New research illuminates the impact of surface properties on bacteria movement

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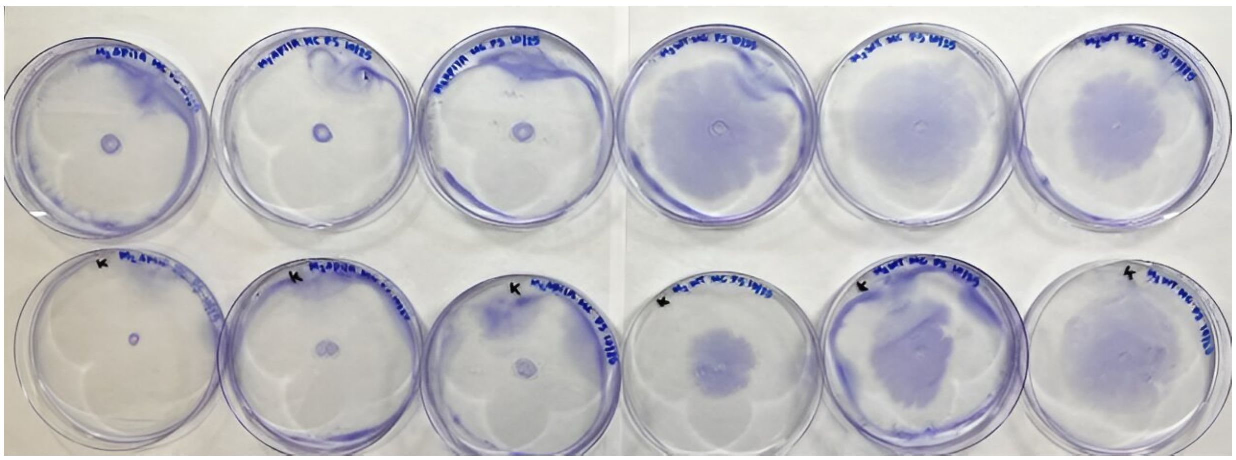

The visualization of twitching motility via crystal violet stain. Credit: Megan O'Hara

As bacteria continue to become more resistant to antibiotics, it will be harder to treat bacterial infections, leading to more severe illnesses, longer hospital stays, and higher mortality rates.

As an undergraduate student at Virginia Tech, Megan O'Hara had a unique opportunity to study how bacteria move across surfaces—a process known as twitching motility—working under the mentorship of Zhaomin Yang, professor of biological sciences. This movement allows bacteria to rapidly colonize new surfaces, including those of tissues and medical implants.

The findings of O'Hara's two-year research efforts led to the surprising discovery of the key role surface properties play in either enabling or preventing this movement. The study was recently published in the journal *mSphere*.

Twitching is powered by tiny structures called type IV pili (T4P). They are part of the weaponry of certain bacteria that allow them to infect and cause harm to humans. Unlike other forms of bacterial movement, such as swimming or swarming, twitching motility occurs on solid or semi-solid surfaces. Twitching motility is a form of motility associated with many bacteria that possess T4P, and some of these bacteria are antibiotic resistant.

"We want to work with these pathogens that have high rates of antibiotic resistance, such as the ones determined by the World Health Organization, because they pose an increased risk to human health," said O'Hara, lead author of the study and who graduated in 2024 with a bachelor's degree in microbiology.

The World Health Organization cites antibacterial resistance as a top 10 threat for global health with an estimated 1.27 million deaths in 2019 directly attributed to drug-resistant infections globally. This number is predicted to rise to 10 million by 2050 if nothing intercedes this pace.

"Combating antibiotic research is really important and a hot area of research right now," O'Hara said. "And one way you can accomplish this is, instead of killing the bacteria, you take away its weapons and armor such that they can no longer colonize or do harm to our body. They become losers in competition with the good bacteria that normally inhabit our body."

The study revealed an unexpected discovery as the researchers were able to determine that the function of T4P in motility was dependent on the properties of a surface. Their research indicated that bile salts and other detergents enhance bacterial twitching by changing the surface to be hydrophilic instead of affecting the biology of the bacterium. In other words, by manipulating the surface properties, the functionality of the T4P may be altered.

"Learning about T4P is really important because it is what we call a critical virulence factor," O'Hara said. "And why we call it critical is because in many species, once you delete the T4P, the bacteria can no longer cause an infection."

O'Hara is now a first-year Ph.D. student in the biomedical sciences program at University of California San Diego. As an undergraduate and Virginia Tech Presidential Scholar, she received two awards from the Department of Biological Sciences, including the Buikema and Galway Undergraduate Research Award and the David Lyerly Summer Fellowship.

"I am proud of Megan's accomplishment as an undergraduate at Virginia Tech," said Yang. "She is the undergraduate of a professor's dream, smart, driven and independent. It is extraordinary to have an undergraduate as the leading author of a primary research paper."

More information: Megan T. O'Hara et al, Surface hydrophilicity promotes bacterial twitching motility, *mSphere* (2024). DOI: 10.1128/msphere.00390-24

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