RESEARCH PAPER

Analysis of Multidrug Resistance Patterns Across Various Clinical Samples and Their Sensitivity Profiles

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ABSTRACT

UTIs are one of the most widespread examples of bacterial infection in women, especially in pregnancy, and they are becoming more complex due to the development of antibiotic resistance. The aim of the current research was to examine uropathogen distribution, assess the trend of antibiotic susceptibility, and determine the prevalence of the multidrug-resistant (MDR) organisms in clinical isolates. The study involved 766 participants of which 323 were confirmed to have UTI through microbiological examination. Standard culture techniques were used to identify the bacteria isolates, whereas the disc diffusion method was used to determine the susceptibility of bacteria to antibiotics. The findings revealed that the most common pathogen was Escherichia coli that constituted 51.70 percent of the isolates. Analysis of the antibiotic susceptibility revealed that the most effective ones were Fosfomycin and Nitrofurantoin, whereas the highest resistance was to Ciprofloxacin and Amoxicillin-Clavulanate. Around 30.03 percent of isolates were high multidrug resistant. These results indicate the increasing problem of antimicrobial resistance and the significance of regular susceptibility testing and supported antibiotic therapy in successful treatment of urinary tract infections.

Keywords: Urinary tract infection, antimicrobial resistance, multidrug resistance, uropathogen, antibiotic susceptibility.

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1. Introduction

Bacterial infections are a primary source of morbidity and mortality in the world and are generally diagnosed by examining different clinical samples including urine, blood, sputum, pus, and wound swabs. The clinical samples are significant in determining the presence of pathogenic microorganisms that cause infectious diseases and also assist in the determination of relevant antimicrobial therapy. The clinical samples often contain several bacterial pathogens Escherichia coli, Klebsiella spp., Proteus spp., Enterobacter spp. and Staphylococcus spp. are considered to be associated with infections of the urinary tract, respiratory system, bloodstream, and soft tissues. Such microorganisms have various virulence factors that ensure they can colonize the host tissues, epithelial surfaces, avoid the host immune response and develop permanent infections. Escherichia coli is considered one of the most prevalent agents of this category of pathogens and has been linked with 70-95% of some infections, especially those related to the disease of the urinary tract among other clinical manifestations. The bacterial pathogens can also produce toxins and develop biofilms that shield them against the host immune system and antimicrobial therapy that enable the bacterium to persist or reoccur. The fire rate of bacterial infections in hospital environments as well as communal environments has been a significant burden to healthcare systems throughout the world. According to the research, healthcare-associated infections seem to be very common with the percentage of affected hospitalized patients in the developed countries reported as 7-10 percent, and 15 percent in developing regions, meaning that the problem of antimicrobial resistance is one of the most urgent in contemporary medicine. The extensive and largely irrational use of antibiotics in clinical practice has increased the rate at which there is the emergence of resistant bacteria strains, which have minimized the

efficacy of most of the available antimicrobial agents. Resistance is a situation whereby the bacteria develop mechanisms that enable them to survive the exposure of antibiotics that formerly killed them. Such processes are genetic mutation, horizontal gene transfer, enzyme breakdown of antibiotics, drug-target modification, and reduced bacterial cell membrane permeability. According to reports of global surveillance, antimicrobial resistance has been the cause of numerous treatment failures and prolonged infections across the world. Recent research findings suggest that infections with antimicrobial resistance result in millions of deaths each year and raise the cost of health care with prolonged hospitalization and more complicated treatment measures. A more worrying resistance phenomenon is the multidrug resistance (MDR) that is the resistance to several antibiotic classes at the same time exhibited by bacterial pathogens. Multidrug-resistant organisms have gained prominence in clinical environments and have become a significant problem in effective management of infection. Other research studies performed in various healthcare facilities have indicated that the percentage of multidrug-resistant bacterial isolates of clinical samples may reach up to 20 percent to over 60 percent, based on regional and geographical locations to trends in antibiotic use. The development of MDR bacteria to a large extent is linked to the misuse and overuse of antibiotics, poor infection control measures and spread of resistance genes by bacterial populations at a high rate. Bacteria which are able to build biofilms and survive in host tissues also complicate treatment as the protecting mechanisms give bacterial isolates resistance and susceptibility of specific antimicrobial agents. Cultures, identification of bacterial susceptibility to antibiotics, and other laboratory methods can help to obtain the necessary data about antibiotic therapy choice and avoid unnecessary use of insufficiently effective drugs. Observing the profile of antibiotic sensitivity in bacterial pathogens isolated in clinical samples is also used to detect the trends of emerging resistance and assist in antimicrobial stewardship programs that help to promote rational use of antibiotics. Constant monitoring of multidrug resistance among various clinical isolates is thus crucial in enhancing the control of infections, therapeutic decision making as well as the prevention of the transmission of resistant bacterial pathogens in the healthcare sector.

1.2 Research Gap and Study Significance

UTIs are frequent pregnancy complications that still pose a serious issue because of the complications they may cause to the fetus and the mother. Despite a number of studies being conducted on UTIs and their treatment in the clinical setting, few studies have undertaken an in-depth analysis of the bacterial profiles of UTIs in pregnant women and their response to the antibiotics. The growing antimicrobial resistance in the known uropathogenic pathogens, including Escherichia coli, Klebsiella, and Proteus, has further complicated the treatment options as well as cast doubts on the efficacy of traditional antimicrobial treatment. In most clinical facilities, there is a lack of updated local information on trends of pathogen distribution and resistance, and this could result in incorrect empirical treatment. Also, there is increasing relevance of searching a safer and more efficient therapeutic option due to the rising incidence of antibiotic resistance. Thus, the given work is vital because it will determine the bacteria pathogens that cause UTIs among pregnant women, identify their antimicrobial resistance profiles, and add great value that can be used to help develop more effective diagnostic, treatment, and infection control measures in clinical practice.

1.3 Objectives of the Study

1. To separate and detect bacterial pathogens in different clinical specimens by conventional methods of microbiology.
2. To establish the multidrug resistance (MDR) patterns of bacterial isolates of these clinical specimens.
3. To determine the antibiotic sensitivity patterns of the identified pathogens to inform successful antimicrobial treatment and enhance the management of the infection.

2. Materials and Methodology

2.1 Design and Methodological Approach to the study.

The current paper was developed as a laboratory cross-sectional study with analytical features and was intended to measure the levels of multidrug resistance in bacterial pathogens collected on different types of clinical samples and determine their sensitivity profiles to antibiotics. The design of methodology was such that it produced clinically relevant data of the prevalence of bacterial isolates, level of antimicrobial resistance, as well as the relative efficacy of commonly employed antibiotics. Instead of carrying out the study to identify bacterial samples, the study combined microbiological isolation, phenotypic characterization, antimicrobial susceptibility tests, and

statistical analysis to bring about an in-depth perspective of the resistance trends in clinical practice. This method was deemed to be suitable as it allowed the simultaneous measurement of prevalence, resistance burden, and sensitivity pattern of different types of samples, which facilitated the use of evidence-based therapies in healthcare delivery. The design was also in line with the overriding aim of the study which was to discover new multidrug-resistant organisms and determine the consequences of their implications on infection management. The approach was largely quantitative in nature and attracted more to descriptive and comparative analysis of laboratory results. This framework offered a powerful foundation regarding the interpretation of bacterial response in the context of drugs as a standard approach and the indication of the increasing problem of antimicrobial resistance in everyday clinical microbiology.

2.2 Study Area and Duration

The research was conducted in a clinical microbiology laboratory, which was a part of a medical facility, and the daily clinical diagnostic infections are made. Clinical samples of bacterial isolates on diverse clinical diseases are received in large numbers in the laboratory by various hospital units and outpatient departments, making the laboratory an appropriate location to study the bacterial isolates. The experiment was done within a given time frame whereby samples were gathered, cultivated, identified and examined based on conventional microbiological protocols. Having the study in a functioning diagnostic laboratory made sure that the results were a true reflection of actual clinical situations and current trends in antimicrobial resistance levels that were experienced in the care of patients.

2.3 Collection of Clinical Samples

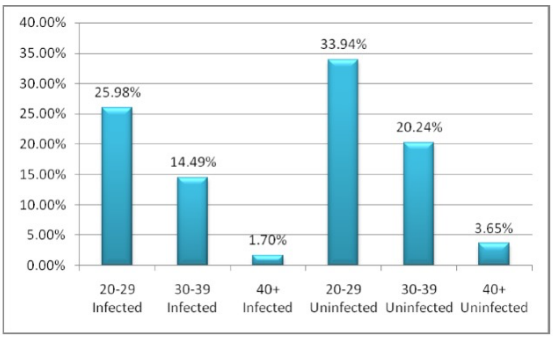
Clinical samples of diverse type such as urine, blood, sputum, pus, and wound swabs were taken on patients with possible bacterial infections. To reduce contamination, all specimens were collected according to standard aseptic methods in order to maintain microbiological results. All the samples were placed in sterile containers and labelled and immediately taken to the laboratory to undertake. Handling of the specimen was done appropriately and transportation was done in good time to preserve the viability of organisms and reliability of culture findings. The multiplicity of sample types was useful in estimating a wider range of bacterial triggers of infection in various anatomical locations.

3.4 Bacterial Pathogen Isolation and Identification.

The isolates obtained were treated through conventional microbiological techniques of isolating and identifying bacterial pathogens. The samples were inoculated on the relevant culture media like MacConkey agar, blood agar and nutrient agar based on the nature of the specimen or the pathogen under suspicion. Inoculated plates were incubated at 37 o C in a period of 18-24 hours and growth was observed in terms of morphology of colonies, size, pigmentation, haemolytic pattern and lactose fermentation properties where necessary. Gram staining was used to identify the preliminarily and this was followed by a series of biochemical tests to identify the species of bacteria. Such procedures made it possible to identify clinically significant pathogens that are commonly related to infections, such as Gram-negative and Gram-positive bacteria. The correct identification of the organisms was needed as it was the foundation of further antimicrobial susceptibility test and resistance profiling.

4. Results

4.1 Age Distribution of Infection among the participants of study.



The age distribution of infection among the participants of the study was examined with the aim of coming up with the age-maternal age relationship and the prevalence of urinary tract infections. The findings showed that women in the 20-29 years age bracket were more infected and this is the most active reproductive age group. The number of infected participants in this group was 199 (25.98%), and the number of uninfected participants was 260 (33.94%), which indicates that the risk of infection in this age group is relatively high, but a significant percentage of uninfected participants was also observed. The infection rate was moderate among 302 participants in 30 years of age and 302 participants in 39 years of age with the prevalence of infection among 111 and 155 individuals respectively. The proportion of young people with infection was also lower in the older age groups since among people aged 40 years and older only 13 persons (1.70) were infected and 28 persons (3.65%) were uninfected. In general, the cumulative

distribution revealed that 323 (42.17) participants were infected whereas 443 (57.83%) participants are not infected out of the 766 respondents who are considered in the study. The cumulative percentage also shows the distribution of the infection status of the various age groups. These results indicate that women belonging to the younger reproductive age group seem to be more exposed to infection, which may be attributed to physiological and behavioral aspects related to the reproductive health. The fact that there was however a significant percentage of uninfected respondents of the same age group though is a pointer that age in itself is not a determinant of whether one is infected. The relative distribution between the infected and uninfected people in the various age groups is depicted in Figure 1 which gives a pictorial display of the correlation between age and infection status.

4.2 Trimester-specific Distribution of Infection among the participants.

The prevalence of urinary tract infection among the participants was further done based on the trimester of pregnancy in an attempt to establish whether the prevalence of infection differed among different stages in gestation. The findings show that infection was present in all the three trimesters but there was a variation in the rates. During the first trimester, 82 (10.71) participants were infected and 132 (17.23) participants were uninfected, which is not a high infection level in early pregnancy. During the second trimester, 143 participants (18.67) were infected and this was the highest percentage of infection cases in all the trimesters with 184 participants (24.02) being uninfected. This implies that women are a little bit more vulnerable to urinary tract infections in the mid-pregnancy period. During the third trimester, the amount of infected (98) and uninfected (127) participants has a percentage of 12.80 and 16.57, respectively, indicating that the prevalence of infection is still significant during the latter part of pregnancy. In general, the results prove that UTI is distributed during pregnancy, not limited to any particular trimester. The existence of the uninfected and infected individuals in each trimester is also indicative of the fact that a number of physiological, hormonal and behavioral factors might be at play in determining the presence of infection during pregnancy. Table 1 represents the detailed presentation of infection status throughout the three trimesters, whereas Figure 2 presents the graphical representation of the comparative presentation of the individuals who were infected and those who were not throughout the energy levels of pregnancy.

Table 1: Trimester vs Infection Status

Category	Frequency	Percentage	Valid Percentage
First Trimester Infected	82	10.71%	10.71
Second Trimester Infected	143	18.67%	18.67
Third Trimester Infected	98	12.80%	12.80
First Trimester Uninfected	132	17.23%	17.23
Second Trimester Uninfected	184	24.02%	24.02
Third Trimester Uninfected	127	16.57%	16.57
Total	766	100%	100%

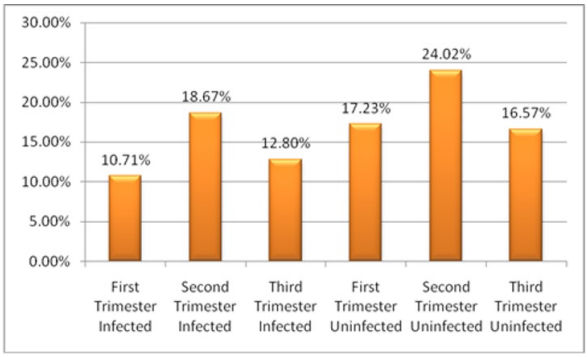
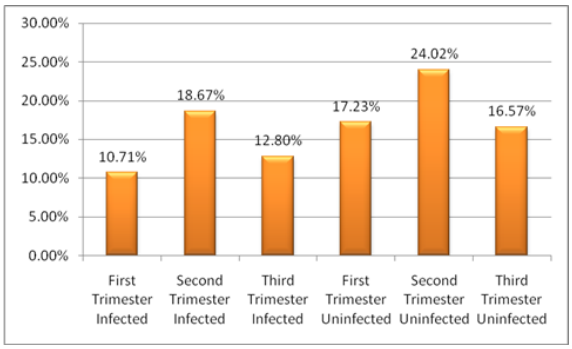


Figure 2: Trimester vs Infection Status



4.3 Prevalence of Urinary Tract Infection among Participants

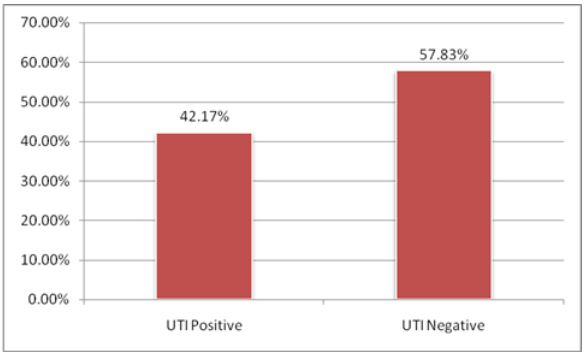
The incidence of urinary tract infection amongst the research participants was measured to identify the total burden of infection among the population that is being used in the study. The data indicated that among the entire participants 766, 323 people (42.17%) had urinary tract infection and 443 people (57.83%) were not infected. These values demonstrate that even though most of the participants were not infected, a significant percentage of pregnant women had urinary tract infection at the time when the study was conducted. The fact that over two-fifths of the participants had a presence of infection indicates the clinical value of UTI in pregnancy and the relevance of early diagnosis, regular screening, and proper treatment. The data, furthermore, indicate that UTIs are a frequent health issue in pregnant women, and may have a potential to impact maternal comfort and pregnancy outcomes in case they are not managed in a proper manner. The relative distribution between the

infected and the non-infected participants gives a better picture of the burden of infection among study population. Table 2 shows the detailed numerical distribution of UTI-positive and UTI-negative cases, whereas the graphical representation of the proportion of those infected and not infected participants is drawn in Figure 3, which graphically depicts the prevalence pattern of urinary tract infection among the participants, who took part in the study.

Table 2: UTI Positive vs Negative (n = 766)

Status	Frequency	Percentage	Valid Percentage	Cumulative Percentage (%)
UTI Positive	323	42.17%	42.17	42.17
UTI Negative	443	57.83%	57.83	100.00
Total	766	100%	100%	

Figure 2: UTI Positive vs Negative (n = 766)

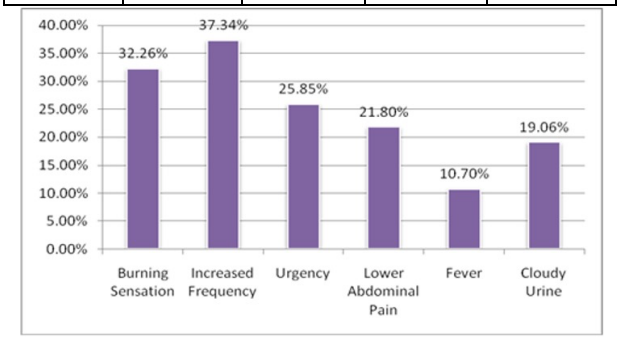


4.4 Prevalence of Clinical Symptom among the UTI patients.

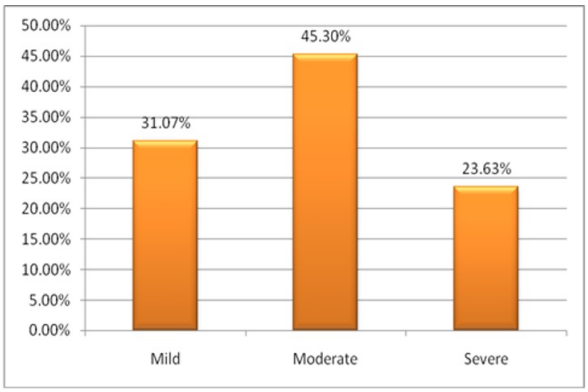
The commonality of the clinical symptoms of the participants diagnosed with urinary tract infection was determined in order to understand the most frequently reported symptoms of the disease. The findings show that the most common symptom was increased frequency of urination which was identified in 286 participants (37.34) and can be considered a major clinical sign of infection. The next thing that was reported was that 247 participants had burning during urination (32.26%), which indicates irritation and inflammation of the urinary tract. The urgency of urination was reported by 198 participants (25.85%), and lower abdominal pain was reported by 167 participants (21.80%), which means moderate discomfort in relation to infection. Also, it was found out that cloudy urine was present in 146 participants (19.06%), and it could indicate the presence of bacterial infection and inflammatory alterations in the urinary tract. The most uncommon symptom among the respondents was fever as it was reported in 82 participants (10.70%). Such results imply that the majority of the urinary tract infections in the population under study were manifested by local urinary symptoms and not by serious systemic manifestations. The extensive distribution of these symptoms among the participants is reported in Table 3, whereas the graphic display showing the relative frequency of various symptoms is left in Figure 4 as it evidently demonstrates that the most common symptom among the participants is the increased urinary frequency and the burning sensation.

Table 4.10: Frequency of UTI Symptoms

Symptom	Frequency	Percentage	Valid Percentage	Cumulative Percentage (%)
Burning Sensation	247	32.26%	32.26	32.26
Increased Frequency	286	37.34%	37.34	69.60
Urgency	198	25.85%	25.85	95.45
Lower Abdominal Pain	167	21.80%	21.80	117.25
Fever	82	10.70%	10.70	127.95
Cloudy Urine	146	19.06%	19.06	147.01
Total	766	100%	100%	



4.5 Distribution of UTI Symptoms by degree of severity.

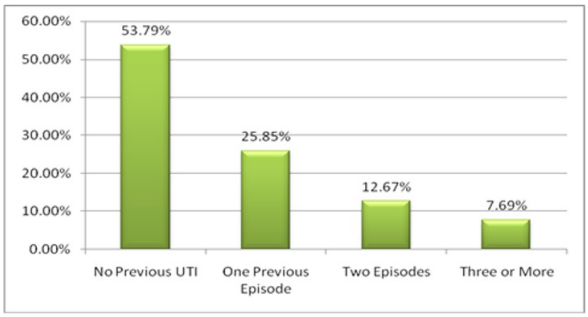


The symptoms of the urinary tract infection in the participants were assessed to learn the overall clinical severity of the condition among the study population. The findings show that the most prevalent levels were moderate, as they were recorded in 347 respondents (45.30%), which is why such a significant percentage of the population experienced distinguishable symptoms, which needed medical intervention, but were not that severe. A total of 238 participants (31.07%), reported mild symptoms meaning that quite a number of the cases were characterized by relatively few symptoms and could have been identified during routine screening or early clinical examination. Conversely, only 181 participants (23.63% of the total number) had severe symptoms, which proves that about a quarter of the respondents had a major clinical distress related to suffering a urinary tract infection. The distribution pattern indicates that even though there were many cases of moderate nature infection, a significant percentage of cases still developed to a more severe manifestation and it is important to note the urgent need of early diagnosis and treatment to avoid complications. The numerical distribution of the symptom severity between the participants is provided in Table 4, and the graphical representation showing the proportions of mild, moderate, and severe symptom severity is shown in Figure 5, where the one can see the visual illustration of the prevalence of the moderate cases of the symptoms in the affected population.

Table 4: Symptom Severity Index

Severity Level	Frequency	Percentage	Valid Percentage	Cumulative Percentage (%)
Mild	238	31.07%	31.07	31.07
Moderate	347	45.30%	45.30	76.37
Severe	181	23.63%	23.63	100.00
Total	766	100%	100%	

4.6 History of Past UTI Episodes among the participants.



The previous history of episodes of urinary tract infection of the participants was examined to comprehend the pattern of recurrence of UTIs in the study group. The findings show a significant number of respondents 412 (53.79) reported having no history of urinary tract infection in the past meaning that more than half of them were first-time infections during pregnancy. Nonetheless, the percentage of reported previous episodes of infection was quite high, with 198 participants (25.85%) having one episode of infection in the past, which means that the problem of infection recurrence is rather widespread among pregnant women. Moreover, 97 participants (12.67) had undergone two past instances, and 59 participants (7.69) had undergone three or more instances of infection, which indicated that a smaller but clinically significant cohort of participants had recurrent UTIs. These results indicate that as much as there are a lot of cases where infections happen as isolated cases, a considerable number of women are prone to recurrent infections and this could depend on factors like personal hygiene, changes in the anatomy during pregnancy, immune system and the history of past infections. The existence of recurrent UTIs raises the necessity of preventive measures and the clinical follow-up of the pregnancy to minimize the chances of the frequent occurrence of the infection. Table 5 gives the specific distribution of past UTI history among the participants, whereas Figure 6 presents the graphical account of the percentage of participants based on the number of past episodes of infections, which gives a clear visual comparison of recurrence patterns of the study population.

Table 5: Past UTI Episodes

History of UTI	Frequency	Percentage	Valid Percentage	Cumulative Percentage (%)
No Previous UTI	412	53.79%	53.79	53.79

One Previous Episode	198	25.85%	25.85	79.64
Two Episodes	97	12.67%	12.67	92.31
Three or More	59	7.69%	7.69	100.00
Total	766	100%	100%	

4.7 Multidrug Resistance (MDR) and Analysis.

The susceptibility and resistance patterns of bacteria isolates to antibiotics were assessed in order to determine the efficacy of the commonly used antimicrobial agents and to determine the prevalence of the multidrug resistance organisms in the isolates obtained after cases of urinary tract infections. The general 323-bacterial isolates infection profile showed different rates of effectiveness of the used antibiotics as shown in Table 6.

Table 6: Overall Antibiotic Sensitivity Matrix (n = 323 isolates)

Antibiotic	Sensitive (n)	Intermediate (n)	Resistant (n)	Sensitivity (%)
Nitrofurantoin	238	37	48	73.68
Amoxicillin-Clavulanate	189	46	88	58.51
Ceftriaxone	201	39	83	62.23
Ciprofloxacin	174	52	97	53.87
Gentamicin	212	41	70	65.63
Fosfomycin	247	28	48	76.47

Fosfomycin was found to have the highest sensitivity rate of 76.47 with a close second of Nitrofurantoin at 73.68, which means that these two antibiotics are still highly sensitive in most of the isolates within the study population. The semi-presence of gentamicin and Ceftriaxone was also mediocre, with the sensitivity rates of 65.63% and 62.23% respectively, indicating that these medications could also be regarded as alternative treatment means in some clinical cases. Comparatively, Ciprofloxacin and Amoxicillin-Clavulanate exhibited relative lower sensitivity of 53.87 and 58.51 per cent, which shows the development of resistance in a significant percentage of bacterial isolates. The pattern of resistance to the tested antibiotics is displayed in Table 7 showing that Ciprofloxacin was the most resistant with the resistance being 30.03, then Amoxicillin-Clavulanate with a resistance of 27.24 and Ceftriaxone with a resistance of 25.70.

Table 7: Antibiotic Resistance Pattern (n = 323 isolates)

Antibiotic	Resistant Isolates (n)	Resistance (%)
Nitrofurantoin	48	14.86
Amoxicillin-Clavulanate	88	27.24
Ceftriaxone	83	25.70
Ciprofloxacin	97	30.03
Gentamicin	70	21.67
Fosfomycin	48	14.86

Gentamicin had the highest resistance rate of 21.67% followed by Nitrofurantoin and Fosfomycin with the lowest resistant rate of 14.86, indicating the relatively preserved antimicrobial activity of the two. In order to further investigate the trend of resistance among the most common organisms in the study, Escherichia coli was further analysed regarding its pathogen-specific response to antibiotics. Table 8 displays the antibiotic sensitivity of E.

Table 4.24: Antibiotic Sensitivity of E. coli (n = 167 isolates)

Antibiotic	Sensitive (n)	Resistant (n)	Sensitivity (%)
Nitrofurantoin	134	33	80.24
Amoxicillin-Clavulanate	96	71	57.49
Ceftriaxone	108	59	64.67
Ciprofloxacin	87	80	52.10
Gentamicin	121	46	72.46%
Fosfomycin	139	28	83.23%

coli (n = 167 isolates), where Fosfomycin was the most sensitive (83.23%), then Nitrofurantoin was the next most sensitive (80.24%), which indicates that both are very effective to be used as first-line urinary antibiotics against E. coli. Gentamicin had a sensitivity rate of 72.46 and Ceftriaxone had been found to be moderately effective with a rate of 64.67. Ciprofloxacin however had the least sensitivity of 52.10 implying that there is rising resistance in E. coli isolates which may hamper its common usage in empirical treatment. Table 9 also summarized the sensitivity patterns of other uropathogens and are also assessed.

Table 9: Species-wise Sensitivity of Other Uropathogens (n = 156 isolates)

Pathogen	Sensitive Isolates (n)	Resistant Isolates (n)	Sensitivity (%)
Klebsiella spp.	38	25	60.32
Proteus spp.	24	17	58.54
Staphylococcus aureus	17	11	60.71
Enterococcus spp.	15	9	62.50

Enterococcus species exhibited the greatest sensitivity of 62.50, then Staphylococcus aureus and Klebsiella species exhibited a sensitivity of 60.71 and 60.32 respectively, with the lower sensitivity of the Proteus species at 58.54. Despite the fact that the differences between the species were not so great, the results helped to identify that the prevalence of multidrug resistant (MDR) bacterial isolates was moderate yet had an indication of gradual decrease. Table 10 shows that MDR and non-MDR isolates distribution is as follows 97 isolates (30.03) are characterized by multidrug resistance and 226 isolates (69.97) are non-MDR.

Table 10: Multidrug Resistance (MDR) vs Non-MDR Isolates (n = 323)

Category	Number of Isolates	Percentage (%)
MDR Isolates	97	30.03%
Non-MDR Isolates	226	69.97%

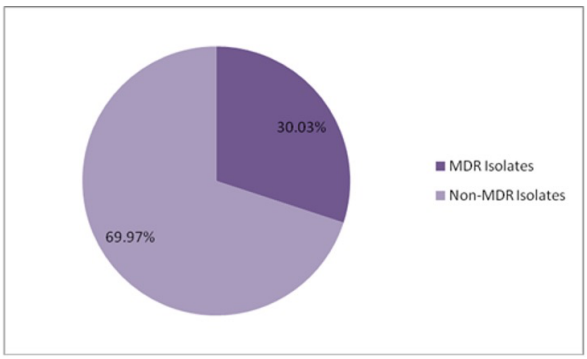


Figure 7 also shows this distribution and thus it is clear that most of the isolates were susceptible to the normal treatment yet close to a third of infections were associated with multidrug resistant bacteria which is a major clinical issue. Statistical analysis was also employed to generate the relationship between the type of pathogen and the resistance to antibiotics and the findings were tabulated as given in Table 11. The chi-square value of 6.82 and a p-value of 0.033 is a statistically significant association between pathogen type and resistance pattern such that some bacteria species were found to be more susceptible to antibiotic resistance than others. Besides, the prevalence of MDR infections was evaluated based on the trimester of pregnancy to suspect that the pattern of resistance might be different in various gestation periods.

Table 11: Association Between Pathogen Type and Resistance (Chi-Square Analysis)

Variable	Chi-Square Value	Degrees of Freedom	p-value
Pathogen Type vs Resistance	6.82	3	0.033

The Table 12 presents the trimester-wise distribution of MDR cases whereas the figure illustrating this distribution is Figure 8. It was found out that the second trimester had the highest proportion of 42.27 MDR followed by the third trimester 30.93 MDR with the first trimester having the least proportion of 26.80. The results are also indicative that MDR infections can be experienced at any phase during pregnancy and they are not particular to a particular pregnancy trimester despite the fact that the differences were not extreme but medium. In general, the analysis of antibiotic resistance indicates the increasing burden of antimicrobial resistance in UTIs and the need to do constant surveillance and susceptibility testing to ensure proper use of antibiotics to treat an infection.

Table 12: Trimester vs MDR Occurrence (n = 97 MDR cases)

Trimester	MDR Cases (n)	Percentage (%)
First Trimester	26	26.80%
Second Trimester	41	42.27%
Third Trimester	30	30.93%

4.14 Summary of Research Findings and Hypothesis Testing

Research question and hypothesis analysis offered a holistic perspective on the role of the gathered data in fulfilling the goals of the research. The results demonstrate that the key research aims were justified by quantifiable evidence based on microbiological study, clinical observations and statistical testing. The mapping of findings showed that Escherichia coli was the most dominant uropathogen which included 51.70 percent of the bacterial isolates, which proved its leading role in urinary tract infection in the study group. The analysis of antibiotic susceptibility also demonstrated moderate resistance patterns with 30.03 of the total amount of isolates identified as multidrug

resistant (MDR) indicating that the burden of resistance is significant, but not overwhelming. The role of infection in maternal and fetal health was also discussed in clinical evaluation of which negative outcomes were observed in 121 cases as compared to 74 cases with no complications, which underscored the clinical significance of early detection and management. Besides the microbiological results, the assessment of treatment methods revealed that 73.37% of the patients improved clinically after treatment, which proves the efficacy of the implemented management interventions. Behavioral and awareness-related issues also were determined in the study as well indicating that 50.78 percent of respondents were willing to implement the suggested therapeutic or preventive strategies, which indicated a moderate awareness and favorable attitude to treatment interventions. Moreover, evidence-based management practices led to the recovery improvement of 30.37%, which showed the usefulness of clinical decision-making on the basis of guidelines. The summarization of these integrated findings is introduced in Table 13 that shows the results of the key research question and the outcomes of hypothesis testing. Statistical testing also proved that the entire hypothesis tested were significant with p-values of 0.001 to 0.027, which showed that the observed relationships were not as chances are high that all of them occurred by chance. All hypotheses are accepted, which indicates great coherence of the study design, collected information, and observed results, which supports the reliability of the research findings.

Table 13: Integrated Summary of Research Findings and Hypothesis Testing

Research Question / Hypothesis	Key Finding / Statement Tested	Supporting Data / Statistical Result	Decision
Predominant uropathogens	*E. coli* most common	51.70% of isolates	Supported
Antibiotic susceptibility patterns	Moderate resistance with MDR present	30.03% MDR isolates	Supported
Maternal–fetal complications	Higher adverse outcomes with UTI	121 vs 74 cases	Supported
Effectiveness of alternative therapies	Majority improved clinically	73.37% improvement	Supported
Awareness and treatment preferences	Moderate awareness with good acceptance	50.78% willing	Supported
Evidence-based management benefit	Recovery improved after guideline use	30.37% increase	Supported
H1	Difference in UTI prevalence between pregnant and non-pregnant women	$p = 0.015$	Accepted
H2	Association between pathogen type and antibiotic resistance	$p = 0.026$	Accepted
H3	Relationship between UTI and adverse maternal-fetal outcomes	$p = 0.001$	Accepted
H4	Effectiveness of alternative therapies in UTI management	$p = 0.027$	Accepted
H5	Correlation between awareness and willingness to use alternative therapy	$p = 0.001$	Accepted
H6	Improvement in outcomes after	$p = 0.012$	Accepted

	evidence-based clinical management		

5. Discussion

The current research gives valuable information concerning the trends in urinary tract infection, bacterial distribution and antibiotic resistance amongst the study participants. Among the key results of the research, it is necessary to note the rather high incidence of the urinary tract infection among the participants, which can be interpreted as the evidence that UTIs are still a prevalent issue in clinical practice, especially in the reproductive age group of women. The allocation of clinical samples and bacterial isolates proved that infections were observed in various demographic and physiological factors, such as the differences in age groups and pregnancy trimesters. The results also established Escherichia coli as the main uropathogen with other bacteria like Klebsiella species, Proteus species, Staphylococcus aureus and Enterococcus species coming in second position which is in line with the normal microbiological profile of UTI infections. The other important finding of the study was that there were multidrug resistant (MDR) organisms, and about one-third of the isolates were resistant to more than one antibiotic group. This shows that there is a growing tendency of antimicrobial resistance in the bacterial population and that there is a rising difficulty in controlling infections by using standard therapeutic agents. The analysis of the antibiotic susceptibility also showed that Fosfomycin and Nitrofurantoin were still the most effective antibiotics to most bacterial isolates, which indicated that both Fosfomycin and Nitrofurantoin can still be useful in the face of empirical treatment. Conversely, other antibiotics like Ciprofloxacin and Amoxicillin-Clavulanate were relatively less sensitive and this is exhibiting emerging resistance trends which may restrict their application in clinical practice. These results are generally in agreement with prior research studies which have indicated the growing resistance to more regularly used antibiotics, especially fluoroquinolones and even some beta-lactam antibiotics with older first-line urinary antibiotics retaining more favourable action against uropathogens. The fact that it compares with previous studies hence lends credence to the fact that antibiotic misuse and overuse can help in the emergence of resistant bacterial strains. Clinically and as a public health issue, the findings highlight the significance of regular antimicrobial susceptibility testing, the right use of antibiotics, and the on-going monitoring of the resistance trends to provide proper management of the urinary tract infection. The existence of multidrug resistant organisms also has an emphasis on the necessity to select antibiotics and preventive measures based on the evidence to minimize the recurrence of infection and the extent of spreading the resistant pathogen in medical institutions. On the whole, the results of the work under consideration provide important information to the existing body of knowledge regarding the patterns of bacterial resistance and help to create better clinical recommendations in treating UTI.

5. Discussion

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7. Limitations of the Study

Despite the fact that the current research has given some useful information on the incidence of urinary tract infection, distribution of bacteria, and resistance pattern of antibiotics, some shortcomings must be noted. One, the research was carried out in a small clinical environment and the study sample represented a given geographic location, thus limiting the applicability of the study to the general population. Second, the research was mainly based on the cultural-based identification of bacteria and antibiotic susceptibility testing; more complex molecular methods to identify resistance genes were not used because of the lack of resources. Third, the research used the isolates that were collected in the process of the study, which might not necessarily reflect the seasonal changes or the long-term resistance patterns. Moreover, the study primarily measured the frequently used antibiotics, and new antimicrobial agents were not measured. These drawbacks imply that the outcomes are to be viewed in the framework of the research design and resources at hand.

8. Future Research Directions

Future researchers would need to consider increasing the sample size and adding several healthcare facilities to get more representative data regarding the trends of urinary tract infections and antimicrobial resistance. The inclusion of molecular diagnostic tools like polymerase chain reaction (PCR) and genomic analysis would assist in the detection of specific resistance genes and mechanisms that make multidrug resistance. There can also be better understanding of the changing trends in resistance with time through longitudinal studies. Also, further studies might be able to assess the efficacy of other therapeutic options like new antimicrobial drugs, combination medications, and prophylactic measures. Further research of patient-associated risk factors, behavioral determinant factors, as well as environmental factors can add to the enhanced preventive and management strategies of urinary tract infections.

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10. Conflict of Interest

The authors state that they have no conflict of interest in publication of this study.

References

1. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nature Reviews Microbiology*. 2015;13(5):269–284.
2. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. *American Journal of Medicine*. 2002;113(1):5–13.
3. Gupta K, Hooton TM, Naber KG, et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women. *Clinical Infectious Diseases*. 2011;52(5):103–120.
4. Stamm WE, Norrby SR. Urinary tract infections: disease panorama and challenges. *Journal of Infectious Diseases*. 2001;183(S1):1–4.
5. Nicolle LE. Urinary tract infections in pregnancy. *Current Opinion in Infectious Diseases*. 2014;27(1):76–82.
6. Ronald A. The etiology of urinary tract infection: traditional and emerging pathogens. *American Journal of Medicine*. 2002;113(1):14–19.

7. Tadesse BT, Ashley EA, Ongarello S, et al. Antimicrobial resistance in Africa: a systematic review. *BMC Infectious Diseases*. 2017;17:616.
8. World Health Organization. Global action plan on antimicrobial resistance. WHO Press; 2015.
9. Ventola CL. The antibiotic resistance crisis: causes and threats. *Pharmacy and Therapeutics*. 2015;40(4):277–283.
10. Magiorakos AP, Srinivasan A, Carey RB, et al. Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria. *Clinical Microbiology and Infection*. 2012;18(3):268–281.
11. Karlowsky JA, Lagacé-Wiens PR, Simner PJ, et al. Antimicrobial resistance in urinary tract pathogens. *International Journal of Antimicrobial Agents*. 2011;38:3–7.
12. Hooton TM. Clinical practice: uncomplicated urinary tract infection. *New England Journal of Medicine*. 2012;366(11):1028–1037.
13. Medina M, Castillo-Pino E. An introduction to the epidemiology and burden of urinary tract infections. *Therapeutic Advances in Urology*. 2019;11:1–7.
14. Tandogdu Z, Wagenlehner FME. Global epidemiology of urinary tract infections. *Current Opinion in Infectious Diseases*. 2016;29(1):73–79.
15. Gupta K, Trautner B. Diagnosis and management of recurrent urinary tract infections in non-pregnant women. *BMJ*. 2013;346:f3140.
16. Wagenlehner FME, Naber KG. Treatment of bacterial urinary tract infections. *International Journal of Antimicrobial Agents*. 2004;24:59–66.
17. Gupta K, Bhadelia N. Management of urinary tract infections from multidrug-resistant organisms. *Infectious Disease Clinics of North America*. 2014;28(1):49–59.
18. Kahlmeter G. An international survey of antimicrobial susceptibility of pathogens from uncomplicated urinary tract infections. *Journal of Antimicrobial Chemotherapy*. 2003;51(1):69–76.
19. Naber KG, Schito G, Botto H, et al. Surveillance study in Europe and Brazil on clinical aspects and antimicrobial resistance epidemiology in female patients with cystitis. *BMC Infectious Diseases*. 2008;8:39.
20. Sanchez GV, Master RN, Karlowsky JA, Bordon JM. In vitro antimicrobial resistance of urinary *Escherichia coli* isolates among U.S. outpatients. *Antimicrobial Agents and Chemotherapy*. 2012;56(4):2181–2183.
21. Paterson DL. Resistance in gram-negative bacteria: Enterobacteriaceae. *American Journal of Infection Control*. 2006;34:20–28.
22. Shakya P, Shrestha D, Maharjan E, et al. Antibiotic resistance among uropathogens. *BMC Research Notes*. 2017;10:360.
23. Linhares I, Raposo T, Rodrigues A, Almeida A. Frequency and antimicrobial resistance patterns of bacteria implicated in community urinary tract infections. *Journal of Infection and Public Health*. 2013;6(6):438–445.
24. Mazzulli T. Resistance trends in urinary tract pathogens. *Journal of Urology*. 2002;168:1720–1722.
25. Dielubanza EJ, Schaeffer AJ. Urinary tract infections in women. *Medical Clinics of North America*. 2011;95(1):27–41.