Scientists reveal how gut microbes 'recover' after antibiotic treatment

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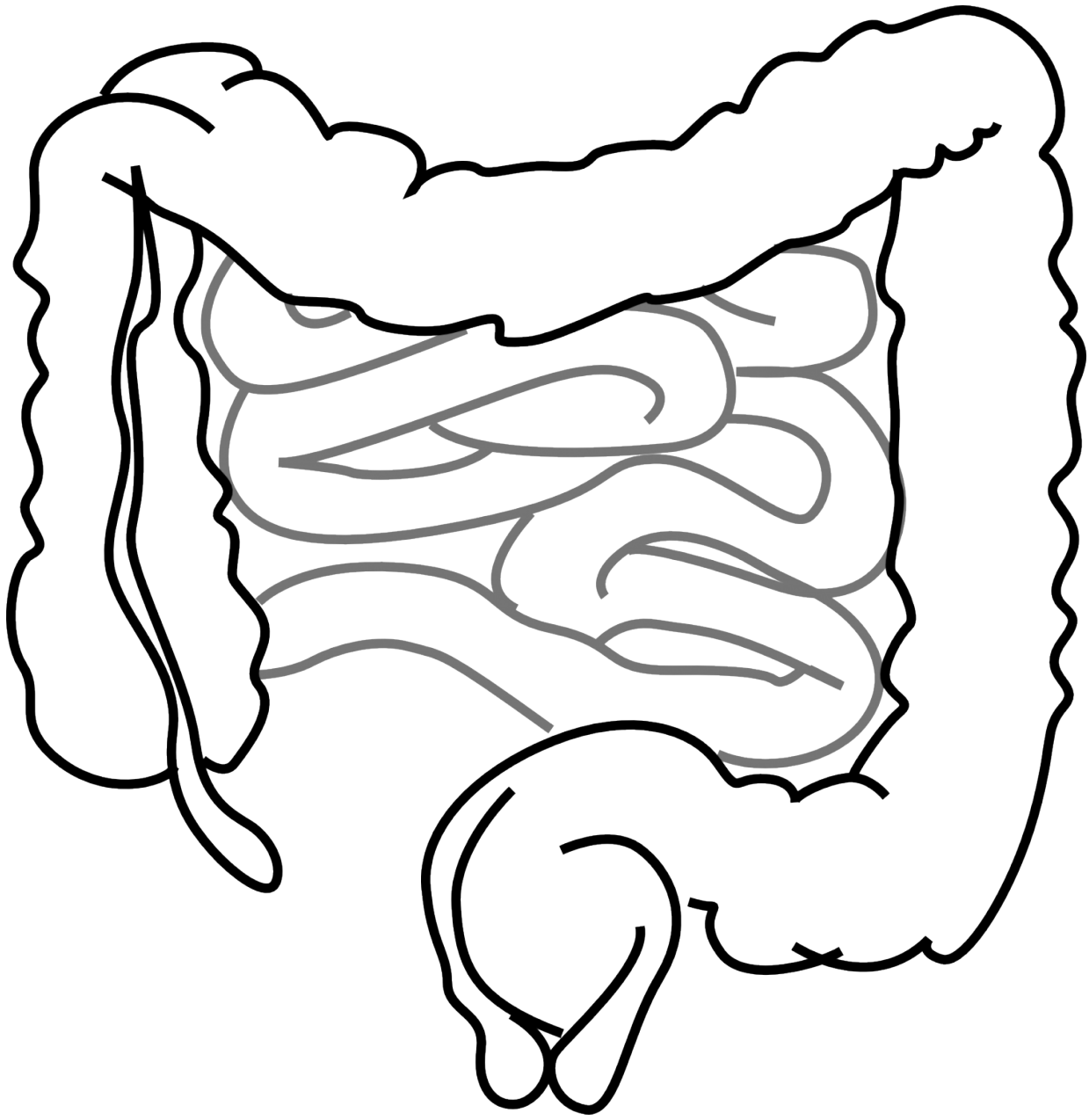

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New insight on how antibiotics affect the gut microbiome—the community of microbes that live inside us—has been published in the journal *eLife*.

The study in mice hints at new methods for maintaining a healthy microbiome or controlling invasion from harmful, disease-causing bacteria.

"The gut microbiome consists of a community of microbes which, when disturbed, exposes the host to risks such as infection," says first author Aspen Reese, who led the study while a Ph.D. student at Duke University, North Carolina, US. "While it was already known that antibiotics kill or prevent the growth of bacteria in the gut, it was not clear exactly how and when those changes affect the gut environment."

To learn more about this question, Reese and her team sought to understand what ecological changes happen to microbiota during and after treatment with broad-spectrum antibiotics—treatments that act against a wide range of harmful bacteria.

The scientists began by administering antibiotics to mice over five days to broadly inhibit their gut bacteria. They found that the gut's redox potential—a measure of the chemical environment including an estimate of how easily organisms are able to respire within it—increased under antibiotic treatment. While evidence suggested that these redox shifts were associated with the host immune system, the shifts also occurred when gut microbial communities were treated with antibiotics in an artificial gut that had no immune system.

"We also saw that as antibiotics removed bacteria and reduced their metabolic rates in the mouse gut, there was an increase in oxidising agents called electron acceptors," Reese explains. "This new environmental state meant that the microbial community which recolonised after treatment looked very different from the original community."

The bacteria that appeared immediately following treatment, including some potentially harmful species, were able to take advantage of the electron acceptors to grow quickly. As they grew, they used up the excess resources, causing the gut environment to return to its normal state. However, this did not guarantee recovery of the original microbial community.

"Antibiotics may drive some microbe species extinct in a gut community, so new microbial immigrants from outside the mouse—in this case from an untreated mouse in the same cage—were likely needed to return the microbiota to its original state," says senior author Lawrence David, Assistant Professor of Molecular Genetics and Microbiology at Duke University.

Together, these results suggest new ecological models for how antibiotics reshape the gut microbiome and how redox shifts could be associated with intestinal disease, with changes in electron acceptor availability setting the stage for post-antibiotic recolonisation of gut bacteria.

"In the future, our work could help inform the development of drugs that either include chemical alterations of redox potential, or that introduce competitors for excess electron acceptors, to help treat microbial disorders or prevent antibiotic-associated infections," Reese concludes.

More information: Aspen T Reese et al, Antibiotic-induced changes in the microbiota disrupt redox dynamics in the gut, *eLife* (2018). DOI:

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