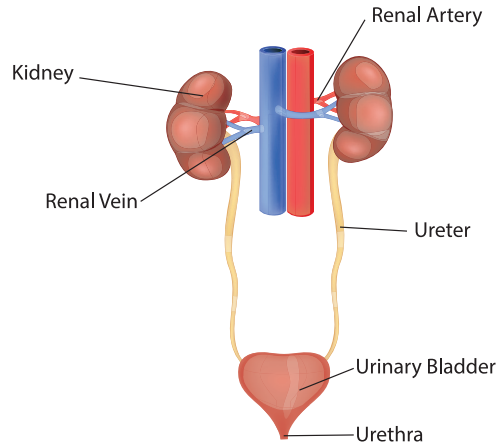
Myth Busted: *E. coli* in the Urinary Tract

Aarya had been uncomfortable all day. She felt like she had to go to the bathroom almost constantly. During fourth period, her teacher was having trouble believing she really needed a bathroom break for a third time during class. When she did get to the bathroom, she had a painful, burning sensation when she urinated. She decided to go see the school nurse. The nurse told her she probably had a UTI, or urinary tract infection, and sent her home with a recommendation that she see a doctor as soon as she could, today if possible.

Not as sterile as you think

"There are no bacteria in the bladder of a healthy woman!" For more than 60 years, medical students were taught that urine in a healthy woman with no infection was sterile (meaning there are no bacteria present) and if bacteria were found, it was a sign of infection. Recent studies have changed all of that.



A diagram of the urinary system.

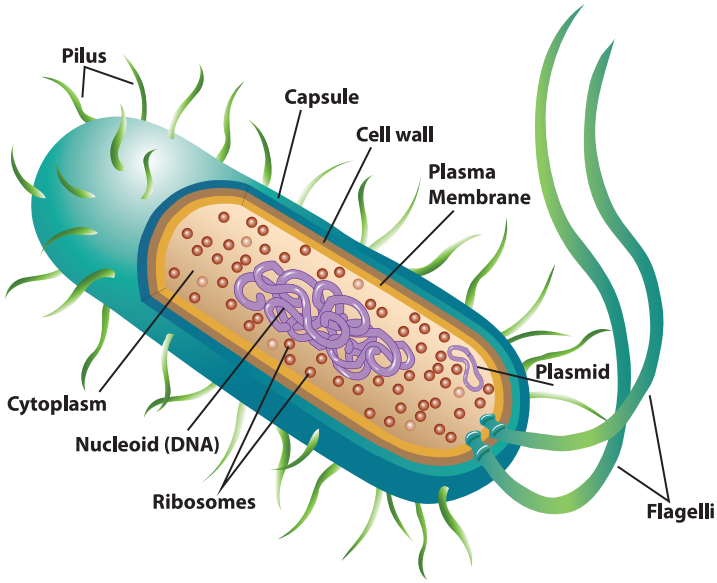
Researchers found that the bladder does contain bacteria and other microbiota (community of microorganisms), and the community is diverse! After sampling urine from 77 different healthy women with no symptoms, scientists were able to identify and classify 149 different bacterial strains that were found in the bladders of multiple women. Among those strains were bacteria that commonly cause urinary tract infections, such as *Escherichia coli* (known as *E. coli*), as well as many types of beneficial bacteria such as *Lactobacillus iners (L. iners)*. In addition, researchers found similarities in the microbiota of the bladder and vagina, but differences between the microbiota of the bladder and gastrointestinal tract. The bladder and the vagina had many kinds of bacteria in common. The bladder and the gastrointestinal tract have very few bacteria in common, but *E. coli* does sometimes occur in the bladder. If *E. coli* is already present normally in the bladder of many women, why does it cause urinary tract infections?

A closer look at *E. coli*

Escherichia coli is one of the most recognized bacterial species in the world, and it is found almost everywhere: raw meat, produce, water, soil, and growing normally in our intestines. Hundreds of different strains of *E. coli* have been identified. Most strains of *E. coli* coexist with their hosts (us and other mammals) in harmony. For example, several strains of *E. coli* aid in digestion and defend their hosts against other harmful microbes.

There are also strains that are harmful or pathogenic and cause infections like urinary tract infections, meningitis, and intestinal infections. The strains that cause urinary tract infections are called uropathogenic *E. coli* (UPEC) and are highly specialized. In healthy people, UPEC are uncommon in the bladder but common in the human intestinal tract. UPEC find their way into the urinary tract when it becomes contaminated with fecal matter. This may happen when a person does not clean thoroughly enough after a bowel movement, or if the urethra comes in contact with fecal material in some other way.

So what happens when the unfamiliar strains get into the bladder?



A diagram of a bacterium showing pili, the fiber-like structures they can use to stick to surfaces in the body.

When UPEC get into the urinary tract, they often change the kind of nutrients they consume so that they can live and grow on the kinds of proteins and minerals found in the bladder and urine. Many UPEC have a wide range of structures, including thin fibers, called pili (singular: pilus), that help them to adhere to surfaces. The bacteria's ability to adhere to surfaces means that they can move along a surface and use that surface, and the food it may provide, to grow and reproduce. Some UPEC can also sense urine, and they use the rush of urine flow as a signal to cling to the bladder walls tightly. These bacteria clinging to the walls of the bladder and the urethra sometimes irritate these tissues. The bacteria can also produce toxins. This can cause a burning sensation or bladder spasms that make it feel like you have to urinate urgently.

Because they are uncommon in the bladder, once UPEC get into the bladder the body tries to destroy the UPEC by engulfing them. While most of the foreign bacteria in the bladder are killed during this process, others, including some UPEC, invade the bladder cells and start to form little bacterial clusters inside the human cells. The bacteria then start to produce a sticky mess of proteins and sugar that surrounds the highly organized bacterial cluster, protecting the bacterial cells from being killed by the human cells.

Sound bad? It gets worse. The highly organized bacterial cluster, or biofilm, starts to take over its environment (the human bladder cell it is growing in). The bacteria begin consuming cell structures and growing and reproducing until the colony within the bladder cell gets so large it starts to bulge into the bladder space. Once the bacterial colony gets big enough, it bursts out of the cell it is growing in. The bacteria then latch on to cells nearby and start infecting those cells as well.

So how do we get rid of these little creatures?

One way to combat urinary tract infections is through steps to prevent them in the first place. Drinking plenty of water will make you need to use the bathroom more frequently, and urinating can help flush out some of the bacteria before they have a chance to attach to the bladder walls. Go to the bathroom when you have to! Holding urine for long periods can allow time for bacteria to attach to the bladder walls and grow and reproduce. Also, be mindful of bathroom habits. The main source of pathogenic *E. coli* bacteria is the rectum, so avoid contact between the urinary tract and the rectum. This is particularly important if you have diarrhea. Having diarrhea can make bowel movements unpredictable, which can increase the chances of pathogenic *E. coli* spreading to the urethra. If you do experience symptoms of a urinary tract infection, see your doctor right away and explain your symptoms clearly so you get the treatment you need.

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