

Bacteriophages – A ray of hope in the war against antimicrobial resistance

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Since the discovery of penicillin by Alexander Fleming in 1928, antibiotics have dramatically transformed the landscape of modern medicine. They have saved countless lives, enabled life-saving surgical interventions, and served as a foundation for managing infectious diseases. However, the overuse and misuse of antibiotics in both clinical and agricultural settings have led to an alarming rise in antimicrobial resistance, a phenomenon where once-treatable infections become increasingly difficult or even impossible to cure. The World Health Organization has identified AMR as one of the top ten global public health threats facing humanity [1,5]. If current trends continue, resistant infections are projected to claim as many as ten million lives annually by 2050, outpacing cancer in terms of mortality and may cause a cumulative global economic loss of up to \$100 trillion [2].

To tackle this global crisis, scientists and clinicians are revisiting a century-old solution: bacteriophages. These viruses, which specifically infect and destroy bacteria, were discovered in the early 20th century. Phages operate with specificity, targeting only the pathogenic bacteria of interest while sparing the beneficial microbiota. Though they were used therapeutically in parts of Europe and the former Soviet Union before antibiotics became widespread, interest in phage therapy waned in the West after the antibiotic revolution. However, the rising tide of AMR has catalyzed a global resurgence in phage research and clinical application [3].

Around the world, significant progress has been made in revitalizing phage therapy [4, 6]. In Georgia, the Eliava Institute has remained a longstanding center for phage-based treatment. Compassionate-use cases in the United States have shown life-saving results in patients suffering from chronic or multidrug-resistant infections. Regulatory agencies like the U.S. Food and Drug Administration and the European Medicines Agency have begun to acknowledge the potential of phage therapy by permitting expanded access and case-to-case usage, showing that phage therapy is steadily transitioning from experimental treatment to structured therapeutic practice.

In Pakistan, the development of bacteriophage therapy remains in its nascent stages, though recent years have seen a rise in scientific interest. Several academic institutions have begun isolating and characterizing phages from sewage and hospital wastewater, targeting local multidrug-resistant strains. Despite these promising developments, the clinical translation of phage therapy remains limited. No dedicated phage therapy centers currently exist in the country, and phage treatments are not yet integrated into routine medical practice. These interventions, are hindered by the absence of a national regulatory framework, insufficient funding for translational research, and a lack of awareness among healthcare professionals regarding the practical utility and safety of phage therapy. To move forward and catch up with international advancements, a dedicated, purpose-built “Bacteriophage Research laboratory” has been established at Armed Forces Institute of Pathology, Rawalpindi, with the aim to establish first of its kind Phage-bank in Pakistan and provide microbiological support for compassionate bacteriophage therapy in difficult to treat and non-responding bacterial infections.

In conclusion, as the world battles an escalating crisis of antimicrobial resistance, bacteriophages offer a ray of hope—a precise, biologically sound solution drawn from nature itself. Pakistan faces significant challenges in integrating phage therapy into its healthcare system. The time to act is now, before the AMR crisis reaches a point of no return.

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DOI: [https://doi.org/10.1016/s1473-3099\(18\)30482-1](https://doi.org/10.1016/s1473-3099(18)30482-1)

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