The urinary tract of otherwise healthy individuals is relatively resistant to bacterial infection. The urinary system has multiple, redundant systems to help protect itself from microbial invasion. Normal bladder-emptying mechanisms impede bacterial multiplication. The low pH and high organic acid concentration of urine make it capable of inhibiting the growth and proliferation of numerous microorganisms. Urinary frequency experienced during a UTI is, in part, a physiologic attempt to “flush” out the microorganisms via increased diuresis. The epithelial cells of the bladder are coated with a type of mucus (uromucoid) that helps to prevent the adherence of bacteria to the bladder wall. Tamm-Horsfall protein (THP), produced in the kidney and secreted into the urine, is a urinary protein that binds specifically to type 1 fimbriated \textit{E. coli}, the main cause of UTI of women.\textsuperscript{1} Research has shown that the kidney produces defensins—antimicrobial peptides that play a pivotal role in nonspecific host defense.\textsuperscript{2}

In spite of these mechanisms, urinary tract infections (UTI) are one of the most common bacterial infections in humans, accounting for more than eight million patient visits per year.\textsuperscript{3} Acute urinary tract infections (UTI) are primarily a disease of young, sexually active women. Approximately one in three women will experience at least one diagnosed UTI necessitating antibiotic treatment by the age of 24, and 40\% to 50\% of women will experience at least one UTI during their lifetimes.\textsuperscript{4} The annual cost to healthcare services reaches $2 billion in the United States alone.\textsuperscript{5}

UTIs have been traditionally classified according to the anatomical site of the infection. Examples of lower urinary tract infections include cystitis, urethritis, and prostatitis, while pyelonephritis and perinephric abscess are examples of upper urinary tract infections. Cystitis and urethritis are considered superficial mucosal infections, while pyelonephritis, abscess and prostatitis demonstrate a much greater degree of tissue invasion. We will focus on cystitis in this section.
Risk Factors for Urinary Tract Infections

**Gender:**

*Women*

Being a woman certainly increases the risk for a urinary tract infection (UTI). A short urethra (approximately 4 cm.) combined with close proximity to the anus provides a setup for migration of gram-negative organisms from the bowel to the urethra. Intercourse massages the urethra allowing the infective organisms to gain access to the bladder. The use of spermicides shifts the healthy flora of the vagina and increases the risk of urinary tract infection. Normally, the high concentration of urea in the bladder, the presence of leukocytes in the bladder wall, and the dilutional effect of urine serve to prevent infection, however, many women still become symptomatic. Voiding after intercourse and avoiding spermicides are often recommended but studies have failed to show that these measures are seldom effective for reducing recurrent UTI.\(^6\)

In middle-aged and elder females, relaxation of the pelvic support muscles can lead to prolapse and descent of the uterus, pulling the floor of the bladder along with it. The bladder then protrudes into the vagina, creating a pouch - cystocele - that fails to empty during voiding. Urinary stasis can then lead to recurrent infections.

*Men*

Acute bacterial infection is unusual in a man less than fifty years of age, however, prostatitis and obstruction from an enlarged prostate can both lead to a UTI. There is a small increased risk in non-circumcised males.

*Pregnancy:*

Pregnancy causes a decrease in ureteral tone, peristalsis and function of the vesicoureteral valves leading to an increased risk of upper urinary tract infection during this time.
Approximately 20-30% of asymptomatic lower urinary tract infections will lead to pyelonephritis during pregnancy. It is important to be watchful for urinary symptoms during pregnancy and to test for nitrites and leukocyte esterase during routine prenatal visits.

**Low Estrogen:**
Decreasing serum estrogen levels in women alter the stratified squamous epithelium of the vagina. This altered epithelium is not a friendly environment for the adherence and proliferation of *Lactobacilli*, probiotic organisms that helps maintain a low vaginal pH. A higher vaginal pH allows gram-negative bacteria to multiply in the vagina and periurethral area, allowing easy access to the urethra. With restoration of the stratified squamous epithelium, *Lactobacilli* become prevalent once again. A Cochrane review of four randomized controlled trials concluded that the use of oral estrogen did not reduce the risk of recurrent UTI, though *vaginal* estrogen has been shown to reduce recurrent UTI in elder women.

**Obstruction:**
Obstruction of the bladder outlet can be caused by a number of conditions - enlarged prostate, tumor, stone, or stricture. When the free flow of urine is prevented, infection is more likely to occur and ascend upwards into the kidney. If the obstruction is severe, hydronephrosis can develop, possibly impairing renal function. If obstruction is suspected, a thorough evaluation of the urinary emptying system must be undertaken, as well as determining kidney function (e.g., serum creatinine).

**Vesicoureteral Reflux:**
This condition is found more frequently in children than adults. Reflux, or the retrograde flow of urine from the bladder back into the ureters and possibly the kidneys, occurs when there is increased pressure in the bladder, such as during urination. While a small amount of reflux can occur in normal healthy individuals, anatomic abnormalities can
cause the retrograde flow to be more marked. Children with severe urinary reflux often go on to develop renal damage and scarring. Urine should always be checked in young children who have a fever with no obvious foci of infection. Recurrent UTI in a child should prompt a thorough evaluation by a qualified practitioner (e.g., urologist).

**Neurogenic Bladder:**

A number of conditions can interfere with the bladder’s nerve supply - multiple sclerosis, diabetes, spinal cord injury, tertiary syphilis, etc. When normal voiding signals are impaired, urine remains in the bladder for extended periods of time. Urinary stasis can lead to infection. If a urinary catheter is used to empty the bladder, bacteria can easily gain access into the urethra and bladder. Indwelling catheterization should be reserved only for those individuals with sacral ulcers, those with urinary retention that cannot be managed surgically or with medication and who cannot do intermittent catheterization, and in those who are severely impaired where intermittent catheterization or frequent change of bedding would cause discomfort.

**Medications:**

Urinary stasis can be caused by a number of medications including anticholinergic and sympathomimetics. Over the counter cold remedies and antihistamines can make urination more difficult, especially amongst elders, and increase the likelihood of infection.

**Symptoms of a Urinary Tract Infection**

Most of us are familiar with the symptoms of a bladder infection in a healthy adult, however, symptoms may vary between age groups and it should be kept in mind that a number of individuals with significant bacteriuria may be totally asymptomatic.

**Pediatrics:**

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Cystitis can be asymptomatic or present with symptoms of dysuria, urgency, bedwetting, suprapubic pain, or frequency. Vomiting is also common. If a urinary dipstick indicates infection, a clean catch midstream urine sample should be obtained, refrigerated, and submitted for culture. In toddlers and infants, sterile in-and-out catheterization should be used to obtain the specimen.

Pyelonephritis usually presents with a high fever (greater than 102 F), flank pain, costovertebral angle tenderness, and an ill-appearing child. Pyelonephritis is much more common in children with urinary reflux. Urinary specimens and blood cultures should both be obtained before initiating any antimicrobial therapy.

*Adults:*

Many women will present with the common symptoms of a bladder infection - frequency, urgency, and dysuria. It is generally recommended that those with classic UTI symptoms be treated empirically, and telephone consultation is increasingly being seen as an acceptable method of identifying and treating women with a UTI. Women who are pregnant, who have a history of recent UTI, recurrent UTI or vaginal symptoms should be seen for evaluation.

A urinalysis by dipstick should be done to determine if an infection is present. Urine cultures are not needed in non-complicated, non-pregnant women with cystitis. However, women should be counseled to return to the clinic if symptoms worsen or are not relieved within three days.

Pyelonephritis typically presents with fever, flank pain, costovertebral angle tenderness, and an ill-appearing individual. Pregnant women with pyelonephritis are generally admitted to the hospital for intravenous antibiotics and observation. Healthy individuals who present with pyelonephritis should have a urine culture sent before starting antimicrobials and then carefully followed. Hospitalization is not usually necessary in
this group of individuals. Evaluation for the cause of the infection should be undertaken (e.g., reflux, enlarged prostate, etc.)

Vaginitis, or vaginal infection, should be considered in women who present with burning and pyuria. Cervical cultures should be obtained if one is suspicious of infection and a microscopic examination of the vaginal discharge performed. In uncircumcised men, rule out contaminated smegma as a cause of pyuria. All adult men with symptoms of a urinary tract infection should be evaluated by history and physical for sexually transmitted diseases and prostatitis.

_Elders:_

The detection of a urinary tract infection in elders is often missed. Place of residence matters. UTI is the second most common infection in elder women living in the community, whereas in residents of long-term care facilities and hospitalized, it is the number one cause of infection. Asymptomatic bacteriuria is transient in older women, often resolves without any treatment, and is not associated with morbidity or mortality.

Symptoms can include changes in mental status, decreased appetite, and somnolence, as well as the usual symptoms of dysuria, frequency, and urgency. Elders may have a mild fever or be hypothermic. Fever cannot be relied upon to determine the presence or absence of infection in elder individuals. Consider a urine culture if the dipstick is suspicious, as numerous species of both gram-negative and gram-positive bacteria are responsible for infections amongst elders when compared to young adults. Blood cultures should be obtained to evaluate for urosepsis if indicated.

More severe cases of pyelonephritis, and infection in pregnant women, elders or children may require hospitalization and intravenous antibiotics.

**Diagnosis**
The evaluation of the urine diagnostic purposes has been used since at least the time of Hippocrates. The color, amount of sediment, smell, and sometimes even the taste of urine assisted ancient healers in their understanding of illness. With the invention of the microscope, urine examination became more sophisticated starting in the 1830s. In 1957, the first urine dipstick that could detect glucose and protein in the urine became available. Dipstick urinalysis is now capable of testing for pH, ketones, protein, glucose, specific gravity, bilirubin, urobilinogen, nitrite, leukocyte esterase, and hemoglobin.

A dipstick analysis is conducted on a “clean-catch” midstream urine sample. A positive nitrite and/or leukocyte esterase test is indication to begin treatment. A positive nitrite result indicates the presence of at least 100,000 bacteria per ml however, the test is only able to detect bacteria which are capable of reducing nitrates in the urine to nitrites; *Escherichia coli, Klebsiella, Proteus, Staphylococcus, and Pseudomonas*. Some gram-positive bacteria and yeasts may give a false-negative result. Those who are taking large doses of ascorbic acid can also receive a false-negative nitrite test because nitrate is converted to ammonia, nitric oxide and nitrogen in the presence of ascorbic acid, not nitrite. If the specific gravity and urine urobilinogen are high, a false-negative test can also result. A positive LE, especially in the present of blood, strongly suggests a UTI and the absence of LE means one should consider an alternative diagnosis.

The European Association of Urology recommends dipstick urinalysis to detect pyuria, hematuria, and nitrite if UTI is suspected.\(^\text{11}\) The absence of pyruia strongly suggests an alternative diagnosis. The American College of Obstetricians and Gynecologists states that dipstick urinalysis for LE or nitrite is a rapid and inexpensive screening test, with a sensitivity of 75 percent and specificity of 82 percent.\(^\text{12}\)

Urine cultures are indicated in pregnant women, infants, children, elders, and anyone in whom pyelonephritis is suspected. The urine culture should be obtained before initiating antimicrobial therapy.

**The Organisms**

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There are a variety of organisms that can infect the urinary tract. The gram-negative bacteria are the major offenders with *Escherichia coli* accounting for approximately 80% of infections in patients less than fifty years of age. Other gram-negative organisms include *Proteus*, *Klebsiella*, and *Enterobacter*. *Proteus* and *Klebsiella* are more common in those with urinary tract stones. *Serratia* and *Pseudomonas* are most often found in those individuals with urinary obstruction or from manipulation of indwelling catheters.

Gram-positive bacteria can also cause infection, especially *Staphylococcus saprophyticus*, which is frequently found in the urine of young women. If *Staphylococcus aureus* is found in a urine culture, one should maintain an index of suspicion for a kidney infection. *Chlamydia trachomatis* and *Neisseria gonorrhoeae*, sexually transmitted infections, can also cause symptoms of urinary frequency and urgency in women. Non-bacterial sources such as *Ureaplasma urealyticum* and *Mycoplasma hominis* account for a small number of urinary tract infections.

Bacterial adhesion allows the organism to gain a foothold into the bladder. Most of the gram-negative bacteria that are responsible for urinary tract infections express a number of molecules on their surface, which allow them to “attach” themselves to the bladder mucosa. Type 1 fimbriae, produced by *E. coli* and several other cystitis causing *Enterobacteriaceae*, are able to attach to mannose residues on cell membranes. These fimbriae allow bacteria from the gut, *E. coli* primarily, to attach to the perineum and vagina - making their way to the urethra. Once the bacteria have attached to the bladder mucosa - inflammation and clinical symptoms appear.
Treatment of Acute Uncomplicated Cystitis and Recurrent UTI

The goals of treatment are to relieve symptoms, eradicate the offending organism, avert damage to the kidney, and prevent recurrences. Antibiotics are the mainstay of therapy. Patients with more severe illness or who cannot maintain oral hydration are typically hospitalized for administration of IV antibiotics and fluids, especially children <1 year of age, the elders, immune-compromised patients, and pregnant women.

D-Mannose

D-mannose is a naturally occurring sugar present in numerous fruits that is excreted in the urine virtually unchanged where it acts as a decoy in the bladder, binding to the fimbria of gram negative uropathogens, preventing their ability to attach to mannose receptors embedded in the bladder and urethral mucosa. A study of 308 women with history of recurrent UTI and no other significant comorbidities were randomly allocated to three groups after being treated initially with antibiotics for acute cystitis.\(^\text{13}\) The first group (n = 103) received prophylaxis with two grams of D-mannose powder in 200 ml of water daily for six months, the second (n = 103) received 50 mg nitrofurantoin per day and the third group served as control and received no prophylactic therapy. Overall 98 patients (31.8%) had recurrent UTI: 15 (14.6%) in the D-mannose group, 21 (20.4%) in nitrofurantoin group, and 62 (60.8%) in no prophylaxis control group, with the rate significantly higher in no prophylaxis group compared to active groups (P < 0.001). While the dose of antibiotic was lower than what is typically used (100 mg per day), this was a very useful study in showing the effectiveness of D-mannose, a substance that has no adverse effects and is very well tolerated.

Probiotics

Researchers continue to evaluate the role of probiotics in the prevention of recurrent UTI, especially in women, as specific species appear to inhibit the growth of uropathogens within the vagina. \textit{Lactobacillus rhamnosus} GR-1, \textit{L. fermentum} B-54, \textit{L. reuteri} RC-14,
and *L. crispatus* all show significant potential act as a potential barrier to the ascension of uropathogens into the urinary bladder.

A 12-month double-blinded double placebo study randomized postmenopausal women with recurrent UTI to either 480 mg per day of trimethoprim–sulfamethoxazole (TMP-SMX, Bactrim) or *L. rhamnosus* GR-1 and *L. reuteri* RC-14 twice daily.\textsuperscript{14} After 12 months, the antibiotic was found superior. An intention-to-treat analysis showed a between-treatment difference of only 0.4 UTIs per year, which while statistically significant is rather meaningless clinically.

Vaginal application of probiotics might be particularly useful. In a randomized placebo controlled trial, premenopausal women who received intravaginal suppositories containing *L. crispatus* after antimicrobial treatment had a high vaginal colonization rate and significantly lower (15%) recurrence of UTI than the placebo group (27%).\textsuperscript{15}

**T’s Take:** The questions of species selection and optimal administration route continue to plague researchers, complicating recommendations made by clinicians. At this time, I generally recommend Femdophilus by Jarrow, which contains 5 billion CFU *L. rhamnosus* GR-1 and *L. reuteri* RC-14 per capsule. I instruct women to insert one capsule per day for two weeks intravaginally before bed and then twice per week, along with the use of a panty liner to collect any discharge.

**Herbal Medicine**

Herbal medicine can be used to both treat and prevent urinary tract infections. Some herbs have been clinically evaluated through scientific means while others have been used since historical times to relieve the symptoms of cystitis.

**Cranberry (*Vaccinium macrocarpon*)**

A member of the heath family, cranberry grows in marshy areas and is commonly found throughout the northeastern part of the United States where the indigenous peoples used
the berries for food and medicine. It was said that the plant could be used to treat fever and other “pestilent” disease. Modern research has focused primarily upon the plant’s benefit to the urinary tract, especially for the prophylaxis of recurrent UTI. The proanthocyanadins (PACs) present in the fruit inhibit the adherence of bacteria to the uroepithelial cells lining the urinary tract. Research has shown that the PACs in cranberry cause *E. coli* rods, including those that are multi-drug resistant, to lose the expression of P fimbriae, thus preventing adherence and attachment to the uroepithelial cells. While most of the research has been focused on cranberry, these effects have actually been found to be stronger in lingonberry (*Vaccinium vitis-idaea*). More research is needed to determine if these two species may be used interchangeably or if one species is superior to another in preventing recurrent UTI.

While the use of cranberry for the prevention of bladder infections is widely accepted by the both the public and medical communities, a 2012 review failed to find cranberry effective in the prevention of UTI. One must look critically at the totality of the evidence, however, as several studies included in the review had very high dropout rates due to the inability of participants to consume large quantities of the juice over extended periods of time, while several small studies showed the tables/juice as effective as antibiotics for prophylaxis.

**T’s Take:** I am still a fan of cranberry tablets (500 mg 1-2 times per day) for otherwise healthy women for the prevention of recurrent UTI, especially when combined with D-mannose.

**Uva Ursi (*Arctostaphylos uva ursi*)**

Bearberry leaf preparations have long been used for the treatment of lower urinary tract infection and inflammation. The leaves contain arbutin at 6-12%, with a small amount of methylarbutin and free hydroquinone. The metabolites of arbutin are considered to be the primary constituents responsible for the herb’s urinary antiseptic activity. Although it was originally thought that hydroquinone could only be liberated from arbutin in alkaline
urine, newer research has challenged this hypothesis. After undergoing hepatic conjugation, hydroquinone is further metabolized by intracellular enzymes present in bacterial cytoplasm. Alkalization of the urine does not appear to be a prerequisite for improving the antiseptic properties of hydroquinone released from arbutin.

The urinary excretion of arbutin metabolites was examined in a randomized crossover design in 16 healthy volunteers after a single oral dose of bearberry leaves dry extract (BLDE), either as film-coated tablets (FCT) or aqueous solution (AS). With FCT, 64.8% of the arbutin dose administered was excreted; with AS, 66.7% was excreted (p = 0.61). The maximum mean urinary concentration of hydroquinone equivalents was a little higher and peaked earlier in the AS group versus the FCT group, although this did not reach statistical significance. No significant differences between the two groups were found in the metabolite patterns detected (hydroquinone, hydroquinone-glucuronide, and hydroquinone-sulfate).

It appears that tea, tincture or tablets are all appropriate dosage forms for uva ursi.

When urine was collected from healthy volunteers three hours after the ingestion of 1.0 gram of arbutin, it was subjected to in vitro antibacterial testing. Antibacterial activity against *E. coli, Pseudomonas aeruginosa, Proteus mirabilis* and *Staphylococcus aureus* was noted. Uva ursi had a prophylactic effect on recurrent cystitis in a double-blinded, prospective, randomized study of 57 women who had experienced at least three episodes of cystitis in the year preceding the study and at least one episode in the previous six months that had been successfully treated with antibiotics. Patients received either three tablets of UVA-E (containing a hydroalcoholic extract of uva ursi leaves with a standardized content of arbutin and methylarbutin and of dandelion root and leaves) or placebo three times daily for one month. After 7 and 12 months the patients were examined and during the year any occurrences of cystitis were treated with antibiotics. At the end of the year none of the patients in the uva ursi group had had a recurrence of cystitis compared to 23% of the placebo group (p < 0.05).

In spite of the lack of controlled clinical trials, bearberry leaves are endorsed by the European Scientific Cooperative on Phytotherapy (ESCOP), the British Herbal Medicine
Association and the German Commission E for minor infection/inflammatory disorders of the lower urinary tract. The dose recommended by these authorities is that which provides 400-800 mg/d arbutin, divided into 2-3 doses. This is equivalent to 1.5 – 3.0 grams in infusion or cold aqueous extract or 2-5 ml of a tincture (1:5) 3 times daily.

Bearberry is contraindicated during pregnancy.\textsuperscript{27} This may be due to the potential toxicity of hydroquinone to the fetus. In bone marrow, hydroquinone produces microtubulin dysfunction,\textsuperscript{28} while exposure of human lymphocytes and cell lines to hydroquinone has been shown to cause various forms of genetic damage.\textsuperscript{29} Uva ursi is also generally contraindicated during lactation.\textsuperscript{30} Gastrointestinal irritation, nausea and vomiting may occur due to high tannin content.\textsuperscript{31}

Most authorities recommend using uva ursi for no longer than 1–2 weeks at a time and no more than five times a year due to concerns about the safety of arbutin and hydroquinone. One case of Bull’s eye maculopathy secondary to prolonged use of uva ursi was reported in the literature.\textsuperscript{32} However, a recent review of experimental and human studies found that uva ursi was safe when used at the aforementioned dose even for extended periods of time.\textsuperscript{33}

T’s Take: Uva ursi is absolutely my go to herb for uncomplicated UTI. I can’t even remember the last time I prescribed an antibiotic for a young healthy woman. I generally prescribe 3-4 grams/d leaf with ~400-600 mg arbutin for 48 hours and then 2-3 grams and 200-300 mg arbutin for an additional three days. I like to use uva ursi with corn silk.

**Clinical Pearl: Pipsissewa (Chimaphila umbellata)**

*Think of using pipsissewa when one has difficulty tolerating uva-ursi or perhaps when one is choosing an antimicrobial for long-term use to prevent recurrent UTI. It contains lower amounts of arbutin, tannins, as well as methylsalicylate.*

*Tincture 1:5 50 alcohol 2-3 ml four times per day for acute infection, or twice daily for long-term use.*

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Berberine Rich Plants (Goldenseal, Barberry, Oregon Grape)

Berberine, an alkaloid found in a number of plants including goldenseal (*Hydrastis canadensis*), barberry (*Berberis vulgaris*), Oregon grape (*Berberis aquifolium*), and goldthread (*Coptis chinensis*), has long been used for the treatment of UTI. Activity against *Staphylococcus aureus* and *Escherichia coli* has been documented, while crude methanol extracts of golden seal root and rhizome were shown to be very active against multiple strains of *Helicobacter pylori*. A study found that when urine samples were obtained from five volunteers after they taken berberine chloride orally 0.9 g/d for three days, berberine and a number of its metabolites were recovered in the urine, confirming its ability to exert its antimicrobial activity in the kidney and bladder.

Berberine containing herbs are contraindicated during pregnancy by almost all authorities. The acute toxicity LD50 for berberine in rats was shown to be 713 mg/kg. The dose is generally 2-3 grams per day for acute treatment.

**T’s Take:** I often use goldenseal or Oregon grape root in those with recurrent UTI for 6-8 weeks or when I was concerned that I need additional antimicrobial activity.

**Juniper (*Juniperus communis and other species*)**

Juniper fruit and leaves are used in many parts of the world as medicine. Oil of Cade is made from the wood of *Juniperus oxycedrus*, which grows in the Mediterranean region. This oil is used topically for a variety of skin disorders. The pounded fruit is used for urinary difficulties, as well as diabetes. The berries (modified cones actually) are excellent urinary antiseptics, though, there has not been much research conducted in this area. They are rich in antiseptic volatile oils, which are excreted via the kidney. There is some concern regarding its safety in those with diminished renal function. Most of the adverse event reports have been due to the essential oil. Juniper is not safe in pregnancy.

**Birch (*Betula pendula. B. alba*)**
The bark, buds, and leaves of the silver and white birch tree have been treasured in herbal medicine for centuries. Rich in betulin and betulinic acid, both of which exert anti-inflammatory and diuretic activity. Betulinic acid is also being investigated for possible anti-cancer properties, particularly in melanoma. Birch leaves and bark have long been used topically for the treatment of warts, atopic dermatitis and other skin conditions. It can easily be made into salve or added to the bath.

The German Commission E monograph approves the use of birch leaf “for irrigation therapy in bacterial and inflammatory conditions of the lower urinary tract and renal gravel; as supportive treatment in rheumatic complaints.” It is a urinary antiseptic and is effective against urinary tract pathogens. All tested concentrations of birch leaf extract significantly decreased the growth and replication of E. coli, as well as blocking its adhesion to uroepithelial cells. It is also an effective anti-spasmodic, easing painful urinary spasms. The dose is generally 2-3 grams per day for acute cystitis, or 3-5 ml tincture -2-3 times per day.

Of interest: xylitol, a type of sugar, is sometimes made from birch and has been approved by the FDA for use in food. Betulin, present in large quantities in the bark was shown in an open non-randomized study in Germany to be effective for treating actinic keratosis. A larger clinical trial found some benefit, as well, though not to the degree seen in the open study.

**Corn Silk (Zea mays)**

The use of corn and corn silk for “affections of the kidney and bladder” can be traced back to the Incas. Corn silk (CS) is made from stigmas, the yellowish-thread like strands from the female flower of maize. It continues to be used for the treatment of cystitis, edema, kidney stones, prostate disorders, urinary infections and bedwetting. It soothes and relaxes the lining of the bladder and urinary tubules, hence reducing irritation. Parke-Davis introduced a corn silk product in the 1880s for the treatment of urinary pain and spasm. Physicians of the time felt that corn silk was useful for minor urinary complaints, though many debated whether it was more of a urinary demulcent than a diuretic agent.
These physicians of old may have been right according to modern research. Though tradition and some older data supported a diuretic activity, the aqueous extract did not result in significant diuresis when given in oral doses of 5g/kg to guinea pigs, nor did it increase 12-24 hour urine output in dogs. Pharmacological studies (in vitro and in vivo) have confirmed that corn silk has antioxidant, hypoglycemic, and antibacterial properties. Corn silk was shown to decrease *E. coli* adhesion by interacting with the bacterial outer membrane proteins.

The British Herbal Compendium lists corn silk as both a mild diuretic and urinary demulcent. The former German Commission E also recognizes the use of corn silk as a mild diuretic. Corn silk is quite benign and is often included in herbal formulae designed to ease the pain of cystitis. No contraindications are found in the literature. The dose is generally is 1-3 grams for relief of acute cystitis but I recommend just drinking it freely for the first couple of days.

**T’s Take:** great urinary demulcent to reduce dysuria.

**Java Tea (*Orthosiphon stamineus*)**

The leaves and stems of this member of the mint family has long been used in folk medicines of subtropical Asia and Australia as a treatment for urinary tract disorders and gout. It is used in modern times for similar conditions plus the treatment of high blood pressure and diabetes. It contains a number of compounds including diterpenes (e.g., orthosiphols), rosmarinic acid and rather significant quantities of potassium. The German Commission E listed its approved use for, “Irrigation therapy for bacterial and inflammatory diseases of the lower urinary tract and renal gravel.” The European Scientific Cooperative on Phytotherapy gives a similar indication, “Irrigation of the urinary tract, especially in cases of inflammation and renal gravel, and as an adjuvant in the treatment of bacterial infections of the urinary tract.” There have only been a small number of human studies and these all suffer from short duration and very small numbers of participants. A review by the European authorities concluded that due to its long-standing use and based on the available documentation (e.g., review of animal data and
small human studies of short duration) that a traditional use can be granted. They found it acceptable as an adjuvant diuretic in the treatment of minor urinary tract infections.

**T’s Take:** I often recommend Traditional Medicinals Back on Tract tea, which contains per teabag: java tea 1050 mg, cornsilk 105 mg and 595 mg of a proprietary blend of organic hibiscus, peppermint, cranberry and stevia. It is an excellent part of a preventive strategy.

**Clinical Pearl: Kava (Piper methysticum)**

*Don’t forget kava when it comes to more severe urinary spasm. Kava is stronger than many other urinary antispasmodics and should be considered when the spasm is severe. It combines nicely with cornsilk, goldenrod, birch, etc.*

**Nettle (Urtica dioica)**

The roots of nettle are widely used for the treatment of enlarged prostate, while the leaves have long been relied upon as a useful diuretic. The German Commission E approves nettle leaf as a supportive therapy in patients with lower urinary tract infections and to prevent urinary gravel. Research has shown that it has weak growth-inhibiting effects on *E. coli*, which lends some support to its traditional use.⁴⁷

**Couch Grass (Agropyron repens)**

The rhizomes of couch grass have long used to treat urinary complaints. You might be more familiar with its common name, dog grass, as our canine friends often consume it when feeling sick. Studies have shown that couch grass impairs *E. coli* adhesion to bladder mucosa by interacting with bacterial outer membrane proteins.⁴⁸ Couch grass may also be of use in those with uric acid stones. The combination of 24 mEq/d potassium citrate and 100 mg/d couch grass dry extract along with appropriate pharmacological and dietary treatment, decreased number and size of urinary stones and statistically significant reduction in urinary uric acid excretion.⁴⁹
Golden Rod (*Solidago canadensis, Solidago virgaurea*)

The aerial parts of golden rods have long been used medicinally both topically and internally. Its very name suggests that it was highly regarded as a medicine, *solidago* means, "to make whole." Golden rod is widely used as a folk medicine to reduce allergies and is included in numerous traditional formulas for pain and arthritis.

More than a few herbalists believe that golden rod has a place in any chronic urinary condition. It increases the amount of urine while reducing inflammation in the bladder, probably secondary to its flavonoids and saponins. It is also an excellent urinary antispasmodic. A study found that when combined with Orthosiphon and birch, solidago reduces the recurrence of UTI in women who had been treated with antibiotics. This same combination, with the addition of cranberry extract, was shown in a pilot study to reduce microbial colonization in patients with indwelling urinary catheters.

Some Suggestions for Clinical Use:

**Acute Treatment**

- Nature’s Way purple top (965 mg uva ursi and 132 mg arbutin per 2 capsules) take 2 caps 3-4 times daily for 48 hours and then 2-3 times daily for 72 hours. OR
- Eclectic Institute Urinary Tract Support each capsule contains extracts equivalent to:
  - 500 mg uva ursi, marshmallow root, corn silk and
  - 400 mg goldenseal root
  - Take 2 caps 3-4 times per day for 48 hours and then 2-3 times daily for 48-72 hours OR
- Could consider Swanson Birch Leaf extract 400 mg taken 4 times per day for 3-4 days AND
- Traditional Medicinals Back on Tract tea – 1 cup three times per day.
  - Each teabag contains
    - Java tea 1050 mg
    - Cornsilk 105 mg
• Proprietary blend 595 mg of organic hibiscus, peppermint, cranberry and stevia

For Recurrent UTI

- D-mannose – 1000 mg two times daily (Solaray D-mannose with Cranactin provides 1000 mg D-mannose and 400 mg cranberry extract in 2 capsules) AND
- Fem-Dophilus – 2 capsules per day (if female) AND
- Traditional Medicinals Back on Tract tea – 1 cup daily OR
- Swanson Birch Leaf extract 400 mg taken 2 times per day OR
- Herb Pharm Golden Road extract – 25 drops twice daily

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