



URINARY TRACT INFECTION

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Abstract : The Urinary Tract Infection (UTI) is a seasonal infection prevalent in coastal areas whose intensity varies among various age groups. Escherichia coli is one of the major causative organisms. The current study is to the frequency of UTI in the Coastal region, understand the recent advances in alternative treatment & their efficacy. The known medication for the UTI is quinolones and cephalosporin. Cranberry extract is the only medicine used from a plant source that is expensive and not native to India. The main cause of UTI to spread is a lack of hygiene, sexual intercourse, and inadequate consumption of water. Change in the pH of the urethra during puberty & menopause in women facilitates the growth of opportunistic Uropathogens. Innate immunity can also contribute to the resistance of the body but a recent study says that infection rate varies among individuals considering their age, immunity, and lifestyle. The pathogens causing UTI are developing resistance against multiple drugs. From this study, we understand that Cranberry is the only plant source for the treatment of UTI in combination with antibiotics. There is a need to understand the importance of improving innate immunity and to know the best treatment regime to treat UTI.

Keywords - Antibiotics, Gastrointestinal bacteria, Pregnant women, Cystitis, Uropathogenes, recurrent UTI.

INTRODUCTION

Urinary tract infection is one of the most common infections in pregnant women. UTI is a condition in which germs or microbes grow and multiply in the urinary tract in significant numbers. Based on the presence or absence of symptoms, UTI can be divided into 2, namely asymptomatic UTI (asymptomatic bacteriuria) and symptomatic UTI (symptomatic bacteriuria). Pregnant women often have asymptomatic UTIs/asymptomatic bacteriuria. Asymptomatic UTI is characterized by the discovery of bacteria in urine culture with several 10⁵ cfu/mL or more without any symptoms of UTI. In patients with signs and symptoms of UTI such as dysuria, frequency (frequent urination), urgency (unable to hold urine), pollakiurias, hematuria and the presence of pyuria (>7 leukocytes/mL), bacteria with a count of more than 10² cfu/mL were found. mL in urine culture can already be said to be UTI (symptomatic). Based on the location of infection, UTI can be classified into lower UTI consisting of urethritis and cystitis and upper UTI consisting of urethritis and pyelonephritis. Urinary tract infection (UTI) is one of the most prevalent disease affecting people from all age groups including neonate and geriatric age groups. Every year about 150 million people are being diagnosed with urinary tract infection worldwide. Each and every woman has a lifetime risk of developing UTI is 60%; by contrast, men have a lifetime risk of only 13%^[1]. Pregnant women experience higher rates of intrauterine growth

restriction and low birth-weight infants. The presence of a UTI has also been shown to increase the risk of preterm labor, preterm birth, pregnancy-induced hypertension, preeclampsia, amnionitis and anemia. The objective of the present study is to assess the prevalence of UTI among pregnant women, married and unmarried women. UTIs are infections that can occur in the urethra (urethritis), bladder (cystitis), or kidneys (pyelonephritis) and are one of the world's most common infectious diseases, affecting 150 million people each year, with significant morbidity and high medical costs (e.g. it has been estimated that the economic burden of recurrent UTIs in the United States is more than \$5 billion each year) Although symptomatology varies depending on the location of these infections, UTIs have a negative impact on patients relationships, both intimate and social, resulting in a decreased quality of life UTIs are classified as either uncomplicated (UUTIs) or complicated (CUTIs). UTIs typically affect healthy patients in the absence of structural or neurological abnormalities of the urinary tract^[2].

EPIDEMIOLOGY OF UTI

The cause of UTI is about 6 days of disability per episode, and thus, in the aggregate, result in substantial morbidity due to their considerable frequency; indeed, they are the most frequent bacterial infections in women. Estimates of UTI incidence among young men in the same age range are several logs less at 5–8 infections per 10,000. On the basis of hospital UTIs are the most frequent bacterial infection seen in the outpatient setting: 1 in 3 women will develop a UTI requiring antibiotic treatment by age 24, and 50% experience at least 1 UTI during their lifetime. The incidence of cystitis is significantly higher in women than men, likely the result of anatomic differences. Specifically, the shorter female urethra can facilitate bacterial transit from the urethral opening to the bladder. Colonization of the vaginal introitus by gastrointestinal pathogens can also increase the likelihood of urinary tract infiltration. Other factors, including urinary tract obstruction, incomplete voiding, and aberrant structural anatomy also predispose individuals to UTIs. Additional risk factors include prior history of UTIs, vaginal intercourse within the past 2 weeks, use of contraception with spermicide, low vaginal estrogen levels and individual genetic background While a number of comorbidities increase susceptibility to UTI, the majority of UTIs occur in otherwise healthy women. The most common bacterial cause of uncomplicated community-acquired UTI is uropathogenic *Escherichia Coli* (UPEC), representing >80% of infections. These bacteria inhabit the lower intestinal tract of warm-blooded vertebrates where they lead a seemingly innocuous existence until they gain access to a niche, such as the urinary tract, where they can cause disease. Other pathogens commonly associated with uncomplicated UTI include *Staphylococcus saprophyticus*, *Klebsiella* species, *Proteus mirabilis*, and *Enterococcus faecalis*^[3]. It is estimated that 150 million UTIs occur yearly on a global basis, resulting in more than 6 billion dollars in direct health care expenditures. Infections are rare in boys except in association with anatomic or functional abnormalities in the first year of life. Infections are also infrequent among 2 to 13-year-old girls, but some young girls experience multiple repeated episodes of recurrent cystitis or pyelonephritis. The incidence of UTIs markedly increases among young women during adolescence, with an estimated 7 million acute uncomplicated infections occurring annually in the United States, as determined on the basis of data extrapolated from surveys of physicians. In a recent prospective study of acute UTIs in young women, the incidence was 0.5–0.7 per year. Recurrent infections become a problem in 25%–30% of women who experience an initial infection. Most uncomplicated infections in women do not result in long-term sequelae or renal damage. However, such infections typically survey data, at least 250,000 cases of pyelonephritis per year occur in the United States^[4].

Figure -1 shows epidemiology of Urinary tract infections (UTIs) are caused by a wide range of pathogens, including Gram-negative and Gram-positive bacteria, as well as fungi. Uncomplicated UTIs typically affect women, children and elderly patients who are otherwise healthy. Complicated UTIs are usually associated with indwelling catheters, urinary tract abnormalities, immunosuppression or exposure to antibiotics. The most common causative agent for both uncomplicated and complicated UTIs is uropathogenic *Escherichia coli* (UPEC). For uncomplicated UTIs, other causative agents are (in order of prevalence) *Klebsiella Pneumoniae*, *Staphylococcus saprophyticus*, *Enterococcus faecalis*, Group B *Streptococcus* (GBS), *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Candida* spp. For complicated UTIs, the other causative agents are (in order of prevalence) *Enterococcus* spp, *K. Pneumoniae*, *Candida* spp, *S. aureus*, *P. mirabilis*, *P. aeruginosa* and GBS.

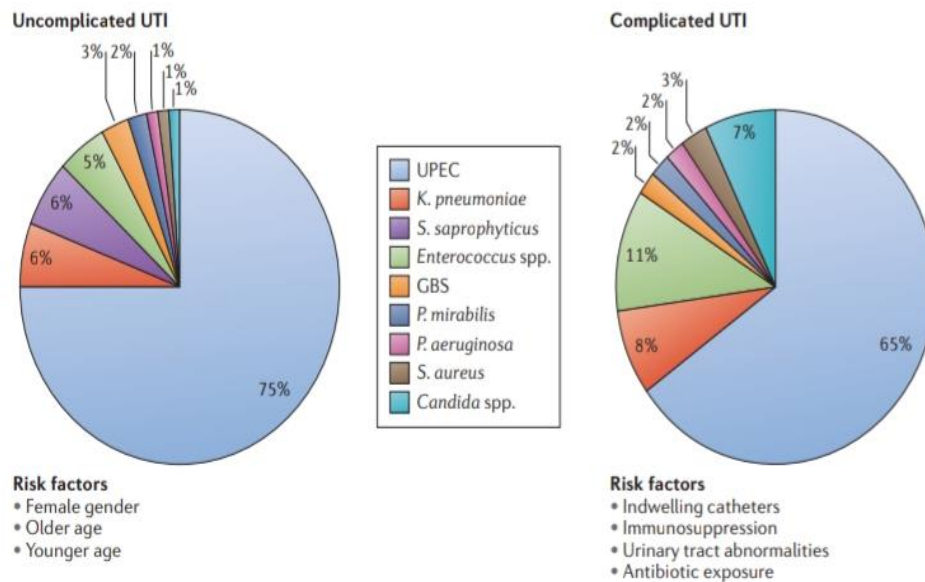


Figure - 1: Epidemiology of urinary tract infections.

ETIOLOGY

A bacterial etiology can usually be demonstrated for most episodes of UTI, and the most common bacterial species seen in various patient groups have now been well defined. However, there remain patient groups in whom etiology is unclear. Even among young women with acute symptoms and pyuria, there is subset in whom no pathogens can be isolated. A substantial number of men with prostatitis of the nonbacterial but inflammatory category have no apparent microorganism demonstrable, and interstitial cystitis remains an idiopathic syndrome. Assessment of such patients for newly recognized pathogens, such as *Mycoplasma genitalium*, or the use of broad host-range 16s rRNA probes to identify new pathogens in these patient groups would be of interest. Normally urine is sterile. It is usually free of bacteria, viruses and fungi but does contain fluids, salts and waste products. An infection occurs when tiny organisms, usually bacteria from the digestive tract, cling to the opening of the urethra and begin to multiply. Most infections arise from one type of bacteria, *E. coli* which normally lies in the colon. The organisms most commonly responsible for catheter-associated UTIs are *E. coli*, *Proteus mirabilis*, *P. aeruginosa*, and *Streptococcus faecalis*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Mycobacterium tuberculosis*, *Actinomyces*, *Nocardia*, *Candida* etc can cause UTI. In addition *Mycoplasma* and *Chlamydia* may be associated with sexually transmitted UTI^[5].

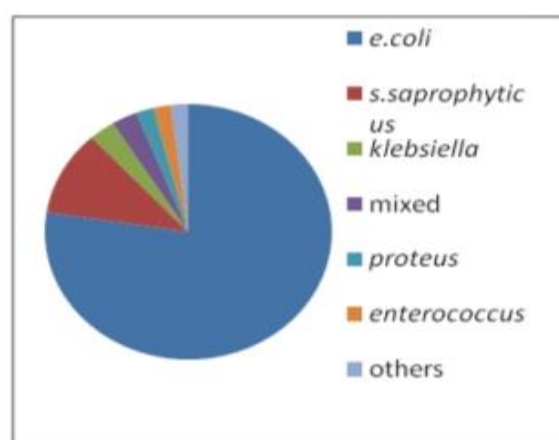


Figure-2: Diagram showing contribution of various microbes for causing the UTI: *E. coli* 79%, *S. Saprophyticus* 11%, *Klebsiella* 3%, Mixed 3%, *Proteus* 2%, *Enterococcus* 2%, others 2%.

SIGNS AND SYMPTOMS

- ❖ Men and women aged under 65 years:
 - Dysuria — discomfort, pain, burning, tingling or stinging sensation on urination;

- Frequency — passing urine more often than usual;
- Urgency — a strong desire to empty the bladder, which may lead to urinary incontinence;
- Nocturia — passing urine more often than usual at night;
- Haematuria — blood in urine;
- Suprapubic discomfort/tenderness;
- Urine may appear cloudy to the naked eye or change colour or odour.
- ❖ Pyelonephritis symptoms:
 - Kidney pain/tenderness in back, under ribs;
 - Myalgia, flu-like illness;
 - Nausea/vomiting;
 - Shaking chills (rigors) OR temperature over 37.9°C (or below 36°C in people aged over 65 years).
- Common urinary tract infection (UTI) symptoms in women include:
 - Urge to urinate frequently, often in small amounts
 - Burning with urination
 - Cloudy urine
 - Strong unpleasant smell of urine
 - Dark or bloody urine
 - Pelvic pain
 - Flank or back pain (kidney infection)
 - Fever, chills (usually with kidney infection)
 - Other possible symptoms include bloating, vaginal discharge
- Common urinary tract infection (UTI) symptoms in men include:
 - Urge to urinate frequently, often in small amounts
 - Burning with urination
 - Cloudy urine
 - Strong unpleasant smell of urine
 - Dark or bloody urine
 - Rectal pain (kidney infection)
 - Flank or back pain (kidney infection)
- Other symptoms may include penile, testicular and abdominal pain, and penile discharge
- Common urinary tract infection (UTI) symptoms in children include:
 - Urge to urinate frequently, often in small amounts
 - Burning with urination
 - Cloudy urine
 - Strong unpleasant smell of urine (not as reliable in children)
 - Dark or bloody urine
 - Abdominal pain
 - Fever, vomiting
 - Other symptoms (especially in newborns and infants) may include hypothermia, diarrhea, jaundice, diabetes.
 - Poor feeding and in some children, bedwetting
- The following also increase your chances of developing a UTI:
 - Advanced age (especially people in nursing homes)
 - Problems emptying your bladder completely (urinary retention)
 - A tube called a urinary catheter inserted into your urinary tract
 - Bowel incontinence
 - Enlarged prostate, narrowed urethra, or anything that blocks the flow of urine
 - Kidney stones
 - Pregnancy^[6].

PATHOGENESIS OF UTI

Urinary tract infections (UTIs) begin when gut-resident uropathogens colonize the urethra and subsequently the bladder through the action of specific adhesins. If the host's inflammatory response fails to eliminate all bacteria, they begin to multiply, producing toxins and enzymes that promote their survival. Subsequent colonization of the kidneys can evolve into bacteremia if the pathogen crosses the kidney epithelial barrier. In complicated UTIs, infection by uropathogens is followed by bladder compromise, which occurs with catheterization. A very common situation is the accumulation of fibrinogen on the catheter as a result of the strong immune response induced by catheterization. Uropathogens, through the expression of fibrinogen-binding proteins, bind to the catheter. Bacteria also multiply as a result of biofilm protection, and if the infection is left untreated, it can progress to pyelonephritis and bacteremia. UTIs are the most common bacterial infection in humans worldwide and the most common hospital-acquired infection. The spread of UTIs is closely linked to the effectiveness of a number of strategies that uropathogens have developed to adhere to and invade host tissues. Often, the infection does not seem particularly severe, especially in the early stages, but it can worsen significantly in the presence of complicating factors. Complicating factors that are involved in the progression of UTI are biofilms, urinary stasis due to obstruction, and catheters. UTIs comprise a heterogeneous group of clinical disorders that vary in terms of the etiology and severity of conditions. The risk of UTI is influenced by a wide range of intrinsic and acquired factors, such as urinary retention, vesicoureteral reflux, frequent sexual intercourse, prostate gland enlargement, vulvovaginal atrophy, and family history. The use of spermicides may also increase the risk of UTI in women. A urine culture with $\geq 10^5$ colony-forming units/mL without any specific UTI symptoms is defined asymptomatic bacteriuria, as it usually resolves spontaneously and does not require treatment. Asymptomatic UTIs should be treated only in selected cases, such as pregnant women, neutropenic patients, and those undergoing genitourinary surgery, as antibiotic treatment may contribute to the development of bacterial resistance. In contrast, symptomatic UTIs are commonly treated with antibiotics that can alter the intestinal and vaginal microbiota, increasing the risk factors for the spread of multidrug-resistant microorganisms^[7].

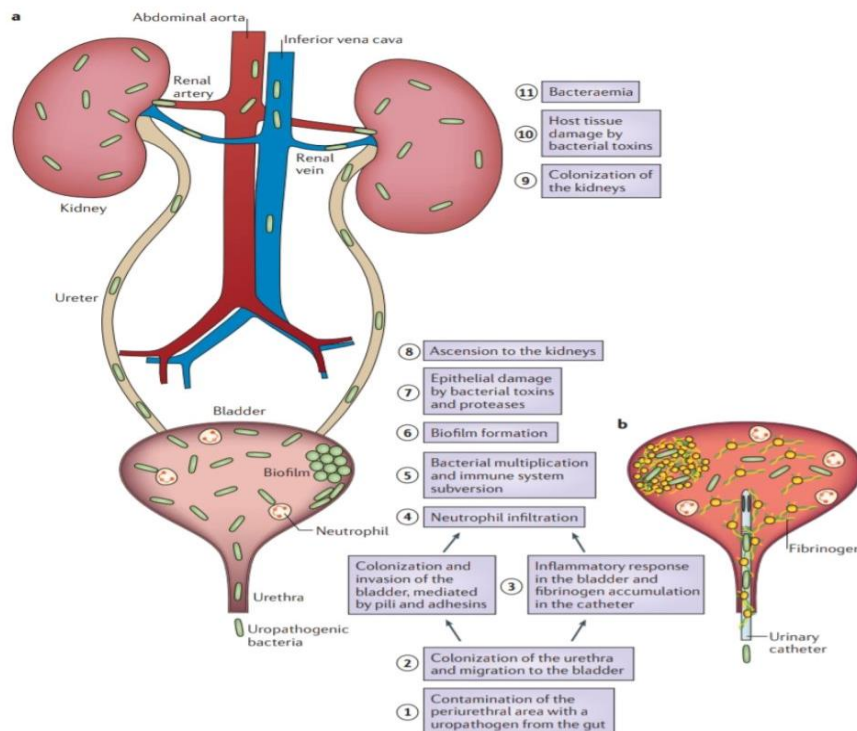


Figure -3: Pathogenesis of urinary tract infections

A | Uncomplicated urinary tract infections (UTIs) begin when uropathogens that reside in the gut contaminate the periurethral area (step 1) and are able to colonize the urethra. Subsequent migration to the bladder (step 2) and expression of pili and adhesins results in colonization and invasion of the superficial umbrella cells (step 3). Host inflammatory responses, including neutrophil infiltration (step 4), begin to clear extracellular bacteria. Some bacteria evade the immune system, either through

host cell invasion or through morphological changes that result in resistance to neutrophils, and these bacteria undergo multiplication (step 5) and biofilm formation (step 6). These bacteria produce toxins and proteases that induce host cell damage (step 7), releasing essential nutrients that promote bacterial survival and ascension to the kidneys (step 8). Kidney colonization (step 9) results in bacterial toxin production and host tissue damage (step 10). If left untreated, UTIs can ultimately progress to bacteraemia if the pathogen crosses the tubular epithelial barrier in the kidneys (step 11). **B** | Uropathogens that cause complicated UTIs follow the same initial steps as those described for uncomplicated infections, including periurethral colonization (step 1), progression to the urethra and migration to the bladder (step 2). However, in order for the pathogens to cause infection, the bladder must be compromised. The most common cause of a compromised bladder is catheterization. Owing to the robust immune response induced by catheterization (step 3), fibrinogen accumulates on the catheter, providing an ideal environment for the attachment of uropathogens that express fibrinogen-binding proteins. Infection induces neutrophil infiltration (step 4), but after their initial attachment to the fibrinogen-coated catheters, the bacteria multiply (step 5), form biofilms (step 6), promote epithelial damage (step 7) and can seed infection of the kidneys (steps 8 and 9), where toxin production induces tissue damage (step 10). If left untreated, uropathogens that cause complicated UTIs can also progress to bacteraemia by crossing the tubular epithelial cell barrier (step 11).

PATHOPHYSIOLOGY OF UTI

UTI is a broad term that encompasses different types of infection. If bacteria colonising the urethra reach the bladder, it can cause a lower urinary tract infection (i.e. cystitis) and if bacteria further ascend into the kidney, this is described as an upper urinary tract infection (i.e. pyelonephritis). If left untreated, UTIs can result in life-threatening infections, such as urosepsis (i.e. organ dysfunction caused by systemic response to UTI) and bacteraemia. It has been reported that UTIs account for 5% of severe sepsis cases, which have a mortality rate of 20–42%.^A If the Bacterial count of the urine sample is $\geq 10^4$ colony forming units per ml (c.f.u./ml) can be considered as an infected urine sample accompanied by microscopic examination of the urine. Based on the number of c.f.u./ml the severity of the infection can be determined. If the count is less than 10^2 c.f.u./ml that it can be considered as low count and diagnosed as acute infection. Usually, females have a high rate of infection because of the short urethra, and males with abnormal function of prostate with high urine retention are sensitive to infection as retention of urine for a longer duration helps bacteria to colonize^[8].

RISK FACTORS

- Sexual intercourse — the urethra comes into contact with bacteria from the genitals and anus, Urinary catheter
- Using a diaphragm with spermicide for contraception that may alter vaginal pH;
- Diabetes mellitus (high levels of sugar in urine provide a good environment for bacteria to multiply);
- Inability to empty bladder (e.g. obstruction by diaphragm, bladder stone or enlarged prostate gland; pregnancy, where baby is pressing on the bladder; Structural or functional urinary tract abnormalities)
- Menopause — decreases the vaginal pH;
- Immunosuppression — more susceptible to infection.
- Infrequent voiding – The bacteria spends a greater amount of time in the bladder allowing it time to replicate and take hold.
- Incomplete voiding – An excess amount of urine is left in the bladder and the bacteria is not completely flushed out with each void.
- Personal Hygiene – Perineal contamination with faeces increases the risk of coliform bacteria in the vagina and near the urethra will increase the risk of urinary tract infections.
- Sexual Activity – Trauma to the urethra and surrounding tissue may increase susceptibility to infection and also the bacteria can be mechanically pushed into the urethra.
- Use of spermicidal contraception – The actual spermicide changes the normal flora in the vagina and more coliform bacteria colonize the area. The presence of these strains of bacteria leads to a greater risk of a UTI.
- Genetics – Certain cells on the vaginal mucosa and the urethra can express receptors that actually allow certain bacteria to attach and pull themselves into the bladder causing an increase risk of a UTI.

- **Hormonal Status** – A lack of estrogen allows for thinning and deficiency of the tissue in the vagina and urethral that may allow for greater susceptibility to UTIs. This lack of estrogen also changes the pH of the vagina which allows for colonization with more coliform bacteria and increases the risk of UTIs.
- **Diabetes** – Persistently high blood sugar levels cause immunosuppression which allows for greater susceptibility to UTIs.
- **Immunosuppression** – There are a variety of causes of immunosuppression which decreases a person's ability to fight off infections^[9].

DIAGNOSIS

The diagnosis of a UTI should be based on clinical signs and symptoms, with additional testing, such as urine dipstick and culture, as required. However, the reliability of these tests can vary depending on gender and age. In addition, detailed history-taking that covers the following can help to confirm or exclude a UTI diagnosis:

- Family history of urinary tract disease such as polycystic kidney disease;
- Possibility of pregnancy in women of childbearing age — a pregnancy test should be carried out if the patient is unsure;
- Past medical history, including risk factors for recurrent UTI, such as neurological condition, known structural kidney abnormalities, diabetes mellitus, immunosuppression, urolithiasis, and bladder catheterisation;
- Sexual history, such as sexual contact within past three months, sexual partner, signs and symptoms of sexual transmitted disease and method of contraception use;
- Recent courses of antibiotic can inform antibiotic choice.

Cloudy or smelly urine alone without other signs and symptoms does not warrant treatment of UTI especially for patients aged over 65 years. Reasons for change in colour or odour of urine include hydration status, food intake and medication, such as vitamin B6. If patient has a urinary catheter, also check for catheter blockage and consider catheter removal or replacement.

Urine culture and urine dipstick:

The urine culture and dipstick tests should be interpreted in the context of clinical signs and symptoms, and should only be requested if there is suspicion of a UTI. When bacteria exist within an environment such as the urinary tract, without causing disease, the host is said to be colonised. If the pathogen invades the host's tissues and multiplies, the host is infected with the pathogen. Colonisation of bacteria in the urine or "asymptomatic bacteriuria" is not harmful, even though it causes a positive urine dipstick and urine culture. Asymptomatic bacteriuria does not warrant antibiotic treatment. The only two exceptions for treating asymptomatic bacteriuria are pregnant women, owing to the risk of pyelonephritis causing preterm birth, and patients who are undergoing urological procedures where mucosal trauma is expected to reduce the risk of post-operative infection. Ideally, urine culture should be taken before starting antibiotics to ensure better microbiological culture yield.

Patients aged over 65 years and patients with a urinary catheter:

Up to 50% of patients over 65 years of age and almost 100% of patients that have had a catheter in situ for more than one month have colonisation of bacteria in the urine that has not caused infection. Treating asymptomatic bacteriuria in patients over 65 years and patients with a urinary catheter is more likely to cause harm, exposing the patient to potential adverse effects secondary to an antibiotic, increased risk of *Clostridioides difficile* and emergence of AMR. Consequently, in patients aged over 65 years or in any patient with a catheter in situ, a diagnosis of a UTI should only be made following a full clinical assessment, including vital signs and detailed history-taking. A positive urine dipstick analysis or urine culture alone cannot be used to confirm a diagnosis of UTI.

Men aged under 65 years:

Lower UTI is uncommon in men under the age of 65 years; pyelonephritis or other differential diagnoses should be considered. For those with symptoms of a lower UTI, a urine sample should be sent for diagnosis. Urine dipstick may also be used to confirm the diagnosis, but it is unreliable to rule out infection.

Women aged under 65 years:

For women under the age of 65 years who present with two or more signs and symptoms of UTI, no additional testing or sample is required for diagnosis. If there is only one symptom, urinary dipstick can be used as a diagnostic aid. A urine sample should be sent if there is a possibility of a resistant organism, such as extended-spectrum beta-lactamases E.coli.

Risk factors for resistance include:

- Recurrent UTI;
 - Failure of previous antibiotic;
 - Hospital admission lasting over seven days in the past six months;
 - Residence in a care home;
 - Recent travel and receiving healthcare in a country with increased antimicrobial resistance;
- Previously known UTI (within one year) caused by bacteria resistant to co-amoxiclav (amoxicillin/clavulanate), cephalosporins or quinolones, or recent treatment with these agents.

DIFFERENTIAL DIAGNOSIS:

While delirium and/or fever can be a symptom of UTI in patients over 65 years of age, in isolation, it is not enough for a diagnosis of UTI. Other causes of delirium, including pain, different origin of infection, poor nutrition, constipation, dehydration, medication and environment change should be considered. Older patients who present, following a fall, with asymptomatic bacteraemia are often diagnosed with a UTI, which leads to the initiation of antibiotic treatment. Assessment for other causes of a fall, such as visual impairment, muscle weakness or polypharmacy is recommended. For all sexually active men and women, sexually transmitted infections (STIs) are one of the differential diagnoses, as they can present with dysuria. Women experiencing menopause with vaginal dryness, burning, irritation, pain on sexual intercourse and urinary symptoms of urgency, frequency and dysuria should be examined for genitourinary syndrome of menopause. In men, acute prostatitis may present with the same symptoms of UTI, such as dysuria, high frequency or urgency to urinate, in addition to lower back, suprapubic, perineal pain or tender prostate on rectal examination. In instances where there is scrotal pain and epididymis swelling, in addition to dysuria and other UTI symptoms, epididymitis should be suspected^[10].

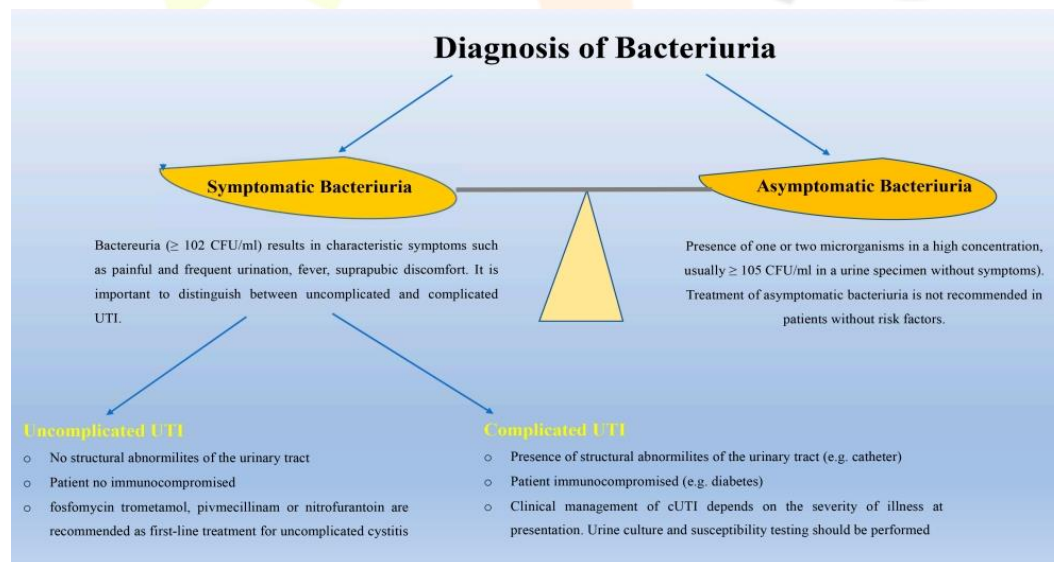


Figure - 4: Diagnosis and management of bacteriuria.

TREATMENT

Treatment for a UTI should be designed for each patient individually and is usually based on the patient's underlying medical conditions, what pathogen(s) are causing the infection, and the susceptibility of the pathogen(s) to treatments. Patients who are very ill usually require intravenous (IV) antibiotics and admission to a hospital; they usually have a kidney infection (pyelonephritis) that may be spreading to the bloodstream. Other people may have a milder infection (cystitis) and may get well quickly with oral antibiotics. Still others may have a UTI caused by pathogens that cause STDs and may require more than a single oral antibiotic. The caregivers often begin treatment before the

pathogenic agent and its antibiotic susceptibilities are known, so in some individuals, the antibiotic treatment may need to be changed. In addition, pediatric patients and pregnant patients should not use certain antibiotics that are commonly used in adults. For example, ciprofloxacin (Cipro) and other related quinolones should not be used in children or pregnant patients due to side effects. However, penicillins and cephalosporins are usually considered safe for both groups if the individuals are not allergic to the antibiotics. Patients with STD-related UTIs usually require two antibiotics to eliminate STD pathogens. The less frequent or rare fungal and parasitic pathogens require specific antifungal or antiparasitic medications; these more complicated UTIs should often be treated in consultation with an infectious disease expert. All antibiotics prescribed should be taken even if the person's symptoms disappear early. Reoccurrence of the UTI and even antibiotic resistance of the pathogen may happen in individuals who are not adequately treated. Over-the-Counter (OTC) medicines offer relief from the pain and discomfort of UTIs but they don't cure UTIs. OTC products like AZO or Uristat contain the medicine, phenazopyridine (Pyridium and Urogesic), which works in the bladder to relieve pain. This medication turns urine an orange-red color, so patients should not be worried when this occurs. This medication can also turn other body fluids orange, including tears, and can stain contact lenses. The efficacy of fruit extract of cranberry against Tamm-Horsfall Protein in human urine and its anti-adhesive activity against UPEC was investigated. Results indicated inhibition of adhesion of UPEC strain UTI89 to human T24 bladder cells. The glycoprotein THP is characterized by conserved high-mannose moieties, this binds to type 1 fimbriated UPEC. The type 1 fimbriae interact with mannose residues from uroplakin on the surface of uroepithelial cells, which serves as an adhesion receptor for the bacterium as type 1 fimbriae are known to interact with mannose residues from uroplakin on the surface of urothelial cells, THP interferes in the binding of the bacteria to uroplakins.

Most commonly used Antibiotics for UTIs and its possible side effects:

1. Macrodantin (Macrobid or nitrofurantoin) –Side effects of long-term use may include fibrosis or scarring of the lungs and peripheral neuropathy. Generally, the medication is considered safe during pregnancy, except with rare genetic metabolic deficiencies.
2. Bactrim (Septra or sulfa/TMP) –This drug should not be taken early during pregnancy and may affect the effectiveness of oral contraceptives.
3. Trimethoprim –It should not be taken during pregnancy.
4. Quinolones (Levaquin, Levofloxacin, or Cipro) – This drug should not be taken during pregnancy.
5. Cephalosporin (Keflex) – This may affect the effectiveness of oral contraceptives.
6. Doxycycline –It is not safe during pregnancy or breastfeeding. Convention Treatments: Antibiotics, Vaccines, Nano-medicine, Fruits and berries; Alternative Systems of Medicine: Ayurveda, Unani, Essential oils, Homeopathy, Herbal medicine^[11]

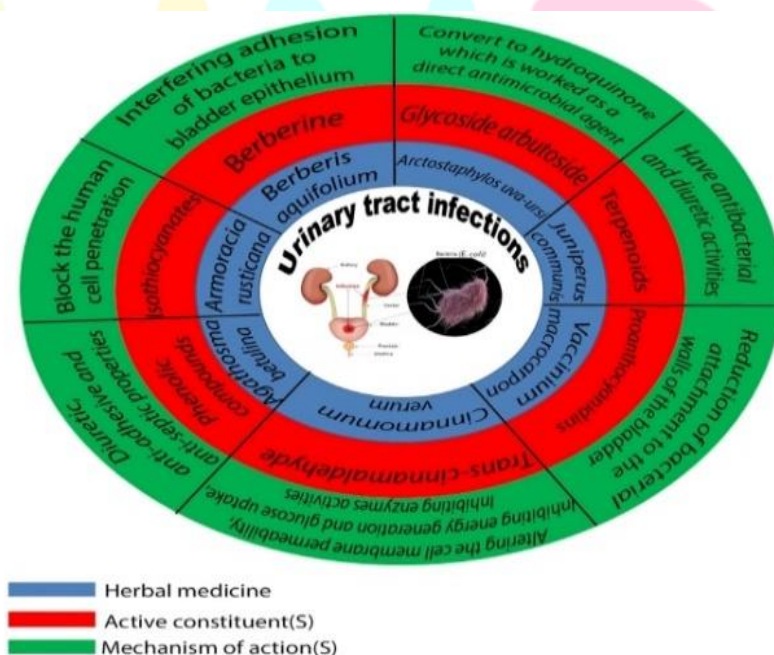


Figure -5: herbal medicines in the treatment of UTI.

CONCLUSION

Although UTIs are often considered to be easily managed infections, they remain a huge burden for millions of individuals and our healthcare system. The increasing prevalence of antibiotic resistance among uropathogens presents a major challenge to the clinical management of UTIs. Recurrent infections, including those caused by antibiotic-sensitive pathogens, are exceptionally common and are likely attributable in part to the establishment of recalcitrant intracellular bacterial reservoirs within the bladder mucosa. Eradication of these clinically relevant reservoirs will require a better understanding of the underlying molecular mechanisms that allow for their persistence. The ongoing development of new antimicrobial approaches, such as the use of pilicides and mannosides in conjunction with antibiotics, will provide new treatment options, while the identification of new vaccine candidates and optimized vaccination protocols promises relief to individuals who suffer from recurrent or chronic UTI.

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