectively) (14).

The association of *Acinetobacter* species and UTIs is well established. Risk factors predisposing to infection with such bacteria include prolonged hospital and intensive care unit admission, surgical intervention, and prolong antibiotics use (15). In this study, few causes of UTI resulted from *Acinetobacter* species showing 100% resistance to aztreonam and amoxicillin/clavulanic were reported. Unfortunately, due to missing data, it was not possible to determine whether or not those patients were exposed to above-mentioned risk factors.

In a previous study in Iraq, it was indicated that about 50% of the bacteria causing UTI were gram positive and the vast majority of them were staph species (7). Surprisingly, in this study, 2 cases of UTI caused by staph species were found. This is difficult to explain and more study is needed in this respect.

It was previously demonstrated that the distribution of microorganisms causing UTI was age dependent (3, 16). A lower prevalence of *E. coli* isolates was found in patients younger than 13 years or older than 60 years. Unfortunately, such a comparison was not reliable in the present study as the majority (60%) of the patients were within the age range of 31-45 years old.

## Conclusion

The current study makes a clear case that resistance of microorganisms causing UTI has reached alarming levels and immediate plan is required to cope with the issue. Another important finding of this study is that continuous surveillance of antibacterial resistance is required to monitor the changes taking place in the sensitivity pattern in any society. Strengthening local and global antibiotics resistance surveillance is critical since it provides essential information for global strategies, monitors the effectiveness of public health measures, and determines new trends and threats.

## Conflict of Interests

None.

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