The Ethical Implications of CRISPR-Cas9

Karthik Kuppuswamy*

CRISPR-Cas9 is an illuminating discovery in the biotechnical industry; the potential impact of a gene-splicing technology with unprecedented precision and simplicity is monumental. As indicated by the name, the functionality of this innovation relies on two distinct components operating in tandem. Cas9 is a nonspecific endonuclease, which is the mechanism utilized to cleave the DNA. To identify the genomic locus of the undesirable mutation, however, a gRNA (guide RNA) is necessary, hence CRISPR. This biological apparatus originated in the uniquely adaptive immune systems of various bacteria and archaea, in which it is employed to stave off invasive bacteriophages[1]. The implications of CRISPR-Cas9 are extraordinary: disorders born of genetic irregularities can be eliminated with the refinement of this technology. Unfortunately, the primary advantage of CRISPR-Cas9 is also where its potential for abuse lies; the myriad of benefits associated with CRISPR-Cas9 are rife with ethical uncertainties. The relative simplicity of this technology and the fact that it can be operated with minimal knowledge and equipment has intrinsically negative consequences. The purpose of this article is to delve into the potential manipulation of CRISPR-Cas9 technology for morally questionable intent.

*Freshman Student, Fulton Science Academy.
kkuppuswamy@fultonscienceacademy.org

1 Controversy

The advent of CRISPR has reignited the controversy of human germline alteration. Because of its uniquely direct treatment approach, CRISPR's promise as an unconventional treatment for a devastating category of diseases means that it cannot be dismissed as a passing gimmick. As a result, researchers have imposed a temporary prohibition on gene line modification until the implications of CRISPR have been comprehensively analyzed[2]. Despite the indefinite delay of the implementation of CRISPR, the debate between those who believe CRISPR technology should be harnessed and those who believe it transcends an ethical barrier rages on.

Although the progression of human germline editing has stalled, numerous other applications of CRISPR are being actively pursued in the scientific world. For years, genetic modification has been conducted on a host of organisms: mosquitoes, plants, and even microorganisms[3]. However, the relative simplicity of CRISPR necessitates concern over generational interference and small-scale genetic modification. Consequently, the ever-expanding influence of genetically modified organisms warrants the reinforcement of the regulation of this practice. To dispel the objections of skepticists and naysayers, it is imperative that the general public has complete confidence in the safety of GMOs. One, if not the most effective means of communicating this to the public, is through the establishment of firm restrictions and ethical boundaries by federal agencies. Legislative action will create a rigid framework for the acceptable use of CRISPR by severely penalizing those who infringe upon regulations.

The imposed moratorium on CRISPR was almost singlehandedly catalyzed by an experiment conducted by He Jiankui. Commonly referred to as the "designer baby" experiment, Jiankui circumvented medical restrictions and utilized CRISPR to induce a mutation in the HIV-1 gene[4]. He did so without any consultation whatsoever, and the scientific community collectively condemned his actions. This unforgivable transgression resulted in 3 years of imprisonment and suspension of research activity by the Chinese government. The inclusion of this story is significant because it substantiates the concerns surrounding CRISPR; the fact that Jiankui was able to subvert medical authorities and perform these experiments is understandably worrying.

Despite Jiankui's actions, CRISPR has proved exceptionally promising in the field of immunotherapy and somatic cell modification. Although CRISPR's most notable contributions are hereditary, it has potential in everything from cancer

immunotherapy to stem cell replication[3]. The fact that CRISPR exhibits both expansive treatment and prevention is the most beneficial characteristic of gene therapy.

2 CRISPR Technology with Mosquitoes

One particular instance involving CRISPR technology that emphasizes its sheer capability is the attempted eradication of disease-ridden mosquitoes. This specific application is especially dangerous because of how unpredictable its ecological impact is. This effort, which is directed at carriers of the Plasmodium virus and dengue fever—two diseases that have plagued historically destitute countries for centuries—explores a radical method of gene modification known as gene drives. Gene drives use numerous methods to inhibit the transmission of disease, some of which include sterilizing male mosquitoes and reducing the lifespan of the mosquito population. Gene drives are particularly potent in that the modification of a few mere specimens can propagate the artificially implanted characteristic exponentially through generational progression[5]. This development is the result of a unique ability of a gene drive to copy a mutation activated by CRISPR to both chromosomes. Consequently, all subsequent generations will inherit the mutation. Such drastic interference in ecological processes, particularly in a context as ubiquitous as the presence of mosquitoes, can decimate a species and engender an irreversible environmental imbalance. This instability may ripple throughout the ecosystem, devastating secondary species that rely on mosquitoes for sustenance and encouraging invasive species to occupy the now-absent biological niche. From this arises numerous unanswered questions: Can deviations from the anticipated mutations be neutralized promptly? How will the dynamic of the ecosystem shift after these changes? And most importantly, How does this impact humanity in the long-term? Responding to these concerns will require dedicated research and strict administrative action, measures that are currently inadequate.

3 Conclusion

When considering CRISPR in the context of general healthcare, it is important to consider more practical aspects like affordability and availability. With the introduction into the general public comes many complications: clinical trials

and unintended mutations are but a few. Although CRISPR itself is relatively affordable, the biologics and secondary treatments are not[6]. Naturally, there will be selfishly motivated medical faculty that prioritize this treatment for monetary gain, exteriorizing the need for regulation. The immediacy of governmental action is pivotal. An ultimatum must be established immediately, and irresponsible use of this technology should be quashed. Lenience on behalf of the government could be misinterpreted as tolerance, which would have disastrous consequences. Because the application of CRISPR is inevitable, the implications detailed here should impel immediate action. CRISPR's legacy relies entirely on how humanity harnesses it, so we have a moral obligation to be proactive in ensuring that it will leave a positive, lasting impact.

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