Study: Cities have individual microbial signatures

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The downtown Dallas, Texas (USA) skyline from a levee along the Trinity River. Facing southeast. Credit: drumguy8800/Wikipedia

Cities have their own distinct microbial communities but these communities don't vary much between offices located in the same city, according to a new study. The work, published this week in *mSystems*, an open access journal from the American Society for Microbiology, offers insight into what drives the composition of microbes in built environments.

Sampling microbes from nine offices in three North American cities, the research, directed by Northern Arizona University in Flagstaff, also

found that human skin contributes heavily to the composition of built environment surfaces and that office floors have more microbes than other surfaces, likely because of soil and other materials deposited from workers' shoes.

"We suspect that in the absence of extreme conditions like flooding, microbes may be passively accumulating on surfaces in the built environment rather than undergoing an active process," said senior study author J. Gregory Caporaso, PhD, an assistant professor of biological sciences and assistant director of the Center for Microbial Genetics and Genomics at the university. "As we continue to expand our understanding of the microbiology of the built environment, possibly including routine monitoring of microbial communities to track changes that may impact human health, our results will help inform future research efforts."

To understand how microbes establish in built environments over time, Caporaso and colleagues monitored three offices over a one-year period in each of the following cities: Flagstaff, San Diego and Toronto. In each office they installed three sampling plates, with one plate each on the floor, ceiling and wall; each plate contained two or three swatches each of painted drywall, ceiling tile and carpet, as well as sensors that allowed them to monitor parameters of the environment including equilibrium relative humidity on the surfaces of the swatches, available light, occupancy, and temperature. Samples were collected in four six-week sampling periods, one per season. Then, they used laboratory techniques called 16S rRNA gene sequencing and ITS-1 to profile bacterial and fungal communities found in the samples.

The team found that floor samples regardless of material contained more microbes than wall or ceiling surfaces; that frequent sampling of the test plates disrupted the microbial communities only slightly; and that cities had their own signature microbial communities.

"This was especially interesting because even within each city, the offices we studied differed from each other in terms of size, usage patterns, and ventilation systems," said Caporaso, "suggesting that geography is more important than any of these features in driving the bacterial community composition of the offices within the ranges that we studied."

The Flagstaff offices had richer microbial communities than those in San Diego or Toronto, which were more similar to each other, though Caporaso said it's unclear why.

To see if any particular office workers or body sites were sources for the microbes seen in offices, the researchers also collected human skin, nasal, oral, and fecal microbiome samples from 11 workers at one of the Flagstaff offices, and from individuals performing the sampling techniques in all three cities.

Across all nine offices, the team found that human skin bacterial communities were the largest identifiable source of the office bacterial community samples, with at least 25-30 percent of the office surface microbiome derived from human skin. The human nasal microbiome also appeared to be a small but consistent source of office surface microbial communities. The largest source of microbial communities in these offices, however, was from non-human sources such as the environment.

Researchers found no significant associations between the office microbes collected and indoor environmental variables such as temperature or humidity.

The team will next simulate flooding events to examine how fungal communities in the built environment change over time.