HHMI
HOWARD HUGHES MEDICAL INSTITUTE

RESEARCH NEWS

MARCH 15, 2010

Bacterial "Signatures" Linger on Users' Keyboards

Call it CSI: Microbe. Howard Hughes Medical Institute researchers have found that skin bacteria left behind on keyboards and computer mice can identify the objects' users.

The discovery may one day aid law enforcement in identifying suspects based on the unique bacterial communities found at crime scenes, according to Howard Hughes Medical Institute Early Career Scientist Rob Knight.

Knight is a coauthor of a report on the research, which was performed in collaboration with Noah Fierer, an assistant professor in the Department of Ecology and Evolutionary Biology at the University of Colorado, published the week of March 15, 2010, in the *Proceedings of the National Academies of Sciences.*

"We're cautiously optimistic that this technique could be widely applicable, but before anyone can stand up in a courtroom and defend it, we need to spend a lot more time and money on validation."
- Rob Knight

"We were very surprised to see that the bacteria left on the keyboard keys and the mice were essentially a random sample of what was on the fingertips and palms of the users," says Knight, an assistant professor of Chemistry & Biochemistry and Computer Science at the University of Colorado at Boulder. "We're cautiously optimistic that this technique could be widely applicable, but before anyone can stand up in a courtroom and defend it, we need to spend a lot more time and money on validation."

Knight said when the team began its study, he expected the computer devices to carry one distinct community of bacteria, while a person's hands would support a different community. "You'd think the conditions for bacterial survival on a keyboard – a hard, dry surface – would differ enough from the conditions on the skin that the bacteria would differ," he says. Instead, many of the same bacteria that thrived on skin also survived on the devices, and were specific to each person.

For the study, Fierer personally swabbed all the letter keys on the keyboards and all 10 fingers from each of their three users, and then examined a specific bacterial gene from each sample. The gene, called the *16S* ribosomal RNA gene, serves as a handy method for identifying bacterial species. Every cell on Earth carries a *16S* gene, but the gene changes over time just enough to distinguish one species from another. Each bacterial sample can generate a unique signature of the entire mix of bacteria present. Comparing those signatures – which derive from algorithms Knight developed – can peg two microbial communities as closely related.

In this case, the *16S* profiles from the fingers of the keyboard users closely matched the *16S* profiles from each user's keyboard.

After this unexpected and spectacular result, Fierer then wanted to see if Knight's algorithm could pick out which computer user a sample came from, in a database of the bacterial communities from many people. In an earlier project, Fierer, Knight, and colleagues had compiled a database of *16S* rRNA profiles derived from the bacteria on the palms of about 200 people. For this experiment, Fierer and Knight's teams swabbed computer mice regularly used by nine of those individuals, ran their *16S* rRNA profiles, and then queried the database. Sure enough, the method correctly identified all nine mousers without any false positives.

The technique, at this point, has only been demonstrated on objects that a person touches regularly and repeatedly, says Knight. In experiments not reported in the new paper, Knight found that objects handled only once, such as a new glass beaker, did not provide enough bacterial DNA to analyze, although differences in surface properties could also be important. "So far, we have only shown that this method can work for objects that the same person has handled over a long period of time," Knight says. Emerging technologies that can amplify DNA from a single bacterial cell might one day expand the usefulness of the method. Knight is also working to develop computer algorithms that can sort out whether more than one individual has been regularly touching an object or surface.

A spate of recent research into the human microbiome – all the microbes that live in and on the human body – suggests that humans serve as hosts for an astounding diversity of microorganisms. In fact, each of us supports as many as 10 times the number of microbes as there are cells in the human body. Two years ago, Knight, Fierer, Jeffrey I. Gordon at Washington University in St. Louis, and their colleagues reported that the composition of microbial communities varies considerably from place to place on the same person's body. For instance, the mix of bacteria on a person's arm differs from the mix on their forehead. The bacterial mix also appeared fairly stable over time. For instance, after hand-washing, palm bacteria recover and display the same mix as before hand-washing. Knight says those results led Fierer to suggest that microbial communities might serve as tools for identification.

Much work remains before the technique could ever aid law enforcement efforts, says Knight. “We plan to build a large database of bacterial sequences from people and the objects they touch and then we'll be able to calculate how probable it is that a sample came from one suspect versus another,” he says. “The results in this paper are promising, but today it would probably be at least a million-dollar project to try to develop it for forensics. However, DNA sequencing technology is getting dramatically cheaper every year.”