The Good, The Bad, and The Ethics of CRISPR-CAS9

Martin A. Sierra, Erick Perez, and Angel Martinez

City College of New York

ENGL 21003 K: Writing For The Sciences

Professor Anna Voisard

March 25, 2025

Abstract

The article reviews the acronym CRISPR (Clustered Regularly Interspaced Short Palindromic Repeat), which is a new concept to alter the genes of humans and unborn babies. Many scientists in the world claim it's the way to make healthy and physically gifted babies/humans which can help humanity going forth. Their research has shown postive positive claims, such as the possibility of making new medicine and helping later babies to have specific genes to prevent them from having a specific disease, disorder, disability, or anything that is seen as ideal for a human's health. However, there are negatives with this type of gene editing for humans as genetically modified babies can be met with off-target side effects such as health complications. For instance, using this gene editing can result in damaged genes which could affect the offspring and/or the future generations. These negatives bring up discussions about the ethics of how unborn babies shouldn't have their genes altered since it's unnatural because people have certain beliefs that it wouldn't be morally right especially due to the harmful or unnatural results. CRISPR could also lead to situations where people no longer feel that their children are no longer related to them because of editing changing the genes of the offspring. There is still a lot of research and studies to make sure if CRISPR technology is safe and reliable to use for every human, but there is a good case to make for either side.

Introduction

Gene editing is an important topic in science. It has been a part of our lives for many decades. First, it was mostly used on plants to improve their traits, such as tolerance to stress, grain production, and metabolic processes. Recently, a new gene editing technology is being experimented with and used by the name of CRISPR for purposes such as improving domestication traits in ground cherry tomatoes, wild tomatoes, generating citrus varieties with

resistance to bacteria, and developing cacao plants resistant to disease. Scientists have been using CRISPR to experiment with humans to create ideally what seems to be optimal and healthy babies. This gene-editing tool has allowed scientists to edit DNA with precision. Its most controversial application is editing human embryos, thus creating "CRISPR babies." CRISPR has the potential to eliminate genetic diseases, enhance human abilities, and transform the future of medicine. However, it also introduces ethical, social, and safety concerns that have been the focus of intense international debates.

Benefits

One major advantage that the CRISPR baby procedure can result in is restricting the DNA to prevent certain diseases from forming. According to the data from Table 3 in “Appraisal of CRISPR Technology as an Innovative Screening to Therapeutic Toolkit for Genetic Disorders” (Shabid 2024, Zahra 2024, Aslam 2024, Shamim 2024, Ali 2024, Aslam 2024, Khan 2024, Arshad 2024) there is potential for preventing the transmission of inherited diseases, and the development of infectious diseases like STDs. This research tells us that we can prevent HIV, which can save vast amounts of people. Even families that have a history of diseases, like diabetes. Eliminating the risk of giving the offspring a chronic disease can benefit humans by helping combat that ongoing issue that plagues our bodies. It can reduce a large amount of money spent because there isn't a need to spend more money on other alternative treatments for diseases or any other health risk. This can lower insurance rates and make more time for other medical emergencies.

Another benefit of the procedure is that with technology, you can detect early signs of cancer and genetic variants faster. “The CRISPR system could possibly cure the disorders caused by these generating mutations by switching of the respective oncogenes or by switching

on the tumor suppressor genes in activation or suppression of telomeres as another potential application in cancer therapy" (Shabid 2024, Zahra 2024, Aslam 2024, Shamim 2024, Ali 2024, Aslam 2024, Khan 2024, Arshad 2024). In this research journal, it stated that CRISPR is crucial to humanity since some cancers can't be detected early but, in the future, technology can improve to detect any cancers and possibly be able to cure a patient with such an illness. This also can result in possibly preventing someone from dying since some cancers can kill someone quickly without any warnings or noticeable symptoms.

Other than the ability to prevent and detect earlier diseases, with the help of CRISPR technology, you can cure diseases. Table 3 from “Appraisal of CRISPR Technology” (Shabid 2024, Zahra 2024, Aslam 2024, Shamim 2024, Ali 2024, Aslam 2024, Khan 2024, Arshad 2024), reveals that they had the potential to cure genetic diseases and be able to cure latent diseases. Another study says “Results of gene-editing CRISPR system to eliminate the HIV genome from the eukaryotic cells lines and success in the results have provided the potential of and promising strategies in treating HIV infection” (Golkar 2020). This is very useful because a mother has a disease such as HIV and she then proceeds to breastfeed her child, they can get infected but with CRISPR they can be cured. Sometimes parents don’t even know about their own diseases, however, if they pass it to their child by accident, they can save their child before any real harm is done to them. This also works with other age groups such as kids or even adults. Another example by this article would be if they are struggling with COVID-19, which can be cured when the procedure is readily available to the public.

The procedure for CRISPR babies can also help enhance the life of the baby or even potentially more advanced humans by building up their immune system, or improving their senses. The possibility of vaccines that could be made is great as people can take it with an easy

shot or they can be given to underfunded areas as the technology progresses. Inside the article "Will CRISPR-Cas9 have Cards to play against cancer?", this presents ". In the mere future, CRISPR will slash to identify life-threatening diseases and provide a roadmap to develop vaccines, thereby "nearing the beginning of the end of cancers, infectious diseases and hereditary disorders"" (Daisy 2020, Shreyas 2020, Anitha 2020). Another article states "The CRISPR/Cas Rx-based RNA editing method is effective in treating autosomal-dominant hearing loss, opening the door for its future use in several other hereditary diseases of the hearing and other organ systems" (Shadid 2024, Zahra 2024, Aslam 2024, Shamin 2024, Ali 2024, Aslam 2024, Khan 2024, Arshad 2025). This source demonstrates that if the offspring or the parents can't hear or see, there is an opportunity that they may be able to see/hear again which are things that can be argued that humanity takes for granted. This is also beneficial for groups such as genetically short people to have babies who can exceed their previous height expectancy or any other obstacle/lacking aspect of their child to have to achieve their ideal child.

Cons

CRISPR gene editing has helped scientific research by opening up opportunities for gene editing and the control of genetic conditions. It's regarded as an innovation that has the ability to improve human health and alter the course of medicine going forward. Despite how encouraging these developments are, it is impossible to ignore the moral and social consequences of CRISPR babies. Apart from offering solutions to health problems, this same technology also raises ominous concerns regarding inequality, safety, and the basic principles of human DNA.

Gene editing is seen as dangerous because it involves changing human genes in such a way and will be passed on in the following generations of an individual's bloodline. Genes are

inherited by previous generations and by researchers modifying them this may result in your family genes being lost. Scientists worry about mistakes such as unexpected changes or incompletely modified cells that can generate health complications when modifying genes. These mistakes include unexpected mutations, which may result in unwanted health consequences (Ledford, H.(2019). Some embryos could contain a mixture of edited and unedited cells, and therefore the outcome(s) would be indefinite. This raises concern due to the uncertainty of not being sure what will happen when this happens, causing a significant issue when it comes to gene editing. When it comes to additional ethical concerns such as how it can affect future generations, whether it can be done or not, and other safer alternatives like choosing healthy embryos instead of gene editing.

Preventing genetic disorders is one of the potential benefits of gene editing, but there is also another enormous risk involved. CRISPR can make off-target genetic alterations, which lead to health problems such as cancer or other genetic illnesses which are the same things that CRISPR aims to combat. There are also ethical concerns such as genetic inequality, where enhancements will only be possible for the affluent, and another concern with the risk of designer babies. Designer babies are custom-like babies where people choose certain attributes like intelligence or looks instead of just removing disease, similar to a game where you choose a character's appearance and strengths (Ledford, H. (2020). However, a report by an international panel warned that CRISPR is not yet safe enough to use on human embryos due to unknown long-term consequences. The He Jiankui scandal, the researcher who genetically edited twin babies in 2018, highlighted the dangers of uncontrolled genetic editing. His work was globally condemned, and he later got imprisoned for violating scientific protocols. Many experts like to recommend Pre-implantation Genetic Diagnosis (PGD) as a safer alternative. PGD allows

doctors to screen embryos for illness without editing DNA, thus bypassing the risks of CRISPR but still preventing genetic diseases(Ledford, H. (2020). In summary, while CRISPR is so promising, it is not yet safe to apply to humans. There is more research, ethical discussions, and strict regulation needed before responsibly applying it.

Ethics

The morals and ethics of gene editing make the topic controversial due to the opposing viewpoints regarding the topic and where the moral line ends. One opposing viewpoint comes from the public concern about CRISPR. More specifically, a situation where the benefits are being used for situations such as war. This includes situations where babies are being born and edited for the sole purpose of being used as biological weapons to fight in wars or certain conflicts (Wiley, et al., 2024). This can feel like a violation of human rights or freedom of choice especially for these gene-edited babies since they are being born just to be used for a specific purpose. The Oviedo Convention argues that this changes what it means to be human which could mean something deeper, especially in terms of being born naturally through editing and not a special anomaly that has benefits over others (Wiley, et al., 2024).

There's a big scientific consensus that gene editing should only be used in humans to treat serious conditions that otherwise have no alternate solutions to be treated. One Bioethicist named Greely states that he agrees and condemns the use of gene editing outside of these reasons. Especially in a case where He Jiankui, has inserted a mutation into CRISPR to help someone fight HIV. This action was condemned by the Bioethicist and there are even arguments saying there are alternatives to prevent HIV and combat it (Scully, 2021). In Europe however, "The ethics committee of the French national biomedical research agency (INSERM) has put forward recommendations to foster responsible use of genome-editing technologies…" This

means that not everyone is opposed to the idea of CRISPR and gene editing as a whole because it can be beneficial to humans. Other European countries' stances indicate that there are a couple of challenges before lifting the ban on genome editing as the moral limits, uses, and everything else on ethical grounds are being discussed (Hirsch, et al., 2017).

These conversations are being held so the public and other communities can decide what is and what isn't acceptable for CRISPR to be used on regarding humans. This is also mainly due to the safety stigmatism against CRISPR and especially its off-target effects. One example would be single-celled embryos as they would have off-target risks deemed unethical because of the unintended changes in certain locations and effects that are both unknown on the cells which can cause complications and put the gene-edited humans at a major health risk (Schleidgen et al., 2020). According to Schleidgen, "On the other hand, it is argued that these risks would not speak against germ-line editing, but rather in favor of further research with the aim of risk minimization." This is an argument that states that because of these effects it wouldn't deter CRISPR, but would be used for more research to reduce these effects however as stated before. These risks would prompt a national ban or restriction of gene editing such as CRISPR as a result (Schleidgen et al., 2020). Still, with the recent advancements in CRISPR, it is brought up that eventually CRISPR can minimize the risks to an acceptable level where it is ethics and this is because of the off-target effects deeming CRISPR to be harmful and irreversible so the argument is to mitigate the damage caused by it (Schleidgen et al., 2020).

There is a line between both parties as the main argument against CRISPR is safety but these safety concerns are being debated. NASEM has even asked for the public's help to assess what the criteria would be for ethical CRISPR's use. This would involve weighing the risks and benefits that would be considered extra or unnecessary and the prevention of disease or

disability. Overall the ethics are being discussed to bring more beneficence to a patient who has CRISPR used on them as using such applications to prevent health problems such as diseases are deemed unproblematic by the public. However, these limits are still being debated about what lines are being crossed and to what extent it is used to benefit the patient or unborn as well (Juengst, E. T. 2017, pg. 16).

Conclusion

After researching and putting together our findings, we have concluded that CRISPR is not only promising due to its potential in its benefits to unborn children but is also risky due to its cons and introduces ethical debates on its use. Benefits such as being able to edit/modify DNA in such a way as to prevent certain diseases and disabilities. This is helpful especially if there are no alternatives to combat a particular negative attribute/condition that occurs in the human body like HIV/AIDS that can be treated but not cured by any other means. However, it proposes a risk due to its cons because DNA modifications can cause off-target effects. These effects can result in health complications and even cause the same diseases and complications that CRISPR was aimed to get rid of or even worse ones. These cons make CRISPR a health risk when applied to humans.

There is more research, ethical discussions, and strict regulation needed before responsibly applying it. Then when it comes to ethics, there are mainly concerns about the risks that come involved with CRISPR and even unethical uses of CRISPR especially ones such as bioterrorism and other uses that are deemed as a violation of human rights as opposed to being born normally. However, there are ethical debates regarding to what extent CRISPR should be used and in which scenarios it can be used because people are starting to see the benefits of

CRISPR but it is a moral challenge to discuss the lines that shouldn't be crossed when it comes to gene-editing tools.

References

Cyranoski, D. (2019). The CRISPR-baby scandal: what's next for human gene-editing. *Nature (London)*, *566*(7745), 440–442. https://doi.org/10.1038/d41586-019-00673-1

Daisy, P. S., Shreyas, K. S., & Anitha, T. S. (2021). Will CRISPR-Cas9 Have Cards to Play Against Cancer? An Update on its Applications. Molecular Biotechnology, 63(2), 93–108. https://doi.org/10.1007/s12033-020-00289-1

Golkar, Z. (2020). CRISPR: a journey of gene-editing based medicine. Genes & Genomics, 42(12), 1369–1380. https://doi.org/10.1007/s13258-020-01002-x

Hirsch, F., Levy, Y., & Chneiweiss, H. (2017). CRISPR-Cas9: A European position on genome editing. *Nature*, *541*(7635), 30. http://dx.doi.org.ccny-proxy1.libr.ccny.cuny.edu/10.1038/541030c

JUENGST, E. T. Crowdsourcing the Moral Limits of Human Gene Editing? Hastings Center Report, [s. l.], v. 47, n. 3, p. 15–23, 2017. DOI 10.1002/hast.701. Disponível em: https://research-ebsco-com.ccny-proxy1.libr.ccny.cuny.edu/linkprocessor/plink?id=f77b5c3b-c65e-3557-b705-44a4a60b38b5. Acesso em: 10 mar. 2025.

Ledford, H. (2019). CRISPR babies: when will the world be ready? *Nature (London)*, *570*(7761), 293–296. https://doi.org/10.1038/d41586-019-01906-z

Ledford, H. (2020). "CRISPR babies" are still too risky, says influential panel. *Nature (London)*. https://doi.org/10.1038/d41586-020-02538-4

Shahid, A., Zahra, A., Aslam, S., Shamim, A., Ali, W. R., Aslam, B., Khan, S. H., & Arshad, M. I. (2025). Appraisal of CRISPR Technology as an innovative screening to Therapeutic toolkit for genetic Disorders. Molecular Biotechnology. https://doi.org/10.1007/s12033-025-01374-z

Schleidgen, S., Dederer, H.-G., Sgodda, S., Cravcisin, S., Lüneburg, L., Cantz, T., & Heinemann, T. (2020). Human germline editing in the era of CRISPR-Cas: risk and uncertainty, inter-generational responsibility, therapeutic legitimacy. *BMC Medical Ethics*, *21*(1). http://dx.doi.org.ccny-proxy1.libr.ccny.cuny.edu/10.1186/s12910-020-00487-1

Scully, J. L. (2021). A biographer and a bioethicist take on the CRISPR revolution. *Nature*, *591*(7849), 196+. http://dx.doi.org.ccny-proxy1.libr.ccny.cuny.edu/10.1038/d41586-021-00579-x

Wiley, L., Cheek, M., LaFar, E. *et al.* The Ethics of Human Embryo Editing via CRISPR-Cas9 Technology: A Systematic Review of Ethical Arguments, Reasons, and Concerns. *HEC Forum* (2024). https://doi-org.ccny-proxy1.libr.ccny.cuny.edu/10.1007/s10730-024-09538-1