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## **Review of Urinary Tract Infections in Pregnancy: Risks, Complications and Management**

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**Abstract**

**Background:** Urinary tract infections (UTIs) are common in pregnant women due to significant changes during gestation. UTIs can affect any part of the urinary system and are typically caused by bacteria, though fungi and viruses can also be responsible. Asymptomatic bacteriuria (ASB) is frequent in pregnancy and must be treated to prevent serious maternal and fetal complications. Routine screening for ASB is standard in prenatal care, and treatment with safe, effective antibiotics is essential. Preventive strategies also help reduce UTI during pregnancy.

**Aim of the study:** The study aimed to explore the changes that occur during gestation, which predispose pregnant women to UTIs, assess the diagnostic methods and select the most effective treatment to prevent complications.

**State of knowledge:** Urinary tract infections (UTIs) are common perinatal complications, with higher prevalence in pregnancy due to changes that occur during gestation. UTIs can perform as asymptomatic bacteriuria (ASB), cystitis and pyelonephritis, which can result in severe complications. Clinical guidelines recommend screening for ASB in early pregnancy and prescribing a short course of antibiotics if detected. Escherichia coli is the most common cause of UTIs. As most antibiotics cross the placenta, treatment must be safe for the fetus and effective against the pathogens. Guidelines recommend short courses of antibiotics.

**Conclusions:** UTIs in pregnancy are common and lead to serious complications if untreated.

Pregnant women are more susceptible to UTIs due changes that occur during gestation. Healthcare professionals play a critical role in managing UTIs during pregnancy. Early detection through routine screening and prompt treatment is crucial for optimal outcomes. Healthcare professionals, including obstetricians, should educate patients on preventive measures and recognizing early UTI symptoms.

**Keywords:** Urinary Tract Infections, Pregnancy, Maternal Outcomes, Perinatal Infections

**Abbreviations:** UTIs- urinary tract infections; ASB- asymptomatic bacteriuria

## **1. Introduction**

Urinary tract infections (UTIs) are one of the most common infections, significantly more prevalent in women than in men. Over 50% of women experience at least one UTI during their lifetime [1]. A contributing factor is primarily the anatomical structure of the lower urinary tract and its proximity to the genital and gastrointestinal organs. The relatively shorter length of the female urethra reduces the distance that bacteria must travel to reach the bladder. Additionally, frequent or excessive use of intimate hygiene products can disrupt the natural bacterial flora, increasing susceptibility to UTIs. Pregnancy is a specific period during which the risk of UTIs is heightened. UTIs are the most commonly diagnosed infections during pregnancy, affecting 50-60% of all pregnant women [2]. These infections can occur in any part of the urinary system, including the kidneys, ureters, bladder and urethra.

They are caused by microbial invasion, most commonly by bacteria, though fungi and viruses can also be responsible. Symptomatic UTIs can be categorized into lower and upper UTIs. Lower UTIs affect the bladder and urethra. Bladder infection (cystitis) is characterized by symptoms such as dysuria (painful urination), frequent urination and suprapubic pain. Urethral infection (urethritis) may present with painful urination and discharge, often linked to sexually transmitted infections (STIs). Upper UTIs involve the ureters and kidneys.

Kidney infection (pyelonephritis) is a more severe condition and often comes with symptoms like flank pain and tenderness in the presence of pyuria (pus in the urine). These symptoms are highly suggestive of pyelonephritis and differentiate it from other urinary tract infections [3]. Systemic symptoms as fever, chills, nausea and vomiting can occur. It often results from an ascending infection from the lower urinary tract [4].

UTI can also perform as asymptomatic bacteriuria (ASB), defined as the presence of significant levels of bacteria in the urine without typical symptoms such as dysuria, urgency, frequency, hematuria or suprapubic discomfort [5]. ASB occurs in 2-10% of pregnancies [6]. ASB is most frequently observed in early pregnancy, with only small proportion of women developing it in later stages of pregnancy [7]. ASB should be treated in a pregnant woman even if there are no symptoms, to avoid progression to symptomatic infections such as cystitis or pyelonephritis and other complications during gestation [8]. Screening for ASB is a key component of prenatal care and is universally recommended during the first trimester or at the first prenatal visit [9].

## 2. Etiology

Urinary tract infections are caused by the ascending migration of bacteria from the perineal region into the urethra, progressing to the bladder, and in severe cases, the upper urinary tract, including the ureters and kidneys. The majority of these infections are attributed to gram-negative bacteria that colonize the lower gastrointestinal and genitourinary tracts. *Escherichia coli* (*E.coli*), a facultative anaerobic gram-negative rod, is by far the most common uropathogen, responsible for up to 80% of both uncomplicated and complicated UTIs. These bacteria possess virulence factors, such as pili and adhesins, which facilitate their attachment to the urothelium, enabling colonization and the initiation of infection.

Other gram-negative pathogens commonly implicated in UTIs include *Klebsiella pneumoniae* and *Proteus Mirabilis*. Gram-positive organisms, though less common, also contribute to UTIs. *Staphylococcus Saprophyticus* is a frequent cause of uncomplicated UTIs in sexually active young women. Enterococcal species are more commonly associated with complicated UTIs. Group B streptococcus (*Streptococcus agalactiae*) poses significant risks in pregnancy. Group B streptococcal bacteriuria during pregnancy is associated with an increased risk of early-onset neonatal sepsis, emphasizing the importance of its identification and treatment in this population [10]. In certain cases, viruses and fungi may cause UTIs, more likely in immunocompromised patients. Adenoviruses have been identified as a cause of hemorrhagic cystitis. Fungal pathogens, most commonly *Candida* species, are associated with UTIs in patients with diabetes. Emerging pathogens and increasing antimicrobial resistance further complicate the management of UTIs. *Pseudomonas aeruginosa* and *Enterobacter* species are significant causes of nosocomial UTIs and are often associated with multidrug resistance, requiring advanced therapeutic strategies [11, 12].

## 3. Diagnosis

The diagnosis of urinary tract infection relies on a combination of clinical symptoms and laboratory tests. Typical symptoms of UTIs, such as dysuria, urgency, frequency, suprapubic discomfort or flank pain, provide the initial basis for suspicion. UTIs can be confirmed by 2 main laboratory tests: urinalysis and urine cultures. Urinalysis is a rapid and widely available test that identifies markers of infection in the urine. Key findings suggestive of a UTI include: leukocytes (white blood cells) - indicative of inflammation or infection; nitrites - produced by gram-negative bacteria, such as *Escherichia coli*, which reduce urinary nitrates to nitrites; red blood cells (hematuria) - may be present due to inflammation or irritation of the urinary tract; bacteria - microscopic examination of urine can reveal the presence of bacteria. Urinalysis is a useful screening tool but should not be the sole diagnostic method, particularly when symptoms are nonspecific or absent. Urine culture is regarded as the gold standard for diagnosing UTIs. It involves growing microorganisms from a urine sample to identify the causative pathogen and determine its susceptibility to antibiotics. The results of urine culture guide targeted therapy, especially in cases where empirical treatment fails, or antibiotic resistance is a concern. In asymptomatic individuals, a colony count of  $\geq 100,000$  ( $10^5$ ) CFU/mL is diagnostic for asymptomatic bacteriuria. In symptomatic individuals, a colony count of  $\geq 1,000$  ( $10^3$ ) CFU/mL confirms infection.

Complicated UTIs, such as pyelonephritis, imaging studies are often required to assess the extent of the infection and identify potential underlying abnormalities. Ultrasound and computed tomography are commonly used to visualize the urinary tract.

#### **4. Anatomical, Physiological and Immunological Changes in Pregnancy**

The urinary tract is normally sterile above the urethral sphincter, including the urinary bladder, ureters, renal pelvis and calyces. In the distal part of the urethra and the area around the urethral meatus, bacteria are physiologically present. These bacteria do not cause urinary tract infections, but, along with the vaginal microbiota, play a protective role in preventing the colonization of the urinary tract by uropathogenic bacteria. Maintaining the balance of this microbiota is vital, as disruptions can increase the risk of urinary tract infections.

Pregnant women are more susceptible to UTIs due to significant anatomical and physiological changes. These changes, while essential for supporting fetal growth and development, also create conditions favorable for bacterial colonization and infection.

##### **Anatomical Changes**

The growing uterus exerts direct pressure on the bladder and ureters, potentially causing partial obstruction and slowing urine flow, which increase the risk of urinary stasis. Increased bladder capacity during pregnancy leads to longer intervals between voiding.

This delay in urination further encourages bacterial proliferation, as stagnant urine provides a nutrient-rich medium for bacterial growth.

##### **Hormonal Changes**

Elevated levels of progesterone during pregnancy play a crucial role in the increased susceptibility to UTIs. Progesterone induces smooth muscle relaxation, which reduces ureteral peristalsis. This diminished contraction of the ureters impairs urine flow and promotes urinary stasis. Additionally, relaxation of the detrusor muscle, responsible for bladder emptying, leads to incomplete voiding and residual urine. Dilation of the renal pelvis and ureters (hydronephrosis) occurs as early as the first trimester and worsens as pregnancy progresses. All these factors facilitate bacterial colonization and growth [13].

##### **Immune Modulation**

During pregnancy, progesterone is associated with modulation of the immune system to support the fetus. Reduced activity of natural killer (NK) cells and macrophages impairs the clearance of urinary pathogens. These effects, while necessary for maintaining pregnancy, significantly increase the risk of UTIs [14]. The efficacy of defense mechanisms and the virulence mechanisms of pathogens influence the development of infection.

##### **Urine Composition**

Pregnancy is associated with noticeable changes in urine composition that further predispose women to UTIs. The pH of urine often becomes more alkaline, particularly in later stages of pregnancy. This alkalinity creates an environment conducive to the growth of certain uropathogens, such as *Escherichia coli*.

The presence of glucose in the urine (glycosuria) is another common finding during pregnancy, especially in women with gestational diabetes or preexisting diabetes. Glucose-rich urine provides a nutrient-rich environment that supports bacterial growth. High glucose levels in urine not only promote bacterial proliferation but also facilitate bacterial adhesion to the epithelial cells lining the urinary tract. This adhesion makes it easier for bacteria to establish colonies and cause infection [15].

### **5. Other Risk Factors of UTIs in pregnancy**

Certain groups of women face a greater risk of development urinary tract infections during pregnancy. Diabetes is a known risk factor for UTIs. It impairs immune function and causes glycosuria, creating an environment conducive to bacterial growth. Similarly, conditions such as polycystic kidney disease or congenital abnormalities of the urinary tract predispose women to UTIs due to structural or functional impairments in urinary drainage. Sickle cell disease is another known risk factor, as it can lead to vaso-occlusive crises that impair renal function and increase susceptibility to infections. Additionally, women with a history of recurrent UTIs are also more likely to experience infections during pregnancy [16]. Maternal age, race, and socioeconomic status are also associated with varying risks of UTIs during pregnancy. Studies have shown that UTIs are more prevalent among younger women and those from lower socioeconomic backgrounds. Limited access to healthcare, poorer hygiene conditions and nutritional deficiencies may all contribute to this increased risk. Certain racial and ethnic groups may also face disparities in UTI prevalence, although these associations are often linked to underlying socioeconomic and environmental factors rather than race itself. Some researches had highlighted the role of nutritional deficiencies, particularly low vitamin D levels, in increasing susceptibility to UTIs. Vitamin D plays an essential role in modulating the immune response, and its deficiencies may impair the body's ability to combat infections, including those affecting the urinary tract. Pregnant women with insufficient vitamin D levels are more likely to develop UTIs than those with adequate levels, emphasizing the importance of maintaining a balanced diet and appropriate supplementation during pregnancy [17]. Personal hygiene practices are another critical factor. Poor perineal hygiene, such as improper wiping techniques or infrequent changing of underwear, increases the risk of bacterial migration from the gastrointestinal tract to the urinary tract. This risk is heightened during pregnancy due to the anatomical and hormonal changes that favor bacterial colonization.

### **6. Complications of Untreated UTIs**

Untreated urinary tract infections in pregnancy pose significant risks to both maternal and fetal health, as they can progress from asymptomatic bacteriuria to symptomatic infections, leading to potentially life-threatening complications. Pregnant women with asymptomatic bacteriuria have been shown to experience preterm deliveries [18]. Women identified with asymptomatic bacteriuria in early pregnancy without treatment have a 20-30 fold increased risk of progressing to pyelonephritis during pregnancy compared to those without bacteriuria [19]. Pyelonephritis is the most serious complication of UTI during pregnancy, posing immediate threats to maternal health. The infection can escalate to cause perinephric abscess and sepsis, particularly if left untreated.

Sepsis, a life-threatening condition is characterized by organ dysfunction resulting from an uncontrolled infection, remains a leading cause of maternal morbidity. Other maternal complications linked to UTIs during pregnancy include anemia and hypertensive disorders such as preeclampsia [20]. The consequences of untreated UTIs extend beyond maternal health and can significantly impact fetal and neonatal well-being. Pyelonephritis is associated with preterm labor and premature rupture of membranes, both of which contribute to poor neonatal outcomes. Infants born preterm or with low birth weight are at an increased risk for complications such as neonatal sepsis, respiratory distress syndrome, and long-term developmental issues. Intrauterine growth restriction (IUGR) is another potential complication, resulting from impaired placental function due to maternal infection and inflammation. In severe cases, maternal sepsis or prolonged infection may result in stillbirth or neonatal death [21,22]. Recurrent UTIs during pregnancy can lead to persistent anatomical and physiological changes in the urinary tract, such as scarring or reduced renal function. These changes may predispose women to chronic kidney disease or recurrent infections postpartum. Additionally, recurrent infections may disrupt the natural progression of pregnancy, necessitating more intensive medical interventions and monitoring. Consequently, early diagnosis of UTI, proper management and an appropriate and preventive approach are very important measures to prevent complications during pregnancy.

## **7. Management and treatment**

Treating urinary tract infections during pregnancy requires a careful balance between ensuring the safety of the fetus and effectively targeting the pathogens causing the infection. Almost all antibiotics cross the placenta, so clinicians must select medications that are both safe for fetal development and effective against the specific causative bacteria. Guidelines universally recommend short courses of antibiotics, generally lasting less than seven days, for treating asymptomatic bacteriuria and cystitis, as prolonged courses do not offer additional benefits in these cases [23]. For UTIs treatment in pregnancy, antibiotics such as oral beta-lactams (e.g. amoxicillin-clavulanic acid and cephalosporins) are recommended as first-line options due to their established safety profiles [24]. Fosfomycin, another commonly used and well-tolerated antibiotic, is administered as a single-dose treatment for uncomplicated UTIs. However, nitrofurantoin, while effective, should be avoided due to the risk of hemolytic anemia in newborns affected by glucose-6-phosphate dehydrogenase (G6PD) deficiency [25]. Pregnant women diagnosed with pyelonephritis should be admitted to hospital due to increased risk of serious complications, including preterm delivery, sepsis and maternal morbidity [26]. In these cases, close monitoring and parenteral antibiotic therapy are essential. Recommended antimicrobials for managing pyelonephritis include amoxicillin combined with an aminoglycoside, third-generation cephalosporins (e.g. ceftriaxone), or carbapenems [27]. These agents are chosen for their broad spectrum coverage while maintaining a safety profile compatible with pregnancy. Certain antibiotics, such as tetracyclines, fluoroquinolones (e.g. ciprofloxacin), and trimethoprim, are contraindicated during pregnancy due to teratogenic risks and potential adverse effects on fetal development [28]. When initiating treatment, healthcare providers must carefully assess the risk-benefit ratio, tailoring therapy to the individual patient's circumstances while considering both maternal and fetal well-being.

Supportive care is a crucial aspect of managing UTIs in pregnancy, particularly in cases of pyelonephritis. This includes ensuring adequate hydration through oral or intravenous fluids to maintain renal perfusion and support urinary flow. Analgesics and antipyretics can be used to alleviate pain and fever, while antiemetics may help manage associated nausea and vomiting [29]. In addition to medical therapy, an ultrasound scan of the urinary tract is recommended in cases of pyelonephritis to identify potential contributing factors, such as hydronephrosis, urinary stones, or structural abnormalities [30]. Detecting and addressing these issues is vital to prevent recurrence and further complications. Following the completion of antibiotic therapy, a repeat urine culture is essential to confirm the eradication of the infection. Persistent bacteriuria, which may indicate inadequate treatment or reinfection, warrants further evaluation and possibly an extended or alternative antibiotic regimen. Comprehensive follow-up ensures the resolution of the infection and reduced the risk of adverse outcomes for both the mother and the developing fetus.

## **8. Prevention**

Preventing urinary tract infections involves a range of lifestyle and hygiene practices aimed at reducing the risk of bacterial growth and colonization in the urinary system. One of the most important preventive measures is maintaining adequate hydration, minimum 1, 5 to 2 liters of water per day. This encourages regular urine production and helps flush bacteria out of the urinary tract. Frequent urination is another crucial preventive measure, as it helps avoid urinary retention, which can create a favorable environment for bacterial growth.

Delaying urination for extended periods allows bacteria, such as *Escherichia coli*, the most common pathogen associated with UTIs, to multiply and ascend into the bladder or other parts of the urinary tract. Proper perineal hygiene also plays a significant role, especially for women, as the female anatomy places the urethra closer to the anus, increasing the potential for bacterial transfer. Effective hygiene practices include wiping from front to back after urination or defecation, wearing breathable cotton underwear, and avoiding irritants such as harsh soaps or douches in the genital area. In addition to these measures, some studies suggest that cranberry products, such as unsweetened juice or supplements, may help in preventing UTIs. Cranberries contain proanthocyanins, compounds believed to inhibit the adherence of bacteria, particularly *Escherichia coli*, to urothelial cells lining the bladder. Without this adhesion, bacteria are less likely to infect the mucosal surface and cause an infection. However, while promising, the effectiveness of cranberry products may vary, and they are typically recommended as a complementary measure rather than a primary form of prevention [31, 32].

## **9. Conclusion**

Urinary tract infections (UTIs) in pregnancy are a significant medical issue due to the combined effects of hormonal, anatomical and immunological changes that occur during gestation. These changes increase the susceptibility of pregnant women to infections, posing potential risks to both maternal and fetal health. Health professionals play a critical role in ensuring that pregnant women receive timely and appropriate care to mitigate these risks. Early detection of UTIs is paramount, starting with routine screening for asymptomatic bacteriuria (ASB) during prenatal visits.



By identifying and treating ASB, healthcare providers can prevent the progression of infection to symptomatic conditions such as cystitis or pyelonephritis. Accurate diagnosis, often facilitated through urine culture, allows for the selection of targeted antibiotic therapy that is both effective against the causative pathogens and safe for the developing fetus. Effective management of UTIs in pregnancy involves not only the treatment of active infections but also the implementation of preventive strategies. Obstetricians should educate their patients about the importance of proper hygiene, adequate hydration and regular urination to reduce the risk of infection. The consequences of untreated UTIs in pregnancy can be severe, leading to maternal complications such as sepsis and preeclampsia, as well as fetal complications such as preterm delivery, low birth weight and even fetal mortality. These potential outcomes underscore the importance of prompt and effective management. Obstetricians and other healthcare professionals must prioritize patient education, empowering women to recognize the early symptoms of UTIs and seek medical attention promptly.

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