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Antibiotic Resistance in Bacterial Species: A Retrospective Study of Cultures in Kirkuk City, Iraq

Mirna K. Faiq[*1]

[1]Department of Pharmacology and Toxicology, College of Pharmacy, University of Kirkuk, Kirkuk, Iraq.
Ph.D. Clinical Pharmacy

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Corresponding author:
Mirna K. Faiq
mi rnakifah@uokirkuk.edu.iq

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Abstract

Background: Antimicrobial resistance poses a significant public health challenge that impacts individuals of all ages and is linked to high mortality rates due to the substantial burden of infectious diseases.

Objective: This study aimed to identify the most prevalent pathogenic bacteria responsible for various infections in Kirkuk, Iraq, and to assess the antibiotic susceptibility patterns of these pathogens.

Methods: This retrospective observational study was conducted in Kirkuk, Iraq, from October 2023 to August 2024, involving 498 patients. Specimens were collected from local hospitals and some private laboratories in the city.

Results: Most specimens (84.1%) were obtained from outpatients, with urine isolates being the most prevalent (60.44%). The most commonly identified pathogens were E. coli (33.53%), Staphylococcus aureus (MRSA) (18.67%), and Klebsiella spp. (12.24%). E. coli exhibited the highest resistance rates to Cephalothin, Cefpodoxime, Cefuroxime, and Cefoxitin, while showing lower resistance to Lincomycin, Imipenem, Amikacin, and Meropenem. Staphylococcus aureus (MRSA) demonstrated the highest resistance rates to Penicillin, Cefuroxime, Cefixime, and Ceftriaxone, but lower resistance to Rifampicin, Nitrofurantoin, Imipenem, and Meropenem. Klebsiella spp. Showed resistance to nearly all antibiotic types.

Conclusions: This study identified an increase in antimicrobial resistance rates to commonly used antibiotics among patients in Kirkuk. These results emphasize the critical need to address antimicrobial resistance in a setting where antibiotics are routinely overprescribed.

مقاومة المضادات الحيوية في الأنواع البكتيرية: دراسة رجعية للعينات في محافظة كركوك، العراق

ميرنا كفاح فائق[1]

فرع الادوية والسموم، كلية الصيدلة، جامعة كركوك، كركوك، العراق

الخلاصة

تُشكل مقاومة مضادات الميكروبات تحديًا كبيرًا للصحة العامة، يؤثر على الأفراد من جميع الأعمار، ويرتبط بارتفاع معدلات الوفيات بسبب العبء الكبير للأمراض المعدية. هدفت هذه الدراسة إلى تحديد أكثر البكتيريا المسببة للأمراض انتشارًا، والمسؤولة عن أنواع مختلفة من العدوى في كركوك، العراق، وتقييم أنماط حساسية هذه البكتيريا للمضادات الحيوية. أُجريت هذه الدراسة الرصدية بأثر رجعي في كركوك، العراق، في الفترة من أكتوبر 2023 إلى أغسطس 2024، وشملت 498 مريضًا. جُمعت العينات من مستشفيات محلية وبعض المختبرات الخاصة في المدينة. تم الحصول على معظم العينات (84.1%) من مرضى العيادات الخارجية، وكانت عزلات البول الأكثر انتشارًا (60.44%). وكانت أكثر مسببات الأمراض شيوعًا هي الإشريكية القولونية (33.53%)، والمكورات العنقودية الذهبية **(MRSA) (18.67%)**، وبكتيريا الكلبسيلا. (12.24%). أظهرت الإشريكية القولونية أعلى معدلات مقاومة للسيفالوثين، والسيفبودوكسيم، والسيفوروكسيم، والسيفوكسيتين، بينما أظهرت مقاومة أقل للينكومايسين، والإيميبينيم، والأميكاسين، والميروبينيم. أظهرت المكورات العنقودية الذهبية **(MRSA)** أعلى معدلات مقاومة للبنسلين، والسيفوروكسيم، والسيفيكسيم، والسيفترياكسون، ولكنها أظهرت مقاومة أقل للريفامبيسين، والنيتروفورانتوين، والإيميبينيم، والميروبينيم. أظهرت الكلبسيلة مقاومة لجميع أنواع المضادات الحيوية تقريبًا. حددت هذه الدراسة زيادة في معدلات مقاومة مضادات الميكروبات للمضادات الحيوية شائعة الاستخدام بين المرضى في كركوك. تؤكد هذه النتائج على الحاجة الماسة لمعالجة مقاومة مضادات الميكروبات في بيئة تُوصف فيها المضادات الحيوية بشكل مفرط وروتيني.

Introduction:

A major public health concern that affects people of all ages is antimicrobial resistance (AMR) [1]. Due to the high prevalence of infectious diseases, it is linked to greater mortality rates and higher medical costs, particularly in low- and middle-income nations [2]. Because different species and strains of bacteria have distinct modes of action against antibiotics, variations in bacterial resistance to these drugs exist [3]. Antibiotic resistance against a wide range of bacteria and diseases can result from using antibiotics for purposes not prescribed by medical advice, which can harm health [4]. Incomplete treatment, missing doses, utilizing leftover medication, and using antibiotics without a prescription are all examples of misuse [5]. Antibiotic misuse, overuse, and self-medication are acknowledged as major causes of AMR. Antimicrobial resistance is defined as microorganisms' resistance to antimicrobial agents to which they were once sensitive by the World Health Organization (WHO) [6]. Prolonged illness, higher number of visits to medical facilities, longer hospital stays, the need for more costly treatments, and even mortality are all effects of antimicrobial resistance (AMR) [4]. Antibiotic self-medication is a worldwide problem that impacts both industrialized and developing nations [7]. Studies on the Iraqi populace have revealed a high rate of inappropriate antibiotic use, which may lead to a rise in health problems [8,9]. In Iraq, there were 3,400 deaths directly linked to AMR in 2019, along with an additional 12,400 deaths associated with it. Furthermore, Iraq ranks 80th for the lowest age-standardized mortality rate per 100,000 population related to AMR among 204 countries [8,10]. Some research on bacterial resistance has demonstrated significant diversity in resistance mechanisms. Most antibiotic resistance has developed either through mutations or the transfer of genetic material between microorganisms [11]. Recent studies have identified around 400 different bacteria exhibiting approximately 20,000 potential resistance genes [12,13]. Antibiotics have not only been instrumental in saving patients' lives but have also significantly contributed to major advancements in medicine and surgery. Iraq has implemented a "One-Health" strategy to address AMR by coordinating efforts across all sectors that utilize antibiotics, including food, agriculture, animal health, and both human and animal healthcare. The action plan focuses on AMR through targeted interventions, sharing information, and enhancing awareness. It also incorporates stewardship practices, as well as infection prevention and control measures [14]. This study aimed to identify the most prevalent pathogenic bacteria that cause different infections in Kirkuk, the city located in northern Iraq, and determine the antibiotic susceptibility patterns of these pathogens.

Patients and Methods

Study population

The present investigation was a retrospective observational study carried out in Kirkuk city, Iraq. The study was conducted from October 2023 to August 2024. A total of 498 patients were included in this study: patients (outpatients) at local hospitals in Kirkuk (Al-Nasr Hospital, Azadi Teaching Hospital, and Kirkuk Teaching Hospital) and some private laboratories.

For a simple random sample, the formula is:

$$n = \frac{z^2 . p(1-p)}{E^2}$$

Here:
n= sample size
z= Z-value (e.g., 1.96 for 95% confidence)
p= estimated proportion (0.5 if unknown)
E= margin of error (e.g., 0.05)

$$n = \frac{1.96^2 . 0.5(1-0.5)}{0.05^2} = \textit{round to } 385$$

The samples that were taken in this study included (Urine, Blood, High vaginal swab, Groin swab, Appendectomy fluid, Throat swab, Nasal swab, Tracheostomy tube swab, Ear swab, Sputum, Abdomen abscess, Cerebrospinal fluid, Acid-fast bacillus sputum, Skin scrape, Wound swap, Ovarian cyst, Cardiovascular line, Stool, Semen, and breast abscess). Each specimen was inoculated on a different medium according to the manufacturer and incubated at 37 ◦C for 24 h. The urine and stool cultures were inoculated on CLED, Hektoen agar medium, respectively. The other specimens (nasal, sputum, throat swab, blood, wound swab, CSF, tracheostomy tube swab, ear swab, H.V.S and semen) were inoculated on several mediums, namely, Chocolat, MacConkey, and Brain heart infusion broth. Mueller Hinton Agar (Microxpress®, India) were used for the identification of bacteria and antimicrobial susceptibility testing. The AMR was interpreted by the Clinical and Laboratory Standards Institute (CLSI) guidelines.

Inclusion and Exclusion criteria

Participants included in this study were patients over 18 years old. Those who cultures and antibiotic resistance measured in the hospital, clinics outside the hospital or both (The most widely used antibiotic susceptibility testing methods in Clinical Microbiology are based on the phenotypic detection of antibiotic resistance by measuring bacterial growth in the presence of the antibiotic being tested [15]. The participants under eighteen years and with incomplete data were excluded from this study.

Ethical considerations

This study was conducted according to Good Clinical Practice standards and guidelines of the Declaration of Helsinki [16]. Furthermore, the protocol was approved by the Ethical Committee of the University of Kirkuk - College of Pharmacy, assigned the number (RECAUKCP1) beside approved by Kirkuk Health Department, as well as the approval of the Director of (Azadi Teaching Hospital, and Kirkuk Teaching Hospital), with maintaining the confidentiality of patients' information.

Statistical analysis

Statistical analysis was performed using the IBM SPSS for Windows version 26.0 software (IBM Corp., Armonk, NY, USA). Continuous variables were expressed in mean ± standard deviation (SD) for normally distributed data. Descriptive statistics (N, %) were conducted for all study items.

Results

Demographic, Isolates, and Pathogen types of the study

This study involved 498 participants with an age mean ± SD (39 ± 17 years) old, predominantly female (67.9%). The majority of specimens were collected from outpatients (84.1%), with urine isolates being the most common type (60.44%). The demographic, isolates of all individuals enrolled in this study are summarized in Table 1. Most common pathogen identification (by culture and isolation) included E. coli, Staphylococcus aureus (MRSA), Klebsiella spp., Staphylococcus spp., Pseudomonas spp. and Acinetobacter spp. Respectively. Distribution (numbers) of the main isolated pathogens illustrated in Figure1.

Distribution of the main isolated specimen types and the most common pathogens

In urine and High vaginal swab specimens, E. coli was the most prevalent pathogen, detected in 44.2% and 28% respectively. While in wound swabs and blood specimens, Staphylococcus aureus (MRSA) was the most prevalent pathogen, detected in 27.9% and 39.3%, respectively. In sputum specimens, Klebsiella spp. was the most prevalent pathogen, detected in 22.5%. Distribution of the main isolated pathogens is summarized in Table 2.

The pattern of antimicrobial resistance in the top bacteria isolated

For E. coli, the highest resistance rate (Calculate resistance rates by dividing the number of resistant isolates by the total number of isolates tested, then multiplying by 100 to get a percentage). Is noted against Cephalothin, Cefpodoxime, Cefuroxime and Cefoxitin. While the resistance rate is lower to Lincomycin, Imipenem, Amikacin, and Meropenem. For Staphylococcus aureus (MRSA), the highest resistance rate is noted against Penicillin, Cefuroxime, Cefixime and Ceftriaxone. While the resistance rate is lower to Rifampicin, Nitrofurantoin, Imipenem, and Meropenem. For Klebsiella spp., the resistance rate is noted against approximately all types of AB but mostly to Cefoxitin, Cefpodoxime, Azithromycin, Cefuroxime and Penicillin. For Pseudomonas spp. and Acinetobacter spp., the resistance rate is noted against approximately all types of AB. The pattern of AMR in the top three bacteria isolated is illustrated in Table 3.Of the 498 clinical samples, the majority of the E. coli isolates were obtained from urine samples (133; 79.6%), followed by wound swap (8; 4.8%), High Vaginal swap (7; 4.2%), blood (5; 2.9%), stool (5; 2.9%), sputum (3; 1.8%), and Abdomen abscess (2; 1.2%) samples. Escherichia coli isolates were more prevalent in females (74.3%) than in males (25.7%). In urine samples, the isolation of E. coli was higher in females (76.7%) than in males (23.3%). The distribution of the E. coli isolates from other clinical samples in both genders is summarized in Table 4**.**

Antibiotic Resistance Profiles of the Top One pathogen from the Top One Isolated specimen

Overall Antimicrobial Resistance Patterns of Escherichia coli Isolated from Urine Specimen illustrated in Figure 2. The highest resistance rate is noted against Cefpodoxime 97.7%, Cefoxitin 89.6%, Cefixime 87.7%, Tetracycline 83.3%, Cephalothin 83.3% and Cefuroxime 80%. While resistance rate is less to Lincomycin 0%, Imipenem 11.3%, Vancomycin 11.11%, Meropenem 13.3%, Netilmicin 16.3%, Amikacin 18.3%, Piperacillin 22.2%, Nitrofurantoin 27.5%, Ticarcillin 28.6% and Erythromycin 30%.

Discussion: Antibiotics lose their effectiveness when infectious agents stop responding to their treatment. According to studies, AMR results in longer hospital stays, higher resource usage, elective surgery cancellations, complications from organ transplants and chemotherapy, higher readmission rates, and an increase in death [8]. The occurrence of multidrug-resistant (MDR) organisms is increasing, leading to significant morbidity and mortality among patients [17]. These infections have been associated with a rise in hospitalization duration of up to 20% and are linked to worse outcomes, with mortality rates reaching as high as 40% in cases of hospital-acquired MDR infections [18].Gram-negative and Gram-positive bacteria are among the most significant microorganisms found in hospital environments, responsible for various infections in inpatients, including urinary tract infections, respiratory tract infections, burn infections, and bloodstream infections [19, 20]. Patients and healthcare professionals may abuse antimicrobial agents as a result of inadequate AMR surveillance, posing serious healthcare problems. About 33.53% of the organisms recovered from culture media in this investigation were E. coli, followed by

Klebsiella spp. and Staphylococcus aureus (MRSA). Conversely, a 2019 study carried out in Baghdad discovered that, at roughly 19.5%, Staphylococcus aureus was the most common bacterium recovered from culture medium, followed by E. coli and Klebsiella pneumoniae [21]. According to this study, urinary tract infections (UTIs) were more common in females than in males, and both genders' rates increased with age [22]. E. coli isolation was also more common in female urine samples. E. coli showed the highest resistance rates to cephalothin, cefpodoxime, cefuroxime, cefoxitin, cefixime, ceftazidime, and cefotaxime, regardless of the kind of specimen. On the other hand, nitrofurantoin, amikacin, vancomycin, imipenem, meropenem, and lincomycin had decreased resistance rates. Amoxicillin, Cefoperazone, Cefuroxime, Cefotaxime, Rifampin, Norfloxacin, Doxycycline, and Tetracycline were among the antibiotics to which E. coli shown resistance in 2021 research conducted in Basrah; nevertheless, the antibiotics with the lowest percentages of resistance were Imipenem, Amikacin, Nitrofurantoin, and Gentamicin [23]. Therefore, the best choices for treating this bacterium are imipenem, amikacin, and nitrofurantoin. The antimicrobial sensitivity analysis of urine samples indicated that E. coli isolates were highly sensitive to Lincomycin, Clindamycin, Imipenem, Vancomycin, Meropenem, Netilmicin, Amikacin, Piperacillin, Nitrofurantoin, Ticarcillin, and Erythromycin, while showing resistance to Cefpodoxime, Cefoxitin, Cefixime, Tetracycline, Cephalothin, and Cefuroxime. According to a 2020 study done in Duhok, E. coli isolates from urine were resistant to ampicillin, cefepime, and ceftriaxone but significantly sensitive to ertapenem and imipenem [24]. In wound swabs, the most prevalent pathogens identified were Staphylococcus aureus (MRSA), E. coli, Pseudomonas spp., Acinetobacter spp., and Klebsiella spp. While another study in Kirkuk 2019 identified E. Coli, Klebsiella, and Citrobacter, Proteus, Staphylococcus aureus, and Staphylococcus epidermidis prevalent bacterial infection from wound [25]. Due to its resistance to the majority of medications, Staphylococcus aureus (MRSA) is a difficult-to-treat source of staph infections [26]. Additionally, hospitals and other healthcare facilities, as well as the neighborhood where you live, work, and attend school, can harbor Staph infections, including those brought on by MRSA. Serious infections brought on by MRSA have the potential to cause sepsis or even death [23]. MRSA was the most common pathogen in wound swabs, blood, and urine specimens in our investigation, whereas Staphylococcus aureus was the primary growth in ear, throat, and wound swabs in the Baghdad study 2019 [21]. According to this study, MRSA had the lowest rates of resistance to imipenem, meropenem, nitrofurantoin, and rifampicin. Nitrofurantoin, Doxycycline, Levofloxacin, and Rifampicin were found to have the lowest MRSA resistance rates in the Basra study [23]. Additionally, with a 10% resistance rate, Rifampicin was found to be the most effective antibiotic against MRSA in wound samples and is advised as the optimal course of treatment for wound infections [25]. Klebsiella spp., which were resistant to almost all antibiotics, were mostly isolated from blood, sputum, and urine samples for this investigation. Due in part to the difficulty of precisely identifying K. pneumoniae in laboratory conditions, this bacterium is considered an opportunistic pathogen and the primary cause of nosocomial infections [27]. In response to the growing worldwide issue of antimicrobial resistance, the World Health Organization has designated Klebsiella pneumoniae as a high-priority species and encourages the discovery of novel antibiotics [28]. According to recommendations made by the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), doctors should only give antibiotics when required [29]. The results show that outpatients, who made up around 84% of our patient data, had a notably high proportion of bacterial resistance in their cultures. There are other reasons for this alarming trend. Since broad-spectrum antibiotics treat a variety of bacteria, including both good and harmful types, many doctors frequently administer them before culture results are available, which can encourage resistance. The situation is further made worse by the availability of over-the-counter (OTC) antibiotics, which pharmacists can prescribe without a prescription [8,11,30-33]. Antibiotics and other prescription-only medicines (POM) are readily available without a prescription in Iraq, even though the Ministry of Health (MOH) has issued stringent restrictions regulating their use. As a result, self-medication with antibiotics is highly prevalent [34]. Uncontrolled access to antibiotics raises the possibility of abuse and overuse, which eventually fuels the community's growing resistance rates.

Conclusion

The study highlights a concerning trend of increased antimicrobial resistance (AMR) to commonly used antibiotics among patients in Kirkuk. To address this issue effectively and safeguard the efficacy of antibiotics, the following concrete.

Recommendations are proposed:1-Hospital Antibiotic Policies: to ensure that antibiotics are used appropriately, hospitals should create and enforce standardized antibiotic stewardship policies.2. Prospective Research Paths: carry out additional research on particular infections that are common in the area. Investigate how different interventions, such as public education campaigns and policy reforms, affect the decline in AMR rates.3. Public awareness strategies include: Educational Campaigns: Start public health initiatives to inform the public about the dangers of antibiotic abuse and the significance of following treatment recommendations. And make readily available resources, including pamphlets and internet content, that describe the risks of self-medication and the necessity of using antibiotics appropriately.

Limitations: There was only one governorate included in this study. More thorough results would be obtained if the survey was expanded to cover more Iraqi governorates. Furthermore, certain antibiotic sensitivity tests are limited to a small number of antibiotic kinds and do not cover all of them, which affects the accuracy of the results. Consequently, care should be taken when extrapolating the results of this study to other people.

Table 1. Socio-demographic Isolates, the Pathogen types of all individuals

Age (mean ± SD)		**39 ± 17 years**
Gender (N, %)	Male Female	160 (32.1%) **338 (67.9%)**
Department (N, %)	Internal medicine Department Surgical Department Obstetrics and Gynecology Department Orthopedics and Burns Department Respiratory care unit Emergency Department Cardiac care unit Oncology Department Outpatients (O.P)	14 (2.81%) 14 (2.81%) 1 (0.2%) 9 (1.8%) 10 (2%) 25 (5%) 2 (0.4%) 4 (0.8%) **419 (84.1%)**
Isolates (N, %)	Urine Blood High vaginal swab Groin swab Appendectomy fluid Throat swab Nasal swab Tracheostomy tube swab Ear swab Sputum Abdomen abscess Cerebrospinal fluid (Acid-fast bacillus) sputum Skin scrape Wound swap Ovarian cyst Cardiovascular line Stool Semen Breast abscess	**301 (60.44%)** **33 (6.62%)** **25 (5.02%)** 1 (0.2%) 1 (0.2%) 4 (0.8%) 4 (0.8%) 4 (0.8%) 5 (1%) **31 (6.22%)** 9 (1.8%) 1 (0.2%) 6 (1.2%) 3 (0.6%) **43 (8.63%)** 7 (1.4%) 3 (0.6%) 9 (1.8%) 6 (1.2%) 2 (0.4%)

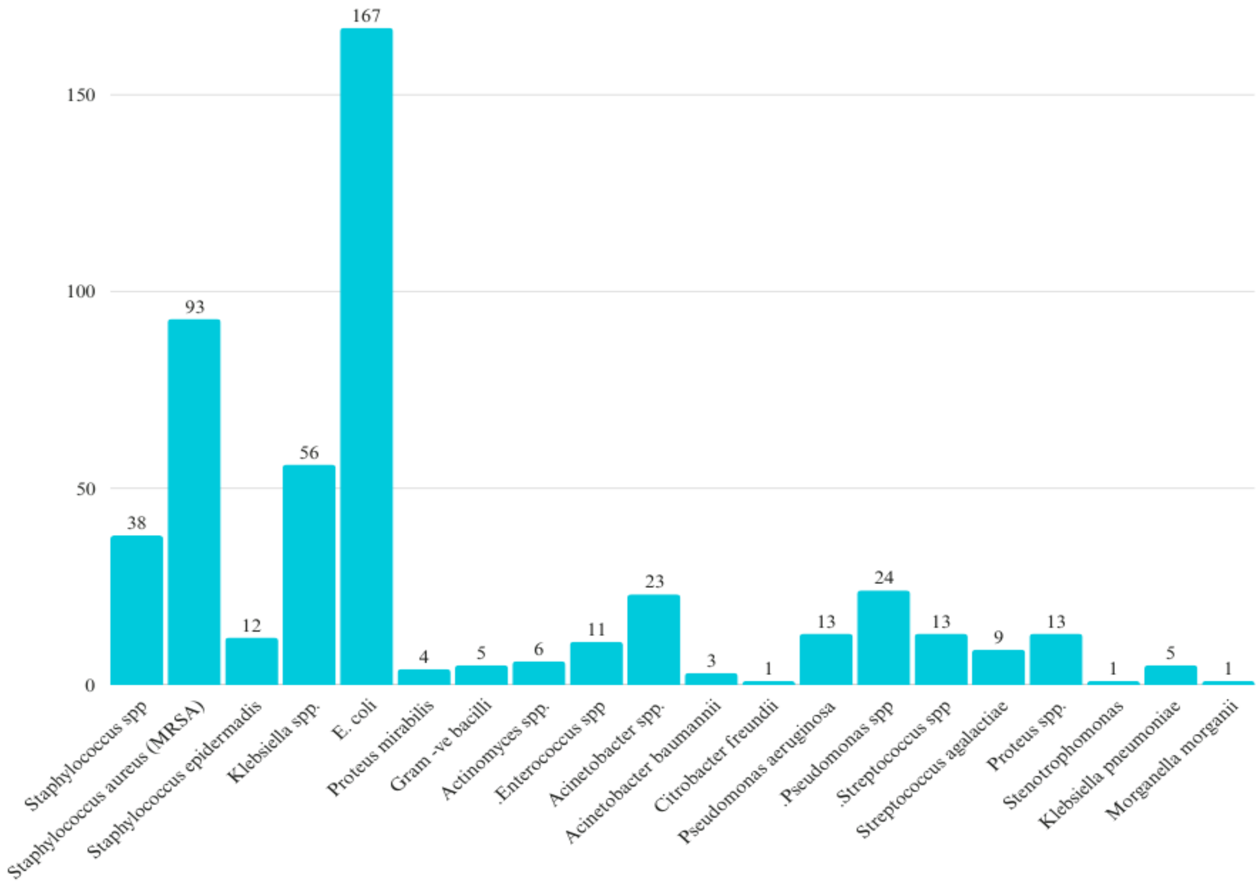

Figure 1: Distribution of the isolated pathogens.

Table 2. Distribution of the main isolated specimen types and top six pathogens.

Specimen	N, %	N, %	N, %	N, %	N, %	N, %
Urine (n= 301)	**E. coli** 133 (44.2%)	**Staphylococcus aureus (MRSA)** 49(16.2%)	**Klebsiella spp.** 30(9.9%)	**Staphylococcus spp.** 25(8.3%)	**Pseudomonas spp.** 15(4.9%)	**Acinetobacte r spp.** 12(3.98%)
Wound swap (n=43)	**Staphylococcus aureus (MRSA)** 12(27.9%)	**E. coli** 8(18.6%)	**Pseudomonas spp.** 5(11.6%)	**Klebsiella spp.** 4(9.3%)	**Acinetobacter spp.** 4(9.3%)	**Staphylococc us spp.** 3(6.97%)
Blood (n=33)	**Staphylococcus aureus (MRSA)** 13(39.3%)	**Klebsiella spp.** 6(18.1%)	**E. coli** 5(15.1%)	**Pseudomonas spp.** 4(12.1%)	**Staphylococcus spp.** 2(6.06%)	**Acinetobacte r spp.** 1(3.03%)
Sputum (n=31)	**Klebsiella spp.** 7(22.5%)	**Staphylococcus aureus (MRSA)** 4(12.9%)	**Pseudomonas spp.** 4(12.9%)	**Staphylococcus epidermidis** 3(9.67%)	**E. coli** 3(9.67%)	**Streptococcus spp.** 3(9.67%)
High vaginal swab (n=25)	**E. coli** 7(28%)	**Streptococcus agalactiae** 6 (24%)	**Klebsiella spp.** 5(20%)	**Proteus spp.** 2(8%)	**Staphylococcus aureus (MRSA)** 2(8%)	**Staphylococc us spp.** 1(4%)

Table 3. The pattern of AMR in the top three bacteria isolated (E. coli, Staphylococcus aureus (MRSA), and Klebsiella spp.

Antibiotics	E. coli 167	Staphylococcus aureus (MRSA) 93	Klebsiella spp. 61
Amoxicillin/clavulanic acid	68.6%	71.5%	68.3%
Amoxicillin	75%	N/T	N/T
Amikacin	16.6%*	39%	50%
Azithromycin	**80.4%**	**89%**	**85.3%**
Aztreonam	69.4%	50%	78.9%
Ciprofloxacin	57%	64%	51.85%
Cefotaxime	**80.5%**	**80.8%**	62.5%
Ceftriaxone	77.3%	**89%**	68%
Ceftazidime	**81.4%**	**87.5%**	66.7%
Chloramphenicol	25%*	21.8%*	50%
Cefixime	**85.6%**	**91.7%**	78%
Doxycycline	48.3%	48.8%	75.6%
Netilmicin	16%*	28.6%*	43%
Levofloxacin	41.3%	258%	61.5%
Cefepime	68.5%	56.25%	71.1%
Ampicillin +cloxacillin	33.3%	N/T	62.5%
Cefoxitin	**93%**	78.7%	**90%**
Sulfamethoxazole /trimethoprim	62.2%	60%	72.5%
Erythromycin	40%	73.3%	75%
Gentamycin	51.5%	56.25%	66.7%
Imipenem	14.6%*	20%*	47.8%
Meropenem	16.5%*	27.8%*	37.8%
Nalidixic acid	70%	62.5%	62.5%
Nitrofurantoin	27.4%*	16%*	60%
Norfloxacin	53%	**85.2%**	57.1%
Clindamycin	N/T	54.4%	N/T
Penicillin	58%	**95%**	**80%**
Piperacillin	58.3%	N/T	40%
Tetracycline	**80.5%**	68.6%	**79.16%**
Ticarcillin	50%	N/T	N/T
Lincomycin	0%*	N/T	N/T
Vancomycin	18.2%*	N/T	N/T
Cephalothin	**100%**	N/T	N/T
Rifampicin	44.5%	7.7%*	N/T
Colistin	41.7%	N/T	N/T
Tobramycin	55.5%	N/T	N/T
Cefuroxime	**93%**	**87.5%**	**80%**
Cefpodoxime	**98%**	N/T	**87.5%**

Bold: above 80% resistance.
***:** Below 30% resistance.
N/T: Not tested.

Table 4. The Occurrence of Escherichia coli Isolated from Various Clinical Specimens Based on gender

Source of isolation	Total No. (%)	Male (No.%)	Female (No.%)
Urine	133 (79.6%)	31 (23.3%)	102 (76.7%)
Wound swap	8 (4.8%)	4 (50%)	4 (50%)
High Vaginal swap	7 (4.2%)	0 (0%)	7 (100%)
Blood	5 (2.9%)	2 (40%)	3 (60%)
Stool	5 (2.9%)	1 (20%)	4 (80%)
Sputum	3 (1.8%)	3 (100%)	0 (0%)
Abdomen abscess	2 (1.2%)	0 (0%)	2 (100%)

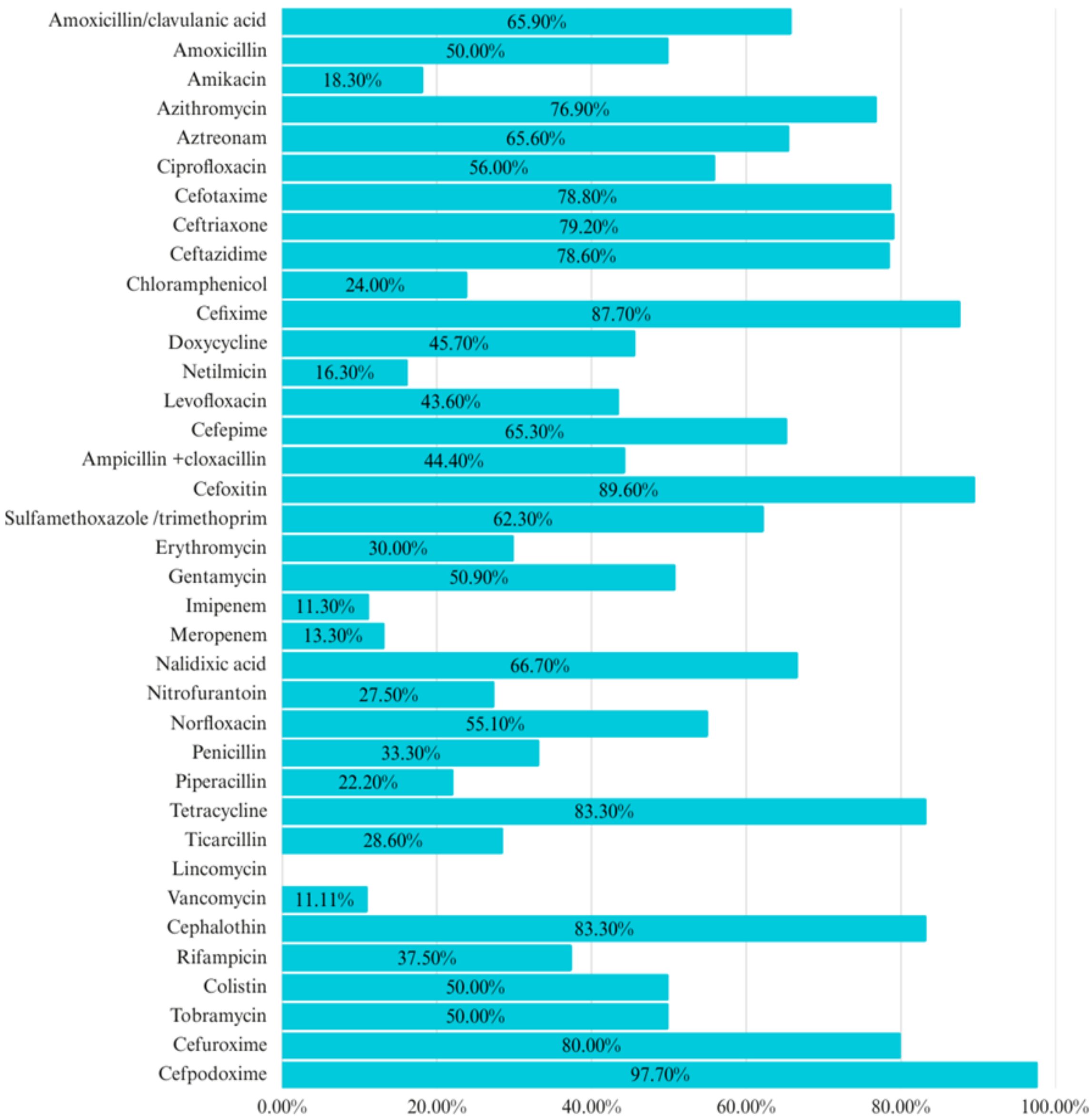

Figure 2. Overall Antimicrobial Resistance Patterns of Escherichia *coli* Isolated from Urine Specimens.

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