Daily bathroom showers may deliver face full of pathogens, says study

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A new University of Colorado at Boulder study indicates that biofilms clinging to the inside of bathroom showerheads can harbor up to 100 times the levels of pathogens found in background municipal water. Credit: Glenn Asakawa, University of Colorado

While daily bathroom showers provide invigorating relief and a good cleansing for millions of Americans, they also can deliver a face full of potentially pathogenic bacteria, according to a surprising new University of Colorado at Boulder study.

The researchers used high-tech instruments and lab methods to analyze roughly 50 showerheads from nine cities in seven states that included New York City, Chicago and Denver. They concluded about 30 percent of the devices harbored significant levels of Mycobacterium avium, a pathogen linked to pulmonary disease that most often infects people with compromised immune systems but which can occasionally infect healthy people, said CU-Boulder Distinguished Professor Norman Pace, lead study author.

It's not surprising to find pathogens in municipal waters, said Pace. But the CU-Boulder researchers found that some M. avium and related pathogens were clumped together in slimy "biofilms" that clung to the inside of showerheads at more than 100 times the "background" levels of municipal water. "If you are getting a face full of water when you first turn your shower on, that means you are probably getting a particularly high load of Mycobacterium avium, which may not be too healthy," he said.

The study appeared in the Sept. 14 online edition of the Proceedings of the National Academy of Sciences. Co-authors of the study included CU-Boulder researchers Leah Feazel, Laura Baumgartner, Kristen Peterson and Daniel Frank and University Colorado Denver pediatrics department Associate Professor Kirk Harris. The study is part of a larger effort by Pace and his colleagues to assess the microbiology of indoor environments and was supported by the Alfred P. Sloan Foundation.

Research at National Jewish Hospital in Denver indicates that increases in pulmonary infections in the United States in recent decades from so-called "non-tuberculosis" mycobacteria species like M. avium may be linked to people taking more showers and fewer baths, said Pace. Water spurting from showerheads can distribute pathogen-filled droplets that suspend themselves in the air and can easily be inhaled into the deepest parts of the lungs, he said.

Symptoms of pulmonary disease caused by M. avium can include tiredness, a persistent, dry cough, shortness of breath, weakness and "generally feeling bad," said Pace. Immune-compromised people like pregnant women, the elderly and those who are fighting off other diseases are more prone to experience such symptoms, said Pace, a professor in the molecular, cellular and developmental biology department.

The CU-Boulder researchers sampled showerheads in homes, apartment buildings and public places in New York, Illinois, Colorado, Tennessee and North Dakota.

Although scientists have tried cell culturing to test for showerhead pathogens, the technique is unable to detect 99.9 percent of bacteria species present in any given environment, said Pace. A molecular genetics technique developed by Pace in the 1990s allowed researchers to swab samples directly from the showerheads, isolate DNA, amplify it using the polymerase chain reaction, or PCR, and determine the sequences of genes present in order to pinpoint particular pathogen types.

"There have been some precedents for concern regarding pathogens and showerheads," said Pace. "But until this study we did not know just how much concern."

During the early stages of the study, the CU team tested showerheads from smaller towns and cities, many of which were using well water rather than municipal water. "We were starting to conclude that pathogen levels we detected in the showerheads were pretty boring," said Feazel, first author on the study. "Then we worked up the New York data and saw a lot of M. avium. It completely reinvigorated the study."

In addition to the showerhead swabbing technique, Feazel took several

individual showerheads, broke them into tiny pieces, coated them with gold, used a fluorescent dye to stain the surfaces and used a scanning electron microscope to look at the surfaces in detail. "Once we started analyzing the big metropolitan data, it suddenly became a huge story to us," said Feazel, who began working in Pace's lab as an undergraduate.

In Denver, one showerhead in the study with high loads of the pathogen Mycobacterium gordonae was cleaned with a bleach solution in an attempt to eradicate it, said Pace. Tests on the showerhead several months later showed the bleach treatment ironically caused a three-fold increase in M. gordonae, indicating a general resistance of mycobacteria species to chlorine.

Previous studies by Pace and his group found massive enrichments of M. avium in "soap scum" commonly found on vinyl shower curtains and floating above the water surface of warm therapy pools. A 2006 therapy pool study led by Pace and CU-Boulder Professor Mark Hernandez showed high levels of M. avium in the indoor pool environment were linked to a pneumonia-like pulmonary condition in pool attendants known as "lifeguard lung," leading the CU team into the showerhead study, said Pace.

Additional studies under way by Pace's team include analyses of air in New York subways, hospital waiting rooms, office buildings and homeless shelters. Indoor air typically has about 1 million bacteria per cubic meter and municipal tap water has rough 10 million bacteria per cubic meter, said Pace.

So is it dangerous to take showers? "Probably not, if your immune system is not compromised in some way," said Pace. "But it's like anything else -- there is a risk associated with it." Pace said since plastic showerheads appear to "load up" with more pathogen-enriched biofilms, metal showerheads may be a good alternative.

"There are lessons to be learned here in terms of how we handle and monitor water," said Pace. "Water monitoring in this country is frankly archaic. The tools now exist to monitor it far more accurately and far less expensively that what is routinely being done today."

In 2001 the National Academy of Sciences awarded Pace the Selman Waxman Award -- considered the nation's highest award in microbiology -- for pioneering the molecular genetic techniques he now uses to rapidly detect, identify and classify microbe species using nucleic acid technology without the need for lab cultivation. That same year he was awarded a MacArthur Foundation "genius grant" for his work.

Source: University of Colorado at Boulder (news : web)