Me and My Microbiome

John K. Nixon

Until recently I had always imagined that human beings, and other life forms, existed within well-defined limits as essentially self-contained operating physiological systems. We have our own built-in immune systems that help to protect us from hostile microbes invading the body and causing outbreaks of disease.

I knew of course that we carry some bacteria and viruses on and inside our bodies, some of which are beneficial (particularly in the digestive system where they aid in breaking down some foods to facilitate digestion). Bacteria and viruses on the other hand have long had an image problem, as we tend to think of them as pathogens that have to be eradicated to maintain our health.

It turns out that we carry around with us a complex ecosystem of microbes that has been described by science writer Jennifer Ackerman as the Ultimate Social Network. This microbiome, as it is known, contains trillions of bacteria and other microorganisms that inhabit our skin, mouth, genital areas and intestines. In fact bacterial cells outnumber the much larger human cells by a factor of ten to one! All told, the microbes in your body can weigh up to three pounds in an average adult (about as much as your brain).

In addition to bacteria our bodies contain bacteriophages, bacteria-infecting viruses that are much smaller than bacteria and are the most abundant life-form on this planet. The majority of microbes inhabiting our bodies are beneficial or are unobtrusive free-loaders. They aid in digesting our food, manufacture vital vitamins and anti-inflammatory proteins and train our immune systems to fight infectious intruders. Only a small minority can cause us harm. For instance, about a third of us host in our nostrils Staphylococcus aureus, a bacterium that is normally benign but that can sometimes turn virulent. It can create havoc if it escapes from its normal environment and can cause anything from a harmless pimple to a life-threatening infection.

About 350 years ago Anton van Leeuwenhoek first spotted bacteria in samples of saliva and pond water with a primitive microscope. Viruses were only discovered about a century ago. They are much smaller than bacteria and are far more numerous than all other life forms combined. Until recently we were largely ignorant of the abundance of microbial life as we were unable to cultivate most microorganisms in the laboratory. Recent advances in DNA sequencing have enabled microbiologists to study whole populations in a given environment without the need to grow them in a Petri dish.

There is growing concern over the rise of so-called super bugs that have developed resistance to all known antibiotics. Much of the blame for this has been attributed to the overuse of antibiotics in the past. In addition the indiscriminate use of antibiotics during childhood may cause problems in later life. As Stanford University microbiologist Nathan Wolfe has pointed out, many of the beneficial bacteria on which we
rely get caught in the crossfire, as it were. The stomach microbe *Helicobacter pylori* is a case in point. This bacterium has been known to cause stomach ulcers in some people, but in most cases it serves to regulate immune cells in the stomach. It has been noted that a shrinking share of adults carry these bacteria, due in part to repeated high doses of antibiotics in childhood.

In a study published in 2011, Martin Blaser of New York University demonstrated the role played by this bacterium in controlling appetite by influencing the production of the hormone ghrelin in the gut. This hormone signals the brain to continue eating. When levels of *H. pylori* decline, the concentration of the hormone rises, which leads to overeating. Thus there is evidence that the overuse of antibiotics in childhood may be linked to the epidemic of obesity that we now see in developed countries. The decline in populations of *H. pylori* is also thought to be linked to a rise in asthma in American youth.

In the past ten years, the development of powerful computers and high speed gene sequencers have yielded many surprises. A census of microbial genes in the human digestive system published in 2010 revealed some 3.3 million genes from over 1,000 species, which is about 150 times the 20,000 to 25,000 genes in the human genome. It appears that our individual fates, health and even behaviour may have more to do with variations in the genes located in our microbiome than in our own body cells.

This of course raises the key question: Who is in charge – our bodies or our microbes? I can foresee the time when some sharp defence lawyer will argue that his client was not responsible for his actions, with the real culprits being some rogue bacteria. This will give a new twist to the “Devil made me do it” defence.

Regardless of who is in charge, for me at least it brings into focus the stunning complexity of life and the intricate balance between microscopic organisms forged over millions of years of evolution. A wondrous universe indeed!

---

*References*

1. *The Ultimate Social Network* by Jennifer Ackerman, Scientific American, June 2012.

*John Nixon* is a professional engineer living in West Vancouver. Most of his career has been devoted to consulting engineering in mining and metallurgy. He holds a B. Eng. degree from McGill University and an MBA from York University.