

Urinary Tract Infection

WHAT IS A URINARY TRACT INFECTION?

General Description of Urinary Tract Infections

A urinary tract infection (UTI) is a condition where one or more structures in the urinary tract become infected after bacteria overcome the structures' strong natural defenses. Despite these defenses, UTIs are the most common of all infections and can occur at any time in the life of an individual. Almost 95% of cases of UTIs are caused by bacteria that typically multiply at the opening of the urethra and travel up to the bladder (known as the ascending route). Much less often, bacteria spread to the kidney from the bloodstream. [See Box The Urinary System and Its Defenses.]

Different classifications have been devised to help physicians choose treatments and determine the causes of UTIs.

Primary or Recurrent. UTIs are classified as primary or recurrent, depending on whether they are the first infection or whether they are repeat events.

Community- or Hospital-Acquired. UTIs are also sometimes grouped according to where they are acquired:

- **Community-Acquired Infections.** Most UTIs are thought to develop in the community at large. It is unclear how primary community-acquired infections occur or how they are spread. Although most cases have been thought to arise sporadically, a rare outbreak caused by drug-resistant bacteria in three states between 1996 and 2000 suggests epidemic spread of community-acquired infections could be more common than previously thought and may be spread via contaminated food. Most community-acquired infections are not serious and probably develop when the intestines become colonized with bacteria that are also predisposed to infecting the urinary tract.
- **Hospital-Acquired Infections.** UTIs are also commonly acquired in the hospital, often due to contaminated urinary catheters. Hospital-acquired infections tend to be more serious because the bacteria that cause them are often resistant to drug treatment and patients are often in poor general health

Uncomplicated and Complicated. UTIs are also sometimes further defined as either being *uncomplicated* or *complicated* depending on the factors that trigger the infections.

- **Uncomplicated infections** are only associated with bacterial infection, most often *Escherichia coli* (*E. coli*). They affect women much more often than men.
- **Complicated infections**, which occur nearly as often in men as in women, are also caused by bacteria but they occur as a result of some anatomical or structural abnormality. Often they are associated with catheter use in the hospital setting, bladder and kidney dysfunction, or kidney transplant (especially in the first three months after transplant). Recurrences occur in up to 50% to 60% of patients with complicated UTI if the underlying structural or anatomical abnormalities are not corrected.

Classifications Based on Symptoms and Levels of Infection. UTIs can also occur without symptoms and with symptoms but very low bacterial levels.

- When bacteria is present and there are no symptoms it is called asymptomatic UTI or also *bacteriuria*.
- Some patients can also have symptoms of infection with very low bacterial counts. In such cases, the condition is called acute urethral syndrome.

Uncomplicated Urinary Tract Infections (UTIs)

Cystitis. Cystitis is the most common urinary tract infection and is sometimes referred to as *acute uncomplicated UTI*. It occurs in the lower urinary tract (the bladder and urethra) and nearly always in women. In most cases, the infection is brief and acute and only the surface of the bladder is infected. Deeper layers of the bladder may be harmed if the infection becomes persistent, or chronic, or if the urinary tract is structurally abnormal.

Pyelonephritis (Kidney Infection). When infection spreads to the upper tract (the ureters and kidneys) it is called *pyelonephritis*, or more commonly, kidney infection. As many as half of all women with cystitis may have infections of the upper urinary tract at the same time as cystitis.

Urethritis. When infection is limited only to the urethra, the infection is known as *urethritis*. This is a common sexually transmitted disease in men.

Complicated Urinary Tract Infections

Complicated UTIs may develop because of any one of a number of physical problems and affect any gender and age group. The common feature in most complicated UTIs is the inability of the urinary tract to clear out bacteria because of a physical condition that causes obstruction to the flow of urine or problems that hinder treatment success.

Recurrent Urinary Tract Infections

Recurrence is common after both complicated and uncomplicated UTIs.

- After a single uncomplicated acute urinary tract infection, 27% to 48% of women will have a recurrence. Infections usually recur a few months apart.
- The risk after a complicated UTI is even higher; between 50% and 60% of individuals will have recurrent infection by 4 to 6 weeks following treatment if the underlying problem is not corrected.

Recurrence is often defined as either *reinfection* or *relapse*.

Reinfection. About 80% of recurring UTIs are reinfections. A reinfection occurs several weeks after antibiotic treatment has cleared up the initial episode and is caused by a different organism from the one that caused the original episode. The infecting agent is usually introduced through the rectal region from fecal matter and moves up through the urinary tract. It should be noted that the original infecting organism frequently persists so it is often difficult to distinguish a reinfection from a relapse.

Relapse. Relapse is the less common form of recurrent urinary tract infection. It is diagnosed when a UTI recurs within two weeks of treatment of the first episode and is caused by the same organism. Relapse usually occurs in kidney infection (pyelonephritis) or is associated with obstructions such as kidney stones, structural abnormalities, or, in men, chronic prostatitis.

Asymptomatic Urinary Tract Infection (Asymptomatic Bacteriuria)

When a person has no symptoms of infection but significant numbers of bacteria have colonized the urinary tract, the condition is called asymptomatic UTI (also called asymptomatic bacteriuria). (In general, there must be at least 10^5 UTI bacteria per milliliter of urine.) The condition is harmless in most people and rarely persists, although it does increase the risk for developing symptomatic UTIs.

Screening for asymptomatic bacteriuria is not necessary during most routine medical examinations, with the following exceptions:

- Pregnant women (who are at higher risk for kidney infections)
- People undergoing urologic surgery (such as prostate surgery in men), in whom the condition can lead to serious infection.

It also may be an indicator for serious health problems in the elderly.

Acute Urethral Syndrome

Some people have symptoms of cystitis but have a bacterial count lower than that ordinarily found in UTI. Such patients are sometimes diagnosed with acute urethral syndrome. This condition is usually caused by *E. coli* or other bacteria that cause cystitis, but in lower numbers, or by a sexually transmitted disease such as chlamydia or gonorrhea.

THE URINARY SYSTEM AND ITS DEFENSES

The Urinary System

The urinary system helps maintain proper water and salt balance throughout the body and also expels urine from the body. It is made up of the following organs and structures:

- The two kidneys, located on each side below the ribs and toward the middle back, play the major role in this process. They filter waste products, water, and salts from the blood to form urine.
- Urine passes from each kidney to the *bladder* through thin tubes called *ureters*.
- Ureters empty into the *bladder*, which rests on top of the *pelvic floor*. This is a muscular structure similar to a sling running between the pubic bone and the base of the spine.
- The bladder stores the urine, which is then eliminated from the body via another tube called the *urethra*, which is the lowest part of the urinary tract.

Defense Systems Against Bacteria

Infection does not always occur when bacteria are introduced into the bladder. A number of defense systems protect the urinary tract against infection-causing bacteria:

- Urine itself functions as an antiseptic, washing potentially harmful bacteria out of the body during normal urination. (Urine is normally sterile, that is, free of bacteria, viruses, and fungi.)

- The ureters are structurally designed to prevent urine from backing up into the kidney.
- The prostate gland in men secretes infection-fighting substances.
- The immune system in both sexes continuously fights bacteria and other harmful micro-invaders. In addition, immune system defenses and antibacterial substances in the mucous lining of the bladder eliminate many organisms.
- In normal fertile women, the vagina is colonized by lactobacilli, beneficial micro-organisms that maintain a highly acidic environment (low pH). Acid is hostile to other bacteria. Lactobacilli also produce hydrogen peroxide, which helps eliminate bacteria and reduces the ability of *E. coli* to adhere to vaginal cells. (*E. coli* is the major bacterial culprit in urinary tract infections.)
- Some interesting research suggests that when bacteria infect the bladder, the cells that line the bladder literally sacrifice themselves and self-destruct (a process called apoptosis). In so doing, they fall away from the lining, carrying the bacteria with them. This eliminates about 90% of the *E. coli*.
- Some researchers have identified a possible natural antibiotic called human beta-defensin-1 (HBD-1), which fights *E. coli* within the female urinary and reproductive tracts.

WHAT ARE THE INFECTIOUS AGENTS THAT CAUSE URINARY TRACT INFECTIONS?

Bacterial Strains in Uncomplicated UTIs

Bacteria are the primary organisms that cause UTIs, mostly one called *Escherichia coli* (*E. coli*).

Bacterial Strains in Cystitis (Acute Uncomplicated UTI). The bacterial strains likely to cause acute uncomplicated UTI are the following:

- *E. coli* is responsible for between 72% and 85% of cystitis cases in younger women, and more than 50% in women over 50. In most cases of UTI, *E. coli*, which originates as a harmless micro-organism in the intestines, spreads to the vaginal passage, where it invades and colonizes the urinary tract. One study suggests that even when infected cells lining the bladder die and slough off, carrying the *E. coli* bacteria with them, some bacteria can invade into deeper tissue in the bladder, where they survive to reinfect the patient later on.
- *Staphylococcus saprophyticus* may be another common culprit, especially in younger women. Interestingly, infections caused by this bacteria have a seasonal variation, with a higher incidence in the summer and fall than in the winter and spring.
- Klebsiella and enterococci bacteria are often found in UTIs in older women.
- *Proteus mirabilis* is the other common bacterium associated with these infections.
- *Pseudomonas aeruginosa* is a rare bacterial cause and is most often detected in hospital-acquired UTIs.
- Some evidence suggests that *Ureaplasma urealyticum* and *Mycoplasma hominis*, which are generally harmless organisms, may be responsible for occasional urinary tract disorders.

Bacterial Strains in Acute Uncomplicated Pyelonephritis (Kidney Infection). The bacteria that cause pyelonephritis are generally the same bacteria that cause cystitis. There is some evidence, however, that the *E. coli* strains in pyelonephritis are more virulent (able to spread and cause illness).

Organisms in Complicated Infections

- Complicated UTIs, which are related to physical or structural conditions, are apt to be caused by a wider range of organism. *E. coli* is still the most common organism, but others have also been detected, including the following: Other intestinal bacteria, including klebsiella, *P. mirabilis*, and citrobacter.
- Fungal organisms, particularly candida species. (*Candida albicans*, for example, causes the "yeast infections" that also occur in the mouth, digestive tract, and vagina.)
- Others include *Pseudomonas aeruginosa*, enterobacter, and serratia species; gram-positive organisms, including enterococcus species; and *S. saprophyticus*.

Bacterial Strains in Recurrent UTIs

Recurring infections are often caused by different bacteria than those that caused a previous or first infection.

Even if the reinfecting bacterium is still *E. coli*, it may be a variant of the original infecting *E. coli* strain. Such strains produce substances such as P-fimbriae that tend to make the bacteria more infectious. Uncommon causes of reinfection include species of ureaplasma and *Mycoplasma hominis*, which are sometimes associated with acute urethral syndrome.

Factors in Overcoming the Bacterial Defense Systems

The bacteria that cause most UTIs are very common and nearly everyone harbors them. It is not clear, then, how they proliferate and break down the natural defenses of the body. Among the possible ways this occurs are the following.

Changes in the Acid–Alkaline Balance of the Urinary Tract. Changes in the amount or type of acid within the genital and urinary tracts are major contributors to lowering the resistance to infection. For example, beneficial organisms called *lactobacilli* increase the acidic environment in the urinary tract. Reductions in their number (which, for example, occurs with estrogen loss after menopause), *increases* pH and therefore the risk of infection.

Biofilm. One theory, called the biofilm mode of growth, suggests that sometimes bacteria form capsules that adhere to the urinary tract, which protects them from many of the normal defenses.

WHAT ARE THE SYMPTOMS OF URINARY TRACT INFECTIONS?

Symptoms of Lower Urinary Tract Infections (Cystitis and Urethritis)

Symptoms of lower urinary tract infections usually begin suddenly and may include one or more of the following symptoms:

- The urge to urinate frequently, which may recur immediately after the bladder is emptied.
- A painful burning sensation. (If this is the only symptom, then the infection is most likely urethritis.)
- Discomfort or pressure in the lower abdomen. The abdomen may feel bloated.
- Cramping in the pelvic area or back.
- The urine often has a strong smell, looks cloudy, or contains blood. This is a sign of *pyuria*, or a high white blood cell count in the urine, and is a very reliable indicator of urinary tract infections.
- Occasionally, fever develops.

Symptoms of Kidney Infection (Pyelonephritis)

Symptoms of kidney infections tend to affect the whole body and to be more severe than those of cystitis. They may include the following:

- Severe cystitis symptoms, which include frequent, irritating, and strong-smelling urine that can be cloudy and contain blood. (In some patients with kidney infection, the only symptoms may be those of cystitis. In such cases, pyelonephritis should be strongly suspected if symptoms last seven to ten days. People at highest risk for such "silent" upper urinary tract infections include patients with diabetes, impaired immune systems, or a history of relapsing or recurring UTIs.)
- An increased need to urinate at night.
- Chills and persistent fever (typically lasting more than two days).
- Pain that runs along the back at about waist level.
- Vomiting and nausea.

Symptoms of UTIs in Infants and Toddlers

UTIs in infants and preschool-aged children tend to be more serious than those that occur in young women, in part because they are more likely to occur in the kidneys and *upper* urinary tract. (Older children are more likely to have lower urinary tract infections and standard symptoms.) Infants and young children should always be checked for UTIs if the following symptoms are present:

- A persistent high fever of otherwise unknown cause, particularly if it is accompanied by signs of feeding problems and debility, such as listlessness and fatigue. (Between 3% and 5% of infants and toddlers who are brought to the emergency room with fevers have UTIs.)
- Painful, frequent, and foul smelling urine.
- Cloudy urine.
- Abdominal and low back pain may be present.
- Vomiting and abdominal pain (usually in infants).
- Jaundice (yellowing of the skin and the whites of the eyes) in infants, particularly jaundice that develops after eight days of age.

Symptoms of UTIs in Elderly Patients

The classic lower UTI symptoms of pain, frequency, or urgency and upper tract symptoms of flank pain, chills, and tenderness may be absent or altered in elderly patients with UTIs. In one study, only 20% of older patients had new urinary complaints, and many had no symptoms at all.

Symptoms of UTIs that may occur in seniors but not in younger adults may include mental changes or confusion, nausea or vomiting, abdominal pain, or cough and shortness of breath. Concomitant illness may further confuse the picture and make diagnosis difficult.

WHAT ARE THE RISK FACTORS FOR URINARY TRACT INFECTIONS?

Risk Factors for Primary UTIs in Women

After the flu and common cold, urinary tract infections are the most common medical complaint among women in their reproductive years. Women are 30 times more likely to have cystitis than men are. Every year, about one in nine American women have at least one UTI, and up to 60% of all women will develop a urinary tract infection at some time in their lives. A third of these women will have a recurrence within a year. Furthermore, each year about 250,000 women develop kidney infections (pyelonephritis) and 100,000 are hospitalized for treatment.

The risk for UTIs, both symptomatic and asymptomatic, is highest after menopause. About 2% to 5% of young women have asymptomatic bacteriuria; in women over 65, the prevalence is 10% to 15%.

Structure of the Female Urinary Tract. In general, the higher risk in women is mostly due to the shortness of the urethra, which is 1.5 inches compared to 8 inches in men. Bacteria from fecal matter can be easily transferred to the vagina or the urethra.

Sexual Behavior. Frequent sexual activity increases the risk of urinary tract infection, and studies indicate that nearly 80% of all urinary tract infections occur within 24 hours of intercourse. A number of different factors are responsible for the increased incidence of UTIs among sexually active women:

- Highly active sexual behavior may increase the risk for sexually transmitted infections such as chlamydia, gonorrhea, or herpes simplex virus. Such agents may cause urethritis (infections in the urethra).
- Women having sex for the first time or who have intense and frequent sex after a period of abstinence are at risk for a condition called honeymoon cystitis.
- A sudden increase in the frequency of sexual intercourse poses a significant risk for UTI, particularly if a diaphragm is used.
- Sexual position (e.g., with the woman on top) can contribute to the risk.

Contraceptives may also contribute to risk in a number of ways:

- The spring-rim of the diaphragm may bruise the area near the bladder neck, making it susceptible to bacteria.
- Unlubricated condoms may injure vaginal tissue and make it vulnerable to infections. (Using a sterile water-based lubricant may help reduce this risk. Petroleum-based lubricants should be avoided because they weaken latex condoms.)
- Spermicides are not protective, and, in fact, greatly increase the risk for urinary tract infections.
- Some women experience UTI as an allergic reaction to latex in condoms or to oral contraceptives.

Pregnancy. Although pregnancy does not increase the rates of asymptomatic bacteriuria, it does increase the risk that it will progress to a full-blown infection. About 2% to 11% of pregnant women have asymptomatic bacteriuria and, of those, 13% to 27% will develop a kidney infection late in their term. (Frequent urination, a common symptom of UTI, during early pregnancy is most likely due to pressure on the bladder.)

Although all pregnant women should be tested for UTIs, those at particularly high risk are those with the following conditions or situations:

- Diabetes.
- Sickle cell trait.
- Members of low-income groups.
- Women who have had many children.
- A history of childhood UTIs.
- Women who have undergone a cesarean section with catheterization of the bladder.
- Women who have received epidural anesthesia.

Women who have had a UTI before or during pregnancy also have a higher risk of developing recurrent urinary tract infections after delivery. Approximately 25% to 33% of women who experience bacteriuria during pregnancy will have another urinary tract infection, sometimes as long as 10 to 14 years later.

Other Risk Factors in Women. Women who have skin allergies to ingredients in soaps, vaginal creams, bubble baths, or other chemicals that are used in the genital area are at high risk for UTIs because bacteria may enter through the allergic reaction sites. Smoking and taking tub baths have also been implicated in increasing the risk for recurrent urinary tract infections.

Risk Factors of Recurring Infection in Women

Almost 20% of all women who recover from a bout of cystitis experience recurrent episodes. The major groups of women who are at highest risk for recurrent infections are young highly sexually active women and postmenopausal women. It might be argued that nearly all women who have a urinary tract infection are at risk for another, particularly

if they are not treated for the first one.

Lifestyle Factors. Why urinary tract infections become chronic and recurring in many women is not entirely clear, but researchers are identifying certain lifestyle factors that may increase the risk in specific women:

- Engaging in sexual intercourse more than four times a month.
- Recent changes in sexual partners.
- Having a mother with a history of UTIs.
- Having a first UTI before age 15.
- Use of spermicides.

Biologic and Physical Factors. Some women may also have certain biologic or anatomical factors that increase the risk for recurring UTIs:

- Having a shorter than average distance between the urethra and the anus.
- Carrying a compound called sialosyl galactosyl globoside (SGG) on the surface of kidney cells, which is a highly powerful receptor for *E. coli* bacteria.
- Certain women have a genetic susceptibility to becoming infected in the vaginal area with greater numbers of disease-causing organisms that adhere to the lining.
- Certain women may be deficient in human beta-defensin-1 (HBD-1), believed to be a naturally occurring antibiotic.

Changes in the Aging Woman. Changes after menopause put older women at particular risk for primary and recurring UTIs. In fact, studies indicate that between 20% and 25% of women older than 65 have UTIs. A number of biologic factors in older women may also contribute to this risk:

- With estrogen loss, there is a reduction of certain immune factors in the vagina, which results in *E. coli* adhering to vaginal cells.
- Levels of lactobacilli (the protective organisms) decline after menopause, perhaps due to drops in estrogen.
- Some women carry the blood group P1, which, as they get older, makes them susceptible to large numbers of cells in the vagina and urethra attracting and binding a specific strain of *E. coli*. This strain is resistant to normal infection-fighting mechanisms.
- The walls of the urinary tract thin out, weakening the mucous membrane and reducing its ability to resist bacteria.
- The bladder may lose elasticity and fail to empty completely.

Aside from menopause, other very strong risk factors for recurrences that are associated with aging include urinary incontinence and previous operations on the genital or urinary tracts. A UTI during the previous year increases the likelihood of a single recurrence by seven-fold and of multiple recurrences by 18-fold. Additional risk factors for UTIs in older women include diabetes, vaginal itching or dryness, having had children, and poor overall health.

Risk Factors in Children

Primary UTIs in Children. About 2% of children develop urinary tract infections. Because males are more likely to be born with structural abnormalities of the urinary tract, UTIs during the first six months of life are more common in boys. The rates are about equal in toddlers. Afterward, however, UTIs are far more common in girls. By the age of five, UTIs are 50 times more common in girls than in boys. Within the first 10 years, boys will have a 1% and girls a 3% chance for developing a UTI. Attendance at day care centers may foster the spread of some drug-resistant bacteria, although this is uncommon.

Vesicoureteral reflux (VUR) is the source of urinary tract infections in 30% to 50% of childhood cases. This is a structural defect of the valve-like mechanism between the ureter and bladder that allows urine to flow backward, carrying infection from the bladder up into the kidneys.

Recurring UTIs in Children. Recurrence will occur in about 30% of boys and 40% of girls. According to one study, the risk for recurrence is highest in children with severe UTI caused by vesicoureteral reflux, and such recurrences nearly always occur within the first six months after the first UTI.

Risk Factors in Men

Men become more susceptible to UTIs after 50 years of age, when they are more likely to develop prostate problems; 5% to 15% of men older than 65 will have asymptomatic bacteriuria.

Unhealthy Elderly Adults

All older adults who are immobilized, catheterized, or dehydrated are at increased risk for UTIs. Nursing home residents, particularly those who are incontinent and demented, are at very high risk. Up to 40% of elderly patients who

live in nursing homes will contract a urinary tract infection. In most cases, the infections do not produce symptoms and are no more harmful than similar infections in the general population. Nursing home patients, however, are at higher risk for developing symptoms.

Specific Risk Factors for Complicated UTIs

Catheters and Hospitalizations. About 40% of all infections that develop in hospitalized patients are in the urinary tract, and 80% of those are due to catheters. Nearly all patients who need urinary catheters develop high levels of bacteria in their urine, and the longer the catheter is in place, the higher the risk for infection. Catheterized patients who develop diarrhea are nine times more likely to develop UTIs than are patients without diarrhea. In most cases of catheter-induced UTIs (90% in one study), the infection produces no symptoms. Because of the risk for wider infection, however, anyone requiring a catheter should be screened for infection. Catheters should be used only when necessary and should be removed as soon as possible.

Kidney Stones. In some cases, kidney stones can cause urinary tract obstruction that leads to infection, particularly pyelonephritis. Symptoms of severe urinary tract infection in people with a history of kidney stones may indicate obstruction, which is a serious condition.

Diabetes. Diabetes puts women (but not men) at significantly higher risk for asymptomatic bacteriuria. The longer a woman has diabetes, the higher the risk. (Control of blood sugar appears to have no effect on this condition.) The risk for symptomatic complicated UTIs may also be higher in people with diabetes. In fact, certain UTI-related abscesses are reported only in patients with diabetes. These patients are also at higher risk for fungal-related UTIs.

Prostate Conditions in Men. Benign prostatic hyperplasia (BPH) can produce obstruction in the urinary tract and increase the risk for infection. In men, recurrent urinary tract infections are associated with prostatitis, an infection of the prostate gland that can also be caused by *E. coli*.

Sickle Cell Anemia. Patients with sickle cell anemia are particularly susceptible to kidney damage from their disease, and UTIs put them at even greater risk.

Anatomical Abnormalities. Some people have structural abnormalities of the urinary tract that cause urine to stagnate or flow backward into the upper urinary tract. Such conditions include the following:

- A prolapsed bladder (cystocele) can result in incomplete urination so that urine collects, creating a breeding ground for bacteria.
- Tiny pockets called diverticula sometimes develop inside the urethral wall and can collect urine and debris, further increasing the risk for infection.

Kidney Problems. Nearly any kidney disorder increases the risk for complicated UTIs.

Antibiotics

Antibiotics often eliminate *lactobacilli*, the protective bacteria, along with harmful bacteria. This causes an overgrowth of *E. coli* in the vagina. In one study, the risk for UTI increased during the 15 to 28 days that women were taking antibiotics. In fact, some research suggests that taking antibiotics for a urinary tract infection increases the risk for a subsequent infection.

Medical Conditions that Increase the Risk for UTIs

AIDS and Immunosuppressed Patients. Any infection is dangerous in people whose immune systems are damaged, and UTIs are no exception, particularly pyelonephritis.

HOW SERIOUS IS A URINARY TRACT INFECTION?

Emotional Distress

In the great majority of women with recurrent UTIs, urinary discomfort and emotional distress are the primary concern. One study reported significant impairment of a woman's quality of life during symptom periods, which affected social function, vitality, and emotional well-being.

Medical Complications of Urinary Tract Infections in Adults

Nearly all urinary tract infections are mild, treatable, and have no long-term consequences. Serious physical complications can occur in some cases, however, most often in hospitalized patients:

Obstruction and Widespread Infection. Very severe upper urinary tract infections may cause obstruction that results in widespread and even life-threatening infection. Patients who develop UTIs in the hospital are at increased risk for such

infections. In one particularly dangerous form of kidney infection that obstructs the ureter, mortality rates exceed 40%. The condition should be suspected in diabetics who have severe UTIs with a slow response to antibiotics.

Kidney Damage. In high-risk adults, recurrent UTIs may cause scarring in the kidneys, which over time can lead to hypertension and eventual kidney failure. People with UTIs who develop serious kidney disease from UTIs are likely to have other predisposing diseases or structural abnormalities. (Recurrent urinary tract infections, even in the kidney, almost never lead to progressive kidney damage in otherwise healthy women.)

Urge Incontinence. Recurrent UTIs may increase the risk for urge incontinence after menopause. (People with urge incontinence experience leakage and the need to urinate frequently.)

Kidney Stones. Kidney stones can be *caused* by urinary tract infections (as well as increase the risk for UTIs in the first place). Those known as struvite stones are almost always caused by urinary tract infections due to bacteria that secrete certain enzymes. These enzymes raise urine concentrations of ammonia, which composes the crystals that form struvite stones. The stone-promoting bacterium is usually proteus, but others include pseudomonas, klebsiella, providencia, serratia, and staphylococci.

Complications of Urinary Tract Infections in Pregnancy

Urinary tract infections during pregnancy pose particular risks for both mother and child:

- If asymptomatic bacteriuria is not detected and treated promptly in pregnant women, as many as 25% develop kidney infection (pyelonephritis), which in turn increases the risk for premature delivery, infant death, and later chronic kidney disease.
- Even if kidney infection does not develop, untreated UTIs occurring in the first and third trimester of pregnancy increase the risk for mental retardation and developmental delay in the infant from 1.2% to 2%.
- Certain strains of *E. coli* can increase the risk for complications during pregnancy, including miscarriage or premature delivery, even if pyelonephritis does not develop.
- Infants of women who harbor *Ureaplasma urealyticum* also have an increased risk for respiratory infections.

Complications in Children with Urinary Tract Infections

Urinary tract infections are a major cause of hospitalization in children. Untreated, they can be very serious, particularly in children under four years old. Fortunately, with prompt treatment childhood cases of upper urinary tract infections rarely cause any serious consequences.

Spread of Infection. Widespread infection is a major complication of a primary infection. It should be noted that laboratory tests in some infants with UTI may suggest the presence of meningitis (inflammation of the spinal column). This is ordinarily a serious condition, but, according to one study, in most of these UTI cases the outcome is good with treatment and there do not appear to be any neurological symptoms afterward.

Kidney Scarring. In children who develop serious or recurrent UTIs, a greater concern is kidney scarring. This occurrence in young growing kidneys is much more serious than in the mature kidney. Over the years, it increases the risk for hypertension and kidney failure. In one study, evidence of scarring developed in 6% of children who had been hospitalized for a urinary tract infection. Children most at risk for this complication include the following:

- Children with vesicoureteral reflux. (Carefully managed vesicoureteral reflux without scarring is not associated with serious complications.)
- Abnormally structured urinary tracts.
- Recurrent kidney infections.
- A delay in treating an acute UTI.

One encouraging 2000 study followed children with evidence of kidney scarring for 16 to 26 years. On average, their total kidney function was well preserved, although the scarred kidney had signs of lower function, and patients with scarring in both kidneys were at higher risk for future problems. Earlier studies have shown poorer results, which, evidence suggests, are now improving with early detection and better follow-up.

WHICH TESTS WILL CONFIRM THE DIAGNOSIS OF URINARY TRACT INFECTIONS?

A physical examination and urine samples are the standard initial tests both to diagnose urinary tract infections and rule out other conditions. These tests may not be necessary if the patient has clear-cut UTI symptoms, including frequent urination and, in women, vaginal burning, without other complications such as fever, chills, and pain in the kidney. In such cases, a phone call may confirm the diagnosis, and the physician may be willing to call in a prescription for antibiotics to the pharmacy. Increasingly, a nurse rather than a physician is consulted for uncomplicated urinary tract infections. A good response to antibiotic therapy usually eliminates the need for further tests. Pregnant women should be screened for *E. coli* because of the risk of complications, including miscarriage, from certain strains.

Ruling Out Other Conditions with Similar Symptoms

Studies have shown that about 50% of women with symptoms of a UTI actually have some other condition. Such cases may be caused by irritation of the urethra, vaginitis, interstitial cystitis, or sexually transmitted diseases (STDs). Some of these problems may also accompany or lead to UTIs.

Vaginitis. Vaginitis is a common problem caused by a fungal infection (candidiasis), by bacteria, or by sexually transmitted diseases. Occasionally, the infection causes frequent urination, mimicking cystitis. The typical symptoms of vaginitis are itching and an abnormal discharge.

Sexually Transmitted Diseases. Women with painful urination but whose urine does not exhibit signs of bacterial growth in culture may have a sexually transmitted disease. The most common culprit is the organism *Chlamydia trachomatis*. Other STDs that may be responsible include gonorrhea and genital herpes. One analysis noted that certain symptoms, namely painful urination, the frequent urge to urinate, blood in the urine, or back pain, all suggest a UTI. Vaginal symptoms such as discharge or irritation, on the other hand, more commonly indicate a STD.

Interstitial Cystitis. Interstitial cystitis (IC) is an inflammation of the bladder wall that occurs predominantly in women. The average age of patients with IC is 40, but 25% of cases occur in women under 30. Symptoms are very similar to cystitis, but no bacteria are present. Pain during sex is a very common complaint in these patients, and stress may intensify symptoms.

Bladder Cancer. Bladder cancer is a rare cause of painful urination and is more common in men than in women.

Kidney Stones. The pain of kidney stones along with blood in the urine can resemble the symptoms of pyelonephritis. There are no bacteria present with kidney stones, however.

Thinning Urethral and Vaginal Walls. After menopause, the vaginal and urethral walls become dry and fragile, causing pain and irritation that can mimic a UTI.

Disorders in Children that Mimic UTIs. Problems that might cause painful urination in children include reactions to chemicals in bubble bath, diaper rashes, and infection from the pinworm parasite.

Prostate Conditions in Men. Prostate conditions, including prostatitis (inflammation of the prostate) and benign prostatic hyperplasia, can cause symptoms similar to urinary tract infections.

Physical Examination

During an exam, the physician should examine the pelvic and vaginal area in women. Men require a digital rectal examination to determine if prostate enlargement is present. The physician will also examine the male genitals for signs of infection. In both men and women, the physician should also check the abdomen and areas around the kidneys for swelling and tenderness.

Dipstick Tests

Dipstick tests are increasingly used to obtain a diagnosis of UTIs and are now available in drug stores without a prescription. The test employ a chemical that reacts to nitrites, substances produced by many of the bacteria that cause UTIs. This chemical is available on a stick that is dipped into a urine sample. In women with symptoms, the dipstick is proving to be a quick and practical way to identify most cases of infection. Dipstick tests may also be useful for identifying UTIs in children and infants.

A positive test (which shows infection) is helping to avoid more expensive tests, such as urine cultures. A negative dipstick test helps to avoid unnecessary antibiotics, which are contributing to the growing problem of antibiotic resistance. Urine dipstick tests can be just as accurate as more expensive urine analysis tests, although they are not entirely accurate and studies report that they may miss up to 25% of actual UTIs.

Urine Samples

A urine sample is needed for more extensive testing. In most cases, the physician requests a clean-catch sample. There are also other methods for collecting urine depending on the patient's condition.

Clean-Catch Sample. The goal of a clean-catch sample for UTI is a sample free of contaminants normally present at the opening of the urethra (e.g., white blood cells and bacteria unrelated to UTIs). To obtain an untainted urine sample, physicians usually request a midstream, or clean-catch, urine sample. To provide this, the following steps are taken:

- Patients first wash their hands thoroughly then wash the penis or vulva and surrounding area four times, with front-to-back strokes, using a new soapy sponge each time.
- The patient begins urinating into the toilet and then stops after a few drops.

- The patient then positions the container to catch the middle portion of the stream. Ideally, this urine will contain only the bacteria and other evidence of the urinary tract infection.
- The patient then urinates the remainder into the toilet.
- The patient securely screws the container cap in place without touching the inside of the rim.

The sample is generally given to the physician or sent to the laboratory for analysis. For the majority of cases of suspected cystitis, this sample is considered adequate. However, a 2000 study reported that the clean-catch sample had identical contamination rates as a simple urine sample taken with no precautions. Researchers in the study suggested that in young, sexually active women with symptoms of cystitis, a urine sample may not even be necessary.

Incontinence Pads. Testing and diagnosing UTIs in elderly patients who are incontinent is especially difficult, because of the similarities in symptoms of urinary incontinence and infection. Researchers have found that pressing a dipstick into an incontinence pad is an effective way to screen for urinary tract infections in incontinent patients.

Collection with a Catheter. Some patients (e.g., small children, elderly people, or hospitalized patients) cannot provide a urine sample. In such cases, a catheter may be inserted into the bladder to collect urine. This is the best method for providing a contaminant-free sample.

Urinalysis

A urinalysis involves a physical and chemical examination of urine. In addition, the urine is spun in a centrifuge to allow sediments containing blood cells, bacteria, and other particles to collect. This sediment is then examined under a microscope. A urinalysis, then, offers a number of valuable clues for an accurate diagnosis:

- Simply observing the urine for color and cloudiness can be important.
- Acidity is measured.
- White blood cells (leukocytes) are counted. A high count in the urine is referred to as *pyuria*. (A leukocyte count of over 10 per microliter of urine indicates pyuria.) Pyuria is usually sufficient for a diagnosis of UTI in nonhospitalized patients if standard symptoms (or just fever in small children) are also present.

Treatment can be started without the need for further tests if the following urinalysis results are present in patients with symptoms and signs of UTIs:

- A high white cell count.
- Cloudy urine.

Gram Stain

If physicians suspect that bacteria other than *E. coli* may be present, a Gram stain is used to help predict the species. This is a staining procedure used to make bacteria visible through a microscope. Many bacteria are categorized by the terms *gram positive* and *gram negative*.

- Bacteria that turn pink from staining are called gram negative.
- Those that turn blue are called gram positive.

E. coli is gram negative and is the most common cause of UTIs. If physicians suspect that bacteria other than *E. coli* are causing a UTI, a Gram stain is useful for identifying other species.

Urine Culture

A urine culture is a urine specimen observed for 24 to 48 hours in a laboratory for the presence of any bacterial growth. It is not routinely performed but may be conducted under certain circumstances:

- If urinalysis is negative but the patient has severe UTI symptoms, particularly in hospitalized patients who have a catheter and who develop fever or other signs of infection.
- If the infection is recurrent.
- If the physician suspects complications.
- If girls younger than two have a high fever of unknown origin that lasts two days or more.

Even if bacteria are present in the culture, a diagnosis of UTI depends on symptoms and gender:

- Even without symptoms, the presence in a culture of at least 100,000 colonies of any single type of bacterium per milliliter of urine usually provides conclusive evidence of infection in women.
- In women who experience pain while urinating, a diagnosis of infection is made with as low a count as 100 colonies per milliliter. (One study found that half of women who had low counts in an initial specimen progressed to high counts in two days.)
- Men are considered to have an infection with a count of only 1,000.

Urinary tract infection is nearly always caused by a single species of bacteria. If a mix of different species is found, the test is considered contaminated and is redone.

Cultures have limitations. For example, even if *E. coli* is indicated, researchers are recognizing variants of this bacteria. Certain types may indicate a higher risk for a second infection, while others may even be protective against recurring infections. Furthermore, some organisms, such as chlamydia, are not detected using ordinary cultures and require special tests. Indications for such tests may be the presence of pus (consisting of dead white blood cells and bacteria) but no bacterial growth.

Investigative Tests

An interesting test called the *Diag-Nose* is under investigation in England. The test first involves mixing urine with a specific growth medium, which the bacteria consume. They then emit characteristic odors that are detected by the device and identified as UTI bacteria. More research is warranted.

Imaging Techniques

Because of the expense and the limited accuracy of imaging procedures, these techniques are used only for the following:

- Serious and recurrent cases of pyelonephritis.
- When structural abnormalities are suspected.
- If infections do not respond to treatment.
- If a physician suspects obstruction or an abscess.
- As follow-up care in children.

Ultrasound. Ultrasound is a noninvasive, risk-free imaging test that can be used to screen for hydronephrosis (obstructions of the flow of urine), kidney stones that predispose to infection, and kidney abscesses. In men, ultrasound can detect enlargement or abscesses of the prostate and, when combined with x-rays, is an accurate method for detecting incomplete emptying of the bladder, a common cause of UTI in men older than 50. In children with urinary tract infections, they also can be used to detect vesicoureteral reflux, the defect of the valve-like mechanism between the ureter and bladder. They are not as accurate as voiding cystourethrograms [see below].

Nuclear Scans. Imaging techniques called nuclear scans may be useful in certain complicated cases, such as detecting kidney scarring after pyelonephritis in children. They produce better images and expose the patient to far less radiation than x-rays do. One such scan called dimercaptosuccinic acid (DMSA) scintigraphy first employs injections of tiny amounts of radioactive tracing medicine. A scanning machine (scintillation or gamma camera) is then used to detect pictures of the tracer in the kidney. This information is recorded on a computer screen or on film.

Magnetic Resonance Imaging (MRI) or Computed Tomography (CT). Magnetic resonance imaging (MRI) and computed tomography (CT) scans are noninvasive advanced imaging techniques that are sometimes used when nuclear scans are inconclusive. A CT scan is useful for ruling out kidney stones or obstructions in women with recurrent UTIs.

X-Rays. Special x-rays can be used to screen for structural abnormalities, urethral narrowing, or incomplete emptying of the bladder, which can cause stagnation of urine and predispose to infection.

- *Voiding cystourethrogram* is an x-ray of the bladder and urethra. To obtain a cystourethrogram, a dye, called contrast material, is injected through a catheter inserted into the urethra and passed through the bladder.
- An *intravenous pyelogram (IVP)* is an x-ray of the kidney. For a pyelogram, the contrast matter is injected into a vein and eliminated by the kidneys. In both cases, the dye passes through the urinary tract and reveals any obstructions or abnormalities on x-ray images. Due to the possible risks to the fetus, x-rays are not performed on pregnant women.

Cystoscopy. Cystoscopy is used to detect structural abnormalities, interstitial cystitis, or masses that might not show up on x-rays during an IVP. The patient is given a light anesthetic and the bladder is filled with water. The procedure uses a cystoscope, a flexible, tube-like instrument that the urologist inserts through the urethra into the bladder.

Other Diagnostic Tests for Kidney Infections and Severe UTIs

No noninvasive test will differentiate between upper and lower urinary tract infections. This is a particular problem because of the high percentage of women whose cystitis symptoms mask infections that also exist in the upper tract.

Antibiotic Trial. The best current test for pyelonephritis is the short-term antibiotic therapy given for cystitis. If the infection returns within two weeks after treatment, upper urinary tract infection is usually present.

Blood Cultures. If symptoms are severe, blood cultures will be taken to determine whether the infection is in the bloodstream and threatening other parts of the body.

WHAT ARE THE TREATMENTS FOR SYMPTOMS OF URINARY TRACT INFECTIONS

Although antibiotics successfully treat most urinary tract infections, severe symptoms can persist for several days until treatment effectively eliminates the bacteria. (One study revealed that many women who suffer from UTIs often wait one or two days before seeing a physician. As a result, up to another two or more days may pass before treatments can take effect and relieve symptoms.) A number of options are available for treating symptoms until the antibiotics are effective. It should be stressed that all of these drugs treat only symptoms and are not cures; they should never be used to replace antibiotics.

Phenazopyridine

Phenazopyridine (Barodium, Eridium, AZO Standard) relieves pain and burning caused by the infection. It should not be taken for more than two days and should be discontinued when symptoms are relieved. Side effects include headache and stomach distress. The drug turns urine a red or orange color, which can stain fabric and be difficult to remove. In rare cases, it can cause serious side effects, including shortness of breath, a bluish skin, a sudden reduction in urine output, shortness of breath, and confusion. In such cases, patients should call the physician immediately.

Antispasm Agents

Drugs that reduce bladder spasms include methenamine (Atrosept, Prosed, Urised) or flavoxate (Urispas). These agents can have severe side effects that the patient should discuss with the physician.

HOW ARE ANTIBIOTICS USED IN TREATING URINARY TRACT INFECTIONS?

A variety of antibiotics are available for UTIs. The choices depend on many factors, including whether the infection is complicated or uncomplicated or primary or recurrent. Treatment decisions should not necessarily be based on the actual bacteria count. If a woman has symptoms, even if bacterial count is low or normal, infection is probably present and antibiotic treatment should be considered. [See Box Specific Antibiotics Used for Most UTIs.]

Specific Antibiotics Used for Most UTIs

Amoxicillin. Until recent years, the standard treatment for a UTI was 10 days of amoxicillin, a penicillin antibiotic, but it is now ineffective against *E. coli* bacteria in up to 25% of cases. A combination of amoxicillin-clavulanate (Augmentin) is now sometimes given for drug-resistant infections.

TMP-SMX. The current typical treatment is a three-day course of the combination drug trimethoprim-sulfamethoxazole, commonly called TMP-SMX (Bactrim, Cotrim, Septra). It should not be used in patients whose infections occurred after dental work or in patients allergic to sulfa drugs. Allergic reactions can be very serious. Trimethoprim (Proloprim, Trimplex) is sometimes used alone in those allergic to sulfa drugs. It should be noted that TMP-SMX interferes with the effectiveness of oral contraceptives.

Fluoroquinolones. Antibiotics known as fluoroquinolones (also called quinolones) are now standard alternatives to TMP-SMX. Examples of quinolones include ciprofloxacin (Cipro), norfloxacin (Noroxin), ofloxacin (Floxacin), levofloxacin (Levaquin), gatifloxacin (Tequin), and sparfloxacin (Zagam). These antibiotics are effective against a wide range of organisms but are expensive and, in general, used only for the following conditions:

- In patients with complicated or catheter-induced UTIs.
- In patients who do not respond or who are allergic to TMP-SMX.
- In communities where there are high rates of bacteria resistant to TMP-SMX. One analysis noted that fluoroquinolones become cost effective when resistance rates to TMP-SMX exceed 22%, a level that is becoming increasingly common in many states as well as in individual hospitals nationwide.
- In elderly patients. A 2001 study of older women (mean age 80) with UTIs, about half of whom were living in nursing homes, found that 96% responded to ciprofloxacin, compared with 87% to TMP-SMX.

Pregnant women should not take fluoroquinolone antibiotics.

Nitrofurantoin. Nitrofurantoin (Furadantin, Macrofantin) is a relatively inexpensive antibiotic that is used specifically for urinary tract infections. Unlike many of the other drugs, however, it must be given for more than three days, even in cases of simple cystitis, and is not useful for treating kidney infections. It interacts with many drugs and other chronic or serious medical conditions may also affect its use. It should not be used in pregnant women within a week or two of delivery, in nursing mothers, or in those with kidney disease.

Fosfomycin. The antibiotic fosfomycin (Monurol), which comes in an orange-flavored, soluble powder, is proving to be another good alternative. It can be an effective one-dose treatment for many women, including those who are pregnant.

Cephalosporins. Antibiotics known as cephalosporins, either second generation (cefuroxime axetil, cefaclor, cefprozil) or third generation (cefixime, cefotaxime, cefpodoxime) are also alternatives for infections that do not respond to standard treatments.

Tetracyclines. Long-term treatment with tetracycline or doxycycline (both are tetracyclines) may be used for infections that are caused by mycoplasma or chlamydia. Tetracyclines have unique side effects among antibiotics, including skin reactions to sunlight, possible burning in the throat, and tooth discoloration.

Aminoglycosides. Aminoglycosides are given by injection for very serious bacterial infections. Gentamicin is an example.

Antibiotics for Uncomplicated UTIs

Oral antibiotic treatment cures 85% of uncomplicated urinary tract infections, although the rate of recurrence remains high. There is some debate over whether to treat young sexually active women with high bacterial counts but no symptoms (asymptomatic bacteriuria). Given growing bacterial resistance to antibiotics and the benign nature of this condition, many experts do not recommend routine treatment.

Specific Antibiotics Used. The antibiotics used most often for uncomplicated UTIs are either trimethoprim-sulfamethoxazole (TMP-SMX) or an antibiotic known as a fluoroquinolone. Pregnant women should not take fluoroquinolones. For uncomplicated UTIs, better options during pregnancy may be sulfisoxazole or a cephalosporin. [See Box Specific Antibiotics Used for Most UTIs.]

Duration of Treatment. Studies are now reporting that uncomplicated female UTIs can often be successfully diagnosed over the phone. In such cases, a health professional provides the patient with a three-day antibiotic regimen without even requiring a urine test. A *single* oral dose of antibiotics, usually TMP-SMX (Bactrim, Cotrim, Septra) or a fluoroquinolone, is sometimes prescribed in mild cases, but cure rates are generally lower than with the three-day regimens. (Longer-term therapy, given for seven to 10 days, is now mostly limited to men, children, the elderly, people with diabetes with any UTI, and women with pyelonephritis or who are pregnant.) After a week of antibiotic treatment, most patients are free of infection. If the symptoms do not clear up within the first few days of therapy, physicians generally suggest that women discontinue their antibiotic and provide a urine sample for culturing in order to identify the specific organism causing the condition.

Treatment for Relapsing Infection

A relapsing infection (caused by the same organism as the first episode) occurs within three weeks in about 10% of women. Relapse is treated similarly to a first infection but the antibiotics are continued for at least two weeks. (Relapsing infections may be due to structural abnormalities, abscesses, or other problems that may require surgery, and such conditions should be ruled out.)

Bacterial Resistance to Antibiotics

Of major concern for physicians and the public is the emergence of strains of common bacteria, including *E. coli*, that are resistant to specific antibiotics. The prevalence of such bacteria has dramatically increased worldwide, in large part due to widespread use of antibiotics in people and animal feeds.

Resistance to antibiotics is most often observed in the hospital setting. Unfortunately, there has been a major worldwide increase within the community in *E. coli* resistance to standard antibiotics used for UTIs. More than 20% of *E. coli* bacteria are now resistant to ampicillin, cephalothin, and resistance is increasing rapidly to TMP-SMX. In general, resistance rates to TMP-SMX range from about 10% in the northeast US, 22% in some Western states, to up to 50% overseas. Resistance to fluoroquinolones also appears to be emerging as a growing problem, particularly in UTIs in older women. *E. coli* resistance to nitrofurantoin and gentamicin, is still under 2%, but as these drugs are increasingly used, resistant bacterial will also increase.

Antibiotic Treatment and Prevention of Reinfections

By six weeks, the rate of reinfection is 18% among those taking TMP-SMX and may be up to 40% in patients taking short-term therapy of other types of antibiotics. All women with an initial episode of UTI should use hygienic measures to prevent recurrences. [See What Are the Non-Antibiotic Measures for Preventing Recurrent Urinary Tract Infections?]

Self Treatment. A number of studies now suggest that many, if not most, women with recurrent UTIs can accurately self-diagnose an infection and self treat recurrent UTIs without going to a physician:

- As soon as the patient develops symptoms, she takes the antibiotic. Infections that occur less than twice a year are usually treated as if they were an initial attack, with single-dose or three-day antibiotic regimens.

- At that time, she also performs a clean–catch urine test and sends it to the physician for culturing to confirm the infection.

A physician should be consulted under the following circumstances:

- If symptoms have not completely resolved within 48 hours.
- If there is a change in symptoms.
- If the patient suspects that she is pregnant.
- If the patient has more than four infections a year.

Women who are not good candidates for self–treatment are those with impaired immune systems, previous kidney infections, structural abnormalities of the urinary tract, or a history of infection with antibiotic–resistant bacteria.

Preventive Antibiotics (Prophylaxis). Prophylaxis (preventive antibiotics) is an option for women who experience two or more symptomatic UTIs within six months or three or more over the course of a year. A woman's own perception of discomfort should guide her decisions on whether to use preventive antibiotics or not. The increasing use of antibiotics for many common infections is causing concern because of emerging strains of common bacteria that have become resistant to standard antibiotics. [See Box Bacterial Resistance to Antibiotics.]

Regimens for Recurrent Infections. Preventive regimens for recurrent infections may vary depending on the circumstances:

- The physician may prescribe continuous preventive low–dose antibiotics for six months to a year. Typical regimens include one dose of nitrofurantoin (50 mg), one–half tablet of TMP–SMX, or one dose of cephalexin (250 mg) daily. Taking the antibiotic at bedtime may be most effective. (Taking TMP–SMX for as long as five years has been reported to be effective and well tolerated.)
- If the infection is related to sexual activity and episodes recur more than three times per year, a single preventive dose taken immediately after intercourse has proven to be very effective in many cases. Effective antibiotics in such cases include TMP–SMX, nitrofurantoin, cephalexin, or a fluoroquinolone (such as ciprofloxacin). (Fluoroquinolones are not appropriate during pregnancy.)
- In elderly people with frequent recurrences, half doses of trimethoprim are beneficial.

Antibiotics for Kidney Infections

Treating Uncomplicated Kidney Infections. Patients with uncomplicated kidney infections (pyelonephritis) are those who are not experiencing nausea or vomiting and show no other overt symptoms of kidney involvement. Sometimes patients are first given an antibiotic injection, if indicated. In general, the standard treatment for uncomplicated pyelonephritis is a 14–day course of oral antibiotics, usually TMP–SMX or ampicillin. A 2000 study reported, however, that a seven–day course of ciprofloxacin was as effective as 14 days of TMP–SMX for patients with uncomplicated kidney infections. In any case, a urine culture is obtained within one week of completion of therapy and again four weeks later.

Treating Moderate to Severe Kidney Infections. Patients with moderate to severe acute kidney infection and those with severe symptoms or other complications may need to be hospitalized. In such cases, antibiotics (ceftriaxone and gentamicin) are usually given intravenously for three to five days or until symptoms are relieved and patients have not shown any signs of fever for 24 to 48 hours.

One study reported that oral cefixime may be as effective as intravenous antibiotics in small children with UTIs and fever. In any case, adult patients are switched to oral antibiotic therapy after symptoms have subsided and continued for another two weeks; treatment for longer than this has no additional benefit. If fever and back pain persist after 72 hours of antibiotic administration, the physician will usually order imaging tests to see if abscesses, obstructions, or other abnormalities are present. [See What Tests Will Confirm the Diagnosis of Urinary Tract Infection, *above*.]

Treating Chronic Kidney Infections. Patients with chronic pyelonephritis are often treated with long–term antibiotics, even during periods when they have no symptoms.

Treating the Pregnant Woman with a Kidney Infection. Pregnant women with pyelonephritis have, to date, been hospitalized for treatment, but a study found that outpatient treatment is safe and effective if the condition develops in the early months of pregnancy. In the study, women were given an injection of ceftriaxone in the emergency room, observed for a few hours, and then administered a second injection. After this, they were sent home with a prescription for an oral antibiotic.

Antibiotics for Urethritis in Men

Urethritis in men has typically been treated with a seven–day regimen of doxycycline. Some research is showing that a single dose of azithromycin may be just as effective while causing fewer side effects. One–dose treatment also improves compliance, so cure rates may even be better than with a long–term regimen. Of concern, however, is an

infection that spreads to the prostate gland, which is harder to treat, so most physicians still prefer the longer regimen. It should be noted that azithromycin and similar antibiotics do not cure the infection and may mask the symptoms of an accompanying sexually transmitted disease, such as gonorrhea. Tests for such diseases should be conducted if urethritis is diagnosed.

Preventive Treatments for Children with Vesicoureteral Reflux

Antibiotics are often used to prevent infections in children (particularly girls) with vesicoureteral reflux. The current choices include low doses of nitrofurantoin and trimethoprim. The treatment usually continues for years with the idea that the condition will resolve when the child has grown. A long-term study in 2001 found that in children with moderate to severe vesicoureteral reflux who were receiving antibiotics (along with hygiene measures), marked improvement occurred in 52% of the children after five years and in 77% after 10 years. The problem disappeared altogether in 14% of the children after five years, and in 52% after 10 years. Still, there have been few well-conducted studies, and the use of long-term antibiotics remains controversial. In some earlier studies, the benefits of long-term medications were limited, and one report suggested they may put children at higher risk for developing infections with bacteria that are resistant to common bacteria.

Surgery to correct the reflux is the alternative when the condition does not resolve over time with antibiotics. Debate is ongoing over whether surgery might be a better first option than long-term antibiotics. Studies are finding no significant difference in kidney damage between children who are treated with antibiotics or surgery.

MANAGEMENT OF CATHETER-INDUCED URINARY TRACT INFECTIONS

Preventing Catheter-Induced Infections

Catheter-induced urinary tract infections are very common, and preventive measures are extremely important. Catheters should not be used unless absolutely necessary, and they should be removed as soon as possible. One study found that catheters impregnated with antibiotics reduced UTI rates during the two weeks they were in place after surgery. Reducing the risk for infections during long-term catheter use, however, remains problematic.

Catheter Coatings. Catheter coatings, such as silver nitrate and other substances, are being tested and are showing some benefits, but the problem is still not resolved.

Intermittent Use of Catheters. If a catheter is required for long periods, it is best to use it intermittently if possible (as opposed to an indwelling catheter). Some physicians recommend replacing it every two weeks to reduce the risk of infection and irrigating the bladder with antibiotics between replacements.

Daily Hygiene. A typical catheter is one that has been preconnected and sealed and uses a drainage bag system. To prevent infection, some of the following tips may be helpful:

- Drink plenty of fluids, including three glasses of cranberry juice a day.
- The catheter tube should be free of any knots or kinks.
- Clean the catheter and the area around the urethra with soap and water daily and after each bowel movement. (Women should be sure to clean front to back.)
- Wash hands before touching the catheter or surrounding area.
- Never disconnect the catheter from the drainage bag without careful instructions from a health professional on strict methods for preventing infection.
- Keep the drainage bag off the floor.
- Stabilize the bag against the leg using tape or some other system.

Antibiotics for Catheter-Induced Infections

Patients using catheters who develop UTIs with symptoms should be treated for each episode with antibiotics and the catheter should be removed, if possible. A major problem in treating catheter-related UTIs is that the organisms involved are constantly changing. Because there are likely to be multiple species of bacteria involved, experts generally recommend an antibiotic that is effective against a wide variety of micro-organisms. These medications include those in the fluoroquinolone group and drug combinations such as ampicillin plus gentamicin or imipenem plus cilastatin.

Although high bacteria counts in the urine (bacteriuria) occur in most catheterized patients, administering antibiotics to *prevent* a UTI is rarely recommended. Many catheterized patients do not develop symptomatic urinary tract infections even with high bacteria counts. If bacteriuria occurs without symptoms, antibiotic therapy has little benefit if the catheter is to remain in place for a long period.

WHAT ARE THE NON-ANTIBIOTIC MEASURES FOR PREVENTING RECURRENT URINARY TRACT INFECTIONS?

General Female Hygiene

The following hygiene tips may be helpful for women at risk for UTIs:

- Cleanse the genital and urinary areas from front to back with soap and water after each bowel movement.
- Avoid tight-fitting pants.
- Wear cotton-crotch underwear and panty hose, changing both at least once a day. (Mild detergents are best for washing underwear.)
- Take showers rather than baths.
- Avoid bath oils, feminine hygiene sprays, douches, and powders. In fact, as a general rule, any product containing perfumes or other possible allergens should not be used near the genital area.
- Choose sanitary napkins instead of tampons (which some physicians believe encourage infection). Napkins and tampons, in any case, should be changed after each urination.
- Urinate frequently.

Sexual Precautions

The following recommendations may reduce the risks from sexual activity:

- Keep the genital and anal areas clean before and after sex.
- Urinate before and after intercourse to empty the bladder and cleanse the urethra of bacteria. Note: these precautions are not proven to prevent UTIs.
- Discuss the best contraceptive choice with a physician. To reduce the risk for UTIs, a woman in a monogamous relationship should consider contraceptive devices that don't contain spermicides. [See also the Well-Connected Report, #91 Female Contraception.] Uncoated condoms do not pose a risk for recurrent UTIs, but the friction they produce in use may pose a risk for infection. Uncoated condoms are also not as protective against sexually transmitted diseases.
- Avoid sex with multiple partners. This can cause sexually transmitted diseases and UTIs.

Estrogen

Postmenopausal women who use an estrogen vaginal cream or estrogen-releasing vaginal ring (Estring) have a significantly lower incidence of recurring urinary tract infections than women not using such topical estrogens. Researchers suggest that estrogen may resist infection by increasing the number of lactobacilli, the micro-organisms that fight infection by lowering the vaginal pH levels and preventing *E. coli* from adhering to vaginal cells. Taking oral estrogen does not seem to provide the same benefit as the topical forms, and in any case is proving to have some health risks.

Dietary Considerations

Fluids. Many physicians believe that emptying the bladder frequently will help prevent bladder irritation and therefore recommend drinking plenty of water daily and urinating often. Alcohol and coffee should be avoided.

Cranberries, Blueberries, and Ligonberries. Cranberries, blueberries, and lignonberry, a European relative of the cranberry, are three fruits that may have protective properties. Researchers are finding that red pigments in these closely related fruits called tannins (or proanthocyanadins) prevent *E. coli* bacteria from adhering to cells in the urinary tract, thereby inhibiting infection. Fructose, a sugar found in fruits and honey that is often added to fruit juices, may also interfere with bacterial adhesion.

Cranberry juice offers well-known protection against urinary tract infections. In one study, only 15% of elderly women who drank cranberry juice daily for six months experienced UTIs, compared with 28% of women who did not drink the juice. Its effects were stronger in helping the body rid itself of infections than in preventing them in the first place, but it showed benefits in both situations.

Studies have suggested that for protection, it is necessary to drink at least one to two cups of 30% cranberry juice daily, or to take at least 300 mg to 400 mg in tablet form twice daily.

Vitamin C. Taking vitamin C regularly may make urine more acidic and less hospitable to bacteria, but there is no evidence that it prevents UTIs.

Probiotics

Lactobacilli. Some researchers are investigating *probiotics* (essentially friendly organisms), particularly lactobacilli, which may protect against infections in the genital and urinary tracts. Some of these strains, particularly acidophilus,

are used to make yogurt. Lactobacilli have the potential to help protect women from UTIs in a number of ways:

- Maintain a low pH environment.
- Hinder *E. coli* growth.
- Produce hydrogen peroxide, which produces an environment hostile for bacteria.

In one 2001 study, a drink containing a strain of lactobacilli called GG did not appear to protect against UTI recurrences, possibly because the dose was too low for the healthy bacteria to flourish.

Escherichia Coli 83972. A strain of *E. coli* called 83972 is being investigated because it can grow in the urinary tract without causing infection, crowding out other potentially harmful bacteria. Some research suggests that it may be protective in certain individuals, including those with spinal cord injuries or urinary catheters.

Vaccines

Vaccines are being developed against urinary tract infections. There is some urgency in the need for such vaccines, as bacterial strains resistant to many common antibiotics are becoming increasingly prevalent. The Urovac vaccine, for example, is an immune-boosting vaginal suppository made from 10 heat-killed strains of common UTI-causing bacteria. In early trials 55% of women who received the vaccine plus booster doses remained free of recurrences at six months, compared to 22% who got a dummy vaccine or the vaccine without boosters. None had serious side effects. Investigators are also testing a vaccine that prevents *E. coli* from attaching to the lining of the bladder.

Circumcision in Infant Males

Although there is some controversy over whether circumcision helps prevent UTIs in boys, a 2000 analysis of nearly 15,000 male infants born in 1996 reported that the uncircumcised boys younger than one year had nine times the risk for UTIs as circumcised boys. (This risk is still very low.)

Biofeedback in Children

Some research indicates that in children who are prone to UTIs because of problems related to urine voiding, teaching them to relax and control their pelvic muscles using biofeedback, a technique that provides visual and auditory clues in response to specific exercises, results in fewer recurrences of infection.

WHERE ELSE CAN INFORMATION ABOUT URINARY TRACT INFECTIONS BE OBTAINED?

National Kidney and Urologic Diseases Information Clearinghouse, Three Information Way, NIDDK, NIH, 31 Center Drive, MSC 2560, Bethesda, MD 20892-2560. Call (800-891-5388) or on the Internet (<http://www.niddk.nih.gov>) Provides information from a number of government sources and patient information, *Urinary Tract Infections In Adults*.

American Urological Association (AUA) or on the Internet (<http://www.auanet.org/>) and its journal (<http://www.jurology.com/>)

American Foundation for Urologic Disease, 1128 North Charles Street, Baltimore, MD 21201. Call (800-242-2383) or (410 468-1800) or on the Internet (<http://www.afud.org/>)

National Association for Continence (NAFC), Box 8310, Spartanburg, SC 29305-8306. Call 800-BLADDER or (864-579-7900) or fax (864-579-7902) or on the Internet (<http://www.nafc.org/>) Although devoted to information on continence, the association will provide names of specialists in urinary tract infections in local areas.

Interstitial Cystitis Association (ICA), 51 Monroe St., Suite 1402, Rockville, MD 20850. Call (301-610-5300) or on the Internet (<http://www.ichelp.com>). Provides patients with information and support network.

National Women's Health Resource Center, Women's Health Interactive
1136 East Stuart, Ft. Collins, CO 80525-1276 Call (970-282-9437) or fax (970-282-0023) or on the Internet (<http://www.healthywomen.org/>)

National Women's Health Network, 514 10th St. NW, Suite 400, Washington, DC 20004. Call (202-347-1140) or (202-628-7814) for health information or (<http://www.womenshealthnetwork.org/>) Membership is \$25 per year and provides a bimonthly newsletter and access to information. Reports cost \$6.00 for members and \$8.00 for nonmembers.

American Urogynecologic Society, 2025 M Street NW, Suite 800, Washington, DC 20036. Call (202-857-1167) or on

the Internet (<http://www.augs.org/>). This organizations is concerned with urologic and gynecologic problems that coincide in women. Site gives names of professionals in specific locations.

American College of Obstetricians and Gynecologists, Resource Center, 409 12th Street SW, P.O. Box 96920, Washington, DC 20090–6920. Call (202–638–5577) or on the Internet (<http://www.acog.com/>)

FIND A SPECIALIST

Find a Gynecologist

<http://www.acog.com/member-lookup/>

Find a Urogynecologist

<http://www.augs.org/>

Review Date: 9/30/2002

Reviewed By: Harvey Simon, MD, Editor-in-Chief, Well-Connected reports; Associate Professor of Medicine, Harvard Medical School; Physician, Massachusetts General Hospital

The information provided herein should not be used during any medical emergency or for the diagnosis or treatment of any medical condition. A licensed physician should be consulted for diagnosis and treatment of any and all medical conditions. Call 911 for all medical emergencies. Links to other sites are provided for information only — they do not constitute endorsements of those other sites. Copyright 2002 A.D.A.M., Inc. Any duplication or distribution of the information contained herein is strictly prohibited.

