



# Efficacy of Bacteriophages in Combination with Antibiotics for Treating Wounds in Burn Patients Infected with Multidrug-Resistant Bacteria

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## ABSTRACT

**Introduction:** Wound infections are a leading cause of sepsis in burn patients, significantly increasing mortality and morbidity related to burns. Addressing drug and antibiotic resistance is crucial in managing these infections. This study explored the outcomes of using bacteriophages (natural viruses targeting bacteria) alone and with antibiotics to treat infections caused by multidrug-resistant bacteria.

**Methods and Materials:** Data were gathered through systematic searches of Google Scholar, PubMed, Web of Science, and Scopus, without time restrictions, using keywords such as "bacteriophage", "burn patients", "multidrug-resistant bacteria", "infections", and "antibiotics". Inclusion criteria encompassed articles focusing on the efficacy and safety of bacteriophages and antibiotic cocktails in treating burn wounds infected with multidrug-resistant bacteria. Two researchers conducted data extraction, initially screening titles and abstracts and retrieving full-text articles as necessary.

**Results:** Results indicated the effectiveness of phage and antibiotic therapies against infections caused by multidrug-resistant bacteria, including strains R10266, R9316, and *Pseudomonas*, susceptible to phages but resistant to antibiotics. Comparing bacteriophage therapy with standard treatments for burn patients infected with *Pseudomonas aeruginosa* demonstrated that some patients received bacteriophages exclusively, while others were treated with silver sulfadiazine cream, a conventional burn treatment. Laboratory studies assessed *Pseudomonas aeruginosa* strains from burn patients under three conditions: a group treated with a single phage, another with a combination of two phages either concurrently or sequentially, and a third with cocktails phages and antibiotics at sub-MIC and MIC levels. Evidence demonstrated that antibiotics effectively reduced bacterial load, while phages successfully treated infections. The combination of phages and antibiotics proved to be the most effective method for eliminating multidrug-resistant bacteria. Moreover, combining phages with antibiotics such as carbapenem and colistin significantly reduced bacterial counts and restored antibiotic sensitivity. Additionally, the production of outer membrane vesicles, structures that enhance bacterial resistance, decreased. These strategies effectively targeted and eliminated bacterial infections.

**Conclusion and Discussion:** Our findings reveal that combining bacteriophages and antibiotics is a practical step in treating infections caused by drug-resistant bacteria.

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