E. coli's adaptation to extreme temperatures helps explain resistance to certain drugs

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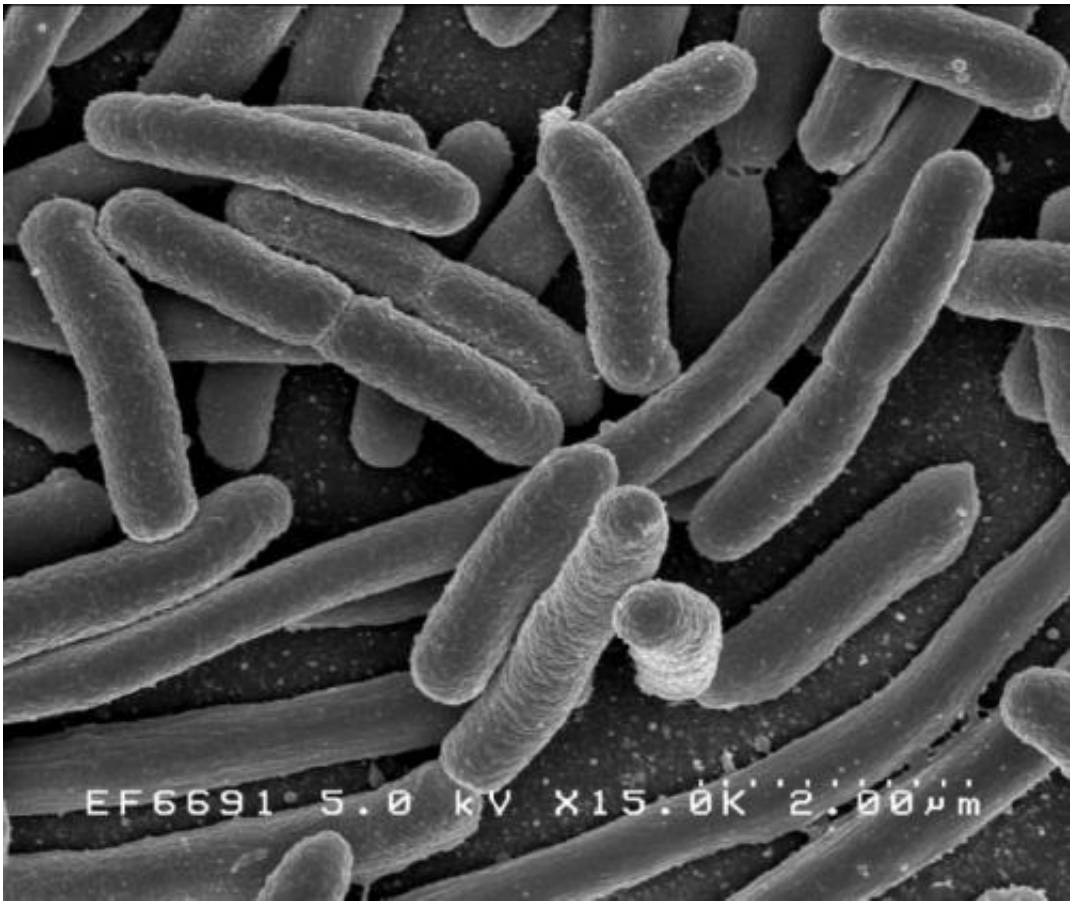

Escherichia coli. Credit: Rocky Mountain Laboratories, NIAID, NIH

Long before bacteria had to contend with antibiotic drugs, they had to survive extreme temperatures as Earth warmed and cooled over millennia. Could the adaptations they evolved to

temperature—especially heat—help explain why certain strains are resistant to certain drugs? A new study by a research team at the University of California-Los Angeles that includes Santa Fe Institute External Professor Pamela Yeh suggests that defenses against extreme temperatures, do, indeed, give *E. coli* bacteria an advantage in fending off certain drugs.

"Our code name for this paper was 'temperature as drugs.' Because we found that different temperatures had to act as a stressor just as a drug acts as a stressor to a bacterial population," says Yeh. "So it came from a real basic question: Do drugs affect bacteria in some of the same ways that temperature affects bacteria?"

It turns out that the same mechanisms *E. coli* evolved to deal with temperature endowed it with a built-in defense against drugs. But this advantage only goes so far: while heat-tolerant bacteria may be better able to resist drugs that stress bacteria in the same way high temperatures do, that also makes them more sensitive to drugs that mimic the effect of cold.

The work could help doctors administer antibiotics in a more precise way.

"I think it's an interesting first step, because if we think about how we treat a patient with an infection, depending on where it is, your body has different temperatures at different locations," says Tina Manzhu Kang, a first co-author of the study. "We found some antibiotics work better with lower temperatures. So that's something you might want to consider when deciding on a treatment."

The team is now looking at how other stressors may have affected *E. coli*. "There have been a number of stressors that have been there since the beginning of life, such as pressure, and we think the bacteria may

have also built up resistance to those," says Mauricio Cruz-Loya, the paper's other first co-author.

The paper, "Stressor interaction networks suggest antibiotic resistance co-opted from stress response to temperature," appears in The *ISME Journal*.

More information: Mauricio Cruz-Loya et al, Stressor interaction networks suggest antibiotic resistance co-opted from stress responses to temperature, *The ISME Journal* (2018). DOI: 10.1038/s41396-018-0241-7

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