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ETHICAL IMPLICATIONS OF GENE EDITING TECHNOLOGIES: A COMPREHENSIVE REVIEW OF THE ETHICAL DATABASES SURROUNDING CRISPR-CAS9 AND OTHER GENE EDITING TOOLS

Kristi Sharma

Student

Amity Institute of Biotechnology

Amity University, Noida

India

Abstract: Genetics has undergone a revolution because of gene editing technologies, especially CRISPR-Cas9. These technologies allow for accurate, effective, and cost-effective modifications to DNA. Although the scientific world applauds these developments for their potential to improve human capacities and eliminate genetic diseases, there are significant ethical questions. The goal of this paper is to present a thorough analysis of the ethical discussions surrounding gene editing technology by looking at case studies, moral dilemmas, and legal issues.

Keywords

Gene editing, CRISPR-Cas9, ethics, genetic modification, legal issues, genetic flaws, human genetics.

1.Introduction

Genetic research and treatment have been completely revolutionized by gene editing technologies, particularly the CRISPR-Cas9 system. The early 2010s saw the discovery of CRISPR-Cas9, which makes precise modifications to the DNA sequence possible. This makes it easier to improve hereditary qualities and fix genetic flaws. Gene editing presents substantial ethical and legal challenges despite its possible advantages. The possible abuse of the technology, unforeseen effects, and ethical ramifications of modifying human genetics are the main topics of these worries.

2. Case Studies

2.1 Case Study 1: Human Embryo Editing in China
The birth of twin girls whose embryos had been altered using CRISPR-Cas9 to confer HIV resistance was revealed by Chinese scientist He Jiankui in 2018. This news brought attention to the moral dilemmas surrounding gene editing in human embryos and caused indignation throughout the world. The technology was not yet safe for human usage, according to critics, and the experiment went beyond ethical standards pertaining to consent and the children's possible long-term impacts (Liang et al., 2018).

2.2 Case Study 2: Beta-Thalassemia and Sickle Cell Illness
Treatment for hereditary illnesses including sickle cell disease and beta-thalassemia may be possible with CRISPR-Cas9. Clinical investigations have shown that by correcting the genetic defects causing the disorders, gene editing may be able to heal these conditions (Frangoul et al., 2020). These encouraging experiments highlight the therapeutic potential of CRISPR-Cas9, but they also highlight the importance of ethical supervision.

3. Ethical challenges of gene editing

3.1 Safety and efficacy
Ensuring the technology is safe and effective is the main ethical challenge associated with gene editing. Serious hazards arise from off-target consequences, which occur when sections of the genome are altered without purpose. Long-term research and rigorous testing are necessary to guarantee the safety and efficacy of gene editing (Baltimore et al., 2015).

3.2 Germline editing

Particularly contentious is the process of altering eggs, sperm, or embryos in order to modify the human germline. These changes can be inherited and passed on to subsequent generations. Given that future generations cannot consent to the genetic modifications done on their behalf, this raises consent-related concerns (Nuffield Council on Bioethics, 2018).

4. Ethical Issues in Gene Editing

4.1 Knowledgeable Consent
A fundamental component of moral medical practice is informed consent. But getting fully informed consent is difficult when it comes to gene editing, particularly when it comes to germline operations. The technology's dangers, advantages, and unknowns must be completely disclosed to potential subjects (Evitt et al., 2015).

4.2 Fairness and Parity
Technologies for gene editing could make already-existing socioeconomic injustices worse. The wealthy may have exclusive access to costly gene therapies, creating a genetic divide in which certain people are genetically treated or enhanced to a greater extent than others (Gyngell et al., 2017).

5. Ethical concerns

5.1 Treatment vs. Enhancement
It is morally difficult to distinguish between the medicinal and enhancing uses of gene editing. Enhancement entails raising the standard of behaviour for humans, such as intelligence or physical prowess, whilst therapeutic applications seek to treat or prevent illness. The latter calls into question the social ramifications of producing "designer babies" as well as issues of justice (Savulescu et al., 2015).

5.2 Acting as God

The idea of "playing God" is a reflection of worries about basic components of life being taken over by humans. Some claim that gene editing crosses ethical bounds because it enables people to make significant modifications to the genetic composition of species, including oneself (Sandel, 2007).

6. Legal concerns

6.1 Normative Structures

Nation-state laws pertaining to gene editing differ greatly from one another. While some countries have more lax rules, others have more stringent laws. To address ethical and safety concerns, there must be an international consensus on the control of gene editing technologies (Ledford, 2015).

6.2 Intellectual property and patents

Regarding access and innovation, the patenting of gene editing technology presents moral and legal questions. Although patents can encourage research, they can also monopolize the biotechnology industry and restrict access to potentially life-saving treatments (Contreras & Sherkow, 2017).

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