# ORIGINAL ARTICLE

# Incidence and Predictors of Recurrent Urinary Tract Infection in Women After First Episode: A Prospective Study

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**ABSTRACT:**
**Background:**Urinary tract infection (UTI) is one of the most common bacterial infections affecting women and is a major cause of morbidity and antibiotic use. Although most first episodes respond well to treatment, a substantial proportion of women experience recurrent UTI, leading to repeated healthcare visits, increased antimicrobial exposure, and reduced quality of life. Identifying the incidence and predictors of recurrence after the first episode is essential for early intervention and prevention strategies, particularly in tertiary care settings where antimicrobial resistance is an emerging concern. **Aim:**To determine the incidence of recurrent urinary tract infection in women after a first documented episode and to identify clinical, behavioral, and microbiological predictors associated with recurrence. **Materials and Methods:**This prospective observational study included 82 adult women presenting with a first episode of culture-confirmed urinary tract infection at a tertiary care hospital. Detailed demographic, clinical, and behavioral data were recorded at baseline. Midstream urine samples were collected for routine analysis and culture with antibiotic susceptibility testing. All patients received culture-guided antibiotic therapy and were followed for the occurrence of recurrent UTI, defined as a symptomatic, microbiologically confirmed infection after resolution of the initial episode. **Results:**Recurrent urinary tract infection occurred in 24 of 82 patients, yielding an incidence of 29.27%. Recurrence was significantly associated with age above 45 years, sexual activity, postmenopausal status, poor perineal hygiene, and low fluid intake (p < 0.05). *Escherichia coli* was the most commonly isolated pathogen (59.76%). Multidrug-resistant organisms were significantly more frequent among women with recurrent UTI (54.17%) compared to those without recurrence (29.31%). On multivariate analysis, age >45 years, poor perineal hygiene, low fluid intake, and multidrug-resistant infection emerged as independent predictors of recurrence. **Conclusion:**Recurrent UTI affects nearly one-third of women after a first episode. Identification of modifiable risk factors and resistant pathogens at initial presentation can guide targeted preventive strategies and optimize antimicrobial stewardship to reduce recurrence.
**Keywords:**Recurrent urinary tract infection; Women; First episode UTI; Risk factors; Antimicrobial resistance

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## INTRODUCTION

Urinary tract infection (UTI) is among the most frequent bacterial infections affecting women and represents a major cause of outpatient visits, antibiotic prescriptions, and short-term morbidity. Women are predisposed because of anatomical and physiological factors that facilitate ascending infection from periurethral colonization to the bladder, and occasionally to the upper urinary tract. Beyond the immediate symptoms of dysuria, frequency, urgency, and suprapubic discomfort, UTIs create broader clinical challenges due to their high occurrence, impact on quality of life, and contribution to antimicrobial exposure at the population level.[1] Although many first-episode UTIs respond well to appropriate therapy, recurrence remains a key problem in clinical practice. Standard treatment approaches for acute uncomplicated cystitis emphasize short-course, targeted antimicrobials and the importance of local susceptibility patterns to guide empiric choices. In tertiary care settings, clinicians often encounter women with varied risk profiles, prior healthcare exposures, and pathogen resistance patterns, which can complicate early management decisions and influence the likelihood of subsequent infection episodes.[2] Most first-episode UTIs in adult women present as uncomplicated lower urinary tract infection, typically caused by uropathogenic organisms that originate from gastrointestinal reservoirs and colonize periurethral and vaginal sites. Clinical diagnosis is guided by symptom patterns and supported by urine testing when indicated, while urine culture provides definitive microbiological confirmation and enables susceptibility-based therapy. The initial episode is clinically important because it may represent either a transient event with complete eradication or the beginning of a recurrent course driven by host factors, behavioral exposures, microbial virulence, or incomplete pathogen clearance.[3] A central determinant of outcomes following the first UTI episode is the local epidemiology of uropathogens and their antimicrobial susceptibility. Community-acquired *Escherichia coli* remains the most common pathogen in women with acute uncomplicated infection, but resistance patterns vary substantially across regions and over time,

356

particularly for commonly used oral agents. Contemporary surveillance has shown measurable resistance to traditional first-line or frequently prescribed drugs in multiple European settings, reinforcing the need for institution- and region-specific data to inform empiric regimens and stewardship strategies.[4] Recurrent UTI is generally defined as repeated symptomatic infections occurring after documented resolution of a previous episode, and it can occur either as reinfection with a new strain or relapse due to persistence of the same organism. Clinically, recurrent UTI is important because it increases healthcare utilization, exposes patients to repeated antibiotics, and may lead to anxiety, reduced daily functioning, and avoidance of activities perceived to trigger symptoms. Reviews of recurrent UTI in women consistently highlight that recurrence is not rare and is influenced by a mix of modifiable behavioral factors and non-modifiable host factors, making it a priority condition for preventive counseling and risk stratification.[5] The mechanisms underlying recurrence are multifactorial. Host susceptibility can be shaped by age-related and hormonal influences on vaginal flora and mucosal defenses, urinary tract functional factors affecting voiding and residual urine, and behavioral exposures that increase bacterial access to the lower urinary tract. At the pathogen level, uropathogens may possess adhesins, biofilm capacity, and other virulence features that facilitate colonization and persistence. Importantly, repeated or inappropriate antimicrobial exposure can select resistant organisms and disrupt protective microbiota, creating conditions that favor persistence or rapid reinfection.[6] Antimicrobial resistance adds an additional layer of complexity in recurrent disease. Increasing resistance among uropathogens can lead to suboptimal empiric therapy, prolonged symptoms, delayed microbiological clearance, and higher risk of relapse or early reinfection. Multidrug-resistant (MDR) strains—particularly within globally distributed lineages—have been increasingly recognized in urinary isolates and are clinically relevant because they limit oral treatment options and may necessitate broader-spectrum agents, further propagating resistance selection pressure.[6] Guideline-based care increasingly emphasizes both effective treatment and prevention, alongside antimicrobial stewardship and careful diagnostic confirmation. International and regional guidance highlights the need to distinguish localized versus systemic infection, ensure appropriate specimen collection and interpretation, and promote rational antibiotic use informed by resistance trends. In the context of recurrence, guidelines also stress identifying modifiable risk factors, considering non-antibiotic preventive measures where appropriate, and limiting unnecessary antibiotic exposure to reduce collateral damage and selection of resistant organisms.[7]

## MATERIALS AND METHODS

This prospective observational study was conducted at a tertiary care hospital to evaluate the incidence and predictors of recurrent urinary tract infection (UTI) in women following their first documented episode of UTI. The study focused on systematic clinical and laboratory evaluation of eligible participants presenting to outpatient and inpatient services of the hospital. A total of 82 female patients diagnosed with a first episode of urinary tract infection were included in the study. Women aged 18 years and above who presented with clinical features suggestive of UTI and had microbiological confirmation on urine culture were enrolled after obtaining informed consent. Only patients with a clearly documented first episode of UTI were considered to ensure accurate assessment of recurrence.

### Inclusion and Exclusion Criteria

Inclusion criteria comprised adult women with symptoms of lower or upper urinary tract infection and a positive urine culture confirming the diagnosis. Patients with a history of previous UTIs, known structural or functional abnormalities of the urinary tract, chronic kidney disease, pregnancy, diabetes mellitus with complications, immunosuppressive conditions, ongoing antibiotic use for other infections, or indwelling urinary catheters were excluded to minimize confounding factors influencing recurrence.

### Methodology

Baseline demographic data including age, marital status, educational level, and socioeconomic status were recorded. Detailed clinical history was obtained with emphasis on presenting symptoms, sexual activity, personal hygiene practices, contraceptive use, menopausal status, fluid intake, and history of recent hospitalization. Physical examination findings were documented systematically for all participants.

### Laboratory Investigations

Midstream clean-catch urine samples were collected under aseptic precautions for routine urine analysis and culture sensitivity testing. Urine cultures were processed according to standard microbiological protocols, and significant bacteriuria was defined based on colony-forming unit counts. Antibiotic susceptibility testing was performed to guide appropriate treatment. Additional laboratory parameters such as complete blood count and renal function tests were obtained where clinically indicated.

### Treatment and Follow-Up Evaluation

All patients received antibiotic therapy based on urine culture sensitivity results in accordance with institutional treatment protocols. Patients were followed prospectively for the occurrence of recurrent UTI, defined as a symptomatic episode with microbiological confirmation following resolution of

the initial infection. Clinical symptoms and laboratory findings during follow-up visits were documented to identify recurrence.

The primary outcome measure was the incidence of recurrent urinary tract infection after the first episode. Secondary outcome measures included identification of potential predictors of recurrence such as age, sexual activity, contraceptive methods, menopausal status, hygiene practices, infecting organism, and antibiotic resistance patterns.

### Statistical Analysis

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 16.0. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. The incidence of recurrent UTI was calculated proportionally. Associations between potential predictors and recurrence were analyzed using appropriate statistical tests, including chi-square test for categorical variables and independent t-test for continuous variables. Multivariate logistic regression analysis was performed to identify independent predictors of recurrent UTI. A p-value of less than 0.05 was considered statistically significant.

### RESULTS

### Baseline demographic and clinical characteristics (Table 1)

The study included 82 women with a first episode of urinary tract infection. The majority of patients belonged to the 31–45-year age group, accounting for 37.80% of the study population, followed by those aged 18–30 years (34.15%). Women older than 45 years constituted 28.05% of cases. Most participants were married (68.29%), while 31.71% were unmarried. With respect to hormonal status, a larger proportion of women were premenopausal (71.95%), whereas postmenopausal women represented 28.05% of the cohort. Sexual activity was reported by 74.39% of patients, indicating that the majority of women presenting with a first episode of UTI were sexually active, while 25.61% were not.

### Incidence of recurrent urinary tract infection (Table 2)

During follow-up, 24 out of 82 patients developed a recurrent episode of urinary tract infection, giving an overall recurrence rate of 29.27%. The remaining 58 patients (70.73%) did not experience any recurrence following successful treatment of the initial episode.

### Association of risk factors with recurrent UTI (Table 3)

Analysis of potential risk factors demonstrated several statistically significant associations with recurrent UTI. Women aged above 45 years showed a higher rate of recurrence (45.83%) compared to those without recurrence (20.69%), and this association was statistically significant (p = 0.018). Sexual activity was also significantly associated with recurrence, with 87.50% of women in the recurrent UTI group being sexually active compared to 68.97% in the non-recurrent group (p = 0.041). Postmenopausal women had a significantly higher proportion of recurrent infections (41.67%) than those without recurrence (22.41%), with a p-value of 0.047. Poor perineal hygiene was reported in 58.33% of women with recurrent UTI versus 31.03% in those without recurrence, showing a significant association (p = 0.022). Similarly, low daily fluid intake was significantly more common among women with recurrent UTI (66.67%) compared to those without recurrence (41.38%), with a p-value of 0.031.

### Microbiological profile and antibiotic resistance (Table 4)

The microbiological analysis of urine cultures from the initial UTI episode revealed that *Escherichia coli* was the most commonly isolated organism, accounting for 59.76% of cases. This was followed by *Klebsiella* species in 18.29%, *Enterococcus* species in 12.20%, and *Proteus* species in 9.76% of patients. When antibiotic resistance patterns were analyzed, multidrug-resistant organisms were significantly more frequent among patients who developed recurrent UTI (54.17%) compared to those who did not have recurrence (29.31%). This difference was statistically significant (p = 0.028), indicating that infection with multidrug-resistant pathogens increases the likelihood of recurrence.

### Multivariate analysis of predictors of recurrent UTI (Table 5)

Multivariate logistic regression analysis was performed to identify independent predictors of recurrent urinary tract infection. Age greater than 45 years emerged as a significant predictor, with an adjusted odds ratio (AOR) of 2.84 (95% CI: 1.12–7.19; p = 0.027). Poor perineal hygiene was found to be the strongest independent predictor of recurrence (AOR 3.21; 95% CI: 1.29–7.98; p = 0.012). The presence of a multidrug-resistant organism was also independently associated with recurrent UTI (AOR 2.67; 95% CI: 1.08–6.58; p = 0.034). Additionally, low fluid intake significantly increased the risk of recurrence (AOR 2.45; 95% CI: 1.01–5.92; p = 0.046).

**Table 1. Baseline Demographic and Clinical Characteristics of the Study Population (n = 82)**

| Variable | Number (n) | Percentage (%) |
|---|---|---|
| **Age Group (years)** | | |
| 18–30 | 28 | 34.15 |
| 31–45 | 31 | 37.80 |
| >45 | 23 | 28.05 |
| **Marital Status** | | |
| Married | 56 | 68.29 |
| Unmarried | 26 | 31.71 |
| **Menopausal Status** | | |
| Premenopausal | 59 | 71.95 |
| Postmenopausal | 23 | 28.05 |
| **Sexual Activity** | | |
| Sexually active | 61 | 74.39 |
| Not sexually active | 21 | 25.61 |

**Table 2. Incidence of Recurrent Urinary Tract Infection During Follow-up (n = 82)**

| Outcome | Number (n) | Percentage (%) |
|---|---|---|
| Recurrent UTI | 24 | 29.27 |
| No recurrence | 58 | 70.73 |

**Table 3. Association of Selected Risk Factors with Recurrent UTI (n = 82)**

| Risk Factor | Recurrent UTI n (%) | No Recurrence n (%) | p-value |
|---|---|---|---|
| **Age >45 years** | 11 (45.83) | 12 (20.69) | 0.018 |
| **Sexually active** | 21 (87.50) | 40 (68.97) | 0.041 |
| **Postmenopausal status** | 10 (41.67) | 13 (22.41) | 0.047 |
| **Poor perineal hygiene** | 14 (58.33) | 18 (31.03) | 0.022 |
| **Low fluid intake** | 16 (66.67) | 24 (41.38) | 0.031 |

**Table 4. Microbiological Profile and Antibiotic Resistance in Initial UTI Episode (n = 82)**

| Isolated Organism | Number (n) | Percentage (%) |
|---|---|---|
| *Escherichia coli* | 49 | 59.76 |
| *Klebsiella* spp. | 15 | 18.29 |
| *Enterococcus* spp. | 10 | 12.20 |
| *Proteus* spp. | 8 | 9.76 |

**Table 5. Multivariate Logistic Regression Analysis of Predictors of Recurrent UTI**

| Predictor | Adjusted Odds Ratio (AOR) | 95% CI | p-value |
|---|---|---|---|
| Age >45 years | 2.84 | 1.12–7.19 | 0.027 |
| Poor perineal hygiene | 3.21 | 1.29–7.98 | 0.012 |
| Multidrug-resistant organism | 2.67 | 1.08–6.58 | 0.034 |
| Low fluid intake | 2.45 | 1.01–5.92 | 0.046 |

## DISCUSSION

In the present prospective cohort of 82 women with a first culture-confirmed UTI, the overall recurrence rate was 29.27% (24/82). This is comparable to the classic cohort reported by Foxman et al. (1990), where 26.60% (30/113) of women experienced at least one culture-confirmed recurrence within 6 months after the initial episode, supporting that recurrence remains a frequent outcome even after an apparently "first" infection.[8]

Our recurrence rate (29.27%) was higher than that seen in younger community cohorts. In the randomized trial by Barbosa-Cesnik et al. (2011) among 319 college women after an acute UTI, the overall recurrence rate was 16.90%, with recurrences distributed similarly between cranberry (20.00%) and placebo (14.00%) arms over 6 months. The higher recurrence observed in our tertiary-care population likely reflects differences in age distribution, comorbidity exclusion patterns, and exposure to healthcare/antibiotics compared with healthier student populations.[9]

Age and hormonal status showed a clear relationship with recurrence in this study. Women >45 years had a recurrence proportion of 45.83%, and postmenopausal women had recurrence in 41.67%, with age >45 remaining an independent predictor (AOR 2.84). This aligns with evidence that hypoestrogenic states predispose to recurrent infection; in the landmark trial by Raz et al. (1993) in postmenopausal women with recurrent UTI, the placebo group experienced 5.90 episodes per patient-year, while vaginal estrogen

reduced recurrences to 0.50 episodes per patient-year, highlighting the biologic contribution of menopause-related mucosal changes to recurrence risk.[10]

Sexual activity was significantly associated with recurrence in our cohort, as 87.50% of women with recurrent UTI were sexually active compared with 68.97% without recurrence (p = 0.041). This pattern is consistent with epidemiologic evidence that intercourse-related exposure is a major driver of recurrent infection; Scholes et al. (2000) reported markedly increased odds of recurrent UTI with higher recent intercourse frequency and spermicide exposure, reinforcing sexual behavior as a key modifiable risk domain that matches the direction and strength of association observed in our population.[11]

Poor perineal hygiene was common among women who recurred in this study (58.33% vs 31.03%, p = 0.022) and was the strongest independent predictor (AOR 3.21). Earlier behavioral work has shown that "hygiene/behavior" variables often contribute modestly when studied in isolation; for example, Foxman et al. (1985) found only moderate associations for individual habits (e.g., RR ≥ 1.40 for selected behaviors such as tampon use and soft drink intake) with both initial and recurrent UTI, suggesting that clusters of practices may matter more than any single factor. Our stronger adjusted effect may reflect local hygiene practices and the tertiary-care case-mix, where risk behaviors can be more concentrated and persistent.[12]

Low daily fluid intake showed a significant relationship with recurrence in this study (66.67% vs 41.38%, p = 0.031) and remained independently predictive (AOR 2.45), supporting hydration as a practical preventive target. Similar magnitude of effect was demonstrated in occupational settings: Nygaard et al. (1997) reported that women who drank less than desired at work had a 2.21-fold higher risk of UTI (95% CI 1.45–3.38) than those who drank the volume they wanted, providing external quantitative support for the biologic plausibility of our fluid-intake finding.[13]

Microbiologically, E. coli was the predominant pathogen in our first-episode cultures (59.76%), followed by Klebsiella spp. (18.29%), Enterococcus spp. (12.20%), and Proteus spp. (9.76%). Although E. coli remained the leading organism, its proportion was lower than that often seen in uncomplicated community cohorts, suggesting greater organismal diversity in tertiary-care presentations. Importantly, organism type can influence recurrence dynamics: Foxman et al. (2000) showed that a first UTI caused by E. coli was followed by a second UTI three times more often than a non-E. coli first UTI (24% vs 8%; p = 0.02), supporting the concept that E. coli virulence/colonization advantages can accelerate recurrence—consistent with E. coli being the dominant organism in our cohort as well.[14]

Antibiotic resistance also appeared clinically important. In our study, multidrug resistance was significantly more frequent in women who developed recurrence (54.17%) compared with those who did not (29.31%; p = 0.028), and MDR remained an independent predictor (AOR 2.67). Compared with large community-acquired datasets, this represents a substantial resistance burden: the multinational ECO.SENS interim report by Kahlmeter et al. (2000) found E. coli comprised 80% of uropathogens and reported resistance rates of 30% to ampicillin/sulphamethoxazole, 15% to trimethoprim (alone or with sulphamethoxazole), 6% to nalidixic acid, 3% to ciprofloxacin, and ≤2% to agents such as nitrofurantoin and fosfomycin. The much higher MDR proportion observed among our recurrent cases suggests that resistant pathogens may impair effective eradication or promote persistence/relapse, thereby amplifying recurrence in tertiary-care settings.[15]

## CONCLUSION

This prospective study demonstrates that nearly one-third of women experienced recurrent urinary tract infection following a first episode, highlighting recurrence as a common and clinically relevant outcome. Increasing age, poor perineal hygiene, low fluid intake, and infection with multidrug-resistant organisms were identified as significant independent predictors of recurrence. The findings emphasize the importance of early risk stratification, patient education on modifiable behaviors, and judicious antibiotic use after the first UTI episode. Targeted preventive strategies at the initial presentation may help reduce recurrence rates and limit antimicrobial resistance in women with urinary tract infection.

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