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## Messenger RNA (mRNA)-Based Therapeutics: A Transforming Frontier in Contemporary Pharmacology

*Sushma Singh\*, Saumya Awasthi*

Shri Ramswaroop Memorial University, Tindola, Lucknow-Deva Road, Barabanki, U.P. - 225003, India

**Email Id:** [serviceheb@gmail.com](mailto:serviceheb@gmail.com)

### ABSTRACT

Messenger RNA (mRNA)-based therapeutics have rapidly emerged as a transformative approach in modern pharmacology, offering new directions for the prevention and treatment of a diverse array of diseases. Initially brought to public attention through the development of COVID-19 vaccines, mRNA technologies have since demonstrated promise in areas such as protein replacement therapy, cancer immunotherapy, and next-generation vaccine platforms. This article provides a concise review of key advances in mRNA therapeutic design, delivery strategies, and clinical applications from 2022 to 2025. Developments in circular and self-amplifying RNA formats, optimization methods to reduce immunogenicity, and innovations in lipid nanoparticle (LNP) delivery systems are explored. The manuscript also addresses challenges related to safety, stability, regulatory approval, and equitable access. With continued innovation and expanding clinical validation, mRNA therapies are expected to play a pivotal role in treating infectious diseases, genetic disorders, and cancer.

**Keywords:** mRNA, lipid nanoparticles, immunotherapy, RNA vaccines, targeted delivery

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