

**Republic of Iraq
Ministry of Higher Education
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Babylon University
College of pharmacy**



**Determination of the most prevalent microbes causing UTI and
their antimicrobial resistance**

Research submitted to the University of Babylon- College of pharmacy of the
requirements for obtaining a Bachelor's degree in pharmacy

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

"يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ ۗ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ"

"

"صدق الله العلي العظيم"
سورة المجادلة - الآية ١١

Dedication

Dedicated to,

Our parents who taught us to believe in ourselves,

our teachers who used to lead us to light,

to our Al-hashd and army men who spread peace,

and finally, to our supervisor who helped us along the project work time,

Dr. Rasha AbdulMahdi

Acknowledgement

Owing to the blessing of The Almighty God, we finished this research project.

We want to express our gratitude towards our families for their encouragement.

We take the opportunity to record our thanks to our supervisor,

Dr. Rasha AbdulMahdi.

We also record our thank to all who directly or indirectly offer their helping in this venture.

Abstract

Urinary tract infections (UTIs) are a severe public health Problem and are caused by a range of pathogens High recurrence rates and increasing antimicrobial resistance among uropathogens threaten to greatly increase the economic burden of these infections.

This research aimed to detect the commonest agent causing UTI and their susceptibility to various antibiotics, in addition to study the effect of some factors that could be related to the infection distribution such as the gender and age of patient. Therefore, data of (250) cases have been collected from several hospitals in Babylon city such as IMAM AL-Sadiq hospital and AL-Hashemiah hospital , Hilla Teaching Hospital and analyzed. The results showed that the most frequent causative agents are Staphylococcus aureus, E.coli, klebsiella sp, Streptococcus agalactiae, pseudomonas aeruginosa, Citrobacter sp, Streptococcus pyogenes, Proteus sp, Enterococcus faecalis, Enterobacter sp, Staphylococcus saprophyticus (with the ratio 91%,58%,36%,15%,15%,7%,7%,7%,4%,4%,4%, respectively). Also we found that the Staphylococcus aureus is more sensitivity to (Nitrofurantion, Meropenem) with the ratio (72%, 59%) compare to (Imipenem, Erythromycin). While E.coli showed high sensitivity to (chloramphenicol, Meropenem) with the ratio (90%, 87.5%) compare to (Pipracillin, Trimethoprim). Will Klebsiella sp is more sensitivity to (Imipenem, Chloramphenicol) with the ratio (94%, 57%) compare to (Tetracycline, Aztreonam). While Streptococcus agalactiae showed high sensitivity to (Amoxicillin, Ciprofloxacin) with the ratio (93%, 90%) compare to (Vancomycin, Clindamycin). Will Pseudomonas aeruginosa is more sensitivity to (Imipenem, Ciprofloxacin) with the ratio (95%, 75%) compare to (Amoxicillin, Amikacin). Finally, we found that UTI is more prevalence among women 77% compare to men 23%. In addition, the (20-30) ages is more susceptible to UTI infection than others with a ratio 78%.

1. INTRODUCTION

A urinary tract infection is an infection in any part of your urinary system - kidneys, ureters, bladder and urethra. Most infections involve the lower urinary tract - the bladder and the urethra. Women are at greater risk of developing a UTI than men. Urinary tract infections (UTIs) are some of the most common bacterial infections, affecting 150 million people each year worldwide [1].

In 2007, in the United States alone, there were an estimated 10.5 million office visits for UTI symptoms [2,3]. UTIs are a significant cause of morbidity in infant boys, older men and females of all ages. Serious sequelae include frequent recurrences, pyelonephritis with sepsis, renal damage in young children, pre-term birth and complications caused by frequent antimicrobial use, such as high level antibiotic resistance and *Clostridium difficile* colitis [4,5].

UTI is commonly caused by bacteria, mostly by Gram-negative bacteria such as *Escherichia coli*, *Proteus* species, *Pseudomonas aeruginosa*, *Acinetobacter* species, *Klebsiella* species, *Enterobacter* species, and *Citrobacter* species. Among Gram positive bacteria, *Staphylococcus saprophyticus*, *Enterococcus* species, and Coagulase-negative *Staphylococcus* are common predictable spectrum of bacteria which are responsible for causing UTIs [6,7].

As compared to non-pathogenic bacteria, the bacteria which are responsible for causing UTIs have more aggressive virulence factors which enhance their host cell attachment, colonization as well as invasion abilities. These bacteria avoid evasion of the immune system of host by the help of certain virulence factors which may be comprised of various cellular components such as pili, capsule, lipopolysaccharides, and various other cell surface structures [6].

Certain human anatomical as well as physiological factors are responsible for increasing the incidence of UTI, for example, length of the urethra is shorter in

females as compared to males which leads to an increased chance of acquiring UTI [8].

Urinary tract infection has different types depending on the infectious agent and infected location.

1.1. TYPES of Urinary tract infections

Most UTIs are caused by bacteria, but some are caused by fungi and, in rare cases, by viruses. UTIs are among the most common infections in humans.

Your urinary tract is made up of your: (**kidneys, ureters, bladder, urethra**)

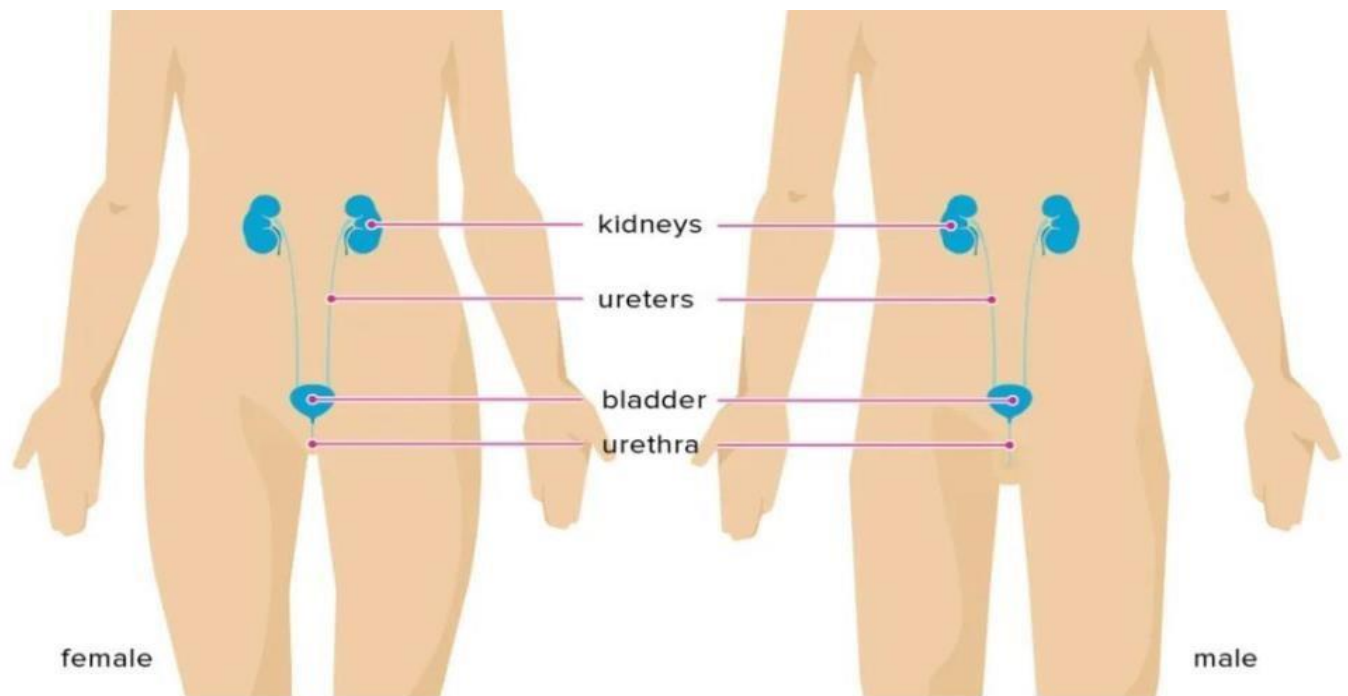


Fig 1 .Urinary system in male and female

Most UTIs only involve the urethra and bladder, in the lower tract. But UTIs can involve the ureters and kidneys, in the upper tract. Although upper tract UTIs are rarer than lower tract UTIs, they're also usually more severe [9,10,11,12].

1.1.1. Upper Urinary tract infections

Upper tract UTIs affect the kidneys. These can be potentially life threatening if bacteria move from the infected kidney into the blood. This condition, called urosepsis, can cause dangerously low blood pressure, shock, and death. Symptoms of an upper tract UTI include:

(pain and tenderness in the upper back and sides, chills, fever, nausea, vomiting) [9,12,13,14].

1.1.2. Lower Urinary tract infections

Lower tract infections — These include cystitis (bladder infection) and urethritis (infection of the urethra). Lower urinary tract infections commonly are caused by intestinal bacteria, which enter and contaminate the urinary tract from below, usually by spreading from the skin to the urethra and then to the bladder. Urethritis also may be caused by microorganisms that are transmitted through sexual contact, including gonorrhea and Chlamydia. Another form of male urinary infection is prostatitis which is an inflammation of the prostate.

Symptoms of a lower tract UTI include: (burning with urination, increased frequency of urination without passing much urine, increased urgency of urination, bloody urine, cloudy urine, urine that looks like cola or tea, urine that has a strong odor, pelvic pain in women, rectal pain in men) [29].

Urinary tract infection occur as a result of interactions between the uropathogen and host and their pathogenesis.

1.2. Urinary tract infection pathogenesis

The urinary tract infection (UTI) occurs when the pathogen is able to enter the urinary tract system and reach more than 10⁵ colony/ml in urine. UTI is known as the second common cause of infectious diseases. UTI accounts for approximately 40% of all infections acquired in the hospitals and 50% of bacteremia that can prolong the hospitalization and increase the morbidity and mortality rate of patients. Studies have shown that UPEC (Uropathogenic Escherichia coli) strains are able to develop UTI in a complex process. After entering the intestinal E. coli strain with the origin of normal flora from the urethra into the urinary tract system, it reaches the bladder and binds to the surface epithelium of bladder using the bacterial adhesin factors. These bacteria can be internalized into the facet cells of bladder and changed the circumstances for their survival [21].

Also there are various risk factors associated with UTI.

1.3. Risk factors of UTI

Anything that reduces your bladder emptying or irritates the urinary tract can lead to a UTI. There are also many factors that can put you at an increased risk of getting a UTI [30].

These risk factors include:

(Recent instrumentation of the renal tract, Abnormality of the renal tract, Incomplete bladder emptying – particularly by prostatic obstruction in men, Antibiotic use changes the vaginal flora and promotes 8ephalexin8n of the genital tract with E. coli, resulting in subsequent increased risk of UTI, Sexual activity, New sexual partner, Use of spermicide, Diabetes, Presence of catheter, Institutionalisation, Pregnancy, Immunocompromise, Genetic component to risk –

increased incidence of UTI in the immediate female relatives of women with recurrent UTI, and associated genes have been identified) [22].

Antibiotics usually are the first treatment for urinary tract infections. And you can take it if you're having symptoms and a positive urine culture.

1.4. Urinary tract infection treatment and management

1.4.1. General measures

Some women may find it helpful to be made aware of the risk factors for recurrent infection. These include:

- Use of spermicide
- Frequent sexual intercourse
- New sexual partner

Cranberry juice has been traditionally advised as being helpful in the prevention and treatment of UTI but the evidence base is low and it is not recommended by current guidelines.

Also traditionally, a number of measures have been advised, such as increasing fluid intake and personal hygiene behaviours (for example, avoiding delay in urination, wiping from front to back after defecation, avoiding douching), but there is no evidence to support these [23].

1.4.2. Pharmacological

Trimethoprim or nitrofurantoin remains the drug of first choice for the empirical treatment of uncomplicated UTI. 10-20% of *E. coli* infections may be resistant. Current recommendations suggest that the treatment period should be no longer than three days in women with uncomplicated UTI, although should remain at seven days for the treatment of UTIs in men [24].

First-line therapy in mild cases of uncomplicated pyelonephritis is oral ciprofloxacin for 7-10 days [26].

Co-amoxiclav and 9ephalexin usually feature as alternatives in local guidelines. Studies suggest the use of topical oestrogen in postmenopausal women reduces recurrence of UTI [27]. However, the Scottish Intercollegiate Guidelines Network (SIGN) states it should not be used for prevention [24]. Prophylactic low-dose antibiotics may be helpful in certain circumstances:

In women, for recurrent cystitis associated with sexual intercourse, trimethoprim 100 mg may be taken within two hours of intercourse. This is an off-label use.

In women, for recurrent infection not associated with sexual intercourse, a six-month course of a low-dose antibiotic may be used (such as trimethoprim 100 mg nocte or nitrofurantoin 50-100 mg nocte).

Paracetamol and/or non-steroidal anti-inflammatory drugs (NSAIDS) are of use for symptomatic relief. Asymptomatic bacteriuria should not be treated in adults with catheters or in non-pregnant women [25].

PRACTICAL SECTION

2.METHODS

2.1 Study population

The study population was drawn from patients attending IMAM AL-Sadiq hospital and AL-Hashemiah hospital , Hilla Teaching Hospital. The data of 250 patients with UTI was collected from 2022\8\20 to 2023\1\15.They were made up of 193

woman and 57 man and aged between 1-80 years. Finally, the data was analyzed for detecting deferent aspects such as the infectious agent frequency, the relationship of age and gender with the infection, as well as the bacterial susceptibility of different antibiotics.

3.Results

3.1. Effect of the gender on the UTI

Urinary tract infection can affect on men and women of all ages but women are more likely to get a urinary tract infection (UTI). As shown in the chart below:

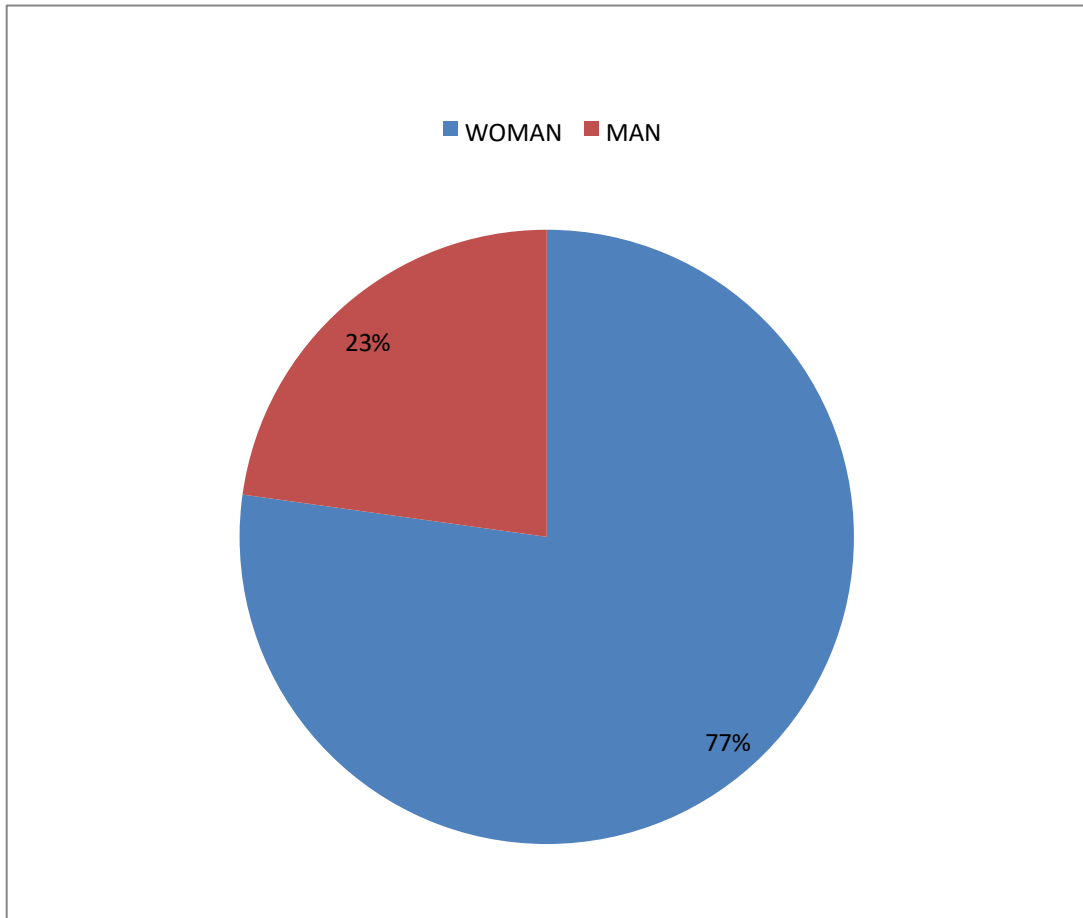


Chart 1. Relationship of gender with UTI.

Regard to gender , the result showed that the number of females was a large percentage , as it was 77% compare to male 23%

3.2. Effect of the age on UTI

With regard to ages, the ages of the participants ranged from 1 to 90 years, but the ages that experienced complications in a large proportion were from their twenties.

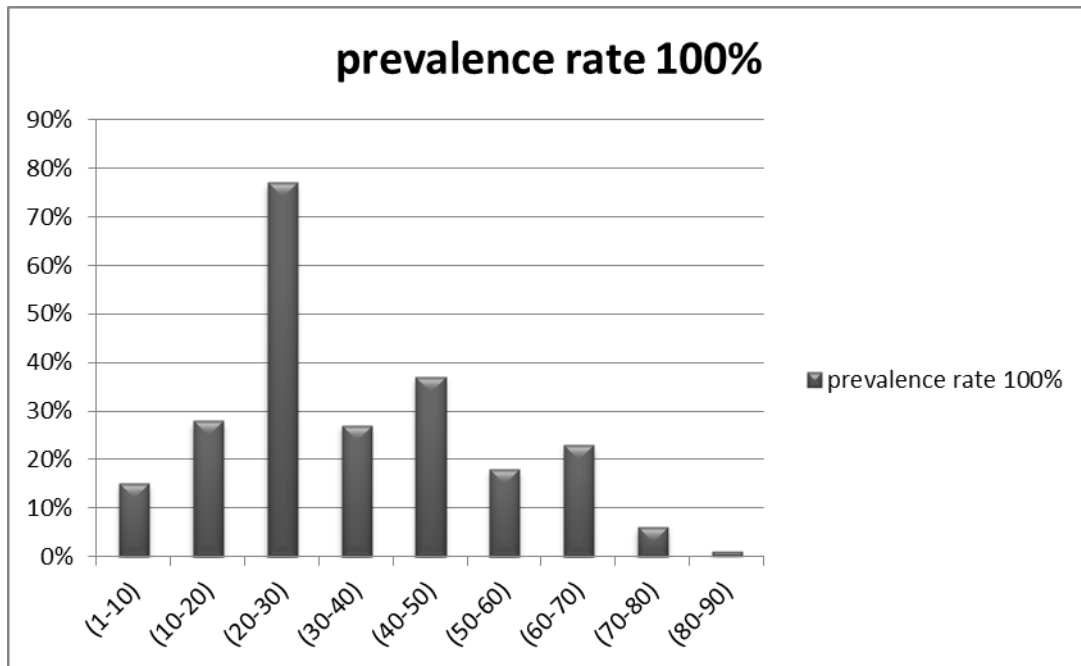


Chart 2. Effect of age on UTI.

As well as with regard to ages, the ages of the participants ranged from 1 to 90 years. The most infected ages and in large proportion (20-30)yrs was 78% and the lowest infected ages (80-90)yrs was 2%.

3.3. Frequency of the infectious bacteria in the UTI

Bacterial infections have a large impact on public health. A urinary tract infection is caused by micro-organisms, usually a bacteria . Chart below show the most prevalence bacteria .

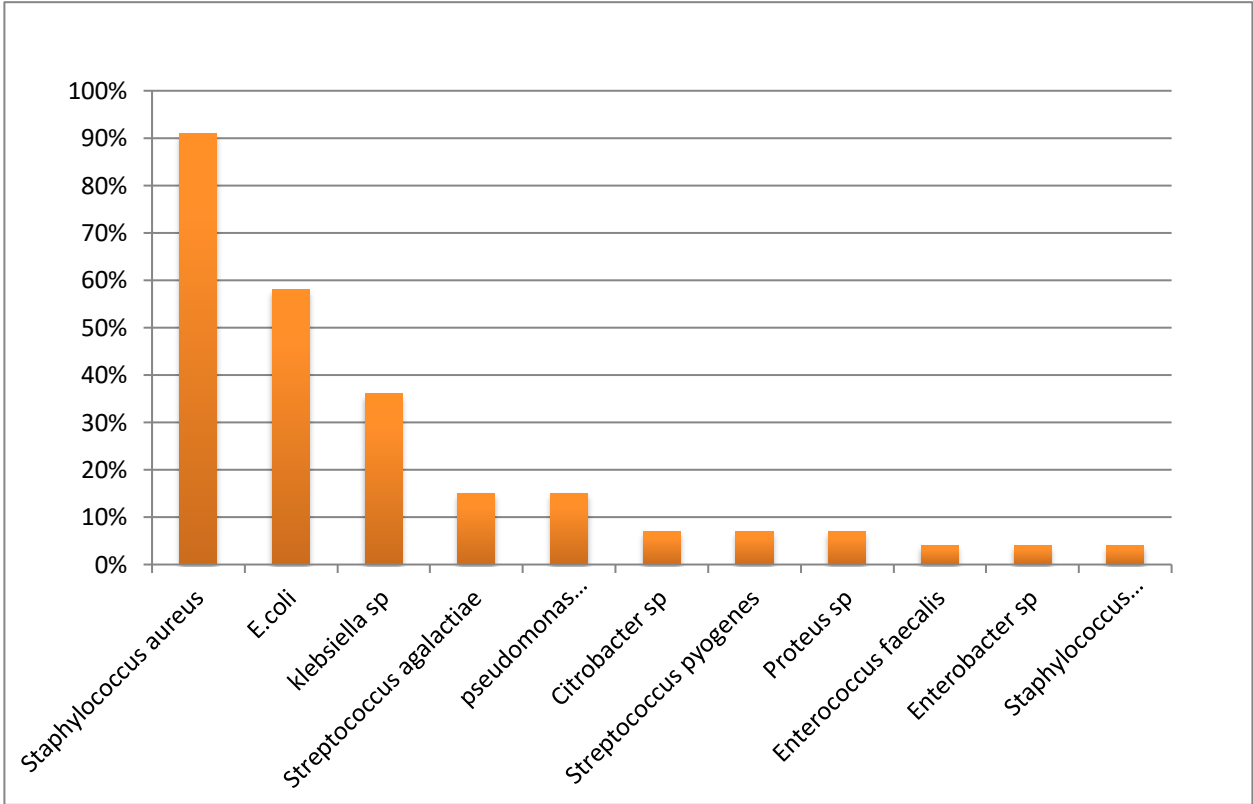


Chart 3. Prevalence of bacteria in the UTI.

The results showed that the most infected bacteria are Staphylococcus aureus about 91% and the lowest infected bacteria are Staphylococcus saprophyticus about 4% from collected samples.

3.4. susceptibility of the most prevalence bacteria to various antibiotics

Susceptibility testing is performed on bacteria causing an individual's infection after they have been recovered in a culture of the specimen. Testing is used to determine the potential effectiveness of specific antibiotics on the bacteria and/or to determine if the bacteria have developed resistance to certain antibiotics.

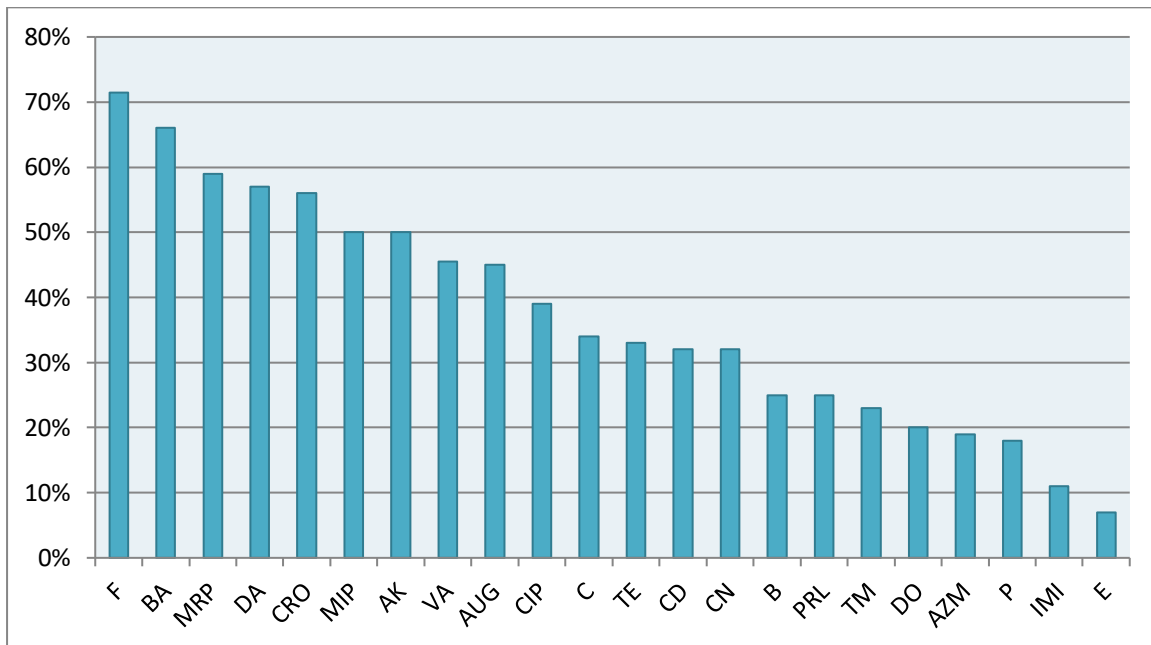


Chart 4. Sensitivity percentage of Staphylococcus aureus to various antibiotics.

The susceptibility of staphylococcus aureus to various antibiotics, the results found that S. aureus showed high sensitivity to the Nitrofurantoin (72%), Boronic acid (66%), Meropenem (59%), Clindamycin (57%), Ceftriaxone (56%), Meropenem (50%), Amikacin (50%) compare to Vancomycin,

Amoxicillin+Clavulanic acid,Ciprofloxacin,Chloramphenicol,Tetracyclin,
 Clindamycin, Gentamycin,Bacitracin,piperacillin,Tobramycin
 ,Doxicyclin,Azithromycin,pencillin,Imipenem,Erythromycin with ratios (46%,45%,39%,34%,33%,32%,32%,25%,25%,23%,20%,19%,18%,11%,7%, respectively).

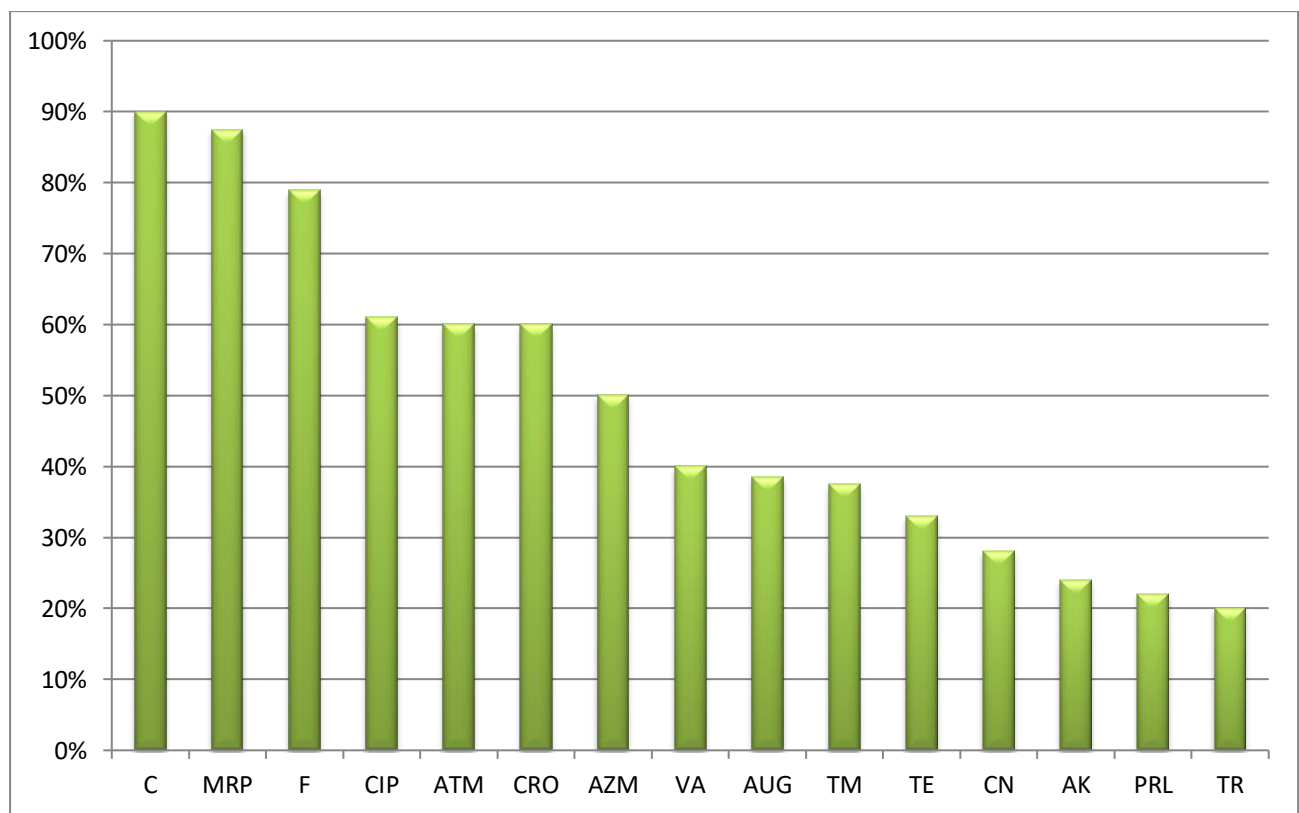


Chart 5. sensitivity percentage of E.coli to various antibiotics

The results shows that E.coli presented high sensitivity to the Chloramphenicol (90%), Meropenem (88%), Nitrofurantoin (79%), Ciprofloxacin (61%), Aztreonam (60%), Ceftriaxone (60%), Azithromycin (50%) compare to Vancomycin, Amoxicillin+Clavulanic acid, Tobramycin, Tetracyclin, Gentamycin, Amikacin, piperacillin, Trimethoprim with ratios (40%, 39%, 38%, 33%, 28%, 24%, 22%, 20%, respectively)

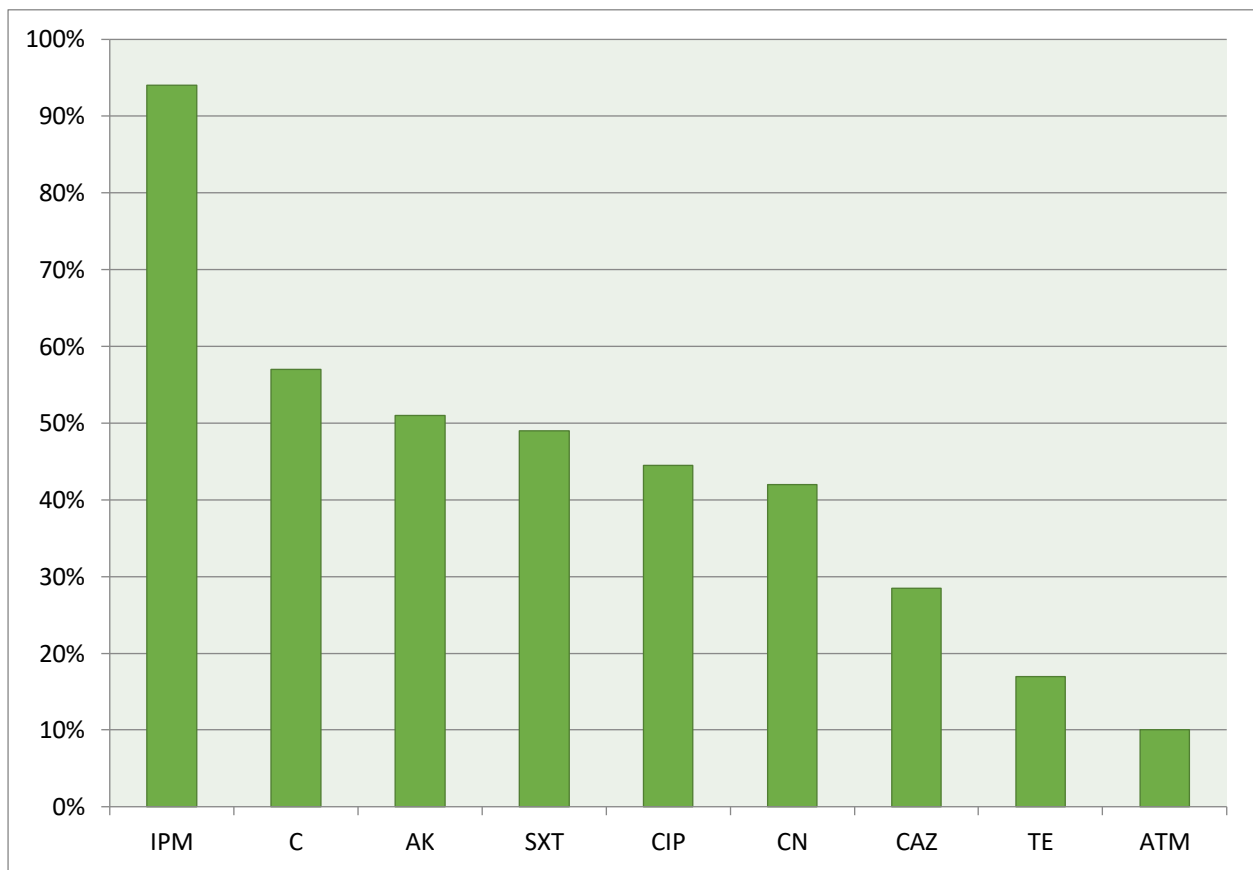


Chart 6. sensitivity percentage of Klebsiella sp to various antibiotics

The susceptibility of Klebsiella sp to various antibiotics, the results found that Klebsiella sp showed high sensitivity to Imipenem (94%), Chloramphenicol (57%), Amikacin (51%) compare to Trimethoprim/sulfamethoxazole,

Ciprofloxacin, Gentamycin, Ceftazidimi, Tetracyclin, Aztreoman with ratios (49%, 45%, 42%, 29%, 17%, 10%, respectively)

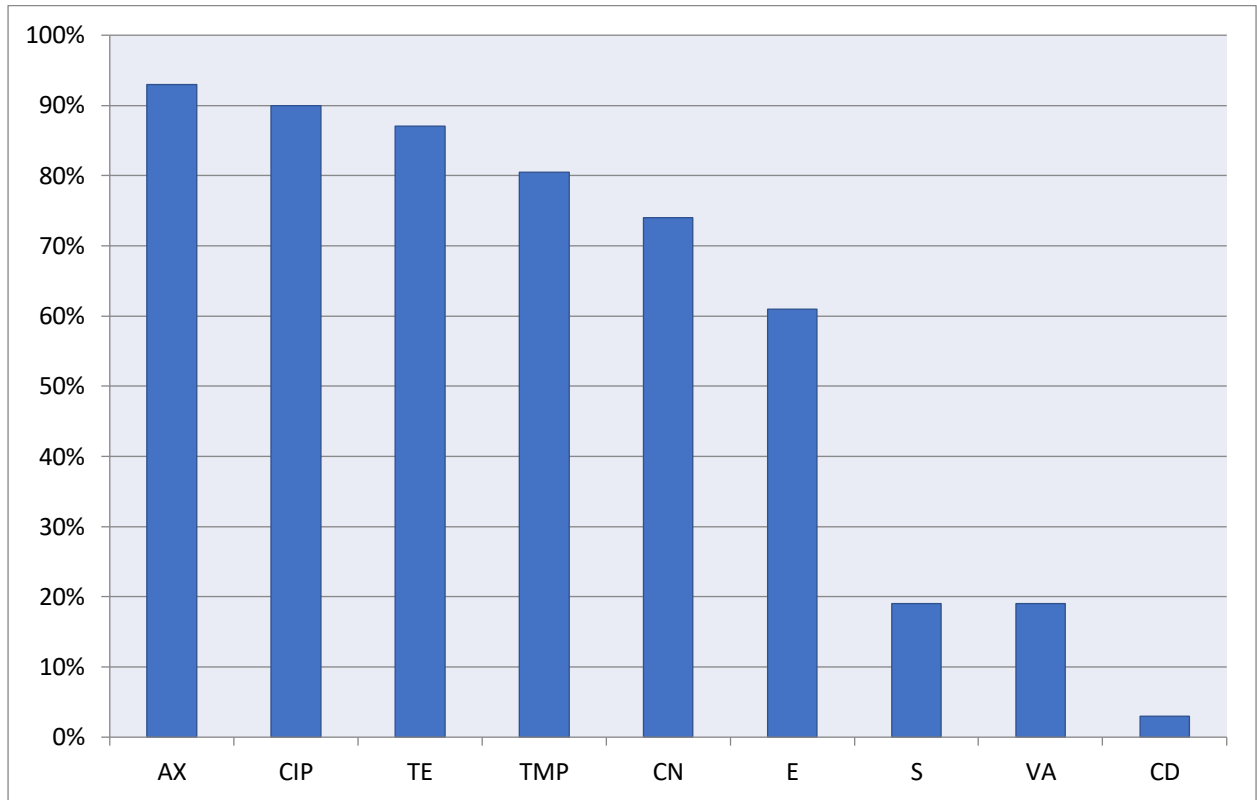


Chart 7. sensitivity percentage of Streptococcus agalactiae to various antibiotics

The susceptibility of Streptococcus agalactiae to various antibiotics, the results found that Streptococcus agalactiae showed high sensitivity to Amoxicillin (93%), Ciprofloxacin (90%), Tetracyclin (87%), Trimethoprim (81%), Gentamycin (74%), Erythromycin (61%) compare to Streptomycin (19%), Vancomycin (19%), Clindamycin (3%).

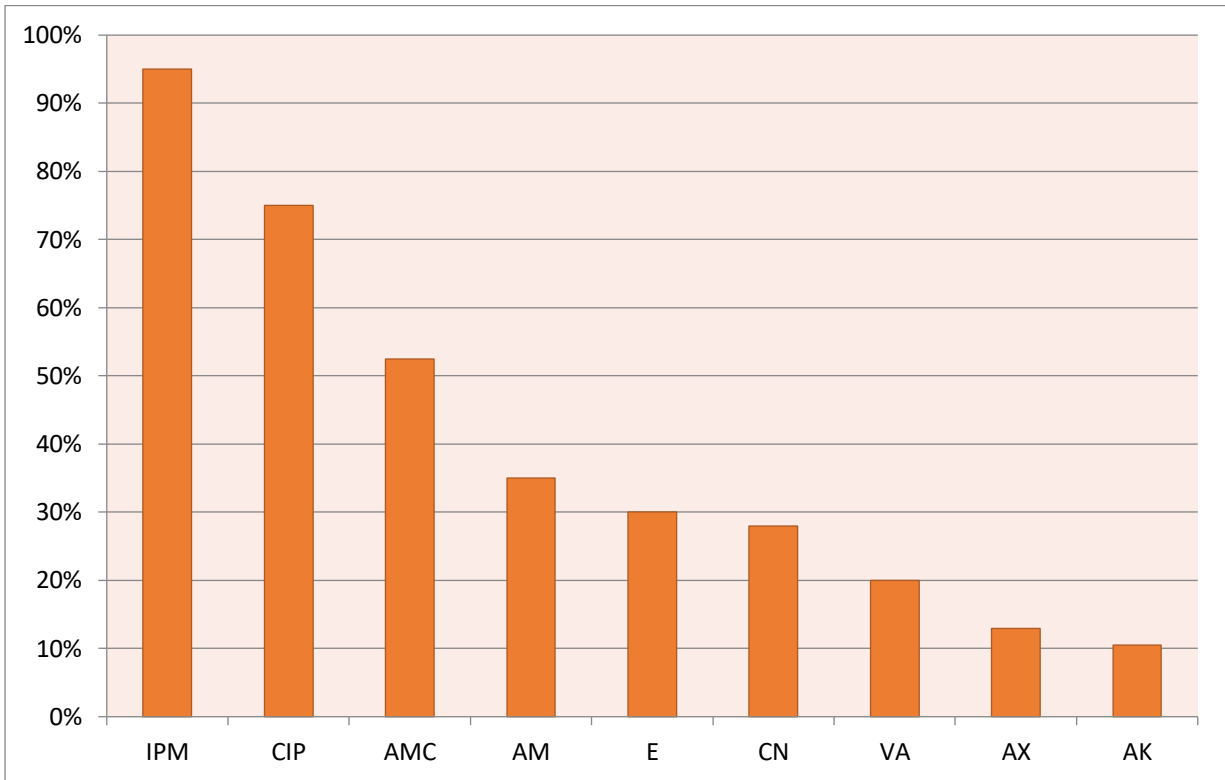


Chart 8. Sensitivity percentage of Pseudomonas aeruginosa to various antibiotics.

The susceptibility of *Pseudomonas aeruginosa* to various antibiotics, the results found that *Pseudomonas aeruginosa* showed high sensitivity to Imipenem (95%), Ciprofloxacin (75%), Augmentin (53%) compare to Ampicillin, Erythromycin, Gentamycin, Vancomycin, Amoxicillin, Amikacin with ratios (35%, 30%, 28%, 20%, 13%, 11%, respectively).

4. Discussion:

Urinary tract infections are infections of the urethra, bladder, ureters, or the kidneys, which comprise the urinary tract. *E. coli* bacteria cause the majority of UTIs, but many other bacteria, fungi, and parasites may also cause UTIs. . In this research we found that gram negative is higher infection agent compare to

gram positive bacteria E.coli is the most prevalence Gve- causes. whereas Staphylococcus aureus is the most prevalence Gve+ cause (Chart 3) this agree with [31].

There are several risk factors could effects on the susceptibility of patient to the infection such as the gender, age , Antibiotic use, Diabetes, Pregnancy. The results showed that females have a higher risk for UTIs 77% than males (chart 1) this agree with [32]. Also the we observed that age between 20-30 is more susceptible to UTI infection than other ages (chart 2), this agree with [33], who found that UTI is affecting both genders but women in the age group 15-44 are more prone to this infection. Bacteria that cause UTI grow around the urethral opening among men and women, but in women the periurethral area provides more places for bacteria to grow. The vaginal cavity provides an additional niche for growth. Bacteria also move easily from the vagina to the urethral opening. This, combined with the shorter distance from the urethral opening to the bladder, increases the chance that a potential uropathogen can ascend to the bladder, multiply in the urine, and invade bladder walls or ascend further to the kidneys causing UTI [28]. There are home remedies for UTI, but most may, at best, help reduce the risk or discomfort of UTIs. They are not considered cures for the disease. The antimicrobial activity of different antibiotics have been studied for most prevalence bacteria (charts 4, 5, 6, 7, 8). The result showed that Nitrofurantoin, Boronic acid have high antibacterial activity against Staphylococcus aureus, this agree with [34]. While the Chloramphenicol have highest activity against E.coli this agree with [35]. While the Imipenem have highest activity against Klebsiella sp this agree with [36]. While the Amoxicillin have highest activity against Streptococcus agalactiae this agree with [37], [38]. While the Imipenem have highest activity against Pseudomonas aeruginosa this agree with [39].

5. Conclusion:

Urinary tract infections (UTIs) are a severe public health Problem and are caused by a range of pathogens High recurrence rates and increasing antimicrobial resistance among uropathogens threaten to greatly increase the economic burden of these infections. The aim of this study is to identify the prevalence of urinary tract infection in the community who attended a Primary Health Care Centers at Hilla City. In research we study the population that was drawn from patients attending IMAM AL-Sadiq hospital and AL-Hashemiah hospital, Hilla Teaching Hospital. The data of 250 patients with UTI was collected. They were made up from both gender. Finally, the data was analyzed for detecting deferent aspects such as gender , infected agent , ages , ratios of sensitive and resistant antibiotics of different bacteria species. The study concluded, regard to gender, where we noticed that the number of females was a large percentage , and low percentage in male. According to ages ,the most infected ages and in large proportion in twenties and the lowest infected ages in older people. Also found the most infected bacteria are Staphylococcus aureus and the lowest infected bacteria are Staphylococcus saprophyticus. The most sensitive antibiotics of staphylococcus aureus is F (Nitrofurantoin).And the lowest sensitive antibiotics of staphylococcus aureus is E (Erythromycin),and the most sensitive antibiotics of E.coli is C (Choramphenicol) ,and the lowest sensitive antibiotics of E.coli TMP (Trimethoprim). Thus healthcare professionals must improve their knowledge of UTI, change their attitude towards it and improve both treatment and primary and secondary prevention of UTI. Since there is a high prevalence of UTI among women combined with an increasing population there is a great need for further knowledge about this area and also a great need for intervention studies. To prevent, detect and treat UTI among women, the connection between the associated factors and UTI

should be explored further. More attention has to be given to women with UTI and it has to be prevented.

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