'Bugs' on the subway: Monitoring the microbial environment to improve public health

June 28 2016

The trillions of microbes that transfer from people to surfaces could provide an early warning system for the emergence of public health threats such as a flu outbreak or a rise in antibiotic resistance, according to a study from Harvard T.H. Chan School of Public Health. The researchers took to the Boston subway system to find out what kinds of bugs people across the city are passing around—and how they might help preserve or disrupt our health.

The study, which will be published online June 28, 2016 in the American Society for Microbiology's journal *mSystems*, is the first high-precision microbial survey in a mass-transit environment to look at multiple surface types and materials. (Reporters: Watch an embargoed video.)

"We were surprised to find that the microbes that we collected on surfaces that people touch—and sometimes sneeze on—had low numbers of worrisome pathogens or antibiotic resistance genes. These environments have drastically lower virulence profiles, in fact, than are observed in a typical human gut," said senior author Curtis Huttenhower, associate professor of computational biology and bioinformatics. "Our findings establish a baseline against which deviations can be used as an early warning system to monitor public health."

With the support of the Massachusetts Bay Transit Authority, the researchers collected samples by swabbing seats, seat backs, walls,

vertical and horizontal poles, and hanging grips inside train cars from three subway lines, as well as touchscreens and walls of indoor and outdoor ticketing machines at five subway stations. Detailed data were collected on the environment in which each sample was taken. The samples were then studied using metagenomic sequencing.

The researchers found that the type of surface—and how humans interact with it—was the greatest determinant of microbial community structure. Skin- and oral-associated microbes —transferred by touching and coughing or sneezing—were found on surfaces such as poles and hand grips. Vaginal microbes, which can be transferred through clothing, were found on seats. Greater amounts of non-human microbes, such as those seen in plants, were found on outdoor ticketing touchscreens. Little variation was observed between geographically distinct train lines and stations serving different demographics.

The findings are consistent with previous microbial DNA sequencing-based studies that have revealed that microbial communities in the built environment are greatly influenced by their human occupants. Further study of the separate influences of human contact, surface type, and surface material will help identify mechanisms through which microbial communities form and persist on surfaces within built environments.

"Our next steps are to find out which microbes are dead or alive and which can be transferred between people," said first author Tiffany Hsu, a research assistant in the Department of Biostatistics.

Other Harvard Chan School authors included Regina Joice, Jose Vallarino, Galeb Abu-Ali, Afrah Shafquat, Casey DuLong, Catherine Baranowski, Xochitl C. Morgan, and John D. Spengler.

This study was supported by a grant from the Alfred P. Sloan Foundation.

More information: "Urban transit system microbial communities differ by surface type and interaction with humans and environment," Tiffany Hsu, Regina Joice, Jose Vallarino, Galeb Abu, Erica M. Hartmann, Afrah Shafquat, Casey DuLong, Catherine Baranowski, Dirk Gevers, Jessica L. Green, Xochitl C. Morgan, John D. Spengler, Curtis Huttenhower, *mSystems*, online June 28, 2016, DOI: 10.1128/mSystems.00018-16

Provided by Harvard T.H. Chan School of Public Health

Citation: 'Bugs' on the subway: Monitoring the microbial environment to improve public health (2016, June 28) retrieved 9 April 2024 from https://phys.org/news/2016-06-bugs-subway-microbial-environment-health.html

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