

# Recurrent Urinary Tract Infections in Women: Etiology, Risk Factors, and Prevention Strategies

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**Abstract:** Over 150 million instances of urinary tract infections (UTIs) are recorded each year, making it one of the most common bacterial illnesses affecting women globally. Infections that climb from the urethra to the bladder and, in extreme situations, to the kidneys are the main cause of them. *Escherichia coli* is the primary causative agent, accounting for around 70–80% of infections. *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Klebsiella pneumoniae*, and *Staphylococcus saprophyticus* are additional pathogens. Asymptomatic bacteriuria, pyelonephritis, cystitis, and complex or uncomplicated types are all included in the categorization of UTIs.

Inflammation, colonization, and bacterial attachment to uroepithelial cells are all part of the pathophysiology. Female anatomy, sexual behavior, pregnancy, postmenopausal changes, and the use of catheters or spermicides are risk factors. Clinical symptoms (dysuria, frequency, and suprapubic discomfort) are used to make the diagnosis, which is then supported by laboratory results from urinalysis, urine culture, and imaging if required. In addition to hydration, anti-inflammatory drugs, and, in certain situations, herbal therapies, treatment entails antibiotic medication customized to the pathogen and resistance profile that have been established. Recurrence is greatly decreased by preventive measures such frequent urine, proper hydration intake, and hygiene education. Preventing problems like pyelonephritis and kidney scarring requires prompt diagnosis and customized therapy.

**Keywords:** Urinary tract infection; cystitis; pyelonephritis; *Escherichia coli*; women; risk factors; antibiotic therapy; diagnosis; prevention; recurrence.

## Introduction

Despite the vast array of pharmaceutical medications available today, treating urinary tract infections in gynecology remains a pressing issue. This is because post-infectious diseases, relapses, and an extensive prevalence of pathology are common in women of all ages. Pregnancy is known to cause anatomical and physiological changes in the urinary system, which raise the risk of infection problems and need particular treatment. Recurrent cystitis in perimenopausal and postmenopausal women can be caused by atrophic alterations in the genitourinary tract, which can significantly lower the patients' quality of life. 25–35% of women in the 20–40 age range experience at least one infection episode annually.

The most prevalent kind of acute cystitis is found in the structure of simple UTIs. In Russia, between 26 and 36 million instances of acute cystitis are reported annually. Between 0.5 to 0.7 bouts of acute cystitis occur in one woman annually. The pathogenetic and etiological factors, the degree of inflammatory process prevalence, the degree of bladder wall morphological abnormalities, and the clinical characteristics of the illness are all taken into consideration when classifying simple UTIs. The following nosologies are part of the clinical categorization of urinary tract infections that has been established thus far in compliance with the clinical guidelines of the European Association of Urology (published in 2001 and revised in 2004): urosepsis, urethritis, complex urinary tract infections (with or without pyelonephritis), uncomplicated lower urinary tract infections (acute uncomplicated cystitis),

and uncomplicated upper urinary tract infections (acute uncomplicated pyelonephritis). It is acceptable to categorize the illness as complex if the patient's symptoms persist for more than seven days and appropriate antibiotic treatment is unsuccessful for longer than seventy-two hours.

A unique position among urinary tract infections is held by chronic cystitis. Chronic cystitis can be classified into the following types:

- a) Latent chronic cystitis:
  - persistent latent cystitis with a steady latent course (no symptoms, no bacteriological or laboratory evidence, and only endoscopic detection of the inflammatory process);
  - latent chronic cystitis with frequent exacerbations (two or more times a year, depending on the type of acute or subacute cystitis);
  - chronic latent cystitis with rare exacerbations (activation of inflammation by type of acute, no more than once per year);
- b) persistent chronic cystitis proper (persistent) – positive laboratory and endoscopic data, persistent symptoms in the absence of impaired bladder reservoir function;
- c) interstitial cystitis (persistent pain symptom complex, severe symptoms, impaired bladder reservoir function). Gram-negative enterobacteria are the most frequent cause of acute cystitis, with *Escherichia coli* being found in 70–95% of cases. *Staphylococcus saprophyticus* is identified in 5–20% of cases, particularly in young women.

Rarely, *Klebsiella* species, *Proteus mirabilis*, *Streptococcus B, D*, *Mycobacterium TB*, and *Treponema pallidum* can cause acute cystitis. The pathogenesis of urethritis and cystitis in women is undeniably linked to urogenital infections (*Chlamidia trachomatis*, *Ureaplasma urealyticum*, *Neisseria gonorrhoeae*, *Mycoplasma hominis*, and *Trichomonas vaginalis*). It should be mentioned that urine samples from individuals with simple UTIs do not show any pathogenic microorganisms in 0.4 to 30% of instances. Women are at risk for developing cystitis due to a number of factors, including:

- anatomical and physiological characteristics (short and wide urethra, close proximity to natural infection reservoirs, the anus and vagina);
- active sexual life;
- concurrent gynecological diseases that change the vagina's normal ecosystem (inflammatory procedures, hormonal imbalances); spermicide-based contraception; physiological alterations in the urinary tract during pregnancy; and atrophic diseases of the urogenital tract during the perimenopause and postmenopause.

In contrast to hematogenous, lymphogenic, and urinogenic (descending) routes, ascending bladder infection has been shown to have a more significant role in the development of acute cystitis in women by several international and domestic researchers. Bacterial adhesion to uroepithelial cells is a significant pathogenic element in the development of urinary tract infections. This adherence can take two forms:

- a) cohabitation with the host cell through a combined glycocalyx (persistence);
- b) damage to the glycocalyx and contact with the cell membrane.

It should be noted that because adherent bacteria do not establish colonies on nutritional media, they are often undetectable. In this sense, their presence in the diagnosis of recurring infections is underestimated.

Adhesins and pilins are protein structures found in uropathogenic strains of *Escherichia coli* that give the bacterium their sticky properties. Microorganisms attach to one another by fimbriae and exchange genetic material, or plasmids, which carry all of the virulence factors. Both fimbrial and non-fimbrial

adhesins are used to identify uropathogenic strains of *Escherichia coli*. Adhesives 1, P, S, and AFA exhibit varying degrees of tropicity towards distinct epithelial types.

Adhesin P-carrying *E. Coli* strains show tropicity to the renal parenchyma and merge strongly with the urethra's transitional and squamous epithelium. Genetically distinct adhesins can be synthesized by a single strain of uropathogenic *E. coli*. The potential for antibiotic resistance and the survival of germs in the human genitourinary system are determined by the diverse defensive qualities of bacteria. It has been demonstrated that during pregnancy, the prevalence of asymptomatic bacteriuria rises to 18%. More than 105 uropathogens in 1 milliliter of urine indicates a chronic bacterial colonization of the urinary system without any accompanying clinical symptoms, which is known as asymptomatic bacteriuria.

It is necessary to treat asymptomatic bacteriuria as it increases the chance of developing clinical signs of urinary tract infections, such as gestational pyelonephritis. Urinary tract infections have been found to be associated with a higher incidence of pregnancy, delivery, and postpartum problems. Recurrent bouts of cystitis in perimenopausal and postmenopausal women are marked by a prolonged course and are typically linked to the development of urogenital tract atrophic alterations.

### Urinary Tract Infections in Women

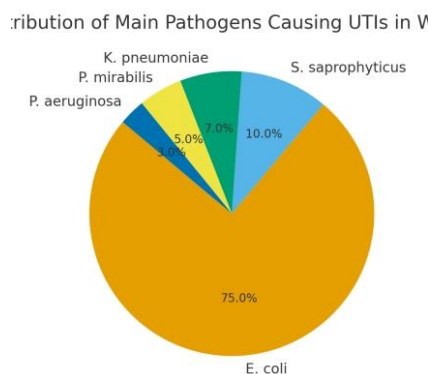
This document presents key information from a study on urinary tract infections (UTIs) in women, including the main causative agents, risk factors, and visualization of their relative frequencies.

**Table 1. Major Pathogens Causing Urinary Tract Infections in Women**

No.	Microorganism	Frequency (%)	Notes
1	<i>Escherichia coli</i>	70–80%	Main causative agent, originates from intestinal flora
2	<i>Staphylococcus saprophyticus</i>	10–15%	Common in young, sexually active women
3	<i>Klebsiella pneumoniae</i>	5–10%	Opportunistic, often hospital-acquired
4	<i>Proteus mirabilis</i>	5–8%	Urease producer, leads to stone formation
5	<i>Pseudomonas aeruginosa</i>	2–5%	Associated with catheterization and chronic infection

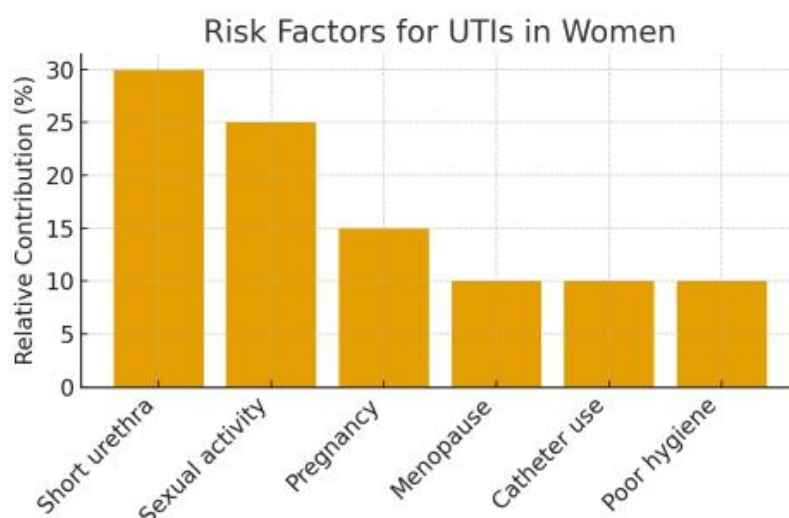
Clearly demonstrates that *Escherichia coli* is the dominant causative agent of urinary tract infections (UTIs) in women, accounting for approximately 70–80% of all cases. Other pathogens such as *Staphylococcus saprophyticus*, *Klebsiella pneumoniae*, *Proteus mirabilis*, and *Pseudomonas aeruginosa* contribute to a smaller portion of infections but are clinically significant, especially in recurrent or hospital-acquired cases.

**Chart 1. Distribution of Main Pathogens Causing UTIs in Women**



Visually confirms that *E. coli* overwhelmingly predominates among uropathogens, emphasizing the importance of targeted antimicrobial therapy that covers this microorganism as a priority.

**Chart 2. Risk Factors for UTIs in Women**



Highlights that anatomical and physiological characteristics—particularly the short female urethra—along with sexual activity and pregnancy, are the leading risk factors for UTIs in women. Hormonal and atrophic changes during menopause also contribute significantly to disease recurrence.

Atrophic and dystrophic processes in the estrogen-dependent tissues and structures of the lower third of the genitourinary tract—the vagina, bladder, pelvic floor muscles, and ligamentous apparatus of the pelvis—lead to the development of urogenital disorders, also known as urogenital atrophy in menopause. Just as obvious a sign of menopause as hot flashes are atrophic alterations in the urogenital tract. Thirty percent of women over 55 and seventy-five percent of women over 70 suffer from urogenital diseases.

Recurrent urinary tract infections (recurrent cystitis) that are resistant to conventional antibiotic treatment are among the unique symptoms that affect about 11% of women. Recurrent urinary tract infections, which are characterized by a wave-like course with periods of exacerbation, such as acute or subacute cystitis with varying recurrence rates, and periods of remission when there are no clinical, laboratory, or bacteriological data that would indicate an active inflammatory process, are risk factors for atrophic changes in the urogenital tract.

Recurrent urinary tract infections occur in around 30% of people who also have symptoms of an overactive bladder. The idea of ascending bladder infection states that a portion of urine entering the urethra and a sharp rise in detrusor pressure are accompanied by a corresponding rise in intraurethral pressure (to retain urine), which is followed by a partial discharge of urine from the urethra into the bladder and the entry of distal urethral microflora.

Age-related and estrogen-deficit-related alterations occur in the urothelium and vaginal epithelium. Exfoliating superficial and transitional epithelial cells are seen in the urothelium of women on hormone replacement treatment. These cells are likely discharged in the urine after attaching to uropathogens.

The urethral epithelium of women who do not get hormone replacement treatment is mostly composed of single exfoliated cells and basal and parabasal cells with a broad base. They could serve as a holding area for uropathogens that have attached. The increased frequency of recurrent UTIs in postmenopausal women with urogenital atrophy and the efficacy of local estrogens in alleviating symptoms are explained by the difference in the degree of exfoliation of urethral cells with adherent uropathogens.

Pollakiuria (more than eight urinations per day), nocturia (more than one episode of urination per night), urgent need to pee, urgent urinary incontinence, stress urinary incontinence, and recurrent urinary tract infections are examples of urinary problems in urogenital diseases. The patient's symptoms, medical history, and the findings of a general urinalysis are used to make the diagnosis of acute cystitis, which often presents no challenges.

There are situations in which a prescription can be written without laboratory testing. For the first time, a urine culture investigation has not been demonstrated to ascertain the pathogen's sensitivity in the instance of acute uncomplicated cystitis. However, this examination is required in the event that the condition recurs or if appropriately recommended medication proves unsuccessful (EAU recommendations, 2001, 2004). The presence of more than 10<sup>3</sup> CFU of uropathogens in 1 milliliter of an average urine sample is the diagnostic criteria for acute uncomplicated cystitis in women.

In a hospital context, the primary diagnostic responsibilities include bacteriological confirmation of the pathogen and thorough identification of concurrent illnesses, anatomical anomalies, and functional disorders that impede lower urinary tract urodynamics. When patients with urogenital disorders have symptoms of an overactive bladder and urinary disorders, a thorough urodynamic examination is conducted (the bladder's physiological and cystometric volume, maximum urine flow rate, maximum urethral pressure, urethral resistance index, and the presence or absence of abrupt increases in urethral and detrusor pressure are evaluated). When treating cystitis, etiological and pathogenetic aspects should be considered. The main goal is to eradicate the reasons behind the recurrent lower urinary tract infection.

Surgery is one pathogenetic therapy for chronic cystitis that aims to eliminate the causes of urodynamic problems and rectify structural alterations. Local hormone therapy is a crucial component of treatment for women with urogenital diseases who have recurrent UTIs. In comparison to a placebo, the effectiveness of estrogens in reducing recurrent UTIs was found to be statistically significant for systemic estrogens (relative risk: HR 1.08; confidence interval: CI 0.88–1.33), local estrogens (HR 0.25; CI 0.13–0.50), and ring estrogens (HR 0.64; CI 0.47–0.86). Antibacterial therapy is the etiological treatment.

The range of antimicrobial activity, the degree of antibiotic resistance, pharmacokinetics, safety profile, pharmacoeconomic evaluation of the regimen, and the outcomes of comparative randomized trials demonstrating the drug's efficacy must all be considered when selecting an antibacterial medication.

When more than 10–20% of the microorganisms in a population are resistant to an antibacterial medicine, it is not feasible to take the medication because of its ineffectiveness. The following medications are used to treat acute cystitis in accordance with the Federal Guidelines for Doctors on the Use of Medicines, the American and European Urological Associations' guidelines, and the ideas of evidence-based medicine: trimethoprim/sulfamethoxazole, fluoroquinolones, fosfomycin trometamol (once); inhibitor-protected penicillins and oral cephalosporins of the I–III generation, alternative amoxicillin/clavulanate, nitrofurantoin, nalidixic acid, and co-trimoxazole; cephalosporins of the I–III generation, fosfomycin trometamol (once) in pregnant women.

Cranberry extract-based formulations are frequently employed in the complicated treatment of urinary tract infections, as well as for relapse prevention. Fructose and proanthocyanidin, two compounds found in cranberry fruits, attach to proteins on *E. coli*'s fimbriae and so prevent the bacteria from adhering to the urinary tract's epithelial lining. Cranberry juice has been shown to be highly beneficial in preventing urinary tract infections (evidence level A) in a systematic assessment of the Cochrane database.

Taking cranberries during pregnancy and breastfeeding did not cause any negative side effects. Recently, Zhuravit, a biologically active food additive made by Medan Pharma JSC in Poland, was made accessible in our nation. It comes in handy soft capsule form and contains 220 mg of cranberry fruit extract (*Vaccinium macrocarpon*). It is advised to administer Zhuravit for two to four weeks,

taking one capsule three times a day for the first three days and then one capsule once a day after that. The treatment plan can be prolonged as needed. In addition to being utilized as an auxiliary agent in complicated therapy for urinary tract illnesses, zhuravit is used for prophylaxis.

Several more conservative therapeutic approaches are employed in hospital settings in addition to sensible antibacterial and anti-inflammatory medication. Tricyclic antidepressants are recommended for individuals with significant mental lability in order to rectify emotional responses brought on by irritative symptoms. Complex therapy frequently makes use of nonsteroidal anti-inflammatory medications, antihistamines, mast cell stabilizers, angioprotectors, kinin antagonists, anticholinergic medications, immunotherapy using medications that include pathogen antigenic material, immunomodulators, and physiotherapy approaches.

Therefore, preventing and treating urinary tract infections in women necessitates a comprehensive strategy that minimizes consequences and takes into account etiological, pathogenetic, and age-related factors. More research is required to determine how well cranberry preparations work to treat UTIs while accounting for physiological stages of a woman's life, such as pregnancy, breastfeeding, and menopause.

## Conclusion

Urinary tract infections continue to be a major public health issue, especially for women who are fertile. Women are more susceptible to recurring infections because of the physiological and anatomical features of the female urinary system. A key component of effective care is early diagnosis by clinical and laboratory examination, followed by antibiotic treatment tailored to the organism. Reducing the incidence and recurrence of UTIs requires the implementation of preventive measures, such as better cleanliness, enough hydration, and behavioral changes. Using antibiotics sensibly is also essential to halting the emergence of antibiotic resistance.

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