Antibiotic Response Pattern of Seven (UTI) Infecting Bacteria Isolated from Patients with Urinary Tract Infections Towards 25 Antibiotics

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Abstract:
Background: Urinary tract infections (UTIs) impact approximately 150 million people globally each year. Numerous studies indicate a growing prevalence of antibiotic resistance in adults suffering from UTIs. The increase in multidrug-resistant (MDR) bacteria represents a major public health challenge.
Aims: The study aims to elucidate prevalent antibiotic resistance patterns in bacterial urinary pathogens.
Methods: A total of 2028 Uren samples were cultured to assess 25 antibiotics against 7 bacterial genera. Collected data were systematically analyzed. Antibiotic efficacy was determined by the ratio of susceptible to resistant samples across bacterial cultures.
Results: AUGMANTIN (AMC) has emerged as the antibiotic exhibiting the most substantial percentage of sensitivity, attaining an exemplary rate of 84.21% (n = 16) in the framework of the total samples analyzed, whereas OXACILIN (OX) was noted to possess the highest documented rate of resistance, remarkably reaching 100% (n = 10) against *E. coli*. Furthermore, CEFTAZIDIME (CAZ) demonstrated the pinnacle of sensitivity at 100% (n = 8), succeeded by VANCOMYCIN (VA) recording a sensitivity rate of 90.9% (n = 11), while CIPROFLOXACIN (CIP) and GENTAMYCIN (CN) exhibited total resistance at 100% (n = 4 and 5) against *Eitrobacter sp.* Conversely, AMIKACIN (AK) and AUGMANTIN (AMC) manifested the highest sensitivity at 100% (n = 13 and 9), whereas AMPICILIN (AMP) and OFLOXACIN (OFX) documented the utmost resistance at 100% (n = 3 and 12) on *Klebsiella sp*. CEFTRIAXONE (CRO) and NITROFURANTOIN (F) revealed the highest sensitivity at 80% (n = 4 and 8), while CEPHALEXIN (CL), DOXYCYCLINE (DO), and OFLOXACIN (OFX) exhibited complete resistance at 100% (n = 5, 4, and 8 respectively) against *Nitrobacteria sp*. OXACILIN (OX) demonstrated the highest sensitivity at 87.5% (n = 7), while AZITHROMYCIN (AMZ), CEFIXIME (CFM), CEFTRIAXONE (CRO), CIPROFLOXACIN (CIP), and NITROFURANTOIN (F) recorded a 100% resistance rate (n = 5, 6, 7, 5, and 7 respectively) on *Pseudomonas sp*. AUGMANTIN (AMC) exhibited the highest sensitivity at an impressive 100% (n = 8), while CEPHALEXIN (CL), OXACILIN (OX), ERYTHROMYCIN (E), and OFLOXACIN (OFX) demonstrated absolute resistance rates of 100% (n = 10, 7, 9, and 10 respectively) against *Staphylococcus aureus*. Ultimately, OFLOXACIN (OFX) revealed the highest sensitivity rate at 71.42% (n = 5), while CEFIXIME (CFM), OXACILIN (OX), and ERYTHROMYCIN (E) recorded a total resistance rate of 100% (n = 12, 7, and 8 respectively) against *Staph hemolytic*.

Key words: UTI , antibiotic , resistance , bacteria .

الملخص:
اظهر أوجمانتين (AMC) أعلى نسبة حساسية، محققًا معدلًا مثاليًا قدره 84.21% (ن = 16) ضمن إجمالي العينات التي تم تحليلها، بينما لوحظ أن أوكساسيلين (OX) قد حقق أعلى معدل مقاومة يصل الى 100% (ن = 10) مع الإشريكية القولونية. علاوة على ذلك، أظهر سيفتازيديم (CAZ)ذروة الحساسية بنسبة 100% (ن = 8)، يليه فانكومايسين (VA) مسجلاً معدل حساسية قدره 90.9% (ن = 11)، بينما أظهر سيبروفلوكساسين (CIP) وجنتاميسين (CN) مقاومة بنسبة 100% (ن = 4 و5) مع بكتريا الإنيتروبكتر. وعلى العكس من ذلك، أظهر أميكاسين (AK)وأوجمانتين (AMC)على حساسية بنسبة 100٪ (ن = 13 و 9)، في حين حقق أمبيسيلين (AMP) وأوفلوكساسين (OFX) أقصى مقاومة بنسبة 100٪ (ن = 3 و 12) مع بكتريا الكليبسيلا.كما أظهر المضاد الحيوي سيفترياكسون (CRO) و نيتروفورانتوين (F) أعلى حساسية بنسبة 80٪ (ن = 4 و 8)، في حين أظهر سيفالكسين (CL) و دوكسيسيكلين (DO) و أوفلوكساسين (OFX) مقاومة كاملة بنسبة 100٪ (ن = 5 و 4 و 8 على التوالي) ضد Nitrobacteria sp. أظهر أوكساسيلين (OX) أعلى حساسية بنسبة 87.5٪ (ن = 7)، في حين سجل أزيثروميسين (AMZ) و سيفكسيم (CFM) و سيفترياكسون (CRO) و سيبروفلوكساسين (CIP) و نيتروفورانتوين (F) معدل مقاومة بنسبة

100٪ (ن = 5 و 6 و 7 و 5 و 7 على التوالي) مع البكتريا . *Pseudomonas sp.* أظهر أوجمانتين (AMC) أعلى حساسية بنسبة 100% (ن = 8)، بينما حقق سيفالكسين (CL)، وأوكساسيلين (OX)، وإريثروميسين (E)، وأوفلوكساسين (OFX) معدلات مقاومة بنسبة 100% (ن = 10، 7، 9، و10 على التوالي) مع المكورات العنقودية الذهبية. في النهاية، أظهر أوفلوكساسين (OFX) أعلى معدل حساسية بنسبة 71.42% (ن = 5)، بينما سجل سيفكسيم ((CFM، وأوكساسيلين (OX)، وإريثروميسين (E) معدل مقاومة بنسبة 100% (ن = 12، 7، و8 على التوالي) مع المكورات العنقودية الذهبية الانحلالية.

الكلمات المفتاحية: عدوى الجهاز البولي، مقاومة المضادات الحيوية،- بكتريا .

Introduction

Urinary tract infection (UTI) predominantly arises from the colonization of pathogenic microorganisms within the genitourinary system **(Shatalov, 2015)** and are defined as the presence of classical signs and/or symptoms and urine culture demonstrating the presence of known uropathogens above the given threshold (>100 cfu/ml urine to 100,000 cfu/ml urine) **(Foxman, 2010) .** This condition represents a significant public health challenge in developing nations, as it is prevalent in both hospital and community contexts, leading to considerable morbidity and mortality **(Abejew *et al.*, 2014)**. The determinants linked to the elevated incidence of UTI among the populace encompass age, sex, sexual behavior, contraceptive practices, prior episodes of UTI, the presence of indwelling catheter devices, and issues related to hygiene **(Seifu and Gebissa, 2018)**. Among the uropathogenic bacteria responsible for urinary tract infections, Escherichia coli is recognized as the most prevalent organism in both community and hospital settings **(Moroh *et al.*, 2014).**

Antibiotic resistance significantly impacts public health, necessitating swift detection in clinical settings for timely identification of resistant pathogens. Infection-control specialists and clinicians require the laboratory to quickly identify and characterize resistant bacteria to reduce transmission and enhance antibiotic selection. This urgency is particularly relevant for ESBL-producing bacteria. The epidemiological landscape of ESBL-producing bacteria is increasingly intricate, with diminishing distinctions between hospital and community settings **(Batabyal, 2018).**

Urinary Tract Infections (UTIs) are systematically categorized into two distinct classifications: complicated and uncomplicated; the former classification is contingent upon the existence of anatomical or functional urological anomalies, gestational conditions, compromised immune status, and the manifestation of clinical indicators associated with tissue invasion or systemic involvement **(Geerlings, 2016).** The successful incursion of bacteria into the urinary tract is contingent upon a myriad of factors, which may be ascribed to the host, including the efficacy of barrier defense mechanisms, hormonal modulation of the immune response, and alterations in the genital microbiota, or to elements inherent to the pathogen itself, such as the size of the inoculum, virulence determinants that facilitate adhesion or invasion of the urinary tract epithelium, and the development of biofilms that provide a defensive shield against both host immune responses and antimicrobial therapies **(Barber *et al.*, 2013).** The predominant microorganisms identified as etiological agents of community-acquired urinary tract infections (UTIs) were *E. coli* and extended-spectrum beta-lactamase (ESBL)-producing Escherichia coli. In these instances, resistance rates to commonly utilized antibiotic therapies were elevated, with the notable exceptions being Fosfomycin, nitrofurantoin, and Carbapenems. Conversely, for other pathogens, including Klebsiella and Proteus species, resistance rates to trimethoprim-sulfamethoxazole (TMP-SMX) and fluoroquinolones were comparatively low. The presence of hypertension and diabetes was found to be significantly correlated with ESBL-producing E. coli when contrasted with ESBL-non-producers. As a general recommendation, the elucidation of additional risk factors, including the presence of diabetes or hypertension, may facilitate an enhanced selection of therapeutic strategies, in conjunction with the identification of the causative pathogen **(Zavala-Cerna *et al.*, 2020).**

Antimicrobial resistance has been acknowledged as a significant issue for the future management of infectious diseases, resulting in recurrent prescriptions, persistent symptoms, complications, heightened utilization of broad-spectrum antimicrobials, and increased mortality rates. A direct correlation exists between the quantity of antimicrobials prescribed and the extent of resistance observed in various microbial organisms **(Cheng *et al.*, 2012).** Nevertheless, the interplay between antimicrobial usage and the emergence of resistance may be intricate **(Magee *et al.*, 1999).**

The escalation of age, the presence of multiple co-morbidities, diminished socioeconomic status, and previous exposure to antibiotics within the community were all found to be significantly correlated with the occurrence of resistant E. coli Bacteraemia, which is associated with heightened mortality rates, with advancing age serving as the most potent predictor. This underscores the imperative for judicious antibiotic utilization in primary care settings, particularly among the frail and multi-morbid demographic **(McCowan *et al.*, 2022).**

Balfour *et al.* (2022) delineated a pronounced prevalence of trimethoprim resistance (41%) and multi-drug resistance (MDR) (40.5%) in *E. coli* Bacteraemia associated with urinary tract infections (UTIs). Noteworthy risk factors for trimethoprim resistance encompassed a history of urinary trimethoprim-resistant E. coli (OR 9.44) and the administration of trimethoprim (OR 2.10). Furthermore, the frequency of community antibiotic prescriptions was identified as a risk factor (OR 1.19). These observations advocate for the reconsideration of trimethoprim as a first-line therapeutic agent in individuals exhibiting risk factors for resistance.

a research focuses on community-acquired uropathogenic *Escherichia coli*, specifically examining resistance rates over a span of 13 years. It underscores noteworthy resistance levels to ampicillin (53.9%) and trimethoprim (32.4%), while indicating a decrease in resistance for Co-Amoxiclav, cephalexin, and trimethoprim.

Although the investigation does not explicitly address *E. coli* Bacteraemia, it accentuates the criticality of comprehending local antimicrobial resistance patterns to inform effective empiric treatment for urinary tract infections, which may influence subsequent resistance development. **(Antimicrobial Susceptibility Patterns of Community-Acquired Uropathogenic Escherichia Coli, Dublin 2010-2022, 2023).**

Batabyal. and Himanshu (2018) reported that, the progression of resistance to commonly utilized oral antibiotics in pediatric populations with urinary tract infections (UTIs) is a pressing concern. Various factors contribute to the emergence of such resistance, primarily including high rates of antibiotic consumption, irrational prescribing practices, incomplete therapeutic regimens, and self-medication by patients, all of which culminate in the development of resistance and subsequent treatment failures. A significant underlying factor contributing to self-medication practices is socioeconomic disadvantage.

Elkhouly *et al.*, (2025) concluded that, *E. coli* was identified as the principal pathogen impacting Bactrian individuals of both genders, particularly males and females, with an infection prevalence rate of 22.43% among those aged 11 to 20 years. Moreover, IMIPENEM, a broad-spectrum beta-lactam antibiotic, demonstrated the most significant antagonistic efficacy against all bacterial cultures examined, affecting a total of 71 distinct response cultures. Among the bacterial strains evaluated for IMIPENEM susceptibility, E. coli exhibited the highest susceptibility rate of 56.3%, followed by GENTAMYCIN impacting 38 cultures, while ERYTHROMYCIN showed the least antagonistic activity among the assessed cultures.

Data collection and Methods

Study area: Data of the present study were harvested from Sabratha and Aljimil hospitals during the period of October 2024– March 2025

Data collection:

Samples were procured from patients diagnosed with urinary tract infections (UTIs) who had been documented within the framework of this investigative research. This analysis assessed the patterns of antimicrobial susceptibility exhibited by bacterial isolates derived from individuals diagnosed with urinary tract infections (UTIs). The specimens examined were retrospectively retrieved from patient medical documentation and laboratory records. The results elucidate a troubling pattern of multidrug resistance among various prevalent uropathogens.

Evaluation of antibiosis:

A comprehensive total comprising 2028 distinct cultures of Uren samples was meticulously collected for the purpose of examining the effects of 25 different antibiotics on 7 notable bacterial genera, which include *Staphylococcus hemolyticus*, *Staphylococcus aureus*, Pseudomonas species, *Nitrobacter* species, *Klebsiella* species, *Enterobacter* species, and *Escherichia coli*, all of which were sourced from various laboratories situated within the geographical confines of the study area. The data pertaining to these cultures were meticulously recorded and subsequently subjected to a thorough and rigorous analysis. The evaluation of the effectiveness of the antibiotics utilized in this research was contingent upon a careful assessment of the number of samples exhibiting susceptibility in contrast to those demonstrating resistance for each individual bacterial culture examined in this extensive study.

Results and discussion

Data presented in table (1) reveals that, from a comprehensive examination of a total of (542) distinct antibiotic cultures specifically targeting 25 different antibiotics in relation to *E. coli* cultures associated with urinary tract infections (UTIs), it has been determined that out of these, a total of 253 cultures exhibited sensitivity while a greater number, specifically 289 cultures, displayed resistance to the antibiotics tested. In this evaluation, AUGMANTIN (AMC) emerged as the antibiotic with the most significant percentage of sensitivity, achieving an impressive rate of 84.21% (n =16) in the context of the total samples that were scrutinized, whereas OXACILIN (OX) was observed to have the highest recorded rate of resistance, astonishingly reaching 100% (n =10) among all the examined samples. These findings align with those reported by **Dhany *et al.* (2024)**, indicating *E. coli*'s substantial antibiotic resistance in UTI patients, with resistance rates of 13.3% for Cefixime, 23.8% for ciprofloxacin, and 35.2% for trimethoprim-sulfamethoxazole. Importantly, 52.26% of *E. coli* isolates were identified as ESBL-producing strains, thereby complicating therapeutic interventions. Conversely, the highest susceptibility was noted for Tigecycline, Meropenem, and Ertapenem, with rates between 99.2% and 99.8%. This underscores the critical necessity for culture and sensitivity testing to inform appropriate antibiotic strategies in UTI management. *E. coli* strains from UTI patients displayed notable antibiotic resistance, particularly to Ampicillin, Cephalosporins, Cotrimoxazole, aminoglycosides, and ciprofloxacin. Conversely, these isolates demonstrated enhanced susceptibility to TGC, MEM, TZP, and SCF. Molecular analysis identified resistant genes including Sul1, Aac1, Qnrs, and Sul2, with specific mutations present, highlighting a multifaceted mechanism of antibiotic resistance in the E. coli strains derived from UTI patients **(Haroon *et al* ,2024).**

Table (1) antibiotic response against *E. coli* UTI infection.

Antibiotics	Sensitive	%	Resistant	%	*Total*
AMIKACIN (AK)	4	44.44	5	55.55	9
AMXACILIN (AML)	1	12.50	7	87.50	8
AMPICILIN (AMP)	7	25.00	21	75.00	28
AUGMANTIN (AMC)	16	84.21	3	15.79	19
AZITHROMYCIN (AMZ)	20	54.05	17	45.95	37
BACTRIM (SXT)	20	51.28	19	48.72	39
CEFIXIME (CFM)	4	22.23	14	77.77	18
CEFOTAXIME (C X)T	15	41.67	21	58.33	36
CEFTAZIDIME (CAZ)	2	10.53	17	89.47	19
CEFTRIAXONE (CRO)	8	57.15	6	42.85	14
CEPHALEXIN (CL)	1	16.67	5	83.33	6
CHLORAMPHENICOL(C)	10	34.49	19	65.51	29
CIPROFLOXACIN(CIP)	18	58.06	13	41.94	31
OXACILIN (OX)	0	0.00	10	100.00	10
DOXYCYCLINE (DO)	12	50.00	12	50.00	24
ERYTHROMYCIN (E)	1	10.00	9	90.00	10
GENTAMYCIN (CN)	25	78.13	7	21.87	32
IMIPENEM (IPM)	40	75.48	13	24.52	53
NALIDIXICACIN(NA)	7	41.18	10	58.82	17
NITROFURANTOIN (F)	8	40.00	12	60.00	20
OFLOXACIN (OFX)	3	25.00	9	75.00	12
PENICILILLIN (P)	0	0.00	7	100	7
TETRACYCLINE (TE)	14	51.85	13	48.15	27
TOBRAMYCIN (TOB)	2	33.33	4	66.67	6
VANCOMYCIN (VA)	15	48.38	16	51.62	31
Total response	**253**	**--**	**289**	**--**	**542**

Data in table (2) shows that an analysis of 167 distinct antibiotic cultures targeting 25 antibiotics related to *Eitrobacter sp* cultures in urinary tract infections (UTIs) shows 69 cultures sensitive and 98 exhibited resistant to the antibiotics assessed. CEFTAZIDIME (CAZ) exhibited the highest sensitivity at 100% (*n*=8), followed by VANCOMYCIN (VA) recording 90.9% (*n*=11) while, CIPROFLOXACIN (CIP), and GENTAMYCIN (CN) demonstrated complete resistance at 100% (*n*=4 and 5) among the samples evaluated. A possible explanation of resistance conducted by **Essalhi, *et al,* (2024)** who, identified aminoglycoside-modifying enzyme (AME) genes as key contributors to antibiotic resistance in Enterobacterales isolated from UTI patients. High frequencies of AME genes were detected, particularly AAC (3′)-IIa (27.7%) and AAC(6′)-Ib (25.9%). These enzymes modify aminoglycosides, rendering them ineffective. Additionally, the study found no presence of 16S rRNA methylation genes, indicating that the resistance mechanisms primarily involve AME genes rather than methylation. This highlights the genetic basis of resistance in uropathogenic Enterobacterales.

Table (2) antibiotic response against *Eitrobacter sp* UTI infection.

Antibiotics	Sensitive	%	Resistant	%	*Total*
AMIKACIN (AK)	1	50.00	1	50.00	2
AMXACILIN (AML)	1	20.00	4	80.00	5
AMPICILIN (AMP)	10	83.33	2	16.67	12
AUGMANTIN (AMC)	6	54.54	5	45.46	11
AZITHROMYCIN (AMZ)	1	14.28	6	85.72	7
BACTRIM (SXT)	3	30.00	7	70.00	10
CEFIXIME (CFM)	1	50.00	1	50.00	2
CEFOTAXIME (CTX)	1	20.00	4	80.00	5
CEFTAZIDIME (CAZ)	8	100	0	0.00	8
CEFTRIAXONE (CRO)	5	83.33	1	16.67	6
CEPHALEXIN (CL)	4	80.00	1	20.00	5
CHLORAMPHENICOL(C)	1	33.33	2	66.67	3
CIPROFLOXACIN(CIP)	0	0.00	4	100	4
OXACILIN (OX)	7	50.00	7	50.00	14
DOXYCYCLINE (DO)	3	37.5	5	62.5	8
ERYTHROMYCIN (E)	1	33.33	2	66.67	3
GENTAMYCIN (CN)	0	0.00	5	100	5
IMIPENEM (IPM)	5	55.56	4	44.44	9

Antibiotics	Sensitive	%	Resistant	%	*Total*
NALIDIXICACIN(NA)	1	14.29	6	85.71	7
NITROFURANTOIN (F)	2	18.18	9	81.82	11
OFLOXACIN (OFX)	2	66.66	1	33.34	3
PENICILILLIN (P)	1	33.34	2	66.66	3
TETRACYCLINE (TE)	3	50.00	3	50.00	6
TOBRAMYCIN (TOB)	1	14.29	6	85.71	7
VANCOMYCIN (VA)	1	9.10	10	90.9	11
Total response	**69**	**--**	**98**	**-**	**167**

Data in table (3) indicates that, an analysis of 363 antibiotic cultures targeting 25 antibiotics related to *Klebsiella sp* cultures in urinary tract infections (UTIs) showed that 183 cultures were sensitive while 180 were resistant. In this analysis, AMIKACIN (AK) and AUGMANTIN (AMC) displayed the highest sensitivity at 100% (n=13 and 9), while AMPICILIN (AMP) and OFLOXACIN (OFX) recorded the highest resistance at 100% (n=3 and 12) among the samples examined. The rise of antibiotic-resistant *Klebsiella* pneumoniae in UTIs adversely affects patient outcomes by increasing infection severity and mortality. This resistance results in extended hospitalizations, higher healthcare costs, and the need for costlier or more harmful alternative therapies. The research underscores the necessity for judicious antimicrobial stewardship and the creation of local antibiograms to inform treatment decisions, ultimately seeking to alleviate negative impacts on patient well-being and healthcare costs **(Kumar and Kalpana, 2013).**

Table (3) antibiotic response against *Klebsiella sp* UTI infection .

Antibiotics	Sensitive	%	Resistant	%	*Total*
AMIKACIN (AK)	13	100.00	0	0.00	13
AMXACILIN (AML)	4	40.00	6	60.00	10
AMPICILIN (AMP)	0	0.00	3	100.00	3
AUGMANTIN (AMC)	9	100.00	0	0.00	9
AZITHROMYCIN (AMZ)	11	73.33	4	26.67	15
BACTRIM (SXT)	6	40.00	9	60.00	15
CEFIXIME (CFM)	4	33.33	8	66.67	12
CEFOTAXIME (CTX)	8	44.44	10	55.56	18
CEFTAZIDIME (CAZ)	8	42.10	11	57.84	19
CEFTRIAXONE (CRO)	7	43.75	9	56.25	16
CEPHALEXIN (CL)	16	61.53	10	38.46	26
CHLORAMPHENICOL(C)	12	70.58	5	29.42	17
CIPROFLOXACIN(CIP)	10	52.63	9	47.37	19
OXACILIN (OX)	12	50.00	12	50.00	24
DOXYCYCLINE (DO)	12	60.00	8	40.00	20
ERYTHROMYCIN (E)	5	50.00	5	50.00	10
GENTAMYCIN (CN)	3	50.00	3	50.00	6
IMIPENEM (IPM)	8	40.00	12	60.00	20
NALIDIXICACIN(NA)	5	35.71	9	64.29	14
NITROFURANTOIN (F)	13	50.00	13	50.00	26
OFLOXACIN (OFX)	0	0.00	12	100.00	12
PENICILILLIN (P)	7	53.84	6	46.16	13
TETRACYCLINE (TE)	1	16.66	5	83.34	6
TOBRAMYCIN (TOB)	5	41.66	7	58.34	12
VANCOMYCIN (VA)	4	50.00	4	50.00	8
Total response	**183**	**--**	**180**	**--**	**363**

Data in table (4) indicates that, out of 233 antibiotic cultures targeting 25 antibiotics related to *Nitrobacteria sp* in urinary tract infections (UTIs), 112 showed sensitivity and 121 demonstrated resistances. CEFTRIAXONE (CRO) and NITROFURANTOIN (F) exhibited the highest sensitivity at 80% (n = 4 and 8), while CEPHALEXIN (CL), DOXYCYCLINE (DO), and OFLOXACIN (OFX) recorded complete resistance at 100% (n = 5, 4, and 8 respectively). **Zhang *et al.*, (2024)** highlights that under high levels of amoxicillin (AMX) stress, key species associated with antibiotic resistance genes (ARGs) likely derive from nitrogen cycling functional species. This interaction suggests that the presence of ARGs can disrupt nitrogen cycling, leading to nitrogen cycling imbalances and potential nitrogen loss, as indicated by increased levels of nirS and nirK, which are involved in nitrogen transformations. Additionally **Wang *et al.*, (2023)** concluded that, Nitrobacteria, like other bacteria, can acquire antibiotic resistance through horizontal gene transfer (HGT), which involves the exchange of genetic material, including ARGs, between different bacterial species. This process is facilitated by plasmids, transposons, and integrons, which can carry multiple resistance genes and spread them across microbial communities.

Table (4) antibiotic response against *Nitrobacteria sp* UTI infection.

Antibiotics	Sensitive	%	Resistant	%	*Total*
AMIKACIN (AK)	1	33.33	2	66.67	3
AMXACILIN (AML)	6	54.54	5	45.46	11
AMPICILIN (AMP)	3	42.85	4	57.15	7
AUGMANTIN (AMC)	1	25.00	3	75.00	4
AZITHROMYCIN (AMZ)	2	40.00	3	60.00	5
BACTRIM (SXT)	5	45.45	6	54.55	11
CEFIXIME (CFM)	8	47.05	9	52.95	17
CEFOTAXIME (CTX)	4	66.66	2	33.34	6
CEFTAZIDIME (CAZ)	1	20.00	4	80.00	5
CEFTRIAXONE (CRO)	4	80.00	1	20.00	5
CEPHALEXIN (CL)	0	0.00	5	100	5
CHLORAMPHENICOL(C)	1	10.00	9	90.00	10
CIPROFLOXACIN(CIP)	2	66.66	1	33.34	3
OXACILIN (OX)	8	44.44	10	55.54	18
DOXYCYCLINE (DO)	0	0.00	4	100	4
ERYTHROMYCIN (E)	2	25.00	6	75.00	8
GENTAMYCIN (CN)	3	30.00	7	70.00	10
IMIPENEM (IPM)	5	55.56	4	44.44	9
NALIDIXICACIN(NA)	8	66.67	4	33.33	12
NITROFURANTOIN (F)	8	80.00	2	20.00	10
OFLOXACIN (OFX)	0	0.00	8	100	8
PENICILILLIN (P)	12	63.15	7	36.85	19
TETRACYCLINE (TE)	11	73.35	4	26.65	15
TOBRAMYCIN (TOB)	8	57.15	6	42.85	14
VANCOMYCIN (VA)	9	64.28	5	35.72	14
Total response	**112**	--	**121**	--	**233**

Data in table (5) indicates that out of 240 distinct antibiotic cultures targeting 25 antibiotics related to *Pseudomonas Sp* in urinary tract infections, 101 exhibited sensitivity while 139 demonstrated resistance. OXACILIN (OX) showed the highest sensitivity at 87.5% (n =7), while AZITHROMYCIN (AMZ), CEFIXIME (CFM), CEFTRIAXONE (CRO), CIPROFLOXACIN (CIP), and NITROFURANTOIN (F) recorded a 100% resistance rate (n =5,6,7, 5 and 7 respectively). **Aktaş *et al* (2012)** mentioned that, the molecular mechanisms underlying antibiotic resistance in Pseudomonas aeruginosa include the overexpression of cephalosporinases and various beta-lactamases, specifically PER-1 and OXA-10-like beta-lactamases, detected in 11% of the isolates. Additionally, the MEX-R gene was identified in 52% of the strains. The study found that 10% of isolates were imipenem-susceptible, while 7 were ESBL positive, indicating a complex resistance mechanism that complicates treatment options for urinary tract infections caused by this pathogen. Furthermore, **Gajdács, (2020)** concluded that, the molecular mechanisms underlying antibiotic resistance in Pseudomonas aeruginosa isolates from UTI patients include the overexpression of AmpC β-lactamases in 12.28% of cases, carbapenemase production in 7.02%, and overexpression of efflux pumps in 54.39% of isolates. These mechanisms contribute to the observed carbapenem resistance while still allowing susceptibility to cephalosporins, highlighting the potential for alternative treatment options to spare last-resort antibiotics like colistin.

Table (5) antibiotic response against *Pseudomonas Sp* UTI infection .

Antibiotics	Sensitive	%	Resistant	%	*Total*
AMIKACIN (AK)	1	14.28	6	85.72	7
AMXACILIN (AML)	5	71.42	2	28.58	7
AMPICILIN (AMP)	1	25.00	3	75.00	4
AUGMANTIN (AMC)	2	33.33	4	66.67	6
AZITHROMYCIN (AMZ)	0	0.00	5	100	5
BACTRIM (SXT)	6	54.55	5	45.45	11
CEFIXIME (CFM)	0	0.00	6	100	6
CEFOTAXIME (CTX)	5	62.5	3	37.5	8
CEFTAZIDIME (CAZ)	7	77.77	2	22.23	9
CEFTRIAXONE (CRO)	0	0.00	7	100	7
CEPHALEXIN (CL)	7	43.75	9	56.25	16
CHLORAMPHENICOL(C)	5	29.41	12	70.59	17
CIPROFLOXACIN(CIP)	0	0.00	5	100	5
OXACILIN (OX)	7	87.50	1	12.50	8

Antibiotics	Sensitive	%	Resistant	%	*Total*
DOXYCYCLINE (DO)	1	12.50	7	87.50	8
ERYTHROMYCIN (E)	6	40.00	9	60.00	15
GENTAMYCIN (CN)	3	60.00	2	40.00	5
IMIPENEM (IPM)	12	52.17	11	47.83	23
NALIDIXICACIN(NA)	3	37.50	5	62.50	8
NITROFURANTOIN (F)	0	0.00	7	100	7
OFLOXACIN (OFX)	11	55.00	9	45.00	20
PENICILILLIN (P)	6	66.66	3	33.34	9
TETRACYCLINE (TE)	8	57.14	6	42.86	14
TOBRAMYCIN (TOB)	3	60.00	2	40.00	5
VANCOMYCIN (VA)	2	20.00	8	80.00	10
Total response	**101**	--	**139**	--	**240**

The data presented in Table (6) elucidates that among 250 distinct antibiotic cultures targeting 25 antibiotics for Staphylococcus aureus implicated in urinary tract infections (UTIs), 73 cultures exhibited sensitivity while 177 cultures displayed resistance. AUGMANTIN (AMC) demonstrated the highest sensitivity at a remarkable 100% (n=8), whereas CEPHALEXIN (CL), OXACILIN (OX), ERYTHROMYCIN (E), , and OFLOXACIN (OFX) revealed absolute resistance rates of 100% (n=10, 7, 9, and 10 respectively). The predominant factors that contribute to the emergence of antibiotic resistance in *Staphylococcus aureus* encompass the enzymatic inactivation of antibiotics, modifications in target sites, and the presence of efflux pumps. Mechanisms of resistance have developed through horizontal gene transfer and spontaneous mutations, particularly within methicillin-resistant S. aureus (MRSA) strains. Furthermore, the excessive utilization of antibiotics and insufficient infection control measures within healthcare environments exacerbate resistance, thereby necessitating vigilant monitoring and management of antibiotic susceptibility among patients suffering from urinary tract infections **(Pantosti *et al*., 2007).** The principal factors that contribute to antibiotic resistance in Staphylococcus aureus, especially in MRSA, include the expression of penicillin-binding protein 2a (PBP2a) and the synthesis of beta-lactamases. These mechanisms render MRSA resistant to β-lactam antibiotics, consequently leading to an increased prevalence in both healthcare and community settings. The review accentuates the necessity for innovative therapeutic strategies to address this escalating resistance **(Assefa & Alemayehu, 2023).**

Table (6) antibiotic response against *Staphylococcus aureus* UTI infection.

Antibiotics	Sensitive	%	Resistant	%	*Total*
AMIKACIN (AK)	9	40.10	13	59.90	22
AMXACILIN (AML)	7	53.85	6	46.15	13
AMPICILIN (AMP)	4	33.33	8	66.67	12
AUGMANTIN (AMC)	8	100	0	0.00	8
AZITHROMYCIN (AMZ)	3	60.00	2	40.00	5
BACTRIM (SXT)	1	11.11	8	88.89	9
CEFIXIME (CFM)	5	55.56	4	44.44	9
CEFOTAXIME (C X)T	3	60.00	2	40.00	5
CEFTAZIDIME (CAZ)	1	20.00	4	80.00	5
CEFTRIAXONE (CRO)	3	25.00	9	75.00	12
CEPHALEXIN (CL)	0	0.00	10	100	10
CHLORAMPHENICOL(C)	1	8.33	11	91.67	12
CIPROFLOXACIN(CIP)	4	33.33	8	66.67	12
OXACILIN (OX)	0	0.00	7	100	7
DOXYCYCLINE (DO)	6	75.00	2	25.00	8
ERYTHROMYCIN (E)	0	0.00	9	100	9
GENTAMYCIN (CN)	3	30.00	7	70.00	10
IMIPENEM (IPM)	1	7.69	12	92.31	13
NALIDIXICACIN(NA)	4	33.33	8	66.67	12
NITROFURANTOIN (F)	2	25.00	6	75.00	8
OFLOXACIN (OFX)	0	0.00	10	100	10
PENICILILLIN (P)	2	16.66	10	83.37	12
TETRACYCLINE (TE)	2	22.22	7	77.78	9
TOBRAMYCIN (TOB)	1	14.28	6	85.72	7
VANCOMYCIN (VA)	3	27.27	8	72.73	11
Total response	**73**	--	**177**	--	**250**

The presented in table (7) indicates that among 223 antibiotic cultures targeting 25 antibiotics related to *Staph hemolytic* cultures in urinary tract infections (UTIs), 66 cultures showed sensitivity while 157 cultures exhibited resistance. OFLOXACIN (OFX) demonstrated the highest sensitivity rate at 71.42% (n=5), while CEFIXIME (CFM), OXACILIN (OX), and ERYTHROMYCIN (E) recorded a complete resistance rate of 100% (n=12, 7, and 8 respectively) among all samples analyzed. **Froggatt *et al.*, (1989)** isolated *Staphylococcus haemolyticus* from urine in 26% of cases among 70 coagulase-negative staphylococcal isolates. The study found that 77% of *S. haemolyticus* isolates were resistant to three or more antimicrobial agents, with 41% resistant to five or six agents. This high prevalence of resistance, particularly to vancomycin (62%) and Teicoplanin (91%) among multiply resistant isolates, suggests significant clinical implications, as it complicates treatment options for urinary tract infections in hospitalized patients. **Li *et al.*, (n.d.)** reports a prevalence of 86.4% for Meticillin-resistant *S. haemolyticus* (MRSH) among isolates. MRSH exhibited high resistance to multiple antibiotics, including penicillin and ciprofloxacin, while all isolates were susceptible to vancomycin and Teicoplanin. The clinical implications include challenges in treating urinary tract infections caused by MRSH, necessitating careful monitoring and alternative treatment strategies due to the high resistance rates to commonly used antimicrobial agents.

Table (7) antibiotic response against *Staphylococcus haemolyticus* UTI infection.

Antibiotics	Sensitive	%	Resistant	%	*Total*
AMIKACIN (AK)	5	45.45	6	54.55	11
AMXACILIN (AML)	1	12.50	7	87.50	8
AMPICILIN (AMP)	6	66.67	3	33.33	9
AUGMANTIN (AMC)	1	16.67	5	83.33	6
AZITHROMYCIN (AMZ)	5	38.45	8	61.55	13
BACTRIM (SXT)	7	63.64	4	36.36	11
CEFIXIME (CFM)	0	0.00	12	100	12
CEFOTAXIME (C X)T	4	36.36	7	63.64	11
CEFTAZIDIME (CAZ)	6	54.54	5	45.46	11
CEFTRIAXONE (CRO)	8	47.05	9	52.95	17
CEPHALEXIN (CL)	1	14.28	6	85.72	7
CHLORAMPHENICOL(C)	1	33.33	2	66.67	3
CIPROFLOXACIN(CIP)	1	10.00	9	90.00	10
OXACILIN (OX)	0	0.00	7	100	7
DOXYCYCLINE (DO)	1	20.00	4	80.00	5
ERYTHROMYCIN (E)	0	0.00	8	100	8
GENTAMYCIN (CN)	1	10.00	9	90.00	10
IMIPENEM (IPM)	1	16.67	5	83.33	6
NALIDIXICACIN(NA)	1	14.28	6	85.72	7
NITROFURANTOIN (F)	2	20.00	8	80.00	10
OFLOXACIN (OFX)	5	71.42	2	28.58	7
PENICILILLIN (P)	1	12.50	7	87.50	8
TETRACYCLINE (TE)	1	11.11	8	88. 89	9
TOBRAMYCIN (TOB)	2	22.22	7	77.78	9
VANCOMYCIN (VA)	5	62.50	3	37.50	8
Total response	**66**	--	**157**	--	**223**

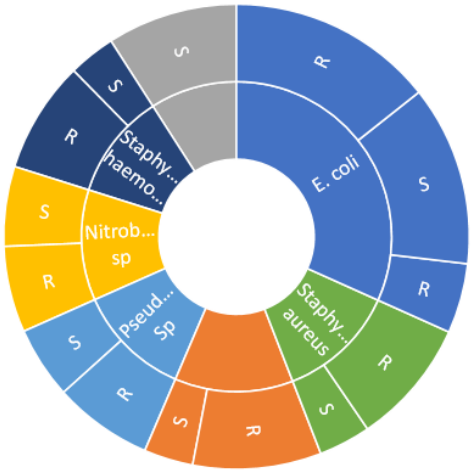

Figure (1) The response of 7 UTI Bacterial species for antibiotics**.**

Conclusion

The antimicrobial susceptibility data reveals significant variability in antibiotic effectiveness across different bacterial species. Augmentin (AMC) consistently demonstrated high efficacy, showing notable sensitivity against *E. coli*, *Klebsiella* spp., and *Staphylococcus aureus*. In contrast, Oxacillin (OX) and Ofloxacin (OFX) frequently exhibited complete resistance, particularly against *E. coli*, *Klebsiella* spp., and *S. aureus*, indicating potential ineffectiveness of these agents in treating infections caused by these organisms. Ceftazidime (CAZ) and Amikacin (AK) showed strong activity against *Enterobacter* and *Klebsiella* spp., respectively, while high resistance rates were observed for commonly used antibiotics such as Cefixime (CFM), Erythromycin (E), and Ciprofloxacin (CIP) in multiple isolates, including *Pseudomonas* and *Staphylococcus* species. These findings underscore the importance of regular surveillance of local antimicrobial resistance patterns and highlight the need for targeted therapy based on culture and sensitivity results rather than empirical treatment. Rational antibiotic use and strict antimicrobial stewardship programs are crucial to combat rising resistance and preserve the efficacy of available drugs.

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