# Bacteria cooperate to repair damaged siblings

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Chris Vassallo, a University of Wyoming doctoral student in the Department of Molecular Biology, performs routine maintenance of bacterial cultures in the lab. Vassallo was lead author of a paper about cell rejuvenation that was published in *PNAS* May 18. Credit: University of Wyoming

A University of Wyoming faculty member led a research team that discovered a certain type of soil bacteria can use their social behavior of outer membrane exchange (OME) to repair damaged cells and improve the fitness of the bacteria population as a whole.

Daniel Wall, a UW associate professor in the Department of Molecular Biology, and others were able to show that damaged sustained by the outer membrane (OM) of a myxobacteria cell population was repaired by a healthy population using the process of OME. The research revealed that these social organisms benefit from group behavior that endows favorable fitness consequences among kin cells.

Wall says, to the research group's knowledge, this is the first evidence that a bacterium can use cell-content sharing to repair damaged siblings.

"It is analogous to how a wound in your body can be healed," Wall says. "When your body is wounded, your cells can coordinate their functions to heal the damaged tissue."

Wall was the senior and corresponding author on a paper, titled "Cell Rejuvenation and Social Behaviors Promoted by LPS Exchange in Myxobacteria" that was published in the May 18 online issue of the *Proceedings of the National Academy of Sciences* (*PNAS*). The journal is one of the world's most prestigious multidisciplinary scientific serials, with coverage spanning the biological, physical and social sciences.

Chris Vassallo, a UW doctoral student in molecular biology and originally from Cheyenne, was the paper's lead author and conducted most of the lab experiments.

"During nutrient depletion, myxobacteria cooperate to build a macroscopic structure called a fruiting body," Vassallo says. "The structure resembles a tree or mushroom in appearance."

A fruiting body is essentially a multicellular organism that produces dormant spores that are resistant to environmental stresses.

These myxobacterial cells, in their native environments, must cope with factors that compromise the integrity of the cell, Wall says. Rather than looking out only for themselves like other bacterial species, the individual myxobacteria cells band together as a social group to assist their kin that become damaged.

"Myxobacteria are unusual for bacteria in that they have a true multicellular life," Wall says. "Researchers are interested in how the evolutionary transition occurred toward multi-cellularity; that is, how cooperation develops and single cells are not just interested in themselves. The Darwinian view is that each individual is out for themselves; 'survival of the fittest.'"

"When environmental cells come together, they compete with each other," Wall continues. "With OME, we think it allows myxobacteria cells to transition from a heterogeneous single cellular life to a more harmonious multicellular life."

While the practical application of the science is to better understand how single cells can evolve to multicellular cells to be cooperative, Vassallo says the research could possibly have future real-world implications for treating infections in humans.

"The most direct applicability could be for antibiotic resistance," Wall says. "Within the paper, Chris did an experiment where one strain of myxobacteria conferred antibiotic resistance to another strain. This works by the cells transferring their OM armor.

"The human skin protects the body and internal cells from environmental stresses. By analogy, bacteria protect themselves with their OM, and they are known to change their armor in response to stress. When they chemically change their armor, they can also change their antibiotic resistance profile."

**More information:** Cell rejuvenation and social behaviors promoted by LPS exchange in myxobacteria, www.pnas.org/cgi/doi/10.1073/pnas.1503553112

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