How to Cite:
Al-Awkally, N. A. M., Ibrahim, H. K., Ali, M. D., Muthanna, F. M., Al-Awkally, A. M., & Yousuf, A. . (2022). Study of antibiotic sensitivity pattern in urinary tract infection. *International Journal of Health Sciences*, *6*(S3), 8896–8913. https://doi.org/10.53730/ijhs.v6nS3.8113

Study of antibiotic sensitivity pattern in urinary tract infection

Noor Alhooda M. Al-Awkally
Department of Medical laboratory, Higher Institute of Science and Technology, Suluq, Libya

Hamza Khalifa Ibrahim
Department of pharmacy, Higher Institute of medical Technology, Bani Waleed, Libya

Maree Dokally Ali
Department of Medical laboratory, Higher Institute of Science and Technology, Suluq, Libya

Fares M. Muthanna
Department of Pharmaceutical Care, School of Pharmacy, Walailak University, Nakhon Si Thammarat, 80160, Thailand
*Corresponding author email: fariszaydi@gmail.com

Alreda Miloud Al-Awkally
Department of Pharmacy, Ministry of health, Darna, Libya

Aejeeliyah Yousuf
Department of Medical Laboratory, Higher Institute of medical Technology, Bani Waleed, Libya

***Abstract*---**Urinary tract infection (UTI) is one of the principal causes of infection worldwide. This study aimed to determine the etiological bacterial pathogens of the UTI and to determine the antibiotic sensitivity pattern of pathogens isolated. Urine samples were tested in the microbiology department of Tobruk Medical Center, Tobruk, Libya from January 2021 to December 2021. The resulted diameters of inhibition zones around the antibiotic discs were measured to the nearest whole mm and interpreted according to protocols standardized for the assay of antibiotic compounds as guided by the National Committee for Clinical Laboratory Standards. Out of 1372 patients, isolates were detected in 171 (12.4%) specimens. Out of these, 137 (77.40%) were female and 40 (22.60%) were male. The prevalence of uropathogens isolated from patients was E. coli, followed by Klebsiella

spp and Proteus spp. In the In Vitro Antibiotic Sensitivity Pattern of Uropathogens, it was seen that E. coli and Klebsiella spp were highly sensitive to Gentamycin, Nitrofurantoin, and Septrin. At the same time, E. coli and Klebsiella spp were highly resistant to chloramphenicol and augmentin. The most effective antimicrobial agent against most bacteria was Gentamycin, followed by Nitrofurantoin. The study found a significant difference between isolated bacteria and gender (p= 0.002). Klebseilla spp. was isolated in abundance in July and December 2021, respectively. The highest isolation of E. coli was in October and November equally. In view of this study's findings, we recommend Gentamicin, Nitrofurantoin, and Septrin as drugs of choice in treating urinary tract infections based on their high sensitivity.

***Keywords*---**Tobruk medical centre, E. coli, Klebsiella spp, augmentin, chloramphenicol, gentamycin, nitrofurantoin.

Introduction

Urinary tract infection (UTI) is one of the leading causes of infection in humans in the community and hospital setting around the world. Urinary tract infections are a serious health problem affecting millions of people each year ([1]. Infections of the urinary tract are the second most common type of infection. UTI incidence occurs due to many pathogens, including gram-negative and gram-positive bacteria and certain types of fungi. [2-3]. These infections are more common in females than in males, and the incidence in women aged 20–40 years ranges from 25 to 30%. In contrast, in elderly patients, older women over 60 years of age, it ranges from 4 to 43% and is a significant cause of morbidity in infant boys. [4-5-6-7] . This is primarily because of anatomic differences, including shorter urethral length and a moist periurethral environment in women. Urinary tract infections typically start with periurethral contamination by an uropathogen residing in the gut, followed by colonization of the urethra and, finally, migration by the flagella and pili of the pathogen to the bladder or kidney. Bacterial adherence to the uroepithelium is key in the pathogenesis of UTI. Infections occur when bacterial virulence mechanisms overcome efficient host defence mechanisms. Upper UTIs, also known as pyelonephritis, develop when uropathogens ascend to the kidneys through the ureters. Infections can occur when bacteria bind to a urinary catheter, a kidney, or a bladder stone or when they are retained in the urinary tract by a physical obstruction. In severe cases of pyelonephritis, the affected kidney may be enlarged, with raised abscesses on the surface (as revealed in imaging studies).

Staphylococcus aureus bacteremia or endocarditis can lead to hematogenous seeding of the bacteria into the kidneys, causing suppurative necrosis or abscess formation within the renal parenchyma [8] . Clinically, UTIs are categorized as uncomplicated or complicated. Uncomplicated UTIs usually affect otherwise healthy people with no structural or neurological urinary tract abnormalities [6-7]. These infections are differentiated into lower UTIs (cystitis) and upper UTIs (pyelonephritis). Several risk factors are associated with cystitis, including female

gender, a prior UTI, sexual activity, vaginal infection, diabetes, obesity, and genetic susceptibility [9-10]. Complicated UTIs are defined as UTIs associated with factors that compromise the urinary tract or host defense. This includes urinary obstruction, urinary retention caused by neurological disease, immunosuppression, renal failure, renal transplantation, pregnancy, and foreign bodies such as calculi, indwelling catheters, or other drainage devices [11-12].

The most common causative agent for uncomplicated and complicated UTIs is uropathogenic *Escherichia coli* (UPEC), [13-14,15,16]. This can affect any part of the genitourinary tract, including the urethra, bladder, ureter, renal pelvis, or renal parenchyma [17] and occurs in all populations and ages. However, various factors include race, genetic factors, age, gender, sexual activity, nocturnal enuresis, and circumcision in boys [18]. UPEC is followed in prevalence by *Klebsiella pneumoniae*, *Staphylococcus saprophyticus*, *Enterococcus faecalis*, group B Streptococcus (GBS) for the agents involved in uncomplicated UTIs, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus,* and *Candida* spp. For complicated UTIs, the order of prevalence for causative agents, following UPEC as most common, is *Enterococcus* spp., *K. pneumoniae*, *Candida* spp., *S. aureus*, *P. mirabilis*, *P. aeruginosa,* and GBS9 [19,20,21]. Multi-drug resistant (MDR) bacteria have been defined as 'resistant to one agent in three or more antibiotic categories [22].

The emergence of antibiotic resistance in UTIs is a severe public health issue, particularly in developing countries such as Libya, because of health awareness obscurity and poor hygienic practices. Therefore, this study was conducted to investigate microbial species isolated from patients with UTI who attended Tobruk Medical Center, Tobruk, Libya, and evaluate their in vitro susceptibility patterns to commonly used antimicrobial agents in Libya. A total of 1372 urine patients with different clinical symptoms of UTIs, (485) males and 887 females, were attended to at the laboratory of Tobruk Medical Center, Tobruk, Libya, were subjected to cultured media and sensitivity tests in the department of microbiology during the period of 12 months, from January 2021 to December 2021.

Material and Methods

Specimen collection and bacterial isolates

Urine samples were tested in the microbiology department of Tobruk Medical Center, Tobruk, Libya, from January 2021 to December 2021. In the case of adults, clean-caught early morning midstream urine samples (MSU) were collected in sterile disposable containers (20 mL) with a tight-fitting lid to prevent leakage. In contrast, in the case of infants, adhesive urine collection bags were used for specimen collection. The urine sample bottles indicated name, age, sex, and time of collection. The samples were analysed bacteriologically using the methods [35].

Culturing of clinical specimens to isolate pathogenic bacteria

Urine samples were tested within 2 h. A standardized sterile micron wire loop for the semi-quantitative method was used for the plating, and it has a 4.0 mm diameter designed to deliver 0.01 ml. A loopful of the well mixed urine sample was inoculated with blood agar, chocolate, agar, Macconky agar, and Cystine Lactose Electrolyts Deficient Agar. All plates were then incubated at 37°C aerobically for 24 h. The strains were subjected to biochemical identification tests to identify bacteria species for TSI (Triple Sugar Iron), gram staining, motility, Indol test, Urea and Citrate agar, and kept aerobically for 24 hours at 37°C with a 5% CO2 atmosphere. [37-40]. The criteria for a positive urine culture for UTI diagnosis were the pure culture or ≤ 2 kinds of bacteria grown ≥ 104 or 105 cfu/ml, as previously described. [40] Exclusion criteria included repeated isolates from the same patient or three types of bacteria grown in a single specimen.

Antibiotic sensitivity test

McFarland Standards are used in the antimicrobial susceptibility testing procedure where the bacterial suspension is compared to Standard McFarland prior to swabbing on Muller Hinton agar. It is a part of quality control to check and adjust the densities of bacterial suspension that can be used for identification and susceptibility testing. However, the used concentration for the antimicrobial susceptibility testing and the culture media performance testing is done by 0.5 McFarland standards in the microbiological laboratory [23]. The Kirby-Bauer disk diffusion method was performed to determine antibiotic susceptibility. The standard disc diffusion procedure determined the in vitro susceptibility of P. aeruginosa and E. coli isolates against antibiotics [38-23]. The bacterial identification and antibiotic susceptibility testing were performed by the VITEK 2 Compact automated system (bioMérieux, France) as previously described [41]. VITEK 2 GP and GN cards were used for bacterial identification. VITEK2 AST-N335 and AST-GN09 cards tested antimicrobial agents for aerobic Gram-negative bacilli were as follows: Augmentin (30ug), Cefotaxime (30µg), chloramphenicol (10 µ), Gentamycin (10Fg), Amikacin (30µg), Nitrofurantoin (300 µg), Septrin (25µg).

The inhibition zones were measured, recorded, and interpreted according to the Clinical Laboratory Standard Institute [29-44]. Four to five similar colonies from overnight growth plates were transferred aseptically in sterile distilled water and vigorously agitated to give a turbidity that matches the 0.5 McFarland standards (approximately 108 cfu/ml) according to D'Amato and Hochstein (1982). Within 15 min, a sterile cotton swab dipped into the culture suspension was used to inoculate solidified Mueller-Hinton agar plates (NCCLS/CLSI, 2007) [38]. Antibiotic discs were dispensed onto the inoculated plate surface agar and incubated at 37 CO for 24 h. The resulted diameters of inhibition zones around the antibiotic discs were measured to the nearest whole mm and interpreted according to protocols standardized for the assay of antibiotic compounds as guided by the National Committee for Clinical Laboratory Standards ("NCCLS"). The results were categorized as: R (resistant), I (intermediate sensitive), and S (sensitive) (Hindler, 1998; NCCLS/CLSI, 2007) [38-43]. *Staphylococcus aureus*

ATCC 25923 strains, *E. coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, and were used for quality control of antibiotic susceptibility testing.

Statistical analysis

Data was entered in Microsoft Excel and analysed using the standard deviation function STDEV, and the test used is the T-test.

Results

Out of 1372 patients, isolates were detected in 171 (12.4%) specimens. Out of these, 887 (64.7%) were female and 485 (35.3%) were male. The distribution of infection among patients' gender was (887/1372, 9.6%) in female patients, while it was (485/1372, 2.7%) in male patients.

Distribution of the cases according to gender

Data illustrated in table (1) showed the distribution of cases according to gender; the females were 887 (64.7%), while the males were 485 (35.3%).

Table 1
Distribution of the cases according to gender

Gender	Number	Percent
Male	485	35.3
Female	887	64.7
Total	1372	100.0

Distribution of the patients according to the departments.

Most of the samples were collected from the outpatient department (n = 805, 58.7%), followed by the pediatric ward (n = 222, 16.2%) and the pediatric intensive care unit (n= 201, 14.7%).

Table 2
Distribution of the patients according to the departments

Departments	Frequency	Percent
Isolation word	3	.2
Cardio care unite	5	.4
Emergency unite	4	.3
Female Medicine word	13	.9
Female Ortho word	2	.1
Female surgical word	5	.4
Laboratory department	35	2.6
paediatric Cardio care unite	1	.1
paediatric medicine word	3	.2
Ear nose throat word	7	.5
Operating theater	1	.1
Male medicine word	4	.3

Male Ortho word	1	.1
Male surgical word	1	.1
New born Intensive Care	30	2.2
Neuron Intensive care unite	1	.1
Outpatient department	805	58.7
paediatric Intensive care unite	201	14.7
Dialysis word	2	.1
Burn shock room	11	.8
paediatric surgical word	14	1.0
paediatric medicine word	222	16.2
intensive care unite	1	.1
Total	1372	100.0

Epidemiology of urinary tract infections

The most common organism found to be positive was Escherichia coli. Out of 1372 samples, E. coli was found positive in 101 (7.4%) of them. The order of prevalence of uropathogens isolated from patients was klebsiella spp 40 (2.9%), Proteus spp 13 (0.9%), followed by Staph aureus 12 (0.9%), Enterobacter spp, pseudomonas spp 2 (0.1%), and Staph saprophyticus 1 (0.1%).

Table 3
Epidemiology of urinary tract infections

Bacterial growth	Frequency	Percent
No growth	1201	87.5
E. coli	101	7.4
Enterobacter spp	2	0.1
klebsiella spp	40	2.9
proteus spp	13	.9
pseudomonas aeruginosa	2	0.1
staph aureus	12	.9
staph saprophyticus	1	0.1
Total	1372	100.0

Effective various Antibiotics to isolated Pathogens

Our results established that isolated E. coli, Enterobacter spp, Klebseilla spp, Proteus spp, P. aeruginosa, Staph aureus, and Staph saprophyticus were highly resistant to Augmentin 107 (7.8%), followed by Chloramphenicol 70 (5.1%). The most effective antimicrobial agent was Gentamycin 72 (5.2%), followed by Nitrofurantoin 50 (3.6%) and Septrin 24 (1.7%). Isolated pathogens show different degrees of resistance to the commonly used antibiotics.

Table 4
Effective of various antibiotics to isolated Pathogens

Augmentin	Frequency	Percent

Valid	S (Staphylococci ≥20 Gram negative bacteria, Streptococci ≥18)	17	1.2
	I (14-17)	13	.9
	R (Staphylococci ≤19 Gram negative bacteria, Streptococci ≤13)	107	7.8
	Total	137	10.0
Missing	System	1235	90.0
Total		1372	100.0
Cefotaxim		Frequency	Percent
Valid	S (≥23)	2	.1
	I (15-22)	4	.3
	R (≤14)	19	1.4
	Total	25	1.8
Missing	System	1347	98.2
Total		1372	100.0
Chloramphenicol		Frequency	Percent
Valid	S (≥18)	13	.9
	I (13-17)	9	.7
	R (≤12)	70	5.1
	Total	92	6.7
Missing	System	1280	93.3
Total		1372	100.0
Gentamycin		Frequency	Percent
Valid	S (≥15)	72	5.2
	I (13-14)	17	1.2
	R (≤12)	66	4.8
	Total	155	11.3
Missing	System	1217	88.7
Total		1372	100.0
Amikacin		Frequency	Percent
Valid	S (≥17)	10	.7
	I (15-16)	6	.4
	R (≤14)	16	1.2
	Total	32	2.3
Missing	System	1340	97.7
Total		1372	100.0
Nitrofurantoin		Frequency	Percent
Valid	S (≥17)	50	3.6
	I≥ (15-16)	35	2.6
	R (≤14)	55	4.0
	Total	140	10.2
Missing	System	1232	89.8
Total		1372	100.0
Septrin		Frequency	Percent
Valid	S (Gram negative bacteria-≥16; Gram positive bacteria-≥19)	24	1.7
	I (Gram negative bacteria 11-15; (Gram negative bacteria16-18)	8	.6

	R (Gram negative bacteria-≤10) Gram positive bacteria-≤15)	55	4.0
	Total	87	6.3
Missing	System	1285	93.7
Total		1372	100.0

Note: I; Intermediate, R; Resistant, S; Sensitive.

Frequency distribution of isolated uropathogens among tested patients according to the gender

Out of these 101 samples, 83 (6%) were females and 18 (1.3%) were males. Klebsiella spp. was found in 40 (2.9%) of the samples. Proteus spp. and Staph aureus were found in 13 (0.9%) and 12 (0.9%) samples, respectively. There was a significant difference between gender and isolated bacteria (p = 0.002).

Table 5
Frequency distribution of isolated uropathogens among tested patients according to the gender

Bacterial growth		Gender		Total
		Infected male (%)	Infected Female (%)	
E. coli	Count	18	83	101
	% of Total	1.3%	6.0%	7.4%
Enterobacter spp	Count	0	2	2
	% of Total	0.0%	0.1%	0.1%
klebsiella spp	Count	11	29	40
	% of Total	0.8%	2.1%	2.9%
No growth	Count	447	754	1201
	% of Total	32.6%	55.0%	87.5%
Proteus spp	Count	4	9	13
	% of Total	0.3%	0.7%	0.9%
pseudomonas aeruginosa	Count	0	2	2
	% of Total	0.0%	0.1%	0.1%
Staph aureus	Count	5	7	12
	% of Total	0.4%	0.5%	0.9%
Staph saprophyticus	Count	0	1	1
	% of Total	0.0%	0.1%	0.1%
Total	Count	485	887	1372
	% of Total	35.3%	64.7%	100.0%

Note: S- Sensitive; I-Intermediate; R- Resistant.

Comparison between isolated uropathogens bacteria and susceptibility patterns to antibiotics

Table 6 shows the percentage of In Vitro Antibiotic Sensitivity Pattern of uropathogens. It was seen that E. coli and Klebseiila spp were highly sensitive to Gentamycin, Nitrofurantoin, and Septrin, whereas E. coli and Klebseiila spp were highly resistant to Chloramphenicol and Augmentin. Staph aureus isolates,

showed high resistance to Augmentin (5.1%) and Gentamycin (3.2%). Pseudomonas aeruginosa isolates, showed resistance to Augmentin 1.5%. Enterobacter isolates appeared resistant to Gentamycin and Septrin 1.3% equally.

Table 6
Comparison between isolated uropathogens bacteria and susceptibility patterns to Augmentin

Augmentin		Augmentin			Total
		S	I	R	
E. coli	Count	6	8	64	78
	% of Total	4.4%	5.8%	46.7%	56.9%
enterobacter spp	Count	0	1	1	2
	% of Total	0.0%	0.7%	0.7%	1.5%
Klebsiella spp	Count	1	3	28	32
	% of Total	0.7%	2.2%	20.4%	23.4%
proteus spp	Count	5	1	5	11
	% of Total	3.6%	0.7%	3.6%	8.0%
pseudomonas aeruginosa	Count	0	0	2	2
	% of Total	0.0%	0.0%	1.5%	1.5%
staph aureus	Count	4	0	7	11
	% of Total	2.9%	0.0%	5.1%	8.0%
staph saprophyticus	Count	1	0	0	1
	% of Total	0.7%	0.0%	0.0%	0.7%
Total	Count	17	13	107	137
	% of Total	12.4%	9.5%	78.1%	100.0%

Table 7
Comparison between isolated uropathogens bacteria and susceptibility patterns to Cefotaxim

Cefotaxim		Cefotaxim			Total
		S	I	R	
E. coli	Count	0	0	11	11
	% of Total	0.0%	0.0%	44.0%	44.0%
Enterobacter spp	Count	0	1	0	1
	% of Total	0.0%	4.0%	0.0%	4.0%
klebsiella spp	Count	0	2	4	6
	% of Total	0.0%	8.0%	16.0%	24.0%
proteus spp	Count	1	1	1	3
	% of Total	4.0%	4.0%	4.0%	12.0%
staph aureus	Count	1	0	3	4
	% of Total	4.0%	0.0%	12.0%	16.0%
Total	Count	2	4	19	25
	% of Total	8.0%	16.0%	76.0%	100.0%

Table 8
Comparison between isolated uropathogens bacteria and susceptibility patterns to Augmentin, Chloramphenicol

Gentamycin		Gentamycin			Total
		S	I	R	
E. coli	Count	45	11	35	91
	% of Total	29.0%	7.1%	22.6%	58.7%
Enterobacter spp	Count	0	0	2	2
	% of Total	0.0%	0.0%	1.3%	1.3%
klebsiella spp	Count	17	3	18	38
	% of Total	11.0%	1.9%	11.6%	24.5%
proteus spp	Count	4	1	5	10
	% of Total	2.6%	0.6%	3.2%	6.5%
pseudomonas aeruginosa	Count	1	1	0	2
	% of Total	0.6%	0.6%	0.0%	1.3%
staph aureus	Count	5	1	5	11
	% of Total	3.2%	0.6%	3.2%	7.1%
staph saporophyticus	Count	0	0	1	1
	% of Total	0.0%	0.0%	0.6%	0.6%
Total	Count	72	17	66	155
	% of Total	46.5%	11.0%	42.6%	100.0%

Table 9
Comparison between isolated uropathogens bacteria and susceptibility patterns to Amikacin

Amikacin		Amikacine			Total
		S	I	R	
E. coli	Count	5	2	5	12
	% of Total	15.6%	6.3%	15.6%	37.5%
Enterobacter spp	Count	0	0	1	1
	% of Total	0.0%	0.0%	3.1%	3.1%
klebsiella spp	Count	5	3	6	14
	% of Total	15.6%	9.4%	18.8%	43.8%
proteus spp	Count	0	1	2	3
	% of Total	0.0%	3.1%	6.3%	9.4%
staph aureus	Count	0	0	2	2
	% of Total	0.0%	0.0%	6.3%	6.3%
Total	Count	10	6	16	32
	% of Total	31.3%	18.8%	50.0%	100.0%

Table 10
Comparison between isolated uropathogens bacteria and susceptibility patterns to Nitrofutantoin

Septrin		**Septrin**			**Total**
		S	**I**	**R**	
E. coli	**Count**	11	3	28	42
	% of Total	12.6%	3.4%	32.2%	48.3%
***Enterobacter* spp**	**Count**	0	0	2	2
	% of Total	0.0%	0.0%	2.3%	2.3%
***klebsiella* spp**	**Count**	7	3	15	25
	% of Total	8.0%	3.4%	17.2%	28.7%
***proteus* spp**	**Count**	2	1	7	10
	% of Total	2.3%	1.1%	8.0%	11.5%
staph aureus	**Count**	4	1	2	7
	% of Total	4.6%	1.1%	2.3%	8.0%
staph saprophyticus	**Count**	0	0	1	1
	% of Total	0.0%	0.0%	1.1%	1.1%
Total	**Count**	24	8	55	87
	% of Total	27.6%	9.2%	63.2%	100.0%

Table 11
Comparison between isolated uropathogens bacteria and susceptibility patterns to Septrin

Nitrofurantoin		Nitrofutantoin			Total
		S	I	R	
E. coli	Count	36	22	27	85
	% of Total	25.7%	15.7%	19.3%	60.7%
Enterobacter spp	Count	1	1	0	2
	% of Total	0.7%	0.7%	0.0%	1.4%
klebsiella spp	Count	9	8	16	33
	% of Total	6.4%	5.7%	11.4%	23.6%
proteus spp	Count	1	0	9	10
	% of Total	0.7%	0.0%	6.4%	7.1%
pseudomonas aeruginosa	Count	0	0	1	1
	% of Total	0.0%	0.0%	0.7%	0.7%
staph aureus	Count	3	3	2	8
	% of Total	2.1%	2.1%	1.4%	5.7%
staph saprophyticus	Count	0	1	0	1
	% of Total	0.0%	0.7%	0.0%	0.7%
Total	Count	50	35	55	140
	% of Total	35.7%	25.0%	39.3%	100.0%

Distribution of samples by months

There is no statistically significant difference between isolated bacteria and different seasons of the year (P =.243). Out of 1372 cases, the majority (n =288;

21%) were in December, followed by 285 (20.8%) and October 212 (15.5%), while the lowest cases were on June 12 (0.9%).

Table 12
Distribution of samples by months

Month		Frequency	Percent
Valid	June	12	.9
	July	285	20.8
	August	163	11.9
	September	205	14.9
	October	212	15.5
	November	207	15.1
	December	288	21.0
	Total	1372	100.0

Comparison between the uropathogen bacteria and the months of the year

The highest isolation of E. coli was in October and November equally. Klebseilla spp. was isolated in abundance in July and December, respectively. The highest Proteus spp isolates were in August and September. Most staph aureus isolation was in July, October and November equally. There is no relationship between months and bacteria, P=.243.

Table 13
A comparison between the uropathogen bacteria and the months of the year

Isolates		Seasons							Total
		June	July	August	September	October	November	December	
E .coli	Count	0	9	7	19	24	24	18	101
	% of Total	0.0%	0.7%	0.5%	1.4%	1.7%	1.7%	1.3%	7.4%
Enterobacter spp	Count	0	1	0	0	0	0	1	2
	% of Total	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
klebsiella spp	Count	0	15	3	3	5	5	9	40
	% of Total	0.0%	1.1%	0.2%	0.2%	0.4%	0.4%	0.7%	2.9%
No growth	Count	12	254	149	179	177	175	255	1201
	% of Total	0.9%	18%	10.9%	13.0%	12.9%	12.8%	18.6%	87.5%
proteus spp	Count	0	2	3	3	2	2	1	13
	% of Total	0.0%	0.1%	0.2%	0.2%	0.1%	0.1%	0.1%	0.9%
pseudomonas aeruginosa	Count	0	0	0	0	1	0	1	2
	% of Total	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%
staph aureus	Count	0	3	1	1	3	1	3	12
	% of Total	0.0%	0.2%	0.1%	0.1%	0.2%	0.1%	0.2%	0.9%

staph saprophyticus	Count	0	1	0	0	0	0	0	1
	% of Total	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Total	Count	12	285	163	205	212	207	288	
	% of Total	0.9%	20.8 %	11.9%	14.9%	15.5%	15.1%	21.0%	100.0%

Discussion

Urinary tract infections (UTIs) are some of the most common bacterial infections, affecting 150 million people each year worldwide and caused predominantly by uropathogenic E. coli, which could lead to recurrence, renal damage, sepsis, or even death. [23:40–42] Up to 60% of women have at least one symptomatic UTI during their lifetime. Around 10% of women in the United States have one or more episodes of symptomatic UTIs each year. [24] Several recent investigations reported the emergence of multidrug-resistant bacterial pathogens from different origins that increased the need for proper use of antibiotics and the detection of the antibiotic of choice. [40] In community and hospital settings, the aetiology of UIs and the antimicrobial susceptibility of UTI-causing bacteria have been changing over the years.

Lower UTIs, also known as cystitis, are significantly more prevalent in women than in men. This is primarily because of anatomic differences, including shorter urethral length and a moist periurethral environment in women. Urinary tract infections typically start with periurethral contamination by an uropathogen residing in the gut, followed by colonization of the urethra and, finally, migration by the flagella and pili of the pathogen to the bladder or kidney. Bacterial adherence to the uroepithelium is key in the pathogenesis of UTI. Infections occur when bacterial virulence mechanisms overcome efficient host defense mechanisms. Upper UTIs, also known as pyelonephritis, develop when uropathogens ascend to the kidneys through the ureters. UTIs in males were significantly lower than in females, occurring primarily in males with urologic structural abnormalities and in older adult males [24].

This study aimed to determine the causative bacterial agent of urinary tract infection among the patients in Tobruk Medical Central. Because it is critical to isolate and identify the causative bacterial agent in UTI management, this study was undertaken to determine the distribution of microbial species isolated from patients with UTI at the laboratory of Tobruk Medical Center in Tobruk, Libya. The susceptibility patterns to antimicrobial agents were tested. In this study, the prevalence rate of isolation of urinary pathogens was 12.4%. In a similar study by Guermazi et al. and Mahmoud et al., the isolation rates were 13.9% and 16.5% [25, 26, 27]. However, the current study's prevalence rate was lower compared to the result of an investigation previously conducted in Tripoli city, Libya (2.7%) [28].

The prevalence of UTIs was higher in females when compared to males, and this was in agreement with other studies by Khalifa et al., Milud et al. and Amal et al. [27, 28, 29]. This result was expected, as females are more susceptible to UTI than males because their urethra is much shorter and nearer to the anus than in

males; therefore, bacteria from the anus can pass easily into the urinary tract. The majority of bacterial species isolated from patients in this study were only 7 bacterial species. Concerning the causative uropathogens in the present study, almost all the isolates belonged to gram-negative bacteria. E. coli was the most prevalent, and Klebseilla spp. was the second most. This finding was in agreement with the common knowledge about the causative agents of UTI, such as that reported by Mohammed et al., and Sahm et al. [26, 30-39-40] and contrary to other studies that reported the predominant bacteria that cause UTI was Klebseilla spp. [28]. The recent results agreed with other studies that dictated that uropathogens are always predictable and E. coli is the leading cause, besides other common Gram negative organisms such as Klebsiella, Enterobacter, and Proteus species [31-40]. However, some pathogens like Proteus spp. and P. aeruginosa predominantly cause complicated UTIs. Subsequently, these uropathogens often form biofilms responsible for colonization and persistence.[30, 32]

In this study, the most resistant antimicrobial agent of isolates was Augmentin. The resistant drugs included Augmentin, similar to the study by Dania et al., [34], while the most effective antimicrobial agent was Gentamycin, followed by Nitrofurantoin. This was contrary to a study by Ama et al. who concluded that the organisms showed sensitivity to Nitrofurantoin. [29] In this study, all the two most frequently isolated organisms showed resistance to commonly used antibiotics like Augmentin and chloramphenicol. The present study investigated UTI at TMC, Tobruk, Libya, where E. coli, was highly sensitive to Nitrofurantoin. The results of the antimicrobial sensitive profile were consistent with many previously reported studies [26, 29, 33]. However, a higher level of resistance was observed against E. coli isolates, the most common cause of UTIs, which demonstrated resistance to chloramphenicol in 53.3% of cases. This study was in contrast to the study of Mohammed et al. [26]. Klebsiella spp. was the most common uropathogen, with a 20.4% resistance to Augmentin. Our result was in agreement with the study of Amal et al. [29] . Furthermore, our results indicated a high susceptibility to Nitrofurantoin. This was in agreement with the study by Khalifa et al. [26]. The proper management and reasonable control policy for reducing the development of antibiotic resistance among microorganisms is an important procedure.

Conclusion

This study determined the prevalence of UTIs among tested patients. It was evident that E. coli was the most prevalent isolate, followed by Klebsiella. spp. These two organisms were highly resistant to the commonly used antibiotics. E. coli was predominant and was isolated from patients, especially females. In view of our study findings, we recommend Gentamicin, On the basis of their demonstrated high sensitivity, we chose Septrin, Nitrofurantoin, as drugs of choice in the treatment of urinary tract infections. To prevent resistance to antibiotics, suitable Therapy as per the bacterial sensitivity pattern needs to be introduced.

Acknowledgment

The authors would like to thank all medical laboratory staff in Tobruk Medical Centre and Dr Hooda Kutrani for their assistance.

Ethical approval

All aspects and protocols of this study were reviewed and approved by the Ethics Committee of Microbiology Department of Tobruk Medical Center with IBR number (1.4.2283)

Declaration of competing interest

The authors declare that they have no any known financial or non-financial competing interests in any material discussed in this paper.

Funding information

No funding was received from any financial organization to conduct this research.

Author Contribution

Study conception and design: N. M.A. Methods: H.K.I. Data collection: M.D.A, and N.M.A. Analysis and interpretation of results: A.M.A. & A.Y. Draft manuscript preparation: N.M.A & F.M.M. Supervision, proofreading and writing final draft: F.M.M. All authors reviewed the results and approved the final version of the manuscript

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