URINARY TRACT INFECTION AND ANTIBIOTIC SUSCEPTIBILITY PROFILE OF UROPATHOGENS AMONG PREGNANT WOMEN

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Abstract
Introduction: Urinary tract infections (UTIs) are widespread amongst pregnant women and may cause severe complications when left untreated. Antibiotic resistance among uropathogens within the population is becoming increasingly common, making effective treatment difficult to achieve.
Objective: To determine the bacterial isolates and patterns of antibiotic susceptibility of uropathogens causing UTIs in pregnant women, and also discuss local resistance patterns.
Materials and Methods: This hospital-based, semi-structured study was conducted at Amna Inayat Medical College, Lahore and University College of Medicine and Dentistry Lahore from September, 2024 to February, 2025. Urine samples from pregnant women who showed signs of UTIs were inoculated into culture media, and the identification of bacteria was performed, followed by antibiotic testing of the isolated bacteria.
Results: The dominant uropathogen was Escherichia coli (70%), which showed high resistance to ampicillin (60%) and trimethoprim-sulfamethoxazole (55%). The resistance levels were lower with nitrofurantoin and ceftriaxone. Three out of every ten isolates were multidrug resistant.
Conclusion: The article suggests the necessity of continuous supervision and personalised forms of treatment to address increased antibiotic resistance in UTIs of pregnant women.

Keywords: Urinary tract infection, Escherichia coli, multidrug resistance, uropathogens, Pakistan.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections during pregnancy in mothers all over the world (1). Uropathogens are the main cause of such infections, and these are a diverse group of bacterial species. Hormonal changes, shifts in renal activities, and anatomical changes as a result of the growth of the uterus make pregnancy a complex phenomenon that influences the pathophysiology of UTIs in pregnant women, leading to stagnation of urine and their susceptibility to any infection attack (2). The increased physiological loading on the kidneys during pregnancy could

also be a reason behind this disposition of women to experience an infection within the urinary system. The majority of the UTIs that are identified in pregnant women are asymptomatic and are known as asymptomatic bacteriuria (ASB). Otherwise, ASB can escalate to advanced levels of infection, such as pyelonephritis, which can further result in sepsis and ultimately in the death of the mother as well (3).

The chance of developing UTIs during pregnancy is increased, and this is the reason why women need screening and prompt care so as to avoid this complication. Research carried out by Teferi et al. (4) also revealed that early identification and appropriate antibiotic treatment are essential in preventing the development of infections to severe levels. In such a way, the bacterial analysis of uropathogens in pregnant women and the tendencies of antibiotic usage are critical to the success of treatment and prevention. There is an increasing incidence of susceptibility of antibiotic uropathogens in pregnant women, leading to complicated UTI treatment, as noted by a few studies. In particular, there has been widespread resistance to several broadly employed antibiotics such as ampicillin, trimethoprim-sulfamethoxazole, as well as the cephalosporins (5). This has made choosing suitable antibiotics even more challenging, and it becomes necessary to keep tabs on local patterns of antibiotic resistance as a means of treating them. According to the studies done by Zwane et al. (6), multidrug-resistant uropathogens are gaining popularity in pregnant women with UTIs, at least in South Africa. This negativity would be a performance problem, since not only impact of an empirical therapy be decreased, but also the general antibiotics would need to be employed, and this would take a toll on the mother's health and the foetus. Other causes that have made the uropathogen resistant to antibiotics are the usage and misuse of antibiotics, lack of antibiotic stewardship and infection control strategies (7). Furthermore, insufficient knowledge regarding appropriate antibiotic use among pregnant women is among the reasons that aggravate the problem of resistance. The increasing epidemic of antibiotic-resistant uropathogens necessitates policymakers to formulate stricter policies and health regulations in attempts to minimise the threat that threatens the entire society (8, 9). Additionally, it is also necessary to observe the uropathogen profile in different regions to understand the dynamics of antibiotic resistance and adapt treatment methods in the future. A study conducted by Dube et al. (10) shows that E. coli was the dominant uropathogen in the four hundred pregnant South African women, followed by K. pneumoniae and P. mirabilis.

These findings resonate with the past findings, which have always crowned Escherichia coli as the typical causative agent of UTIs (11). The diagnosis of UTIs cannot be done without the application of antimicrobial susceptibility testing. Sensitivity of uropathogens to different antibiotics is determined through several methods, such as disk diffusion, E-test and automated systems (12). Other research studies have indicated that the trend between uropathogen antibiotic resistance may differ extensively even at the regional level. Such trends represent a regional variation in antibiotic use and abuse and between regions in bacterial infection epidemiology (13). E. coli is the most common pathogen of the urinary tract in areas such as Eastern Ethiopia, yet resistance to commonly prescribed antibiotics poses an increasingly serious problem (14). One of the most essential elements of UTI treatment in pregnancy is antibiotics. However, there needs to be a balance between successful treatment and minimal chances of antibiotic resistance. Case in point, it is reported that there is a strain of bacteria resistant to nitrofurantoin, which is one of the antibiotics regularly used in the management of UTIs among expectant women.

Nevertheless, it is one of the most favoured because it has very low complications during pregnancy (15). A recent study by Sardar et al. (16) addressed the issue of inappropriate rise of nitrofurantoin resistance and other first-line antibiotics, arguing that treatment guidelines should be reviewed regularly and monitored. Lack of proper hygiene, non-hydration, intercourse, and rampant underlying diseases, such as diabetes, have been the risk factors that have predisposed pregnant women to high incidences of UTIs (17). Additionally, women with a background of regular UTIs or those who have had earlier renal diseases are prone to contracting UTIs during the pregnancy period in large numbers (18). All these risk factors must be considered when designing screening and prevention strategies. Asymptomatic UTIs can be detected during screening, often accompanied by asymptomatic bacteriuria, particularly at the first prenatal care visit, and the development of severe infections can

be avoided in the future (19). The rising problem of antibiotic resistance in uropathogens makes it challenging to treat the related infections, which is why frequent monitoring of the bacterial profile and susceptibility levels is significant.

Objective: To review bacterial profile and antibiotic susceptibility patterns of uropathogens in women with urinary tract infections during pregnancy, and describe local differences and resistance patterns.

MATERIALS AND METHODS

Study Design: Cross-sectional Study.

Study setting: The research project was conducted at Amna Inayat Medical College, Lahore and University College of Medicine and Dentistry Lahore, Pakistan

Duration of Study: The study was conducted over six months, from from September, 2024 to February, 2025.

Inclusion criteria: Pregnant women at any gestational age reporting the symptoms of a UTI or those on regular check due to asymptomatic bacteriuria were included in the study. Those who had informed consent and who were ready to participate were also eligible.

Exclusion Criteria: Women who had been previously treated with antibiotics within the past 2 weeks, those with abnormalities of the urinary tract, or those with medical illnesses such as diabetes or chronic kidney disease were excluded. Additionally, patients who refused to sign informed consent were excluded from the study.

Methods

Pregnant women who met the inclusion criteria were recruited through the outpatient and inpatient departments of Amna Inayat Medical College, Lahore and University College of Medicine and Dentistry Lahore. Each participant provided a sterile midstream urine sample, which was delivered to the microbiology laboratory at the hospital within one hour of collection and processed. Urine cultures were incubated at 37 °C for 24 or 48 hours on regular plates, such as MacConkey plates and blood plates. The disk diffusion technique was used for antibiotic susceptibility testing, following the recommendations of the Clinical and Laboratory Standards Institute (CLSI). The tested antibiotics included the more common drugs used in treating UTIs, namely ampicillin, ciprofloxacin, nitrofurantoin, and ceftriaxone. Interpretation of the results was based on zone diameters and categorised as susceptible, intermediate, or resistant. Demographic information, clinical symptoms, and the presence of comorbidities were also obtained through interviews with the patient and a review of their medical records.

RESULTS

The study involved 200 pregnant women. Amongst them, there were 150 women with symptomatic UTIs, whereas 50 women were flagged in regular surveillance of asymptomatic bacteriuria. The age group of the respondents ranged from 18 to 40 years, with 70 per cent of the respondents falling within the 20- to 30-year age bracket. The most frequently mentioned causes of participants with symptomatic UTIs were dysuria (80%), frequent urination (75%) and lower abdominal pain (65%). A prevalence of asymptomatic bacteriuria of 25 per cent was detected in a group of screened women.

Bacterial Profile of Uropathogens

The uropathogen population was very varied, as indicated by the bacterial isolates from urine cultures. The most prevalent pathogen, occurring in 70 per cent of the cases, was Escherichia coli, followed by *Klebsiella pneumoniae* (10 per cent) and *Proteus mirabilis* (7 per cent). Isolation of other bacterial isolates, such as *Enterococcus faecalis* (5%), *Pseudomonas aeruginosa* (4%), and *Enterobacter cloacae* (4%), was also performed.

Table 1 presents the frequency of bacterial isolates among the study participants.

Table 1: Distribution of Uropathogens in Pregnant Women with UTIs

Bacterial Species	Number of Isolates	Percentage (%)
Escherichia coli	140	70
Klebsiella pneumoniae	20	10
Proteus mirabilis	14	7
Enterococcus faecalis	10	5
Pseudomonas aeruginosa	8	4
Enterobacter cloacae	8	4
Total	200	100

Antibiotic Susceptibility Pattern

The sensitivity to commonly prescribed antibiotics was also observed to be differentially resistant. Ampicillin showed the most significant resistance (60%), followed by trimethoprim-sulfamethoxazole (55%) and then ciprofloxacin (40%). Conversely, lower resistance rates were recorded for nitrofurantoin and ceftriaxone, at 15% and 20%, respectively.

The antibiotic sensitivity of the uropathogens isolated in pregnant women with UTIs is shown in Table 2.

**Table 2: Antibiotic Susceptibility Profile of Uropathogens**

Antibiotic	Susceptible (%)	Intermediate (%)	Resistant (%)
Ampicillin	30	10	60
Trimethoprim-Sulfamethoxazole	35	10	55
Ciprofloxacin	50	10	40
Nitrofurantoin	85	5	15
Ceftriaxone	80	10	20

Resistance to Multiple Antibiotics

More than one-fourth (35%) of the isolates were resistant to more than two antibiotics, indicating high resistance of uropathogens to multiple drugs.

The percentage of multidrug-resistant bacterial isolates is depicted in Figure 1.

Figure 1: Percentage of Multidrug-Resistant Uropathogens in Pregnant Women with UTIs
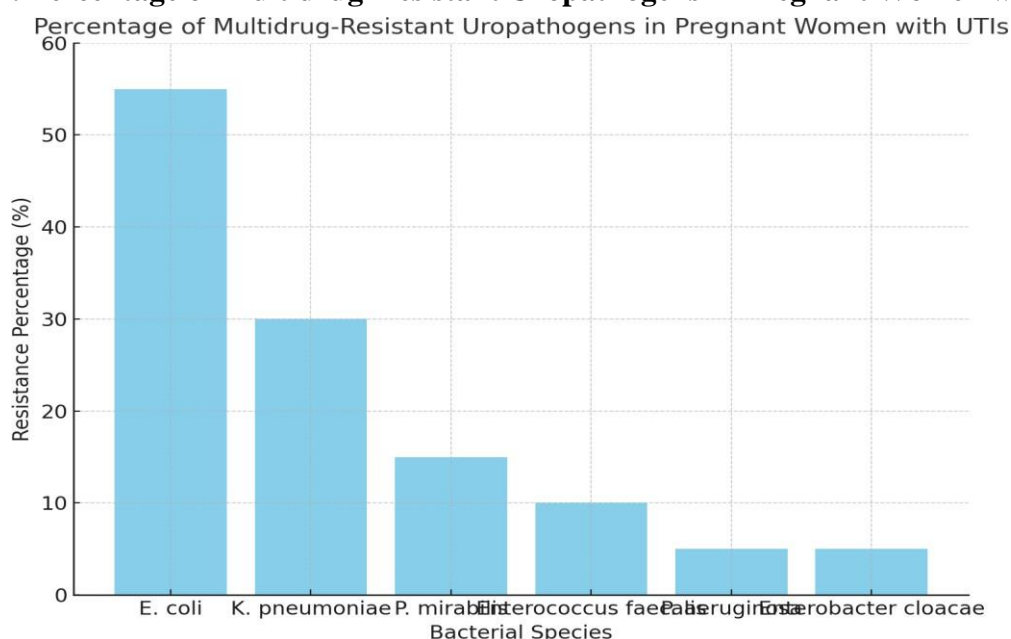
Risk Factors Associated with UTIs in Pregnant Women

The article also examined the risk factors associated with UTIs among pregnant women. The most prominent risk factors identified included a history of UTI (45 %), poor hygienic conduct (30 %), and diabetes (15 %). The other causes, like frequent sexual intercourse and urinary retention, did not occur as often as the others but contributed to the increased risk of UTIs.

Table 3 summarises the possible risk factors for UTIs in the study population.

Table 3: Risk Factors Associated with UTIs in Pregnant Women

Risk Factor	Number of Women (%)
Previous UTI History	90 (45%)
Poor Hygiene Practices	60 (30%)
Diabetes	30 (15%)
Frequent Sexual Intercourse	10 (5%)
Urinary Retention	10 (5%)
Total	200 (100%)

Lastly, the research established that in pregnant women, E. coli was the dominant uropathogen in UTIs, with most of the organisms showing resistance to antibiotics, especially ampicillin and trimethoprim-sulfamethoxazole. Ceftriaxone and nitrofurantoin demonstrated greater efficacy in treating these infections. Moreover, the isolates were primarily found to be multidrug resistant, indicating the importance of frequent monitoring and more specialised treatment policies.

DISCUSSION

UTIs are a prevalent and serious health problem in pregnant women, and they lead to maternal and fetal health consequences. The findings of the bacteria comparison are not contradictory to those found in other regions, as Escherichia coli is the most dominant pathogen in pregnant patients, leading to UTIs (1, 2). Such an observation is further evidence of the global distribution of E. coli as the most prevalent uropathogen in UTI, irrespective of geographical location. The bacterium is particularly adapted to the urinary tract since it also has virulence mechanisms such as fimbriae in order to be able to bind to cells of the uroepithelial cells and the propensity to form biofilms, which protects the bacteria from the host immune system and antibiotics (6). E. coli has a favourable breeding ground during pregnancy, as it is accompanied by hormonal and anatomical changes, which also include dilation of the ureters and urinary stasis. Klebsiella pneumonia, which is most often acquired in hospitals, is characterised by resistance to several antibiotics, and this resistance can complicate treatment (7). Proteus mirabilis, a frequent pathogen in severe UTIs of pregnant women, confirms that even more serious patterns of the disease should be taken into account (8).

Among the most critical issues in managing UTIs among pregnant women is the resistance to antibiotics. Ampicillin resistance of 60% and trimethoprim-sulfamethoxazole of 55% worried me because these antibiotics had been used to treat UTIs in the past in pregnant women (9). Similarly, a 40 per cent cipro-resistance is also shocking since cipro is commonly applied in the treatment of complicated UTIs. The resistance rates identified in this research are not conflicting with any other research carried out in developing countries regarding this topic, as resistance development is a result of the high usage and misuse of antibiotics (10). A key finding in the research was low rates of resistance of nitrofurantoin (15%) and ceftriaxone-based (20%), which are considered safe and effective drugs in treating UTIs during pregnancy. Nitrofurantoin is also a common agent used to treat uncomplicated UTIs in pregnant women, as it poses no teratogenic risks and is well-tolerated in most individuals (11). Ceftriaxone is one of the third-generation cephalosporins whose low resistance signifies that it can be used in treating complicated UTIs, especially at times among hospitalised pregnant women (12,13).

One of the key issues regarding the treatment of UTI involving pregnant women is the problem of drug resistance. In the study, 3 out of 10 bacterial strains were resistant to over two antibiotics, which underscores the applicability of multi-antibiotic-resistant organisms (14). The finding can be likened to another study undertaken in both developing and developed countries, where multidrug resistance has become common in uropathogenic bacteria (15). The multidrug-resistant uropathogens have complicated the treatment regimen and necessitate the use of the broader-spectrum drugs with increased adverse effects and increased risk of manipulation, especially in pregnant women (16,17). The use of antibiotics has escalated to the most influential factor in the rise of resistant infections in Pakistan due to easy access to over-the-counter availability of antibiotics and noncompliance in Pakistan (18).

Additionally, this situation is exacerbated by the low awareness rate among medical professionals and patients regarding the potential dangers of antibiotic resistance. Another significant variable in the study was the correlation between specific risk factors and the development of UTIs in pregnant women. A history of recurrent UTIs was strongly linked to pregnancy-related UTIs, and forty per cent of the participants had a UTI history. This agrees with past studies, which indicate that women who are victims of repeated UTIs stand a higher chance of developing simultaneous occurrences during pregnancy (19). Other risk factors were identified, including poor hygiene practices (30%) and diabetes (15%). Unreasonable hygienic conditions enhance the risk of bacterial infection in the urinary tract, and diabetes may weaken the immune system, exposing patients to infection.

CONCLUSION

Overall, this paper supports the high rates of urinary tract infections (UTI) in pregnant women in Karachi, Pakistan, with Escherichia coli being the most common uropathogen. There is also the alarming emergence of antibiotic resistance, especially to antibiotics often recommended, such as ampicillin, trimethoprim-sulfamethoxazole, and ciprofloxacin, which makes treatment regimens very difficult. Nitrofurantoin and ceftriaxone demonstrated promising efficacy and a decrease in the resistance levels, which is indicative of the fact that, compared to current options, they may continue to serve as effective treatment options. The development of multidrug-resistant pathogens also underscores the importance of an ongoing process of monitoring antibiotic resistance profiles, especially among those at risk, such as pregnant women. It would help to counterbalance the threat of antibiotic resistance by enhancing antibiotic stewardship and awareness of health care, as well as implementing evidence-based interventions regarding managing UTIs in pregnant women.

REFERENCES
1. Bhargava K, Nath G, Bhargava A, Kumari R, Aseri GK, Jain N. Bacterial profile and antibiotic susceptibility pattern of uropathogens causing urinary tract infection in the eastern part of Northern India. Frontiers in Microbiology. 2022 Aug 9;13:965053.
2. Ekuma PU, Ibiam FA, Ekuma MI, Iroha CS, Peter IU, Iroha IR. Evaluating the Bacteria Profile and Drug Susceptibility Patterns of Urinary Tract Infectious Pathogens in Pregnant Women in Abakaliki Metropolis, Nigeria. Int. J. Path. Res. 2023;12(5):52-62.
3. Ejerssa AW, Gadisa DA, Orjino TA. Prevalence of bacterial uropathogens and their antimicrobial susceptibility patterns among pregnant women in Eastern Ethiopia: hospital-based cross-sectional study. BMC Women's Health. 2021 Aug 7;21(1):291.
4. Teferi S, Sahlemariam Z, Mekonnen M, Tamrat R, Bekana T, Adisu Y, Darge T. Uropathogenic bacterial profile and antibiotic susceptibility pattern of isolates among gynaecological cases admitted to Jimma Medical Centre, South West Ethiopia. Scientific Reports. 2023 May 1;13(1):7078.
5. Taha AB. Bacteriological profile, antimicrobial susceptibility, and factors associated with urinary tract infection in pregnant women. The Journal of Infection in Developing Countries. 2024 Mar 31;18(03):391-8.
6. Ngong IN, Fru-Cho J, Yung MA, Akoachere JF. Prevalence, antimicrobial susceptibility pattern and associated risk factors for urinary tract infections in pregnant women attending ANC in some

integrated health centres in the Buea Health District. BMC Pregnancy and Childbirth. 2021 Oct 4;21(1):673.

7. Patil G, Patil D, Patil A, Shrikhande S, Patil AS. Microbiological profile and antimicrobial susceptibility pattern of uropathogens isolated from pregnant women attending a tertiary care hospital in Central India. Cureus. 2024 Oct 3;16(10).

8. Zwane T, Shuping L, Perovic O. Etiology and antimicrobial susceptibility of pathogens associated with urinary tract infections among women attending antenatal care in four South African tertiary-level facilities, 2015–2019. Antibiotics. 2021 Jun 4;10(6):669.

9. Dube R, Al-Zuheiri ST, Syed M, Harilal L, Zuhaira DA, Kar SS. Prevalence, clinico-bacteriological profile, and antibiotic resistance of symptomatic urinary tract infections in pregnant women. Antibiotics. 2022 Dec 25;12(1):33.

10. Sardar M, Devi LS, Khandait M, Borah S, Sharma M. Profile of Uropathogens and their Antibiogram in Pregnant Women with Suspected Urinary Tract Infections. Indian Journal of Health Sciences and Care. 2023 Nov;10(3):89-96.

11. Orji O, Dlamini Z, Wise AJ. Urinary bacterial profile and antibiotic susceptibility pattern among pregnant women in Rahima Moosa Mother and Child Hospital, Johannesburg. Southern African Journal of Infectious Diseases. 2022 Jan 28;37(1):343.

12. Matalka AA, Al-Husban N, Alkuran O, Almuhaisen L, Basha A, Eid M, Elmuhtaseb MS, Al Oweidat K. Spectrum of uropathogens and their susceptibility to antimicrobials in pregnant women: a retrospective analysis of 5-year hospital data. Journal of International Medical Research. 2021 May;49(5):03000605211006540.

13. Mekonnen S, Tesfa T, Shume T, Tebeje F, Urgesa K, Weldegebreal F. Bacterial profile, their antibiotic susceptibility pattern, and associated factors of urinary tract infections in children at Hiwot Fana Specialized University Hospital, Eastern Ethiopia. Plos one. 2023 Apr 5;18(4):e0283637.

14. Joya M, Aalemi AK, Baryali AT. Prevalence and antibiotic susceptibility of the common bacterial uropathogen among UTI patients in French Medical Institute for Children. Infection and drug resistance. 2022 Jan 1:4291-7.

15. Elmanefi ES, Bozakouk IH, Bleiblo FA, Bumadian MM. Bacterial Profile of urinary tract infections and Antimicrobial susceptibility patterns among pregnant women at the Benghazi Medical Centre, Benghazi/Libya. Scientific Journal of University of Benghazi. 2021 Dec 23;34(2).

16. Kebede D, Shiferaw Y, Kebede E, Demsiss W. Antimicrobial susceptibility and risk factors of uropathogens in symptomatic urinary tract infection cases at Dessie Referral Hospital, Ethiopia. BMC microbiology. 2025 Mar 8;25(1):126.

17. Mohapatra S, Venugopal SJ, Kalaivani M, Kant S, Tak V, Panigrahy R, Chunchanur SK, Kocher D, Behera B, Pundir S, Chaudhuri S. Antibiotic resistance of uropathogens among the community-dwelling pregnant and nonpregnant female: a step towards antibiotic stewardship. BMC Infectious Diseases. 2022 Dec 13;22(1):939.

18. Tesfa T, Baye Y, Sisay M, Amare F, Gashaw T. Bacterial uropathogens and susceptibility testing among patients diagnosed with urinary tract infections at Hiwot Fana Specialized University Hospital, Eastern Ethiopia. SAGE open medicine. 2021 Mar; 9:20503121211001162.

19. Al-Shehari WA, Edrees WH, Al-Awar MS, Ahmed AM, Al-Hadheq AA. Antimicrobial Susceptibility Profiles of Uropathogenic Bacteria Isolated from Pregnant Women, Yemen. Al-Razi University Journal for Medical Sciences. 2025 Jul 8;9(2).