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A field study of the types of bacteria causing hospital-acquired urinary tract infections Baghdad

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Abstract

The field study included the isolation and diagnosis of bacterial species in patients with urinary tract infections. Infections were detected in hospitals on the outskirts of Baghdad, including Al-Mahmoudiya, Al-Nahrawan Al-Jadeed, and Al-Madain General Hospitals. This disease is considered one of the most serious health problems facing large numbers of people annually. The research included a study of the health status of (150) individuals suspected of having urinary tract infections who were patients at hospitals on the outskirts of Baghdad. Samples were taken from individuals of different ages and both sexes. The infection was diagnosed through microscopic and culture examination of urine, and drug sensitivity testing was performed on the samples. (28) samples were identified as belonging to one species and (12) as belonging to the species *Escherichia coli*. (12) Sample belonging to the genus *Staphylococcus* (25) samples belong to *Streptococcus* Thirteen (13) samples belonged to the genus *Proteus*, nine (9) to the genus *Klebsiella*, seven (7) to the genus *Enterobacter*, three (3) to *Candida albicans*, and seven (7) to *Aeromonas*. The results of the current study showed that the highest infection rate was in the 3-12 year age group, and it was higher in females than males, reaching 523% in females compared to 48.7% in males. The lowest infection rate was in the 5-65 year age group, with 52.3% of females infected, while no infections were recorded in males in this age group. Drug susceptibility testing was performed on the identified bacterial samples using antibiotics. *E. coli* and *Staphylococcus* showed the highest percentage of resistant strains, while *Candida albicans* and *Aeromonas* showed the lowest resistance rates. resistance ratio.

Keywords: Urinary tract infection, bacteria staphylococcus bacteria, escherichia coli

Introduction

The urinary tract, consisting of the kidneys, ureters, and urethra, is one of the vital systems in the human body. Its function is crucial in filtering the blood of harmful substances and excess materials, eliminating them through urine. Urine, its characteristics, and its contents are good indicators of normal or pathological physiological status, in addition to the kidneys' other functions in maintaining the body's fluid balance. The widespread and indiscriminate use of antibiotics has increased the problem of urinary tract infections. Urinary tract infection (UTI) returns the reason for this is that the continued use of these antibiotics for long periods of time has led to the emergence of resistance in microorganisms and the appearance of a number of strains with high tolerance to antibiotics (Jawetz *et al.*, 1989) ^[9].

Therefore, we can conclude that bacteria are the primary cause of many cases of urinary tract infections, among other organisms responsible for the disease. *E. coli* is one of the most important types of Gram-negative bacteria that are isolated from urine samples of infected individuals.

Staphylococcus, as well as Obiet *et al.* (1996) ^[14], possess mechanisms of resistance to antibiotics (Jawetz *et al.*, 2004) ^[10]. Urinary tract infections (UTIs) may be the sole infection a person experiences, or they may be secondary to other diseases. The infection may occur alone or alongside other conditions such as gastritis, malnutrition, and acute respiratory infections. UTIs are more closely related to the patient's overall health, gender, and age than to the specific symptoms of the various UTI conditions.

Therefore, UTIs are among the most serious health problems affecting millions of people, particularly women. Women are more susceptible than men due to the shorter urethra, the absence of prostatic secretions, pregnancy, and greater susceptibility to fecal contamination.

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Another study proved that the occurrence of UTI increases in sexually active women more than in other groups of women (Howes, 2001) [7]. This disease is not common among men, but it is extremely dangerous if a man is infected with it compared to women.

Urine is free of any bacterial, viral, or fungal contamination. Urinary tract infection occurs when bacteria from the digestive system, specifically those present in the anus and very close to the urethral opening, reach the anus and begin to grow and multiply. The infection may be caused by a single type of bacteria, such as *E. coli*, starting in the urethra and then spreading to the bladder. If left untreated, it can spread to the ureters and then to the kidneys. It can also spread via other routes, such as from the blood to the kidneys or from the intestines to the bladder via the lymphatic system in infected individuals or those exhibiting symptoms.

People vary in their susceptibility to the disease, with some being more prone than others. Furthermore, any urinary tract abnormality that obstructs or impedes urine flow increases susceptibility because urinary stasis provides an opportunity for bacterial growth. This disease is common during childhood. (Vernon *et al.*, 1997) [15].

Women who contracted the disease. Women are more susceptible to recurrent infections, as studies have indicated a higher risk of reinfection due to the presence of probiotic factors in the cells lining the urinary tract. These factors facilitate bacterial adhesion and subsequent migration into the urinary system. This has also been linked to similarities in blood types among women who experience recurrent infections. Jantaush *et al.* (1994) [8] suggested that specific blood group patterns may play a role in susceptibility. The prevalence of the disease varies depending on geographical and health conditions (Fargason *et al.*, 1995) [5], with poor sanitation and malnutrition contributing to higher infection rates (Develay). Also noted this. Others (1996) indicated that poor health conditions contribute to the increased incidence and spread of many diseases, especially those related to these infections. Numerous studies have shown that urinary tract infections are a cause of kidney damage. Furthermore, women with diabetes who have a history of urinary tract infections, particularly in the upper urinary tract, experience a higher prevalence of kidney damage compared to those without urinary tract infections (Wullt, 2003) [16].

It has been found that the pathogenicity of urinary tract infections is not limited to the acute phase but extends to the chronic stage. Renal scarring, which leads to kidney dysfunction, is particularly dangerous in adolescents and children. This scarring can progress to an advanced stage, especially if there is a delay in diagnosis and treatment. Urinary tract infection Abu Daia *et al.* (2000) [3].

Classification of urinary tract infections (UTI)

Urinary tract infections are classified into several groups, including: acute cystitis and recurrent cystitis. Cystitis, acute pyelonephritis, urinary tract infections (UTIs) related to indwelling, asymptomatic bacteriuria, chronic bacteriuria, urethritis, and prostatitis.

Factors contributing to urinary tract infections

It is common for a person to develop a urinary tract infection without showing any obvious symptoms. Some

contributing factors, as mentioned by Orenstein and Wong in 1999, are as follows:

1. The presence of congenital defects in the urinary tract, including the congenital defect between the bladder and the ureter, or what is called Vesicoureteral Reflux. This is due to the backflow of urine to varying degrees, which causes frequent urinary tract infections and may also lead to kidney failure if it is not treated early.
2. Urinary tract obstruction, which leads to recurrent urinary tract infections, which may be followed by kidney atrophy and then kidney failure. The causes of obstruction are due to the formation of kidney stones or the presence of congenital defects in the urinary tract.
3. Pressure from the uterus on the ureter during pregnancy may lead to urinary retention and subsequently to inflammation, especially bacterial pyelonephritis.
4. Sexual contact with a person infected with the bacteria that cause the infection.
5. Having diabetes makes patients susceptible to urinary tract infections, whether bacterial or fungal.

Symptoms associated with urinary tract infection

Bacterial urinary tract infections have telltale symptoms. The patient may complain of some of them, and this condition is called symptomatic bacteriuria. Some of these symptoms are:

1. Pain in the upper urinary tract, which can occur with pyelonephritis (kidney infection).
2. Burning sensation during urination, and a strong urge to urinate, but the patient finds it difficult to do so, resulting in a dribbling urine stream.
3. The appearance of blood in the urine may be microscopic or visible to the naked eye.
4. Discharge of pus from the urethra.

Also, a person may have an infection but show no symptoms; this condition is called asymptomatic bacteriuria.

Materials and Methods

Materials

Metals

1. Blood Agar
2. MacConkey Agar
3. Muller-Hinton Agar
4. Nutrient Agar

**Antibiotic tablets used and their abbreviations

Table 1: Represents antibiotics and their abbreviations

Antibiotics	The summary
Pencillin	P
Amoxicillin /clavulanic acid	AMC
Ampicillin cioxacillin	APX
Cefoperazone	CEP
Vancomycin	VA
Cefotaxime	CTX
Oxacillin	OX
Cefixime	CFM
Chloramphenicol	C
Cefoxitin	CX
Norfloxacin	NOR
Metronidazole	MET
Gentamicin	GM
Trimethoprim sulfamethoxazole	SXT

Methodology of research procedures

Sample collection from patients

Samples were collected from patients referred to Al-Madain, Al-Nahrawan, and Al-Mahmoudiya hospitals in southern Baghdad Governorate from the beginning of April 2023 to the end of April 2025, in cooperation with the Baghdad/Rusafa II Health Directorate. A questionnaire was used to collect information from patients, including their name, age, gender, address, and type of treatment. Urine samples were collected from the hospital's outpatient laboratory and transported to the bacteriology laboratory with the assistance of the support staff.

Microscopic examination of urine from sample members

Urine samples were collected and placed in test tubes. They were centrifuged at 5000 rpm for 15 minutes. The filtrate was discarded, and the deposit was collected. A drop of the deposit was placed on a clean glass slide, covered with a slide cap, and examined under a microscope at 40x magnification to detect pus cells (Al-Dabbagh, 1998) [2].

Culture on media

Urine samples were collected and cultured on suitable media, namely blood agar and MacConkey agar. All urine samples were cultured on these media to isolate the bacteria causing the urinary tract infection, and then diagnosed using a number of conventional tests (Al-Ismail 2007).

Isolation and diagnosis of bacteria

The bacteria were identified by culture on enriched blood agar. Based on colony growth, hemolysis, and differential macconkey agar medium. The diagnosis was based on the bacteria's ability or inability to ferment lactose. Biochemical tests were also used, and the diagnosis was confirmed using the API 20 system.

The current study also found that some individuals did not exhibit clinical symptoms of the disease despite positive bacterial culture results. This, in turn, leads to a complex disease progression that negatively impacts the individual's health. The reason for negative bacterial culture results despite the presence of pus cells is that the patients may have taken antibiotics before the samples were taken, thus preventing the bacteria from appearing in the sample.

The cause may also be a virus that does not grow in environments near the city center, or it may be bacteria that are not isolated using routine methods, such as anaerobic bacteria and other microorganisms. (Al-Ismail, 2007)

Materials needed for resistance testing

- Bacterial cultures aged 24-48 hours.
- Petra dishes containing sterile culture medium
- Antibiotic tablets (Multidisc or Unidisc)

Method of operation for resistance testing

- Using sterile forceps, take one of the tablets containing the antibiotics and place it in one corner of the plate containing the bacterial culture, and press it down slightly to obtain good contact between the tablet and the medium.

- Repeat the above steps with the remaining discs, ensuring that the number of discs is approximately (6) per plate.
- Incubate the plates upside down at a temperature of (37) °C for (24-48) hours. Then, record observations of the inhibition zones surrounding the discs by measuring the diameter of the zone in millimeters and comparing the inhibition zones for different antibiotics and types of bacteria. The different types of bacteria were then compared with the values in the attached table to determine whether the bacteria were resistant, intermediately resistant, or sensitive.

Study results for sample members

The results of the current study, after analysis, showed that the number of infected male samples was (104) out of a total of (150) samples, representing 69.3%, positive for bacterial growth. Of these samples, (28) were *E. coli* and (9) were other bacteria. *Klebsiella* (12) samples belonging to bacteria *Staphylococcus* (13) One sample belonging to *Proteus* bacteria and (25) samples belonging to bacteria *Streptococcus* (7) Sample *Enterobacter* (3) Sample *Candida albicans* (7) The sample belongs to *Aeromonas*, and *E. coli* bacteria are among the most common types of bacteria causing urinary tract infections in both women and men.

Table 2: Shows the types of pathogenic bacteria and the number of infected people, distributed according to the gender of the infected person. * Drug Susceptibility Results:

Type of microorganisms	Number of infected males	The number of Infected females
<i>Escherichia coli</i>	28	7
<i>Staphylococcus</i>	12	7
<i>Streptococcus</i>	25	6
<i>Proteus</i>	13	8
<i>Klebsiella</i>	9	7
<i>Enterobacter</i>	7	1
<i>Aeromonas</i>	7	5
<i>Candida albicans</i>	3	5
The total	104	46

This table shows the results of bacterial isolates causing urinary tract infections and their degree of resistance to the antibiotics used. The resistance of the bacterial isolates to these antibiotics varied, with *E. coli* and *Staphylococcus* showing the highest percentage of resistant strains, while *Aeromonas* and *Candida albicans* showed the lowest percentage of resistance. *E. coli* bacteria showed resistance to antibiotics. The following (M, CFM, OX, CEP APX, AMC, P, STX, CX, NOR, SXT, GN, ET) showed resistance to all *Staphylococcus* bacteria except [the following], while *Streptococcus* bacteria showed resistance to [the following]. *Proteus* bacteria were resistant to (SXT, MET, CX, AMC, P, OX, CEP), while *Klebsiella* bacteria were resistant to (CEP, C, APX, CFM, MET, SXT, NOR, CX). *Enterobacter* bacteria were resistant to (SXT, GEN, MET, CX, CFM, VA, CEP, APX, AMC).

Table 3: Shows the number of bacterial species resistant to some antibiotics

Antibiotic bacteria	<i>Candida albicans</i>	<i>Aeromonas</i>	<i>Enterobacter</i>	<i>Klebsiella</i>	<i>Proteus</i>	<i>Streptococcus</i>	<i>Staphylococcus</i>	<i>E.coli</i>
P	-	-	-	-	-	1	-	6
AMC	1	1	4	-	-	1	11	4
APX	-	-	1	4	5	-	3	4
CEP	-	-	5	4	1	4	3	7
VA	-	-	2	-	-	-	8	-
CTX	-	-	-	-	1	-	8	3
OX	-	-	-	-	-	1	5	2
CFM	-	-	2	2	4	-	1	6
C	-	-	-	1	-	-	12	-
CX	-	-	5	5	-	2	12	4
NOR	-	-	-	2	3	-	5	4
MET	-	-	5	3	3	3	6	10
GEN	-	-	1	-	-	-	6	2
SXT	-	-	3	4	3	2	11	10

Discussion

Laboratory diagnosis of urinary tract infection (UTI) relies on microscopic examination and bacteriological culture of urine samples (Klein, 1996, *et al.*). Microscopic examination depends on the number of pus cells in the microscopic field under maximum power. Research indicates a strong correlation between the presence of bacteria and the appearance of pus cells in urine samples, with a correlation of approximately 80% (Wald & Hiberman, 1997). Based on this, patients are classified as infected or uninfected.

Females are more susceptible to the disease than males (Table 1). This may be due to the proximity of the urethral opening to the anus in females, which facilitates ascending infection more than in males. These results are consistent with what all researchers have found. Andriole 1987; Millar, 1997; Al Mugeiren *et al.*, 1992; Patterson and Larabi *et al.*, 2003 Also with (Abu Daia *et al.*, 2000) [3] and Al-Dabbagh 1998 [2].

The results of the urine sample analysis showed that the infection was present in (104) males out of a total of (150) samples, with (633) positive for microbial growth. Of these infected samples, (28) isolates were identified as belonging to *Escherichia coli*, (9) isolates as belonging to *Klebsiella*, (12%) isolates as belonging to *Staphylococcus aureus*, (13) isolates as belonging to *Proteus*, and (25) isolates as belonging to *Streptococcus*. As shown in Table (2)

It was observed that *E. coli* was one of the most common causes of UTIs, consistent with the findings of researcher Ali. (2011) and (2001, Akbar *et al.*, Wullt *et al* 2003) [16].

As it was the most common cause, it also came in agreement with the researcher (Wajihah 2007).

In addition to other bacteria isolated as pathogens, Gram-positive bacteria such as *Staphylococcus* and *Streptococcus* were also found in association with inflammatory conditions. In studying the incidence of the disease according to age groups, the results showed a significant effect of age groups, with the most affected groups being [unclear - possibly "age group"].

They are (1-10) years old, which contradicts the findings of researcher Al-Ismael (2007).

The results of the current study showed that the highest infection rate was in the (3-12) year age group, and it was higher in females than males, reaching 52.3% in females compared to 48.7% in males.

The lowest infection rate was in the 5-65 age group, with females accounting for 9.035% of cases, while no infections were recorded in males in this age group.

Drug sensitivity testing was performed on the bacterial samples diagnosed using [unclear - possibly a specific drug or test name].

Antibiotic resistance showed that *E. coli* and *Staphylococcus* bacteria exhibited the highest percentage of resistant strains, while other bacteria showed *Candida albicans* and *Aeromonas*

Lowest resistance percentage

The 21-30 age group is the second age group most susceptible to infection. Regarding the antibiotics used, *E. coli* isolates have appeared that are resistant to one or two antibiotics, or multi-resistant to three or more antibiotics. These antibiotics include PIP and AMC (penicillin group), and CF (cancer-free group). (Cephalosporins) GM anti-Affiliate of the group (Aminoglycosides) NOR antidote Affiliate of the group (Sulfonamides), I agree with the researcher (Wajihah (2007)), as *E. coli* isolates have shown resistance to the following antibiotics: (ARK, SEPR, CTX, SXT, OX, CX)

Staphylococcus bacteria have shown resistance to the following antibiotics

AMC, APX, CEP, VA, CTX, OX, CFM, CX, NOR, MET, (GEN, SXT)

Streptococcus bacteria have shown resistance to the following antibiotics:

(AMC, CEP, OX, CX, MET, SXT)

Proteus bacteria, however, showed resistance to the following antibiotics: (ARK, SEPR, CTX, CFM, NOR, MET, SXT)

Klebsiella bacteria have shown resistance to the following antibiotics: APX, CEP, CFM, CX, NOR, MET, and SXT.

Enterobacter bacteria have shown resistance to the following antibiotics: AMC, APX, CEP, VA, CFM, CX, MET, and SXT.

Candida albicans and *Aeromonas* fungi, as well as bacteria, have been shown to be present. Antibiotic resistance (AMC)

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