

Urinary Tract Infections in Children

National Kidney and Urologic Diseases Information Clearinghouse



U.S. Department
of Health and
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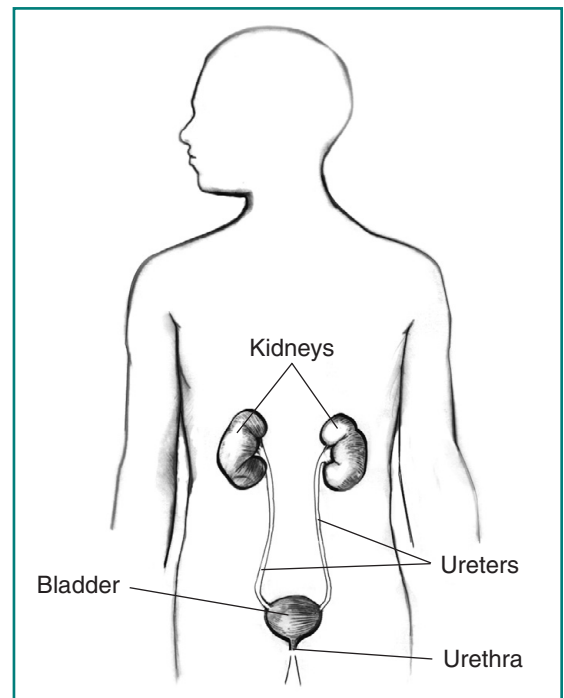
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What is a urinary tract infection (UTI)?

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?

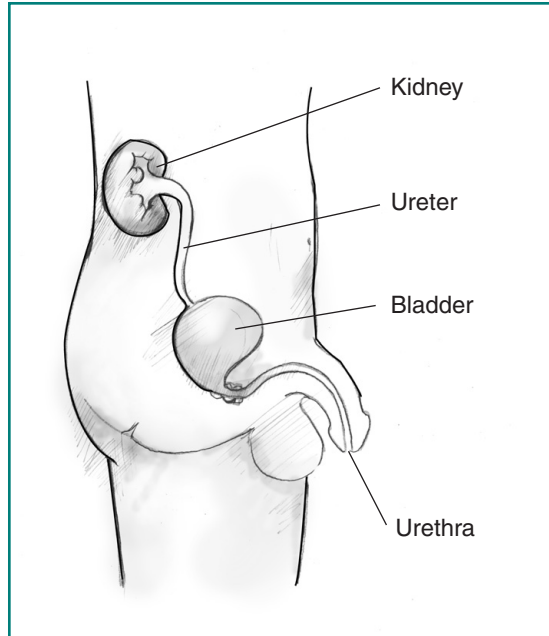
The urinary tract is the body's drainage system for removing wastes and extra water. The urinary tract includes two kidneys, two ureters, a bladder, and a urethra. The kidneys are a pair of bean-shaped organs, each about the size of a fist and located below the ribs, one on each side of the spine, toward 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 an adult produces each day. Children produce less urine each day; the amount produced depends on their age. The urine travels from the kidneys down two narrow tubes called the ureters. The urine is then stored in a balloonlike organ called the



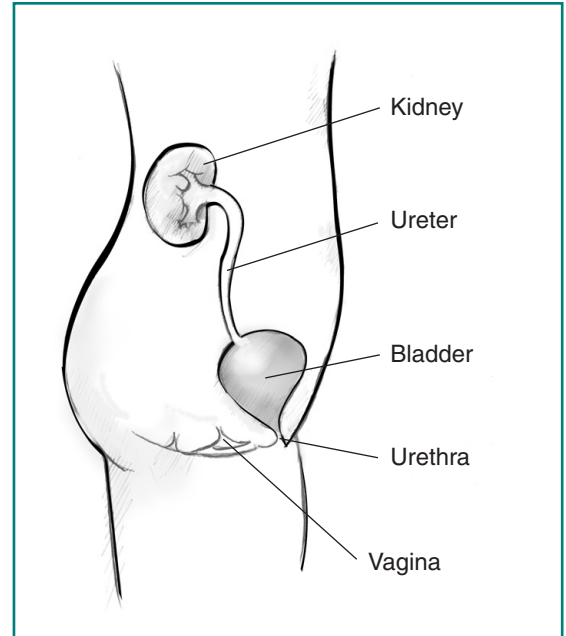
Front view of the urinary tract

bladder. Routinely, urine drains in only one direction—from the kidneys to the bladder. The bladder fills with urine until it is full enough to signal the need to urinate. In children, the bladder can hold about 2 ounces of urine plus 1 ounce for each year of age. For example, an 8-year-old's bladder can hold about 10 ounces of urine.

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



Side view of the male urinary tract



Side view of the female urinary tract

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. 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, or refluxing, toward the kidneys, and urination washes microbes out of the body. 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.

Children who often delay urination are more likely to develop UTIs. Regular urination helps keep the urinary tract sterile by flushing away bacteria. Holding in urine allows bacteria to grow. Producing too little urine because of inadequate fluid intake can also increase the risk of developing a UTI. Chronic constipation—a condition in which a child has fewer than two bowel movements

a week—can add to the risk of developing a UTI. When the bowel is full of hard stool, it presses against the bladder and bladder neck, blocking the flow of urine and allowing bacteria to grow.

Some children develop UTIs because they are prone to such infections, just as other children are prone to getting coughs, colds, or ear infections.

How common are UTIs in children?

Urinary tract infections affect about 3 percent of children in the United States every year. UTIs account for more than 1 million visits to pediatricians' offices every year.¹

¹Freedman, AL. Urinary tract infections in children. In: Litwin MS, Saigal CS, eds. *Urologic Diseases in America*. U.S. 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.: U.S. Government Printing Office; 2007. NIH publication 07-5512:439-458.

Who is at risk for a UTI?

Throughout childhood, the risk of having a UTI is 2 percent for boys and 8 percent for girls. Having an anomaly of the urinary tract, such as urine reflux from the bladder back into the ureters, increases the risk of a UTI. Boys who are younger than 6 months old who are not circumcised are at greater risk for a UTI than circumcised boys the same age.¹

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 growth, 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.

In some children, a UTI may be a sign of an abnormality in the urinary tract that leads to repeated problems. Young children are at the greatest risk for kidney damage from UTIs and defects in the urinary tract. Children with UTIs should receive careful evaluation with prompt treatment. The evaluation may include an examination of the urinary tract using imaging equipment. Because UTIs are less common in boys after the first 4 weeks of life, boys with a UTI should be assumed to have an abnormality of the urinary tract until proven otherwise.

What are the signs and symptoms of a UTI?

Symptoms of a UTI range from slight burning with urination or unusual-smelling urine to severe pain and high fever. A child with a UTI may also have no symptoms. A UTI

causes irritation of the lining of the bladder, urethra, ureters, and kidneys, just as the inside of the nose or the throat becomes irritated with a cold. In infants or children who are only a few years old, the signs of a UTI may not be clear because children that young cannot express exactly how they feel. Children may have a high fever, be irritable, or not eat.

On the other hand, children may have only a low-grade fever; experience nausea, vomiting, and diarrhea; or just not seem healthy. Children who have a high fever and appear sick for more than a day without signs of a runny nose or other obvious cause for discomfort should be checked for a UTI.

Older children with UTIs may complain of pain in the middle and lower abdomen. They may urinate often. Crying or complaining that it hurts to urinate and producing only a few drops of urine at a time are other signs of a UTI. Children may leak urine into clothing or bedsheets. The urine may look cloudy or bloody. If a kidney is infected, children may complain of pain in the back or side below the ribs.

Parents should talk with their health care provider if they suspect their child has a UTI.

How are UTIs diagnosed?

Only a health care provider can determine whether a child has a UTI.

A urine sample will be collected and examined. The way urine is collected depends on the child's age:

- If the child is not yet toilet trained, the health care provider may place a plastic collection bag over the child's genital area. The bag will be sealed to the skin with an adhesive strip. If this method is used, the bag should be removed right after the child has urinated, and the urine sample should be processed

immediately. Because bacteria from the skin can contaminate this sample, the methods listed below are more accurate.

- A health care provider may need to pass a small tube called a catheter into the urethra of an infant. Urine will drain directly from the bladder into a clean container.
- Sometimes the best way to collect a urine sample from an infant is by placing a needle directly into the bladder through the skin of the lower abdomen. Getting urine through a catheter or needle will ensure that the urine collected does not contain bacteria from the skin.
- An older child may be asked to urinate into a container. The sample needs to come as directly into the container as possible to avoid picking up bacteria from the skin or rectal area.

Some of the urine will be examined with a microscope. If an infection is present, bacteria and sometimes pus will be found in the urine. A urine culture should also be performed on some of the urine. 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 reliability of the culture depends on how the urine is collected and how long the urine stands before the culture is started. If the urine sample is collected at home, it should be refrigerated as soon as it is collected. The container should be carried to the health care provider or lab in a plastic bag filled with ice.

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.

How are UTIs treated?

Most UTIs are caused by bacteria, which are treated with bacteria-fighting medications called antibiotics or antimicrobials. While a urine sample is sent to a laboratory, the health care provider may begin treatment with an antibiotic that treats the bacteria most likely to be causing the infection. Once culture results are known, the health care provider may decide to switch the child's antibiotic.

The choice of medication and length of treatment depend on the child's history and the type of bacteria causing the infection. When a child is sick or unable to drink fluids, the antibiotic may need to be put directly into the bloodstream through a vein in the arm or hand or be given as an injection. Otherwise, the medication—liquid or pills—may be given by mouth. The medication is given for at least 3 to 5 days and possibly for as long as several weeks. The daily treatment schedule recommended depends on the specific medication prescribed: The schedule may call for a single dose each day or up to four doses each day. In some cases, a child will need to take the medication until further tests are finished.

After a few doses of the antibiotic, a child may appear much better, but often several days may pass before all symptoms are gone. In any case, the medication should be taken for as long as the health care provider recommends. Medications should not be stopped because the symptoms have gone away. Infections may return, and bacteria can resist future treatment if the medication is stopped too soon.

If needed, the health care provider may recommend an appropriate over-the-counter medication to relieve the pain of a UTI. A heating pad on the back or abdomen may also help.

What tests may be needed after the UTI is gone?

Once the infection has cleared, more tests may be recommended to check for abnormalities in the urinary tract. Repeated infections in an abnormal urinary tract may cause kidney damage. The kinds of tests ordered will depend on the child and the type of urinary infection. Because no single test can tell everything about the urinary tract that might be important, more than one of the tests listed below may be needed.

- **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 certain 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. The child's 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-ray machine captures images of the contrast medium while the bladder is full and when the child urinates. The procedure is performed in a health care provider's office, outpatient center, or hospital by an x-ray technician supervised by a radiologist, who then interprets the images. Anesthesia is not needed, but sedation may be used for some children. 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 child 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 the injection of contrast medium. With most MRI machines, the child 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 child 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 children 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. Radionuclide scans expose a child to about the same amount or less of radiation as a conventional x ray.

- **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 the child 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 child has some kind of nerve damage or dysfunctional voiding—unhealthy urination habits such as holding in urine when the bladder is full.

What abnormalities lead to chronic urinary problems?

Many children who get a UTI have normal kidneys and bladders. But if a child has an abnormality, it should be detected as early as possible to protect the kidneys against

damage. Abnormalities that could occur include the following:

- **Vesicoureteral reflux (VUR).** Vesicoureteral reflux is the abnormal flow of urine from the bladder to the upper urinary tract. In VUR, urine may reflux into one or both ureters and, in some cases, to one or both kidneys. VUR that affects only one ureter and kidney is called unilateral reflux, and VUR that affects both ureters and kidneys is called bilateral reflux.
- **Urinary obstruction.** Blockages to urinary flow can occur in many places in the urinary tract. The ureter or urethra may be too narrow or a kidney stone at some point stops the urine from leaving the body. Occasionally, the ureter may join the kidney or bladder at the wrong place and prevent urine from leaving the kidney in the normal way.
- **Dysfunctional voiding.** Some children develop a habit of delaying a trip to the bathroom and holding their urine because they don't want to leave their play. They may work so hard at keeping the sphincter muscles tight that they are unable to relax them at the right time. These children may be unable to empty the bladder completely. Some children may strain during urination. Persistent straining may cause increased pressure in the bladder that forces urine to reflux into the ureters. Dysfunctional voiding can lead to VUR, accidental urinary leakage, and UTIs.

How are abnormalities in the urinary tract treated?

Some abnormalities in the urinary tract correct themselves as the child grows, but some may require surgical correction. While milder forms of VUR may resolve on their own, one common procedure to correct

VUR is the reimplantation of the ureters. During this procedure, the surgeon repositions the connection between the ureters and the bladder so that urine will not reflux into the ureters and kidneys. This procedure may be performed through an incision that gives the surgeon a direct view of the bladder and ureters or laparoscopically. Laparoscopy is a procedure that uses a scope inserted through a small incision.

In recent years, health care providers have treated some cases of VUR by injecting substances into the bladder wall, just below the opening where the ureter joins the bladder. This injection creates a kind of narrowing or valve that keeps urine from refluxing into the ureters. The injection is delivered to the inside of the bladder through a catheter passed through the urethra, so there is no surgical incision. Evidence of clinically significant obstruction may indicate the need for surgery.

How can UTIs be prevented?

If a child has a normal urinary tract, parents can help the child avoid UTIs by encouraging regular trips to the bathroom. The parents should make sure the child gets enough to drink if infrequent urination is a problem. The child should be taught proper cleaning techniques after using the bathroom to keep bacteria from entering the urinary tract. Loose-fitting clothes and cotton underwear allow air to dry the area. Parents should consult a health care provider about the best ways to treat constipation.

Eating, Diet, and Nutrition

Children with a UTI should drink as much as they wish and not be forced to drink large amounts of fluid. The health care provider needs to know if a child is not interested in drinking or is unable to drink.

Points to Remember

- Urinary tract infections (UTIs) usually occur when the body fails to remove bacteria rapidly from the urinary tract.
- UTIs affect about 3 percent of children in the United States every year.
- Most UTIs are not serious, but chronic kidney infections can cause permanent damage.
- A UTI in a young child may be a sign of an abnormality in the urinary tract that could lead to repeated problems.
- Symptoms of a UTI range from slight burning with urination or unusual-smelling urine to severe pain and high fever. A child with a UTI may also have no symptoms.
- Parents should talk with their health care provider if they suspect their child has a UTI.

Hope through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) sponsors several programs aimed at understanding urologic diseases in adults and children. The NIDDK's Division of Kidney, Urologic, and Hematologic Diseases supports efforts to develop more effective treatments for UTIs in children caused by VUR. The Randomized Intervention for Vesicoureteral Reflux (RIVUR) is a multicenter trial designed to determine whether taking antibiotics every day is an effective way to prevent recurrence of UTIs in children with VUR. More information about the RIVUR study, funded under

National Institutes of Health clinical trial number NCT00405704, can be found at www.csc.unc.edu/rivur.

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.

For More Information

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You may also find additional information about this topic by visiting MedlinePlus at www.medlineplus.gov.

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