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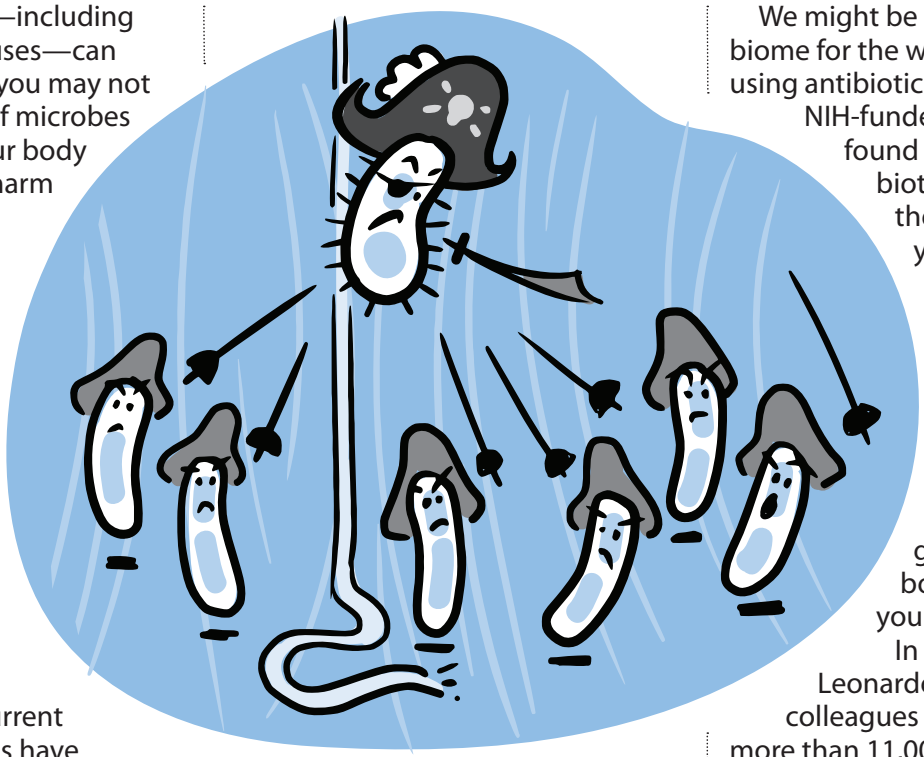
Your Microbes and You

The Good, Bad and Ugly

Microscopic creatures—including bacteria, fungi and viruses—can make you ill. But what you may not realize is that trillions of microbes are living in and on your body right now. Most don't harm you at all. In fact, they help you digest food, protect against infection and even maintain your reproductive health. We tend to focus on destroying bad microbes. But taking care of good ones may be even more important.



You might be surprised to learn that your microbes actually outnumber your own cells by 10 to 1. "The current estimate is that humans have 10 trillion human cells and about 100 trillion bacterial cells," says Dr. Martin J. Blaser at the New York University School of Medicine.

New techniques allow scientists to study these rich microbial communities and their genes—the "microbiome." In 2007, NIH launched the Human Microbiome Project to study microbes in and on the body.

Earlier this year, researchers from almost 80 institutions published a landmark series of reports. They found that more than 10,000 different species occupy the human body. The microbiome actually provides more genes that contribute to human survival than the human genome itself (8 million vs. 22,000). Humans need bacteria and their genes more than most of us thought.

One of the most important things microbes do for us is to help with digestion. The mix of microbes in your gut can affect how well you use and store energy from food. In laboratory experiments, transferring bacteria from certain obese mice to normal ones led to increased fat in the normal mice.

Blaser and his colleagues are concerned that changes in our microbiome early in life may contribute to weight problems later. "We're in the middle of an epidemic of obesity that is very severe," Blaser says. "It's relatively recent, it's widespread across the United States and across the world, and increased calories and decreased exercise seem insufficient to explain this."

We might be changing our microbiome for the worse, he says, by using antibiotics too often. In a recent NIH-funded study, Blaser's team found that low-dose antibiotic therapy affected the gut microbiomes of young mice. Antibiotics also altered how the mice used sugars and fats. After 7 weeks, treated mice had up to 15% more fat than untreated mice. This and other studies suggest that gut bacteria can affect both appetite and how you use energy in food.

In related work, Dr. Leonardo Trasande, Blaser and colleagues analyzed data from more than 11,000 children. Although the results weren't conclusive, they suggest that infants given antibiotics might be at increased risk of becoming overweight. More work will be needed to confirm this connection.

"Microbes in our intestines may play critical roles in how we absorb calories," Trasande says. "Exposure to antibiotics, especially early in life, may kill off healthy bacteria that influence how we absorb nutrients into our bodies, and would otherwise keep us lean."

continued on page 2

continued from page 1

Microbes are also important for your skin, one of the body's first lines of defense against illness and injury. Skin health depends on the delicate balance between your own cells and the microbes that live on its surface.

"Basically, the healthy bacteria are filling all those little niches so that the more dangerous bacteria can't get a foothold onto the skin," says Dr. Julie Segre of NIH.

Segre and other NIH researchers looked at skin microbes collected from different body regions on healthy volunteers. They found that body location has a huge effect on which types of bacteria live. For example, bacteria living under your arms likely are more similar to those under another person's arm than to the bacteria on your own forearm.

Microbes are also important to the body's infection-fighting immune system. In one recent study, NIH scientists examined special mice that were born and raised to be germ-free. These mice seemed to have weak immune function. In contrast, normal mice have vibrant bacterial communities and a rich variety of immune cells and molecules on their skin.

The germ-free mice were exposed to *Staphylococcus epidermidis*, one of the most common bacteria on human skin. Adding this one species of bacteria boosted immune function in the mouse skin. The mice with *S. epidermidis* were able to defend against a parasite, whereas the bacteria-free mice weren't.

"We often have a sense that the bacteria that live on our skin are harmful," Segre says. "But in this study we show that these bacteria can play an important role in promoting health by preventing skin infections from becoming more prolonged, pronounced and more serious."

There's strong evidence that the microbes in the female reproductive tract affect reproductive health and help protect against disease. A recent study also found a diverse community of microbes in the male urinary tract and on the penis. NIH-funded researchers are investigating other positive roles for microbes. One major area of research concerns allergy-related conditions, including childhood asthma, skin allergies, hay fever and eczema.

So what can you do to protect against microbes that cause infection but take care of the ones that help you? We know that washing our hands is important for removing harmful microbes—for example, before eating or after using the bathroom.

Other less obvious things can affect your skin microbes, Segre says. The lotions and creams you use can provide a barrier to protect your skin's moisture, Segre points out, "but in fact you're also putting a fertilizer onto the microbial garden. You're really changing the food source for the bacteria that live on your skin." There's not one right answer about which skin products are best for you, she says. Experiment to see how different ones affect your skin.

Many researchers worry that some people are trying to get too clean. Blaser thinks that people are using sanitizers and antibiotic products too often these days. "Obviously, there are many bad germs, but I think we've gone overboard and it looks like trying to get rid of the bad guys has had a collateral effect on the good guys."

You're never alone when it comes to your microbes. But don't get squeamish about it. Just remember how much you need them. ■

Wise Choices
Protect Your Microbes

- Don't be scared of microbes. Most actually help you.
- Don't pressure your doctor to give you antibiotics. They may cause more harm than good.
- Know when to wash your hands—for example, when preparing food and before eating. To learn more, visit www.cdc.gov/handwashing.
- Don't use antibacterial products you don't need. Antibacterial soaps have little or no health benefit. And antibacterial versions of household products (like phones and staplers) have not been shown to reduce your risk of infection.
- Don't go overboard with hand sanitizers. They're useful in health care settings, but hand washing is a better option in most situations.
- Experiment with different skin moisturizers to see which work best for you.
- There's no conclusive evidence that so-called "probiotic" products have health benefits.

Web Links

For more about microbes living in and on your body, click the "Links" tab at:
http://newsinhealth.nih.gov/issue/Nov2012/Feature1

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National Institutes of Health
Office of Communications
& Public Liaison
Building 31, Room 5B64
Bethesda, MD 20892-2094
nihnewsinhealth@od.nih.gov
Tel: 301-435-7489 Fax: 301-496-0019

Managing Editor Harrison Wein, Ph.D.
Editor Vicki Contie

Contributors Vicki Contie, Alan Defibaugh (illustrations), Helen Fields, Meghan Mott and Harrison Wein

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Gut Feelings About Gastritis

When Your Stomach's Sick

Your stomach lining has an important job. It makes acid and enzymes that help break down food so you can extract the nutrients you need. The lining also protects itself from acid damage by secreting mucus. But sometimes the lining gets inflamed and starts making less acid, enzymes and mucus. This type of **inflammation** is called gastritis, and it can cause long-term problems.

Some people think they have gastritis when they have pain or an uncomfortable feeling in their upper stomach. But many other conditions can cause these symptoms. Gastritis can sometimes lead to pain, nausea and vomiting. But it often has no symptoms at all. If left untreated, though, some types of gastritis can lead to ulcers (sores in the stomach lining) or even stomach cancer.

People used to think gastritis and ulcers were caused by stress and spicy foods. But research studies show that bacteria called *Helicobacter pylori* are often to blame. Usually, these bacteria cause no symptoms. In the United States, 20% to 50% of the population may be infected with *H. pylori*.

H. pylori breaks down the inner protective coating in some people's stomachs and causes inflammation. "I tell people *H. pylori* is like having termites in your stomach," says Dr. David Graham, an expert in digestive diseases at Baylor College of Medicine in Texas. "You usually don't know you have termites until someone tells you, and you ignore it at your own risk." *H. pylori* can spread by passing from person to person or through contaminated food or water. Infections can be treated with bacteria-killing drugs called antibiotics.

One type of gastritis, called erosive gastritis, wears away the stomach lining. The most common cause of erosive gastritis is long-term use of medications called non-steroidal anti-inflammatory drugs. These include aspirin and ibuprofen. "When you stop taking the drugs, the condition usually goes away," says Graham. Doctors might also recommend reducing the dose or switching to another class of pain medication.

Less common causes of gastritis include certain digestive disorders (such as Crohn's disease) and autoimmune disorders, in which the body's protective immune cells mistakenly attack healthy cells in the stomach lining.

Gastritis can be diagnosed with an endoscope, a thin tube with a tiny camera on the end, which is inserted through the patient's mouth or nose and into the stomach. The doctor will look at the stomach lining and may also remove some tissue samples for testing. Treatment will depend on the type of gastritis you have.

Although stress and spicy foods don't cause gastritis and ulcers, they can make symptoms worse. Milk might provide brief relief, but it also increases stomach acid, which can worsen symptoms. Your doctor may recommend taking antacids or other drugs to reduce acid in the stomach.

Talk with a health care provider if you're concerned about ongoing pain or discomfort in your stomach. These symptoms can have many causes. Your doctor can help determine the best course of action for you. ■

Wise Choices
Watch for Ulcers

Gastritis can lead to ulcers over time. Symptoms of ulcers include pain between the belly button and breastbone that:

- starts between meals or during the night
- briefly stops if you eat or take antacids
- lasts for minutes to hours
- comes and goes for several days or weeks

Contact your doctor right away if you have:

- sudden sharp stomach pain that doesn't go away
- black or bloody stools
- vomit that is bloody or looks like coffee grounds

Definitions

Inflammation
Swelling and redness caused by the body's protective response to injury or infection.

Web Links

For more information about gastritis, click the "Links" tab at:
http://newsinhealth.nih.gov/issue/Nov2012/Feature2

Health Capsules

For links to more information, see these stories online:
http://newsinhealth.nih.gov/issue/Nov2012/Capsule1

Brain Cleaning System Discovered

Scientists have discovered a system that drains waste products from the brain. The finding may lead to new ways to treat brain disorders such as Alzheimer's disease.

Our bodies remove dead blood cells and other waste products through a network of vessels called the lymphatic system. The brain, however, uses a different method. Cerebrospinal fluid cleanses brain tissue. Based on previous research, scientists suspected that nutrients and waste were carried away through a slow process called diffusion.

In a new study, scientists used a method called 2-photon laser scanning microscopy to analyze the movement of cerebrospinal fluid in living mouse brains. To their surprise, the researchers found that the fluid flowed along a series of channels surrounding blood vessels. They named this new system the "glymphatic system" because it is similar to the body's lymphatic system but managed by cells in the brain called glial cells.

The scientists speculated that glitches in the glymphatic system might lead to the buildup of harmful waste in the brain. To test this idea, they injected a protein called amyloid beta into the brains of both healthy mice and mice with a faulty glymphatic system. The protein is known to play a role in human Alzheimer's disease. Normal mice cleared amyloid beta rapidly from brain tissue. Mice with faulty glymphatic systems had much slower protein removal.

"This work shows that the brain is cleansing itself in a more organized way and on a much larger scale than has been realized previously," says Dr. Maiken Nedergaard of the University of Rochester Medical Center. "We're hopeful that these findings have implications for many conditions that involve the brain, such as traumatic brain injury, Alzheimer's disease, stroke and Parkinson's disease." ■

Bilingual Booklet on Sports Injuries

A colorful English and Spanish booklet from NIH teaches children and teens how to avoid sports injuries. The 16-page pamphlet, called *Ana's Story*, is a fotonovela that uses a comic-book style format to tell the story of a teen soccer player named Ana.

After spraining her knee during a game, Ana and her family learn how to treat a sports injury promptly to avoid future complications.

The booklet gives tips on how to keep sports safe for kids. Playing sports can improve children's fitness, self-esteem, coordination and self-discipline. But it can also put them at risk for injuries. Activities such as warming up before exercise and staying hydrated can help protect their health.

"*Ana's Story* is a must-read publication for active kids, parents and coaches," says Dr. Stephen I. Katz, director of NIH's National Institute of Arthritis and Musculoskeletal and Skin Diseases. "It follows the success of our first fotonovela, *Isabel's Story*, which teaches about bone health."

To see *Ana's Story* online, visit http://go.usa.gov/YPAF. To order free print copies of *Ana's Story* or *Isabel's Story*, call 877-226-4267, or use the order form at http://catalog.niams.nih.gov. ■

Featured Website
Clinical Trials.gov

ClinicalTrials.gov

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