

# Viruses Destroying Bacteria: Refining Solutions to Antibiotic Resistance

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Antibiotics are a category of drug that inhibits the growth and development of microorganisms. One issue facing modern medicine is the rising levels of antibiotic resistance – bacteria are able to resist the effects of antibiotic medications that were once effective. This resistance is a major health concern because antibiotics are the primary treatment for many common infections, including tuberculosis, blood poisoning, gonorrhea, and pneumonia, which are becoming increasingly harder to treat as a result.

Although it sometimes feels like antibiotic resistance could throw medicine back into the dark ages, a new weapon could bring some hope: bacteriophages, or viruses that prey on bacteria. Bacteriophages are not an entirely new discovery, since these viruses often arise naturally in lab conditions; scientists identified some of them shortly after beginning to study bacteria. But as the fight against antibiotic resistant bacteria becomes more urgent, scientists are working harder to refine bacteriophage therapies and make them suitable for medical use.

Bacteriophages have many advantages over antibiotics. Even though every infected bacterial cell produces more phages, each type of bacteriophage targets only certain species of bacteria rather than all microorganisms; phages therefore are less likely to wipe out the helpful bacteria that populate the healthy human gut. Scientists can also create treatments containing several different viruses, making it more difficult for bacteria to evolve resistance.

However, phages are not yet a perfect treatment. Since they are viruses, the body’s natural defense mechanisms are primed to destroy them, so they won’t simply diffuse to the site of infection. However the synergy between the host immune system and the bacteriophage significantly outweighs the risks it presents. For example, studies have shown that people who lack defensive white blood cells respond far worse to bacteriophage treatments.

Researchers are working to tackle these problems associated with bacteriophages. Drug-resistant pneumonia is a significant threat in the U.S., so researchers focused on the lungs as a target tissue. The delivery vehicle for the bacteriophages had to be large enough to penetrate the lungs and avoid digestion by the immune system. To address this issue, they created oily ‘shells’ that surrounded a watery, phage-filled solution, then dried the shells to create a dry powder that could be inhaled into the lungs.

Once this bacteriophage treatment proved functional under laboratory conditions, they tried it in mice infected with drug-resistant pneumonia. Though the phages did not directly cure the pneumonia, bacterial levels dropped to a point low enough for

the immune system to take control of the infection. Only 13% of the untreated mice survived the infection, whereas all of the mice treated with phages survived.

In the next phase of the study, the researchers obtained samples from patients with pneumonia and cystic fibrosis. The researchers screened the samples and identified three phages that would treat each of the infections. They then screened the samples against a library of different phages, identifying three more phage species that could kill each of the infection samples. Mice with the infections were then treated and all but one were cured of their condition.

The phage particles left the lungs within 18 hours, and the immune system did not appear to respond to the phages in any way. It appears that none of the problems scientists had previously anticipated occurred. This study shows that phages could potentially be more effective than originally expected. The phages can also carry membrane-digesting enzymes, increasing the vulnerability of the bacteria. These results are reassuring, but researchers must do more work before they can declare the arrival of a new era of antibacterial medicine.

## SOURCES

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