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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 modi cations to the genetic code with unprecedented accuracy and e ciency. is capability has profound implications across various domains of pharmacology, from elucidating disease mechanisms to developing targeted therapies tailored to individual genetic pro les [1].

e foundation of CRISPR-Cas systems lies in their ability to recognize and cleave speci c DNA sequences guided by short RNA sequences known as guide RNAs (gRNAs). is 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. e 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. ey empower researchers and clinicians to tailor therapies based on the unique genetic makeup of individual patients, thereby optimizing treatment e cacy and minimizing adverse e ects. For instance, in cancer therapy, CRISPR enables the modi cation of immune cells to better recognize and eliminate tumor cells, showcasing its potential in enhancing the speci city and potency of immunotherapies [2].

e 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. is capability not only streamlines the identi cation and validation of therapeutic targets but also enhances the e ciency of drug screening processes. Moreover, CRISPR-mediated gene editing o ers 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 modi cation of DNA.

System selection: Comparing di erent CRISPR-Cas systems (e.g., Cas9, Cas12a) for speci c applications in pharmacology. Factors treatments are not only e ective but also tailored to the unique genetic makeup of each patient.

References

1.