# Investigating the collateral effects of antibiotics

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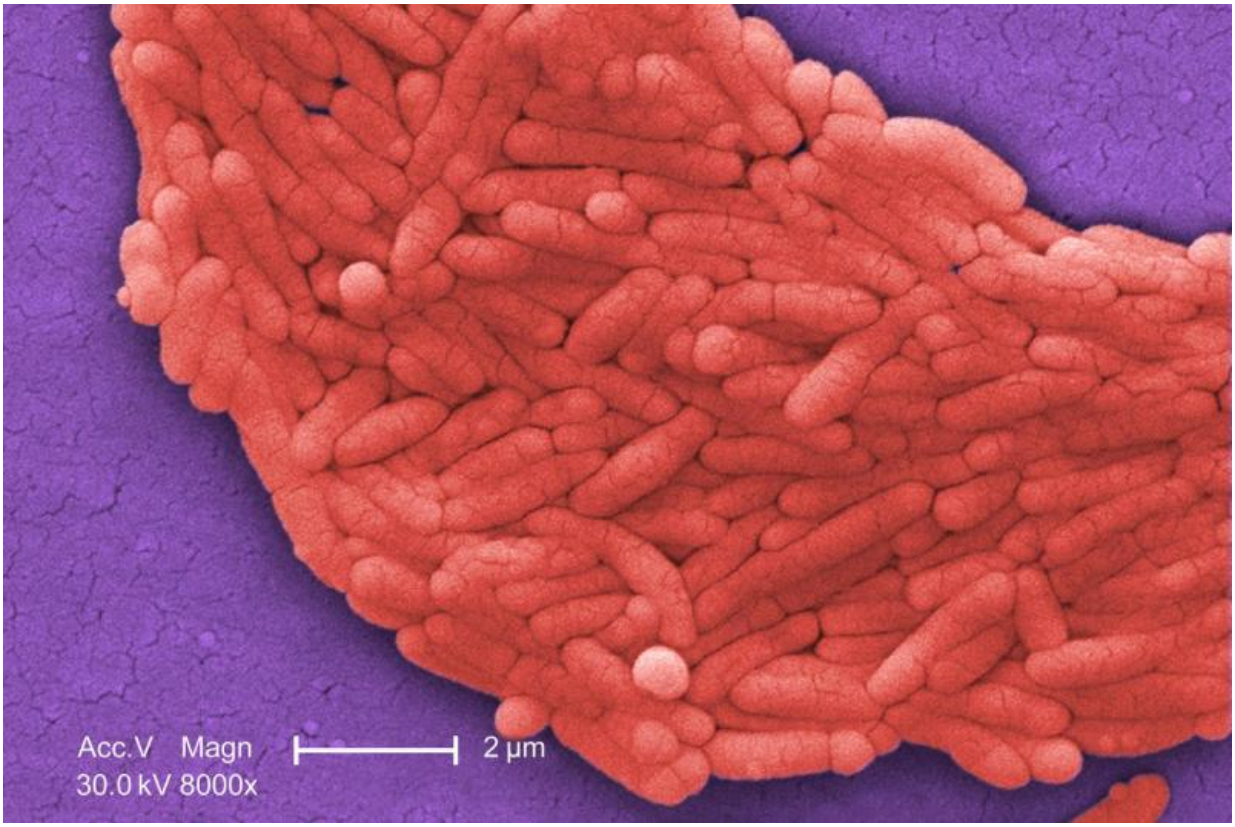


Salmonella forms a biofilm. Credit: CDC

Antibiotics can influence the swimming and swarming ability of multidrug-resistant bacteria, according to a new study in *mSphere*, an open-access journal of the American Society for Microbiology. The

study, conducted using multidrug-resistant *Salmonella*, explored how antibiotics may modulate *Salmonella* virulence mechanisms.

"Understanding the influence of antibiotics on multidrug-resistant bacteria is critical to the proper selection and prudent use of antibiotics while minimizing potential collateral consequences," said co-author Bradley Bearson, PhD, a microbiologist at the National Laboratory for Agriculture and the Environment, part of the United States Department of Agriculture Agricultural Research Service (USDA-ARS).

For several years, researchers at the USDA-ARS have been investigating the consequences of antibiotic exposure on *Salmonella*, including multidrug-resistant strains. "While antibiotics are important drugs to prevent and cure disease in humans and animals, the drugs can sometimes have unintentional side effects both detrimental and beneficial," said Dr. Bearson. "We have been trying to investigate some of the potential collateral effects."

In the new study, researchers evaluated the influence of four different antibiotics (chloramphenicol, kanamycin, streptomycin, or tetracycline) on bacterial motility in six different multidrug-resistant *Salmonella* strains. The six isolates were resistant to ampicillin, chloramphenicol, streptomycin and tetracycline, and three isolates were also resistant to kanamycin.

Motile bacteria use one or more methods to move around, including darting, gliding, sliding, swarming, swimming and twitching. The researchers exposed the bacteria to sub-inhibitory concentrations of the antibiotics while they evaluated motility. Sub-inhibitory concentrations used in this study would inhibit antibiotic sensitive Salmonella isolates, but don't decrease or inhibit the growth of the multidrug-resistant strains.

The researchers discovered that chloramphenicol and tetracycline

reduced both swimming and swarming, though the effect was more pronounced for swimming than for swarming. Kanamycin and streptomycin limited swimming, but had less of an effect on decreasing swarming. In one strain, kanamycin significantly increased swarming.

"We found that most of the antibiotics decreased bacterial motility in multidrug-resistant *Salmonella*, but kanamycin increased the motility in one of the bacterial isolates," said Dr. Bearson. "Since this was surprising, we went on to dig deeper and found that the kanamycin resistance-gene was important, meaning if we put a different kanamycin resistance-gene in the bacterial cell, it didn't enhance the motility like the original gene did. We also found there are some accessory genes in the bacteria that are also required to see that phenotype, but we don't know what those genes are at this point."

Dr. Bearson said that going forward, his lab will try to identify those genes that are involved in the kanamycin enhanced swarming that are not due to the antibiotic resistance gene. "We will do some gene expression studies to try to identify the accessory genes that are involved," said Dr. Bearson.

The researchers say that while antibiotics are valuable tools in human and animal medicine, a better understanding of the potential benefits and negative consequences of their usage is needed. "We are trying to assimilate information about these consequences that would allow physicians and veterinarians to make informed decisions about their antibiotic choice," said Dr. Bearson. For example, he said, if clinicians have two antibiotics that will equally treat a disease in a human or animal, it might be more prudent to use the antibiotic that has an additional beneficial effect or avoid an antibiotic that might have a negative impact.

*Salmonella* is one of the most common causes of bacterial foodborne

infections in the United States. The Centers for Disease Control and Prevention considers multidrug-resistant *Salmonella* a serious threat to public health.