Bacteria stay safe by staying still

To avoid being detected by the innate immune system, some bacteria do nothing at all.

A research team led by Brent Berwin, Ph.D., an associate professor of microbiology and immunology, has taken a close look at interactions between immune cells called phagocytes and *Pseudomonas aeruginosa*, a bacterium that often forms chronic infections in the lungs of people with cystic fibrosis. The researchers found that the likelihood that bacteria will be caught and killed by phagocytes is proportional to the swimming ability of the bacteria.

To establish colonies in human lungs, *P. aeruginosa* moves around using a single flagellum that extends from one end of the bacteria cell, a motion scientists call swimming. The bacteria cells have to be mobile to establish a chronic infection, but once they become part of a colony they stop moving around. It has been unclear, however, why *P. aeruginosa* becomes less vulnerable to phagocytosis once it stops swimming. It had been thought that phagocytes might recognize the flagella on *P. aeruginosa* and other bacteria. But Berwin has found that it is the loss of the ability to swim—not the loss of the flagella—that protects the bacteria. And in a new study published in *PLoS Pathogens*, Berwin reported that the more actively the bacteria swim, the more likely they are to be caught and killed by phagocytes.

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Berwin came to this conclusion after examining several strains of *P. aeruginosa* that had varying swimming abilities. Some of the bacteria were strong swimmers; others couldn't swim at all; and some had limited swimming abilities. The likelihood that the bacteria ended up as food for phagocytes was roughly proportional to their swimming prowess.

An important additional finding is that this mechanism applies to other bacteria as well. Berwin examined the bacteria *Vibrio cholerae* and *Escherichia coli* and found that the same pattern held true—the more the bacteria moved around, the more likely they were to be killed. "We're pretty excited that this seems to be a pretty general mechanism," Berwin says. "It appears to be fairly widespread, at least among the gram-negative bacteria."

Berwin notes that it is still not clear exactly how the phagocytes are able to recognize motion. It's possible, he says, that the phagocytes have receptors that can "see" movement. Another possibility is that a bacteria cell that is swimming might collide with a phagocyte in a way that causes the phagocyte to respond. Or it might simply be that the more bacteria move around, the more likely they are to end up too close to a phagocyte. Whatever the mechanism, he says, "it's a very neat form of pattern recognition."

Now Berwin is working to figure out exactly what happens when a phagocyte crosses paths with bacteria and why phagocytes are more likely to respond to moving bacteria than immobile bacteria. Answering that question would raise some intriguing possibilities, he says, including inducing immobile bacteria to move around to make them vulnerable or improving the ability of phagocytes to recognize immobile bacteria. — Amos Esty

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Brent Berwin (left) and Rustin Lovewell examine colonies of the bacterium *Pseudomonas aeruginosa*.