

**Keywords:** CRISPR; Gene editing; Precision medicine; Pharmacology; Personalized medicine

## Introduction

CRISPR-based gene editing stands as a transformative technology at the forefront of modern biomedical research, particularly revolutionizing the landscape of pharmacology and paving the way for precision medicine. Derived from the prokaryotic immune system, CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) and its associated Cas proteins enable precise modifications to the genetic code with unprecedented accuracy and efficiency.

This capability has profound implications across various domains of pharmacology, from elucidating disease mechanisms to developing targeted therapies tailored to individual genetic profiles [1].

The foundation of CRISPR-Cas systems lies in their ability to recognize and cleave specific DNA sequences guided by short RNA sequences known as guide RNAs (gRNAs). This mechanism not only allows for precise genome editing—enabling corrections of disease-causing mutations and alterations in gene expression—but also facilitates comprehensive studies in functional genomics and drug discovery. The versatility of CRISPR technology spans from identifying novel drug targets through high-throughput screening to engineering precise cellular models for studying drug responses and resistance mechanisms.

In the realm of personalized medicine, CRISPR-based approaches hold immense promise. They empower researchers and clinicians to tailor therapies based on the unique genetic makeup of individual patients, thereby optimizing treatment efficacy and minimizing adverse effects. For instance, in cancer therapy, CRISPR enables the modification of immune cells to better recognize and eliminate tumor cells, showcasing its potential in enhancing the specificity and potency of immunotherapies [2].

The integration of CRISPR technology into pharmacological research has accelerated the pace of drug development by providing insights into genetic underpinnings of diseases and enabling more accurate preclinical models. This capability not only streamlines the identification and validation of therapeutic targets but also enhances the efficiency of drug screening processes. Moreover, CRISPR-mediated gene editing offers opportunities for developing novel therapies for genetic disorders previously considered incurable, such

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bacterial adaptive immunity are adapted for precise genome editing in mammalian cells. Mechanistic studies elucidate the recognition of target DNA sequences by gRNA-guided Cas proteins and subsequent cleavage or modification of DNA.

**System selection:** Comparing different CRISPR-Cas systems (e.g., Cas9, Cas12a) for specific applications in pharmacology. Factors

treatments are not only effective but also tailored to the unique genetic makeup of each patient.

**References**

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