Bacteria and people: In it together

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Next time your digestive system malfunctions in some embarrassing way, you can always blame man's best friend - not the dog, but the bacterial cells that live in your intestines. Not everyone has a dog but we all have enormous communities of bacteria that help us digest food. They don't always do a perfect job, but without them we'd have a tough time surviving.

In fact, our bodies have about 10 times as many bacterial cells as human cells, said David Artis, a microbiologist at the University of Pennsylvania. "Some people have even joked that if one considers the meaning of life," he said, "it could boil down to us being vessels to carry around bacteria."

Artis has been studying our relationship to our resident microbes, the vast majority of which live in our intestines. Recently, he's focused on how they know to be so friendly and refrain from spreading around the body and making us sick.

He's found these so-called commensal bacteria aren't friendly by nature. If that enormous load of intestinal bacterial cells got out into other parts of the body, "they could kill us," he said. Luckily, our immune systems have evolved the ability to police these bugs, keeping them from spreading beyond the intestines, he said. It's a constant process of negotiation between our cells and theirs. When that symbiotic harmony breaks down, good bacteria can escape and make us sick.

All animals carry around symbiotic bacteria, said Rob Knight, an

evolutionary biologist at the University of Colorado, Boulder. Bacteria are good at living with other organisms, and the roots of that relationship probably predated the origin of the animal kingdom some 600 million years ago.

But now, we humans and our resident microbes are facing an unprecedented evolutionary situation, he said. First there was agriculture, which led to a radical change in the human diet, and then, more recently, the switch to an industrialized diet of refined foods. And in the 20th century we changed our internal ecology with antibiotics. Bacterial communities we've lived with for millennia are changing or breaking down, he said.

Several years ago, Knight was part of a study suggesting that delivering babies by caesarian section had the unintended consequence of changing their internal biota. In a small pilot study, he and researchers from the University of Puerto Rico found that vaginally delivered babies were colonized mostly by bacteria they picked up from mom on the trip out, while c-section babies were full of staph that had come from the environment.

Knight said he anticipates the ability to learn much more about our microscopic friends thanks to a $160 million effort to sequence their DNA known as the human microbiome project. By cataloging the microbial ecosystems of about 250 individuals, he said, scientists will be able to figure out what constitutes a normal mix of bacteria types and how our bacteria might signal disease.

Penn's Artis said there are a number of studies that connect microbial changes with diseases, including obesity, diabetes, asthma, and even possibly autism. In some cases where people have chronic infections such as hepatitis C, bacteria that belong in the intestines have migrated out to the spleen and liver, he said, where they may be doing harm.

There's also evidence that friendly microbes have migrated to harmful locations in people with a chronic digestive disorder known as inflammatory bowel disease. He considers these "good bugs gone bad."

By studying mice, he and collaborators have identified the immune cells that keep our good bugs from straying. Called innate lymphoid cells, they are part of the ancient immune system that we share with insects and fish.

In a series of experiments, he and collaborators disabled those cells in mice and found that, indeed, helpful intestinal bacteria escaped to other parts of the body. That situation leads to chronic inflammation. The results were published last week in the journal Science as part of a special series devoted to our resident microbes.

Many interesting questions remain, including whether abnormalities in our bacterial colonies are causing disease, or whether conditions such as diabetes are disrupting our microbes. We and our bacteria are in this together, our evolution forever linked to theirs.