Scientists focus on quorum sensing to better understand bacteria

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The relatively new field in microbiology that focuses on quorum sensing has been making strides in understanding how bacteria communicate and cooperate. Quorum sensing describes the bacterial communication between cells that allows them to recognize and react to the size of their surrounding cell population. While a cell's output of extracellular products, or "public goods," is dependent on the size of its surrounding population, scientists have discovered that quorum sensing, a type of bacterial communication, controls when cells release these public goods into their environments.

In a study appearing in the Oct. 12 issue of the journal *Science*, University of Washington researchers examine the pathogen *Pseudomonas aeruginosa*, which colonizes in the lungs of cystic fibrosis patients. While most cells "cooperate" with each other by producing and sharing public goods when there are enough of their "friends" around, researchers have found that certain individual cells, known as "cheater cells," share in the use of these extracellular products without releasing any of these products themselves.

In Pseudomonas *aeruginosa* these cheaters are quorum sensing mutants that don't make public goods in response to increasing population density. When the researchers manipulated the environment so that the cost of cell cooperation was high (so that the bacterial group had to produce a lot of public goods to survive), the cheater cells overtook the cooperating producer cells, the cooperators then became too rare, and the population collapsed. From this sequence of events, the researchers

induced destabilization of cooperation. They also manipulated environmental conditions to restrict cheaters and stabilize cooperation. Scientists recognize this fundamental research as taking them steps closer to a different antibiotic-independent way to manage infections.

"Perhaps, one day, we'll be able to manipulate infections so that bacterial cooperation is destabilized and infections are resolved, "said Dr. Peter Greenberg, UW professor of microbiology and one of the three authors of the study.

"Biologists think of social interactions as being the push and pull between cooperation and conflict," he explained. "This is true of man and bacteria. Not so many years ago, people didn't think bacteria socialized at all. Now we are beginning to think we might manipulate bacterial social activity for the benefit of human health."

In the future, Greenberg said, this research may enable scientists to manipulate bacterial conditions in order to cause cell populations of dangerous pathogens to collapse.

"By learning about the fundamentals of quorum sensing control of cell cooperation, we are beginning to have a glimmer of insight into how to control and manipulate infecting populations of *P. aeruginosa* and other dangerous pathogens with similar systems," Greenberg said. "We've also gained new insights into how cell cooperation can be stably maintained in biology. It is much more straightforward to study sociality in bacteria than in animals. The payoffs may be in understanding what drives cooperation and conflict in general, and in developing strategies for infection control. "

More information: "Bacterial Quorum Sensing and Metabolic Incentives to Cooperate," by A.A. Dandekar et al., *Science*, 2012.

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