Urinary Tract Infections in Adults

National Kidney and Urologic Diseases Information Clearinghouse

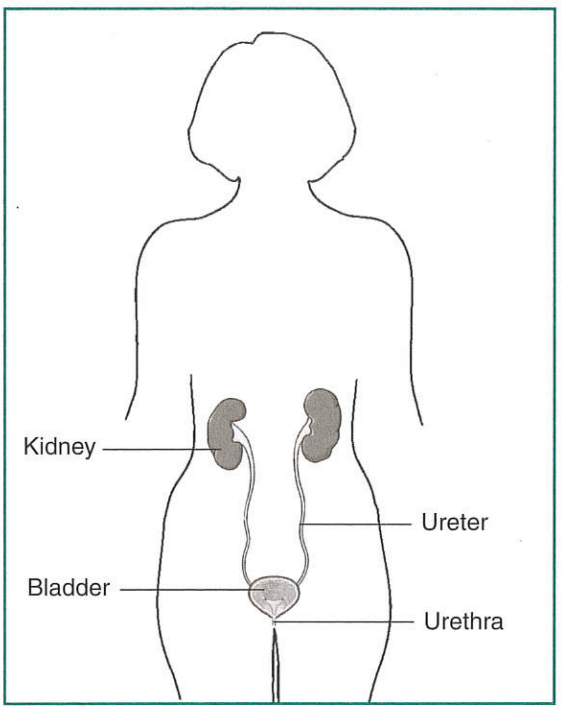
National Institute of Diabetes and Digestive and Kidney Diseases

What is a urinary tract infection (UTI)?

A UTI is an infection in the urinary tract. Infections are caused by microbes—organisms too small to be seen without a microscope—including fungi, viruses, and bacteria. Bacteria are the most common cause of UTIs. Normally, bacteria that enter the urinary tract are rapidly removed by the body before they cause symptoms. However, sometimes bacteria overcome the body's natural defenses and cause infection. An infection in the urethra is called urethritis. A bladder infection is called cystitis. Bacteria may travel up the ureters to multiply and infect the kidneys. A kidney infection is called pyelonephritis.

What is the urinary tract?

The urinary tract is the body's drainage system for removing wastes and extra water. The urinary tract includes two kidneys, two ureters, a bladder, and a urethra. The kidneys are a pair of bean-shaped organs, each about the size of a fist and located below the ribs, one on each side of the spine, toward the middle of the back. Every minute, a person's kidneys filter about 3 ounces of blood, removing wastes and extra water. The wastes and extra water make up the 1 to 2 quarts of urine a person produces each day. The urine travels from the kidneys down two narrow tubes called the ureters. The urine is then stored in a balloonlike organ called the bladder and emptied through the urethra, a tube at the bottom of the bladder.



The urinary tract

When the bladder empties, a muscle called the sphincter relaxes and urine flows out of the body through the urethra. The opening of the urethra is at the end of the penis in males and in front of the vagina in females.

What causes UTIs?

Most UTIs are caused by bacteria that live in the bowel. The bacterium *Escherichia coli (E. coli)* causes the vast majority of UTIs. Microbes called *Chlamydia* and *Mycoplasma* can infect the urethra and reproductive system but not the bladder. *Chlamydia* and *Mycoplasma* infections may be sexually transmitted and require treatment of sexual partners.

The urinary tract has several systems to prevent infection. The points where the ureters attach to the bladder act like one-way valves to prevent urine from backing up toward the kidneys, and urination washes microbes out of the body. In men, the prostate gland produces secretions that slow bacterial growth. In both sexes, immune defenses also prevent infection. But despite these safeguards, infections still occur. Certain bacteria have a strong ability to attach themselves to the lining of the urinary tract.

How common are UTIs in adults?

Urinary tract infections are the second most common type of infection in the body, accounting for about 8.1 million visits to health care providers each year.[1] Women are especially prone to UTIs for anatomical reasons. One factor is that a woman's urethra is shorter, allowing bacteria quicker access to the bladder. Also, a woman's urethral opening is near sources of bacteria from the anus and vagina. For women, the lifetime risk of having a UTI is greater than 50 percent.[2] UTIs in men are not as common as in women but can be serious when they occur.

Who is at risk for a UTI?

Although everyone has some risk, some people are more prone to getting UTIs than others. People with spinal cord injuries or other nerve damage around the bladder have difficulty emptying their bladder completely, allowing bacteria to grow in the urine that stays in the bladder. Anyone with an abnormality of the urinary tract that obstructs the flow of urine—a kidney stone or enlarged prostate, for example—is at risk for a UTI. People with diabetes or problems with the body's natural defense system are more likely to get UTIs.

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[1]Schappert SM, Rechtsteiner EA. Ambulatory medical care utilization estimates for 2006. National health statistics reports; no 8. Hyattsville, MD: National Center for Health Statistics; 2008.

[2]Griebling TL. Urinary tract infection in women. In: Litwin MS, Saigal CS, eds. *Urologic Diseases in America.* Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. Washington, D.C.: GPO; 2007. NIH publication 07–5512:587–619.

Sexual activity can move microbes from the bowel or vaginal cavity to the urethral opening. If these microbes have special characteristics that allow them to live in the urinary tract, it is harder for the body to remove them quickly enough to prevent infection. Following sexual intercourse, most women have a significant number of bacteria in their urine, but the body normally clears them within 24 hours. However, some forms of birth control increase the risk of UTI. In some women, certain spermicides may irritate the skin, increasing the risk of bacteria invading surrounding tissues. Using a diaphragm may slow urinary flow and allow bacteria to multiply. Condom use is also associated with increased risk of UTIs, possibly because of the increased trauma that occurs to the vagina during sexual activity. Using spermicides with diaphragms and condoms can increase risk even further.

Another common source of infection is catheters, or tubes, placed in the urethra and bladder. Catheters interfere with the body's ability to clear microbes from the urinary tract. Bacteria travel through or around the catheter and establish a place where they can thrive within the bladder. A person who cannot urinate in the normal way or who is unconscious or critically ill often needs a catheter for more than a few days. The Infectious Diseases Society of America recommends using catheters for the shortest time possible to reduce the risk of a UTI.[3]

Recurrent Infections

Many women suffer from frequent UTIs. About 20 percent of young women with a first UTI will have a recurrent infection.[4] With each UTI, the risk that a woman will continue having recurrent UTIs increases.[5] Some women have three or more UTIs a year. However, very few women will have frequent infections throughout their lives. More typically, a woman will have a period of 1 or 2 years with frequent infections, after which recurring infections cease.

Men are less likely than women to have a first UTI. But once a man has a UTI, he is likely to have another because bacteria can hide deep inside prostate tissue. Anyone who has diabetes or a problem that makes it hard to urinate may have repeat infections.

Research funded by the National Institutes of Health (NIH) suggests that one factor behind recurrent UTIs may be the ability of bacteria to attach to cells lining the urinary

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[3]Hooton TM, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 international clinical practice guidelines from the Infectious Diseases Society of America. *Clinical Infectious Diseases.* 2010;50(5):625–663.

[4]Tolkoff-Rubin NE, Cotran RS, Rubin RH. Urinary tract infection, pyelonephritis, and reflux nephropathy. In: Brenner BM, ed. *Brenner & Rector's The Kidney.* 8th ed. Vol. 2. Philadelphia: Saunders; 2008: 1203–1238.

[5]Schaeffer AJ. Infections of the urinary tract. In: Walsh PC, Retik AB, Vaughan ED, Wein AJ, eds. *Campbell's Urology.* 8th ed. Vol. 1. Philadelphia: Saunders; 2002: 515–602.

tract. One NIH-funded study found that bacteria formed a protective film on the inner lining of the bladder in mice.[6] If a similar process can be demonstrated in humans, the discovery may lead to new treatments to prevent recurrent UTIs. Another line of research has indicated that women who are "nonsecretors" of certain blood group antigens may be more prone to recurrent UTIs because the cells lining the vagina and urethra may allow bacteria to attach more easily. A nonsecretor is a person with an A, B, or AB blood type who does not secrete the normal antigens for that blood type in bodily fluids, such as fluids that line the bladder wall.[7]

Infections during Pregnancy

Pregnant women seem no more prone to UTIs than other women. However, when a UTI does occur in a pregnant woman, it is more likely to travel to the kidneys. According to some reports, about 4 to 5 percent of pregnant women develop a UTI.[8] Scientists think that hormonal changes and shifts in the position of the urinary tract during pregnancy make it easier for bacteria to travel up the ureters to the kidneys and cause infection. For this reason, health care providers routinely screen pregnant women for bacteria in the urine during the first 3 months of pregnancy.

Are UTIs serious?

Most UTIs are not serious, but some infections can lead to serious problems, such as kidney infections. Chronic kidney infections—infections that recur or last a long time—can cause permanent damage, including kidney scars, poor kidney function, high blood pressure, and other problems. Some acute kidney infections—infections that develop suddenly—can be life threatening, especially if the bacteria enter the bloodstream, a condition called septicemia.

What are the signs and symptoms of a UTI?

Symptoms of a UTI vary by age, gender, and whether a catheter is present. Among young women, UTI symptoms typically include a frequent and intense urge to urinate and a painful, burning feeling in the bladder or urethra during urination. The amount of urine may be very small. Older women and men are more likely to be tired, shaky, and

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[6]Anderson GG, Palermo JJ, Schilling JD, et al. Intracellular bacterial biofilm-like pods in urinary tract infections. *Science.* 2003;301:105–107.

[7]Stapleton AE, Nudelman E, Clausen H, Hakomori S, Stamm WE. Binding of uropathogenic *Escherichia coli* R45 to glycolipids extracted from vaginal epithelial cells is dependent on histo-blood group secretor status. *Journal of Clinical Investigation.* 1992;90;965–972.

[8]Sharma JB, Aggarwal S, Singhal S, Kumar S, Roy KK. Prevalence of urinary incontinence and other urological problems during pregnancy: a questionnaire based study. *Archives of Gynecology and Obstetrics.* 2009;279(6):845–851.

weak and have muscle aches and abdominal pain. Urine may look cloudy, dark, or bloody or have a foul smell. In a person with a catheter, the only symptom may be fever that cannot be attributed to any other cause. Normally, UTIs do not cause fever if they are in the bladder. A fever may mean the infection has reached the kidneys or has penetrated the prostate. Other symptoms of a kidney infection include pain in the back or side below the ribs, nausea, and vomiting.

How are UTIs diagnosed?

To find out whether a person has a UTI, the health care provider will ask about urinary symptoms and then test a sample of urine for the presence of bacteria and white blood cells, which are produced by the body to fight infection. Because bacteria can be found in the urine of healthy individuals, a UTI is diagnosed based both on symptoms and a laboratory test. The person will be asked to give a "clean catch" urine sample by washing the genital area and collecting a "midstream" sample of urine in a sterile container. This method of collecting urine helps prevent bacteria around the genital area from getting into the sample and confusing the test results. Usually, the sample is sent to a laboratory, although some health care providers' offices are equipped to do the testing. For people with recurring infections and patients in the hospital, the urine may be cultured. The culture is performed by placing part of the urine sample in a tube or dish with a substance that encourages any bacteria present to grow. Once the bacteria have multiplied, which usually takes 1 to 3 days, they can be identified. The health care provider may also order a sensitivity test, which tests the bacteria for sensitivity to different antibiotics to see which medication is best for treating the infection.

If a person has recurrent UTIs, the health care provider may order some additional tests to determine if the person's urinary tract is normal.

Kidney and bladder ultrasound. Ultrasound uses a device, called a transducer, that bounces safe, painless sound waves off organs to create an image of their structure. The procedure is performed in a health care provider's office, outpatient center, or hospital by a specially trained technician, and the images are interpreted by a radiologist—a doctor who specializes in medical imaging; anesthesia is not needed. The images can show abnormalities in the kidneys and bladder. However, this test cannot reveal all important urinary abnormalities or measure how well the kidneys work.

Voiding cystourethrogram. This test is an x-ray image of the bladder and urethra taken while the bladder is full and during urination, also called voiding. As the person lies on the x-ray table, a health care provider inserts the tip of a thin, flexible tube called a catheter through the urethra into the bladder. The bladder and urethra are filled with a special dye called contrast medium, to make the structures clearly visible on the x-ray images. The x rays are taken from various angles while the bladder is full of contrast medium. The catheter is then removed and x-ray images are taken during urination. The procedure is performed in a health care provider's office, outpatient center, or hospital by an x-ray technician. The technician is supervised by a radiologist while the images are taken. The radiologist then interprets the images. Anesthesia is not needed, but light sedation may be used for some people. This test can show abnormalities of the inside of the urethra and bladder. The test can also determine whether the flow of urine is normal when the bladder empties.

Computerized tomography (CT) scan. CT scans use a combination of x rays and computer technology to create three-dimensional (3-D) images. A CT scan may include the injection of contrast medium. CT scans require the person to lie on a table that slides into a tunnel-shaped device where the x rays are taken. The procedure is performed in an outpatient center or hospital by an x-ray technician, and the images are interpreted by a radiologist; anesthesia is not needed. CT scans can provide clearer, more detailed images to help the health care provider understand the problem.

Magnetic resonance imaging (MRI). MRI machines use radio waves and magnets to produce detailed pictures of the body's internal organs and soft tissues without using x rays. An MRI may include an injection of contrast medium. With most MRI machines, the person lies on a table that slides into a tunnel-shaped device that may be open ended or closed at one end; some newer machines are designed to allow the person to lie in a more open space. The procedure is performed in an outpatient center or hospital by a specially trained technician, and the images are interpreted by a radiologist; anesthesia is not needed though light sedation may be used for people with a fear of confined spaces. Like CT scans, MRIs can provide clearer, more detailed images.

Radionuclide scan. A radionuclide scan is an imaging technique that relies on the detection of small amounts of radiation after injection of radioactive chemicals. Because the dose of the radioactive chemicals is small, the risk of causing damage to cells is low. Special cameras and computers are used to create images of the radioactive chemicals as they pass through the kidneys. Radionuclide scans are performed in a health care provider's office, outpatient center, or hospital by a specially trained technician, and the images are interpreted by a radiologist; anesthesia is not needed. Radioactive chemicals injected into the blood can provide information about kidney function. Radioactive chemicals can also be put into the fluids used to fill the bladder and urethra for x ray, MRI, and CT imaging.

Urodynamics. Urodynamic testing is any procedure that looks at how well the bladder, sphincters, and urethra are storing and releasing urine. Most of these tests are performed in the office of a urologist—a doctor who specializes in urinary problems—by a urologist, physician assistant, or nurse practitioner. Some procedures may require light sedation to keep a person calm. Most urodynamic tests focus on the bladder's ability to hold urine and empty steadily and completely. Urodynamic tests can also show whether the bladder is having abnormal contractions that cause leakage. A health care provider may order these tests if there is evidence that the person has some kind of nerve damage.

Cystoscopy. Cystoscopy is a procedure that uses a tubelike instrument to look inside the urethra and bladder. Cystoscopy is performed by a doctor in a health care provider's office, outpatient facility, or hospital with local anesthesia. However, in some cases, sedation and regional or general anesthesia are needed. Cystoscopy may be used to look for swelling, redness, and other signs of infection.

How are UTIs treated?

Most UTIs are caused by bacteria, which are treated with bacteria-fighting medications called antibiotics or antimicrobials. The choice of medication and length of treatment depend on the patient's history and the type of bacteria causing the infection. Some antibiotics may be ruled out if a person has allergies to them. The sensitivity test takes 48 hours to complete and is especially useful in helping the health care provider select the antibiotic most likely to be effective in treating an infection. Longer treatment may be needed if the first antibiotic given is not effective.

When a UTI occurs in a healthy person with a normal, unobstructed urinary tract, the term uncomplicated is used to describe the infection. Most young women who have UTIs have uncomplicated UTIs, which can be cured with 2 or 3 days of treatment. Single-dose treatment is less effective. Longer treatment causes more side effects and is not more effective. A follow-up urinalysis helps to confirm the urinary tract is infection-free. Taking the full course of treatment is important because symptoms may disappear before the infection is fully cleared.

Complicated UTIs occur when a person—for example, a pregnant woman or a transplant patient—is weakened by another condition. A UTI is also complicated when the person has a structural or functional abnormality of the urinary tract, such as an obstructive kidney stone or prostate enlargement that squeezes the urethra. Health care providers should assume that men and boys have a complicated UTI until proven otherwise.

Severely ill patients with kidney infections may be hospitalized until they can take fluids and needed medications on their own. Kidney infections may require several weeks of antibiotic treatment. Kidney infections in adults rarely lead to kidney damage or kidney failure unless they go untreated or are associated with urinary tract obstruction.

Bladder infections are generally self-limiting, but antibiotic treatment significantly shortens the duration of symptoms. People usually feel better within a day or two of treatment. Symptoms of kidney and prostate infections last longer. Drinking lots of fluids and urinating frequently will speed healing. If needed, various medications are available to relieve the pain of a UTI. A heating pad on the back or abdomen may also help.

Recurrent Infections in Women

Health care providers may advise women who have recurrent UTIs to try one of the following treatment options:

- Take low doses of the prescribed antibiotic daily for 6 months or longer. If taken at bedtime, the medication remains in the bladder longer and may be more effective. NIH-supported research has shown this therapy to be effective without causing serious side effects.
- Take a single dose of an antibiotic after sexual intercourse.
- Take a short course—2 or 3 days—of an antibiotic when symptoms appear.

To try to prevent an infection, health care providers may suggest women

- drink plenty of water every day
- urinate when the need arises and avoid resisting the urge to urinate
- urinate after sexual intercourse
- switch to a different method of birth control if recurring UTIs are a problem

Infections during Pregnancy

During pregnancy, bacterial infection of the urine—even in the absence of symptoms—can pose risks to both the mother and the baby. Some antibiotics are not safe to take during pregnancy. In selecting the best treatments, health care providers consider various factors such as the medication's effectiveness, the stage of pregnancy, the mother's health, and potential effects on the fetus.

Complicated Infections

Curing infections that stem from a urinary obstruction or other systemic disorder depends on finding and correcting the underlying problem, sometimes with surgery. If the root cause goes untreated, this group of patients is at risk for kidney damage. Also, such infections tend to arise from a wider range of bacteria and sometimes from more than one type of bacteria at a time.

Infections in Men

Urinary tract infections in men are often the result of an obstruction—for example, a urinary stone or enlarged prostate—or are from a catheter used during a medical procedure. The first step in treating such an infection is to identify the infecting organism and the medications to which it is sensitive.

Prostate infections—chronic bacterial prostatitis—are harder to cure because antibiotics may be unable to penetrate infected prostate tissue effectively. For this reason, men with bacterial prostatitis often need long-term treatment with a carefully selected antibiotic. UTIs in men are frequently associated with acute bacterial prostatitis, which can be life threatening if not treated urgently.

How can recurrent UTIs be prevented?

Changing some daily habits may help a person prevent recurrent UTIs.

Eating, Diet, and Nutrition

Drinking lots of fluid can help flush bacteria from the system. Water is best. Most people should try for six to eight, 8-ounce glasses a day. A person who has kidney failure should not drink this much fluid. A health care provider should be consulted to learn how much fluid is healthy.

Urination Habits

A person should urinate often and when the urge arises. Bacteria can grow when urine stays in the bladder too long. Women and men should urinate shortly after sex to flush away bacteria that might have entered the urethra during sex. Drinking a glass of water will also help flush bacteria away.

After using the toilet, women should wipe from front to back. This step is most important after a bowel movement to keep bacteria from getting into the urethra.

Clothing

Cotton underwear and loose-fitting clothes should be worn, so air can keep the area around the urethra dry. Tight-fitting jeans and nylon underwear should be avoided because they can trap moisture and help bacteria grow.

Birth Control

For women, using a diaphragm or spermicide for birth control can lead to UTIs by increasing bacteria growth. A woman who has trouble with UTIs should try switching to a new form of birth control. Unlubricated condoms or spermicidal condoms increase irritation, which may help bacteria grow. Switching to lubricated condoms without spermicide or using a nonspermicidal lubricant may help prevent UTIs.

Points to Remember

- Most urinary tract infections (UTIs) arise from one type of bacteria, *Escherichia coli (E. coli)*, which normally lives in the bowel.
- Symptoms of a UTI in adults may include the following:
  - a frequent and intense urge to urinate
  - a painful, burning feeling in the bladder or urethra during urination
  - feeling tired, shaky, and weak
  - muscle aches
  - abdominal pain
  - only small amounts of urine passed, despite a strong urge to urinate
  - cloudy, dark, or bloody urine or urine that has a foul smell
  - pain in the back or side below the ribs
  - nausea and vomiting
- Fever may indicate a kidney or prostate infection.
- Because bacteria can be found in the urine of healthy individuals, a UTI is diagnosed based both on symptoms and a laboratory test.
- UTIs are treated with bacteria-fighting medications called antibiotics or antimicrobials.

Hope through Research

Scientists are working on developing a vaccine that can prevent UTIs from coming back. Researchers are testing injected and oral vaccines to see which works best. Another method being considered for women is to apply the vaccine directly as a suppository in the vagina. Other scientists are working on identifying ways to prevent UTIs using probiotics.

Participants in clinical trials can play a more active role in their own health care, gain access to new research treatments before they are widely available, and help others by contributing to medical research. For information about current studies, visit *www.ClinicalTrials.gov.*

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