Nice to meet you, thanks for your bacteria

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It seems only a matter of time before “the days of the Petri dish” will be used to refer to an era when culturing bacteria had an air of simplicity that unfortunately is incapable of representing the full glory of the microbial world. With great numbers of scientists pushing the Petri dish aside and using advanced bacterial detection techniques in its place, it’s becoming increasingly clear that while the number of bacteria that inhabit the human body were once considered to be a moderately-sized group, they actually colonize the human body with an abundance that might rival the creatures of the rainforest (many of which, like the human microbiota, have yet to be characterized).

A study led by Dr. Noah Fierer and team of the University of Colorado at Boulder recently reinforced this reality by using PCR and a high-throughput method called pyrosequencing to identify the number and species of bacteria present on the hands of 51 undergraduate students leaving an exam room. When the students’ genetic material was sequenced, results revealed 332,000 genetically distinct bacteria belonging to 4,742 different species on their hands. This marked a hundred-fold increase in the number of bacteria detected in previous studies that had relied on purely culture-based methods (such as the Petri dish) to characterize the human hand microbiota. Each student carried on average 3200 bacteria from 150 species on their hands.

The results caused the team to conclude that the average person’s hands probably carry at least 3,000 different bacteria belonging to more than 100 species. According to Fierer, each student’s bacterial “fingerprint” was unique. All students carried known skin “old timers” such as Streptococcus, Staphylococcus and Lactobacillus. But 45% of the species detected were considered rare. Only five species were found on all the students’ hands, while any two hands – even belonging to the same person – had only 13% of their bacterial species in common. Certain bacteria were more frequent on the dominant hand (right for a right-hander), others on the non-dominant hand.

Fierer is excited by the possibility that the diversity of bacteria on any given human hand may make it possible to tell if an object has been touched by someone, just by looking at the bacteria left behind. Will “bacterial fingerprinting” be added to the cornucopia of techniques used by the modern-day detective? Will it be used to solve crime on the next episode of CSI Miami? It seems that for such a technique to prove accurate, the bacteria on an individual’s hands and the potential object they have touched would have to be characterized rather quickly. Think about it – if the individual ends up in a bacteria-filled arena such as a McDonald’s restroom, the composition of microbes on their hands may change quite rapidly.

Consider people who go to wash their hands after using the toilet. They have to turn on the sink, and will likely do so with their dominant hand. Then, although both hands are bathed with soap and water, one hand has to turn off the faucet, meaning that it is re-exposed to the pre-hand washing bacteria on the faucet handle. On the way out of the bathroom one is offered little choice but to grasp the door handle, which contains the bacterial species of people who ended up washing only one hand as well as the bacteria of those who flat out chose to skip the sink. With Fierer’s study showing that microbial populations differ so greatly from individual to individual, it seems entirely possible that many of the bacterial species on a particular person’s hands at a particular time of day may simply be due to what railings were
recently touched or if one has taken out the garbage.

But Fierer’s data also raises other questions. To the team’s surprise, women harbored different bacteria from men and significantly more kinds, even though women reported washing hands more often. In a follow-up experiment, the team tracked eight people after they washed their hands. While some species of bacteria took a while to repopulate on the freshly-washed hands, others actually preferred the “clean” environment. But the results were consistent in the sense that men always had fewer types of bacteria on their hands.

“We were pretty surprised to see such clear differences between men and women,” says Fierer. “We don’t know the causes.” Differences in sweat and sebum production, hormones, and even the use of cosmetics might be involved, but it could simply be that men’s skin is more acidic – acid environments tend to have less microbial diversity.

Those people familiar with the Marshall Pathogenesis, which implicates latent bacteria in the etiology of inflammatory disease, may not be entirely flabbergasted by Fierer’s results. As described in a recent speech I gave at the 2008 International Congress on Autoimmunity in Portugal, as they age, women may find it harder to fend off invading microbes. In silico data makes for a compelling case that microbe-induced dysregulation of nuclear receptor expression among women may decrease their ability to express certain antimicrobial peptides – natural antibiotics that the body uses to keep microbes under control.

An increasing number of researchers implicate bacteria rather than an overactive immune system in autoimmune disease – illnesses that, like the bacteria found on the hands of Fierer’s study subjects, also favor women. Biomedical researcher Trevor Marshall has shown that some of the pathogens implicated in autoimmune disease have developed ways of slowing the innate immune response. For example, certain species of gliding biofilm bacteria have been shown to create ligands that dysregulate the Vitamin D Receptor – a receptor that has been called the “gatekeeper to the innate immune response,” The bottom line is that, over their lifetimes, women may accumulate higher pathogenic bacterial loads and become more immunocompromised than their male counterparts. Does this possible discrepancy influence the number and species of bacteria on their hands? Only time and further research will tell.

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