



## Prevalence and Antimicrobial Resistance Pattern of Bacterial Strains Isolated from Patients with Urinary Tract Infection in Al-Wahda Hospital in Derna City/Libya

*Abraheem Abdullah Abd Alqawi*

*Faculty of Medical Technology-Derna, National Technical Commission and Technical Education, Libya.*

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### ABSTRACT

**Background:** Urinary tract infection (UTI) is One of the most prevalent infectious diseases in human, where the study aimed to identify the most uropathogen that caused UTIs ,and its the antimicrobial resistance pattern.

**Methods:** the samples were collected from January and December 2021 using a standard data collection form, where the patient outcome records were mined for information on the patients' gender, age, isolated organisms, and susceptibility test results, then statistical analysis was done.

**Results:** 266 from 463 samples were identified as *S. aureus* 14.3% , in addition, the antibacterial resistance rats showed that the highest resistance was against ampicillin/Sulbactam, ceftazidime, and meropenem 79%, while, the lowest was against ciprofloxacin 40%.

**Conclusion:** The study showed that *S. aureus* is the primary cause of UTIs in Derna city, as a result of consuming antibiotics randomly, which resulted in an increase in spread and resistance of *S. aureus*.

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## Introduction

Urinary tract infection (UTI) One of the most prevalent infectious diseases in humans both in clinical and community settings (1), where, UTI is more common among hospitalized patients and may affect about half of people during their lifetime (2). Worldwide, an estimated 150 to 250 million people are diagnosed with urinary tract infections (UTI) each year (1, 3). Any infection of the urinary tract that results in asymptomatic bacteriuria, pyelonephritis, or cystitis is referred to as a UTI (4). UTI may involve only the lower urinary tract or may involve both the upper and lower tract, and classified by the site of infection as the bladder (cystitis), kidney (pyelonephritis), or urine (bacteriuria) (5). Whereas the lower UTIs are known as cystitis and are characterized by a syndrome involving dysuria, frequency, urgency, and sporadically suprapubic tenderness. However, the presence of lower tract symptoms without upper tract symptoms does not rule out upper tract infection, which is also frequently present (6). UTI is observed in both genders, even though both males and females are exposed to the infection, women are more at a ratio of 8:1, where accounting for nearly 25% of all infections, moreover, around 50–60% of women will develop UTIs in their lifetimes, and the estimated number of UTIs per year is 0.5 in young females (7), due to their morphology and reproductive physiology, it is linked to several factors, including age, parity, gravidity, pregnancy, and the presence of diseases that exacerbate the infection (8). Where catheter use is a major risk factor for a UTI, as well as, the use of antibiotics, diabetes mellitus, Manipulation of the urethra, and One of the most typical causes is sexual activity which promotes the migration of bacteria into the bladder, and a kidney transplant, in addition, Anatomical abnormalities of the urinary tract and frequent pelvic exams can both increase one's risk of developing a UTI (9). Furthermore, children's susceptibility to UTIs differs by region and geographic location, as well

as by urine and fecal elimination and poor toilet habits. Drug resistance over time is another factor (10), wherefore, UTI refers to the presence of microbial pathogens within the urinary tract (11) and is defined as the growth of a single pathogen of >10 colony-forming units per milliliter from properly collected mid-stream urine specimens (2), where the majority of infections are brought on by bacteria retrogradely ascending from the fecal flora to the bladder and kidney via the urethra, particularly in females who have a shorter, wider urethra and are more susceptible to microbial transmission (12).

One of the best achievements in modern medicine is the discovery of antibiotics, but the overuse of antibiotics is the first ingredient in increasing microbial resistance, followed by incorrectly prescribed antibiotics. Although UTI is a widespread disease, it can be treated in a short time through the reasonable use of antibiotics, but at present, the UTI is usually treated with antibiotics before receiving the results of the microbiology examination, where the antibiotic is without rational prescription which results in antibiotic resistance and treatment failure (9).

Recurrent urinary tract infection (RUTI) term is three UTIs with three positive urine culture results within a year, or two infections during the previous 6 months, where complicated RUTIs can lead to upper tract infections or urosepsis (13). Three main factors, including pathogen virulence, the host's defense mechanism, and the environment, are thought to be involved in the pathogenesis of RUTI (14).

As is well known, the urinary tract is sterile, but bacteria may rise from the perianal region, possibly leading to UTI, but pathogens in the bladder may stay silent or they may produce irritable symptoms like frequent and urgent urination, and 8% of females may have asymptomatic bacteriuria, which may lead to serious complications like septicemia, shock, and, very rarely, death if the bacteria get into the bloodstream (15). Some bacterial species are able to endure both aerobic

and anaerobic environments. Key virulence factors are associated with the pathophysiology of UTIs exhibit traits such as invasion, colonization, and mediating host defense subversion (16). where, the most prevalent causative organism of UTI is *Escherichia coli*, accounting for about 80% of bacterial isolates, in addition to Gram-positive bacteria which cannot be ruled out in relation to UTI, It is common knowledge that *Staphylococcus* spp., from Gram-positive bacteria, are the second most common bacteria after *Escherichia coli* which cause UTI among inpatient and outpatients (17). *S. aureus* is the staphylococcal species is most dangerous to humans (18). where *S. aureus* is one of such agents involved in the 45 UTI infection, although *S. aureus* causes between 0.5 and 6% of UTIs, but if the infection is left untreated, it can result in a serious condition that could be fatal (1). It has many surface proteins known as microbial surface components, which are able to recognize adhesive matrix molecules and mediate binding to host tissues to start colonization and infection, and virulence genes such as enzymes, toxins, adhesin proteins, and cell surface proteins which play a significant role in the pathogenicity of *S. aureus* strains. *S. aureus* easily creates biofilms on a variety of biotic and abiotic surfaces, in response to a number of factors, including quorum sensing, c-di-GMP, protease, DNase, and hemolysins (19). Despite the distribution and prevalence of virulence genes are different among *S. aureus* strains in different regions, However, toxin genes are associated with the highest frequency of virulence genes (20). *S. aureus* an opportunistic pathogen affecting both immune-competent and immunocompromised individuals, frequently resulting in significant morbidity. Many strains of *S. aureus* carry a wide variety of multidrug-resistant genes on plasmids, which aid the spread of resistance among species (21), moreover, it is known to form biofilms on various surfaces, where, this pathogen can invade renal tissue causing UTI by adherence to uroepithelium and the formation of biofilm, since

the ability of biofilm production in *S. aureus* can increase resistance to commonly used antibiotics, hospitalized patients infected with this organism are at significant risk for treatment failure (1).

## Materials and Methods

### *Study Design and Sampling*

The study is designed as a cross-sectional study. Four hundred and sixty-three urine specimens were collected from patients, who attended daily to Alwahda Hospital. The study extended for one year during the period from January to December 2021. The gender and age of patients, the organisms isolated and the profile of microbial susceptibility were collected from the patient outcome records using a standard data collection form.

### *Culture and identification*

Clean-catch midstream morning urine specimens were collected using the sterile plastic disposable container. Urine samples were plated on CLED agar, MacConkey agar, and blood agar (Oxoid, Basingstoke, UK) using calibrated wire loops and then incubated aerobically at 37 °C for 24 h. From positive cultures, the pathogens were identified according to the standard operating procedures as per the standard microbiological methods. A significant bacterium was considered if urine culture yielded  $\geq 10^5$  CFU/mL.

### *Antimicrobial susceptibility test*

Antimicrobial susceptibility test was done on Mueller-Hinton agar (Oxoid, Hampshire, England) using Kirby-Bauer disk diffusion method. The tested antimicrobial agents were: sulfamethoxazole (25 µg), nitrofurantoin (300 µg), cefotaxim (5 µg), amoxicillin/clavulanic acid (30 µg), vancomycin (30 µg), ciprofloxacin (5 µg), meropenem (10 µg), ampicillin/sulbactam (20 µg),

cefuroxime (30 µg), and Ceftazidime (30 µg) (Oxoid, England). Clinical Laboratory Standards Institute (CLSI) guidelines were used to interpret the resistance data.

### Statistical analysis

IBM SPSS Statistics 20 program was used to perform the analysis. Frequently test was applied to find out the most common type of bacteria in the study sample among the UTI isolates. In addition, the Crosstab test was performed to determine the resistance of the most common bacteria among urine samples to antibiotics.

### Result

A total of 463 urine specimens were tested, 266 (57.4%) were positive bacteria, the dominant bacterial pathogen was gram-positive that being with *Staphylococcus aureus* as the most prevalent (14.3%) followed by *Escherichia coli* (12.0%), *Staphylococcus saprophyticus* (5.6%), *Pseudomonas aeruginosa* (3.9%), *Klebsiella* (3.0%), and *Proteus* (1.0%). As shown in Figure 1.

The overall susceptibility profile of bacterial isolates is shown in table (1). The result showed the highest rate of resistance is against ampicillin/sulbactam, ceftazidime, and meropenem (79%), followed by nitrofurantoin, amoxicillin/clavulanic acid, and cefuroxime had overall resistance rates of 53.7%, 59.7%, and 65.6% respectively as shown in Figure 2. Majority of *S. aureus* isolates were susceptible to ciprofloxacin with a susceptibility rate of 34%.

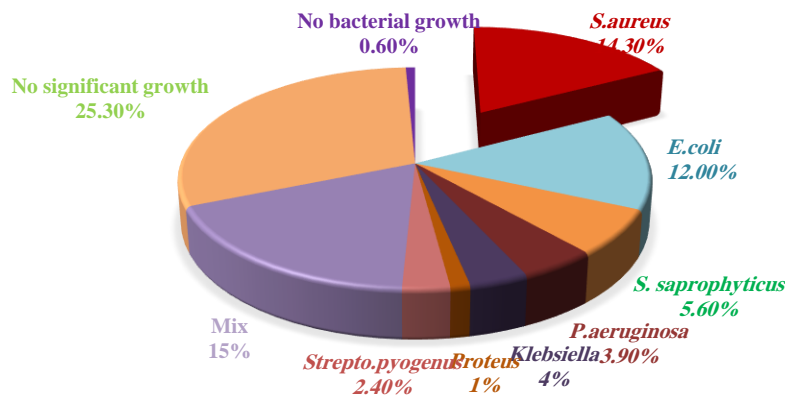
### Discussion

The most common infectious diseases that affect people are urinary tract infections (UTIs), which are a significant public health issue with a high

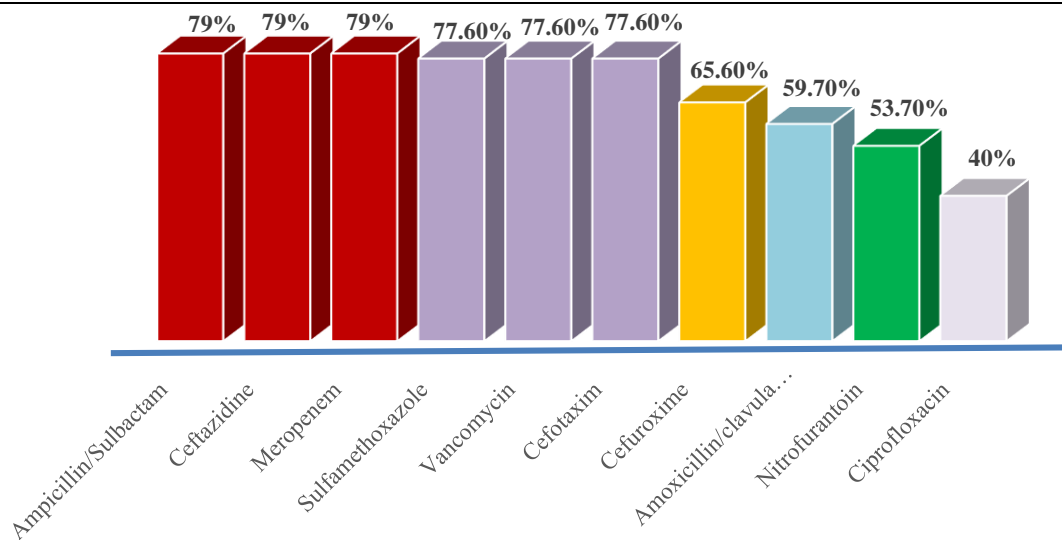
economic cost (22). A variety of human infections, including urinary tract infections, are caused by microbes attaching to surfaces and creating extracellular polymer matrix of biofilms (23). A recognized threat to public health worldwide is antimicrobial resistance. Some commonly occurring bacterial infections, like those of the urinary tract, become difficult to treat due to bacterial infections' resistance to antibiotics, which can reduce the number of effective treatment options (24). UTIs are mostly caused by both Gram-positive and Gram-negative bacteria and by some fungi (25). In recent years, an increasing incidence of UTIs caused by resistant bacterial strains has been observed (26). In the current study, the prevalence of urinary tract infection represents 266 (57.4%) out of a total of (463) urine samples, these the results showed that UTIs occupy more than half of the tested urine samples. *S. aureus* was recorded as one of the prevalent isolates in this study with (14.3%). The results of the present study concurred with those of earlier studies published by Al-Muaala et al in 2022 which explained that One of the common isolates was identified as *S. aureus* (27). And also study to compare conducted that the prevalence of UTI in Saudi Arabia by Selim et al in 2022 (28), the study was conducted from (October 2020 to February 2022), this study showed that from 292 urine samples, 103 bacterial strains (35.3%) were identified as *S. aureus*, while the results of the current study differed with other studies in Tripoli and Messalatal/ Libya that showed a different observation where *E. coli* was the most commonly isolated from urine samples (29, 9), where the prevalence of *S. aureus* is well documented, with various degrees of detection rates within different regions in the same country and across countries, where there are different epidemiological factors such as different geographical (30).

**Table 1.** Antimicrobial susceptibility results of 67 *S. aureus* isolates.

Antimicrobial agent	Susceptible (%)	Resistant (%)
Ampicillin/Sulbactam	21	79
Ceftazidime	21	79
Meropenem	21	79
Sulfamethoxazole	22.4	77.6
Vancomycin	22.4	77.6
Cefotaxim	22.4	77.6
Cefuroxime	34.4	65.6
Amoxicillin/clavulanic acid	40.3	59.7
Nitrofurantoin	46.3	53.7
Ciprofloxacin	60	40



**Figure 1.** The prevalence of bacterial strains isolated from urine specimens.



**Figure 2.** The resistance rate of *S. aureus* isolates against the antibiotics.

The high occurrence of *S. aureus* in the present study may be attributable to the organism's virulence, due to its low growth requirements, and ability to survive long in most unfavorable environments and to find a susceptible host. The isolates from UTIs included in the current investigation showed a significant level of antibiotic resistance, where most bacteria exhibited resistance to at least three antibiotics, the highest resistance rate is against ampicillin/Sulbactam, ceftazidime, and meropenem (79%), while the lowest resistance rate against ciprofloxacin with resistance rate of (40%). in 2022 Alhamadani & Oudah stated that *S. aureus* was completely susceptible to meropenem and ceftazidime, this is a different to the findings of this investigation, but there is a fairly close result in Ciprofloxacin (31). These variations in *S. aureus*'s sensitivity pattern could be related to environmental variables like widespread antibiotic overuse and abuse, which has favored the formation of resistant strains, just as it might be the case with other organisms in a given area or community. The guidelines highlight the necessity of using different antibiotic empiric therapies depending on the local prevalence of resistance pattern (32).

## Conclusion

The colonization of antibiotic-resistant bacteria in the urinary tract due to the overuse of antibiotics that are often not prescribed by a prescription, the wrong use of them and not taking them at the specified times, or not completing the prescribed dose, all of these led to the spread of UTI infection all the way to its complications. In this study, *S. aureus* causes the majority of UTIs in Derna city/ Libya. Since *S. aureus* is very resistant to ampicillin/sulbactam, ceftazidime, meropenem nitrofurantoin, amoxicillin/clavulanic acid, and cefuroxime, while ciprofloxacin is the antibiotic of choice that could be used to treat UTIs.

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## Ethics approval and consent to participate

Not applicable.

## Conflict of interest

None declared.

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