**What if viruses eliminated the need for antibiotics?**

02

# Viral Solution

Within Reach | **Transitional** | Visionary

Bioengineered viruses serve as a form of precision treatment for bacterial infections, eradicating antibiotic-resistant infections and eliminating the need for antibiotics.

**UNCERTAINTIES**

Technology, Values

**MEGATREND** (Most significant)

Advanced Health and Nutrition

**TRENDS**

Communicable & Non-Communicable Diseases
Genomics
Longevity & Vitality
Precision/Personalised Medicine

**TECHNOLOGIES**

Biotechnology
Nanomedicine
Real-Time Analytics

**SECTORS IMPACTED**

Agriculture & Food
Consumer Goods, Services & Retail
Data Science, AI & Machine Learning
Health & Healthcare
Materials & Biotechnology

**KEYWORDS**

Antibiotics
Antimicrobial Resistance
Bacteriophages
Food Security
Phage Therapy

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**deaths annually by 2050,** sitting just behind cancer – at 10.5 million – as a leading cause of mortality worldwide

## WHY IT MATTERS TODAY

Antimicrobial resistance (AMR) is a rapidly accelerating global health crisis that threatens to reverse decades of progress in modern medicine. AMR is projected to cause an average of 8.2 million deaths by 2050,[491] sitting just behind cancer – at 10.5 million – as a leading cause of mortality worldwide.[492] AMR is closely linked to the misuse and overuse of antimicrobials in humans, animals and plants, which has led to the emergence of drug-resistant pathogens.[493] AMR presents a substantial barrier to achieving the Sustainable Development Goals (SDGs), particularly the targets within SDG 3 related to newborn survival and healthy ageing.[494]

AMR also threatens the sustainability of agriculture, where it is primarily driven by the misuse of antimicrobials. This results in reduced animal health and welfare in food production, leading to increased food insecurity, safety concerns, and economic losses for farmers.[495] A new report from the World Organisation for Animal Health estimates that annual livestock production losses due to AMR could equal the consumption needs of 746 million people.[496] In a more pessimistic scenario, this figure could rise to around 2 billion people.[497]

Bacteriophage (also known as phage) therapy is not new. Phages – viruses that infect and replicate within bacterial cells – have proven effective against bacterial infections.[498] Bacteriophages were initially noted by British bacteriologist Ernest Hankin in 1896 after he observed antibacterial effects in river water in India. Frederick Twort and Félix d'Hérelle coined the term 'bacteriophage' following d'Hérelle's pioneering use of phage therapy in 1919.[499]

Bacteriophage therapy is currently limited in clinical application.[500] Phage production began commercially in the 1920s, with companies such as L'Oréal in France and Eli Lilly in the United States creating phage-based treatments for various bacterial infections until antibiotics became mainstream.[501] The George Eliava Institute of Bacteriophages, Microbiology and Virology in Georgia is the world's largest bacteriophage collection: over 1,000 phages and 12,000 bacterial strains.[502] The Phage Therapy Unit at the Hirszfeld Institute of Immunology and Experimental Therapy in Poland provides outpatient phage therapy as an experimental treatment.[503]

## THE OPPORTUNITY

Bacteriophages (viruses targeting bacteria) are engineered to destroy or alter bacterial cells,[504] eliminating the need for antibiotic treatment. Nanobots enable the delivery of specific therapies that target bacterial cells, while real-time monitoring allows the identification of bacteriophages tailored to each bacterial profile, optimising treatment efficacy and triggering timely introduction of new phages.[505] This is complemented by the use of advanced machine intelligence to analyse bacterial behaviour and identify strains likely to cause infection.[506]

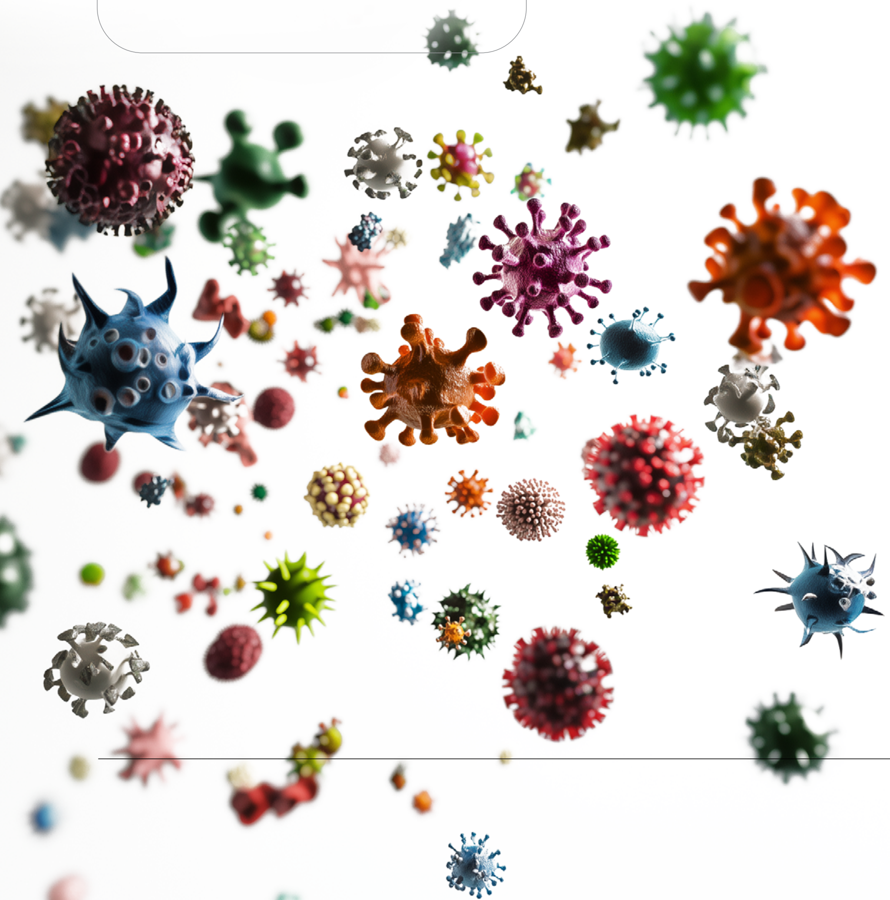
Beyond detecting and targeting bacteria,[507] phages can be used to prevent food contamination[508] and, in veterinary settings, effectively treat infections in livestock, reducing reliance on antibiotics and promoting safer food supply chains.[509]

### BENEFITS

Precision treatment of bacterial infections; elimination of antibiotic resistance and even removal of the need for antibiotics; increased food safety; enhanced global health security.

### RISKS

Bacterial resistance to phages; regulatory challenges; viral mutations; increased health access inequality as antibiotic production stops; potential misuse; unknown long-term effects on human health; lack of social acceptance.



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