Global Study of Microbes in 60 Cities Finds Each Has Unique Fingerprint of Viruses and Bacteria

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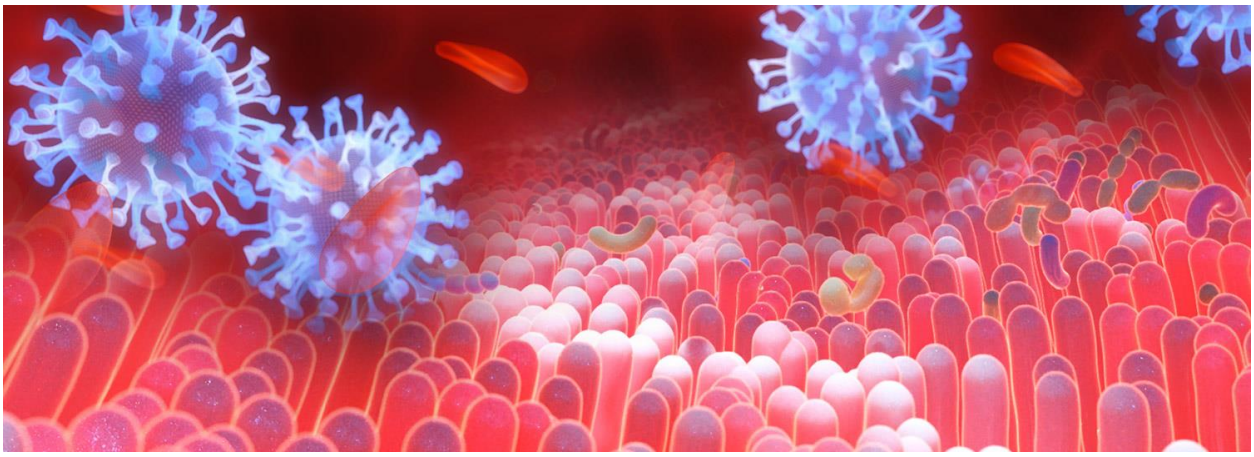


Researchers turn now to see how COVID-19 pandemic affected microbiome in each city

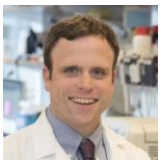
Lynn Schriml, PhD

Each city has its own unique microbiome, a “fingerprint” of viruses and bacteria that serves as type of city profile, according to a new study from an international consortium of researchers that included a team from the University of Maryland School of Medicine (UMSOM). The international project, which sequenced and analyzed samples collected from public transit systems and hospitals in 60 cities around the world, was published today **in the journal *Cell***.

The research is considered to be the largest-ever global metagenomic study of urban microbiomes, spanning both the air and the surfaces of multiple cities. It features a comprehensive analysis for all the microbial species identified—including thousands of viruses and bacteria and two newly identified single-cell organisms not found in reference databases.

Study co-author **Lynn Schriml, PhD**, UMSOM Associate Professor in the **Department of Epidemiology & Public Health** and Scientist at the Institute for Genome Sciences (IGS), led the

study sampling efforts for Baltimore's transit systems. ***"Baltimore's distinct microbial signature reveals a unique, fascinating, and diverse world, providing insights into geographical variation and previously unknown microbial genomes,"*** she said.



Christopher Mason, PhD

Added study senior author **Christopher Mason, PhD**, a professor at Weill Cornell Medicine and the director of the WorldQuant Initiative for Quantitative Prediction: ***"Every city has its own 'molecular echo' of the microbes that define it. If you gave me your shoe, I could tell you with about 90 percent accuracy the city in the world from which you came."***

The study was conducted before the COVID-19 pandemic shut down cities throughout the world, so the researchers are now looking at how the pandemic affected the microbiome fingerprint of each city. ***"It's a good question,"*** Schriml said, ***"and we are addressing this in follow-up research."*** The consortium launched the MetaCOV project in 2020 to investigate the change in urban metagenomes and isolate the presence of the SARS-CoV-2 virus (the virus that causes COVID-19) in urban environments (e.g. ATM machines, wastewater, hospitals, transit systems).

Findings in the latest research are based on an analysis of 4,728 samples from cities on six continents, taken over the course of three years, and represent the first systematic worldwide catalogue of the urban microbial ecosystem. In addition to distinct microbial signatures in various cities, the analysis revealed a core set of 31 species that were found in 97 percent of samples across the sampled urban areas. The researchers identified 4,246 known species of urban microorganisms, but they also found that any subsequent sampling will still likely continue to find species that have never been seen before, which highlights the raw potential for discoveries related to microbial diversity and biological functions awaiting in urban environments.

In the future, the findings also have many potential practical applications, including identifying potential new compounds that can be used as antibiotics and small molecules annotated from biosynthetic gene clusters (BGCs) that have promise for drug development.

Dr. Schriml joined the International Metagenomics and Metadesign of Subways and Urban Biomes (MetaSUB) consortium in 2016 to gain greater insight on urban built environments through studying the composition and variation of microbes across Baltimore and Washington

D.C. mass transit systems. The MetaSUB consortium has expanded since then to include projects sampling diverse built environments, including sewers, monuments and hospitals with Dr. Schriml sampling biofilms on the Orpheus Monument at Fort McHenry and the Soldiers' National Monument at Gettysburg in 2018. She had been joined by study co-author Emmanuel Mongodin, PhD, former Assistant Professor of Microbiology and Immunology at UMSOM and IGS faculty member. Last year, he left the UMSOM to become a program director at the National Heart, Lung, and Blood Institute.

Cell, Danko et al.: “A global metagenomic map of urban microbiomes and antimicrobial resistance” **https://www.cell.com/cell/fulltext/S0092-8674(21)00585-7** DOI: 10.1016/j.cell.2021.05.002