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Editing the human genome: Should we?

Genetic engineering has long been a pipedream; something that scientists in movies use to bring extinct animals roaring back to life. While we haven't discovered how to return the dodo to Mauritius, science has made great strides toward the practical use of genetic engineering for other uses. There is evidence that suggests genetic engineering research could lead to the elimination of many health issues including cancer and other terminal diseases("WHO issues new recommendations", 2021), but with these fantastic promises come a myriad of ethical questions.

For thousands of years, human beings have experimented with the genetics of many different organisms(Rangel, G, 2015). Up until the 1970s, this consisted almost solely of selective breeding. Scientists and farmers would cross-pollinate two species of apples, creating a more pleasing product or a fruit that was more resilient in the face of cold weather or droughts. Most modern breeds of dogs are the product of selective breeding, producing traits that were helpful or the breeders found endearing. Direct manipulation of an organism's DNA, that genetic material that is the code for who we are, did not begin until the 1970s, with the result being a genetically modified organism or GMO. Since then, there have been varying levels of research around genetic engineering. Agricultural products with this level of genetic engineering have been commercially available since 1992 and insulin produced by GMO bacteria ten years before that in 1982.

The language used around this topic is not the most consistent and can be quite confusing. For our purposes, we will define a few terms. When I refer to a genome, I am

speaking of the sequence of genetic material, specifically DNA, that is the code for life. DNA consists of two twisted strands that are usually called a double helix. The strands are made up of nucleotides of which there are four types; adenine, guanine, cytosine, and thymine, commonly referred to as A T G, and C. In the double helix structure an A on one strand matches with a T on the other strand, and similarly a G with a C. We call this connection a "base pair". Human DNA consists of about 3 billion of these, with each cell of the body containing a complete copy. The order in which the base pairs appear in DNA is what determines many things in an organism. A section of DNA that is responsible for a specific thing in an organism is called a gene. The code of each gene, which humans have 20-25 thousand, is the instructions for the synthesis of an average of three proteins. Proteins are what the human body's structures are built with and control chemical processes. So, if a gene's DNA has an abnormality, the effect can be a range of diseases and conditions from alopecia to cancer. DNA sequencing is the process of mapping the complete order of the 3 billion base pairs of a specific person. Genetic engineering, for the purposes of this discussion, is the manipulation of one or more of these base pairs, to change the genome of an organism.

There are two basic kinds of genetic engineering. The first type is called somatic editing which simply means that the alterations to the genome are not inheritable by offspring. The second kind is called germline editing. Germline editing allows the changes to propagate to all future generations. For this reason, germline editing is significantly more controversial than somatic editing.

Gene therapy is a similar field with the difference being that the genome is not edited but genetic material is introduced to the patient's system. This technique is outside the scope of this paper, but I mention it as a gateway to some of the controversy over genetic engineering. In 1999

there were gene therapy trials targeted at manageable genetic conditions that aimed to cure some awful symptoms. In very publicized cases, things went wrong. An 18-year-old died and a couple of years later a few of the patients developed related cancers(Lewis, T., 2021). The U.S. Food and Drug Administration, or FDA, stepped in and banned the researchers from any human trials for at least five years. This caused funding for gene therapies to dry up. In 2020, the FDA stopped another company that was performing gene therapy after a few patients ended up with cancer. These cases all used different techniques to achieve their results, but the stigma has remained.

Stakeholder Analysis

With a topic as complicated as genetic engineering, there are countless stakeholders. We will focus on two stakeholder groups. The first is a group consisting of medical professionals including doctors and medical researchers who work on finding medical breakthroughs. This group is in favor of furthering research and the use of genetic engineering. The second group is made up of the general public who consider themselves religious and are against the idea of genetic modification.

Stakeholder 1: Medical professionals

Values- Doctors and medical researchers have based their whole lives on trying to help people and prevent premature death. They have sacrificed through years of school to find better ways to keep people healthy and have taken oaths stating as much("The Hippocratic oath: Modern version", n.d.). They value being able to help their patients. This stakeholder group also values that which is provable or disprovable through rigorous scientific research.

Position- Doctors, and the general medical community, hold the opinion that they should be allowed to use whatever treatments offer the best outcomes for their patients. While they recognize some of the ethical issues that arise from genetic engineering, they won't rule it out as it still offers the best path forward. Their belief is that genomic engineering can address diseases we have never been able to fix and offer the chance to treat their patients in a more targeted, less intrusive manner. If a technique is developed that proves to offer superior outcomes, they would be for using that technique. They have no emotional ties to genomic editing.

Claims- The medical community claims that it is their duty to help their patients stay healthy by addressing diseases and disorders. Using a claim of value, they will argue that genetic engineering presents the possibility of curing ailments that no other drugs or procedures can cure and that if the research shows it to be effective and safe, it should be developed and used like any other medical procedure. By way of claim of fact, they will point to the impact that antibiotics and viruses have made by saving countless lives(Vanderslott et al., 2015).

Doctors and researchers will also point to the numerous cases in which a form of genetic engineering has been administered and proven to be highly effective(Daley, 2021). They will point to the fact that since 1983, most insulin in the United States is the product of genetically engineered bacteria as proof that genetic engineering can be done safely and effectively(Miller, 2017).

Outcome- Doctors and researchers argue that it is their duty to provide the best possible healthcare for their patients and that genetic engineering has the potential to be very useful in ways other treatments are not. They say that if they are not allowed to research and eventually administer genomic engineering techniques, there are diseases that may never be cured, and people will suffer needlessly.

Stakeholder 2: General Christian public

Values- This group of people has traditional values. Christianity has shaped everything in their life and has likely been a large part of their life since the beginning. Most people in this group were taught their religious views by their parents and value that family tradition(Diamant, J., Sciupac, E. P., 2020). They place a lot of value in the traditional texts of their religion like The Bible and the teachings of their local church or pastor.

Position- The Christian public holds the position that we should not be altering the genome of any organisms, especially humans. They feel that any attempt to change our genetic code is a direct affront to God's design and that the medical community does not understand the lasting effects well enough.

Claims- Based on their adherence to the sacred texts of the Bible, they will use the claim of value that human beings have been intelligently designed and created by God. They believe that god is infallible and that any negative thing we go through in our lives is for a reason, even if we cannot see the reason for it. They contend that any alteration of the human genome is an affront to God and is just humans trying to play God.

While they can see the struggles presented by genetic disorders, they feel that it is all part of the human condition. In their opinion, those things that the medical community calls "genetic disorders" were intended by our creator, and we should not seek to cure them. To support this claim, they will point to members of the deaf community, and other communities of those affected by genetic conditions, who feel as though their conditions are not disorders.

Additionally, Christians point to the fact that the medical community doesn't truly understand the effects of genetic engineering. Doctors have convinced people that their genetic engineering procedures will improve their conditions in the past and it has led to their death or

caused an even worse disease. In their opinion, scientists are playing God without the omnipotence that God possesses.

Outcome- This group of stakeholders stands to be impacted emotionally if the outcome were to go against their view. It would contradict their world view and many of them would feel as though they were failing to preserve God's vision for His people

Ethical Question-

Should we, as a society, continue to support the advancement in research of genetic engineering and the use of any treatments that are the product of that research?

Stakeholder arguments-

The arguments for continuing the advancement of genetic engineering research use the utilitarianism framework. Through this ethical framework, an action's moral value is based on the balance between the amount of good it does over the amount of harm it causes. An action is moral if it benefits more people than it harms. Their argument is centered on the potentially life-changing and life-saving impact that genetic engineering offers. It is estimated that 32,000 genetic disorders are caused by the relatively simple swapping of two alleles and that a large portion of these types of disorders could be cured with genetic engineering. Also, they will argue that just like any other medical treatment, nobody will be forced to use any of these medical advancements.

According to these stakeholders, the appropriate course of action is to continue to fund research into genomic editing. This would advance the scientific communities' understanding of our genetic code and how we can alter it to cure diseases that cause pain and death to people.

Through increased research and clinical trials, they could understand the long-term effects and better serve their patients.

If the outcome were to go against the medical community, they would be limited in what research they are allowed to do and what kind of procedures they are allowed to offer their patients. This would greatly affect the satisfaction they get from their job and likely would lead to frustration in the profession.

The arguments against continuing the advancement in genetic engineering are made through the lens of the Natural Law Theory. In this framework, the moral value of an action is judged by whether it is in accordance with God's will or not. They will argue that each and every human is the perfect representation of whom God created them to be, and so we should not try to change those things that make us who we are. They contend that many of the genetic disorders are not actually disorders and are actually traits that our omnipotent creator has bestowed upon us.

The preferred course of action according to these stakeholders would be to halt any and all research into genetic editing. Additionally, any currently used treatments that alter human DNA should be made illegal in these stakeholders' eyes. This would preserve the perfect design that God has used to create us.

In the event that the outcome was to go against this set of stakeholders, they would likely suffer emotional trauma. It would cause members of this stakeholder group to feel as though the rapture, or Armageddon, may be upon them and would probably lead to new teachings in the world of Christianity specifically calling out the sin of genetic editing. In practical terms, it would offer them more options for healthcare, but they may not be willing to participate in those kinds of treatments.

Student position-

The field of genomic editing feels like a science fiction topic, but it is real, it is here, and we need to figure out how we, as a society, are going to regulate it. In the movies, we have seen how wrong things could go if scientists get this wrong. While clinical trials and medical regulations are very diligent in making sure a treatment is safe, the medical community has failed us in the past. When it comes to altering human DNA, if we get this wrong it could have very dire results for those affected. With that being said, I am of the opinion that society should invest in the advancement of this field of study. The religious argument doesn't hold weight as not everybody chooses to be religious, and the treatments would be completely optional. The medical benefits stand to relieve countless people of horrible ailments and extend the lives of even more people. These are worthwhile goals that we should strive to achieve with the utmost concern for negative impact and long-term implications.

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