Gene Editing: The Application Without Neglecting Human Rights

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Scientific Benefit and Moral Hindrance:

The production of therapeutic and medical advancements has enabled longevity and health throughout humanity. Within the medicinal realm, treatments have been created that were not even fathomable just a century ago. Ethical questions have risen as this level of progress has the capability to impact the rights and morals of many individuals. Specifically, these questions are being asked as it relates to genetic engineering and gene editing. Several innovations have developed by using proteins to edit genes by replacing the negatively associated gene with the positively associated gene (which results in the desired genetic expression/trait). These fields show tremendous potential to treat countless issues that plague society today. These issues include but are not limited to; the ability to impact the genetic makeup of viral and bacterial pathogens to mitigate pathogenesis[1], the capacity to decrease the prevalence of cancer[6], treatment of myocardial ischemia[12] and the capability to cure genetically linked disease. The list of possible cures is exponential.

The question is, where will this technology be taken once basic therapeutic benefits are achieved? By use of this mechanism, the technology can also be used to create designer babies, or babies that possess the desired traits of the parents. Therein lies the problem… Allowing the technology to proceed for the alteration of physical characteristics in children can create several issues. Many activists say that this is a disturbance of nature, an alteration of the divine that has created humanity as it relates to the aesthetic appeal.[5] Humans possess a certain set of individuality, and to interfere with the natural process may lead to a new set of problems. Diversity is what defines mankind. The DNA of every person is unique to only them. Although there are many problems with this technology, the potential to cure an array of disease sounds

quite convincing. This seems to leave humanity at a standstill, do the numerous benefits outweigh the moral obligation to protect what provides the human condition? The outcome is quite controversial and requires a complex solution.

To avoid this slippery slope, where society reaches a point in which there is no return, a happy medium must be found. The implied benefits of such treatment can be simply justified by the amount of lives that it would save, such that tremendous suffering could be relieved. However, the obstruction of the human genome and the practice of eugenics may provide some unwarranted repercussions. There is certainly a way to harness the innovation and prevent the rapid overuse of this technology. A clear and blatant line must be drawn that no treatment provider crosses. To prevent this catastrophe, it must be made clear that no interference with embryonic development occurs. It is a moral obligation to understand that the embryo will one day be a fully cognizant person who may make their own decision to utilize gene therapy. To interfere with nature in such a way would be a crime in and of itself. This purpose must be established, making the treatment explicitly available to autonomous individuals who provide full consent.

The other variable must also be addressed, that development is not to be interfered with for the single purpose of producing a child with desired physical and sexual traits. Enabling the manipulation of aesthetic features may create a society that is absent feeling, emotion and understanding. A society focused on image and perception of physical being, rather than the content of character. If the human genome becomes identical, then what is the human condition and how does it translate? Complex solutions require different inputs from a diverse population,

if everybody thinks the same then it is likely that the capability to apply numerous solutions to an issue may be compromised. Genetic editing should only be used to treat and prevent disease rather than the creation of designer babies. Innovation in gene-editing has led to the argument that there is a slippery slope in this field of medicine, such that a point will be reached where there is no possibility to recover. The continuous development of genetic therapeutics has the potential to cure several diseases as well as offer numerous benefits to the treatment of infection. So long as embryonic development and interference with religious tradition are respected, the true potential of genetic editing and coding may be brought to bear.

Scientific Possibility:

Innovation is the reason that humans can sustain life, to maintain longevity with the ability to ensure quality of life. Without innovation in the medicinal field, society would look much different. The average human life span would be minimized, and development of disease would be yet another obstacle, provided no answer or solution to the issue. Genetic coding is one of the newest fads in the medicinal field. It can provide several solutions to the numerous diseases that many people are required to live with.

To understand the treatment, the foundational gene science must first be understood. Genes are subsequent sections of DNA and are the functional unit of heredity. These units encode to produce specific proteins or structures, such that their expression leads to a specific outcome for cellular function/development. Gene-editing (commonly known as base-editing) involves the branch of science that allows individuals to remove un-desired genes and replace them with genes that produce a desired outcome. These undesired genes can include anything from the

expression of proteins within a pathogen that allows for their reproduction or traits that are expressed within a human that encode for chronic disease and cancerous cells. To prevent their occurrence or expression, they must first be removed before they can be translated into function. This process revolves around the discovery of Clustered Regularly Interspaced Specific Palindromic Repeats (CRISPR) which is a family of DNA (Deoxyribonucleic Acid) sequences that are found in prokaryotic cells; derived from fragments of DNA from specific bacteria that had once infected the cell.[9] This led to the discovery of the capacity to edit genes within organisms, designed to destroy the DNA of infectious prokaryotic cells entering the host cell.[8]

Most recently, this technology is being studied and developed by CRISPR Therapeutics (as well as several others) for the purpose of treating genetically linked disease and etiology of chronic disease via genetic expression. The CRISPR Associated (cas) protein complexes developed by CRISPR Therapeutics are designed to move into the cell to remove or destroy these undesired genes (coding for possibly toxic or harmful structural expression) from the DNA at the cellular and molecular level. This technology has already been experimented with immensely and has demonstrated several positive outcomes. It is usually assumed that gene editing only occurs within the human genome, but the potential treatment of viruses is rarely pondered. Studies have shown that base-editing is quite efficient in the treatment of pathogens, specifically in the treatment and detection of viruses. The latest CRISPR protein (Cas14) has been tested to demonstrate its efficacy on viruses, where the protein can detect viral DNA (specifically single stranded DNA) that is prevalent in several viruses.[1] CRISPR's cas13 protein complex has also demonstrated achievement in its effects on prokaryotic bacteria at regulating

mobile elements of the prokaryote as it relates to the organisms RNA.[9] Aside from viral/bacterial detection and coding, several chronic diseases can be treated.

Gene therapy can be utilized as an alternative where other solutions may lack stability or prevalence. Chronic Granulomatous Disease (CGD) is an immunodeficiency that results in the decreased activation of antimicrobial phagocytic cells (leading to recurrent childhood infections) where the only form of treatment is Hematopoietic Stem Cell Transplant.[4] This seems to be an issue if there are no stem cells available to transplant, which is why gene therapy is an extremely effective tool in this circumstance. Gene therapy is used via endonucleases that are inserted through viral vectors to prevent the mutations in phagocytic cells.[4] The innovation of gene therapy has proven to be an effective answer when there are not many other options for treatment. Most importantly, there have been several signs of success in gene therapy to treat two of the deadliest forms of disease in the world to date: Cancer and Heart Disease. There have been many successful trials in cancer research relating to the use of gene therapy to reduce the number of cancerous cells and ultimately destroy them. During experimentation with Cas9 protein, the potential to effect and modulate the oncogenic pathway of cancerous cells was observed.[6]

Genetic engineering has the potential to save countless lives from suffering and agony with continued experimentation/clinical trials. If this style of gene therapy becomes FDA approved after proper procedure/clinical trials and is made available to the public, several lives can be saved. The same can be said as gene therapy is being utilized in the treatment of heart disease. A recent study suggests that when gene therapy was used via injection of vascular endothelial

growth factor into the myocardium (muscular layer of the heart), there was a significant decrease in ischemic cells (cells deprived of oxygen).[12] These different forms of genetic editing/coding are where the industry exists currently, demonstrating enormous potential for growth. Existing outside of the healing character involved in genetic therapeutics, some of the most important bioethical questions were presented through experimentation which revolutionized the informed consent with patients as well as the safety for human subjects within clinical trials.[13] This discovery from recent genetic studies involving human subjects describes the new wave of medical ethics revolving around patient autonomy and beneficence for the patient. Gene-editing procedures, despite an unfortunate circumstance, resulted in one of the many driving factors behind modern bioethics.

The scientific benefit of gene therapy is in the early stages and the value that exists within this style of medication can be observed as the field continues to grow. The field exemplifies a large level of potential to mitigate the spread of disease and may offer solutions to some chronic diseases in the coming future. It is also relatively safe to assume that the progression of this industry may result in the ability to treat pathogens and effectively heal those who suffer from a bacterial or viral infection which may otherwise result in death. Humanity continues to create solutions to solve extremely complex problems by using medicinal and therapeutic methodology. Base-editing is one of the most recent scientific developments and seems to possess the largest capacity for solutions in pathology and pathophysiology of disease. Gene-editing has proven to be extremely beneficial as an advancement in modern medicine, and it has only just begun.

The Moral Crisis:

Humanity can simply be defined through its diversity. Each person's genetic makeup is different from one another. To interfere with this pathway, the creation of all people, may result in an irrecoverable conundrum. The argument proposed by many ethicists discusses the potential of gene therapy to spiral into several issues such as designer babies and eugenics, which is a completely valid argument. Who is to say that once the technology has been patented and becomes efficient, individuals would not begin to edit children before they can fully develop? As the technology continues to progress, several ethical issues are being brought to light. One medical issue that gene therapy, especially in embryonic development, may provoke is autonomy misguidance for the developing fetus. In the coming future the developing embryo will turn into an adult with a clear and rational mind of their own. The use of gene-editing on the child may not be a form of treatment that the child would have wanted, even if diseases can be completely deleted from the embryo prophylactically. What if the child preferred to be unique in their own way? Treatment in this fashion would be a direct violation of autonomy to the highest degree, stripping the individual of their rights before they possess the ability to make the decision for themselves.

This issue has a direct relation with the informed consent of said autonomous being. The experimentation with this technology has been quite prevalent in adults but has yet to be tested among the adolescent population, in which case the side effects from the treatment are unknown.[10] So far, there is inadequate study and evidence of the effects of gene therapy in children. It is quite difficult to use children as test subjects with adequate informed consent because children are usually incapable of understanding this style of treatment. In this

circumstance, it is quite difficult to assess the adequacy of the therapeutics ethically because the assessment of physiological response to the treatment would need to occur with consent of the parent and not the child. The ethical violation that may precede this is the possible violation of religious beliefs that revolve around the divine creation of humanity. When the use of gene editing becomes absolute and intends to remove the presence of "God" from human life, the use of the technology then becomes an abuse.[5] The religious argument posed describes that interference with the divine creation of humanity is a direct violation of their religious values. Respect must be granted to all human beings who choose to practice their beliefs. Applied on a universal scale, it is the founding principle of a society based in individual liberty. Disturbance of any citizen's religion via genetic engineering without their full consent is a form of medical paternalism. This would completely negate self-determination regarding medical treatment plans. If the implication of the therapy allows the beholder to use its power for abuse, then the slippery slope has begun, and an impasse will be met.

The safety of the subjects taking place in these trials should also be well considered as it is their right to be fully informed about the intent of the study and be aware of any possible adverse effects in the study.[3] One individual had unfortunately died during the administration of genetic therapeutics, something that must be noted in the consideration of this mechanism for healing.[3] Granted the possibility of side effects as well as many possible ethical violations, is gene-modulation a medicinal option that is necessary? Skeptical analysis of gene editing is an absolute necessity, and the constant progression of the industry gives rise to numerous ethical questions. Violation of these proposals may lead to a massive ethical and religious controversy. It is vital to the human condition that these values are maintained… However, there is a way to

channel the potential of gene therapy and genetic engineering. By use of therapeutics as a cause to relieve pain and illness, rather than the production of artificial fetuses, the power of this medicine can be harnessed without infringing upon any ethical propositions.

The Compromise:

Gene-editing can be the answer to several problems but also creates another set of complications. The issues presented can be avoided if a line is drawn that no medical professional should ever breach. The application of gene-editing programs should not result in a god complex where individuals possess the power to create artificial children that meet their demands. In order for proper application to occur there must be a consensus between the entire community, ranging from medical professionals, government officials, religious representatives, and the general population.[7] The development of this discussion should create a universally applied law – one that transcends all aspects and answers the question for the human condition… A law that does not only pertain to one category. Any violation of this consensus should be punished to prevent the rapid decline that may occur by means of the infringement.

It is important to note that the use of genetic therapeutics is beginning to develop some acceptance among the religious community. The argument that is presented by many forward-thinking religious scholars is that the use of science to further advance medicine may be a gift from "God," that treatment and not abuse is essential.[2,5] The use of contemporary Christian Bioethics has become the new answer for some of these difficult questions regarding medical treatment. A major point to be discussed is that the Church has adopted an Aristotelian

philosophy in which philosophical, non-religious Christian developments can be reasoned with.[2] This merger of philosophy and religion develops a stance of reasoning within the genetic engineering field. Where Saint Thomas Aquinas provides the argument that corruption within a portion of nature does not interfere with nature as a whole.[11] Demonstrating that the manipulation of nature to serve the purpose of health and wellness may not corrupt the entirety of the human race. In which case, the Aristotelian merger of science and religion is developed, to the extent that religion may be able to justify scientific exceptionalism in the modern era. It provokes the idea that science and religion have continuity and may continue to compromise with each other, so long as moral decency is not lost in the process.

It is certainly reasonable to present the argument that a divine creator granted free will to mankind. In which case, the development of technologies such as genetic coding/editing may merely be the result of humans crafting technology to improve society through free will provided by the divine. The further understanding of philosophy and religion develops such that humanity was destined to create some form of medicine as powerful as genetic therapeutics. Ultimately, that the destiny of mankind is defined by the human condition to develop and prosper rather than total divine intervention. This relationship with religion and science walks a fine line, where it is of the utmost importance to maintain a principle that should never be disregarded or forgotten. To maintain this relationship, it is necessary to distinguish between the use and abuse of this medicinal anomaly.

To prevent any violation of religious or moral obligations, it is essential to innovate while respecting these traditions. This therapeutic methodology should only be used to prevent or

relieve pain and suffering, exclusively to produce relief and not to intervene with the natural order of embryonic development.[5] By following a clear rule such as this, innovation may proceed without the desecration of inalienable human rights. Existent within humanity is an innate desire to excel and modernize but it is crucial to ensure that the human condition is rigorously preserved. If humanity does not acknowledge the true potential that gene therapy possesses, it would be crass. Society has the potential to reduce and cure the prevalence of several diseases. The medical community could be responsible for saving countless lives by curing such heinous and destructive diseases such as cancer. Furthermore, the mitigation and control of a pandemic would be much less difficult. Gene therapy has the capacity to manipulate the genetic makeup of several viruses and bacteria. Pathogenesis would cease to be a recurring issue as the ultimate solution could result in the destruction of the pathogen at the molecular level before the genes for viral or bacterial reproduction can be expressed.

The medical community would be doing society a disservice if these options for care are not considered. A large potential to treat and mitigate the prevalence of pathogens exists, as well as the capacity to provide efficient ministrations to those suffering from chronic disease, cancer, or heart disease. All avenues considered; gene-editing may be applied efficiently but must be done cautiously. The ethical question brought about by gene therapy is extremely complex, but if a universal law is established, treatment efficacy absent moral deterioration will be observed.

Relevance:

Genetic therapeutics may solve an entire sector of problems for humanity. The scientific community has a moral obligation to continue to develop technology and solutions for diseases

that continue to plague society. Given the several revelations present in current research, it is likely that gene editing may provide an effective alternative to a variety of treatment plans. With advancements in technology, it will become much more efficient to ensure quality of life and longevity for individuals struggling with infection, chronic disease, heart disease, and cancer.

Soon, the potential to manage these diseases can be expected. However, the nature of the treatment gives rise to an array of possible violations. There are several moral issues that should always be considered within the experimentation and implementation of genetic therapeutics. This does not give reasonable doubt to the treatment nor does it invalidate the intervention, rather it provides a system which must be compromised with and abided by. When using gene-editing, a system of rules must be applied to prevent the unnecessary misuse of the treatment. Ethics should always be considered within clinical trials where the patient should be completely informed of any possible adverse effects that have been observed upon their application. Above all else, the autonomy and self-determination of each patient should be put first regardless of their potential to benefit the research and experiment. Humans should never be treated as test subjects but as a person who characterizes their own dignity, all trials should proceed with paramount respect for the individual's rights.

All aspects considered, the moral obligation of the healthcare community must align with the moral traditions and values of their patient. Religious values should always be respected regardless of the potential to benefit the individual. If the individual's beliefs do not align with the treatment, then the medicinal plan for the patient must be rewritten. Specifically, the violation of the divine creation should be avoided. A devout religious figure may completely

disagree with the manipulation of the fetus' DNA. Preservation of religious rights in medical affairs is of the utmost importance. Any obstruction of these fundamental rights would strip patients of their ability to self-govern. Furthermore, to prevent the rapid overuse and abuse of genetic therapeutics there must be no exceptions for the interference of embryonic development. By manipulating genes to be expressed as aesthetically pleasing traits within the embryo, the human condition will begin to decay. To provide the greatest medical benefit and prevent this rapid decline, a rule must be applied rigorously; such that genetic modification is only utilized for the purpose of treatment, alleviation, and manipulation of disease… nothing more.

Diversity defines humanity. All people are unique and to manipulate this aspect of nature could result in catastrophe. No child should ever lose the right to determine the path of their life because of decisions that were made for them. The creation of artificial children should never be considered as it is the responsibility of the community to ensure that the rights of all individuals are accounted for when utilizing gene therapy and base-editing. The reality of this matter is that society has a moral obligation to continue the development of science to alleviate the suffering and pain caused by disease. However, society is obliged to protect the rights of those in need; especially those who are unable to make medical decisions for themselves. Gene editing has the capacity to cure several diseases, so long as it is applied respectfully and diligently.

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