Study of bacterial and fungal infection of UTi patients in Sabratha and Jemil region

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دراسة انتشار العدوى البكتيرية والفطرية لدى مرضى التهاب المسالك البولية في منطقتي صبراتة والجميل

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Abstract:
Background: Urinary Tract Infections (UTIs) represent a predominant category of bacterial infections. It is estimated that urinary tract infection symptoms result in approximately seven million medical consultations annually, comprising one million outpatient clinic visits, one hundred thousand emergency department engagements, and numerous hospital admissions.
Objectives: the aim of this study is to evaluate the frequency of bacterial pathogens in Urinary Tract Infections (UTIs) across distinct age demographics and gender classifications among individuals in the study area, in addition to examining the effectiveness of the antibiotics prescribed.

Methods: The current investigation was carried out involving (662) participants from September 2022 to March 2023. The specimens were obtained from patients diagnosed with urinary tract infections (UTIs) (n= 662), comprising (450) females and (212) males, who were documented in this study. The cohort was categorized into (7) distinct age classifications. An aggregate of 827 cultures of urine samples was analyzed concerning 25 antibiotics targeting 7 different bacterial genera.

Results: Escherichia coli demonstrated the highest infection prevalence (22.43%) within the (11-20) age demographic, whereas the lowest recorded infection rate (8.37%) was observed in the (0-10) age category. The most significant infection rates among male and female subjects were (22.02%) and (22.73%) respectively, both within the (11-20) age range. Staphylococcus species exhibited the highest infection prevalence (22.03%) in the (11-20) age cohort, while the minimal infection rate (9.32%) was documented in the population over 60 years of age. Among males and females, the infection rates were recorded at (21.43%) and (27.08%) in the (0-10) and (11-20) age groups, respectively. Actinomyces species exhibited the highest infection prevalence (23.73%) in the (11-20) age category, contrasting with the lowest recorded infection rate (3.39%) in individuals over 61 years old. The highest rates among males and females were noted at (21.95%) and (32.47%) within the (11-20), (41-50), and (51-60) age cohorts, respectively. Streptococcus species reported the highest infection prevalence (29.76%) in the (21-30) age group, while the lowest infection rate (1.19%) was recorded in those aged over 61. The highest infection rates for males and females were noted at (35.71%) and (28.57%) in the (21-30) age group. Klebsiella species exhibited the highest infection rate (34.04%) in the (31-40) age group, while no infections were recorded (0.0%) in the age categories (0-10), (11-20), and those over 61 years. The infection rates for males and females were documented at (55.55%) and (31.76%) respectively in the (31-40) age group. Candida species presented the highest infection prevalence (51%) in the (21-30) age category, contrasting with the absence of recorded infections (0%) in both the (0-10) and (>61) age groups, with no infections observed among male subjects. IMIPENEM exhibited the most pronounced effective antagonism against all evaluated bacterial cultures, documenting a total of 71 response cultures. The bacterium that demonstrated the highest susceptibility to IMIPENEM was E. coli 40 (56.3%), succeeded by GENTAMYCIN, which recorded 38 cultures, whereas ERYTHROMYCIN displayed the least effective antagonism among all assessed bacterial cultures.

Keywords: Bactria, Candida, antibiotics, UTIs.

الملخص:
أظهرت بكتريا *E.coli* أعلى معدل انتشار للعدوى (22.43٪) ضمن الفئة العمرية (11-20)، في حين سجل أدنى معدل إصابة (8.37٪) في الفئة العمرية (0-10). كانت أعلى معدلات الإصابة بين الذكور والإناث (22.02٪) و (22.73٪) على التوالي، وكلاهما ضمن الفئة العمرية (11-20). أظهرت أنواع *Staphylococcus* أعلى معدل انتشار للعدوى (22.03٪) في الفئة العمرية (11-20)، في حين سجل أدنى معدل إصابة (9.32٪) في السكان الذين تزيد أعمارهم عن 60 عامًا. بين الذكور والإناث، تم تسجيل معدلات الإصابة بنسبة (21.43٪) و (27.08٪) في الفئتين العمريتين (0-10) و (11-20) على التوالي. أظهرت أنواع *Actinomyces* أعلى معدل انتشار للعدوى (23.73٪) في الفئة العمرية (11-20)، فيما سجل أدنى معدل إصابة (3.39٪) لدى الأفراد الذين تزيد أعمارهم عن 61 عامًا. ولوحظت أعلى المعدلات بين الذكور والإناث بنسبة (21.95٪) و (32.47٪) ضمن الفئات العمرية (11-20) و (41-50) و (51-60) على التوالي. سجلت أنواع *Streptococcus* أعلى معدل انتشار للعدوى (29.76٪) في الفئة العمرية (21-30)، بينما تم تسجيل أدنى معدل إصابة (1.19٪) لدى الذين تزيد أعمارهم عن 61 عامًا. ولوحظت أعلى معدلات الإصابة للذكور والإناث بنسبة (35.71٪) و (28.57٪) في الفئة العمرية (21-30). أظهرت أنواع *Klebsiella* أعلى معدل إصابة (34.04٪) في الفئة العمرية (31-40) ، بينما لم يتم تسجيل أي إصابات في الفئات العمرية (0-10) و (11-20) ومن تزيد أعمارهم عن 61 عامًا. سجلت معدلات الإصابة للذكور والإناث عند (55.55٪) و (31.76٪) على التوالي في الفئة العمرية (31-40). أظهرت أنواع المبيضات *Candida* أعلى معدل انتشار للعدوى (51٪) في الفئة العمرية (21-30) ، على عكس لم تسجل إصابات في كل من الفئتين العمريتين (0-10) و (> 61) ، مع عدم تسجيل إصابات بين الذكور. أظهر *IMIPENEM* أعلى فعالية ضد جميع مزارع البكتيريا المُقيّمة، مسجلا حساسية في 71 مزرعة بكتيرية . وكانت البكتيريا التي أظهرت أعلى حساسية لـ *IMIPENEM* هي*E.coli 40 (56.3%)* ، يليها *GENTAMYCIN* الذي سجّل 38 مزرعة، بينما أظهر *ERYTHROMYCIN*أقل فعالية في التضاد بين جميع مزارع البكتيرية المُقيّمة.

الكلمات المفتاحية: بكتريا، كانديدا، مضادات حيوية، عدوى بولية .

Introduction

Escherichia coli is the primary pathogen associated with urinary tract infections (UTIs), representing 93.55%, 60.24%, and 45.83% of all pathogens identified in urine cultures among pediatric, adult, and geriatric cohorts, respectively **(Alanazi *et al.*, 2018)**. Furthermore, UTIs have been recognized as the most common nosocomial infection, accounting for up to 35% of infections acquired in hospital settings, and they rank as the second leading cause of bacteremia in hospitalized patients **(Stamm, 2002; Weinstein *et al.*, 1990)**. The prevalence of urinary tract infections is 14 times higher in females, which can be attributed to the shorter length of the female urethra and its anatomical proximity to the anal region; hence, roughly 40% of women will encounter at least one UTI during their lifetime, with a considerable number experiencing recurrent episodes. Additionally, the prostate gland contains a bactericidal substance and zinc, which are essential for the elimination of microorganisms, including Escherichia coli. Therefore, such infections can also manifest in the male population **(Faraji *et al.*, 2012).**

The predominant etiological agent of urinary tract infections (UTIs) is the bacterium Escherichia coli, succeeded in prevalence by Proteus spp., *Staphylococcus saprophyticus*, *Klebsiella spp*., and various other members of the *Enterobacteriaceae* family **(Kahlmeter, 2000)**. Numerous strains of both Gram-positive and Gram-negative bacteria have been recognized as potential causative agents of UTIs. Among these, Staphylococcus aureus stands out as the most significant staphylococcal pathogen affecting humans and poses considerable challenges in clinical treatment **(Coates *et al.*, 2014).**

Holland *et al.* (2014) defined *Staphylococcus aureus* bacteremia (SAB) as the detection of *S. aureus* in at least one blood culture specimen. It was noted that the temporal gap between the initial blood culture positive for SAB and the first isolation of SAB within the medical institution was approximately two weeks. The administration of Cefazolin or Flucloxacillin for treating methicillin-sensitive S. aureus, in conjunction with vancomycin, linezolid, or Daptomycin for managing methicillin-resistant *S. aureus* (MRSA), was recognized as effective therapeutic strategies. The incidence of *S. aureus* bacteriuria (SABU) is relatively rare (0.8–4.3%) and may be associated with asymptomatic colonization, primary catheter-associated urinary tract infections, as well as hematogenous spread in patients diagnosed with SAB **(Al Mohajer *et al.*, 2013).**

Schuler *et al.* (2020) documented that a total of 245 patients at the University Hospital Münster, Germany, were subjected to the exclusion criteria from January 1, 2012, to December 31, 2019. Among the 245 patients diagnosed with *S. aureus* bacteriuria, 66 exhibited concurrent SAB (26.9%). Furthermore, they observed a significant prevalence of systemic bacterial infections in patients with SABU, emphasizing the necessity for ongoing surveillance of bloodstream infections, especially in instances where there is an elevation in CRP levels.

Muder *et al.*, (2006) conducted a study involving 102 patients with urinary tract infections (UTIs) and discovered that 82% had recently experienced urinary catheterization, while 33% exhibited symptomatic UTIs at the time of initial *S. aureus* isolation, and 13% were found to be bacteremic. Additionally, *S. aureus* has been identified as a contributing factor to UTIs in individuals with urinary tract catheterization.

Sokhn *et al.* (2020) conducted a comprehensive investigation into the prevalence of urinary tract infections (UTIs) within Lebanon, revealing that the highest prevalence occurred among adults aged 19 to 64 years (44%). The predominant uropathogenic bacterium identified was Escherichia coli (67.1%), succeeded by *Klebsiella pneumoniae* (10%) and Proteus mirabilis (3.7%). The three prevalent uropathogens analyzed exhibited considerable susceptibility to Imipenem (100%) and Meropenem (100%). Notably, 115 (25.1%) of the 458 E. coli isolates displayed resistance to more than eight antibiotics, whereas 107 (23.4%) were sensitive to all antibiotics assessed. A diverse array of antimicrobial agents is utilized in the management of infections induced by *E. coli*,

K. pneumoniae, and *P. mirabilis* **(Wang *et al.*, 2014).** However, these pathogens produce beta-lactamase enzymes, which confer resistance to most antibiotic classes, thus categorizing them as ESBL-producing organisms **(Montso *et al.*, 2019).** Urinary tract infections are predominantly instigated by gram-negative bacteria, although gram-positive pathogens may also play a role. Over 95% of uncomplicated UTIs are monomicrobial. The principal pathogen implicated in uncomplicated UTIs is E. coli (75%–95%), followed by *Klebsiella pneumoniae, Staphylococcus saprophyticus, Enterococcus faecalis*, group *B streptococci, and Proteus mirabilis* **(Sobel, 2014).** *Streptococcus agalactiae,* commonly referred to as group B *Streptococcus* (GBS), serves as the predominant etiological agent of sepsis and meningitis in neonates. Infections caused by GBS result in significant mortality rates among both neonates and adults. The average case fatality rate for invasive GBS infections in the United States from 2008 to 2016 was recorded at 6.5%, with the highest rates observed in elderly individuals with pre-existing medical conditions. In the year 2016, the incidence rate among non-pregnant women escalated to approximately 11 cases per 100,000 individuals **(Francois et al., 2019)**. Furthermore, GBS infection is associated with adverse pregnancy outcomes, even in cases where the women do not exhibit symptoms **(Sendi *et al.*, 2008).** In the United States, the implementation of antibiotic prophylaxis has effectively reduced the incidence of GBS-related neonatal sepsis from 1.8 per 1000 live births during the 1990s to 0.23 in 2015 **(Schrag and Verani, 2013).** Nevertheless, the prevalence of GBS-associated diseases in developing nations remains poorly characterized. A meta-analysis conducted in 2017 across 53 countries revealed early- and late-onset GBS disease incidences of 0.41 and 0.26 per 1000 live births, respectively **(Madrid *et al.*, 2017).**

Actinomycosis is attributed to a diverse array of *Actinomyces* bacteria and manifests as a chronic, supportive, granulomatous infection. In the current study, 26 distinct species of *Actinomyces* have been recognized as part of an individual microbiota or derived from clinical specimens in human subjects. Within this century, 13 out of these 26 species have been documented due to the rapid advancement of contemporary diagnostic techniques **(Márió and Urbán, 2020).** Actinomycosis represents an uncommon infectious bacterial condition instigated by *Actinomyces* species. Approximately 70% of these infections are linked to either *Actinomyces israelii* or *A. gerencseriae* **(Valour *et al.*, 2014).** These microorganisms are predominantly anaerobic in nature **(Ryan and Ray, 2004)**. *A. israelii* is recognized as a typical commensal species residing within the microbiota of the lower reproductive tract in females. Furthermore, they exist as normal commensals within the gut flora of the caecum; consequently, abdominal actinomycosis may arise subsequent to appendectomy **(Hoffman and Barbara, 2012).** *Actinomyces spp*. are primarily located within the human oral cavity. In addition to oral regions, these microorganisms can inhabit various anatomical areas, colonizing the upper respiratory tract, gastrointestinal tract, and the female genitourinary tract, and seldom, the skin **(Hall, 2008).** When the mucosal barrier is compromised, mucosal-resident *Actinomyces* species can penetrate deeper tissues through trauma, surgical interventions, or the presence of foreign bodies, leading to the formation of masses comprising aggregates of branching, filamentous bacilli within these tissues **(Chiller *et al.*, 2001).**

Candida species are classified as opportunistic pathogens. Nevertheless, these microorganisms are typically present within the human body. Infections attributable to *Candida spp*. have risen markedly over the past decade, positioning them among the foremost causes of nosocomial infections, which contribute to significant public health challenges **(Gajdacs, 2019).** The detection of Candida in urine samples may serve as an indicator of a condition necessitating immediate medical attention, such as the management of a urological disorder **(Fisher *et al.*, 2011).** The co-occurrence of Candida spp. alongside other urinary tract pathogens or the simultaneous presence of two distinct fungi, specifically *C. albicans* and another Candida species in urine specimens, has been noted. However, the incidence of co-isolation of yeast–yeast or yeast–bacteria was relatively low: 4.28% among community patients and 8.33% among hospitalized individuals **(Gajdacs *et al.*, 2019).** Although *C. albicans* is the most frequently documented species in urine cultures, other species such as *Candida glabrata*, *Candida parapsilosis*, *Candida tropicalis*, *Candida kefir*, *Candida lusitanae*, *Candida guilhermondii*, and *Candida dubliniensis* can also be isolated from patients with urinary tract infections **(Fazeli *et al.*, 2019).** Additionally, *Candida auris* was recently identified in the urine of a hospitalized patient suffering from Candidemia **(Biagi *et al.*, 2019).** In 2009, a case of *C. auris* was reported in Japan, traced back to discharge from the external ear canal. At that juncture, *C. auris* isolates had disseminated to 20% of the global population as a causative agent of nosocomial infections. Reports have indicated high mortality rates and resistance to antimicrobials, particularly fluconazole. Furthermore, *C. auris* should be regarded as one of the most critical pathogenic fungi due to challenges in microbiological identification at the species level, its significant virulence, and its rapid global dissemination **(Iguchi *et al.*, 2019).**

Data collection and Methods

Study area: Data of the present study were harvested from Sabratha and Aljimil hospitals during the period of September 2022 – March 2023

Data collection: Samples were collected from UTIs patients (*n*= 629): (450) females and (212) males, who were registered in this research data were collected from the medical archives. Patients were divided into (7) age groups**.**

Evaluation of antibiosis: A total of 827 cultures of Uren samples examining 25 antibiotics against 7 bacterial genera (*Staph hemolytic, Staphylococcus aura, Pseudomonas sp, Nitrobacteria sp, Klebsiella sp, Eitrobacter sp,* and *E. coli*) were collected from different labs in the area of the study. Data were recorded and analyzed. Evaluation of antibiotics depended on the number of susceptible samples for every bacterial cultures.

Results and discussion

Escherichia coli is responsible for urinary tract infections (UTIs) globally; thus, enhancing infection control strategies necessitates a comprehensive understanding of the epidemiological distribution and prevalence of UTIs. Consequently, Tables (1-6) delineate the data acquired from the study, categorized by the variables of sex, age, and bacterial infection type.

1. prevalence of the Uropathogen *E. coli*

The data elucidated in table (1) indicates that the age cohort (11-20) exhibited the highest rate of infection (22.43%) among the total positive samples, whereas the lowest infection percentage was observed (8.37%) in the age bracket (0-10). Among females, the most elevated infection rate was noted (22.73%) within the (11-20) age category, contrasting with the minimal infection rate recorded (7.14%) for the (0-10) age group. Conversely, for males, the peak infection rate was documented (22.02%) in the (11-20) age category, while the least infection rate was found (9.17%) in the age group (31-40). **Rahman *et al*. (2019)** asserted that within the age range of 1-20, the prevalence of urinary tract infections (UTIs) was lower for both males and females. Our findings align with their observations when aggregating the patient data into a single cohort. Moreover, our results corroborate those of **Flores-Mireles *et al.* (2015)**, who established that UTIs are primarily instigated by uropathogenic *E. coli* (UPEC), which accounts for over 80% of community-acquired infections, while infections associated with healthcare settings are linked to *Staphylococcus, Klebsiella, Enterobacter, Streptococcus, and Staphylococcus* **(Foxman, 2014).**

Table (1): Prevalence rate of (UTIs) due to *E. coli*.

Age group	Total infection		Gender			
			Females		Males	
	No.	%	No.	%	No.	%
0-10	22	.37%8	11	%7.14	11	%10.10
11- 20	59	%22.43	35	%22.73	24	%22.02
21 – 30	38	%14.54	19	%12.34	19	%17.43
31 - 40	34	%12.93	24	%15.58	10	%9.17
41 - 50	36	%13.69	17	%11.04	19	%17.43
51 – 60	42	%15.97	30	%19.48	12	%11,01
>61	32	%12.07	18	%11.69	14	%12.84
Total	263	%100	154	%100	109	%100

2*.prevalence of the uropathogen *Staphylococcus

The data delineated in Table (2) elucidates that the age demographic of (11-20) years exhibited the highest infection prevalence (22.03%) among the total positive samples, whereas the lowest infection rate was observed (9.32%) in the age category exceeding 60 years. Within the female cohort, the highest infection rate was documented (21.43%) in the (0-10) age group, conversely, the lowest infection rate was noted (7.14%) within the (41-50) age range. In contrast, the male population demonstrated the highest infection rate of (27.08%) within the (11-20) age demographic, while the lowest infection rate was recorded (4.17%) in the (51-60) age brackets. These findings corroborate those of **Bonadio *et al*., (2006)**, who established that the predominant pathogens responsible for urinary tract infections (UTIs) are E. coli, with Proteus, Klebsiella, Streptococcus, and Staphylococcus species also identified as significant pathogenic agents. Furthermore**, Muder *et al.*, (2006)**, reported that among 71 patients, 41 (58%) exhibited at least one positive culture for S. aureus, with an average colonization duration of 4.3 months. Patients exhibiting persistent urinary colonization of *S. aureus* were predisposed to subsequent infections compared to those whose urine was devoid of *S. aureus* (34.6% vs. 10.5%). Out of twenty-seven patients who underwent at least one follow-up urine culture after receiving anti-staphylococcal antibiotic treatment, 20 (84%) presented negative cultures for *S. aureus*. **Nicolle, 2008**, noted that *E. coli* represents the most prevalent etiological agent of UTIs, accounting for over 80% of infections, succeeded by *Proteus, Klebsiella, Pseudomonas, Enterococcus*, and *Staphylococcus* species. Typically, normal urine is devoid of microorganisms; however, bacterial entry from external or internal sources can infiltrate the urinary tract, resulting in inflammation and infection.

Table (2): Prevalence rate of (UTIs) due to *staphylococcus aureus*.

Age group	Total infection		Gender			
			Female		Male	
	No.	%	No.	%	No.	%
0-10	20	16.95	15	21.43	5	10.42
11- 20	26	22.03	13	18.57	13	27.08
21 – 30	21	17.80	10	14.29	11	22.92
31 - 40	13	11.02	7	10.00	6	12.5
41 - 50	12	10.17	5	7.14	7	14.58
51 – 60	15	12.71	13	20.00	2	4.17
>61	11	9.32	7	8.57	4	8.33
Total	118	%100	70	%100	48	%100

3.prevalence of the uropathogen: *Actinomyces sp*

The data elucidated in Table (3) indicates that the age cohort (11-20) exhibited the highest prevalence of infection, accounting for 23.73% of the total positive samples, whereas the age group exceeding 61 years demonstrated the lowest infection percentage at 3.39%. Notably, the peak infection rate among females was observed at 32.47% within the (11-20) age group, in contrast to the minimal infection rate of 2.60% in the (>61) age group. Conversely, males exhibited the highest infection rates of 21.95% in the (41-50) and (51-60) age categories, while the lowest infection rate recorded was 4.88% in the (>61) age group.

From the preceding findings, it is evident that the highest incidence of infection in females, which stands at 32.47% within the (11-20) age category, aligns with the conclusions of Pérez-López (2010), who posited that pelvic actinomycosis is the most prevalent form of genitourinary tract actinomycosis in young, fertile women utilizing intrauterine contraceptive devices (IUDs). Furthermore, various other clinical manifestations have been documented, including primary bladder actinomycosis and testicular actinomycosis in males.

Table (3): Prevalence rate of (UTIs) due to *Actinomyces sp.*

Age group	Total infection		Gender			
			Females		Males	
	No.	%	No.	%	No.	%
0-10	25	%21.19	19	%24.67	6	%14.63
11- 20	28	%23.73	25	%32.47	3	%7.32
21 – 30	15	%12.71	7	%9.09	8	%19.51
31 - 40	15	%12.71	11	%14.29	4	%9.76
41 - 50	17	%14.41	8	%10.39	9	%21.95
51 – 60	14	%11.86	5	%6.49	9	%21.95
>61	4	%3.39	2	%2.60	2	%4.88
Total	118	%100	77	%100	41	%100

4. prevalence of the uropathogen *Streptococcus sp*

The data illustrated in Table (4) indicates that the age bracket of (21-30) exhibited the highest rate of infection, accounting for (29.76%) of the total positive samples, whereas the lowest percentage of infection was noted in the age category (>61) at (1.19%). In females, the peak infection rate was recorded at (28.57%) in the (21-30) age group, whereas the least infection rate was observed at (0.0 %) in the (>61) age bracket. Conversely, in males, the highest infection rate was noted at (35.71%) within the (21-30) age group, while the minimal infection rate was documented at (0.0 %) in the (51-60) age category. Rahman *et al*. (2019) reported that among individuals aged 1-20, the prevalence of urinary tract infections (UTIs) was lower in males at 02% compared to females, which stood at 17%, yielding a combined prevalence of 19%, representing an 11% reduction in comparison to the 21-40 age groups where the prevalence was 30%. Our findings are consistent with their observations when patients are aggregated into a single cohort. Furthermore, our results align with those presented by Flores-Mireles et al. (2015), who posited that the pathogenesis of UTIs generally initiates with the contamination of the per urethral area by uropathogens originating from the gastrointestinal tract, subsequently leading to the colonization of the urethra and an ascending infection to the bladder. Additionally, the majority of UTIs are primarily attributed to uropathogenic *Escherichia coli* (UPEC), which accounts for over 80% of community-acquired infections, while infections associated with healthcare settings are linked to *Staphylococcus*, *Klebsiella*, *Enterobacter*, *Streptococcus*, and *Staphylococcus* species **(Foxman, 2012).**

Table (4): Prevalence rate of (UTIs) due to *Streptococcus sp.*

Age group	Total infection		Gender			
			Females		Males	
	No.	%	No.	%	No.	%
0-10	13	%15.48	11	%15.71	2	%14.29
11- 20	16	%19.05	13	%18.57	3	%21,43
21 – 30	25	%29.76	20	%28.57	5	%35.71
31 - 40	10	%11.90	9	%12.86	1	%7.14
41 - 50	17	%20.24	15	%21.43	2	%14.29
51 – 60	2	%2.38	2	%2.86	0	%0
>61	1	%1.19	0	%0	1	%7.14
Total	84	%100	70	%100	14	%100

5. Prevalence of the uropathogen *Klebsiella sp*

The data illustrated in table (5) indicates that the age group (31-40) experienced the highest infection rate (34.04%) among the total positive samples, whereas the lowest infection rates were observed (0.0%) in the age categories (0-10), (11-20), and (>61). In females, the peak infection rate was noted at (31.76%) within the (31-40) age group, while the minimum infection rate (0.0%) was recorded in those aged (>61). Conversely, among males, the highest infection rate registered was (55.55%) in the (31-40) age group, with the lowest rates (0%) found in the age groups (>61), (11-20), and (0-10). These findings are consistent with the observations of Alzohairy and Khadri (2011), who noted that *Klebsiella* infections are predominantly found in individuals aged (>20-49 years), whereas Pseudomonas infections are more common among children and the elderly (<20 years and >50 years), and *Salmonella typhi* was isolated from elderly individuals (>60 years) suffering from community-acquired infections. Furthermore, Sokhn *et al*. (2020) reported that, from a total of 682 isolates obtained from patients with urinary tract infections (UTIs), *E. coli* emerged as the leading uropathogenic organism (67.1%), followed by *K. pneumoniae* (10.0%) and P. mirabilis (3.7%). Other less prevalent uropathogens accounted for 19.2% of the cases and were excluded from the analysis in our study. The prevalence of extended-spectrum beta-lactamases (ESBL) was determined to be 32.9%, with *E. coli* identified as the primary ESBL-producing organism (35.2%), succeeded by *K. pneumoniae* (27.7%).

Table (5): Prevalence rate of (UTIs) due *to Klebsiella sp*.

Age group	Total infection		Gender			
			Female		Male	
	No.	%	No.	%	No.	%
0-10	9	%9.57	9	10.59%	0	%0.0
11- 20	7	%7.45	7	8.24%	0	0%0.
21 – 30	22	%23.40	21	24.71%	1	11.11%
31 - 40	32	04%34.	27	31.76%	5	55.56%
41 - 50	17	18.09%	16	18.82%	1	%11.11
51 - 60	7	%7.45	5	%5.88	2	%22.22
>61	0	0%0.	0	10.44%	0	0%0.
Total	94	%100	85	100%	9	100%

6.prevalence of the fungal uropathogen *Candida sp*

The data illustrated in table (6) indicates that the age cohort (21-30) exhibited the highest prevalence of infection, accounting for 51% of the total positive samples, whereas the age categories (0-10) and (>61) demonstrated the lowest infection rates, both at 0%. Among females, the peak infection rate of 51% was also noted within the (21-30) age group, while the lowest infection rate of 0.00% was observed in the (0-10) and (>61) age brackets. Conversely, males exhibited an infection rate of 0% across all age categories. These findings suggest that females are more prone to candidiasis compared to males, particularly within the (21-30) age group. Sobel *et al*. (2014) conducted an assessment of the risk factors associated with *candiduria* and *Candida* urinary tract infections, concluding that candiduria is significantly influenced by several risk factors, including extremes of age, female gender, diabetes mellitus, extended hospital stays, admissions to intensive care units, immunosuppressive treatments, recent utilization of broad-spectrum antibiotics, previous surgeries (both urological and neurological), urinary tract abnormalities, and catheterization, among others.

Table (6): Prevalence rate of (UTIs) due to *Candida sp*

Age group	Total infection		Gender			
			Male		Female	
	No.	%	No.	%	No.	%
0-10	0	0%	0	0.00	0	0%
11- 20	3	3%	0	0.00	3	3%
21 – 30	51	51%	0	0.00	51	51%
31 - 40	35	35%	0	0.00	35	35%
41 - 50	6	65%	0	0.00	6	6%
51 - 60	5	%5	0	0.00	5	5%
>61	0	%0	0	0.00	0	0
Total	100	%100	0	0.00	100	100%

Evaluation of antimicrobial susceptibility

1. *E. coli* responsibility.

Escherichia coli demonstrated the greatest susceptibility to IMIPENEM (IPM) at a rate of 40 (56.3%) among all positive IMIPENEM (IPM) cultures. Conversely, 253 (30.5%) cultures of E. coli exhibited varying degrees of susceptibility to the 25 antibiotics that were evaluated.

2. *Eitrobacter sp* responsibility.

Eitrobacter sp exhibited the greatest susceptibility to AMPICILIN (AMP) with a total of 10 instances (33.3%) among all positive AMPICILIN (AMP) cultures. Conversely, 64 (7.7%) cultures of *Eitrobacter sp* demonstrated varying degrees of susceptibility to the 25 antibiotics that were evaluated.

3. *Klebsiella sp* responsibility.

Klebsiella species exhibited the greatest susceptibility to CEPHALEXIN (CL) with 16 instances (57.1%) out of the total identified CEPHALEXIN (CL) cultures. Conversely, 183 (22.1%) instances of *Klebsiella* species demonstrated varying degrees of susceptibility to the 25 antibiotics that were analyzed.

4. *Nitrobacteria sp* responsibility.

Nitrobacteria sp showed the highest susceptibility towards PENICILILLIN (P)11 (52.3%) from the total positive PENICILILLIN (P) cultures. On the other hand, 107 (12.9%) cultures of *Nitrobacteria sp* recorded different levels of susceptibility towards the 25 tested antibiotics.

5. *Pseudomonas sp* responsibility.

Pseudomonas sp showed the highest susceptibility towards OFLOXACIN (OFX)12 (46.1%) from the total positive OFLOXACIN (OFX) cultures. On the other hand, 97 (11.7%) cultures of *Pseudomonas sp* recorded different levels of susceptibility towards the 25 tested antibiotics.

6. *Staphylococcus aureus* responsibility.

Staphylococcus aureus showed the highest susceptibility towards OFLOXACIN (OFX) 5 (23.8 %) from the total positive OFLOXACIN (OFX) cultures. On the other hand, 67 (8.1%) cultures of *Staphylococcus aureus* recorded different levels of susceptibility towards the 25 tested antibiotics.

7. *Staph hemolytic* responsibility.

Staph hemolytic showed the highest susceptibility towards OFLOXACIN (OFX 7 (30.4%) from the total positive OFLOXACIN (OFX) cultures. On the other hand, 65 (6.7%) cultures of *Staph hemolytic* recorded different levels of susceptibility towards the 25 tested antibiotics.

As illustrated in table (7), IMIPENEM (IPM) exhibits the most pronounced effective antagonism against all evaluated bacterial strains, achieving a response in 71 cultures. The bacterial species most sensitive to IMIPENEM (IPM) is E. coli 40 (56.3%), followed by GENTAMYCIN (CN), which demonstrated susceptibility in 38 cultures. Conversely, ERYTHROMYCIN (E) showed minimal effective antagonism across all tested bacterial cultures, with only a single *E. coli* culture exhibiting susceptibility. In contrast, 253 cultures of *E. coli* displayed varying degrees of susceptibility to the 25 antibiotics tested, with *Eitrobacter sp*. following closely with 64 cultures. **Gachuhi (2017)** posited that the antimicrobial susceptibility profiles of *E. coli* strains revealed the following patterns: nitrofurantoin (100%), cefotaxime (86.3%), ciprofloxacin (83.3%), gentamicin (81.7%), ampicillin (45.3%), nalidixic acid (48.5%), and cotrimoxazole (44.1%). Additionally, 85% of the isolates were determined to be multidrug-resistant, thus constraining the treatment options for urinary tract infections (UTIs) with commonly utilized antibiotics, a finding that corroborates our results. Moreover, **Grude *et al.* (2001)** indicated that resistance was marginally more prevalent in E. coli strains sourced from inpatients compared to those from outpatients. A statistically significant difference was observed solely for ampicillin; 75.5% of *E. coli* from inpatients and 78.4% from outpatients demonstrated sensitivity to this antibiotic ($P < 0.001$). The study period also noted a decline in the frequency of *E. coli* susceptible to ampicillin among outpatients, decreasing from 80.3% in 1997 to 76.7% in 1999 ($P < 0.001$), and among inpatients from 76.5% to 74.3% ($P < 0.05$). Furthermore, a significant reduction in sensitivity to sulfonamides in *E. coli* from outpatients was observed (from 78.4% to 72.8%), as well as to trimethoprim (from 84.6% to 80.9%) and TMX (from 88.4% to 84.8%) ($P < 0.001$).

Table (7): Sensitivity of 7 species of Bactria to 25 antibiotics.

Antimicrobial agent	*E. coli*		*Eitrobacter sp*		*Klebsiella sp*		*Nitrobacteria sp*		*Pseudomonas Sp*		*Staphylococcus aura*		*Staph hemolytic*		*Total responses*
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
AMIKACIN (AK)	4	12.1	1	3.0	13	39.3	0	0.0	1	3.0	9	27.2	5	15.1	33
AMXACILIN (AML)	1	4.3	0	0	4	17.3	6	26.0	5	21.7	7	30.4	0	0	23
AMPICILIN (AMP)	7	23.3	10	33.3	0	0	3	10	0	0	4	13.3	6	20	30
AUGMANTIN (AMC)	16	39.0	6	14.6	9	21.9	1	2.4	0	0	8	19.5	1	2.4	41
AZITHROMYCIN (AMZ)	20	47.6	1	2.3	11	26.1	2	4.7	0	0	3	7.1	5	11.9	42
BACTRIM (SXT)	20	42.5	3	6.38	6	12.7	5	10.6	6	12.7	0	0	7	14.8	47
CEFIXIME (CFM)	4	19.0	0	0	4	19.0	8	38.0	0	0	5	23.8	0	0	21
CEFOTAXIME (CX)T	15	38.4	0	0	8	20.5	4	10.2	5	12.8	3	7.6	4	10.2	39
CEFTAZIDIME (CAZ)	2	6.4	8	25.8	8	25.8	0	0	7	22.5	0	0	6	19.3	31
CEFTRIAXONE (CRO)	8	22.8	5	14.2	7	20	4	11.4	0	0	3	8.5	8	22.8	35
CEPHALEXIN (CL)	1	3.5	4	14.2	16	57.1	0	0	7	25	0	0	0	0	28
CHLORAMPHENICOL (C)	10	34.4	1	3.4	12	41.3	0	0	5	17.2	0	0	1	3.4	29
CIPROFLOXACIN (CIP)	18	52.9	0	0	10	29.4	2	5.8	0	0	4	11.7	0	0	34
OXACILIN (OX)	0	0	7	20.5	12	35.2	8	23.5	7	20.5	0	0	0	0	34
DOXYCYCLINE (DO)	12	35.2	3	8.8	12	35.2	0	0	0	0	6	17.6	1	2.9	34
ERYTHROMYCIN (E)	1	8.3	0	0	5	41.6	0	0	6	50	0	0	0	0	12
GENTAMYCIN (CN)	25	65.7	0	0	3	7.8	3	7.8	3	7.8	3	7.8	1	2.6	38
IMIPENEM (IPM)	40	56.3	5	7.0	8	11.2	5	7.0	12	16.9	0	0	1	1.4	71
NALIDIXICACIN (NA)	7	25	1	3.5	5	17.8	8	28.5	3	3.5	4	14.2	0	0	28
NITROFURANTOIN (F)	8	24.2	2	6.0	13	39.3	8	24.2	0	0	2	6.0	0	0	33
OFLOXACIN (OFX)	3	14.2	2	9.5	0	0	0	0	11	52.3	0	0	5	23.8	21
PENICILILLIN (P)	0	0	1	3.8	7	26.9	12	46.1	6	23.0	0	0	0	0	26
TETRACYCLINE (TE)	14	35.8	3	7.6	1	2.5	11	28.2	8	20.5	2	5.1	0	0	39
TOBRAMYCIN (TOB)	2	10.5	0	0	5	26.3	8	42.1	3	15.7	1	5.2	0	0	19
VANCOMYCIN (VA)	15	38.4	1	2.5	4	10.2	9	23.0	2	5.1	3	7.6	5	12.8	39
Total response	253	--	64	--	183	--	107	--	97	--	67	--	56	--	827

Conclusion :

It can be conclusively asserted that the prevalence of the bacterium Escherichia coli, commonly referred to as E. coli, was identified as the most predominant pathogen affecting Bactrian individuals of both sexes, specifically in males and females, whereas it is notable that Escherichia coli exhibited the highest recorded infection prevalence rate of 22.43% within the specific demographic category encompassing individuals aged between 11 to 20 years. Furthermore, it was observed that IMIPENEM, a broad-spectrum beta-lactam antibiotic, displayed the most significant and pronounced effective antagonism against all bacterial cultures evaluated in this comprehensive study, documenting an impressive total of 71 distinct response cultures that were affected. Among the various bacterial strains assessed for susceptibility to IMIPENEM, the bacterium that exhibited the highest degree of susceptibility was E. coli, which recorded a susceptibility rate of 40 (56.3%), followed closely by GENTAMYCIN, which was noted to have an effect on 38 cultures in total, while conversely, ERYTHROMYCIN was found to exhibit the least effective antagonistic activity among all bacterial cultures that were subjected to assessment in this study.

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