



HUMAN ENHANCEMENT OR HEALING? ETHICAL BOUNDARIES OF CRISPR-CAS9 THROUGH THE LENS OF AMĀNAH

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Abstract

From a laboratory gene-editing tool to a clinically useful platform for treating inherited and acquired diseases, CRISPR-Cas9 technology has developed quickly. CRISPR applications raise serious ethical concerns, especially with regard to off-target effects, germline transmission, informed consent, and intergenerational risk, despite promising therapeutic outcomes in conditions like sickle cell disease, β -thalassemia, and cancer immunotherapy. With an emphasis on safety, efficacy, and ethical risk profiles, this systematic review summarizes clinical and preclinical data on CRISPR-based treatments that were published between 2015 and 2025. Simultaneously, it presents the Qur'anic notion of Amānah (trust), which is expressed in Surah al-Ahzāb (33:72), as a normative ethical framework for genomic stewardship. This framework is presented as a supplementary moral philosophy that is consistent with the well-established bioethical principles of responsibility, non-maleficence, and justice rather than advocating religious authority over science. The review concludes that while germline editing is still unethical under both biomedical and Qur'anic ethical paradigms, therapeutic, somatic CRISPR applications may be ethically justified when controlled by caution, transparency, and societal accountability.

Keywords: *CRISPR-Cas9, gene editing, human disease, clinical trial, ethics, germline editing, somatic therapy.*

1. Introduction

One of the most revolutionary advancements in contemporary biomedicine is genome editing. Adapted from bacterial adaptive immunity, the CRISPR-Cas9 system offers unprecedented potential for correcting pathogenic mutations at their source by enabling precise, programmable modification of DNA sequences. CRISPR-based clinical trials have shown encouraging outcomes in cancer and monogenic disorders, signaling a move away from symptomatic treatment and toward molecular correction (Allemailem et al., 2023).

However, the ability to modify the human genome raises moral questions that go beyond traditional risk-benefit analysis in medicine. Global discussion has escalated due to concerns about genomic ownership, long-term harm, and the morality of changing heritable DNA (Binik, 2020). Strong ethical governance frameworks are needed to control the use of CRISPR, especially in human embryos and germline cells, according to international organizations like the World Health Organization (WHO) and UNESCO (Doxzen & Halpern, 2020).

Religious ethical traditions provide understudied but potentially useful normative perspectives in this discourse. Amānah, a trust that only humans bear, is introduced in Surah al-Ahzāb as a moral obligation linked to agency and accountability (Qur'an 33:72) (Bhat, S. (2024)). In secular bioethics, this idea can be reinterpreted as genomic stewardship, which prioritizes accountability over dominion. In order to evaluate CRISPR's potential for treating illness, this review combines scientific data with this moral framework (Wewior, N. (2022)).

Methods

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In accordance with the PRISMA 2020 framework for transparent reporting of non-interventional evidence syntheses, this study used a systematic narrative review methodology. This design was chosen to combine quantitative clinical data with qualitative ethical analyses, which call for structured thematic synthesis rather than meta-analytic pooling. A thorough search of the literature was done using PubMed, Web of Science, and Scopus. Leading biomedical journals, such as Nature Biotechnology, The New England Journal of Medicine, The Lancet, and Cell, were manually screened to guarantee the inclusion of high-impact and translationally relevant studies. Free-text keywords and controlled vocabulary (MeSH terms) were combined to create a predetermined and repeatable search strategy. "CRISPR-Cas9," "gene editing," "human disease," "clinical trial," "ethics," "germline editing," and "somatic therapy" were among the key search terms.

Database-specific syntax was modified to optimize sensitivity and specificity, and boolean operators (AND/OR) were used to refine search results. Before being screened, duplicate entries were eliminated and all retrieved records were imported into a reference management system. After screening titles and abstracts, two independent reviewers evaluated potentially eligible articles in full. To reduce selection bias, disagreements were settled by discussion and agreement.

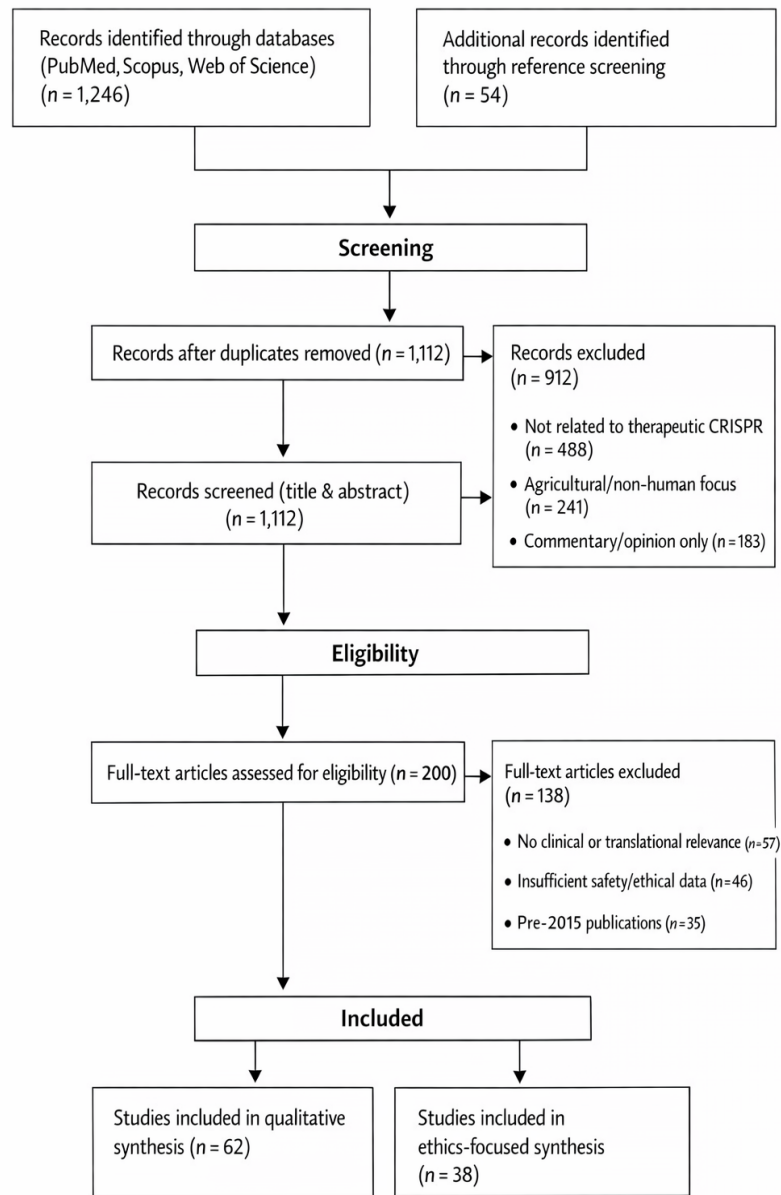
2.1 Eligibility Criteria

Inclusion Criteria

Studies published between January 2015 and December 2025 that included human subjects or clinically relevant animal models with direct translational implications were eligible for inclusion. concentrated on the therapeutic uses of CRISPR-Cas9 gene editing in the management of illness.

Exclusion Criteria

Editorials, narrative commentary, or opinion pieces devoid of empirical or experimental evidence were restricted to CRISPR applications in agriculture, the environment, or industry.



3. Results

3.1 Identified Ethical Debates and Islamic Bioethical Interpretations

The possibility of off-target effects, unforeseen consequences, genomic instability, and irreversible changes are major ethical issues with CRISPR-Cas9 in the treatment of human diseases (Lorenzo et al., 2022). One of the main points of contention in ethical discussions is the difference between somatic cell editing, which is non-heritable, and germline editing, which involves heritable changes that affect future generations (Hammerstein et al., 2019). Concerns about eugenics, the idea of "designer babies," fair access to these cutting-edge treatments, and the possibility of escalating social injustices are all commonly raised. Furthermore, numerous ethical discussions consistently emphasize the need for strong oversight and the absence of a clear regulatory framework (Lau, 2019). The acceptability of CRISPR-Cas9 is frequently



assessed from an Islamic bioethical standpoint using concepts like the sanctity of human life, the preservation of ancestry, and the avoidance of harm(Isa et al., 2020).

3.2 Mechanistic Insights and Experimental Validation of CRISPR-Cas9 in Disease Therapy

Monogenic Disorders

In sickle cell disease and β -thalassemia, CRISPR-mediated editing of hematopoietic stem cells has demonstrated long-lasting clinical benefit by reactivating fetal hemoglobin expression. Vaso-occlusive crises were decreased in early trials with acceptable safety profiles(Frangoul et al., 2021).

Cancer Therapy

Early-phase oncology trials have shown improved antitumor immunity with CRISPR-engineered T cells that target PD-1 or tumor antigens. On the other hand, risks include oncogenic mutations and unintentional immune dysregulation(Lu et al., 2020).

3.3 Safety Concerns

Off-target DNA cleavage, mosaicism, and irreversibility in germline contexts are examples of persistent ethical risks that require ethical restraint because they are still unpredictable(Lu et al., 2020).

4. Ethical Challenges in CRISPR Applications

Somatic editing is consistent with conventional therapeutic ethics and only affects the person being treated. However, germline editing violates the precaution and consent principles by introducing permanent genetic changes that are passed down to future generations. The international bioethical consensus strongly opposes the use of CRISPR for non-therapeutic enhancement because it raises issues of genetic stratification, inequality, and eugenics(Karagyaur et al., 2019).

5. Amānah (Trust) as a Framework for Genomic Stewardship

Surah al-Ahzāb states:

“We offered the Trust (*Amānah*) to the heavens and the earth and the mountains, but they declined to bear it... and man undertook it” (33:72).

When *Amānah* is applied to genomics, it reframes the human genome as entrusted rather than exploitable. It also implies responsibility without absolute ownership, accountability for consequences, and moral restraint despite capability. This is consistent with non-maleficence, intergenerational justice, and precautionary governance. Unlike assertions of scientific foresight, this integration operates at the normative level, enhancing rather than displacing secular bioethics(Ghaly, 2024).

7. Discussion

This analysis shows how Qur'anic moral philosophy can enhance current bioethical discussions without imposing theological authority on scientific methodology. The idea of *Amānah* aligns with worldwide bioethical demands for moderation, care, and accountability in genome editing. These frameworks could support culturally grounded governance of emerging biotechnologies, especially in LMIC contexts. The application of CRISPR-Cas9 is ethically guided by the Islamic concept of *Amānah*, which signifies stewardship of the human genome and requires a responsibility to preserve and protect human life and its inherent dignity(Ghaly, 2024).

The concept of *Amānah* (trust) is introduced in Surah al-Ahzāb as a distinguishing feature of human moral agency.



“Indeed, We offered the Trust (Amānah) to the heavens and the earth and the mountains, but they declined to bear it... and humanity undertook it” (Qur’an 33:72).

According to Rāzī and Ibn Kathīr, traditional Qur'anic exegesis views Amānah as a moral obligation, accountability, and the burden of ethical decision-making rather than as a material object. The application of gene editing for therapeutic interventions targeted at reducing suffering is encouraged by this framework, while adamantly opposing changes that might be interpreted as "tampering with God's creation" or resulting in improvements that aren't medical (Cebeci, 2020).

Amānah reframes the human genome as entrusted instead of owned when it comes to genome editing. In the context of irreversible germline interventions in particular, this interpretation aligns with the global bioethical discourse that emphasizes responsibility toward future generations. The Qur'an supports new scientific ideas but says they should be guided by responsibility, self-control, and fairness. Creating ethical rules and good practices for CRISPR-Cas9 technology requires a careful balance of scientific progress along with moral, social, and religious beliefs. This means promoting open conversations between scientists, ethicists, policymakers, and religious leaders to make sure that new developments are responsible and to consider their potential long-term effects (Isa et al., 2020).

Bringing these together can improve fair rules, public trust, and the legitimacy of policies, all while maintaining scientific quality. Future research should focus on making CRISPR-Cas9 safer and more accurate, improving how it is delivered, and doing thorough long-term studies to see how gene changes affect things. It's important to keep exploring Islamic views on bioethics and to work together with people from different fields. This will help us understand the complex world of genomic medicine and make sure it is used fairly and ethically around the world.

8. Conclusion

CRISPR-Cas9 has the power to change how we treat human diseases, but it needs careful guidelines that consider more than just the technical risks involved. Bringing together Quranic values, especially the idea of trust (Amānah), provides a strong way to manage genetics that aligns with global bioethics standards. Therapeutic somatic editing might be acceptable from an ethical standpoint, but changing genes in embryos or for personal improvement is considered wrong because of unclear science and ethical concerns.

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